

INSTRUCTION MANUAL



SP50-L/SP90-L Solar Panel

Revisions: 12/13



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SP50-L/SP90-L Solar Panel

1. Introduction

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 lead acid batteries. Solar panels operate in both direct and diffuse light, but not at night.

A user-specified 16 AWG cable comes with each solar panel. External voltage regulators, rechargeable batteries, and rechargeable power supplies must be purchased separately. Please contact a Campbell Scientific applications engineer to determine what components will work best for your application.

Campbell Scientific's CH200 12V Charger/Regulator is recommended for use with 12V sealed rechargeable batteries (BP12, BP24, and BP84). The CH200 with software version 5.00 or higher can easily be used with the BP84/PS84 battery (Concorde Sun Xtender™ PVX-840T) when configured through DevConfig version 2.01 or higher. EnerSys Cyclon™ batteries can also be used with the CH200.

NOTE

CH200 OS version 4.0 can also be used with the BP84/PS84, but requires each charging parameter to be set individually. See the CH200 documentation for more information on setting charging parameters.

The SunSaver™ SS-10-12V voltage regulator (CSI pn 18529) is another option for these solar panels, and it can be purchased from Campbell Scientific, Inc.

2. Specifications

The SP50-L/SP90-L work with user-supplied deep cycle marine batteries, 12V sealed rechargeable batteries (BP12, BP24, or BP84), 12V rechargeable power supplies (PS84), and external voltage regulators (CH200 and Morningstar SunSaver™ (SS-10-12V).

	SP50-L	SP90-L
Typical peak power (Pp):	50 W	90 W
Voltage at peak power (Vpp): (voltage from solar panel before regulator)	17.5 V	17.9 V
Current at peak power (Ipp):	2.9 A	5.03 A
Temperature coefficient of power:	-0.45% / °C	-(0.5 ± 0.05)% / K
Length:	83.9 cm (33.0 in)	120.9 cm (47.6 in)
Width:	53.7 cm (21.1 in)	53.7 cm (21.1 in)

Depth:	5.0 cm (2.0 in)	5.0 cm (2 in)
Weight:	6 kg (13.2 lb)	7.7 kg (17.0 lb)
Max. wind speed @ angles greater than 35°:	29 m s ⁻¹ (65 mph)	24 m s ⁻¹ (55 mph)

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 5%. The output panel voltage increases as the panel temperature decreases.

TABLE 2-2. Regulator Specifications (purchased and shipped separately)

Model	CH200	Morningstar SunSaver™ SS-10-12V
Temperature compensation:	Variable, depending on battery manufacturer. Selectable in DevConfig.	-28 mV / °C
Self consumption:	300 µA to 2 mA	6 mA to 10 mA
Operating temperature:	-40° to +60°C	-40° to +85°C
Useable solar current:	2.8 A to 4.3 A	10 A

Pairing the CH200 with the SP90 allows the CH200 to operate at the maximum Useable Solar Current of 4.3 A for longer periods of time than it would with a smaller panel. As the SP90 output current increases above 4.3 A, the CH200 will continue to function at the maximum useable solar current of 4.3. It will remain at this level until the SP90 output once again drops below 4.3 A.

NOTE A second solar panel can be connected to the Morningstar regulator when additional power is required. One Morningstar SunSaver™ SS-10-12V regulator can handle two SP50 or SP90 solar panels.

Two SP90 Solar Panels in Parallel

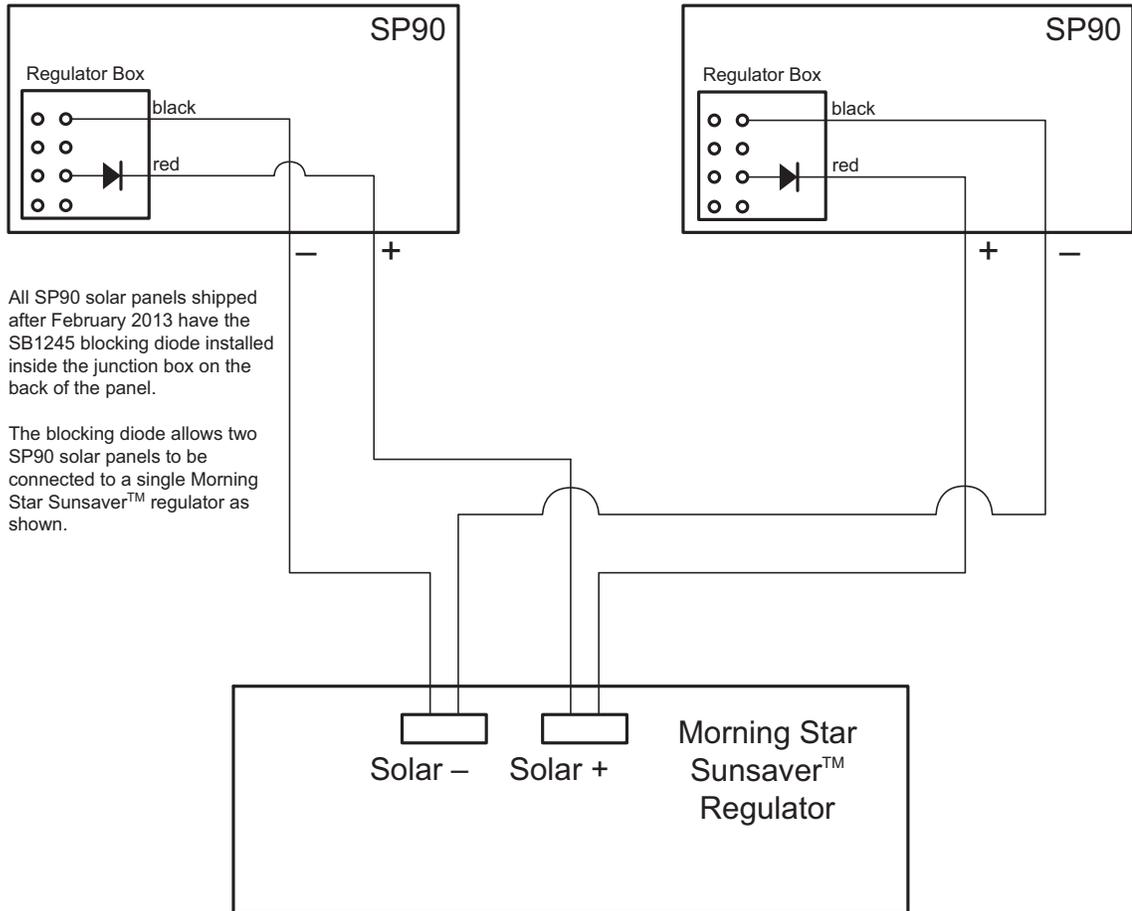


FIGURE 2-1. Wiring two solar panels to one controller

3. Installation

3.1 Parts List

The solar panel ships with two items: one solar panel and one mounting hardware package. The solar panel has a user-specified length of 16 AWG cable wired into the junction box on the back of the panel as shown in FIGURE 3-1. The mounting hardware package contains the mounting brackets and other parts necessary to mount the solar panel to a tripod or tower as shown in FIGURE 3-2 and FIGURE 3-3.

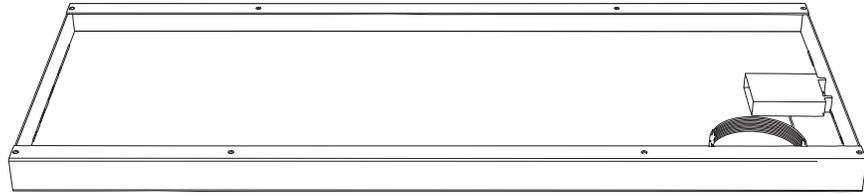


FIGURE 3-1. Solar panel with 16 AWG cable

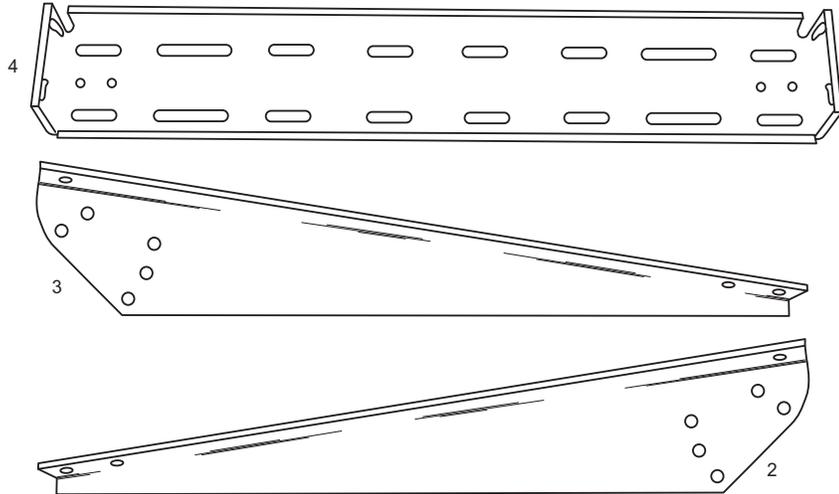


FIGURE 3-2. Mounting brackets included with the solar panel

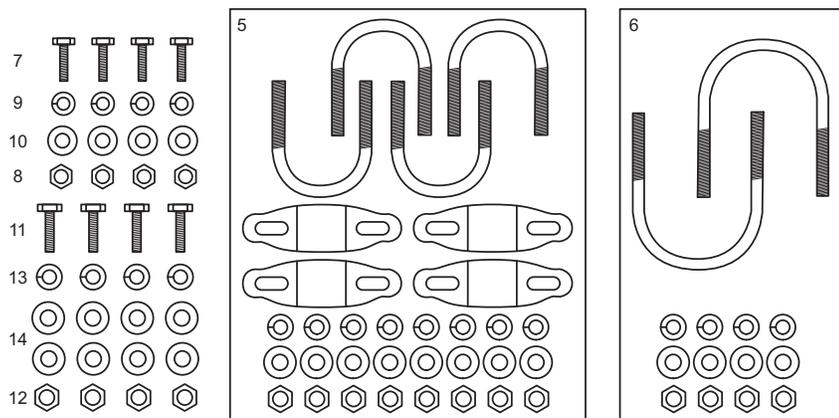


FIGURE 3-3. Mounting hardware included with the solar panel

TABLE 3-1 shows the list of parts included in the mounting hardware package.

TABLE 3-1. Parts List		
Item #	Description	Qty
1	Solar Panel	1
2	Right Arm Bracket	1
3	Left Arm Bracket	1
4	Mount	1
5	5/16-18 x 1.5 U-bolt with lock washers, flat washers, nuts	4
6	5/16-18 x 2.0 U-bolt with lock washers, flat washers, nuts	2
7	1/4-20 x 0.75 Hex bolt	4
8	1/4-20 Nut	4
9	1/4 Lock washer	4
10	1/4 Flat washer	4
11	5/16-18 x 0.75 Hex bolt	4
12	5/16-18 Nut	4
13	5/16 Lock washer	4
14	5/16 Flat washer	8

3.2 Mounting

The solar panel ships with mounting brackets. These brackets can be found in the mounting hardware package. Remove the right and left arm brackets, as well as the mount from the package. Attach the right and left arm brackets, using 1/4-20 x 0.75 hex bolt and nuts as shown in FIGURE 3-4. FIGURE 3-5 shows a closeup view of one of the bolts after it has been tightened. The inset drawing in FIGURE 3-4 shows the correct mounting order for the bolt, nut, and washers.

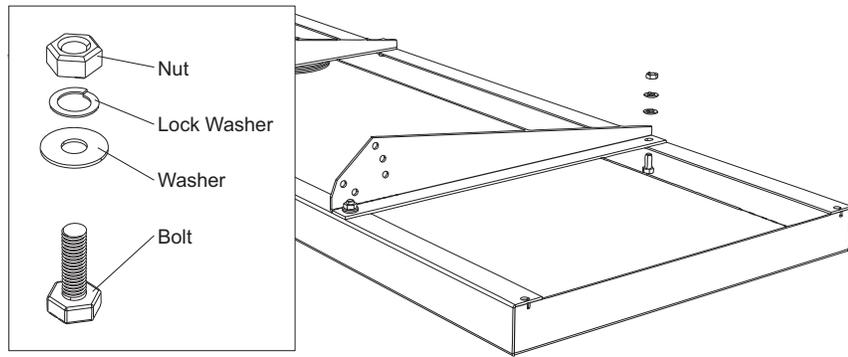


FIGURE 3-4. Attach the arm brackets to the back of the solar panel

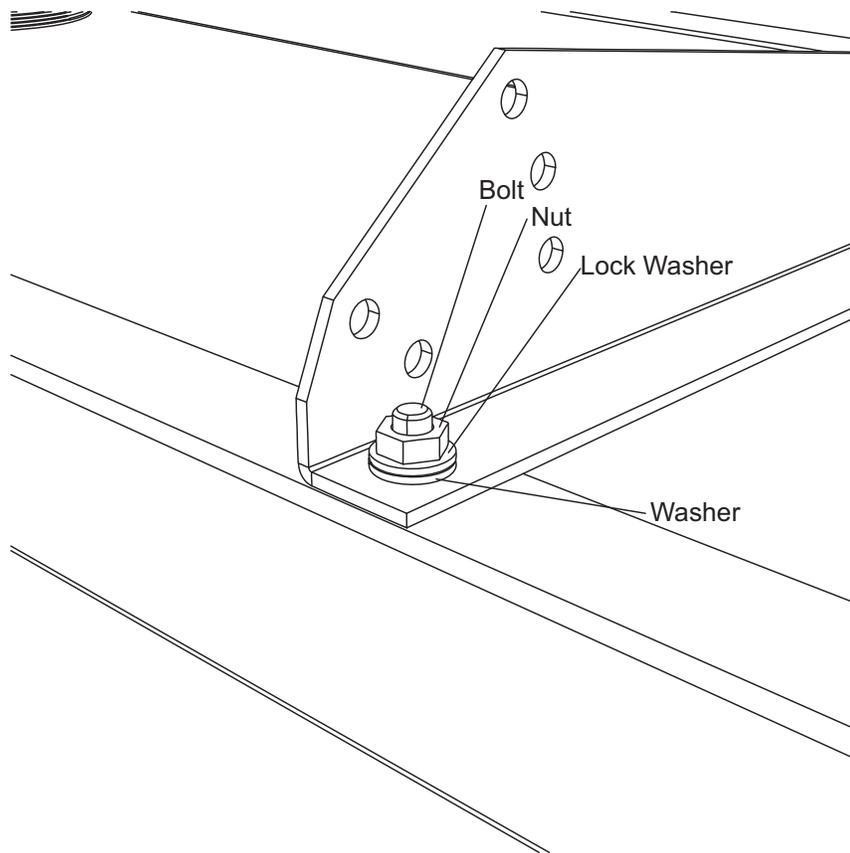


FIGURE 3-5. Use 1/4-20 x 0.75 hex bolts, nuts, lock washers, and flat washers to mount the arm brackets to the solar panel

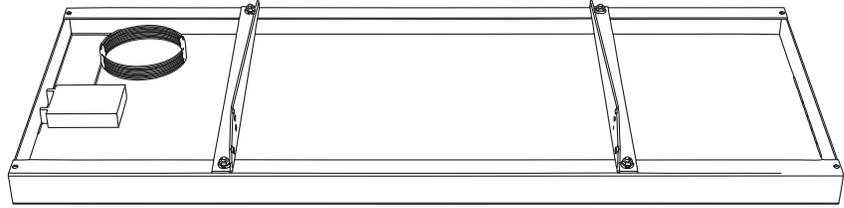


FIGURE 3-6. Right and left arm brackets are attached to the back of the solar panel

Orient the solar panel as shown in FIGURE 3-6. Attach the mount to the back of the solar panel between the right and left brackets already in place as shown in FIGURE 3-7. Hint: jump to Section 3.3, *Orientation*, to determine which holes to use in order to mount the panel at the optimum angle for the site's latitude. Use the 5/16-18 x 0.75 hex bolt and nuts along with the matching lock washers and flat washers. Use a bolt and flat washer from the outside, and a flat washer, lock washer, and nut on the inside as shown in FIGURE 3-8.

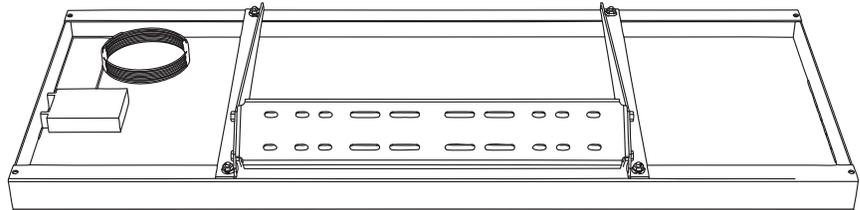


FIGURE 3-7. Attach the mount to the back of the solar panel between right and left arm brackets

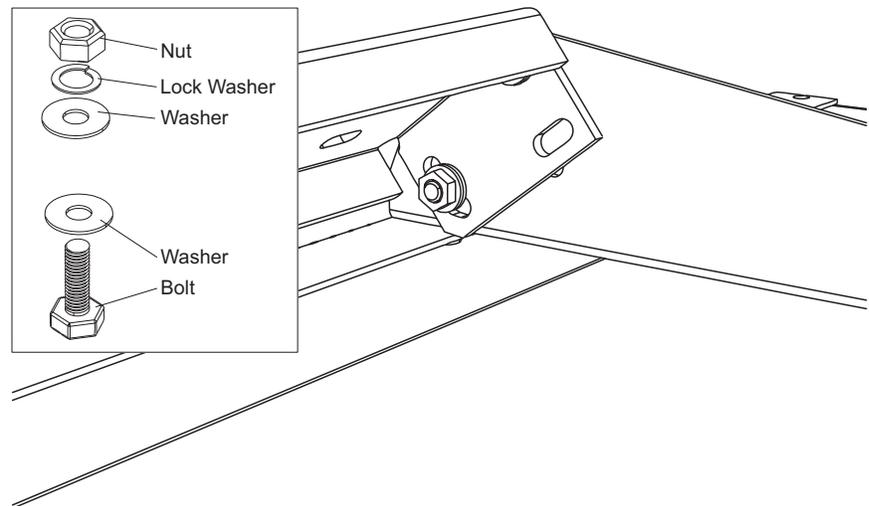


FIGURE 3-8. Use the 5/16 hardware as shown to secure each end of the mount to the arm brackets.

For pole or tripod mounting, use the two 5/16-18 x 2.0 u-bolts included in the package as shown in FIGURE 3-9, FIGURE 3-10, and FIGURE 3-11. To prevent damage to the solar panel, it is recommended that two people mount the solar panel.

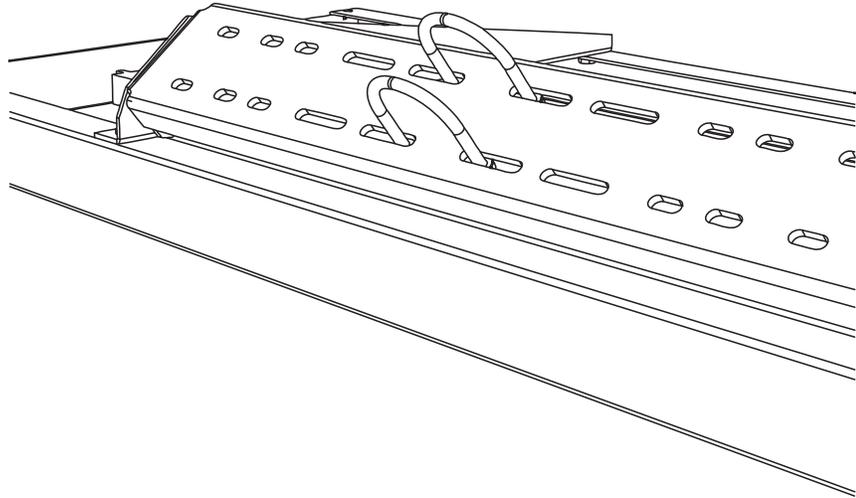


FIGURE 3-9. Two 5/16-18 x 2.0 u-bolts are used for pole or tripod mounting

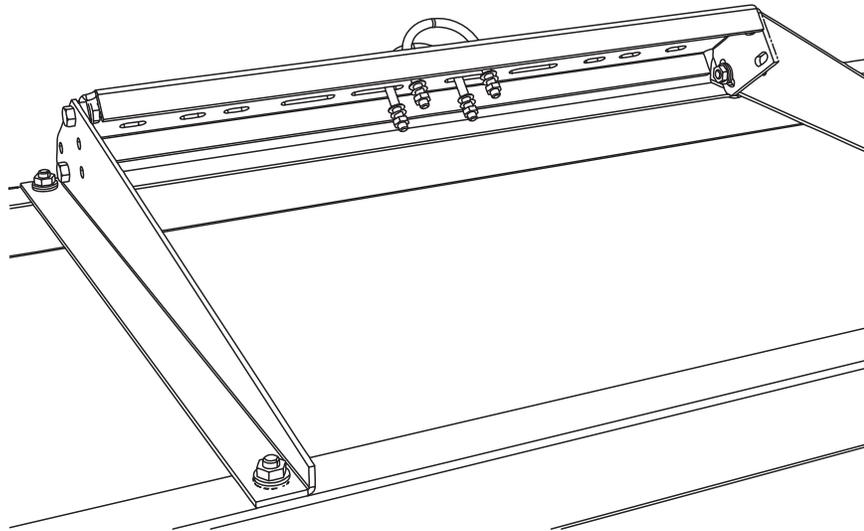


FIGURE 3-10. Lock washers and flat washers are used to secure the two 5/16-18 x 2.0 u-bolts to the solar panel mount

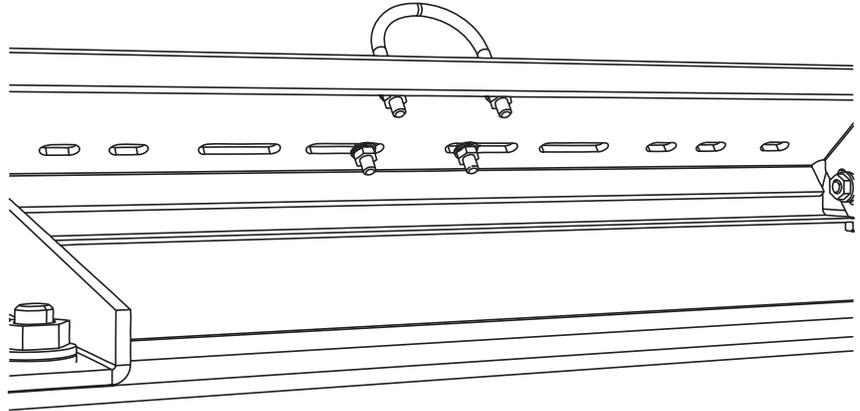


FIGURE 3-11. The solar panel is ready for pole or tripod mounting

The nuts fastening the solar panel mount to the pole or the tripod mast should be as tight as possible without bending the mount. See FIGURE 3-12 and FIGURE 3-13.

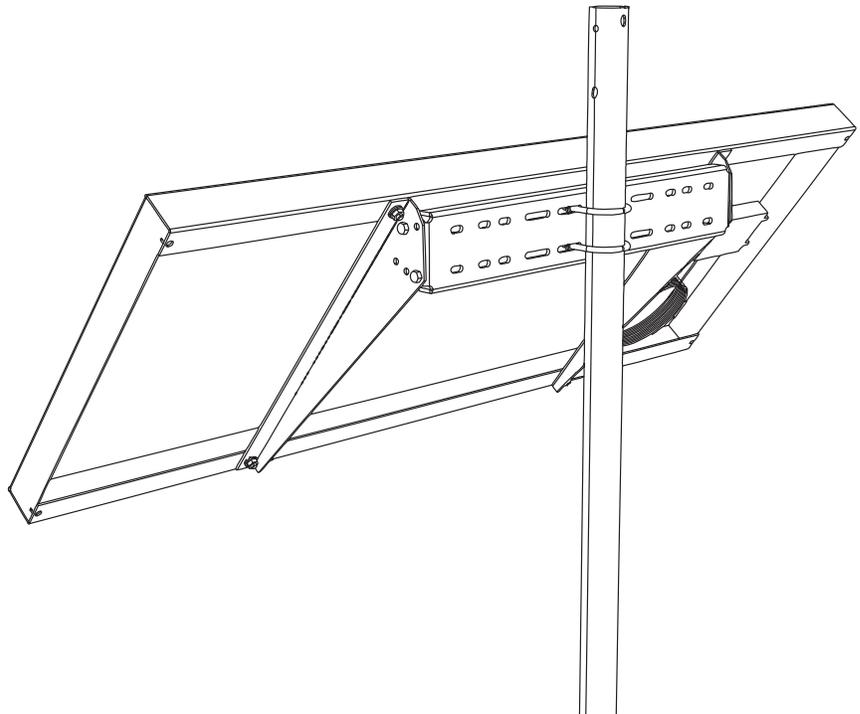


FIGURE 3-12. The solar panel is mounted to a pole using two 5/16-18 x 2.0 u-bolts



FIGURE 3-13. Solar panel mounted on a tripod. Panel can be mounted to the tripod leg.

Alternatively, you can use four 5/16-18 x 1.5 u-bolts to mount the solar panels to two legs of a triangular tower. Select the appropriate sets of holes in the mount to match the width of the tower. See FIGURE 3-14 and FIGURE 3-15.

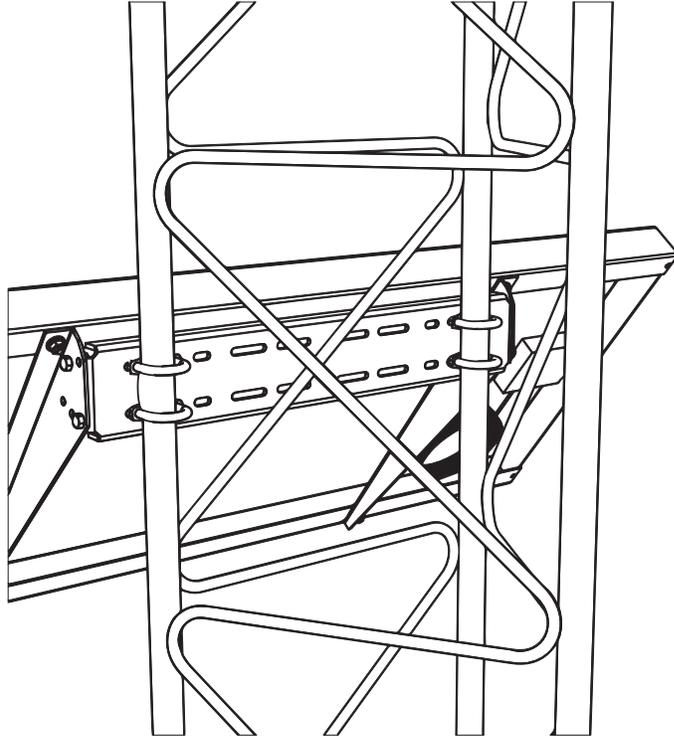


FIGURE 3-14. Two 5/16-18 x 1.5 u-bolts are attached to each side of the solar panel mount for triangular tower mounting

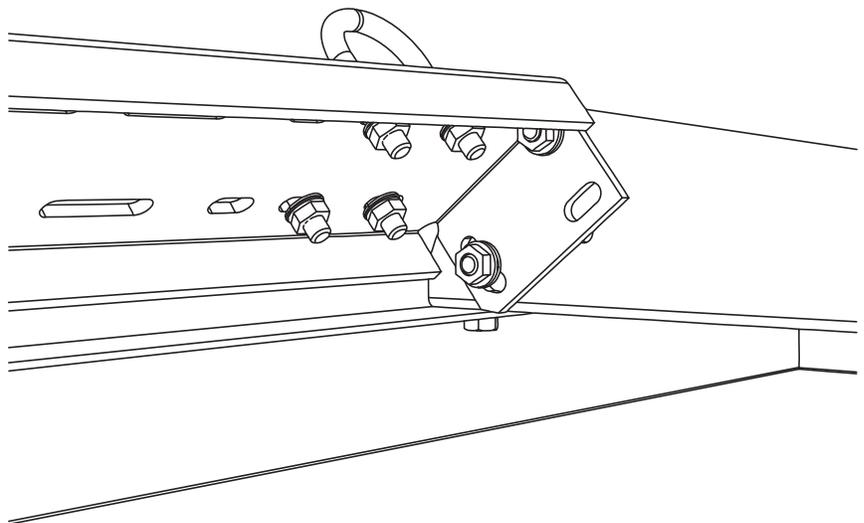


FIGURE 3-15. Reverse angle view showing the 5/16 washers, lock washers, and nuts securing the u-bolts

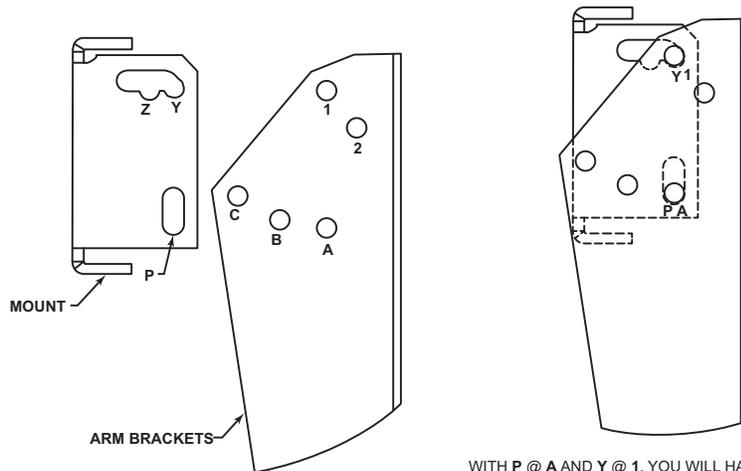
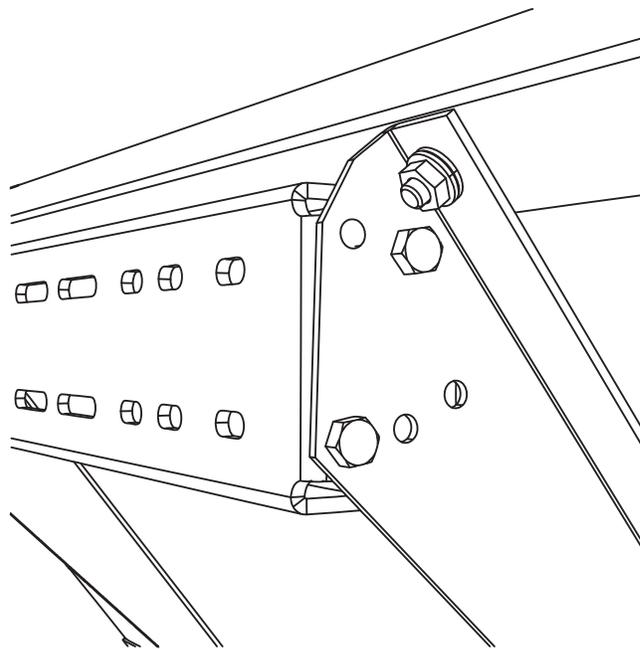
3.3 Orientation

The solar panel should be oriented facing the equator to receive maximum insolation (incident solar radiation) over the course of a year. Suggested tilt angles of the solar panel are given in TABLE 3-2.

After determining the tilt angle, loosen the 5/16” nuts on each side of the solar panel, and reposition the Hex bolt locations according to the hole location settings shown in TABLE 3-3 to adjust the panel. Tighten the two nuts to secure the position. See FIGURE 3-16.

TABLE 3-2. Solar Panel Tilt Angle*	
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.	

TABLE 3-3. Configurations for Desired Angles	
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°



WITH P @ A AND Y @ 1, YOU WILL HAVE A 90° ANGLE.

FIGURE 3-16. Angle settings on right and left arm brackets

3.4 Installation of CH200 Regulator

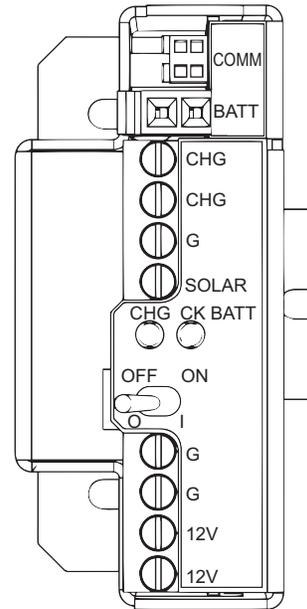
NOTE

For safety reasons, completely cover the solar panel to limit output current and voltage. If nothing is available to cover the panel, be careful not to short solar panel (+) and (-) leads together.

1. Using the supplied mounting hardware, install the CH200 on the mounting plate of an environmental enclosure (see FIGURE 3-17). Verify the On/Off switch is in the 'Off' position.
- 2a. Using the red and black power cable that ships with the BP12 or BP24, plug the end with the two-pin connector into the BATT terminal on the CH200. Attach the RED wire to the positive (+) terminal on the battery. Attach the BLACK wire to the negative (-) terminal on the battery.

The LED on the regulator labeled 'CHG' **SHOULD NOT** be on.

- 2b. If using a deep cycle marine battery, install Battery Terminal Strip Adapters (pn 4386) to each terminal of the battery as shown in FIGURE 3-19. Using the red and black power cable that ships with the CH200, plug the end with the two-pin connector into the BATT terminal on the CH200. Connect the black cable to the "charge" terminal on the Battery Terminal Strip Adapter installed on the battery's negative terminal. Connect the red cable to the "charge" terminal on the Battery Terminal Strip Adapter installed on the battery's positive terminal. The LED on the regulator labeled 'CHG' **SHOULD NOT** be on.
3. Connect the BLACK (-) wire from the solar panel power cable to the G terminal on the regulator located between the CHG and SOLAR terminals. Connect the red (+) wire from the solar panel power cable to the terminal labeled SOLAR on the regulator.
4. If charge current is available from the solar panel, the LED on the CH200 marked 'CHG' will begin to **flash GREEN**. This indicates the battery is charging and verifies proper operation and wiring of the regulator.
5. To supply power to the system, connect the RED power lead from a datalogger to either 12V terminal on the CH200. Attach the BLACK power lead from the datalogger to one of the two G terminals next to the 12V terminals.



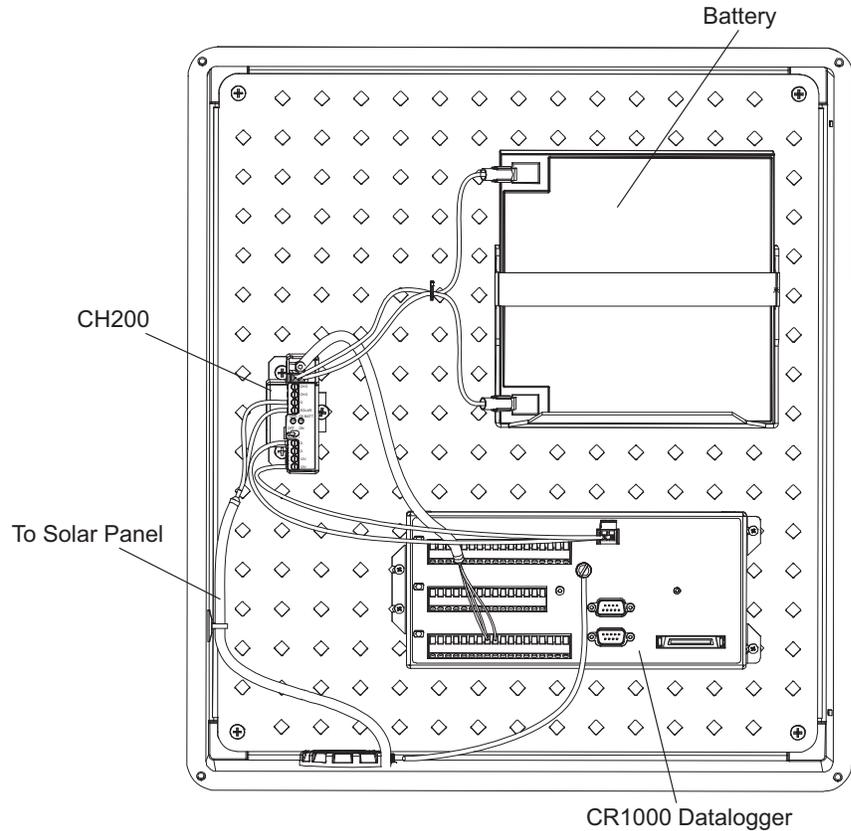


FIGURE 3-17. CH200 wired to solar panel, CR1000, and battery

3.5 Installation of Morningstar SunSaver™ SS-10-12V Regulator

1. Using the supplied mounting hardware, install the Morningstar SunSaver™ SS-10-12V regulator (pn 18529) to the mounting plate of an environmental enclosure (see FIGURE 3-18).
2. If using deep cycle marine battery along with the SP50 or SP85 solar panels, install Battery Terminal Strip Adapters (pn 4386) to each terminal of the user-supplied deep cycle battery as shown in FIGURE 3-19.
3. Using the spade terminated ends of the supplied red and black power cables, secure the black wire to terminal lug #1 marked battery (-) on the regulator. Connect the pigtailed end of the black cable to the “charge” terminal on the Battery Terminal Strip Adapter installed on the battery’s negative terminal. Secure the red wire to terminal lug #2 marked battery (+) on the regulator. Connect the pigtailed end of the red cable to the “charge” terminal on the Battery Terminal Strip Adapter installed on the battery’s positive terminal. With the battery connected and no solar panel input, the green LED on the regulator marked “CHARGING” **SHOULD NOT** be on.

4. Connect the black (-) wire from the solar panel power cable to terminal lug #3 marked solar (-) on the regulator. Connect the red (+) wire from the solar panel power cable to terminal lug #4 marked solar (+) on the regulator. If using a sealed rechargeable battery (BP24, BP84, or PS84), verify that the **metal jumper is installed** to configure the regulator to recharge sealed rechargeable batteries (see FIGURE 3-18). If using a flooded battery (e.g., deep cycle marine battery), then **remove the jumper**. Also note that no connections are made on the load terminals of the regulator for this application (see FIGURE 3-18).
5. If charge current is available from the solar panel, the green LED on the regulator marked “CHARGING” **WILL LIGHT UP**. This will verify proper operation and wiring of the regulator.
6. To supply power to the system, connect the power leads from dataloggers and sensors to the “load” terminals on the Terminal Strip Adapters installed on the battery terminals, positive leads to positive terminal, and negative leads to negative terminal of the battery.

NOTE

The Morningstar SunSaver™ SS-10-12V regulator ships with the jumper **INSTALLED**. If you are using flooded batteries, such as a deep cycle marine battery, **REMOVE** the jumper before installing the regulator.

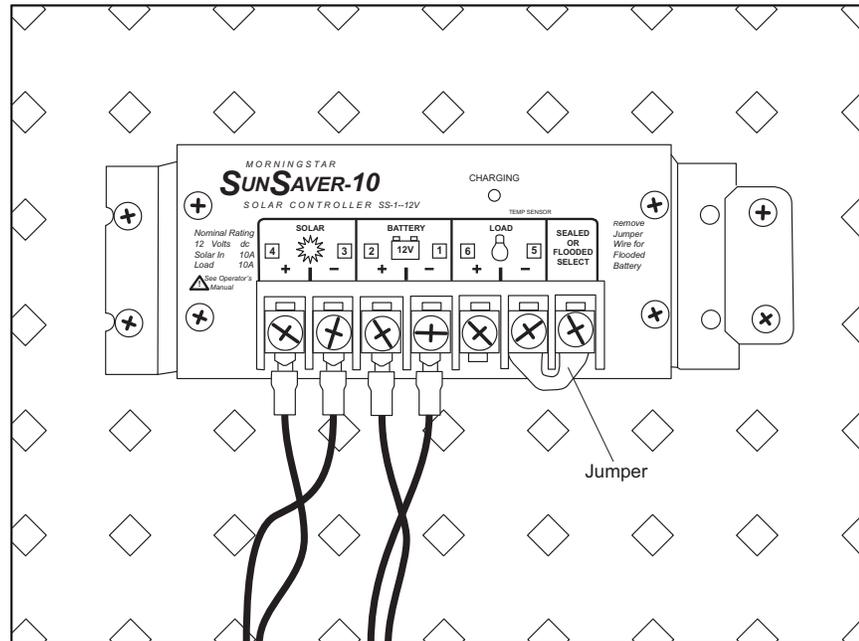
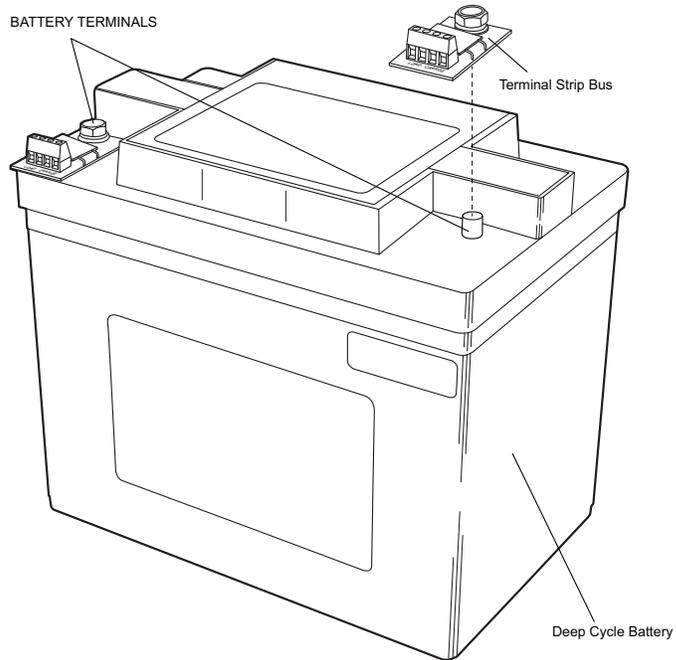


FIGURE 3-18. Morningstar's SunSaver™ SS-10-12V Regulator mounted on an enclosure backplate



WIRING DIAGRAM FOR PN 4386 BATTERY TERMINAL BUS

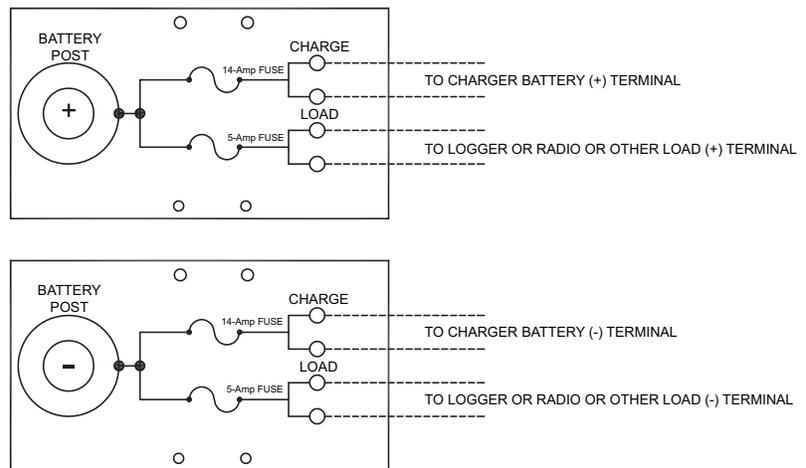


FIGURE 3-19. Battery terminal strip adapters for power connection to external battery

4. Maintenance

An occasional cleaning of the glass improves the solar panel's efficiency. 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 incident solar radiation 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.

For help in troubleshooting the solar panels, please contact a Campbell Scientific applications engineer.

5. Power Considerations

5.1 Proper Solar Power and Lead Acid Battery Sizes

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 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 depend 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.

NOTE

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

On the 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 panels 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). For additional help in computing power budget for a specific system, please contact a Campbell Scientific applications engineer.

5.2 Voltage 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 CH200 is a microcontroller-based smart charge controller that is ideal for external rechargeable 12 Vdc VRLA (Valve Regulated Lead-Acid) batteries like the BP12 or BP24. The controller manages amperage and voltage for safe, optimized battery charging from a solar panel or AC power sources. It also measures various input, output, and status parameters to allow close monitoring of the battery.

The Morningstar SunSaver™ SS-10-12V regulator can also be purchased from Campbell Scientific, and it is not shipped with a solar panel. The regulator connects to the battery via the 15' long 16AWG cable shipped with the regulator.

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

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