Introduction to Photovoltaic Power Systems

This photovoltaic power system operates by converting the sun’s radiation into usable power in the form of electricity as direct current. For nighttime and low ambient light level situations, the load is provided by the battery back-up of the system. This battery is charged via a controller by the photovoltaic module which is responsible for converting the sun’s energy. The diagram below (see Figure 1) describes how the system is wired.

Power is produced as soon as sunlight reaches the photovoltaic module. This power passes through the terminal block and into the controller. The controller splits this power to the battery and load as needed, and sends the power to both via the terminal block. The power can only flow from the photovoltaic module and not back into it (because of factory-installed safeguards in place in the system). The power can also only flow to the load and not from it. The battery has power both flowing into it (charging during the day) and out from it (discharging to the load when required). Circuit protectors are used to protect the system from electrical spikes and short circuits. A low voltage disconnect is built into the controller.

Since these systems rely on sunlight for power, it is important that they are placed in a location which is optimal for sunlight usage. The location is given a rating in Equivalent Sun Hours (ESH), which is an indicator of the amount of sunlight which will reach the photovoltaic module. The system will rely less on battery operation and more on the photovoltaic module power production in areas with a higher ESH.

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**WARNING**

To prevent injury, death, or damage to your photovoltaic system, be sure to follow all warnings and notes in this Instruction Sheet and follow all applicable local and national codes when installing, maintaining, and operating this system.

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**WARNING**

To prevent electric shock, exercise extreme caution at all times when installing, maintaining, and operating this equipment. This equipment may generate dangerous voltages. Cooper Crouse-Hinds has incorporated every practical safety precaution into this equipment; however, photovoltaic modules will create electricity whenever exposed to sunlight, and batteries can store electricity for several days regardless of light conditions. Special electrical regulations may apply because these cells create direct current.

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**WARNING**

To prevent component damage or electric shock, avoid touching any component or any part of the circuitry while the equipment is operating. Do not place heavy loads on associated system cables or maneuver them in a manner which may expose personnel or equipment to current. Do not connect system cables when the terminals are wet or damp. Do not disconnect cables under load.

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**WARNING**

To prevent component damage or electric shock, this system must be used for its intended purpose only. This system is not to be used as a back-up to, or in combination with, utility line power or any other power source.

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**WARNING**

To prevent damage to this system, do not concentrate the light on the surface of these cells under any circumstances to increase the electrical output of the system. The photovoltaic modules are only intended to operate under normal sunlight conditions.

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**WARNING**

To avoid sparking, do not install, clean, or maintain the system when the area is classified as hazardous.

Never install if components appear damaged or incorrectly wired from the factory.
Prior to Installation

Care must be taken to ensure the safety of those installing this equipment. Always verify that the method of installation will be suitable for the environmental and operating conditions in which this system will need to perform.

⚠️ CAUTION

To prevent injury, death, or damage to your photovoltaic system, use caution when handling this equipment. Much of this equipment is heavy and should be handled by two people. Never install this equipment when weather conditions may pose a risk of danger. Always use insulated tools and never wear jewelry or other metallic clothing, as these modules may generate electricity whenever light is present. Always cover the solar array’s front surface with an opaque material to reduce the risk of electrical generation during installation and when performing maintenance operations. Do not install wiring when fingers are wet.

During Installation and Maintenance

Under no circumstance should this system be installed or operated with a damaged solar panel backsheet. Extra care should be taken not to damage the backsheet by dropping it or hitting it with an object. Always mount the solar modules so that the junction box is located at the upper edge of the module. These should also be installed at an angle of no less than 10 degrees (10º) from the horizontal for ease of regularly scheduled cleaning and to help in self-cleaning. Make certain that all electrical connections are securely connected and are done so in a manner to reduce the chance of unauthorized personnel tampering (purposely or inadvertently) with the apparatus. Never attach anything to the back of the module, and make certain to allow for adequate ventilation to the back of the module to reduce the risk of heat build-up.

Components

This solar energy system is comprised of system components. Not included is the SCH40 pole needed for mounting this equipment or any other associated supplies (concrete, grounding rod, U-bolts, etc.).

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Panel</th>
<th>Battery</th>
<th>Regulator</th>
<th>Enclosure</th>
<th>Circuit Protectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOL 5W 12V 7 WR 3R</td>
<td>5 Watt</td>
<td>12 VDC, 7 Ahr</td>
<td>Included</td>
<td>16&quot; x 16&quot; x 10&quot;</td>
<td>Ordinary Location</td>
</tr>
<tr>
<td>SOL 20W 12V 36 WR 3R</td>
<td>20 Watt</td>
<td>12 VDC, 36 Ahr</td>
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<td>16&quot; x 16&quot; x 10&quot;</td>
<td>Ordinary Location</td>
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<tr>
<td>SOL 30W 12V 36 WR 3R</td>
<td>30 Watt</td>
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<td>16&quot; x 16&quot; x 10&quot;</td>
<td>Ordinary Location</td>
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<tr>
<td>SOL 30W 12V 48 WR 3R</td>
<td>30 Watt</td>
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<td>Included</td>
<td>16&quot; x 16&quot; x 10&quot;</td>
<td>Ordinary Location</td>
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<td>12 VDC, 70 Ahr</td>
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<td>Ordinary Location</td>
</tr>
<tr>
<td>SOL 40W 12V 36 WR 3R</td>
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<td>16&quot; x 16&quot; x 10&quot;</td>
<td>Ordinary Location</td>
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<tr>
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<td>Ordinary Location</td>
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<td>Included</td>
<td>16&quot; x 16&quot; x 10&quot;</td>
<td>Ordinary Location</td>
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<td>Ordinary Location</td>
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<td>50 Watt</td>
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<td>65 Watt</td>
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<td>Ordinary Location</td>
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<tr>
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<td>75 Watt</td>
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<tr>
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<td>80 Watt</td>
<td>12 VDC, 99 Ahr</td>
<td>Included</td>
<td>16&quot; x 16&quot; x 10&quot;</td>
<td>Ordinary Location</td>
</tr>
<tr>
<td>SOL 5W 12V 7 WR 3R 2</td>
<td>5 Watt</td>
<td>12 VDC, 7 Ahr</td>
<td>Included</td>
<td>16&quot; x 16&quot; x 10&quot;</td>
<td>Class I, Division 2</td>
</tr>
<tr>
<td>SOL 20W 12V 36 WR 3R 2</td>
<td>20 Watt</td>
<td>12 VDC, 36 Ahr</td>
<td>Included</td>
<td>16&quot; x 16&quot; x 10&quot;</td>
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<td>Class I, Division 2</td>
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<td>SOL 40W 12V 36 WR 3R 2</td>
<td>40 Watt</td>
<td>12 VDC, 36 Ahr</td>
<td>Included</td>
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<td>75 Watt</td>
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<td>16&quot; x 16&quot; x 10&quot;</td>
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<tr>
<td>SOL 80W 12V 99 WR 3R 2</td>
<td>80 Watt</td>
<td>12 VDC, 99 Ahr</td>
<td>Included</td>
<td>16&quot; x 16&quot; x 10&quot;</td>
<td>Class I, Division 2</td>
</tr>
</tbody>
</table>

Note

Other catalog numbers are available upon request.
## Technical Specifications

Specifications are subject to change without notice.

### Photovoltaic Panels

<table>
<thead>
<tr>
<th>Power Rating</th>
<th>Voltage</th>
<th>Dimensions</th>
<th>Material</th>
<th>Temperature Range</th>
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</thead>
<tbody>
<tr>
<td>5W ± 10%</td>
<td>Nominal voltage 12V, voltage at Pmax 16.8V, maximum system voltage 50V per NEC and IEC rating</td>
<td>Length: 9.7&quot; Width: 10.6&quot; Depth: 0.89&quot; Weight: 1.7 lbs.</td>
<td>Clear anodized aluminum alloy 6063T6 frame</td>
<td>-40ºC to +85ºC*</td>
</tr>
<tr>
<td>20W ± 10%</td>
<td>Nominal voltage 12V, voltage at Pmax 16.8V, maximum system voltage 50V per NEC and IEC rating</td>
<td>Length: 16.4&quot; Width: 19.7&quot; Depth: 0.89&quot; Weight: 5.6 lbs.</td>
<td>Clear anodized aluminum alloy 6063T6 frame</td>
<td>-40ºC to +85ºC*</td>
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<td>30W ± 10%</td>
<td>Nominal voltage 12V, voltage at Pmax 17.3V, maximum system voltage 50V per NEC and IEC rating</td>
<td>Length: 23.1&quot; Width: 19.7&quot; Depth: 0.89&quot; Weight: 7.7 lbs.</td>
<td>Clear anodized aluminum alloy 6063T6 frame</td>
<td>-40ºC to +85ºC*</td>
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<tr>
<td>40W ± 10%</td>
<td>Nominal voltage 12V, voltage at Pmax 17.3V, maximum system voltage 50V per NEC and IEC rating</td>
<td>Length: 25.0&quot; Width: 21.1&quot; Depth: 1.97&quot; Weight: 12.7 lbs.</td>
<td>Clear anodized aluminum alloy 6063T6 frame</td>
<td>-40ºC to +85ºC*</td>
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<tr>
<td>50W ± 10%</td>
<td>Nominal voltage 12V, voltage at Pmax 17.3V, maximum system voltage 50V per NEC and IEC rating</td>
<td>Length: 33.0&quot; Width: 21.1&quot; Depth: 1.97&quot; Weight: 12.7 lbs.</td>
<td>Clear anodized aluminum alloy 6063T6 frame</td>
<td>-40ºC to +85ºC*</td>
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<tr>
<td>65W ± 10%</td>
<td>Nominal voltage 12V, voltage at Pmax 17.3V, maximum system voltage 50V per NEC and IEC rating</td>
<td>Length: 43.7&quot; Width: 19.8&quot; Depth: 1.97&quot; Weight: 15.8 lbs.</td>
<td>Clear anodized aluminum alloy 6063T6 frame</td>
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<tr>
<td>75W ± 10%</td>
<td>Nominal voltage 12V, voltage at Pmax 17.3V, maximum system voltage 50V per NEC and IEC rating</td>
<td>Length: 47.0&quot; Width: 21.1&quot; Depth: 1.97&quot; Weight: 17.0 lbs.</td>
<td>Clear anodized aluminum alloy 6063T6 frame</td>
<td>-40ºC to +85ºC*</td>
</tr>
<tr>
<td>80W ± 10%</td>
<td>Nominal voltage 12V, voltage at Pmax 17.3V, maximum system voltage 50V per NEC and IEC rating</td>
<td>Length: 47.0&quot; Width: 21.1&quot; Depth: 1.97&quot; Weight: 17.0 lbs.</td>
<td>Clear anodized aluminum alloy 6063T6 frame</td>
<td>-40ºC to +85ºC*</td>
</tr>
</tbody>
</table>

### Solar Regulator

- **Regulator**
  - Voltage range: 6V to 25V
  - Negative ground
  - 8 - 10 mA power consumption
  - Length: 6.0"; width: 2.2"; depth: 1.3"; weight: 8 oz.
  - 1 or 2 wires per terminal
  - Maximum AWG #10 wire acceptable
  - Exterior 6063T5 aluminum with electrolytic anodized finish
  - Low volt disconnect 11.5V, reconnect at 12.6V

### Batteries

**Batteries Continued**

- **12 VDC 48 Ahr Gelled Electrolyte Battery**
  - Valve regulated gelled electrolyte lead calcium type
  - Voltage 12V, open circuit voltage of 12.8V at 20ºC
  - 48 Ah at c/100 hour rate to 1.75VPC

- **12 VDC 70 Ahr Gelled Electrolyte Battery**
  - Valve regulated gelled electrolyte lead calcium type
  - Voltage 12V, open circuit voltage of 12.8V at 20ºC
  - 70 Ah at c/100 hour rate to 1.75VPC
  - Length: 10.19"; width: 6.83"; height: 7.00"; weight: 42.0 lbs.

- **12 VDC 99 Ahr Gelled Electrolyte Battery**
  - Valve regulated gelled electrolyte lead calcium type
  - Voltage 12V, open circuit voltage of 12.8V at 20ºC
  - 99 Ah at c/100 hour rate to 1.75VPC
  - Length: 10.25"; width: 7.125"; height: 11.00"; weight: 68.4 lbs.

- **12 VDC 7.2 Ahr Maintenance-Free Sealed Battery**
  - Maintenance-free rechargeable sealed lead-acid type
  - Voltage 12V, open circuit voltage of 12.8V at 20ºC
  - 7.2 Ah at c/100 hour rate to 1.75VPC
  - Length: 5.94"; width: 2.56"; height: 4.02"; weight: 5.91 lbs.

### Other Hardware

- **Enclosure**
  - Aluminum alloy construction
  - NEMA 3R environmental rating; other options available upon request

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*Extreme temperatures may affect battery performance as suggested by Figure 2.*

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Figure 2.

*Capacity vs. Operating Temperatures: above are the changes in capacity for wider ambient temperature change, giving the available capacity, as a percentage of the rated capacity, at different ambient temperatures. The curves show the behavior of the battery after a number of cycles.*
Pole Installation

Always check with your local utility companies before digging for pole installation. Failure to do so may result in injury, death, or harm to essential equipment buried underground.

CAUTION
To prevent injury, death, or harm to essential equipment, the pole must be grounded per NEC/CEC. A separate ground may be required if the pole does not offer a suitable means of grounding to Earth.

The pole used as the structural support for the photovoltaic module with mounting hardware and battery box with components must be designed to withstand all possible environmental conditions for the area without failure. This includes wind speeds, rainfall, snowfall, soil erosion, and any other environmental conditions which may exist in the area but are not listed.

Photovoltaic Panel Mounting

Only the included panel mounting kit for side-of-pole installation should be used for installing this panel. A galvanized SCH40 pole between 2” and 4” (nominal) should be used and must be supplied by others. Four (4) U-bolts are required (not provided) and should be sized to the diameter of the pole. Care must be taken to not over-torque any of the bolts used for mounting the panels and frame members. Check for missing parts before installing.

FRAMES FOR LARGE SOLAR ARRAYS (Page 5)

1. Begin by installing the top and bottom horizontal cross bars to the pole using all four (4) U-bolts. Care must be taken to ensure these are level and parallel to another. Install these approximately 20” apart. These will be adjusted later.

2. Install the four (4) aluminum angle mounting feet to the top and bottom horizontal cross bars equidistant from center using eight (8) 5/16” stainless steel bolts, nuts, and washers supplied. Orient these according to Figure 3.

3. Install the upper right and left side panel arms to the mounting feet. Position these as shown in Figure 4 using two (2) 5/16” stainless steel bolts, nuts, and washers supplied.

4. Install the lower side panel arms to the mounting feet and finally to the upper panel arms as shown to create an offset “V” shape using four (4) 5/16” stainless steel bolts, nuts, and washers supplied.

5. Carefully attach the photovoltaic module to the upper left and right side panel arms using the four (4) 1/4” 316 stainless steel bolts, nuts, and washers provided. Proceed to Step 6.

6. THIS STEP REQUIRES AT LEAST TWO PEOPLE. Carefully loosen the two (2) U-bolts holding the bottom horizontal cross bar as well as the two (2) bolts holding the upper left and right side panel arms. Loosen the bolts connecting the upper and lower side panel arms to the lower side panel arms. Loosen the lower side panel arm bolts. DO NOT LOOSEN ANY OTHER BOLTS ON THIS ASSEMBLY AT THIS POINT, AS IT WILL BECOME DANGEROUSLY UNSTABLE. Care must be taken to support all members of the assembly and to not twist the photovoltaic module.

7. Adjust the arms to change the angle of the panel to the desired angle with regard to the position of the sun. The panel must be aimed south (toward the equator, with tilt angles shown in Figure 5).

8. Tighten all bolts loosened in the previous steps, taking care to not over-torque or strip any of them.

9. Wire the cable assembly into the solar terminals within the enclosure as shown in Figure 8. Tighten cable gland to secure to enclosure.

10. Wire the other end of the cable assembly to the solar panel. Ensure to latch the junction box after installing the cable, and that the junction box sealing gasket has been inserted into its groove. The top of the PV panel is where the junction box is located and the panel should always be mounted with the junction box at the top. The junction box is on the underside of the panel and that the panel must be oriented as such when attached to the mount.

FRAMES FOR SMALL SOLAR ARRAYS (Pages 6-7)

1. Attach two lateral braces to solar array with provided hardware.

2. Mount angle brackets to desired location on main horizontal channel with provided bolts (using lateral braces as a guide for spacing).

3. Use U-bolts to fasten horizontal brace to pole.

4. Angle solar panel facing south at the appropriate angle.

5. Proceed to Step 6.

CAUTION
To prevent injury, death, or harm to essential equipment, the pole must be grounded per NEC/CEC. A separate ground may be required if the pole does not offer a suitable means of grounding to Earth.

The pole should be installed in accordance with current local code and ASTM standards for in-ground mounting of structure poles if being directly buried. The pole must be level so that the battery box and photovoltaic module will not exert an excessive amount of torque on the pole, and so that the components are angled properly.

Components have been designed to withstand 90 mph winds, if installed properly. Be sure to follow all instructions for installation, and a type SCH40 pole, as a minimum.
INSTRUCTION GUIDELINES FOR:

MOUNTING STRUCTURE
SIDE OF POLE (LARGE SOLAR PANELS)

Pole must be grounded to NEC/CEC code.
Note: separate ground rod may be required if pole is not suitable for grounding.

See table on page 7 for mounting angle.

U-bolts:
U-bolts are not provided; size depends on pole size selected.

Supply hot dipped or stainless steel U-bolts after specification of pole size and gauge.

Pole must be grounded to NEC/CEC code. Note: separate ground rod may be required if pole is not suitable for grounding.
Figure 4.

Mounting Structure Side of Pole (Small Solar Panels)

Figure 4.

Mounting Structure Side of Pole (Small Solar Panels)
Note: solar panel should be installed in a location which has an unobstructed path to sunlight for the entire day.

Pole must be grounded to meet NEC/CEC and local requirements. Note: separate ground rod and grounding cable may be required if pole is not suitable for grounding.

POSITIONING SOLAR PANEL TO CORRECT INCLINATION ANGLE

Solar Array Inclination angle = latitude + (5° to 15°)

<table>
<thead>
<tr>
<th>Site Latitude</th>
<th>Solar Array Inclination Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9°</td>
<td>15°</td>
</tr>
<tr>
<td>10-20°</td>
<td>Latitude + 5°</td>
</tr>
<tr>
<td>21-45°</td>
<td>Latitude + 10°</td>
</tr>
<tr>
<td>46-65°</td>
<td>Latitude + 15°</td>
</tr>
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</table>

U-bolts or stainless steel strapping recommended for mounting to pole.

Supplied by others.

Figure 5.
Battery and Control Box Mounting (requires 2 people)

The battery box and controls enclosure should come pre-assembled with all major components. The physical mounting of this only involves placing the box below the photovoltaic module also attached to a SCH40 pole.

To prevent injury, death, or damage to your photovoltaic system, extreme caution should be taken whenever entering the control cabinet due to energized components. Photovoltaic panels generate power whenever exposed to ANY light. Cover the panel entirely prior to wiring or servicing with an opaque cover. Batteries are intended to store energy, and will shock, spark, or explode if the terminals are touched or crossed. Prior to installation or servicing, switch all disconnects to OFF position and use only insulated tools.

1. Place the control box below the photovoltaic module far enough away that it does not impede ventilation of the box or module. Make certain that the distance is short enough to allow for the cable connections to the top of the solar module to reach the bottom of the control box. The 2 conductor #10 AWG cable is approximately 15’ long, and is provided with cable glands.

2. Hold the box in place and loosely secure the top using a U-bolt.
3. Attach the bottom U-bolt while still holding the box in place.
4. Level the enclosure so that the battery is in the upright position inside of the enclosure relative to the ground.

For optimal performance and electrical safety, the battery must ALWAYS be positioned upright in the control box.

5. Tighten the top U-bolt.
6. Tighten the bottom U-bolt.

Note: If a suitable flat surface is used for mounting, then appropriately sized hardware must be selected and must be 316 stainless steel for corrosion protection.

WARNING

CAUTION

NOTE: Solar panel instrumentation and antenna cables should enter at bottom of enclosure to minimize moisture from entering enclosure.

Figure 6.

Figure 7.

Note: Mount enclosure as shown to prevent water from entering vents.

Note: Circuit Protectors

SS U-Bolt

SS U-Bolt

Note: Battery should be positioned upright

SS U-Bolt

SS U-Bolt

Note: Mounting slots designed for use with 2-4” U-bolts

SS U-Bolt

SS U-Bolt

Note: A standard combination lock or padlock with a 7.2-8.7mm diameter shackle should be used to keep door closed and sealed; a bolt that meets sizing requirements can be used; however, this option is less secure and can result in unwanted tampering.

SS U-Bolt

SS U-Bolt
Electrical Connection

Note that batteries can explode if improperly connected. Never short circuit a battery by “jumpering” it for any reason.

A negative ground system is required. To ensure proper ground, the negative terminal of the battery must be directly wired to the enclosure chassis.

The control box will arrive with the voltage regulator, circuit breakers, and surge protector (when supplied) pre-wired in the enclosure.

WARNING
To prevent injury, death, or damage to your photovoltaic system, all circuit protectors should be in the OFF position until all electrical connections are made. Connections should ONLY be made to the terminal block and should NEVER be made directly to the solar controller. Remember that the photovoltaic module may at any time be producing electricity, so extra care must be taken to properly ground all equipment and use insulated tools, as well as remove all jewelry. Always follow electrical code for your area when installing one of these systems, as failure to do so could result in injury or equipment failure. Make certain that no bare wires come in contact with any metal surfaces which they are not designed to be connected to.

Installation and Operation Notes:

WARNING
To prevent injury, death, or damage to your photovoltaic system, extreme caution should be taken whenever entering the control cabinet due to energized components. Photovoltaic panels generate power whenever exposed to ANY light. Cover the panel entirely prior to wiring or servicing with an opaque cover. Batteries are intended to store energy, and will shock, spark, or explode if the terminals are touched or crossed. Prior to installation or servicing, switch all disconnects to OFF position and use only insulated tools.

- The controller, battery, and solar panel should be wired via the terminal block per the wiring diagrams (see Figure 8) on page 10.
- Be sure to connect the load last. If the red indicator is lit, then the battery capacity is low and should be fully charged before completing system installation.
- The controller is shipped with a jumper installed for use with sealed batteries. This jumper will optimize sealed battery charging performance and should be used at all times.
- For effective surge protection, the negative battery conductor must be properly grounded according to local code.
- The green LED indicator will turn on any time the photovoltaic module is transferring energy to the controller. This will turn off at nighttime. There will be a small amount of energy at all times going to the battery when the green LED is on.
- The module includes an automatic low voltage disconnect (LVD) feature which disconnects power to the load if the battery charge falls below 11.5 volts. The red LED indicator will also turn on if this occurs. Once the battery is charged to 12.6 volts, the load will be reconnected and the LED will turn off.
- The controller does not need a blocking diode because it automatically prevents reverse current leakage from discharging through the module at night and when battery power operation is occurring.
- The connectors are made to accept up to AWG #10 clamped to 20 inch-pounds. This connection is normally made at the factory.
- If the battery becomes disconnected, the photovoltaic module will continue to provide power to the controller, which will provide power to the load until there is not enough sunlight available to power the load.
- Auxiliary devices may be used to charge the battery without needing to disconnect the battery from the controller.
- Once installed, ensure that no wires or contacts are loose.
- Contact Cooper Crouse-Hinds for breathers/drains, cable glands, or other weatherproofing accessories.
Figure 8.
**Cable Routing**

Cooper Crouse-Hinds provides all of the needed cables for internal wiring of this system. All connections use #10 AWG wire. This kit is also provided with 15’ length of #10 AWG 2 conductor cable for connection from the system terminal block to the solar panel.

**WARNING**

*Note that since this system may supply power at any time during operation, all circuit breakers must be in the OFF position before making any connections. If located in a Class I, Division 2 area, no wiring connections should be made at all until the area has been determined to be cleared of any hazardous gases. Terminal connections may cause arcing and sparking when attaching wires.*

All wiring which is external must be secured and properly protected from the environment per local code. Wiring of equivalent size and type can be substituted in this system for load connection if required. Cooper Crouse-Hinds will not be responsible for damage due to connection of this system to a non-hazardous rated load in a hazardous area.

**Circuit Protection**

Circuit protectors are provided with this system. These are DIN rail mounted and have been sized to meet the load requirement and photovoltaic panel and battery input power of the system. These are supplied pre-wired to their respective terminal blocks. Make sure that circuit protectors are in the OFF position when making or changing connections to this system, and before servicing and maintaining any of the system components. For hazardous location equipment, third-party approved Class I, Division 2 circuit protectors have been supplied, which are acceptable for use in Group A, B, C, and D areas. Standard location circuit protectors must never be used in place of hazardous location circuit protectors.

**Maintaining the System**

**WARNING**

*To prevent injury, death, or damage to your photovoltaic system, extreme caution should be taken whenever entering the control cabinet due to energized components. Photovoltaic panels generate power whenever exposed to ANY light. Cover the panel entirely prior to wiring or servicing with an opaque cover. Batteries are intended to store energy, and will shock, spark, or explode if the terminals are touched or crossed. Prior to installation or servicing, switch all disconnects to OFF position and use only insulated tools.*

The following list of maintenance and inspection duties must be performed at least once every 6 months to ensure optimal performance and safety of this equipment. Always follow local code when performing maintenance and inspections, especially when in hazardous locations in which the system may present a source of ignition for nearby combustible materials. Maintain only during times of shutdown. NFPA 70B maintenance schedule is to be followed.

1. Verify that the correct battery type has been selected on the controller.
2. Verify that the system is charging within the rated current and voltage levels listed.
3. Check that all components are securely mounted and are free of excess dirt, corrosion, and/or insects.
4. Check that airflow around the controller, battery, and photovoltaic module is not impeded for cooling and ventilation.
5. Verify that water is not collecting inside of the enclosure or pole.
6. Verify that the current system conditions are indicative of the current controller functions (for instance, if sunlight is present, the photovoltaic module should be charging the battery until full and operating the load).
7. Check to see that all bolts and mounting components are structurally intact and free of corrosion and dirt.
8. Check for degradation of all associated cabling and cable glands.
9. Panel should only be cleaned with a soft cloth or sponge using water only. Steam/aggressive cleaners/abrasives should never be used. To avoid cracking, wash with water which is equal to the ambient temperature.
10. Weep holes and louvers must be free from debris.

**WARNING**

*To prevent injury, death, or damage to your photovoltaic system, open door carefully - battery may be leaking corrosive fluids.*

11. Ensure water is not leaking into enclosure through any orifice.

We recommend an Electrical Preventive Maintenance Program as described in the National Fire Protection Association Bulletin NFPA 70B: Recommended Practice for Electrical Equipment Maintenance (www.nfpa.org).
## Appendix

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>POSSIBLE REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>No voltage being applied to load</td>
<td>Panel’s view of the sun blocked</td>
<td>Remove snow, foliage, dirt, or any other obstructions</td>
</tr>
<tr>
<td></td>
<td>Defective solar panel</td>
<td>When sun is present, verify voltage is present on output terminals of solar panel</td>
</tr>
<tr>
<td></td>
<td>Panel not adjusted properly</td>
<td>If necessary, re-orient the panel</td>
</tr>
<tr>
<td></td>
<td>Circuit breakers tripped</td>
<td>Check that no system circuit protectors are tripped</td>
</tr>
<tr>
<td></td>
<td>System connections may be defective</td>
<td>Check all system connections; make sure voltage drops are not too high</td>
</tr>
<tr>
<td></td>
<td>Check solar controller for proper LED indications</td>
<td>Red LED on - load disconnected due to low battery voltage; measure the voltage at the controller’s “BATTERY” terminals; if this voltage is above 11.5 Volts, the load should have power; if the “LOAD” terminals do not have power, then the controller may be defective</td>
</tr>
<tr>
<td></td>
<td>Check that system wires are connected with a positive fastening mechanism to their respective equipment</td>
<td>Secure all wires firmly as needed; ensure that all factory-installed wiring is correct per wiring diagrams</td>
</tr>
<tr>
<td></td>
<td>Check that polarity of wires is correct (+ to + and - to -) between all electrical connections</td>
<td>Change polarity of any incorrect connections (note: all positive (+) connections must be made with red wires and all negative (-) connections must be made with black wires</td>
</tr>
<tr>
<td></td>
<td>Check if system wires are chafed or stripped - or are touching a nearby object which is not intended to be energized</td>
<td>Replace affected wire with wire which is equivalent in electrical properties, size, and color</td>
</tr>
<tr>
<td></td>
<td>Check if system wires are stretched, excessively bent, or mechanically stressed</td>
<td>Replace affected wire with wire which is equivalent in electrical properties, size, and color</td>
</tr>
<tr>
<td></td>
<td>Check if the load is capable of being operated by another 12V power source</td>
<td>If not, then repair or replace load as needed; NEVER knowingly connect a faulty load to the kit</td>
</tr>
<tr>
<td></td>
<td>Check if contacts are excessively corroded</td>
<td>Consult Cooper Crouse-Hinds Customer Service for proper cleaning procedures or replace</td>
</tr>
<tr>
<td></td>
<td>Check if circuit protectors are in the “ON” or “OFF” positions</td>
<td>Carefully inspect equipment for signs of a previous short circuit or overload failure</td>
</tr>
<tr>
<td></td>
<td>Check if the solar array is sized to handle the load being given</td>
<td>Check the load calculations for the system to ensure that system components were sized appropriately for the region</td>
</tr>
<tr>
<td></td>
<td>Check if the ESH was properly specified when sizing the system for the installation’s geographic region</td>
<td>Check the load calculations for the system to ensure that system components were sized appropriately for the region</td>
</tr>
<tr>
<td></td>
<td>Check if the battery is adequately charged for the system conditions (i.e. sunlight level, temperature, etc.)</td>
<td>Check for LVD operation and allow battery to recharge fully under normal conditions; replace battery if needed</td>
</tr>
<tr>
<td></td>
<td>Check that battery and solar panel are giving proper voltage and amperage to the regulator</td>
<td>Replace regulator if other equipment appears to be functioning properly</td>
</tr>
<tr>
<td>Incorrect voltage being supplied to load</td>
<td>Charge controller may be defective</td>
<td>Measure the voltage at the “LOAD” terminals; if the voltage is over 15 Volts, then replace controller</td>
</tr>
<tr>
<td></td>
<td>Check if the door was left open</td>
<td>Close door and latch with padlock</td>
</tr>
<tr>
<td></td>
<td>Check that the RF cable entry was made per the IF Sheet instructions</td>
<td>Change radio RF cable entry or contact Cooper Crouse-Hinds Customer Service for parts replacement</td>
</tr>
<tr>
<td></td>
<td>Check that the weep hole is draining properly</td>
<td>Verify that the weep hole is not plugged and is properly sized</td>
</tr>
<tr>
<td></td>
<td>Check that the screen is intact behind the louvers of the enclosure</td>
<td>Replace the screen if necessary</td>
</tr>
<tr>
<td></td>
<td>Check the direction of the louvers</td>
<td>The enclosure is only meant to be mounted with the louvers facing downward</td>
</tr>
<tr>
<td></td>
<td>Check that the solar panel gasket is installed properly</td>
<td>Inspect the junction box on the back of the PV panel carefully to ensure that the seal is present and installed correctly</td>
</tr>
</tbody>
</table>

APPENDIX CONTINUED ON NEXT PAGE
## Problem	|	Possible Cause	|	Possible Remedy
---|---|---
**Battery not charging**
- Incorrect battery type selected	|	Jumper installed for sealed battery; jumper removed for flooded battery
- Solar panel defective	|	Measure the solar panel open circuit voltage and confirm it is within normal limits; if it is low or zero, check the connections and replace panel if necessary
- Solar panel too small for application	|	Check that the load is not drawing more current than the panel can provide
- Bad battery	|	Check if battery voltage declines at night with no load; if battery is unable to maintain its voltage, battery may need to be replaced
- Check for a short circuit in the system	|	Correct short circuit in wiring; if it appears to be in a component, contact Cooper Crouse-Hinds Customer Service for replacement details
- Check if the system is being operated outside of the temperature limitations	|	Never install this system in an environment outside of the listed parameters of operation
- Solar panel life exceeded	|	Solar panels must be replaced every 25 years
- Battery life exceeded	|	Batteries must be replaced every 4 - 6 years

**Load terminals measure -2V**
- When in low voltage disconnect mode and no load connected, this will be measured at the "LOAD" terminals	|	None

**Buzzing noise**
- This is normal and is caused by the way the charging system operates	|	None*

*There is little that can be done to remedy this issue. However, this noise in the system loads can usually be reduced by the following:

A. Minimize cable runs between components
B. Use twisted pair wiring for the power
C. Use good system grounding
D. Add a capacitor across load terminals of controller (22,000μF minimum)