Product Manual

Sensor

HFP01SC

Self-Calibrating
Soil Heat Flux Plate

Revision: 02/2020

RELIABLE SINCE 1974 MONITORING

CAMPBELL SCIENTIFIC

Table of Contents

PDF viewers: These page numbers refer to the printed version of this document. Use the PDF reader bookmarks tab for links to specific sections.

1. Introduction.. 1

2. Cautionary Statements... 1

3. Initial Inspection 1

4. Overview 1

5. Specifications 2

6. Installation 3

6.1 Placement in Soil...3
6.2 Wiring 4
6.3 Programming..5
6.4 Soil Heat Flux and Storage...6
6.5 In-Situ Calibration Theory 6
6.5.1 Calibration Validity Tests 8
6.5.2 Equation and Variable Cross Reference.............................9

7. Maintenance.. 10

8. References 10

Figures

6-1. Placement of sensors 3
6-2. HFP01SC plate...4

Tables

6-1. Wire Color, Function, and Data Logger Connections 5
6-2. Equation and Example Data Logger Program Variable Names 9

HFP01SC Self-Calibrating Soil Heat Flux Plate

1. Introduction

The HFP01SC Self-Calibrating Heat Flux Sensor™ measures soil heat flux, typically for energy-balance or Bowen-ratio flux systems. It is intended for applications requiring the highest possible degree of measurement accuracy. Two sensors can provide spatial averaging. Sites with heterogeneous media may require additional sensors.

NOTE This manual provides information only for CRBasic data loggers. For retired Edlog data logger support, see an older manual at *www.campbellsci.com/old-manuals*.

2. Cautionary Statements

- READ AND UNDERSTAND the *Safety* section at the back of this manual.
- Care should be taken when opening the shipping package to not damage or cut the cable jacket. If damage to the cable is suspected, contact Campbell Scientific.
- Although the HFP01SC is rugged, it should be handled as a precision scientific instrument.

3. Initial Inspection

- Upon receipt of the HFP01SC, inspect the packaging and contents for damage. File damage claims with the shipping company.
- The model number and cable length are printed on a label at the connection end of the cable. Check this information against the shipping documents to ensure the correct product and cable length are received.
- The HFP01SC is shipped with a product certificate.

4. Overview

The HFP01SC Soil Heat Flux plate consists of a thermopile and a film heater. The thermopile measures temperature gradients across the plate. During the in-situ field calibration, the film heater is used to generate a heat flux through the plate. The amount of power used to generate the calibration heat flux is measured by the data logger. Each plate is individually calibrated, at the factory, to output flux.

To get the soil heat flux at the surface, use an HFP01SC to measure soil heat flux; a TCAV Averaging Soil Thermocouple to measure the temporal change in temperature of the soil layer; and a CS616, CS650, or CS655 water content reflectometer to measure soil water content. The temporal change in soil temperature and soil water content are used to compute the soil storage term.

The HFP01SC-L has two cables; the first cable is the signal output cable and the second is the heater input cable.

Features:

- Corrects for errors due to differences in thermal conductivity between the sensor and the surrounding medium, temperature variations, and slight sensor instabilities
- Ideal for energy-balance or Bowen-ratio systems
- Uses self-calibration to provide high-degree of measurement accuracy
- Compatible with Campbell Scientific CRBasic data loggers: GRANITE series, CR6 series, CR3000, CR1000X, CR800 series, and CR1000

5. Specifications

Operating Temperature:	–30 to 70 °C
Storage Temperature:	–30 to 70 °C
Plate Thickness:	5 mm (0.2 in)
Plate Diameter:	80 mm (3.15 in)
Average Power Consumption:	0.02 to 0.04 W
Sensor:	Thermopile and film heater
Heater Voltage Input:	9 to 15 VDC
Heater Voltage Output:	0 to 2 VDC
Expected Accuracy:	±3% of reading
Sensitivity:	Check product certificate for value
Sensor Resistance:	2 Ω
Heater Resistance:	Check product certificate for value
Duration of Calibration:	±3 min. @ 1.5 W; typically done every 3 to 6 hours
Weight without Cable:	200 g (7.05 oz)

6. Installation

6.1 Placement in Soil

The standard set of sensors for measuring soil heat flux includes an HFP01SC Soil Heat Flux Plate, TCAV Averaging Soil Thermocouple, and CS616, CS650, or CS655 water content reflectometer. These sensors are installed as shown in FIGURE 6-1.

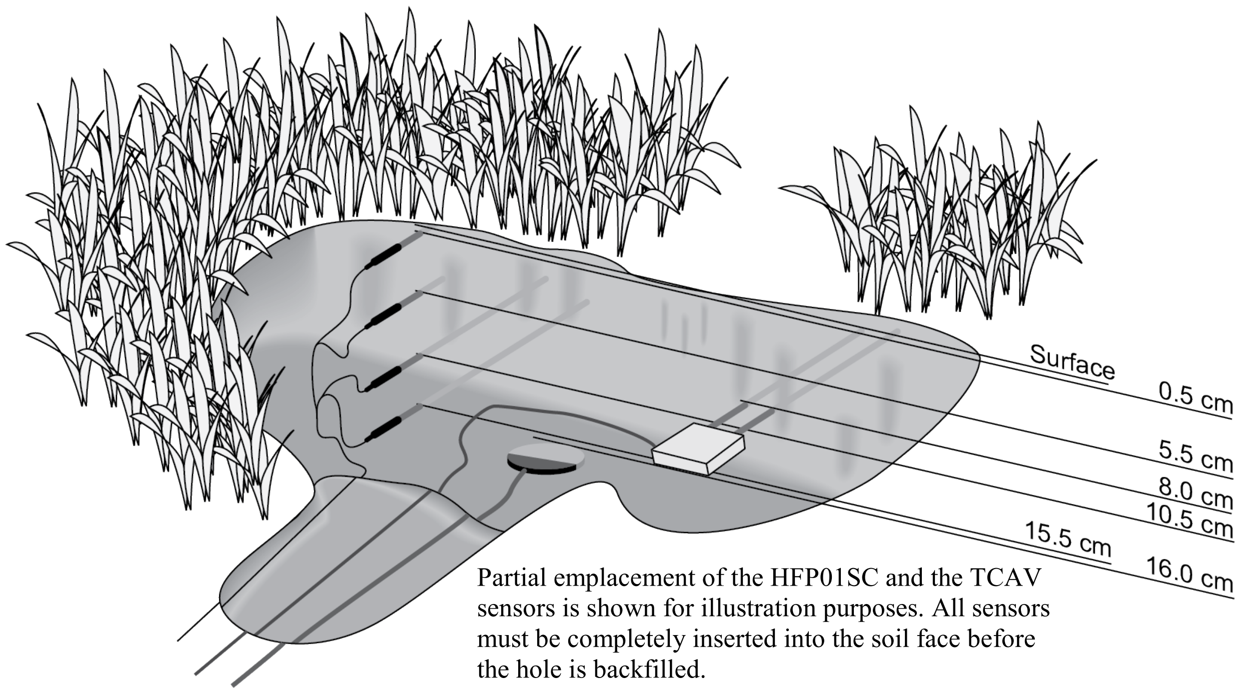

FIGURE 6-1. Placement of sensors

The location of the heat flux plate and thermocouples should represent the area of study. Sites with varied ground cover may require additional sensors to provide a valid spatial average of soil heat flux.

Use a small shovel to make a vertical slice in the soil. Excavate the soil to one side of the slice. Keep this soil intact to ensure replacement with minimal disruption.

The sensors are installed in the undisturbed face of the hole. Measure the sensor depths from the top of the hole. With a small knife, make a horizontal cut 16 centimeters below the surface into the undisturbed face of the hole. Insert the heat flux plate into the horizontal cut.

NOTE Install the HFP01SC in the soil such that the side with the text "this side up" is facing the sky.

CAUTION To make quality soil heat flux measurements, the HFP01SC plate must be in full contact with the soil.

Never run the sensors cable directly to the surface. Rather, bury the sensor cable a short distance back from the hole to minimize thermal conduction on the cable wires. Replace the excavated soil into its original position after all the sensors are installed.

6.2 Wiring

The HFP01SC includes a signal and heater cable (FIGURE 6-2). TABLE 6-1 provides the data logger connections for both single-ended and differential measurements. Typically, differential measurements are used.

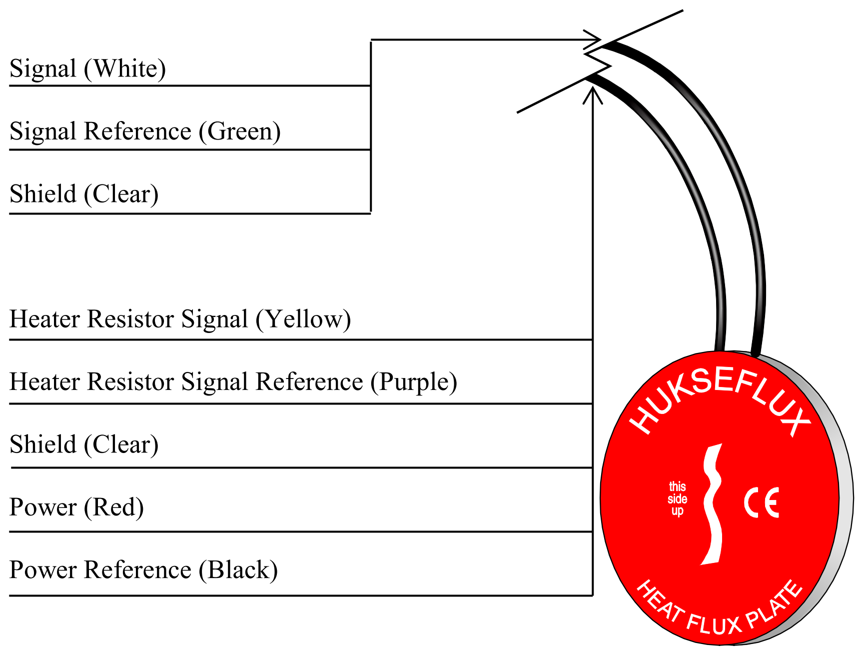

FIGURE 6-2. HFP01SC plate

TABLE 6-1. Wire Color, Function, and Data Logger Connections			
Wire Color	**Wire Function**	**Data Logger Single-Ended Measurement**	**Data Logger Differential Measurement**
White	Sensor Signal	**U** configured for single-ended analog input[1], **SE** (single-ended, analog input)	**U** configured for differential analog input high[1], **DIFF H** (differential high, analog input)
Green	Sensor Signal Reference	⏚ (analog ground)	**U** configured for differential analog input low[1], **DIFF L** (differential low, analog input)
Clear	Shield	⏚ (analog ground)	⏚ (analog ground)
Yellow	Heater Resistance Signal	**U** configured for single-ended analog input[1], **SE** (single-ended, analog input)	**U** configured for differential analog input high[1], **DIFF H** (differential high, analog input)
Purple	Heater Resistance Signal Reference	⏚ (analog ground)	**U** configured for differential analog input low[1], **DIFF L** (differential low, analog input)
Clear	Shield	⏚ (analog ground)	⏚ (analog ground)
Red	Power	**SW12** (switched 12 V)	**SW12** (switched 12 V)
Black	Power Reference	**G** (ground)	**G** (ground)

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

The wiring convention is that the white wire is positive with respect to the green wire, when energy is flowing through the transducer from the side with the text "this side up" to the other side.

NOTE The switched 12 VDC terminal can source enough current to calibrate four HFP01SC plates. If additional HFP01SC plates are needed, an external relay is required to power the additional plates.

6.3 Programming

Programming basics for CRBasic data loggers are in this section. A downloadable example program is available at *www.campbellsci.com/downloads/hfp01sc-example-program*. Programming basics and programming examples for Edlog data loggers are provided at *www.campbellsci.com/old-manuals*.

The HFP01SC output is measured using either a single-ended (**VoltSE**) or differential (**VoltDiff**) instruction. The differential measurement is recommended.

The HFP01SC has a nominal calibration of 15 W m^{-2} mV^{-1}. Each sensor is accompanied by a product certificate. Each sensor also has a unique calibration label on it. The label is located on the pigtail end of the sensor cables.

6.4 Soil Heat Flux and Storage

The soil heat flux at the surface is calculated by adding the measured flux at a fixed depth, d, to the energy stored in the layer above the heat flux plates. The specific heat of the soil and the change in soil temperature, ΔT_s, over the output interval, t, are required to calculate the stored energy.

The heat capacity of the soil is calculated by adding the specific heat of the dry soil to that of the soil water. The values used for specific heat of dry soil and water are on a mass basis. The heat capacity of the moist is given by Equation 1 and Equation 2:

$$C_s = \rho_b\left(C_d + \theta_m C_w\right) = \rho_b C_d + \theta_v \rho_w C_w \quad (1)$$

$$\theta_m = \frac{\rho_w}{\rho_b}\theta_v \quad (2)$$

where C_S is the heat capacity of moist soil, ρ_b is the bulk density, ρ_w is the density of water, C_d is the heat capacity of a dry mineral soil, θ_m is the soil water content on a mass basis, θ_v is the soil water content on a volume basis, and C_w is the heat capacity of water.

This calculation requires site specific inputs for bulk density, mass basis soil water content or volume basis soil water content, and the specific heat of the dry soil. Bulk density and mass basis soil water content can be found by sampling (Klute, 1986). The volumetric soil water content is measured by the water content reflectometer. A value of 840 J kg^{-1} K^{-1} for the heat capacity of dry soil is a reasonable value for most mineral soils (Hanks and Ashcroft, 1980).

The storage term is then given by Equation 3 and the soil heat flux at the surface is given by Equation 4.

$$S = \frac{\Delta T_s\, C_s\, d}{t} \quad (3)$$

$$G_{sfc} = G_{8cm} + S \quad (4)$$

where S is the storage term, G_{8cm} is the soil heat flux at 8 cm, and G_{sfc} is the soil heat flux at the surface.

6.5 In-Situ Calibration Theory

The heat flux measured by the HFP01 or HFP01SC, φ, is given in units $W \cdot m^{-2}$ by

$$\varphi = \left(\frac{1000}{S}\right) V = cV \quad (5)$$

where S is the sensitivity for the sensor in units $\mu V \cdot W^{-1} \cdot m^2$ as provided by the manufacturer, V is the voltage output from the sensor thermopile in mV, and c is the calibration multiplier in units $W \cdot m^{-2} \cdot mV^{-1}$. Equation 5 is given in terms of both the sensitivity and the calibration multiplier for convenience: the sensor calibration certificate from the manufacturer reports a laboratory-calibrated sensitivity, while the example data logger program available at *www.campbellsci.com/downloads/hfp01sc-example-program* expresses the formula in terms of the calibration multiplier.

Campbell Scientific recommends that the sensor be sent in for laboratory recalibration every two years. However, for the HFP01SC, this interval may be increased to five years if regular in-situ calibrations are performed. In-situ calibration compensates for errors arising from the following: 1) thermal conductivity changes between the plate and surrounding media, 2) temperature dependence of the sensor sensitivity, and 3) sensor drift.

The appropriate frequency of in-situ calibration depends on conditions at the site. For example, sites with higher rates of change of moisture or temperature need more frequent calibration, such as every six hours. Sites with less drastic changes need less frequent calibration, such as once a day.

When performing an in-situ calibration, a film heater in the HFP01SC is powered to provide a known heat flux, φ_{cal}, through the sensor. The change in sensor voltage output from when the heater is off to when it is powered on, ΔV, is also measured, thus providing a new calibration multiplier, c_{cal}:

$$c_{cal} = \frac{\varphi_{cal}}{\Delta V} \quad (6)$$

φ_{cal} is calculated as follows:

$$\varphi_{cal} = \frac{P}{2A} \quad (7)$$

Where:

P is the power in W given off by the heater;

The 2 in the denominator is included due to the power generated by the heater dissipating both upwards and downwards, meaning that only half of the flux will pass through the thermopile;

A is the area of the sensor plate in m^2 and is nominally 3.855 x 10^{-3} m^2;

P is equal to the current flowing through the heater, I, multiplied by the voltage across the heater, V_h. However, V_h is unknown, so we put V_h in terms of I and the heater resistance, R_h:

$$P = IV_h = I^2 R_h \quad (8)$$

R_h is found in the manufacturer's calibration certificate and typically has a value in the range of 95 to 110 Ω.

Because the current flowing through the heater is the same as the current flowing through the heater reference resister, we can solve for I using the known resistance of the reference resistor, R_r (nominally 10 Ω), and the measured voltage across the reference resistor, V_r, while the heater is powered:

$$I = \frac{V_r^2}{R_r^2} \quad (9)$$

Substituting Equation 9 into Equation 8 yields the following:

$$P = \frac{V_r^2 R_h}{R_r^2} \tag{10}$$

Now returning to Equation 6, ΔV is measured by taking the absolute difference between voltage output from the sensor when the heater is powered and the average of voltage output before and after the heater has been powered:

$$\Delta V = \left| V_{heat} - \frac{V_0 + V_{end}}{2} \right| \tag{11}$$

Where:

V_{heat} is the voltage output from the sensor once the heater has been powered adequately long to achieve equilibrium (typically at the end of a 180 second heating interval);

V_0 is the voltage output from the sensor at the beginning of the calibration before the heater is powered;

And V_{end} is the voltage output from the sensor at the end of the calibration after the heater has been powered off and its heat has dissipated. After the heater is powered off, a minimum of 180 seconds should be waited before V_{end} is measured.

Finally, by substituting Equation 11 into Equation 6, and Equation 10 into Equation 7 and then into Equation 6, we can solve for the new calibration constant in terms that are all known or measured:

$$c_{cal} = \frac{V_r^2 R_h}{2AR_r^2 \left| V_{heat} - \frac{V_0 + V_{end}}{2} \right|} \tag{12}$$

Once c_{cal} is found, it should replace the original calibration multiplier, c, in Equation 5.

6.5.1 Calibration Validity Tests

To ensure the in-situ calibration is good, it is recommended to test whether the new calibration multiplier is a reasonable value and whether the sensor is adequately responsive. Details on these tests follows.

Test the new calibration multiplier value by converting it to a sensitivity value and then check whether it is within 80% and 105% of the original sensitivity provided on the sensor calibration certificate from its laboratory calibration. That is:

$$0.8S_{lab} < \frac{1000}{c_{cal}} = S_{cal} < 1.05S_{lab} \tag{13}$$

If this condition is not met, the new calibration should be rejected. If several successive calibrations are rejected, the sensor should be inspected and, if needed, returned for laboratory examination and recalibration.

The next tests check for reasonable response rates. Firstly, the calibration multiplier should be rejected and the sensor installation checked if the value of

V_{end} has not returned to value that is close to the voltage output before the calibration, suggesting that the sensor heat is dissipating too slowly to the surrounding media; that is, if the following condition is found:

$$|V_{end} - V_0| > 0.1\Delta V$$

Secondly, the calibration multiplier should be rejected and the sensor installation checked if the sensor output voltage is not adequately stable near the end of the period the heater is powered, as described by the following condition:

$$|V_{heat} - V_{heat-10}| > 0.1\Delta V$$

where $V_{heat-10}$ is the sensor voltage output 10 seconds before measuring V_{heat}.

6.5.2 Equation and Variable Cross Reference

TABLE 6-2 is a cross reference to show how terms in the equations in this section relate to constants and variables in the example data logger program available at *www.campbellsci.com/downloads/hfp01sc-example-program*.

TABLE 6-2. Equation and Example Data Logger Program Variable Names

Description	Variable Name or Constant in Section 6.5 Equations	Variable Name or Constant in Datalogger Program	Units
Heat flux	φ	shf	$W \cdot m^{-2}$
Lab calibration multiplier (from sensitivity on calibration certificate)	$c_{lab} = \frac{1000}{S_{lab}}$	HFP01SC_CAL	$W \cdot m^{-2} \cdot mV^{-1}$
Currently used calibration multiplier	c_{lab} or c_{cal} (depending on whether a calibration has occurred)	shf_cal	$W \cdot m^{-2} \cdot mV^{-1}$
Heater resistance from calibration certificate	R_h	HFP01SC_RSSTNC	Ω
Resistance of heater reference resistor	R_r	HEAT_REF_RSSTNC	Ω
Area of sensor plate	A	HFP01SC_AREA	m^2
Sensor voltage output	V	shf_mV	mV
Sensor voltage output at beginning of calibration (immediately before start of heating interval)	V_0	shf_mV_0	mV
Sensor voltage output 10 seconds before end of heating interval	$V_{heat-10}$	shf_mV_170	mV
Sensor voltage output at end of heating interval	V_{heat}	shf_mV_180	mV
Sensor voltage output at end of calibration	V_{end}	shf_mV_end	mV

TABLE 6-2. Equation and Example Data Logger Program Variable Names			
Description	**Variable Name or Constant in Section 6.5 Equations**	**Variable Name or Constant in Datalogger Program**	**Units**
Voltage across heater reference resistor at end of heating interval	V_r	V_rf_180	mV
Warning flag that is set to TRUE if any calibration tests fail (see Section 6.5.1)	See Section 6.5.1	shf_wrnng_flg	TRUE/FALSE

7. Maintenance

The HFP01SC requires minimal maintenance. Check the cables monthly for rodent damage.

8. References

Hanks, R. J., and G. L. Ashcroft, 1980: *Applied Soil Physics: Soil Water and Temperature Application.* Springer-Verlag, 159 pp.

Hukseflux, 2019: *User Manual HFP01SC, v1624*, *www.hukseflux.com/uploads/product-documents/HFP01SC_manual_v1624.pdf*. Accessed 1 Feb 2020.

Klute, A., 1986: *Method of Soil Analysis.* No. 9, Part 1, Sections 13 and 21, American Society of Agronomy, Inc., Soil Science Society of America, Inc.

Limited Warranty

Products manufactured by Campbell Scientific are warranted by Campbell Scientific to be free from defects in materials and workmanship under normal use and service for twelve months from the date of shipment unless otherwise specified on the corresponding product webpage. See Product Details on the Ordering Information pages at *www.campbellsci.com*. Other manufacturer's products, that are resold by Campbell Scientific, are warranted only to the limits extended by the original manufacturer.

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

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.

Assistance

Products may not be returned without prior authorization.

Refer to *www.campbellsci.com/repair* for up-to-date repair information.

The following contact information is for US and international customers residing in countries served by Campbell Scientific, Inc. directly. Campbell Scientific regional offices handle repairs for customers within their territories. Please visit *www.campbellsci.com/contact* to determine which Campbell Scientific office serves your country.

To obtain a Returned Materials Authorization (RMA) number, contact CAMPBELL SCIENTIFIC, INC., phone (435) 227-9000. Please write the issued RMA number clearly on the outside of the shipping container. Campbell Scientific's shipping address is:

CAMPBELL SCIENTIFIC, INC.
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 or by telephoning (435) 227-9000 (USA). 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, 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.

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

Global Sales & Support Network

A worldwide network to help meet your needs

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