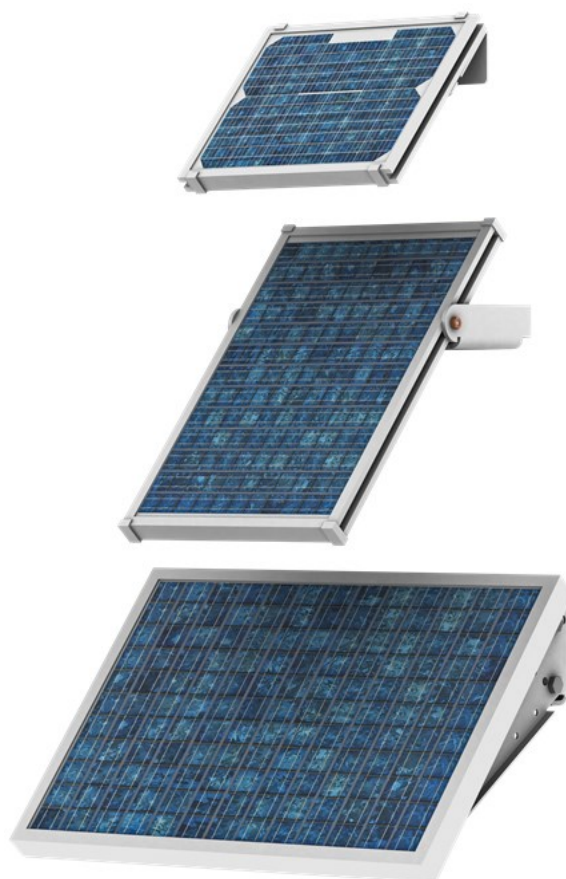




# SP5, SP10, and SP20

Solar Panels



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# 1. Introduction

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Solar panels convert light energy to electricity, or specifically to direct current. The direct current produced is used to provide power to a system and to charge storage batteries. Solar panels operate in both direct and diffuse light, but not at night.

Each solar panel includes a 2-wire cable to attach the panel to a voltage regulator. The regulator and a rechargeable battery are purchased separately from the solar panel.

The SP5 and SP10 have an output level that allows them to be connected directly to the **CHG+** and **CHG-** terminals on the CR300-series data loggers. The SP5, SP10, and SP20 can all be connected directly to the **CHG+** and **CHG-** terminals on the CR6. The data logger will then charge a 12 VDC battery attached to the **BAT+** and **BAT-** terminals on the data logger.

The SP10 10-watt and SP20 20-watt solar panels are intended to recharge the storage batteries incorporated in the PS200, PS150, and CR3000, as well as the BP12 and BP24 battery packs. A CH201, CH200, or CH150 is also required when recharging a BP12 or BP24.

The SP10 and SP20 have two wires stripped and tinned to attach to the charging terminals on the GRANITE 6, CR6, CH201, CH200, PS200, CH150, or PS150. Refer to the product documentation to determine which terminals are used to attach the solar panel.

## 2. Specifications

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	SP5	SP10	SP20
Maximum peak power (Pp):	4.5 W	10 W	20 W
Voltage at peak power (Vpp) (voltage from solar panel before regulator):	16.5 V	16.8 V	16.8 V
Current at peak power (Ipp):	0.27 A	0.59 A	1.19 A
Temperature coefficient (Voc):	-0.45% / °C	-0.37% / °C	-0.38% / °C
Solar panel wire gauge:	20 AWG	20 AWG	20 AWG
Length:	25.1 cm (9.8 in)	41.9 cm (16.5 in)	50.0 cm (19.7 in)

	SP5	SP10	SP20
Width:	26.9 cm (10.6 in)	26.9 cm (10.6 in)	42.2 cm (16.6 in)
Depth:	2.3 cm (0.9 in)	2.3 cm (0.9 in)	5.1 cm (2.0 in)
Weight:	0.9 kg (2.0 lb)	2.1 kg (4.6 lb)	4.4kg (9.7 lb)
Maximum allowable wind gust (standard mount):	not rated	31 m/s (70 mph)	44 m/s (99 mph)
Maximum allowable wind gust (extended mount):	not applicable	58 m/s (130 mph)	58 m/s (130 mph)

**NOTE:**

Solar panel characteristics assume a 1 kilowatt per square meter illumination and a solar panel temperature of 25 °C. Individual panels may vary up to 10%. The output panel voltage increases as the panel temperature decreases.

**Compatible batteries**

SP10/SP20: 12 V lead acid, gel cell, or Absorbed Glass Mat (AGM) storage batteries such as the batteries used with the PS200, PS150, BP12, BP24, and CR3000.

## 3. Installation

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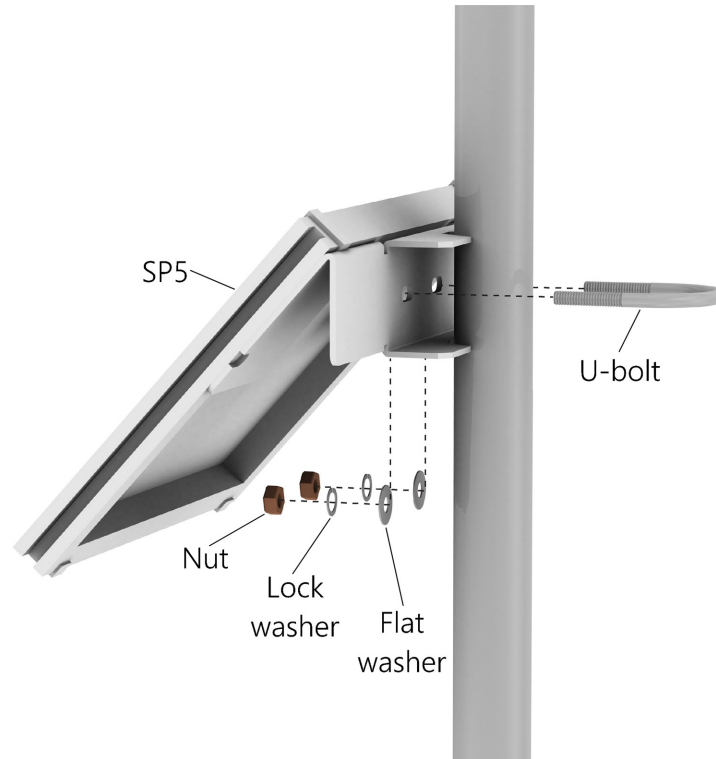
### 3.1 Tool list

- 1/2 in wrench (2)
- 7/16 in wrench
- Torpedo level
- Angle finder

### 3.2 Standard mount assembly

The solar panel mounts to the mast or leg of a tripod, to a tower leg, or any 1 5/8-inch schedule 40 pipe. Refer to [FIGURE 3-1](#) (p. 3) for mounting the SP5. Refer to [FIGURE 3-2](#) (p. 4) (standard

mount) or [FIGURE 3-3](#) (p. 4) (extended mount) for mounting the SP10. Refer to [FIGURE 3-4](#) (p. 5) (standard mount) or [FIGURE 3-5](#) (p. 5) (extended mount) for mounting the SP20. [FIGURE 3-6](#) (p. 6) shows the typical solar panel mounting locations on a tripod or tower. Full instructions for assembling the extended mount bracket are given in [Extended mount assembly](#) (p. 7).



*FIGURE 3-1. SP5 mount*

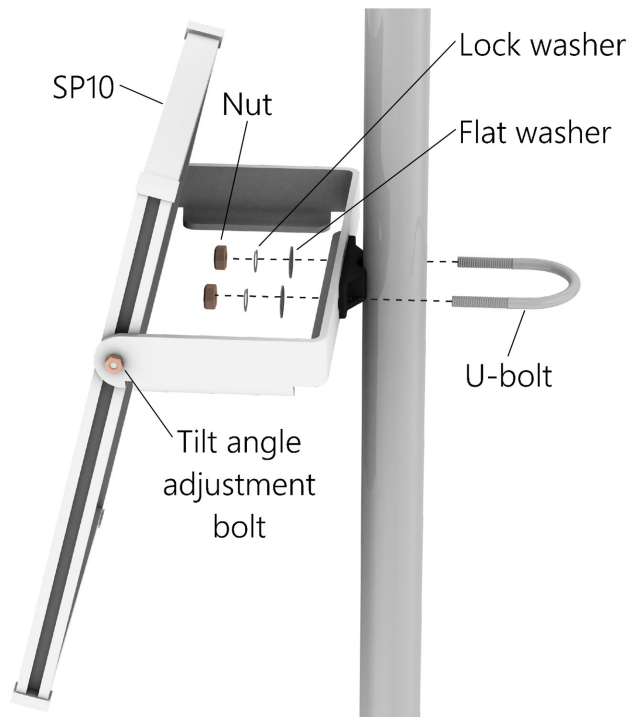


FIGURE 3-2. SP10 standard mount

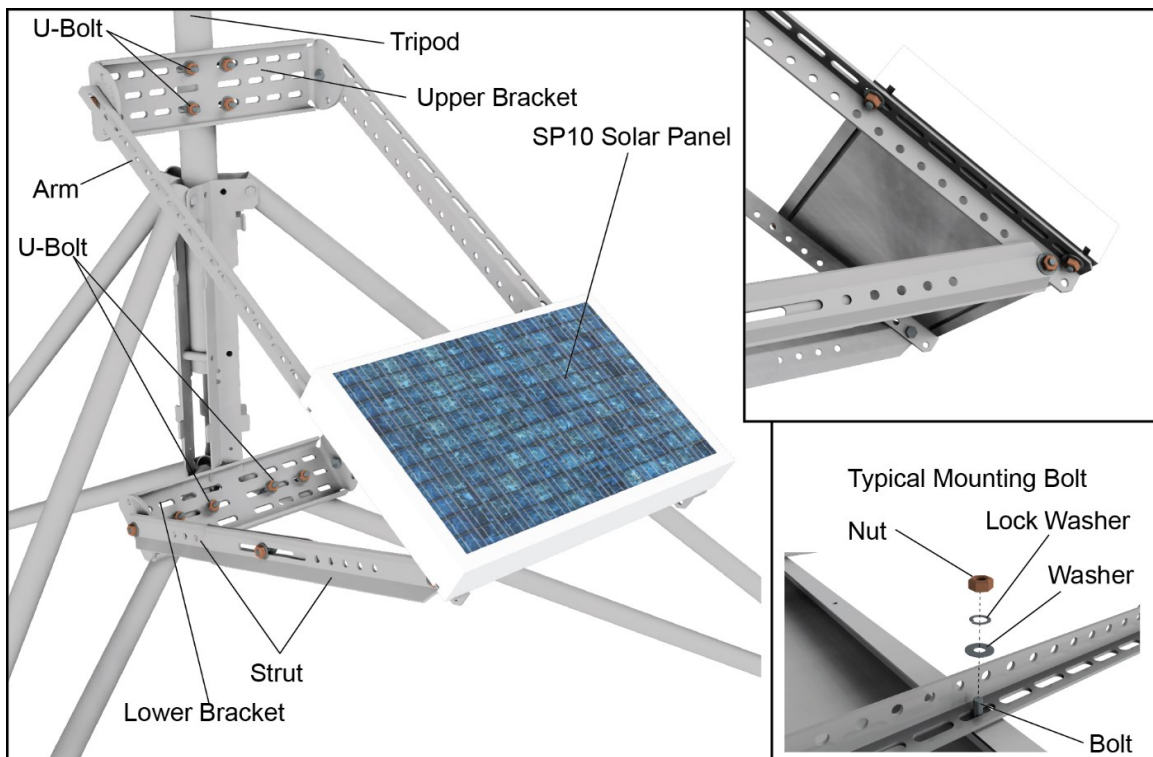


FIGURE 3-3. SP10 extended mount

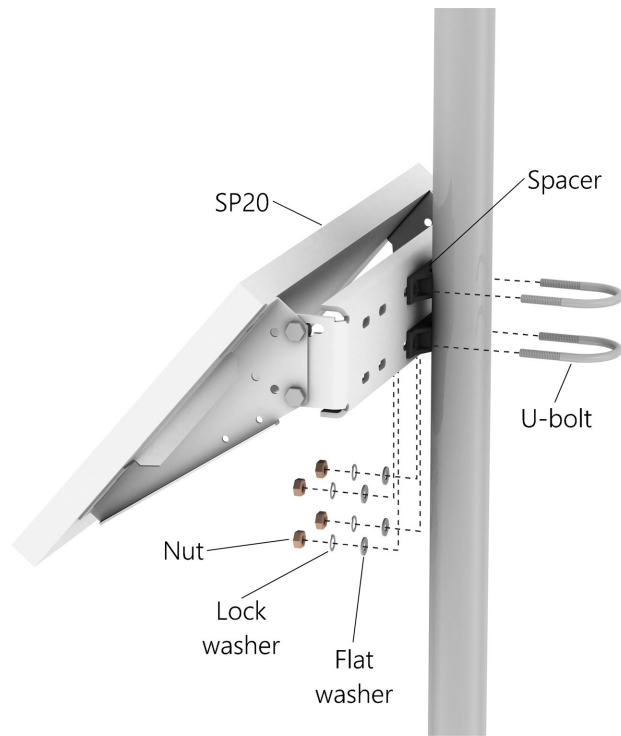


FIGURE 3-4. SP20 standard mount

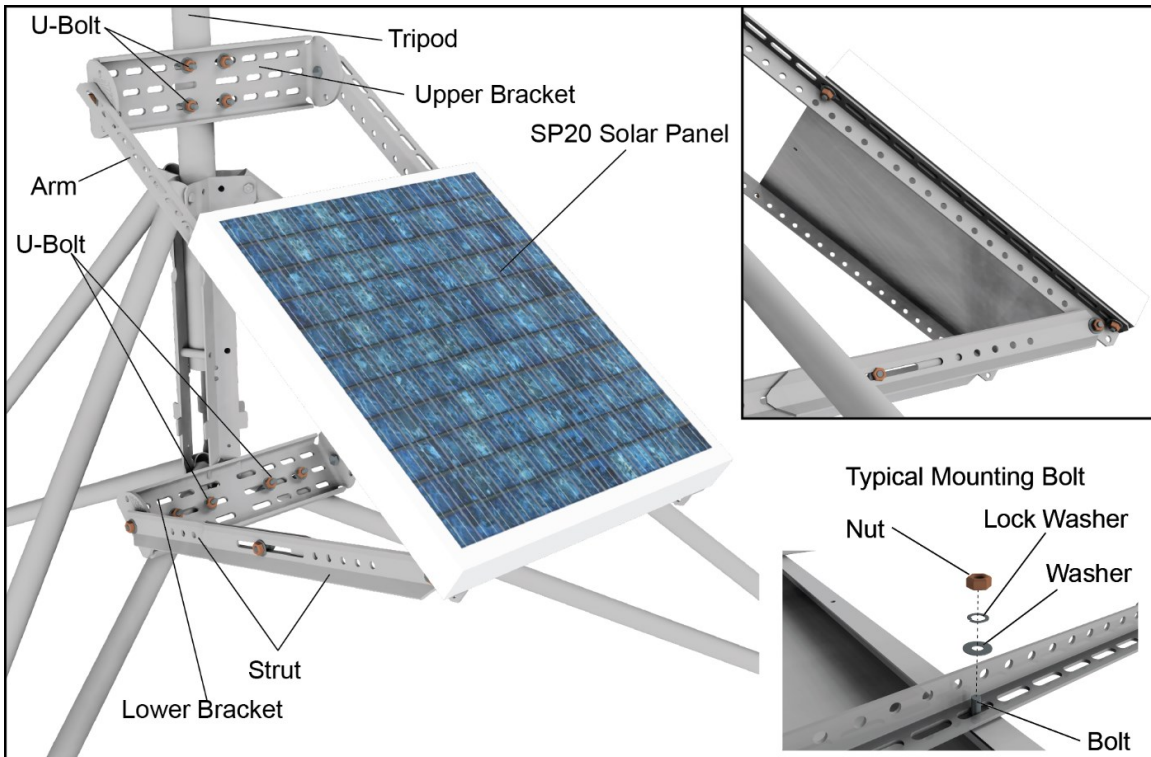
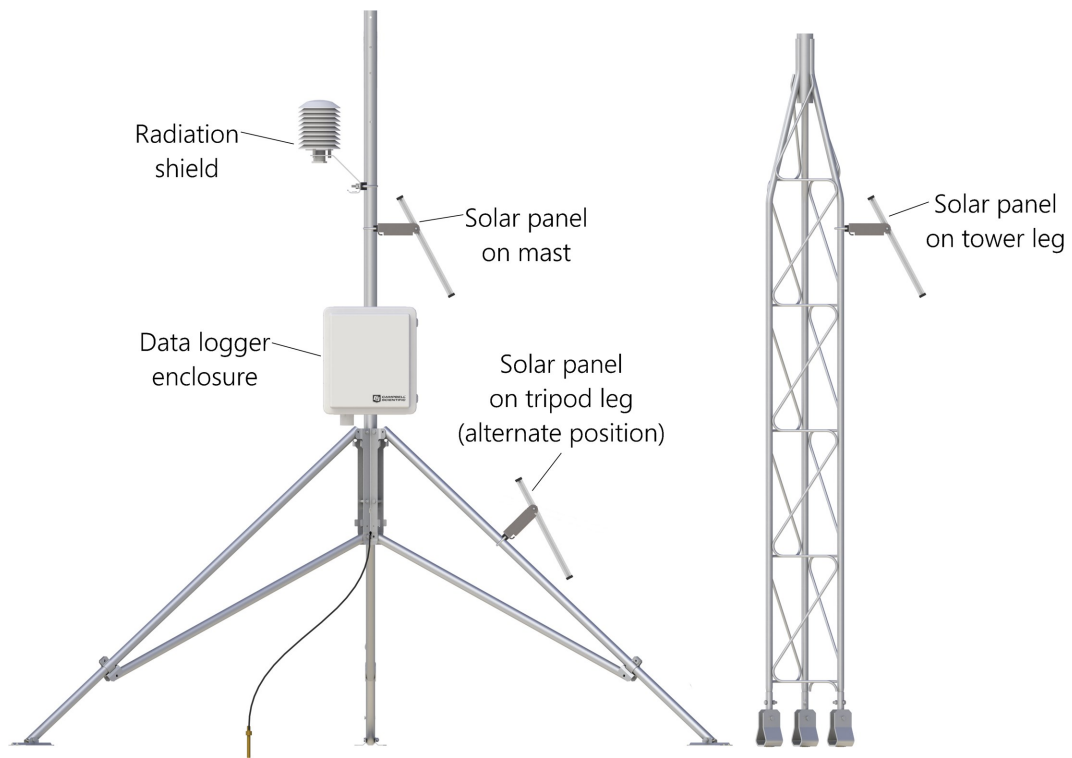


FIGURE 3-5. SP20 extended mount



*FIGURE 3-6. Solar panel mounting locations*

The solar panel is oriented to face the equator, and then mounted to the mast using the U-bolts and 5/16 nuts provided with the panel. The nuts fastening the bracket to the pipe must be as tight as possible without bending the bracket.

Route the solar panel cable to the data logger or power supply/charger. [FIGURE 3-7](#) (p. 7) shows an example of a solar panel connected to the CR6 to run a radiotelemetry system.



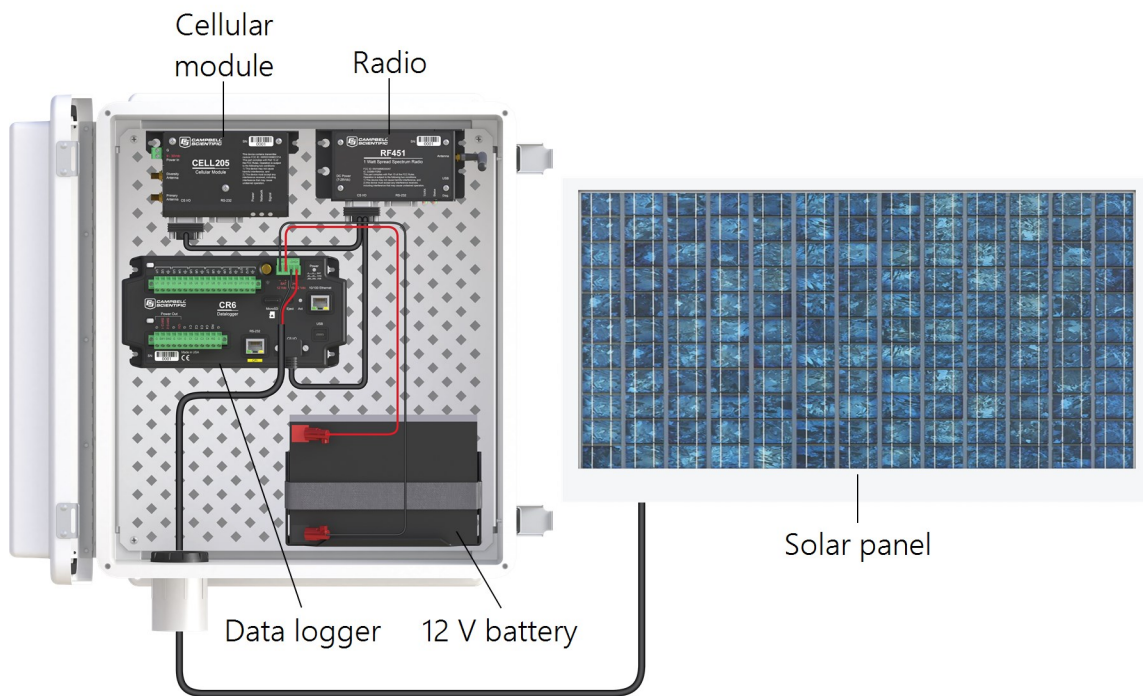


FIGURE 3-7. Regulated solar panel and external battery

## 3.3 Extended mount assembly

**NOTE:**

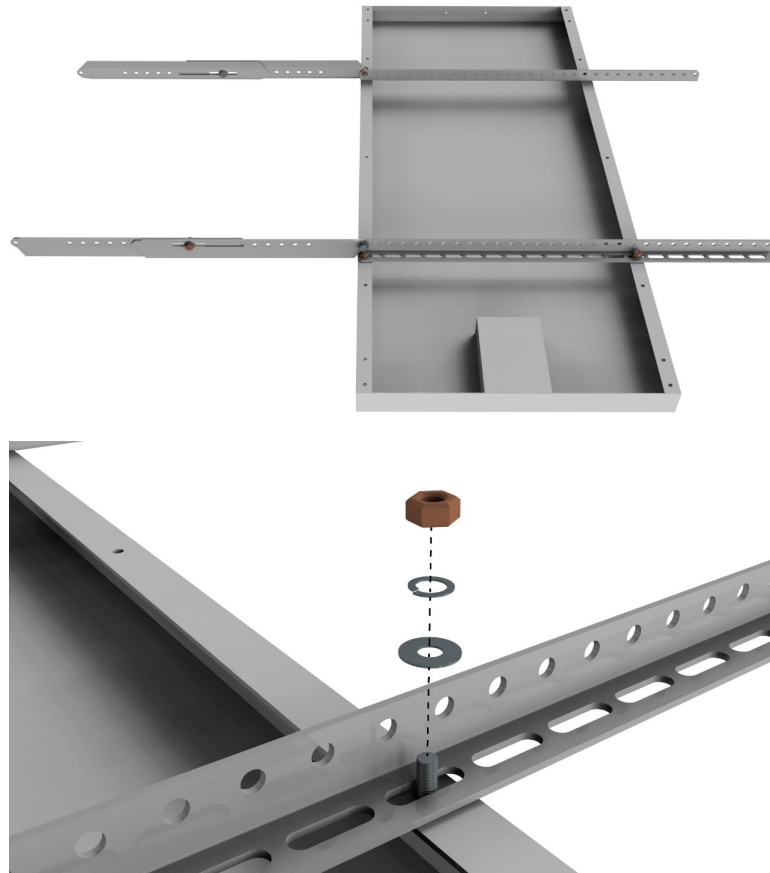
This procedure uses the SP50 in the illustrations. However, the instructions given are also applicable to the SP10 and SP20.

1. Spread a soft towel on a flat surface. Place the solar panel face down on the towel.
2. Place one of the extended mount brackets along the edge ([FIGURE 3-8](#) (p. 8)) to determine which set of holes in the solar panel frame will be used to mount the arms. The correct holes will be just outside of the bracket. For the SP10 and SP20, the arms will mount along the outside edges of the solar panel (see [FIGURE 3-10](#) (p. 10) and [FIGURE 3-12](#) (p. 11)). Set the bracket aside.



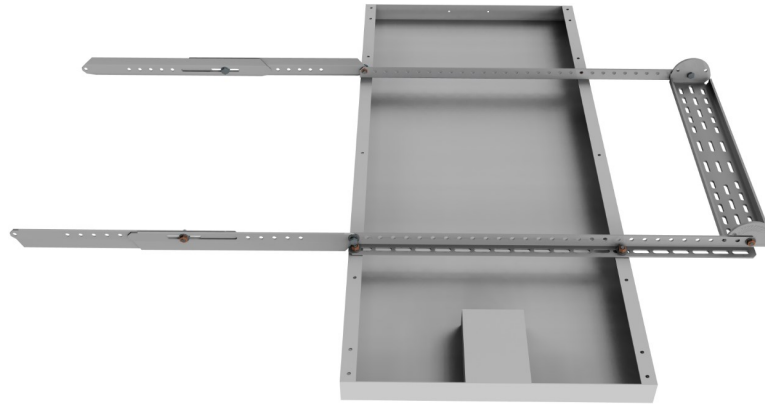
*FIGURE 3-8. Determining the correct mounting holes*

- Determine which edge of the solar panel will be the bottom edge. Place one of the arms so the end with the attached struts is at the bottom ([FIGURE 3-9](#) (p. 9)). Attach each arm with two bolts, washers, lock washers, and nuts. Do not fully tighten the nuts. Repeat for the second arm.



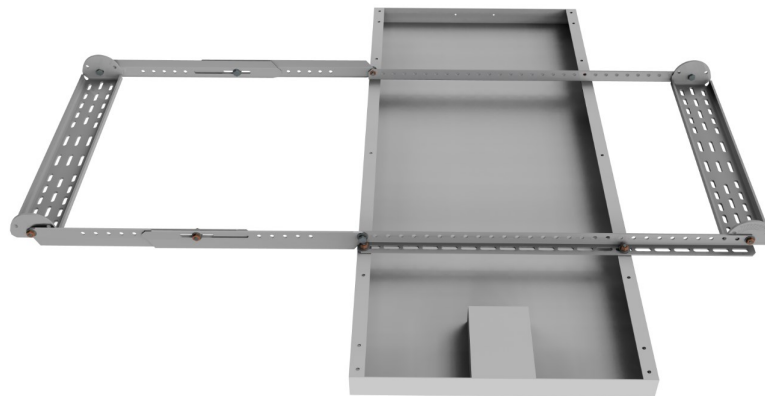
*FIGURE 3-9. Attaching mounting arms*

4. Locate the upper mount bracket with the angle decal on one end. Remove the nut, lock washer, and washer from each end of the bracket and orient the bracket as shown in [FIGURE 3-10](#) (p. 10). Pass the bolts through the bracket and the last hole on each extended mount arm, and then replace the washer, lock washer, and nut on each bolt (see [FIGURE 3-9](#) (p. 9)).



*FIGURE 3-10. Attaching the upper mount bracket*

5. Attach the bottom extended mount bracket to the extended mount struts as shown in [FIGURE 3-11](#) (p. 10).



*FIGURE 3-11. Attaching the lower mount bracket*

6. (If mounting the solar panel on a tower, go to step 8.) With the help of a second person, hold the upper bracket against the tripod mast (FIGURE 3-12 (p. 11)). Use U-bolts, washers, lock washers, and nuts from the hardware bag labeled 'Tripod' to mount the bracket to the mast. Use a torpedo level to ensure the bracket is level. Fully tighten the nuts on both U-bolts.

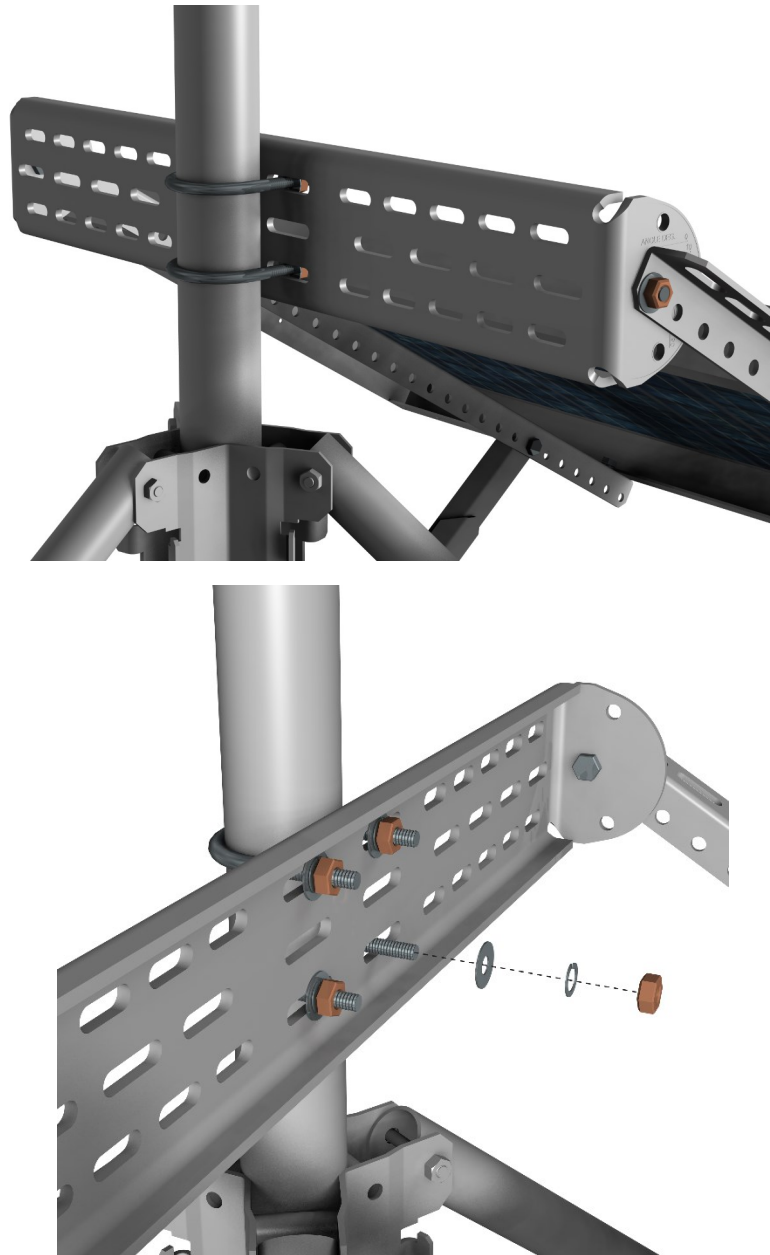
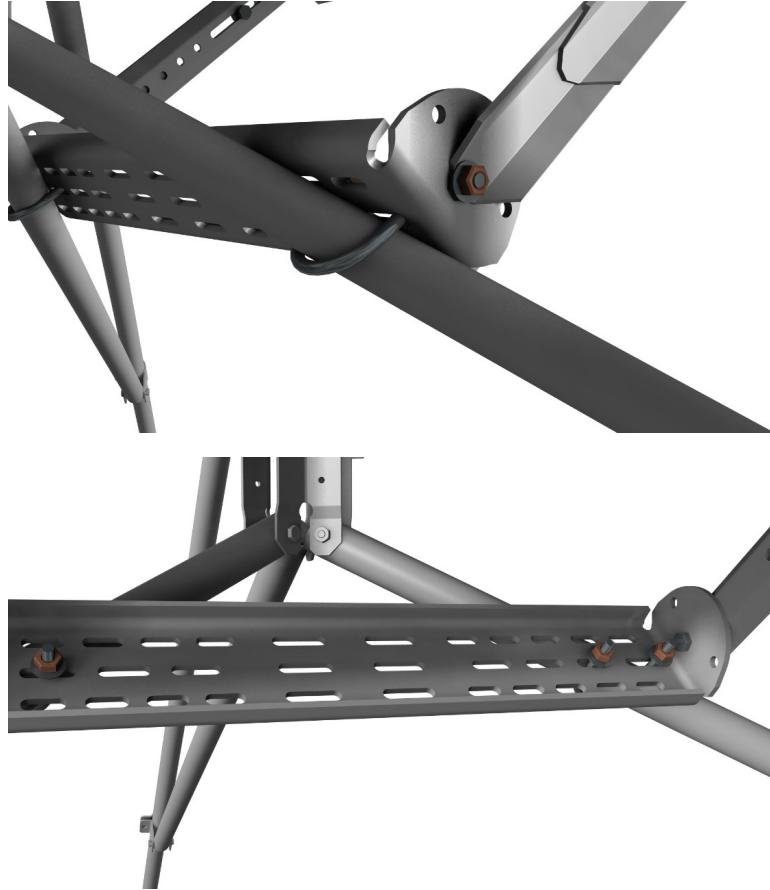


FIGURE 3-12. Attaching the upper mount bracket to the mast

7. Place the lower mount bracket against the tripod leg braces as shown ([FIGURE 3-13](#) (p. 12)). Use U-bolts, washers, lock washers, and nuts from the hardware bag labeled 'Tripod' to mount the bracket on the tripod legs. It may be necessary to rotate the U-bolt so the ends of the bolt pass through holes on different rows in the lower mount bracket. Finger-tighten the nuts. Skip to [Extended mount orientation](#) (p. 16).



*FIGURE 3-13. Attaching the lower mount bracket to the tripod legs*

- (Mounting on towers only.) With the help of a second person, secure the top bracket at the desired height on the tower using U-bolts, washers, lock washers, and nuts (FIGURE 3-14 (p. 13)). Raise the lower bracket until the angle decal on the upper bracket indicates the correct angle for the current latitude. Secure the lower bracket to the tower with U-bolts, washers, lock washers, and nuts. Fully tighten all nuts and bolts.

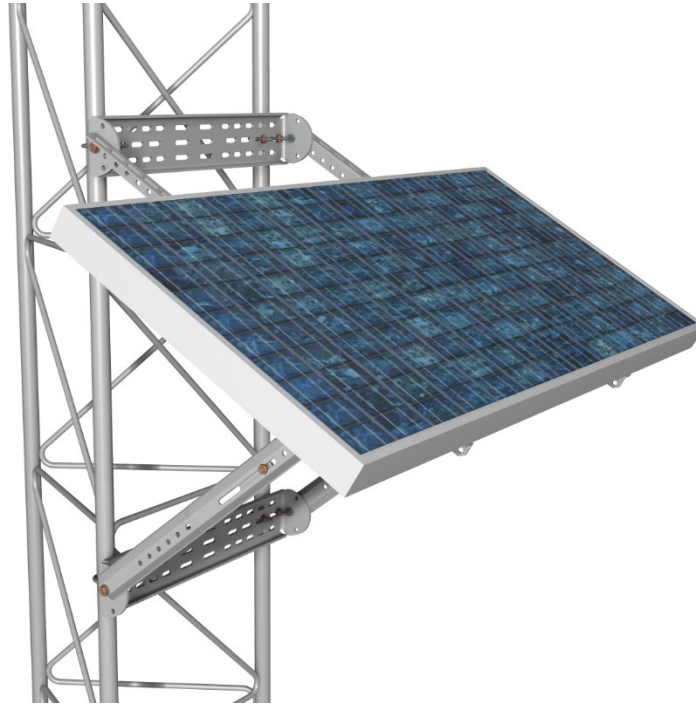


FIGURE 3-14. Extended mount tower installation

## 3.4 Solar panel angle

The solar panel should be oriented to receive maximum insolation (incident solar radiation) over the course of a year. Table 3-1 (p. 14) suggests optimal angles for the solar panel through a range of latitudes.

**NOTE:**

The SP5 mounting bracket has a fixed tilt angle that cannot be adjusted.

Table 3-1: Solar panel tilt angle <sup>1</sup>	
Site latitude (N or S)	Tilt angle
0° - 10°	10°
11° - 20°	Latitude +5°
21° - 45°	Latitude +10°
46° - 65°	Latitude +15°
> 65°	80°

<sup>1</sup>From "Design Aids for Small PV Power Systems," Solorex Corp.

For the standard mount, once the proper tilt angle has been determined, adjust the angle by loosening the two tilt angle adjustment bolts (FIGURE 3-15 (p. 14)) and rotating the solar panel to the correct tilt angle. Tighten the tilt angle adjustment bolts to secure the solar panel.



FIGURE 3-15. Adjust the tilt angle of the SP10

For the SP20 standard mount, the angle is set by the alignment of holes on the mount and arm brackets (FIGURE 3-16 (p. 15)). Refer to Table 3-2 (p. 15) to determine which holes need to be aligned for the correct angle. Use the following procedure to mount the solar panel.

1. Insert a bolt through the correct upper hole on each arm bracket (hole 1 or 2) and through the upper opening (Y and Z) in the mount.



2. Place a washer and nut on the end of each upper bolt, but do not tighten the nuts.
3. Insert a bolt through the correct lower hole on each arm bracket (hole A, B, or C) and through hole P on the mount.
4. Once again, place washers and nuts on the end of each bolt, but do not tighten the nuts.
5. Slide the upper bolts into the correct position (Y or Z) on the bracket, and fully tighten all four nuts.

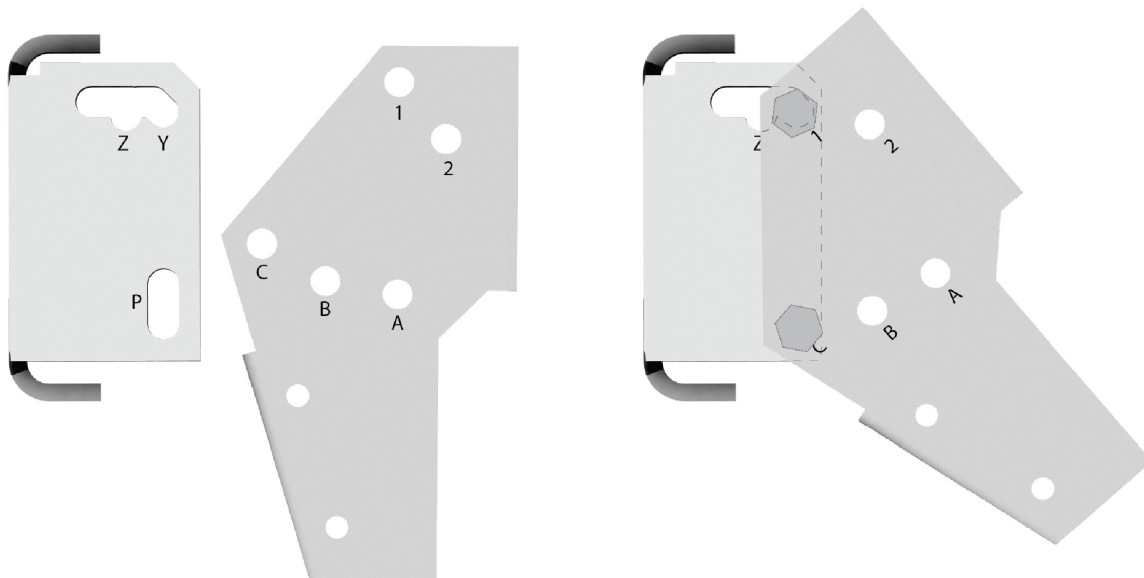


FIGURE 3-16. Angle settings on mounting bracket of SP20

Table 3-2: Configurations for desired angles of SP20	
Hole locations	Angle
Holes P and A aligned with holes 1 and Y	90°
Holes P and A aligned with holes 1 and Z	80°
Holes P and B aligned with holes 1 and Y	70°
Holes P and B aligned with holes 1 and Z	60°
Holes P and C aligned with holes 1 and Y	50°
Holes P and C aligned with holes 1 and Z	40°
Holes P and C aligned with holes 2 and Y	30°
Holes P and C aligned with holes 2 and Z	20°

# 3.5 Extended mount orientation

FIGURE 3-17 (p. 16) shows how to configure the extended mount to achieve different mounting angles. Note that to reach angles greater than 50 degrees, one or both lower struts will need to be removed from the mount.

Refer to Table 3-1 (p. 14) to determine the proper angle for the installation site. Always check the angle of the solar panel to verify the correct angle before tightening the hardware on the extended mount.

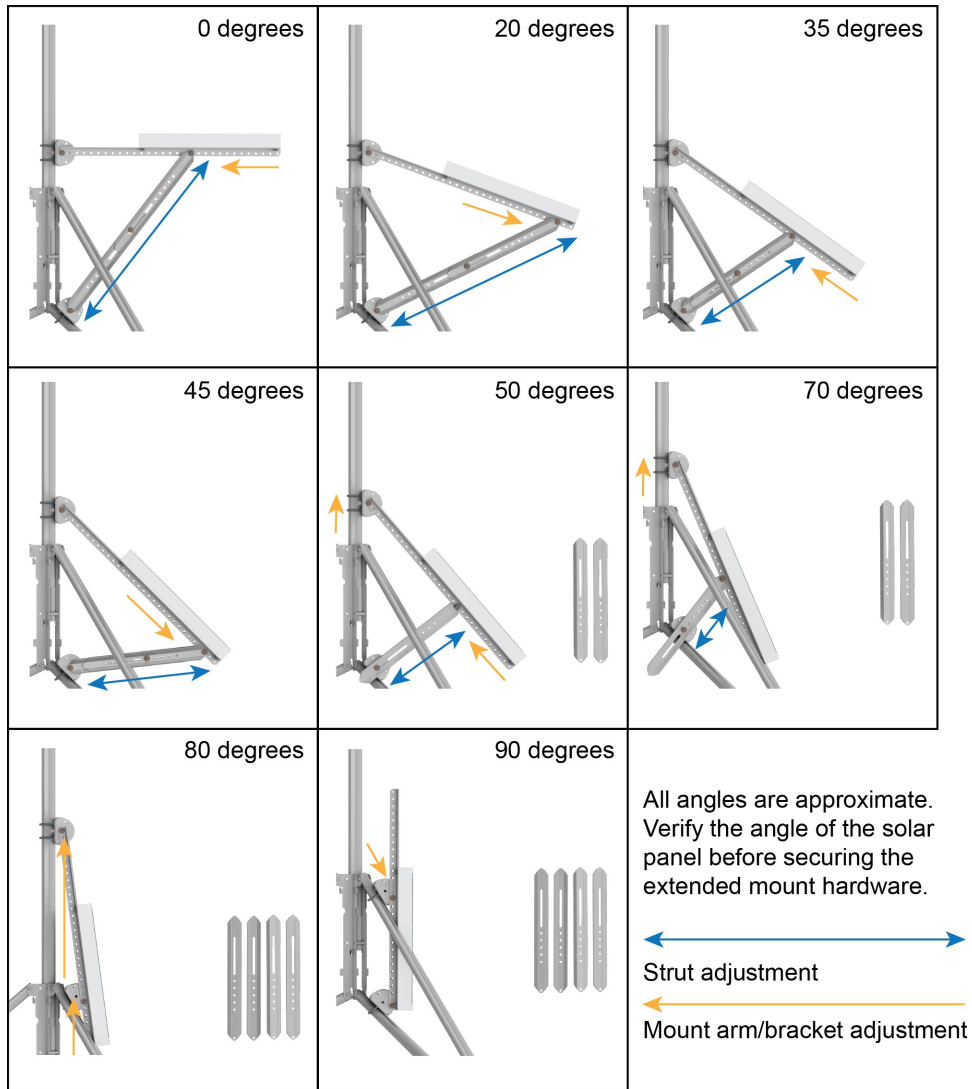


FIGURE 3-17. Extended mounting bracket configurations for different mounting angles

# 4. Maintenance

---

Occasional glass cleaning improves solar panel efficiency. Use a soft sponge and warm water with a small amount of dishwashing detergent to gently clean the solar panel of any dust, grime, or bird droppings. Use a soft, dry cloth or squeegee to remove any residual water from the panel.

If a problem with the solar panel is suspected, check the panel by measuring the voltage output. Check the voltage with a voltmeter connected between the two wires from the solar panel. There must be solar radiation incident on the panel and there must be a load connected to the solar panel. The load can be a data logger, other equipment, or a 75 ohm resistor capable of dissipating solar panel power between the two wires. No voltage output implies a bad solar panel, or cable. The magnitude of the voltage output depends on the incident solar radiation.

# 5. Power considerations

---

## 5.1 Solar panel and storage batteries

The solar panel converts light energy to electricity, or specifically to direct current. The direct current produced is used to provide power to the system and to charge storage batteries.

The solar panel operates in both direct and diffuse light (cloudy days), but not at night.

The minimum battery size and solar panel output required depend on:

- The average current drain of the system
- The maximum time the battery must supply power to the system without being charged
- The location of the site

### **NOTE:**

When some batteries are discharged below a specified voltage, the battery becomes damaged and cannot be recharged.

On average, the solar panel must be able to provide at least the amount of power necessary to operate the system for 24 hours. This means that the solar panel should not only be able to supply power to the system during the day, but it should also be able to provide power necessary to charge the battery for the power lost during the night. In addition, the battery must have enough capacity to power the system during times of no charging (night) and several days of low charging (cloudy and stormy days).

Campbell Scientific has developed an Excel power budget spreadsheet that estimates the solar panel size and battery required for a system based on the components in the system, scan interval, communications interval, and location.

This Excel spreadsheet may be downloaded from [www.campbellsci.com/downloads/power-budget-spreadsheet](http://www.campbellsci.com/downloads/power-budget-spreadsheet).

A video demonstrating how to use the spreadsheet is also available. View it at [www.campbellsci.com/videos/power-budgeting](http://www.campbellsci.com/videos/power-budgeting).

For additional help in computing the power budget for a specific system, please contact Campbell Scientific.

## 5.2 Voltage regulator

The solar panel must be regulated either with a Campbell Scientific regulator or a third-party regulator. The regulator has two basic functions:

- Blocking any current flow from the battery to the solar panel
- Limiting the source current to the battery

The solar panel must be connected to the voltage regulator, not direct to the storage battery.

Campbell Scientific voltage regulators include the CH201, GRANITE 6, CR6, CH200, CR300, and CH150. A separate battery is required for these regulators. The PS200 and PS150 regulators include a 7 Ah battery. The CR3000 has an optional rechargeable base. Two Morningstar SunSaver regulators are also available from Campbell Scientific.

Consult the product documentation to view the maximum charging current for each regulator.

The regulator and battery must be housed in an environmental enclosure. Mounting brackets are included with the regulator for attachment to an enclosure backplate.

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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](http://www.campbellsci.com). Other manufacturer's products, that are resold by Campbell Scientific, are warranted only to the limits extended by the original manufacturer.

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Products may not be returned without prior authorization.

Products shipped to Campbell Scientific require a Returned Materials Authorization (RMA) or Repair Reference number and must be clean and uncontaminated by harmful substances, such as hazardous materials, chemicals, insects, and pests. Please complete the required forms prior to shipping equipment.

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For all returns, the customer must provide a "Statement of Product Cleanliness and Decontamination" or "Declaration of Hazardous Material and Decontamination" form and comply with the requirements specified in it. The form is available from your CAMPBELL SCIENTIFIC regional office. Campbell Scientific is unable to process any returns until we receive this statement. If the statement 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

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

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at [www.campbellsci.com](http://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.
- 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.

## 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.



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