Solar Installation – 7 Things you should know

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Ebbtide 32-342

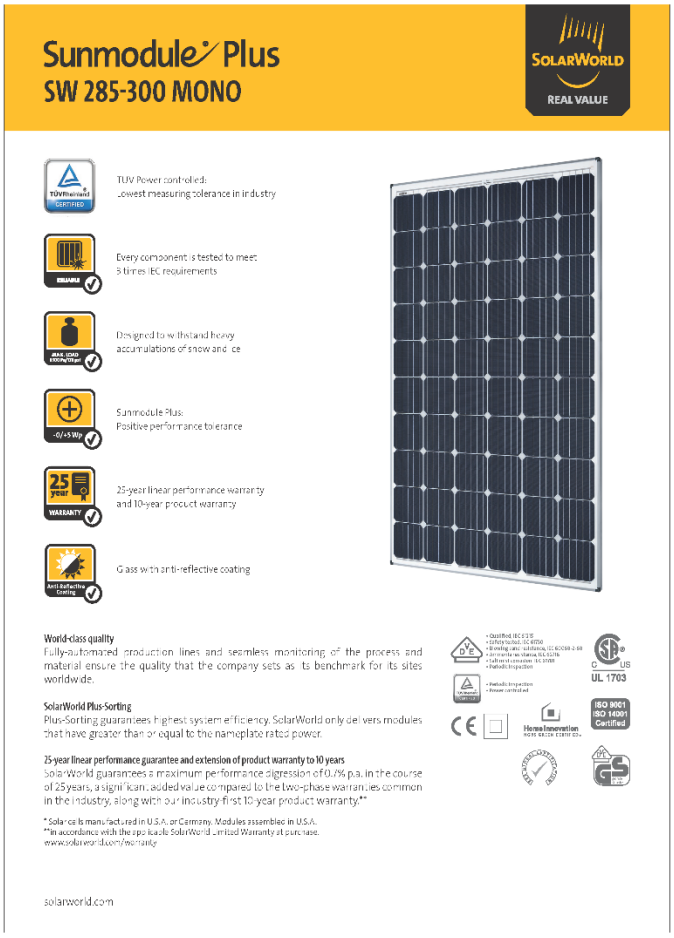
Marine Solar Power is an expensive but worthy investment that can pay for itself in the long run. Especially if you are a cruiser, like to anchor out or just don't want to run the generator as often.

Getting a crappy solar installation however will cost you time, money and frustration with no benefit in return. Many solar installers don't always know what they are doing…even when they claim to! Installation on boats is in many ways like an off the grid installation on dry land but there are some important differences. Corrosion, water intrusion, location selection, equipment placement and shading are a few of them. Any tech can throw a few panels on the roof, screw them in and say "all done" but there is a lot more to it than that.

Whether you plan to install your array yourself or have it professionally done its super important to understand the entire installation process. This way you know the right questions to ask, requests to make and can confidently help design your own solar install…most importantly you'll be able to inspect the finished job. Let's get started.

1. **What kind of panels are best**? Let's start with the different types of solar panels currently on the market, list their benefits and downsides, and then look at a few scenarios where certain types would be better that others.

    - Monocrystalline. Advantages are highest efficiency rates since they are made from the highest-grade silicon, space efficiency, high power output, longest lifespan, and perform better in low light conditions. They are identifiable as the cells are perfectly rectangular with rounded corners. Their efficiency rates are typically 15 to 20% and produce up to four times the output of thin-film panels.
    - Polycrystalline. Advantages are simpler to manufacture, cost less and generate less waste during manufacture. They are identifiable as perfectly rectangular with square corners and have been on the market since 1981. Their efficiency rates are typically 13 to 16%.
    - Amorphous (Thin Film). Advantages are light weight, flexibility, surface adaptability, low light efficiency, durability, temperature resistance. They are identifiable due to their flexibility and lack of a rigid frame. Their efficiency rates are typically 6 to 8%.



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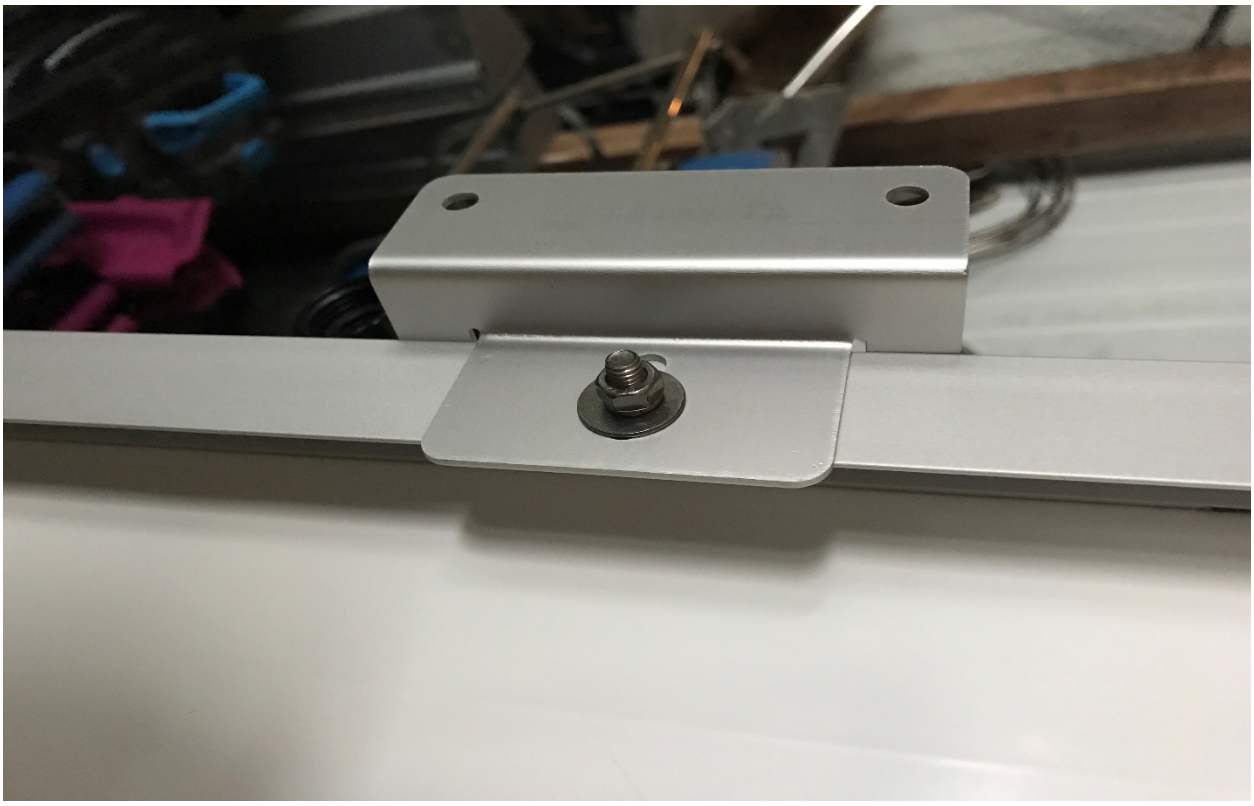
2. **How should they be mounted**? In a typical powerboat application, the monocrystalline or polycrystalline array would be rigidly mounted by their frames to a roof, deck or rail. Amorphous arrays can be installed directly onto a roof, deck or sewn into canvas.

    - Rigid mounting. Advantages are allowing an airgap behind the panels to help cool them during high temperatures, can be used as a sunshield and can be mounted on arms or rails to allow pivoting and rotation if required.
    - Flexible mounting. Advantages are allowing installation directly onto canvas of a bimini or cockpit cover, with proper connectors could be rolled up for storage when not in use and are inconspicuous.

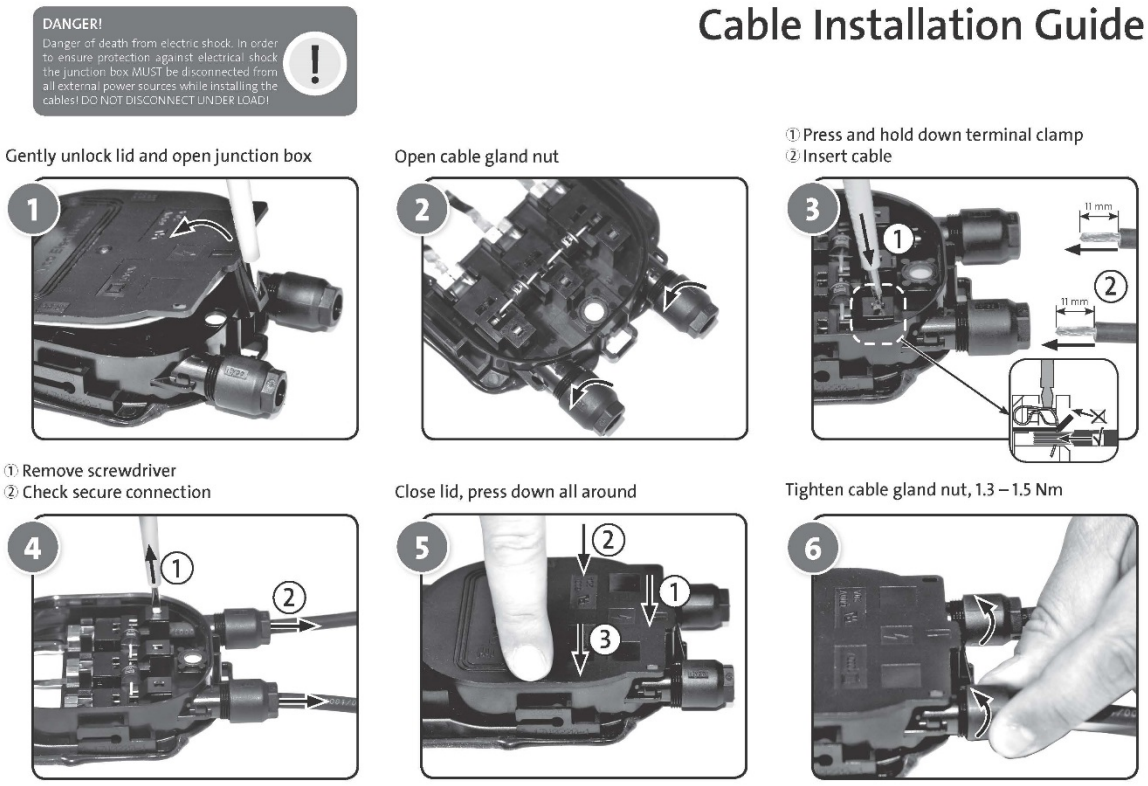


3. **Where should they be mounted**? Here's where it gets a bit tricky. Shading is the #1 cause of panel inefficiency. As little as one corner shaded by a mast, boom, radar or flag will cause degradation of output. As vessels are in a constant state of motion it is nearly impossible to eliminate this problem so any location will be a compromise. Pick the highest and least affected areas to mount your array.

4. **How should they be wired**? Array wiring is standardized and specialized in its manufacture and installation. Connection can be either panels in series or parallel or both depending on your array.

    - Parallel wiring. Much like battery banks solar panels can be wired in parallel through a combiner box at the array. The advantages are higher available current to the controller from the array.

- Series wiring. Again, much like house banks solar panels can be wired in series directly at the array without the use of a combiner box. The advantages are higher available voltage to the controller from the array.
- Series/Parallel wiring. As the name implies this is a combination of multiple panels wired in series (a string) and multiple strings wired in parallel through a combiner box at the array. The advantages are both higher voltage and current to the controller from the array.

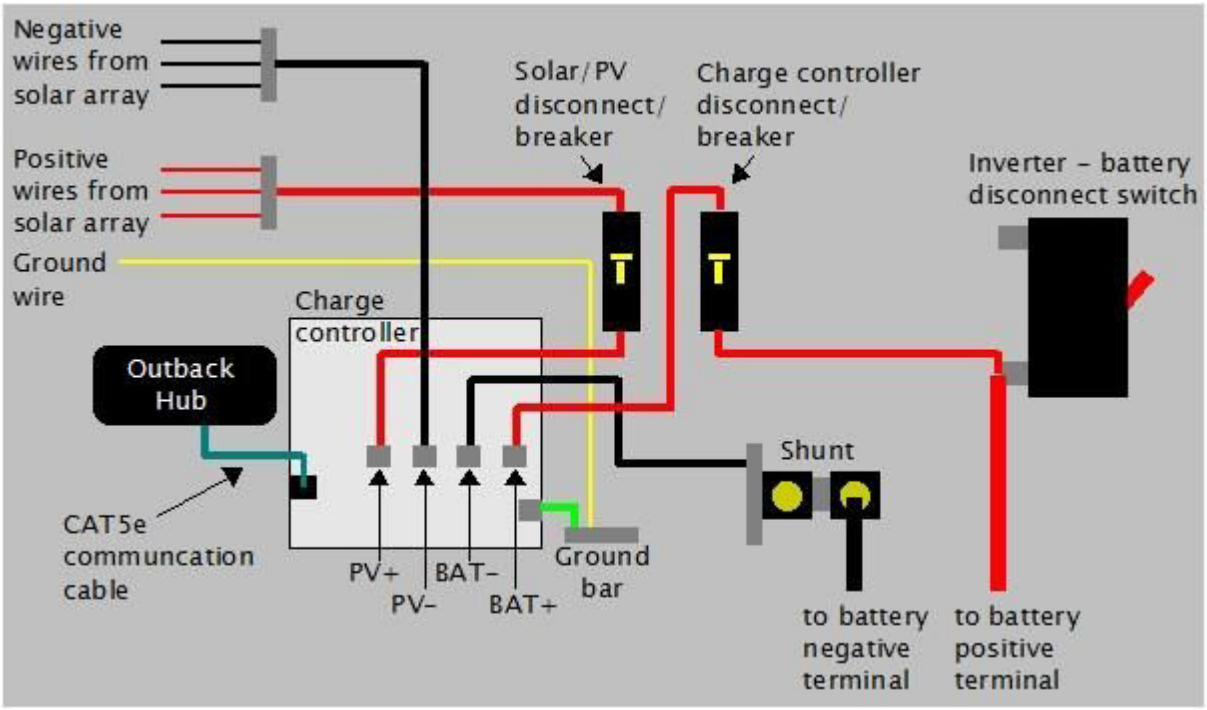


5. **What kind of Charge Controller**? Solar charge controllers are designed to do two primary things within a solar power system: optimize the charging of your deep cycle batteries by the solar panels and prevent electricity from the batteries from going through the solar panels when there is no sun. Many charge controllers offer additional features, including automatically turning DC powered loads on or off, monitor your batteries voltage and amp hours left and even connect to a Wi-Fi network for remote monitoring. Let's start with sizing the controller and the different types of controllers currently on the market, list their benefits and downsides, and then look at a few scenarios where certain types would be better that others.

- Sizing a Charge Controller. Solar charge controllers are specified by both amperage and voltage. You will need a controller that can support the voltage of your solar array, and then the output to your battery bank's voltage (usually 12, 24 or 36 volts). Next, you'll want to make sure your controller has enough capacity to handle the current from your array. A rough estimate is to take the wattage of your solar panels and divide it by your battery bank's voltage to determine the potential current.
- Maximum Power Point Tracking (MPPT). This is the state of the art in charge controller technology. These controllers detect the optimum operating voltage and amperage of the solar array and match that with the battery bank. The result is an additional 15 – 30% more power out of the array versus a PWM controller. Although an MPPT controller is more expensive than its PWM counterpart, it is generally worth the investment in any system over 200 watts.
- Pulse Width Modulation (PWM). This is a traditional style controller. They are robust, inexpensive and widely used in solar applications. The technology of these controllers is limited and they do not offer the ability to maximize power output.

6. **System installation and safety**. Proper installation of a complete solar power system is crucial to its operation and safety. ABYC and National Electric Code standards are both applicable in the installation of overcurrent protection devices, safety switches, wire sizing, equipment location and mounting.

    - Safety Switches. A safety lock out switch must be installed as close and as accessible as possible to the array. Many arrays can produce up to 1000 volts DC and will do so as long as the sun is shining. The disconnect switch must be rated for both the current and voltage of the array.
    - Overcurrent protection. Protection must be installed on both the incoming (array side) and outgoing (battery side) of the controller. The fusing must be sized to *both* the voltage and current available at its location.
    - Wire sizing. Wiring on the array side of the charge controller is specialized in its construction and insulation. Sizing is dependent on the current available from the array. It is typically run to the safety disconnect and overcurrent protection device then directly to the charge controller. Wiring on the battery side of the controller should meet the requirements of the ABYC in both its construction and insulation. Sizing is dependent on the current available from the charge controller. It is typically run to the overcurrent protection device then directly to the battery bank.



7. **How do I monitor the system**? Monitoring the performance of the installed system is the final piece of the of the puzzle. Typically, a monitor is installed remotely from the charge controller and near the state of charge meter and inverter controller. The amount

of information available for display is dependent on which manufacturers charge controller has been installed. At a minimum it should provide simple convenient operation, the ability to program the charge controller remotely and display statistics and performance of the system. Many monitors now can communicate via network or Bluetooth connection and have the ability to provide a remote display of system status.