Working On Exploring

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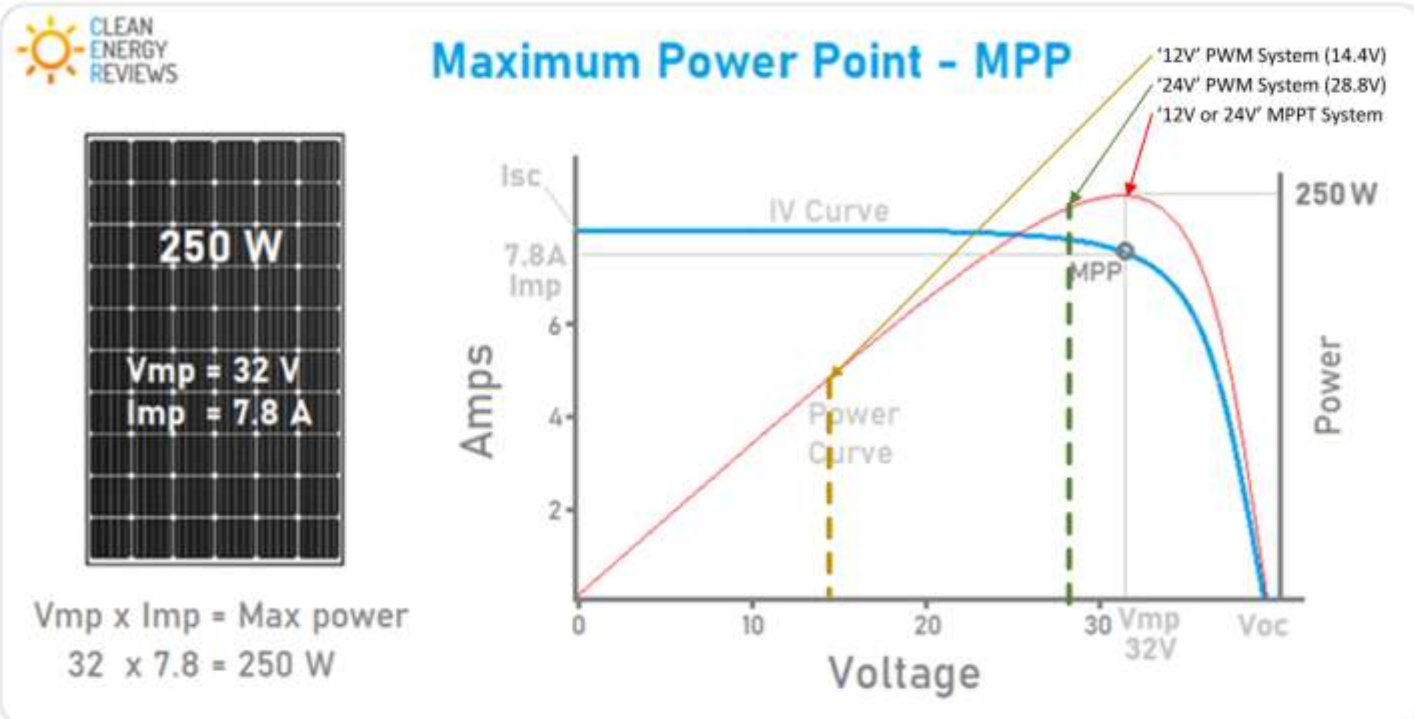
BOONDOCKERS Welcome



Panel Specification

- Voltage at maximum power (Vmp) is the voltage of the panel at its maximum efficiency and rated panel power output, (aka 'power point'). This is useful to know what operating voltage it will produce when under optimal load.
- Current at maximum power (Imp) is the current of the panel at its maximum efficiency and rated power output (aka 'power point'). This is useful to know when calculating wire capacity for connecting panels.
- Open circuit voltage, (Voc) is the voltage the panel delivers when it is receiving illumination of 1kW/sqm and not connected to anything. This is useful when computing the maximum voltage of a panel string in series.
- Short circuit current (Isc) is the current the panel delivers when it is receiving illumination of 1kW/sqm and both panel leads are connected to each other. This is helpful to evaluate the relative health of a panel.

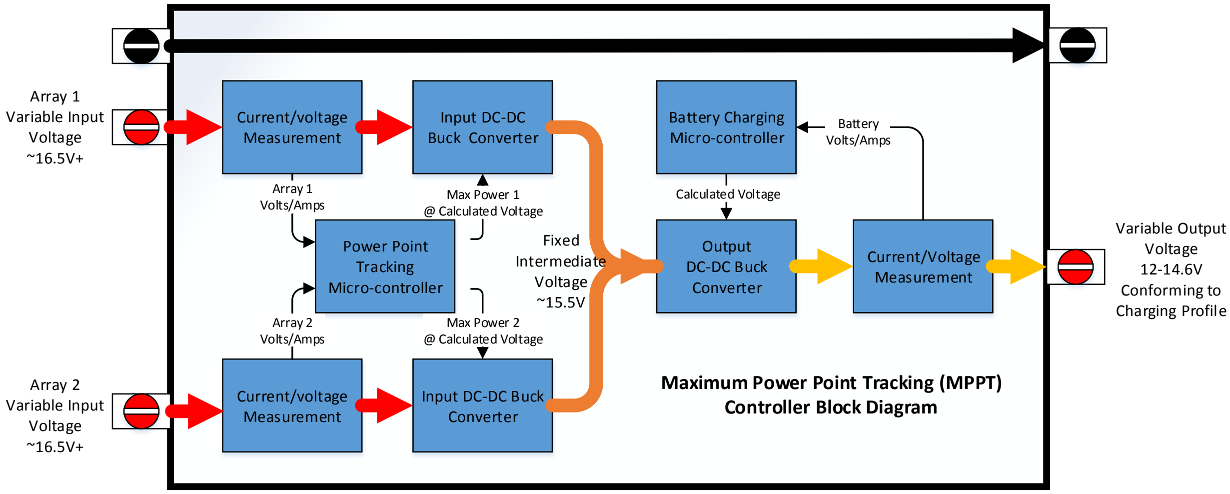
Heat: Adversely affects the performance of a panel. The amount is the difference from Standard Test Conditions (STC)

- Power Temperature Coefficient (Ptc) is % of power/degree centigrade from STC. Typically, power decreases with temperature.
- Mount panels with air space underneath (direct mounted 'flexible' panels will suffer as will the roof structure)
- Tilt panels with slope equal to the latitude of operation. Tilted panels promote natural convection on the backside.

Joining Dissimilar Panels

- Series connected panels must have the same or substantially similar Imp.
- Parallel connected panels must have the same or substantially similar Vmp.
- If neither is true, use a separate charger or dual input charger with arrays of like panels operating separately.

Charge Controller



- The 'right' size the charger is probably slightly below the maximum theoretical capacity (because theoretical performance will be extremely rare if ever). IF your charger is smaller than the maximum theoretical output of your panel array, AND the panels actually reach that peak, they will only do so for a short time. The only negative result is the loss of the small difference between the peak and the charger capacity. It is unlikely to occur anytime other than midday in summertime.
- When series connecting panels, Voc x number of panels = maximum series voltage. This must be less than the Vin(max) of the charger.
- When sizing your charger, take into account the effect of panel tilt. Most RV panels are mounted flat. If so, assume 90% of rated (it will probably be less than that and potentially far less because flat panels get dirty and stay dirty).
- Charger capacity is by amperage of the output to the battery. Output amps x max charge voltage = output power.
- Calculate wire size to the battery by the max charger amperage. Voltage difference between battery and charger is critical because the charge calculation needs accurate battery voltage. Place the charger as close to the batteries as possible.
- Amperage from battery to charger is NOT the same as panel to charger. Calculate wire size from the panels to the charger using Imp x # of parallel panels. Voltage drop between panels and charger is a matter for system efficiency.
- If used, locate over current protection within 7" cable run from *the source of stored energy*. Panels are not a source of stored energy.
- Beware networking MC4 connectors. Most are rated at 20A, (even on 10AWG wire). Only a few are 30A.

Sample System Calculation

A system contains 4-250W panels (using above data) in an array of 2 panels in a serial string, 2 strings in parallel, located 15ft from the charger. The charger is located 3 ft from the battery.

1. Charger minimum input voltage is derived from the maximum array voltage (for two panels in series) = 2 x Voc = 2 x 40V = 80V. Use Voc, not Vmp because when the controller shuts off, each panel puts out Voc. From this we conclude we need a charge controller rated at or above 80V minimum input.
2. Panel to charger cabling is derived from maximum array amperage (occurs from two strings in parallel); Each string = Imp, Two strings = 2 x 7.8A = 15.6A for the array. Use Imp since this is the most it will experience in operation. From this we calculate cable by using ABYC wire ampacity chart using a 3% voltage drop and find that 15.6A in 30ft (total positive and negative cable) = 8AWG. For this, we will need a combiner box since MC4 only supports 10AWG. We chose the 3% voltage drop because of a desire to maintain a higher overall system efficiency. Note; Max current anywhere is 15.6A which is below the 20A limit of the MC4 connectors.
3. Charger size is derived from maximum array power (four panels rated at 250W each); 250W x 4 = 1000W. Charging into an LFP battery system with a 14.6V maximum charging voltage and a 97% efficiency controller, our (theoretical) maximum charge current; a) If these panels were mounted at an angle for maximum productivity; Array output could be 1000W. Therefore; 1000w/14.6V x .97 = 66.4A. In this range, choices are 60A, or 80A. A 10% undersize (60A) is probably acceptable. b) If panels are mounted flat on an RV, they are assessed at 90% of max capacity (likely actually well less). 1000W x .9 /14.6 x .97 = 59.8A. This seems a good fit for a 60A controller. 50A would be a stretch but I'd bet you'd lose little production because flat panels are often dirty.
4. Charger cable size to the battery is derived from the charger capacity; 60A (always use the max charger output, not the capacity of the array), over 6ft (3ft in two cables) at 3% voltage drop (because proper sensing of battery voltage by the charger is important) = 6AWG.
5. Over Current Protection Device (OCPD) at the battery; Since the wire run is so short, it is likely not needed. I would not use one because I assume the cable is in a protected area with all equipment secured, there is little likelihood of wire abrasion finding a ground (especially if the batteries are stored inside the RV which is likely wood). The most likely event would be the controller shorting (unlikely) and if it did happen, it is not likely to support current from an internal short that would cause OCPD to function (semiconductors themselves become fuses). If you want to; The OCPD should be sized for fault (aka short circuit, not overload) which means to use the next size less than 150% = 59.8A x 1.5 = 89.7A. Rounding DOWN (because the OCPD cannot exceed 150%) = 80A.