



TempVue™ 10

PT-100 RTD Class A Precision Air
Temperature Sensor



Please read first

About this manual

Please note that this manual was produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this. 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 from Campbell Scientific it will be suitable for use in your country.*

Reference to some radio transmitters, digital cell phones and aerials (antennas) 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.

Recycling information for countries subject to WEEE regulations 2012/19/EU



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, per [The Waste Electrical and Electronic Equipment \(WEEE\) Regulations 2012/19/EU](#). Campbell Scientific 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 support, please contact Campbell Scientific, or your local agent.

Table of contents



1. Introduction	1
2. Precautions	1
3. Initial inspection	2
4. QuickStart	4
5. Overview	7
6. Specifications	8
7. Installation	9
7.1 Wiring	9
7.1.1 4-wire configuration	9
7.1.2 2-wire configuration	10
7.2 Programming	11
7.2.1 CRBasic programming	11
7.2.1.1 BrHalf4W()	12
7.2.1.2 BrHalf()	12
7.2.1.3 PRTCalc()	13
7.3 Siting	13
7.4 Installation in a radiation shield	15
7.5 Mount the shield	16
8. Operations	17
8.1 Sensor schematic	17
8.2 Reducing measurement noise	18
9. Maintenance, troubleshooting, and calibration	18
9.1 Maintenance	18
9.2 Troubleshooting	19
9.3 Calibration	19
10. References	20
Appendix A. Importing Short Cut code into CRBasic Editor	21
Appendix B. Example programs	22

1. Introduction

The TempVue™10 represents the next generation of air-temperature measurement sensors, meeting all relevant World Meteorological Organization (WMO¹) temperature recommendations.

Designed with the customer in mind, the TempVue 10 easily interfaces with Campbell Scientific or third-party data loggers and fits a wide range of active and passive solar radiation shields. The sensor comes with a short, attached cable and terminates with an M12 connector, which provides exceptional convenience, environmental protection, and data integrity for use in a variety of applications. The TempVue 10 can be wired as a 2- or 4-wire PT-100 sensor, allowing full flexibility and compatibility with your systems.

2. Precautions

- READ AND UNDERSTAND the [Safety](#) section at the back of this manual.
- When opening the shipping package, do not damage or cut the cable jacket. If damage to the cable is suspected, consult with a Campbell Scientific support engineer.
- Although rugged, the TempVue 10 should be handled as a precision scientific instrument.
- Do not bend or damage the measurement tip of the TempVue 10 because this can affect the measurement quality and potentially damage the sensor.
- Do not modify or attempt to repair the TempVue 10 unit without consulting Campbell Scientific.
- This temperature probe meets UKCA and EU declarations of conformity, citing international standards applicable to the product.
- The TempVue 10 should not be buried in soil or submerged in water. Refer to www.campbellsci.com/soil-temperature  or www.campbellsci.com/water-temperature  for a list of sensors that are appropriate for soil, road surface, or water temperature applications.

¹WMO, 2008. See [References](#) (p. 20).

3. Initial inspection

- Upon receipt of the TempVue 10, inspect the packaging and contents for damage. File damage claims with the shipping company.
- Immediately check package contents against the shipping documentation. Contact Campbell Scientific about any discrepancies.
- The calibration certificate shipped with each TempVue 10 includes the Ratio of Rf to Rs (see Figure 3-1 [p. 2]). This value is unique for each sensor. Cross check this serial number on the certificate against the serial number on your sensor to ensure the given Ratio of Rf to Rs corresponds to your sensor. The ratio of Rf to Rs is used as the calibration factor as PRTs vary in their resistance at 0 degrees C, and this is the ratio (a multiplier) of the unit under test to its resistance at 0 C. This provides a more accurate calibration adjustment over a wider range of temperatures.

CS Campbell SCIENTIFIC

Certificate of Calibration

Manufacturer: Campbell Scientific Inc.
Description: Temperature Sensor
Model: TempVue 10
Serial Number: 1003
Calibration Number: Z30512373
Calibration Date: 5-12-2023
Recommended Calibration Interval: 1 Year from date of calibration

As Received Measurements

Reference Temp	DUT Offset	Ratio of Rf to Rs	System Uncertainty (K=2)
N/A	N/A	N/A	N/A

As Returned: Repair/Calibration Measurements

Reference Temp	DUT Offset	Ratio of Rf to Rs	System Uncertainty (K=2)
0.009	-0.09463038	0.9995952	0.0333

Report of Calibration Standards Used

Make/Model	Serial Number	Cal. Due
Keysight 34970A	MY159007768	2024/04
Kochu-Hite 523	EX51257	2024/04
Fluke 1502A	A8C188+42334-51	2024/04

Performing Technician: *[Signature]*






The Quality Management System of Campbell Scientific, Inc. (CSI) is Registered to be in conformance to ISO 9001:2015 for the design, manufacture and service of environmentally rugged measurement and control instrumentation, including data loggers, sensors, wireless telemetry peripherals and products for standalone data acquisition, testing and remote monitoring systems such as weather stations. CSI certifies that at the time of calibration, the above listed instrument met or exceeded published specifications and was calibrated using internationally recognized standards whose accuracies are traceable to SI Units through the National Institute of Standards and Technology or equivalent NMI, an accepted value of a natural physical constant or a ratio calibration technique. No warranty is given or implied that this instrument will maintain specified tolerances throughout the recommended calibration interval.

This certificate only applies to the instrument listed.

Document shall not be reproduced except in full, without the written approval of Campbell Scientific, Inc.
Campbell Scientific, Inc. | 815 W 1800 N | Logan, UT 84321-1784 | 435.227.9000 | 435.227.9001 F | www.campbellsci.com
Page 1 of 1

Figure 3-1. Example calibration certificate

- Table 3-1 (p. 3) shows the components typically shipped with the TempVue 10.

Table 3-1: TempVue 10 components			
Component	Quantity	Description	Image
TempVue 10	1	Measures air temperature	
Extension cable (ordered as an option)	1	Connects the sensor to a data logger.	
Quick deploy guide	1	Provides siting, mounting, and wiring information	
Shield extender	1	Allows sensor to be housed in a 10-plate or 14-plate radiation shield.	
Calibration certificate	1	Provides the Rf to Rs ratio needed for programming.	

- [Figure 3-2](#) (p. 4) shows the TempVue 10 and shield extender in the shipping box.

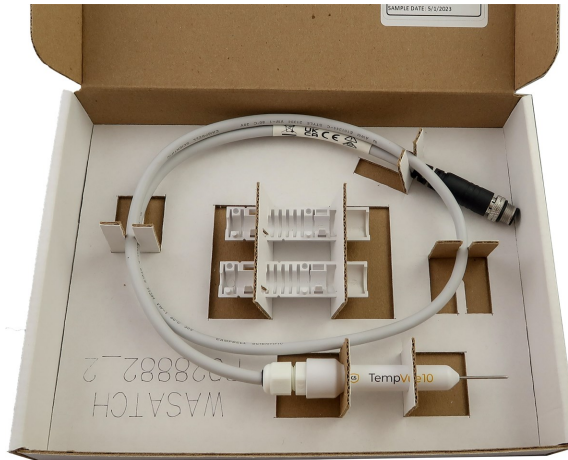


Figure 3-2. Box containing the TempVue 10 and shield extender.

- Refer to [Installation in a radiation shield](#) (p. 15) for instructions about attaching the extender tube to the TempVue 10 for use in longer radiation shields.
- Accessories and replacement parts are listed on the web site product page (see www.campbellsci.com/tempvue10 [↗](#)).

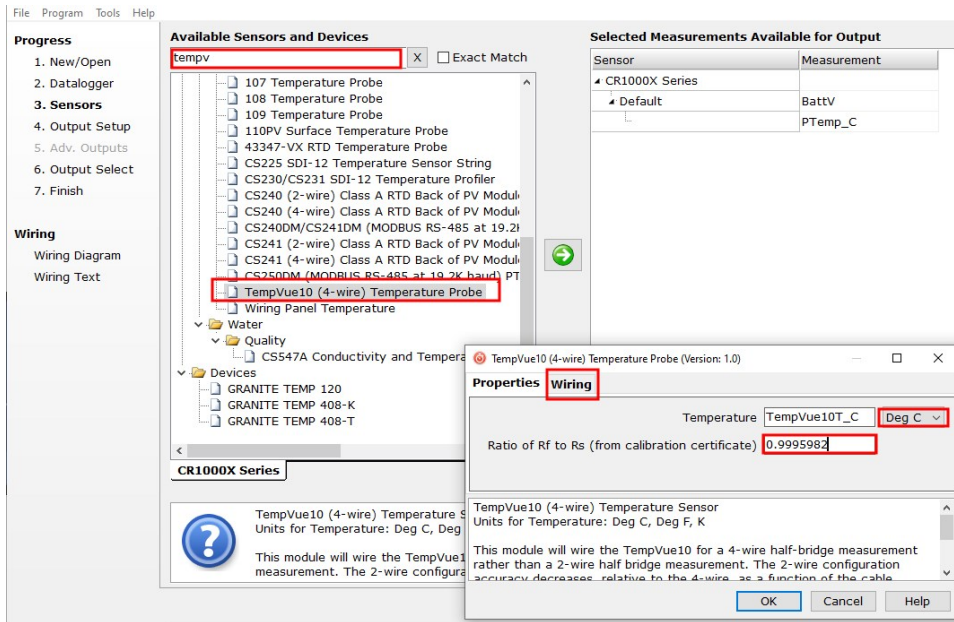
4. QuickStart

A video that describes data logger programming using *Short Cut* is available at: www.campbellsci.com/videos/cr1000x-data-logger-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*, *RTDAQ*, and *PC400*.

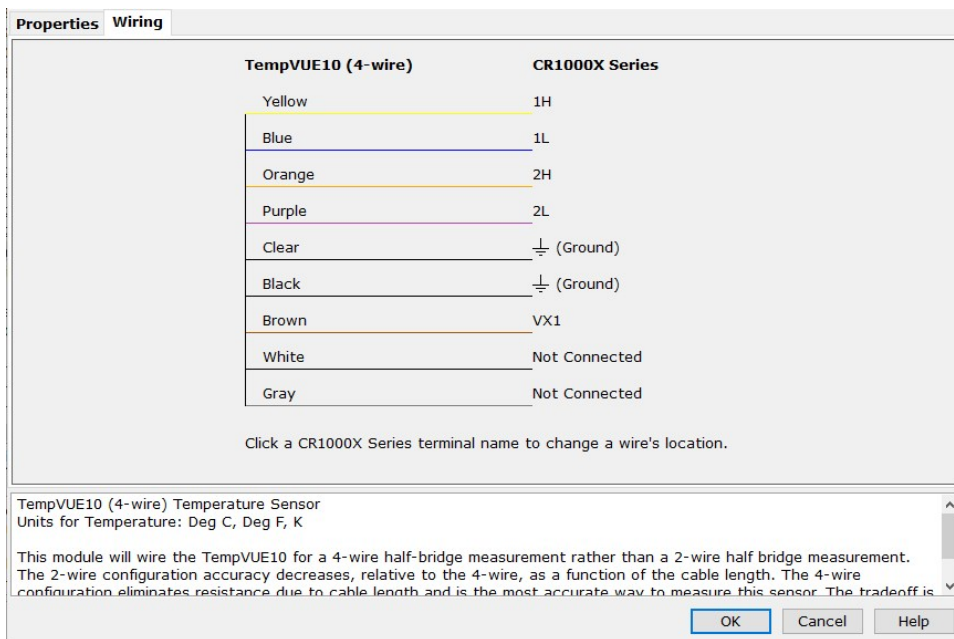
The following procedure shows using *Short Cut* to program the TempVue 10.

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

- In the **Available Sensors and Devices** box, type TempVue 10. You can also locate the sensor in the **Sensors > Temperature** folder. Double click the sensor model. Type the **Ratio of Rf to Rs** value provided in the calibration certificate that was shipped with the sensor. The temperature defaults to degree C. This can be changed by clicking the **Temperature** box and selecting one of the other options.

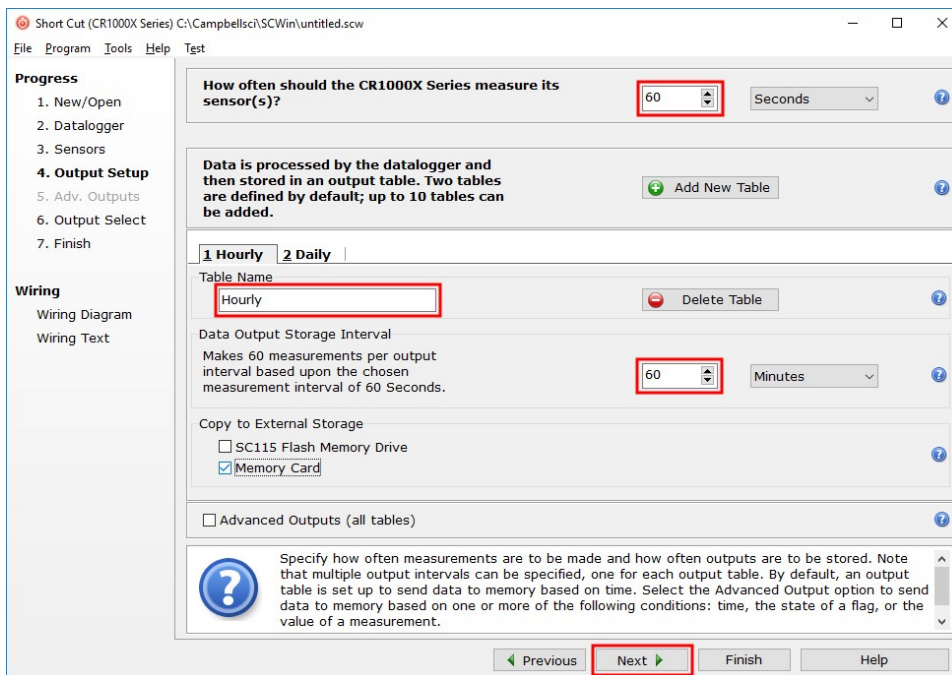


- Click on the **Wiring** tab, wire the sensor, then click **OK**.

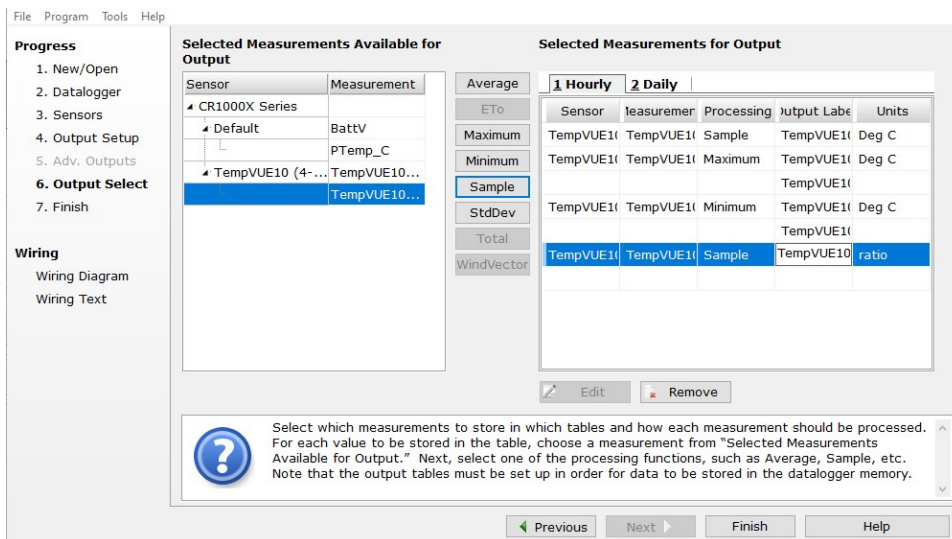


- Repeat steps three and four for other sensors you want to measure. Click **Next**.

- In **Output Setup**, type the scan rate, a meaningful table name, and the **Data Output Storage Interval**.



- Select the measurement and its associated output option.



- Click **Finish** and save the program. If the data logger is connected to the computer, send the program just created to the data logger.
- If the sensor is connected to the data logger, check the output of the sensor in the data display in *LoggerNet*, *RTDAQ*, or *PC400* to make sure it is making reasonable measurements.

5. Overview

The sensor consists of a wire-wrapped, four-wire Pt100 Resistance Temperature Detector (RTD) element encapsulated in an epoxy-filled, stainless-steel housing. The thin yet robust housing, combined with the Pt100 sensing element, provide the first true WMO-compliant sensor to meet the 20-second step response time with an ambient wind speed of only 1 m/s (3.3 ft/s).

The TempVue 10 has a maximum measurement uncertainty of only 0.3 K over the entire measurement range of -80 to $+60$ °C, with only 0.1 Kelvin (K) over the most common temperature range of -40 to $+40$ °C.

When exposed to environments with high wind, sun, or precipitation levels, the TempVue 10 must be housed in a radiation shield, such as the RAD06 6-plate shield.

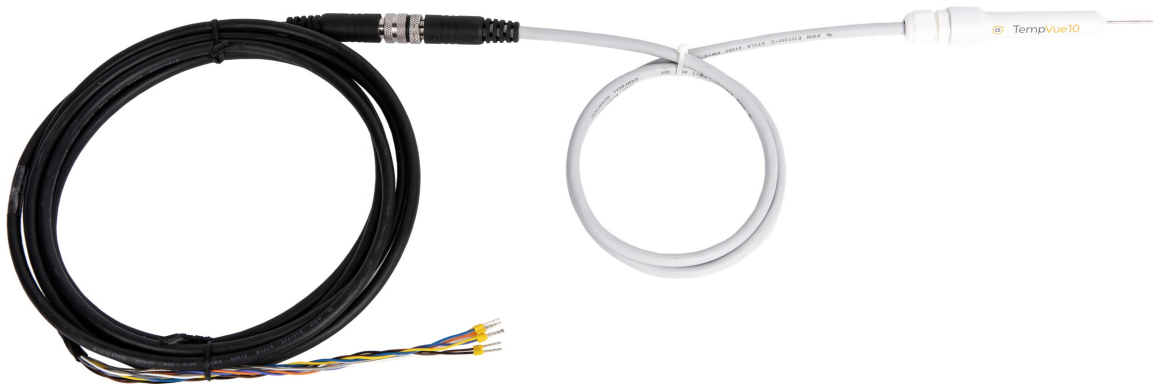



Figure 5-1. TempVue 10 with the extension cable attached

Features:

- Meets WMO step change response time at 1 m/s (3.28 ft/s)
- Maintains high measurement stability over both time and temperature
- Incredibly easy to install or remove for calibration checks
- Highly durable, providing sensor element protection in even the harshest environmental conditions
- Can be wired with a 2-wire or 4-wire platinum resistance thermometer (PRT) configuration
- Allows for cable length adjustments without the need for calibration changes

- Compatible data loggers: GRANITE-series, CR6, CR1000X, CR800 series, CR350-series, CR300-series. CR3000, CR1000

6. Specifications

Sensor description:	100 ohm Class A platinum (PT100) ¹
Measurement uncertainty²:	±0.1 K over –40 to +40 °C (–40 to +104 °F) range ±0.3 K over –80 to +60 °C (–112 to +140 °F) range
Temperature measurement range:	–80 to 60 °C (–112 ° to +140 °F)
Time constant in air:	20 seconds to 63% of step change in 1 m/s wind
Resolution:	Three decimal places (0.001 °C)
Connector type:	M12 (to extend beyond 1 m [3 ft] standard cable length)
Signal type/output:	Analog
Probe diameter:	1.9 cm (0.75 in) maximum
Probe length:	12.1 cm (4.75 in) tip to end of cable gland
Extended probe length:	18.1 cm (7.125 in) tip to end of shield extender
Weight:	70 g (0.15 lb) for probe with shield extender, including standard 1 m (3 ft) cable with M12 connector
Compliance:	View documents at: www.campbellsci.com/tempvue10 

¹Class A refers to ISO 60751:2008 class A standards and the corresponding ASTM E1137 Class A standards.

²Kelvin is the SI unit (International System of Units) for temperature, and used for uncertainty measurements, whereas the range of the product is in Celsius and therefore both are used in these specifications. The WMO guide to Instruments and Observations, Guide no. 8, also uses both Kelvin and Celsius in their recommendation. Regarding resolution of the unit, 1 Kelvin = 1 °Celsius.

7. Installation

If you are programming your data logger with *Short Cut*, skip [Wiring](#) (p. 9) and [Programming](#) (p. 11). *Short Cut* does this work for you. See [QuickStart](#) (p. 1) for a *Short Cut* tutorial.

7.1 Wiring

The TempVue 10 includes a completion resistor integrated in the sensor housing, allowing the sensor to directly connect to the data logger without using a bridge module, such as the 4WPB100 or 3WHB10K. Campbell Scientific offers extension cables in lengths up to 10 m, which connect to the TempVue 10 M12 connector. Contact Campbell Scientific if a longer cable is required.

The TempVue 10 can be wired as a 2- or 4-wire configuration. The 4-wire PRT measurement is the preferred wiring choice, as this provides the highest measurement accuracy and ensures the best quality signal. All TempVue 10 sensors have been calibrated using a 4-wire configuration. Where possible, Campbell Scientific strongly recommends using the 4-wire set up. The specifications are all based on 4-wire operation and the TempVue 10 will meet or exceed WMO recommendations in this configuration. The 2-wire configuration requires fewer terminals, but reduces the measurement quality and increases error.

Data logger connections for these configurations are provided in the following sections.

7.1.1 4-wire configuration

For this configuration, the TempVue 10 probe requires two consecutive differential terminals and one voltage excitation terminal (one excitation terminal can be used for two probes). If the yellow and blue wires connect to **Diff 1H** and **1L**, respectively, then the orange and purple wires should connect to **Diff 2H** and **2L**, respectively.

Connections to Campbell Scientific data loggers are provided in [Table 7-1](#) (p. 10). When *Short Cut* software is used to create the data logger program, wire the sensor to the terminals shown on the wiring diagram created by *Short Cut*.

Color ¹	Wire function	Data logger connection
Yellow	RTD signal/ – RTD	DIFF H (differential high, analog-voltage input) or CR6 U terminal configured for differential high analog input ²
Blue	RTD signal ref	DIFF L (differential low, analog-voltage input) or CR6 U terminal configured for differential low analog input ²
Orange	Sense signal	DIFF H (differential high, analog-voltage input) or CR6 U terminal configured for differential high analog input ²
Purple	Sense signal ref	DIFF L (differential low, analog-voltage input) or CR6 U terminal configured for differential low analog input ²
Brown	Volt excite/ + RTD	VX (voltage excitation), EX (voltage excitation), or CR6 U terminal configured for voltage excitation ²
Black	Excitation reference	⊥ (analog ground)
Clear	Shield G	⊥ (earth ground)

¹The white and gray wires are not used, and should be individually isolated by using electrical tape or wire caps.

²U terminals are automatically configured by the measurement instruction.

7.1.2 2-wire configuration

For this configuration, the TempVue 10 probe requires one single-ended terminal and one voltage excitation terminal (one excitation terminal can be used for two probes). The 2-wire PRT measurement is a secondary wiring option, with decreased measurement quality. This setup reduces the number of terminals needed on the data logger; however, for best measurement practice use the 4-wire set up.

The calibration supplied by Campbell Scientific is valid only for the 4-wire set up. It is recommended to obtain a new TempVue 10 calibration offset from a third-party accredited laboratory to use in the data logger program. Additionally, it is important to use the correct AC noise rejection or signal integration frequency in the CRBasic program measurement parameter. Connections to Campbell Scientific data loggers are given in [Table 7-2](#) (p. 11).

Table 7-2: Wire color, function, and data logger connection for 2-wire configuration

Color ¹	Wire function	Data logger connection
Orange	RTD signal/- RTD	SE (single-ended, analog-voltage input) or CR6 U terminal configured for single-ended analog input ²
Brown	Volt excite/+ RTD	VX (voltage excitation), EX (voltage excitation), or CR6 U terminal configured for voltage excitation ²
Black	Excitation reference	⏏ (analog ground)
Clear	Shield G	⏏ (analog ground)

¹The yellow, purple, blue, white, and gray wires are not used, and should be individually isolated by using electrical tape or wire caps.

²U terminals are automatically configured by the measurement instruction.

7.2 Programming

Short Cut is the best source for up-to-date programming code for Campbell Scientific data loggers. If your data acquisition requirements are simple, you can probably create and maintain a data logger 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 [QuickStart](#) (p. 1). If you wish to import *Short Cut* code into *CRBasic Editor* to create or add to a customized program, follow the procedure in [Importing Short Cut code into CRBasic Editor](#) (p. 21). Programming basics for CRBasic data loggers are provided in the following sections.

7.2.1 CRBasic programming

The CRBasic program needs to measure the resistance and then convert the resistance measurement to a temperature measurement. The CRBasic instruction used to measure the resistance depends on whether it is a 4-wire or 2-wire configuration. The [PRTCa1c\(\)](#) instruction is used to convert the resistance to a temperature measurement. The CRBasic instructions are described in the following sections. Complete program examples can be found in [Example programs](#) (p. 22).

7.2.1.1 BrHal f4W()

The **BrHal f4W()** CRBasic instruction is used to measure the TempVue 10 in a 4-wire configuration. It applies an excitation voltage and makes two differential voltage measurements. The first measurement is made across the fixed resistor (Rf), the second is made across the RTD (Rs). The result is the ratio of the two resistances (Rs/Rf), which is not affected by cable length.

The **BrHal f4W()** instruction has the following form:

```
BrHal f4W(Dest, Reps, Range1, Range2, DiffChan, ExChan, MeasPEx, ExmV, RevEx, RevDiff, SettlingTime, fN1, Mult, Offset)
```

Use the Ratio of Rf to Rs value for the **Mult**. The ratio of Rf to Rs value is included on the calibration sheet and is unique to each sensor. Campbell Scientific recommends using a 50000 µsec **SettlingTime**. Refer to [Reducing measurement noise](#) (p. 18) if in electrically noisy environments.

7.2.1.2 BrHal f()

The **BrHal f()** CRBasic instruction is used to measure the 2-wire configuration. It applies an excitation voltage, delays a specified amount of time, and then makes a single ended voltage measurement.

The **BrHal f()** instruction has the following form:

```
BrHal f(Dest, Reps, Range, SEChan, ExChan, MeasPEx, EXmV, RevEx, SettlingTime, fN1, Mult, Offset)
```

Campbell Scientific recommends using a 50000 µsec **SettlingTime**. For the **Offset**, use a TempVue 10 calibration from a third party accredited laboratory.

For the 2-wire configuration, before the resistance value is converted to temperature, the CRBasic program needs to calculate the Rs/R0 ratio. To do this, include the following:

```
'Calculate the value of Rs
```

```
Rs = Rf*X/(1-X)
```

```
'Calculate the ratio of Rs/R0
```

```
TempVue10RsR0 = Rs/R0
```

Where,

Rf = 10100 (the resistance of Rf)

R0 = 100 (the resistance of the PRT at 0 °C)

X= the **Dest** variable that stores the **BrHal f()** measurement. Refer to [CRBasic Example 2](#) (p. 24) for more information.

7.2.1.3 PRTCalc()

The `PRTCalc()` instruction converts the Rs/R0 ratio to a temperature measurement. The `PRTCalc()` instruction has the following form:

```
PRTCalc(Dest, Repts, Source, PRTType, Mult, Offset)
```

Use option 1 (IEC 60751:2008) for the `PRTType`.

`Source` is the Rs/R0 ratio. When using the `BrHalf4W()` instruction, this is the variable that stores the `BrHalf4W()` measurement. When using the `BrHalf()` instruction, the CRBasic program needs to calculate the Rs/R0 ratio (see `BrHalf()` [p. 12] and [Example programs](#) [p. 22] for more information).

7.3 Siting

The TempVue 10 is intended for air temperature measurements only. The general EPA guidance for standard meteorological stations is to locate the sensor over an open, level area at least 9 m (29.5 ft) in diameter. The surface should be covered by short grass or the natural earth surface where grass does not grow. Sensors should be located at a distance of at least ten times the height of any nearby obstruction and at least 30 m (98.4 ft) from large, paved areas. Sensors should be protected from thermal radiation and adequately ventilated. Protect the filter at the top of the sensor from exposure to liquid water.

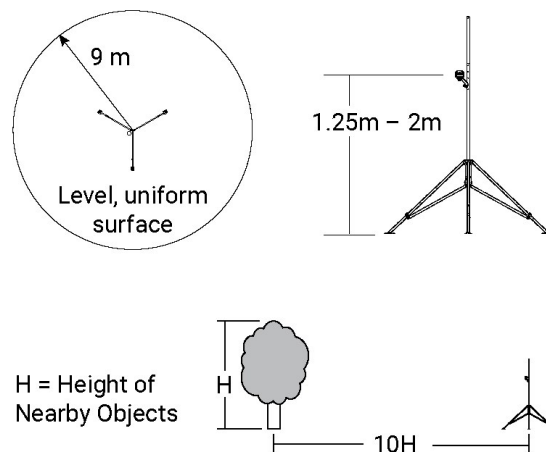


Figure 7-1. Clearances

The sensor should be installed at a standard measurement height which varies depending on the guides being used:

- 1.5 m (4.92 ft) (AASC)
- 1.25 to 2.0 m (4.1 to 6.5 ft) (WMO)
- 2.0 m (6.5 ft) (EPA)

See [References](#) (p. 20) for a list of references that discuss temperature sensors.

When used in the field, the TempVue 10 must be housed in a radiation shield. Compatible radiation shields include the RAD06, RAD10E, and RAD14 unventilated radiation shields and the TS100SS fan-aspirated radiation shield. The white color of these shields reflects solar radiation.

The unventilated radiation shields have a louvered construction that allows air to pass freely though, thereby keeping the sensor at or near ambient temperature. The RAD06, RAD10E, and RAD14 have a double-louvered design that offers improved sensor protection from insect intrusion and driving rain and snow. In addition, compared to shields of a similar appearance, the RAD shields have lower self-heating in bright sunlight combined with low wind speeds giving a better measurement. The RAD shields attach to a crossarm, mast, or user-supplied pipe with a 2.5 to 5.3 cm (1.0 to 2.1 inch) outer diameter.

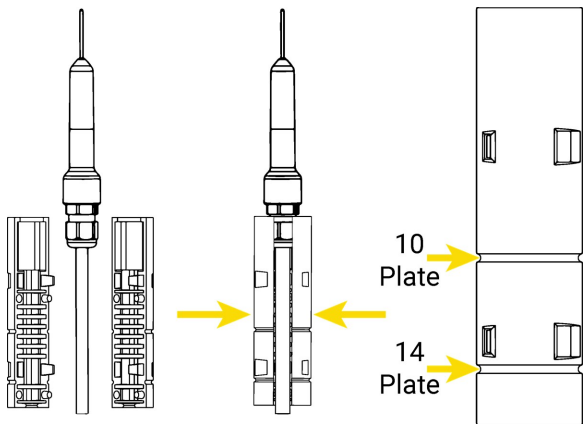
The Apogee Instruments aspirated TS100SS shield can also be used where minimal solar errors and a fast speed of response is desired. It mounts on a crossarm or horizontal pipe (1-1/4 inch to 2 inch IPS).

Tools required for installing a radiation shield to a tripod or tower include:

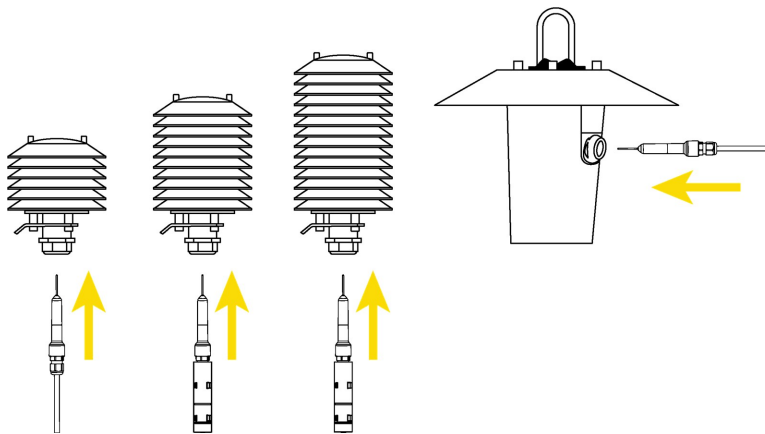
- adjustable wrench (to suit 12 mm (1/2 in) nuts)
- small screwdriver provided with data logger
- small Phillips screwdriver
- UV-resistant cable ties
- small pair of diagonal-cutting pliers
- adjustable wrench with a minimum 50 mm (2 in) jaw size.

7.4 Installation in a radiation shield

1. If using a 10- or 14-plate shield, attach the shield extender.



2. If using a RAD06, RAD10E, or RAD14 shield, loosen the nut on the entry gland at the bottom of the shield.
3. Insert the sensor into the gland.



4. If using an unventilated shield, first tighten, by hand, the nut on the radiation shield gland until the sensor is held firmly in place. Then use the large adjustable wrench to further tighten the gland by 1/2 to 1 turn. Do not overtighten the nut as you risk damaging the sensor body and also making service of the sensor more difficult in the future.



Figure 7-2. Cut away view shows TempVue 10 insertion in a RAD shield

7.5 Mount the shield

1. Attach the radiation shield to the tripod mast, crossarm, or tower leg using the supplied U-bolt or band clamp. See [Figure 7-2](#) (p. 16).
2. Connect the cable to the sensor.
3. Route the cable to the data logger, and secure the cable to the mounting structure using cable ties.

CAUTION:

Failure to secure the cable can lead to breakage of the wires due to fatigue caused by blowing back and forth in the wind.

8. Operations

8.1 Sensor schematic

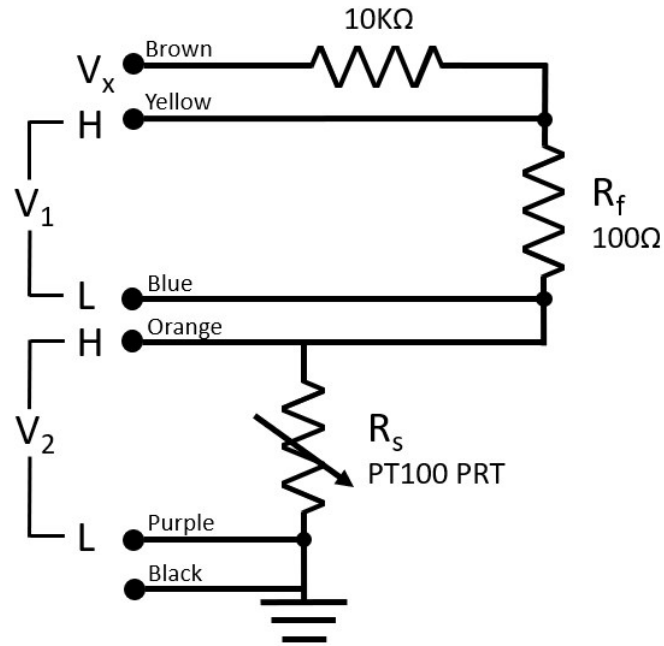


Figure 8-1. TempVue 10 4-wire schematic

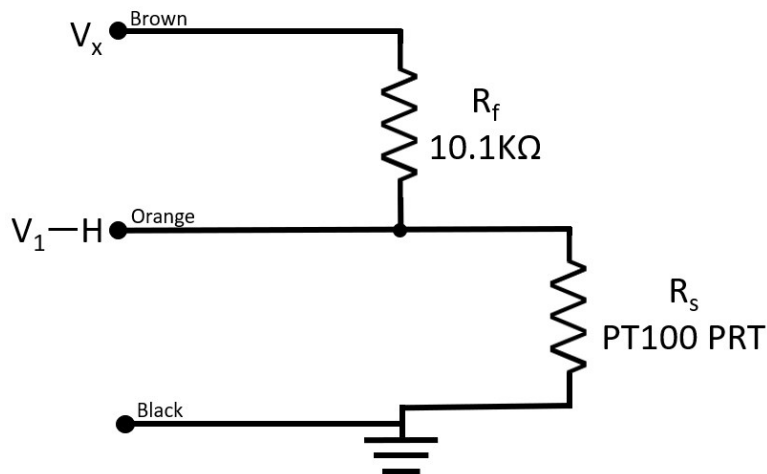


Figure 8-2. TempVue 10 2-wire schematic

8.2 Reducing measurement noise

Excess cable lengths may be prone to electrical noise. The cable should be long enough to form a drip loop, which helps prevent water ingress into the data logger enclosure. However, excess cable coiled in the enclosure should be avoided.

AC power lines, pumps, and motors can be the source of electrical noise. If the TempVue 10 probe or data logger is located in an electrically noisy environment, the measurement should be made with the 60 or 50 Hz rejection options.

Offsets in the measurement circuitry may be reduced by reversing the differential analog inputs (RevDiff).

9. Maintenance, troubleshooting, and calibration

NOTE:

All factory repairs and recalibrations require a returned material authorization (RMA) and completion of the "Statement of Product Cleanliness and Decontamination" form. Refer to the [Assistance](#) page at the end of this manual for more information.

9.1 Maintenance

The TempVue 10 requires minimal maintenance. Periodically check cabling for proper connections, signs of damage, and possible moisture intrusion.

Check the radiation shield monthly to make sure it is free from dust and debris. To clean the shield, first remove the sensor. Dismount the shield. Brush all loose dirt off. If more effort is needed, use warm, soapy water and a soft cloth or brush to thoroughly clean the shield. Allow the shield to dry before remounting.

Ensure the TempVue 10 probe is clean and free of dirt or any soiling by wiping carefully with a lint free cloth and warm soapy water.

9.2 Troubleshooting

Symptom: Temperature is NAN, -INF, -9999, -273

Verify wiring of sensor to the data logger; cross-reference data logger program or the measurement system wiring diagram.

Symptom: Incorrect Temperature

Check the cable for signs of damage and possible moisture intrusion.

Symptom: Unstable Temperature

Make sure the shield and ground wires are connected to data logger ground, and the data logger is properly grounded.

Symptom: Unusually high error detected

Measurements made using 2-wire configurations may have higher error, especially if the program and Rf to Rs ratio values are based on a 4-wire configuration. Please refer to [2-wire configuration](#) (p. 10) for more information.

9.3 Calibration

For the 4-wire configuration, the recommended calibration interval is listed on the calibration certificate (see [Figure 9-1](#) [p. 19]). For the 2-wire configuration, contact the third party accredited laboratory that performed the original calibration for the recommended calibration interval.

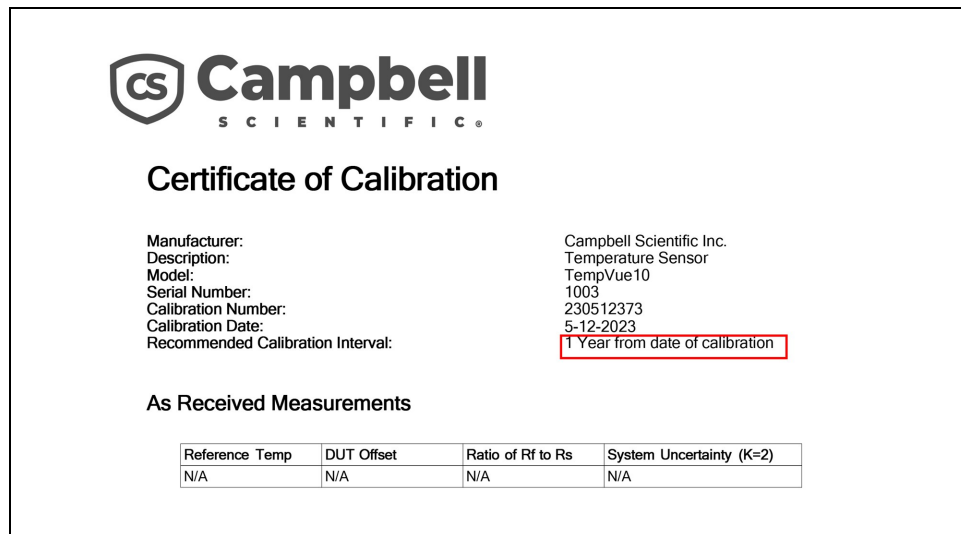


Figure 9-1. Location of recommended calibration interval on the calibration certificate

10. References

- WMO, 2008. *Guide to Meteorological Instruments and Methods of Observation*. World Meteorological Organization No. 8, 7th edition, Geneva, Switzerland.
- WMO, 2021. *Instruments and Observing Methods, Generic Automatic Weather Station (AWS) Tender Specifications*. World Meteorological Organization, Report 136, Geneva, Switzerland.
- AASC, 1985: The State Climatologist (1985) Publication of the American Association of State Climatologists: *Heights and Exposure Standards for Sensors on Automated Weather Stations*, v. 9, No. 4 October, 1985. (www.stateclimate.org/publications/state-climatologist/NOAA-NCY-SCBOOKS-SC77097/00000029.pdf)
- EPA, 2008: *Quality Assurance Handbook for Air Pollution Measurement Systems*, Vol. IV, Meteorological Measurements, Ver. 2.0, EPA-454/B-08-002 (revised 2008). Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711.

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 *CRBasic Editor*. By default, these files reside in the C:\campbellsci\SCWin folder.

Import *Short Cut* program file and wiring information into *CRBasic Editor*:

1. Create the *Short Cut* program, then save it. Click the **Advanced** tab then the **CRBasic Editor** button. Your program file will open in CRBasic with a generic name. Provide a meaningful name and save the CRBasic program. This program can now be edited for additional refinement.

NOTE:

Once the file is edited with *CRBasic Editor*, *Short Cut* can no longer be used to edit the program.

2. To add the *Short Cut* wiring information into the new CRBasic program, open the .DEF file located in the C:\campbellsci\SCWin folder. Copy the wiring information found at the beginning of the .DEF file.
3. Go into the CRBasic program and paste the wiring information at the beginning of the program.
4. In the CRBasic program, highlight the wiring information, right-click, and select **Comment Block**. This adds an apostrophe (') to the beginning of each of the highlighted lines, which instructs the data logger compiler to ignore those lines when compiling. The **Comment Block** feature is demonstrated at about 5:10 in the [CRBasic | Features](#) video .

Appendix B. Example programs

These CR1000X example programs measure the resistance and convert the resistance to temperature in degree Celsius. [CRBasic Example 1](#) (p. 23) uses the 4-wire configuration to measure the TempVue 10. The ratio of R_f to R_s is entered at the beginning of the program as a variable. This value needs to be changed according to the calibration certificate.

[CRBasic Example 2](#) (p. 24) uses the 2-wire configuration to measure the TempVue 10. The 2-wire configuration uses fewer terminals, but the 4-wire configuration provides more accurate measurements.

The following table provides wiring for the example programs.

Color	CR1000X 2-wire connection	CR1000X 4-wire connection
Brown	VX1	VX1
Orange	SE1	2H
Purple	not used	2L
Yellow	not used	1H
Blue	not used	1L
Black	⏏ (analog ground)	⏏ (analog ground)
Clear	⏏ (analog ground)	⏏ (analog ground)

The white and gray wires are not used.

CRBasic Example 1: CR1000X program for TempVue 10 with 4-wire configuration

```
'CR1000X
'
'This program measures the resistance using the BrHalf4W
'instruction and then converts the resistance to temperature
'using the PRTCalc instruction.

'Change RfRs to the Ratio of Rf to Rs value from
'on the calibration certificate
Const RfRs = 1.0000000

'Declare Variables and Units
Public BattV 'CR1000X battery voltage
Public PTemp_C 'CR1000X panel temperature
Public TV10RsR0 'TempVue 10 resistance measurement
Public TempVUE10T_C 'temperature measurement

Units BattV = Volts
Units PTemp_C = Deg C
Units TempVUE10T_C = Deg C

'Define Data Tables
DataTable (Hourly,True,-1 )
  DataInterval (0,60,Min,10)
  Sample (1,TempVUE10T_C,FP2)
  Average (1,TempVUE10T_C,FP2,False)
  Maximum (1,TempVUE10T_C,FP2,False,True)
  Minimum (1,TempVUE10T_C,FP2,False,True)
  Sample (1,TV10RsR0,FP2)
EndTable

DataTable(Daily,True,-1)
  DataInterval(0,1440,Min,10)
  Minimum(1,BattV,FP2,False,False)
  Maximum (1,BattV,FP2,False,False)
  Minimum(1,PTemp_C,FP2,False,False)
  Maximum (1,PTemp_C,FP2,False,False)
EndTable

'Main Program
BeginProg
  'Main Scan
  Scan(10,Sec,1,0)
  'Battery Voltage measurement 'BattV'
  Battery(BattV)

  'Wiring Panel Temperature measurement 'PTemp_C'
  PanelTemp(PTemp_C,60)
```

CRBasic Example 1: CR1000X program for TempVue 10 with 4-wire configuration

```
'Measure the TempVue10 Resistance (4-wire) 'TV10RsR0'  
BrHalf4W(TV10RsR0,1,mV200C,mV200C,1,VX1,1,2100,True,True,50000,60,RfRs,0)  
  
'Convert the resistance to temperature in Deg Celsius  
PRTCalc (TempVUE10T_C,1,TV10RsR0,1,1,0)  
  
'Call Data Tables and Store Data  
CallTable Daily  
CallTable Hourly  
NextScan  
EndProg
```

CRBasic Example 2: CR1000X program for TempVue 10 with 2-wire configuration

```
'CR1000X  
,  
  
'This program measures the resistance using the BrHalf instruction, calculating  
'for Rs, calculates the ratio of Rs/R0, and then converts the resistance ratio  
'to temperature using the PRTCalc instruction.  
  
'Calibration Offset Value  
'Note: This is NOT the DUT offset value on the calibration certificate.  
'That calibration is only valid for the recommended 4-wire configuration.  
'This offset value should be determined by the user from a calibration  
'done with the 2-wire configuration and a reliable reference sensor.  
  
'Caution: Using a 2-wire configuration without a calibration offset could  
'result in inaccuracies greater than 1 degree Celsius.  
  
Const Cal_Offset = 0.0  
Const Rf = 10100 'Resistance of Rf  
Const R0 = 100 'Resistance of the PRT at 0 Deg Celsius  
  
'Declare Variables and Units  
Public BattV 'CR1000X battery voltage  
Public PTemp_C 'CR1000X Panel Temperature  
Public X 'TempVue 10 resistance measurement  
Public Rs 'Resistance of PT100  
Public TempVue10RsR0 'Ratio of Rs/R0  
Public TempVue10T_C 'temperature measurement  
  
Units BattV = Volts  
Units PTemp_C = Deg C  
Units TempVue10T_C = Deg C
```

CRBasic Example 2: CR1000X program for TempVue 10 with 2-wire configuration

```
'Define Date Tables
DataTable (Hourly,True,-1)
  DataInterval (0,60,Min,10)
  Sample (1,TempVue10T_C,FP2)
  Average (1,TempVue10T_C,FP2,False)
  Maximum (1,TempVue10T_C,FP2,False,True)
  Minimum (1,TempVue10T_C,FP2,False,True)
  Sample (1,TempVue10RsR0,FP2)
EndTable

'Main Program
BeginProg
  'Main Scan
  Scan (1,Sec,1,0)
    'Battery Voltage measurement 'BattV'
    Battery(BattV)

    'Wiring Panel Temperature measurement 'PTemp_C'
    PanelTemp(PTemp_C,60)

    'Measure the Tempvue 10 resistance
    BrHalf (X,1,mV200C,1,Vx1,1,2500,True,50000,60,1,0)

    'Calculate the value of Rs
    Rs = Rf*X/(1-X)

    'Calculate the ratio of Rs/R0
    TempVue10RsR0 = Rs/R0

    'Convert the resistance ratio to temperature in Deg Celsius
    PRTCalc (TempVue10T_C,1,TempVue10RsR0,1,1,Cal_Offset)

    'Call Data Tables and Store Data
    CallTable Hourly
  NextScan
EndProg
```


Limited warranty

Covered equipment is warranted/guaranteed against defects in materials and workmanship under normal use and service for the period listed on your sales invoice or the product order information web page. The covered period begins on the date of shipment unless otherwise specified. For a repair to be covered under warranty, the following criteria must be met:

1. There must be a defect in materials or workmanship that affects form, fit, or function of the device.
2. The defect cannot be the result of misuse.
3. The defect must have occurred within a specified period of time; and
4. The determination must be made by a qualified technician at a Campbell Scientific Service Center/ repair facility.

The following is not covered:

1. Equipment which has been modified or altered in any way without the written permission of Campbell Scientific.
2. Batteries; and
3. Any equipment which has been subjected to misuse, neglect, acts of God or damage in transit.


Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page of the manual for a list of [regional offices](#) or visit www.campbellsci.com/contact  to determine which Campbell Scientific office serves your country. For directions on how to return equipment, see [Assistance](#).

Other manufacturer's products, that are resold by Campbell Scientific, are warranted only to the limits extended by the original manufacturer.

CAMPBELL SCIENTIFIC EXPRESSLY DISCLAIMS AND EXCLUDES ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Campbell Scientific hereby disclaims, to the fullest extent allowed by applicable law, any and all warranties and conditions with respect to the products, whether express, implied, or statutory, other than those expressly provided herein.


Campbell Scientific will, as a default, return warranted equipment by surface carrier prepaid. However, the method of return shipment is at Campbell Scientific's sole discretion. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This warranty and the Company's obligation thereunder is in lieu of all other

warranties, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

In the event of any conflict or inconsistency between the provisions of this Warranty and the provisions of Campbell Scientific's Terms, the provisions of Campbell Scientific's Terms shall prevail. Furthermore, Campbell Scientific's Terms are hereby incorporated by reference into this Warranty. To view Terms and conditions that apply to Campbell Scientific, Logan, UT, USA, see [Terms and Conditions](#) . To view terms and conditions that apply to Campbell Scientific offices outside of the United States, contact the [regional office](#) that serves your country.

Assistance

Products may not be returned without prior authorization. Please inform us before returning equipment and obtain a **return material authorization (RMA) number** whether the repair is under warranty/guarantee or not. See [Limited warranty](#) for information on covered equipment.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page of the manual for a list of [regional offices](#) or visit www.campbellsci.com/contact  to determine which Campbell Scientific office serves your country.

When returning equipment, a RMA number must be clearly marked on the outside of the package. Please state the faults as clearly as possible. 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, when equipment is returned to Campbell Scientific, Logan, UT, USA, it is mandatory that a "[Declaration of Hazardous Material and Decontamination](#)" form be received before the return can be processed. If the form is not received within 5 working days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. For details on decontamination standards specific to your country, please reach out to your [regional Campbell Scientific](#) office.

NOTE:

All goods that cross trade boundaries may be subject to some form of fee (customs clearance, duties or import tax). Also, some regional offices require a purchase order upfront if a product is out of the warranty period. Please contact your [regional Campbell Scientific](#) office for details.

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, 6 meters (20 feet), or the distance required by applicable law, whichever is greater, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.
- Only use power sources approved for use in the country of installation to power Campbell Scientific devices.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

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.

Use and disposal of batteries

- Where batteries need to be transported to the installation site, ensure they are packed to prevent the battery terminals shorting which could cause a fire or explosion. Especially in the case of lithium batteries, ensure they are packed and transported in a way that complies with local shipping regulations and the safety requirements of the carriers involved.
- When installing the batteries follow the installation instructions very carefully. This is to avoid risk of damage to the equipment caused by installing the wrong type of battery or reverse connections.
- When disposing of used batteries, it is still important to avoid the risk of shorting. Do not dispose of the batteries in a fire as there is risk of explosion and leakage of harmful chemicals into the environment. Batteries should be disposed of at registered recycling facilities.

Avoiding unnecessary exposure to radio transmitter radiation

- Where the equipment includes a radio transmitter, precautions should be taken to avoid unnecessary exposure to radiation from the antenna. The degree of caution required varies with the power of the transmitter, but as a rule it is best to avoid getting closer to the antenna than 20 cm (8 inches) when the antenna is active. In particular keep your head away from the antenna. For higher power radios (in excess of 1 W ERP) turn the radio off when servicing the system, unless the antenna is installed away from the station, e.g. it is mounted above the system on an arm or pole.

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.

Global Sales and 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: Montrouge, 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: Shephed, 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