Introduction to 12V battery charging from a solar panel

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Basic Components of a 12V Solar Charging System

A basic photovoltaic (PV) solar electric panel system for 12V battery charging comprises a solar panel connected to a charge controller, connected in turn to the battery.

PV Solar panels

The amount of power that a PV solar panel provides is indicated by the wattage (W). The higher the wattage, the more powerful the panel. Wattage can be calculated from the Amps (current) and Volts and vice versa:

Watts = Amps x Volts
Amps = Watts / Volts
Volts = Watts / Amps

There are two main types of solar panel: *amorphous and crystalline*. In general, amorphous perform better than crystalline under low light conditions and don't suffer as much power loss in hot temperatures. However, in good conditions, the efficiency of amorphous panels is lower, and they are physically larger than crystalline panels of the same wattage. Rollable, folding and flexible panels are generally amorphous, whereas crystalline panels tend to be aluminium framed and glass fronted, and therefore heavy and difficult to transport.

If part of a solar panel is in shadow then output from the whole panel goes down, unless there are *bypass diodes* between the cells. Bypass diodes reduce the impact of partial shading.

Blocking diodes prevent power from going back into the panel from the battery at night. They are not necessary if a charge controller is being used, and are usually fitted as standard on smaller flexible modules.

Charge Controllers

The charge controller (or regulator) functions a) to protect the batteries from overcharging; b) to protect the panel from power going back into it from the batteries at night (assuming no blocking diode fitted); and c) helps maintain battery condition by keeping the battery voltage high.

Charge controllers are rated for a certain solar input in Amps. This should always be higher than the rated Amps of the solar panel.

As a rule of thumb, use a controller when the rated Amps of the panel is more than 1% of the battery capacity.

We supply two basic types of controller: on/off and Pulse Width Modulated (PWM). On/off as its name suggests, switches of the power from the panel to the battery when the voltage reaches a certain level, and switches back on when it drops. This means that there are periods of time when there is no power going from the panel to the battery. PWM controllers allow the battery voltage to increase, and then maintain it at a steady but high level.

Sizing a system

In sizing a system correctly, the aim is to balance the power going in from the solar panel with the power going out of the battery over a period of days or weeks (depending on how it is being used). A 10W panel will give 10W (0.6A @ 16.5V) over an hour under standard test conditions (1000W/m sq and 25oC – equivalent to one hour of 'peak' sunshine). In the UK we expect around 4 hours equivalent sunshine in summer and 1 hour in winter. Thus in Winter a 10W panel will give 10W over a whole day, whereas in summer it will give 40W. These are fairly conservative figures – some companies use up to 6 hours in summer, but of course whatever figure you use the panels will perform the same in real life. You can do the same calculations with the Amps.

Simple steps for sizing a 12V system:

- **Find the Wattage of your appliances.** List all the 12V electrical appliances you'll use in a typical day, and find out how many Watts they each consume. Usually this is on the appliance or in its handbook. If you can only find a figure for Amps, simply multiply this by 12, to convert it to Watts.
- **Calculate your daily total Watt-hour requirement.** Estimate how many hours you would use each appliance for over a typical week, then divide by 7 for a daily rate. Multiply each appliance's wattage by the hours you'll use it for in a day. Then add all the totals together to get the final daily total Watt-hours you require
- **Next calculate your panel size.** Simply divide the daily total Watt-hours you require by the hours of equivalent peak sunshine you expect in an average day. This will give you your minimum panel wattage. In the UK, allow 1 hour of sunshine in winter, rising to 4 hours by mid-summer.
- **Then your battery size…** Multiply your daily Watt-hour requirement by 7 to create a weekly requirement, and divide this by 12 to convert back to Amp Hours, which batteries are rated in. Multiply by two to give the correct battery size.
- **And finally, your charge controller.** Size your charge controller according to the

Amps produced by your panel. Calculate the Amps produced by dividing the panel wattage by 16.5.

A worked example:

In one week you want to run a 65W television for 4 hours, and an 8W light for 5 hours.

- Your daily Watt-hour requirement for the TV is 65 x (4/7) = 37Wh; and for the light you require 8 x (5/7) = 6Wh. Your total daily requirement is thus 43W.
- You only intend to use the system in summer, so you need a panel that is 43/4 = 11W or more.
- Your battery size needs to be (43 x 7 x 2)/12 = 50Ah. And you need a charge controller suitable for a solar input of at least 11/16.5 = 0.7A