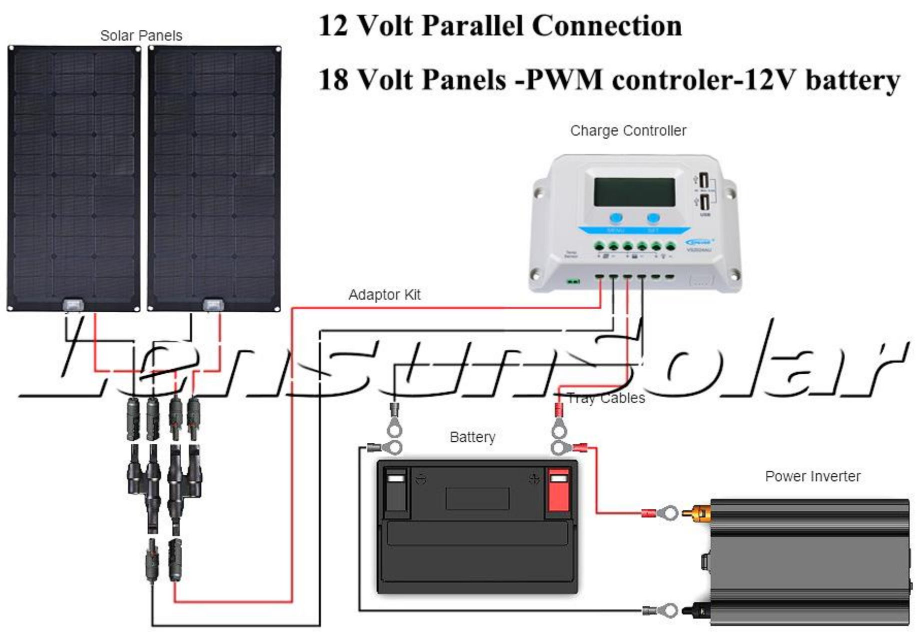
Which type of solar charge controller is the best choice for your solar system? What's the different between a PWM controller and MPPT Controller?

2017-10-12

Solar Charge controller charger or regulator is a device that regulates the voltage and current coming from the Solar panels and going to the battery. It must be added to a solar panel and battery in order to prevent over changing or overvoltage. Most "12 volt" panels put out about 16 – 20 volts, so if there is no regulation, the batteries will be damaged from overcharging. Most batteries need around 13 – 14.5 volts to get fully charged.

The two main types of solar charge controllers are the **PMW** and the **MPPT**. Both technologies are widely used in the off-grid solar industry and are both great options for efficiently charging your battery. But Which type of solar charge controller is the best choice for your solar system? The decision to use PWM or MPPT regulation is not purely based on which power charging method is "better" than the other. Moreover, it involves determining which type of controller will work best in your system's design.

PWM: Pulse-Width Modulation



The PWM controller is in essence a switch that connects a solar panel to a battery. It is often used as one method of float charging. Instead of a steady output from the controller, it sends out a series of short charging pulses to the battery – a very rapid "on-off" switch. The result is that the voltage of the panel will be pulled down to near that of the battery. For example, with a VSS 100-watt panel rated at 18 volts/5.56 amps, you will only get **5.56 amps at 12 volts** or so into the battery. Ohms Law tells us that watts is volts x amps, so your 100 watt panel will only put about 66 watts into the battery.

And the PWM charge controller is a good low-cost solution for small systems only, when solar cell temperature is moderate to high (between 45°C and 75°C).

MPPT: Maximum Power Point Tracking

The MPPT controller is more sophisticated. It will adjust its input voltage to harvest the maximum power from the solar panel and then transform this power to supply the varying voltage requirement, of the battery plus load. Thus, it essentially decouples the panel and battery voltages so that there can be. Since most MPPT controls can take up to **150 volts DC** on the solar panel input side, you can often series two or more of the high voltage panels to reduce wire losses, or to use smaller wire. For example, with the 100 Watt panel mentioned above, 2 of them in series would give you 36 volts at 5.56 amps into the MPPT controller, but the controller would convert that down to about **16.7 amps at 12 volts**.

The resultant twin strengths of an MPPT controller

a) Maximum Power Point Tracking
The MPPT controller will harvest more power from the solar array. The performance advantage is substantial (10% to 40%) when the solar cell temperature is low (below 45°C), or very high (above 75°C), or

when irradiance is very low. At high temperature or low irradiance, the output voltage of the array will drop dramatically. More cells must then be connected in series to make sure that the output voltage of the array exceeds battery voltage by a comfortable margin.

b) Lower cabling cost and/or lower cabling losses
Ohm's law tells us that losses due to cable resistance are Pc (Watt) = Rc x I^2, where Rc is the resistance of the cable. What this formula shows is that for a given cable loss, cable cross sectional area can be reduced by a factor of four when doubling the array voltage.
In the case of a given nominal power, more cells in series will increase the output voltage and reduce the output current of the array (P = V x I, thus, if P doesn't change, then I must decrease when V increases).
As array size increases, cable length will increase. The option to wire more panels in series and thereby decrease the cable cross sectional area with a resultant drop in cost, is a compelling reason to install an MPPT controller as soon as the array power exceeds a few hundred Watts (12 V battery), or several 100s of Watts (24 V or 48 V battery).
To compare PWM and MPPT on the technical level, below you find a comparison table, that takes into account six different aspects: the array voltage, the battery voltage, the system size, the off-grid or grid-tie and the array sizing method.

SUMMARY OF COMPARISON

	PWM Charge Controller	**MPPT Charge Controller**
Array Voltage	PV array & battery voltages should match	PV array voltage can be higher than battery voltage
Battery Voltage	Operates at battery voltage so it performs well in warm temperatures and when the battery is almost full	Operates above battery voltage so it can provide "boost" in cold temperatures and when the battery is low.
System Size	Typically recommended for use in smaller systems where MPPT benefits are minimal	150W – 200W or higher to take advantage of MPPT benefits
Off-Grid or Grid-Tie	Must use off-grid PV modules typically with Vmp 17 to 18 Volts for every 12V nominal battery voltage	Enables the use of lower cost/grid-tie PV Modules helping bring down the overall PV system cost
Array Sizing Method	PV array sized in Amps (based on current produced when PV array is operating at battery voltage)	PV array sized in Watts (based on the Controller Max. Charging Current x Battery Voltage)