

# INSTRUCTION MANUAL



## **SP5, SP10, SP10R, SP20, and SP20R Solar Panels**

Revision: 3/15



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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.

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## 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.

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# ***SP5, SP10, SP10R, SP20, and SP20R*** ***Solar Panels***

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## **1. General**

Solar panels provide a photovoltaic power source for charging lead acid batteries.

The SP5 has an output level that will allow it to be connected directly to the “Charge +” and “Charge –” terminals on the CR200(X)-series dataloggers. The CR200(X) will then charge a 12 Vdc (7 A h or less) battery attached to the “Battery +” and “Battery –” terminals. Batteries larger than 7 A h are not recommended as they may produce excessive heat on the CR200(X) circuit board.

The SP10 10-watt and SP20 20-watt solar panels are intended to recharge the gel cell lead acid batteries incorporated in the PS200, PS150, PS100, CR3000, CR7, or CR9000(X), as well as the BP12 and BP24 battery packs. Either a CH100 or CH200 is also required when recharging a BP12 or BP24.

The SP10 and SP20 have two leads stripped and tinned to insert into the terminals labeled CHARGE on the PS200, PS150, PS100, CH200, CH150, CH100, or CR9000(X). The two wires attach to the green connector on the side of a CR3000 or CR5000 datalogger. With a CR7, the two wires from the solar panel are inserted into the terminals marked SOLAR PANEL located underneath the 700X Control Module. An external gel cell or AGM lead acid battery can be connected to the CR7 at the terminals marked EXTERNAL BATTERY next to the SOLAR PANEL terminals.

The SP10 or SP20 must have a barrel connector (pn 788) to plug into the retired 21XL Micrologger. See Appendix A, *Solar Panel Connector (p. A-1)*, for details.

The SP10R 10-watt and SP20R 20-watt solar panels include an onboard regulator that allow them to recharge user-supplied, 12 Vdc flooded batteries such as deep-cycle marine or RV batteries. They are not intended for Gel Cell or AGM lead acid batteries such as the batteries contained in our PS150, PS200, BP12, BP24, or CR3000. The solar panel’s cable terminates in pigtails that connect directly to the flooded battery.

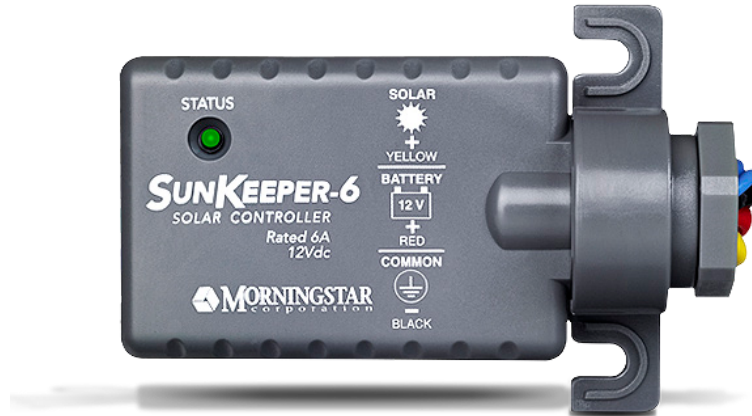


FIGURE 1-1. SunKeeper-6 regulator used on the SP10R and SP20R

## 2. Specifications

	SP5	SP10/SP10R	SP20/SP20R
Typical peak power (Pp)	4.5 W	10 W	20 W
Voltage @ peak power (Vpp) (voltage from solar panel before regulator)	16.5 V	17.5 V	17.1 V
Current @ peak power (Ipp)	0.27 A	0.57 A	1.17 A
Guaranteed minimum peak power	4.05 W	9 W	18 W
Approximate effect of temperature on power	-0.45% / °C	-0.37% / °C	-0.38% / °C
Length, cm	25.1	42.0	50.1
Width, cm	26.9	26.9	42.2
Depth, cm	2.3	2.3	5.0
Weight, kg	0.8	1.50	2.95

**NOTE** The above 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 gel cell or AGM lead acid batteries such as the batteries used with the PS150, BP12, BP24, CR3000, and CR9000(X).

#### SP10R/SP20R

User-supplied 12 V flooded batteries such as a deep cycle marine or RV battery.

### 3. Installation

#### 3.1 Mounting

The solar panel mounts to the mast or leg of a tripod, or any 1 5/8-inch schedule 40 pipe. Refer to FIGURE 3-1 for mounting the SP5. Refer to FIGURE 3-2 or 3-3 for mounting the SP10 and SP10R. Refer to FIGURE 3-4 or 3-5 for mounting the SP20 and SP20R. FIGURE 3-6 shows the typical solar panel mounting locations.

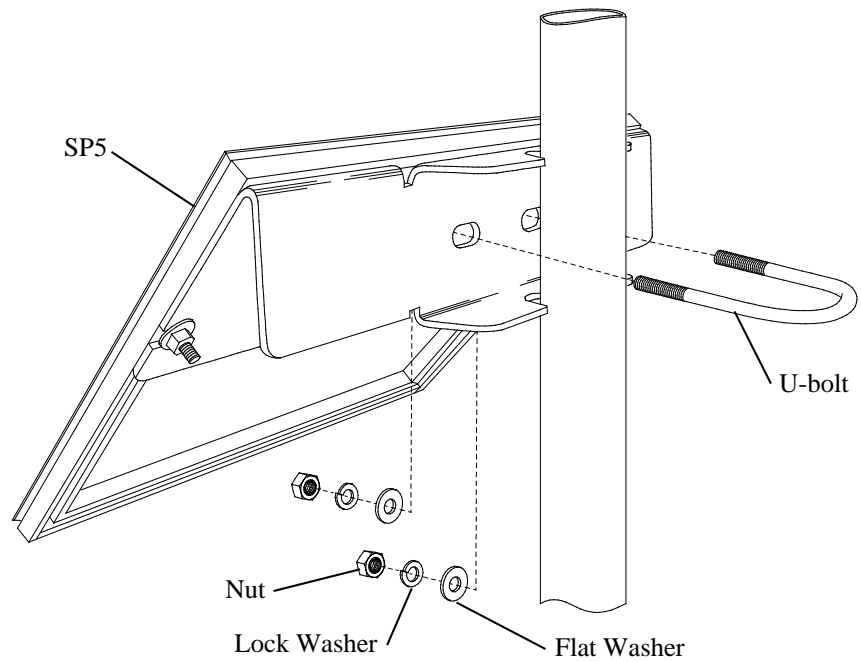


FIGURE 3-1. SP5 mounting

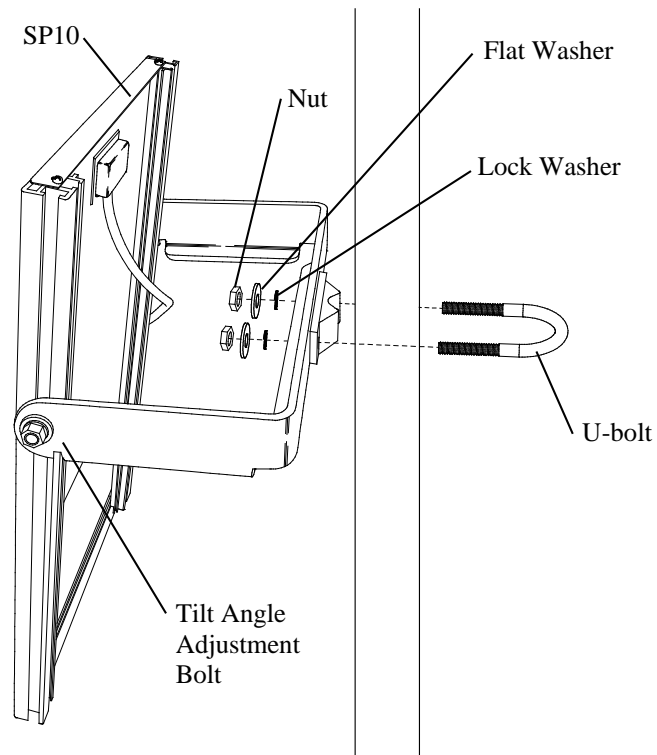


FIGURE 3-2. SP10, SP10R mounting

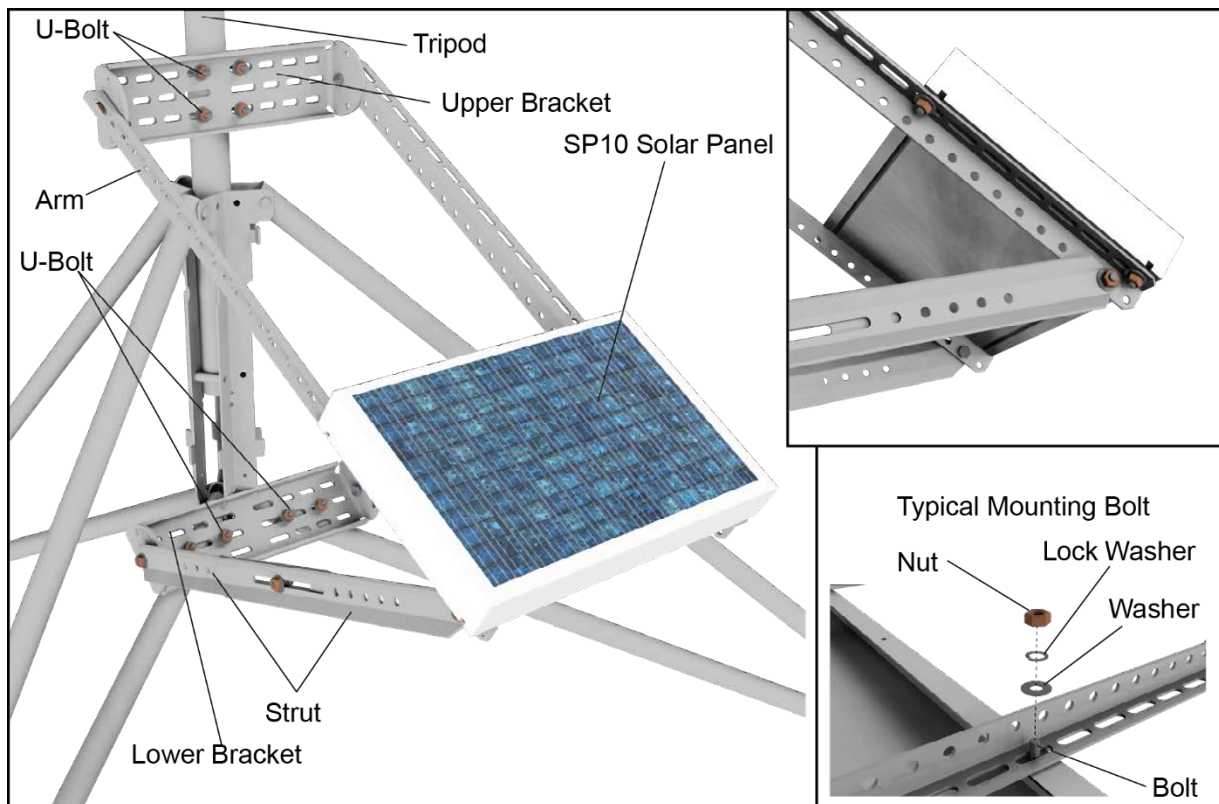


FIGURE 3-3. SP10, SP10R extended mount

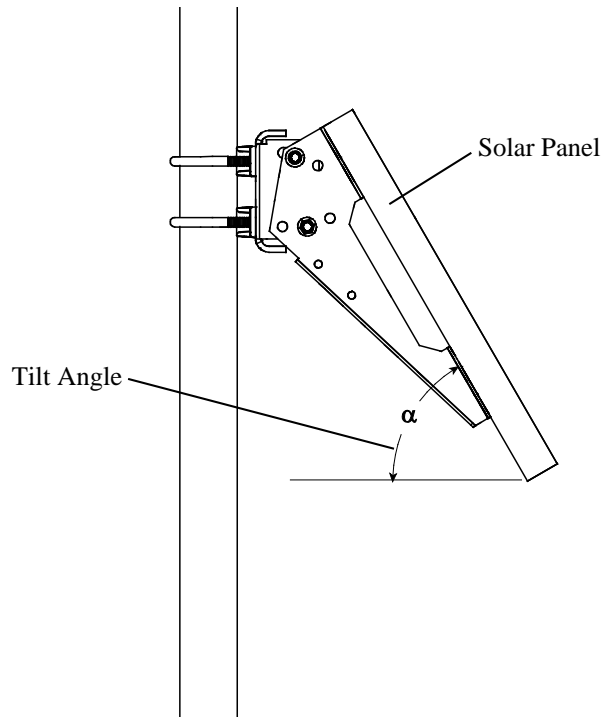


FIGURE 3-4. SP20 solar panel orientation

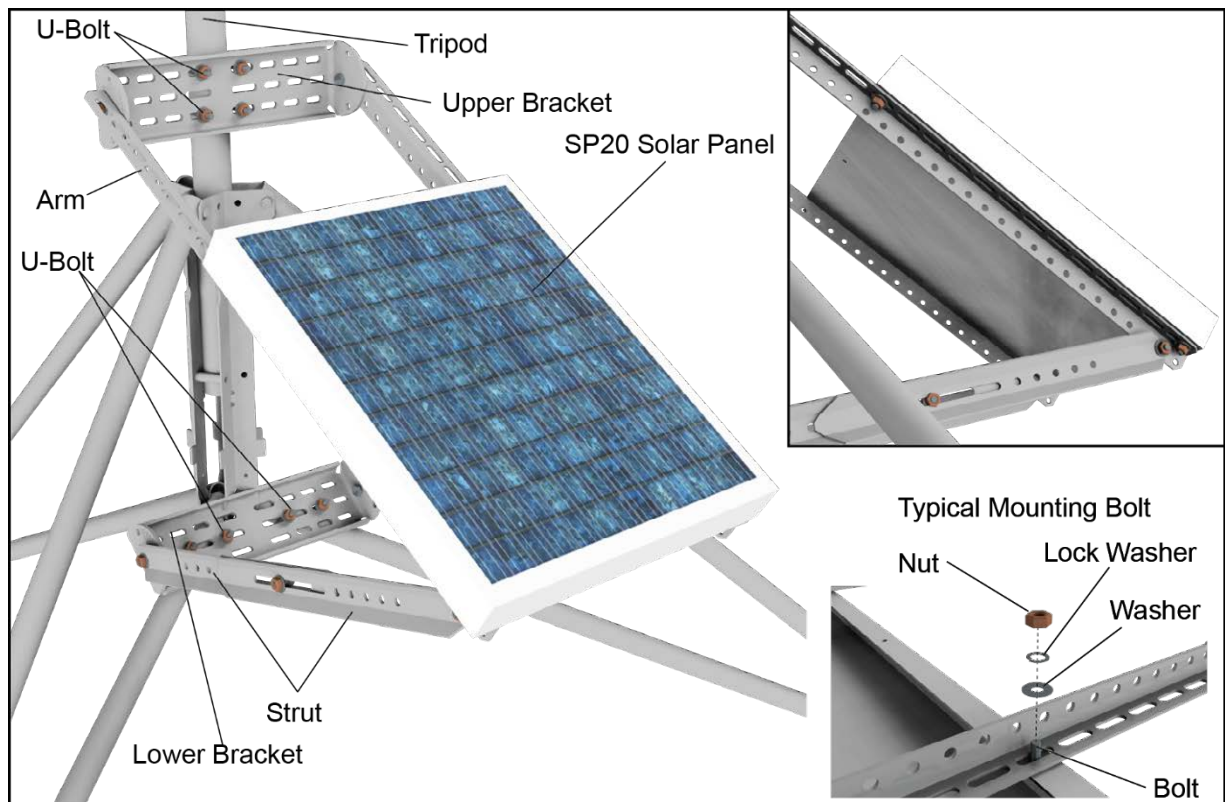


FIGURE 3-5. SP20, SP20R extended mount

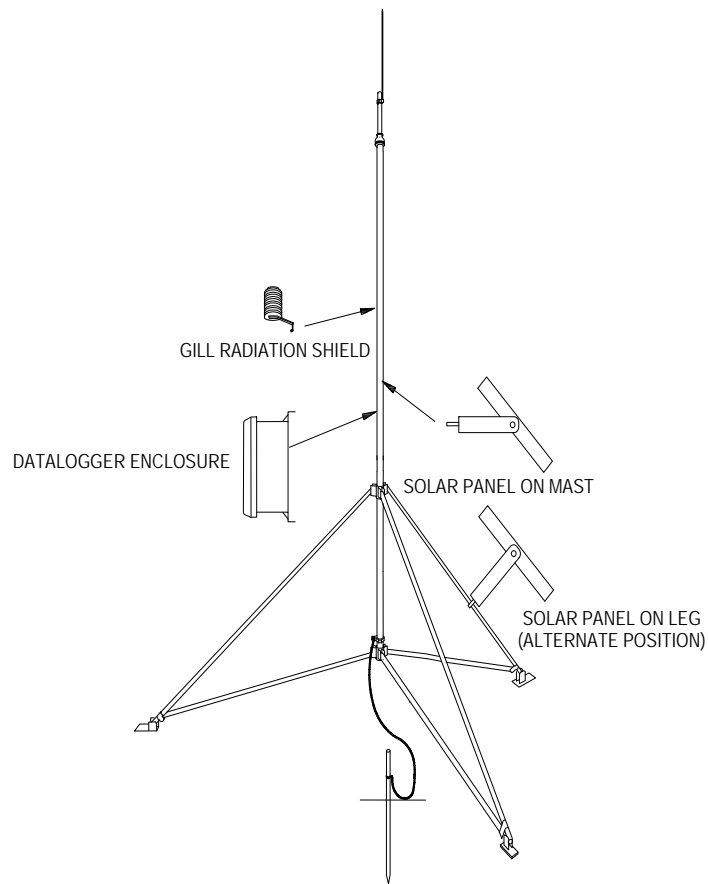


FIGURE 3-6. Solar panel mounting

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

If the SP10 or SP20 solar panel is being used, route the solar panel cable to the datalogger power supply and charging circuitry. If the SP10R or SP20R is being used, attach the leads of the solar panel directly to the external battery with a user-supplied connector. FIGURE 3-7 shows an example of a regulated solar panel connected to an external battery to run a radiotelemetry system.

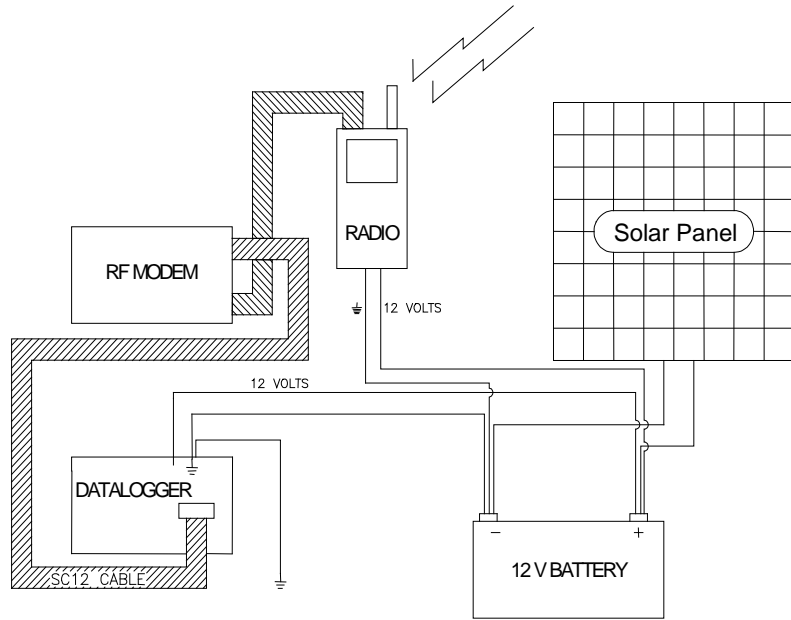


FIGURE 3-7. Regulated solar panel and external battery

### 3.2 Standard Mount Orientation

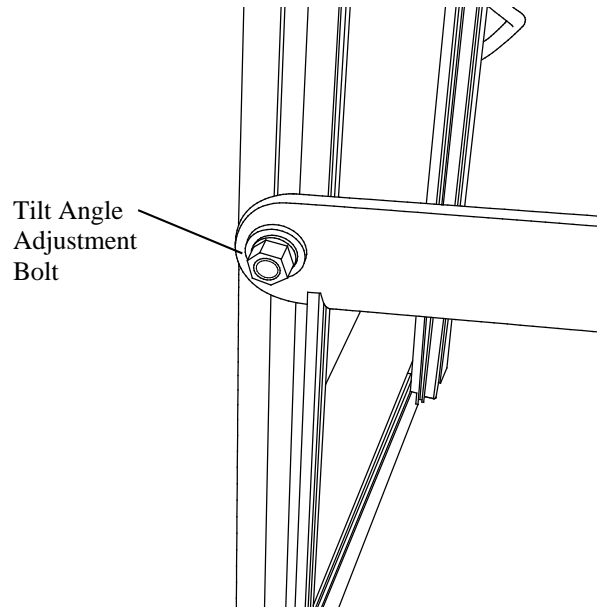
The solar panel should be oriented to receive maximum insolation (incident solar radiation) over the course of a year. TABLE 3-1 suggests optimal angles for the solar panel through a range of latitudes.

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

Site Latitude (N or S)	Tilt Angle
0° – 10°	10°
11° – 20°	Latitude +5°
21° – 45°	Latitude +10°
46° – 65°	Latitude +15°
> 65°	80°

\* From “Design Aids for Small PV Power Systems,” Solorex Corp.

For the SP10 and SP10R, once the proper tilt angle has been determined, adjust the angle by loosening the two tilt angle adjustment bolts (FIGURE 3-8) and rotating the solar panel to the correct tilt angle. Tighten the tilt angle adjustment bolts to secure the solar panel.



*FIGURE 3-8. Adjust the tilt angle of the SP10*

For the SP20 and SP20R, the angle is set by the alignment of holes on the mount and arm brackets (FIGURE 3-9). Refer to TABLE 3-2 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.



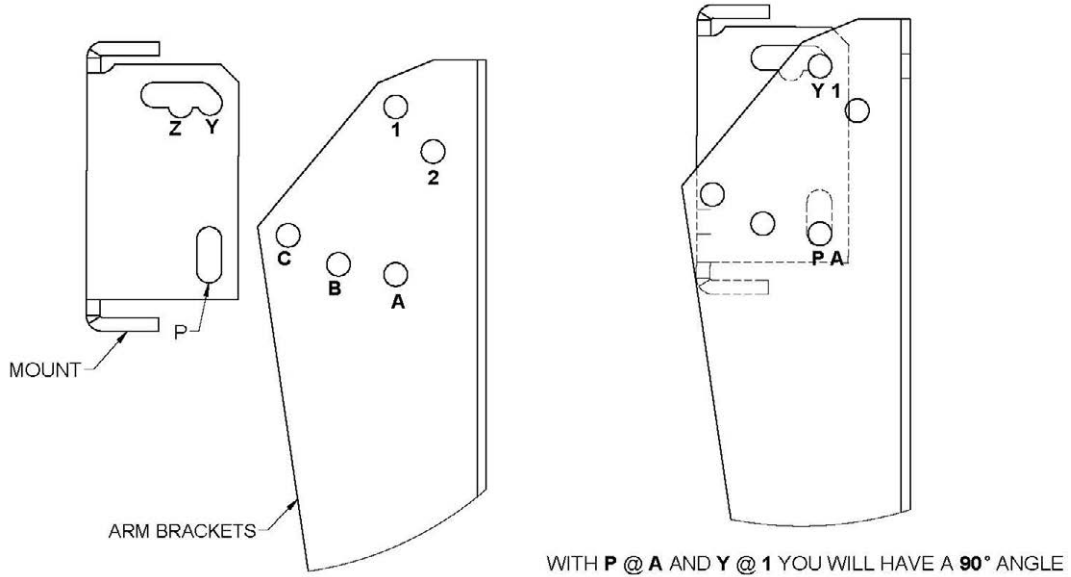


FIGURE 3-9. Angle settings on mounting bracket of SP20

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°

### 3.3 Extended Mount Orientation

When using the extended mounts with the SP10 or SP20, refer to FIGURE 3-10 to determine how to configure the extended mounts for the desired mounting angle. 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 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.



A: 0 Degrees

B: 20 Degrees

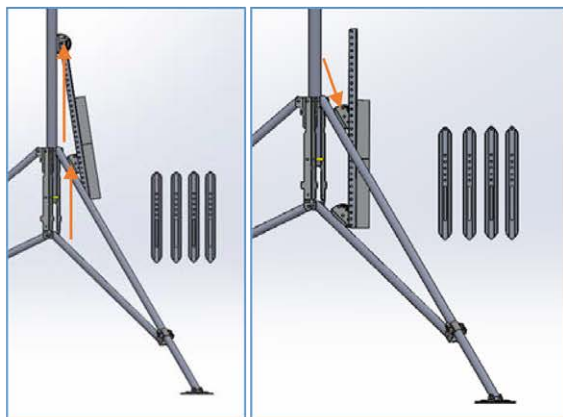
C: 35 Degrees



D: 45 Degrees

E: 50 Degrees

F: 70 Degrees



H: 80 Degrees

I: 90 Degrees

All angles are approximate. Verify the angle of the solar panel before securing the extended mount hardware.

FIGURE 3-10. Extended mounting bracket configurations for different mounting angles

## 4. Maintenance

An occasional cleaning of the glass improves the solar panel's 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, the panel may be checked by measuring the voltage output. Check the voltage with a voltmeter connected between the two leads of 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 the datalogger, other equipment, or a 75 ohm resistor capable of dissipating solar panel power between the two leads. No voltage output implies a bad solar panel, regulator, or cable. The magnitude of the voltage output depends on the incident solar radiation.

## 5. Power Considerations

### 5.1 Solar Power and Lead Acid Batteries

The solar panel converts light energy to electricity, or specifically direct current. The direct current produced is used as a charging source for lead acid 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 depends on 1) the average current drain of the system, 2) the maximum time the battery must supply power to the system without being charged, and 3) the location of the site. When some batteries are discharged below a specified voltage, the battery becomes damaged and cannot be recharged.

The battery supplies power directly to the operating system; the solar panel supplies power to recharge the battery. The solar panel must provide at least as much power to the battery as is being used by the system.

The battery must have enough capacity to power the system during times of no charging (night) or low charging (stormy winter days).

### 5.2 Voltage Regulator

The solar panel must be regulated either with a Campbell Scientific regulator or an attached regulator. The regulator has two basic functions: 1) blocking any current flow from the battery to the solar panel, and 2) limiting the source current to the battery.

The SP5 may be connected directly to the "Charge +" and "Charge -" terminals on the CR200(X) datalogger. Otherwise, the SP5 must be connected to a Campbell Scientific PS200, PS150, PS100, CH200, CH150, or CH100 voltage regulator.

The SP10 and SP20 must be connected to a Campbell Scientific voltage regulator. Campbell Scientific voltage regulators include the PS200, PS150,

PS100, CH200, CH150, or CH100, and the voltage regulator integrated in the base of our CR3000, CR5000, CR7, and CR9000(X) dataloggers.

The SP10R and SP20R have an on-board voltage regulator that connects directly to a user-supplied flooded lead-acid battery such as a deep-cycle marine or RV battery.

# Appendix A. Solar Panel Connector

The SP10 and SP20 solar panels are shipped with the two lead wires stripped and tinned. A barrel connector (pn 788) connector must be attached to use an SP10 or SP20 with the 21XL.

With the connector, the cable can be inserted directly into the 21XL Charging Port on the side of the micrologger.

If it is necessary to solder the connector on the cable, please refer to the diagram below.

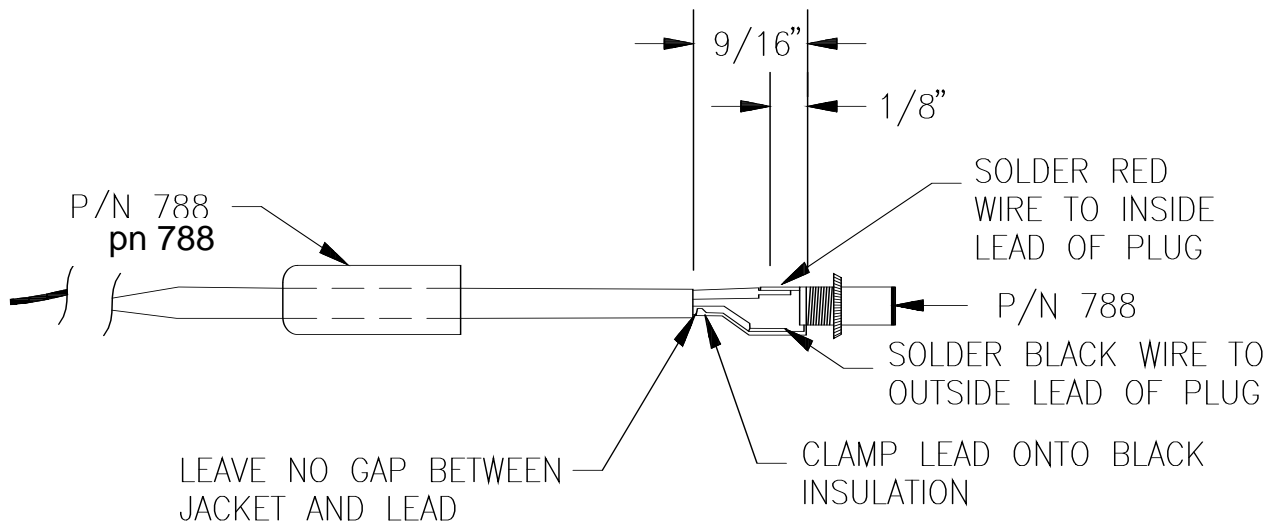


FIGURE A-1. Connector wiring





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