Solar Panel Systems

Panels / Controllers / Batteries

Brief discussion on Solar Panel Systems

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Solar Panel Types

- Thin-film
- Polycrystalline
- Monocrystalline

Thin-Film

- Efficiency: Lowest efficiency (~10–12%).
- Appearance: Flexible and lightweight, can be made from various materials like cadmium telluride (CdTe) or amorphous silicon (a-Si).
- Durability: Shorter lifespan and higher degradation rate.
- Cost: Generally the cheapest option.
- Best Use: Ideal for portable applications or on surfaces where traditional rigid panels can’t be installed (e.g., RVs, curved surfaces).

Polycrystalline

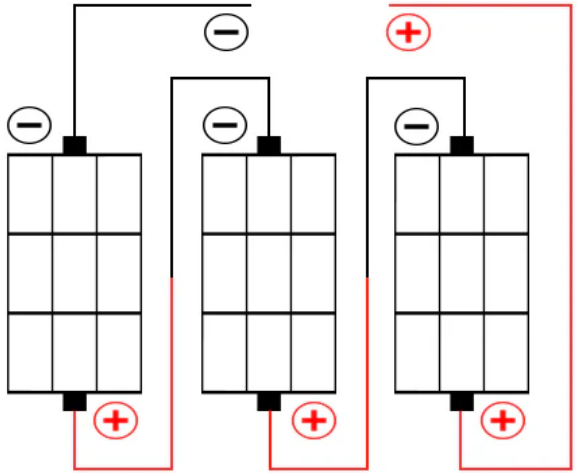
- Efficiency: Moderate efficiency
- Appearance: Blue speckled look, made from multiple silicon crystals.
- Durability: Slightly shorter lifespan than monocrystalline, but still long (~20–25 years)
- Cost: More affordable due to simpler manufacturing process.
- Best Use: Suitable for larger installations where space is not a constraint.

Monocrystalline

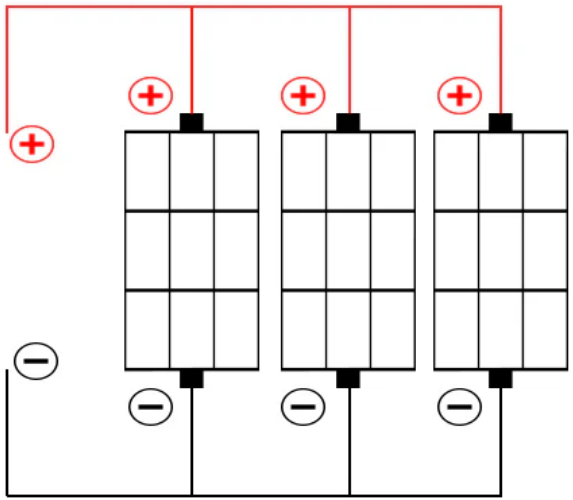
- Efficiency: Highest efficiency
- Appearance: Uniform dark black color, made from a single crystal structure.
- Durability: Longest lifespan (~25+ years).
- Cost: Higher cost due to complex manufacturing process.
- Best Use: Ideal for areas with limited space where maximizing power output is essential.

Panel Connection Types

Quiz Time!!
100W Panels
17V



Series

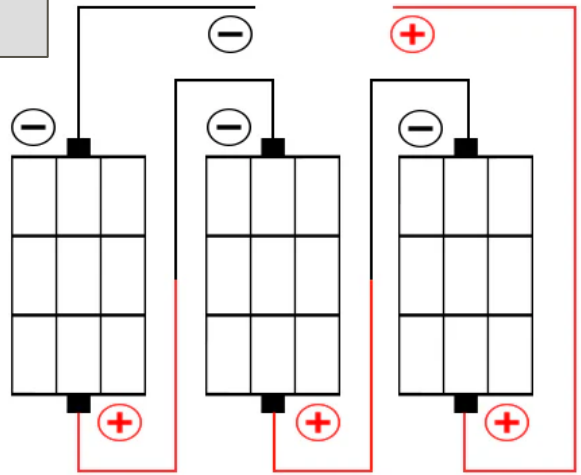


Parallel

Panel Connection Types

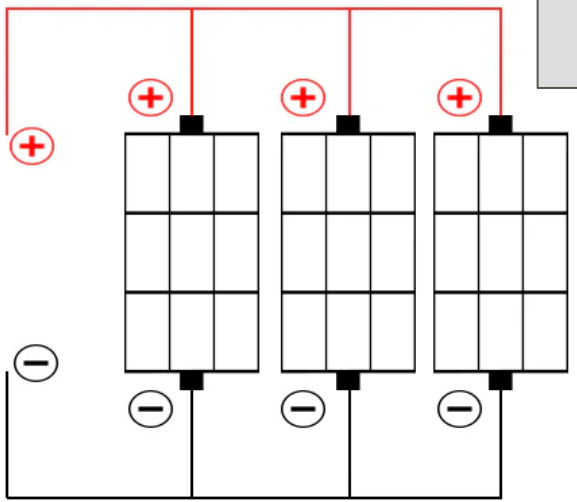
Quiz Time!!
100W Panels
17V

300W
51V
5.8A



Series

100W
17V
17.6A



Parallel

Series Connected Panels

Running more than one panel gives you the ability to run in either series or parallel.

- Panels are connected end-to-end, with the positive terminal of one panel connected to the negative terminal of the next.
- The voltages of all panels are summed, the current remains the same as that of a single panel.
- Best for systems where higher voltage is needed - MPPT Controller

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Charge Controller Types

PWM - Pulse Width Modulation

MPPT - Maximum Power Point Tracking

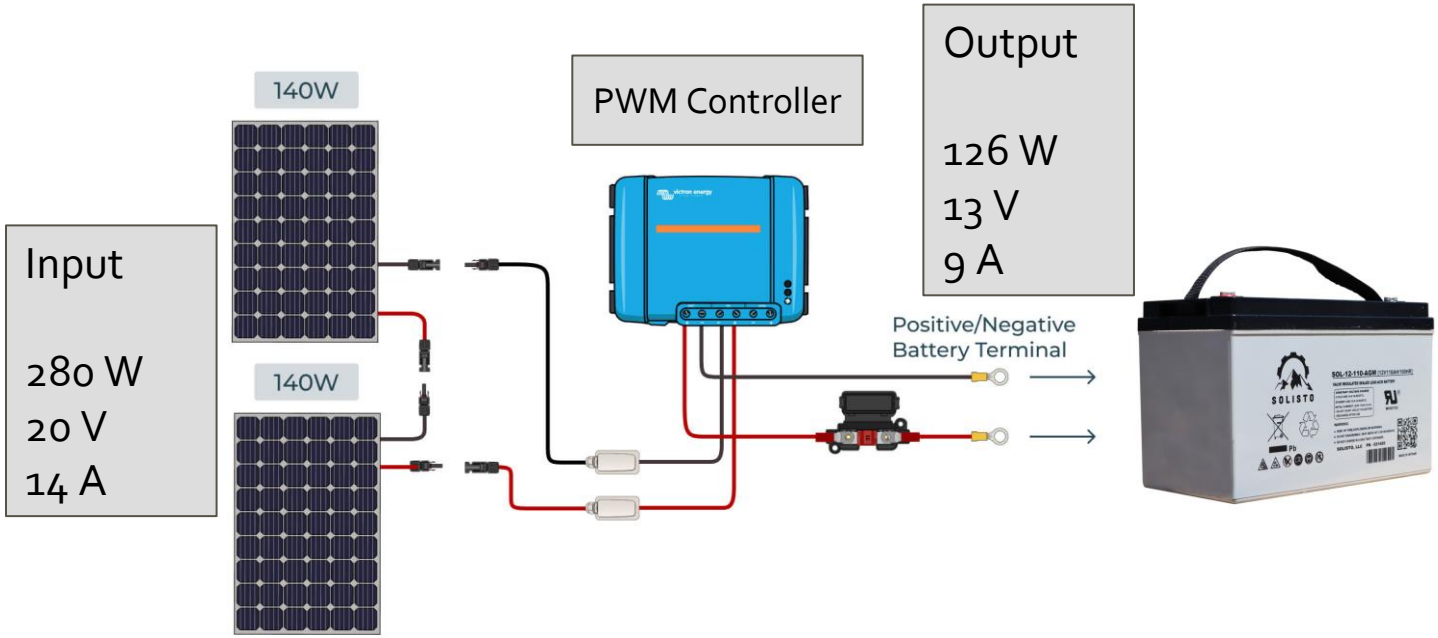
PWM Charge Controllers

- PWM controllers are basic and lower cost than a MPPT. They basically drop the input voltage to the desired setting based on battery type which means less wattage to charge the system.
- This controller is about 75-80% efficient.
- As the battery charges in lowers the current to prevent damaging the batteries and overcharging.

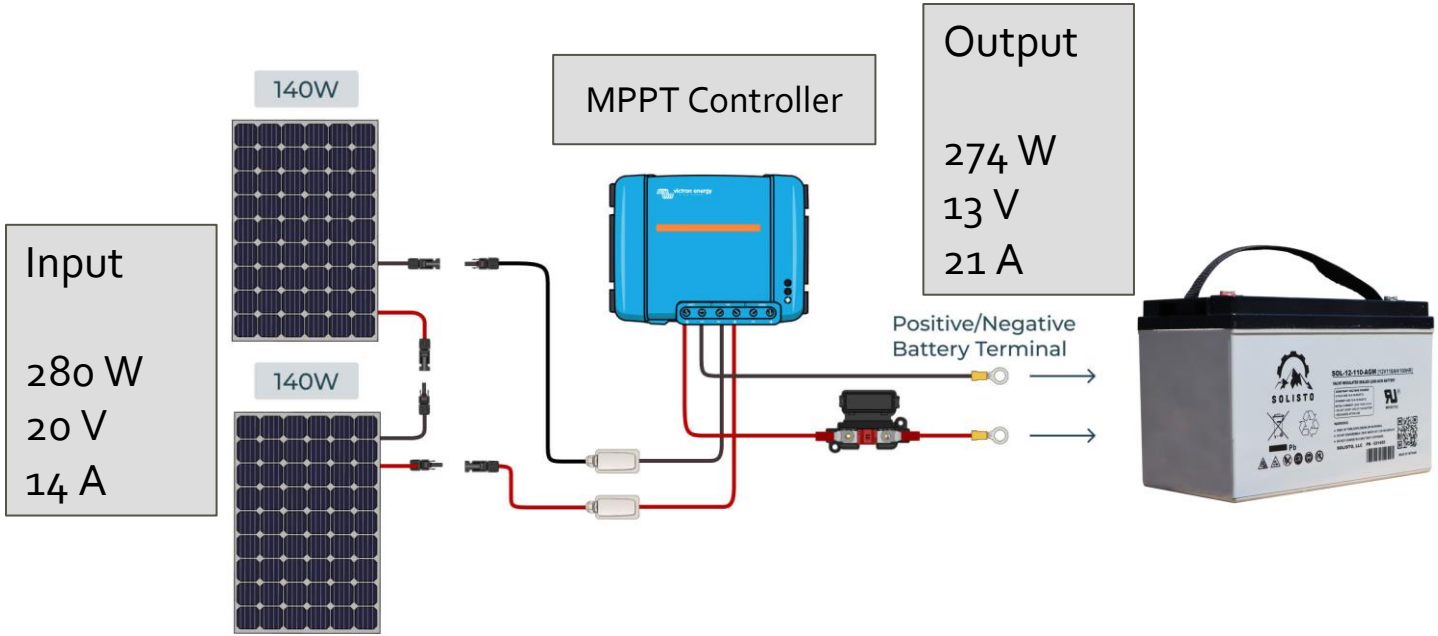
MPPT Charge Controllers

- MPPT controllers are more expensive than PWM. The electronics inside allow to take the incoming voltage (in some cases upwards of 100Vdc) and increase the amperage of the output.
- This controller can be up to 98% efficient.
- Since they can take higher voltages and turn that into increased current it allows you to charge much more efficiently in lower light conditions like cloudy days.

PWM Controller Example



MPPT Controller Example



Battery Types

- Lead Acid
- AGM
- Lithium

Lead Acid Battery

- Least Expensive
- Approx 300 Charge Cycles
- Lifespan 1-2 Years
- Charge Time ~8 Hours
- High Cost over 10 years. 5 Battery Changes

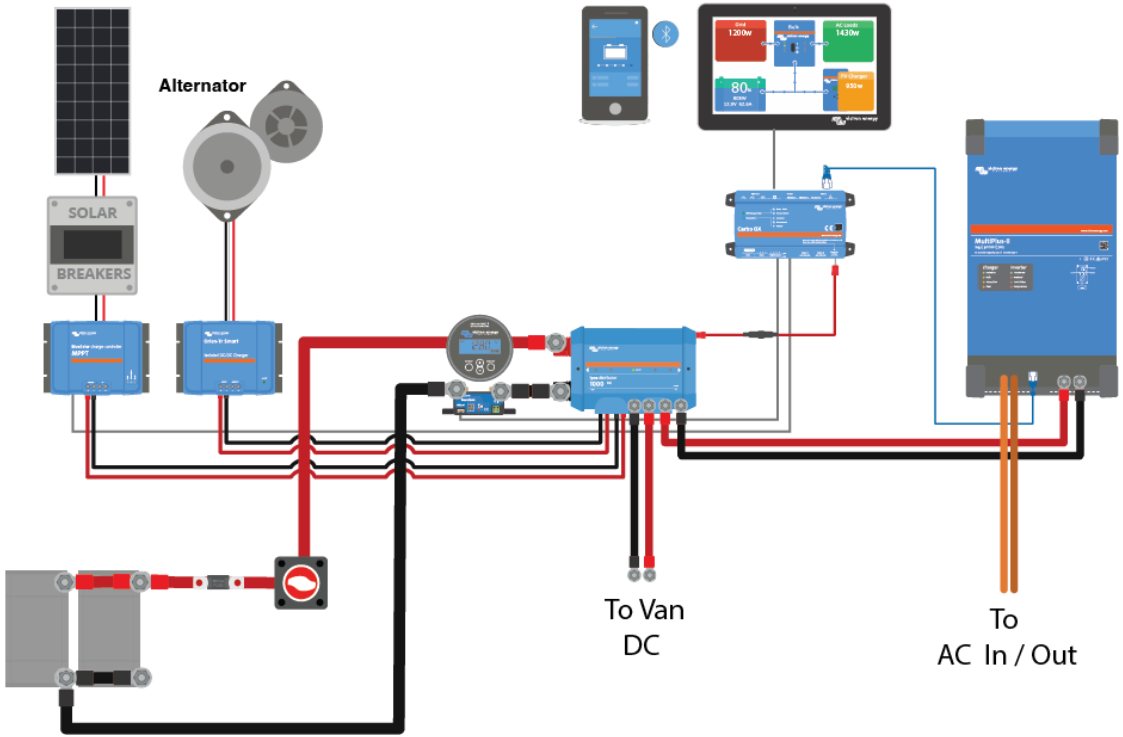
AGM Battery

- Mid-Range Price
- Approx 500 Charge Cycles
- Lifespan 2-3 Years
- Charge Time ~8 Hours
- Medium Cost over 10 years. 3 Battery Changes

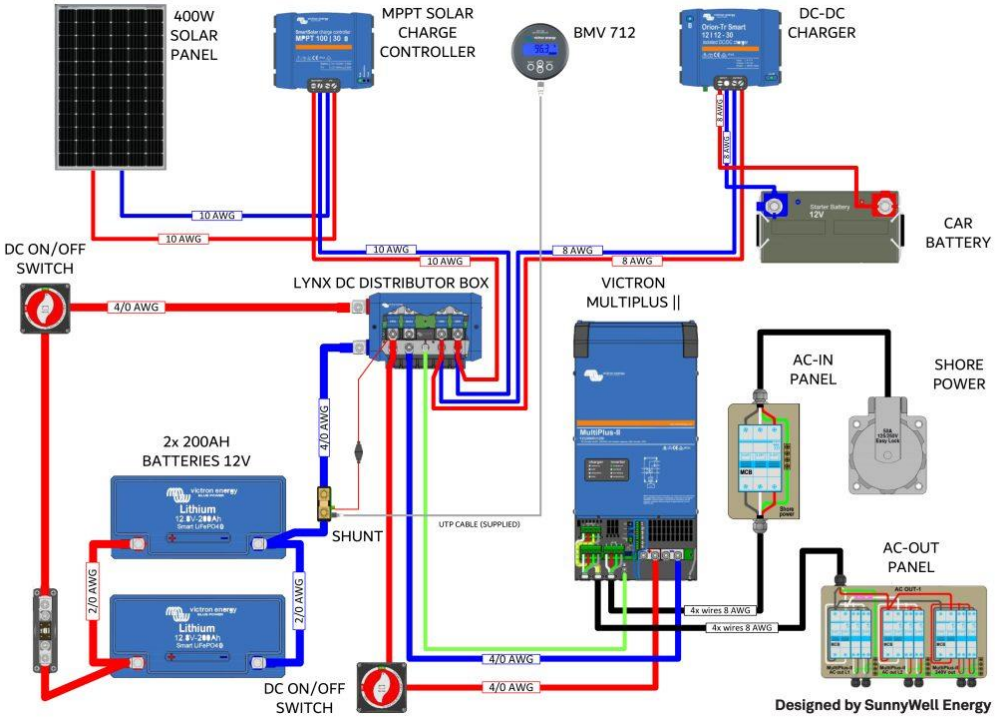
Lithium - LiPo Battery

- Most Expensive
- Over 3000 Charge Cycles
- Lifespan 10+ Years
- Charge Time 3-6 Hours
- Battery will last 10 Years

Simple RV/Camper Van Diagram



Advanced RV/Camper Van Diagram



Recommended Manufacturers

Victron Energy

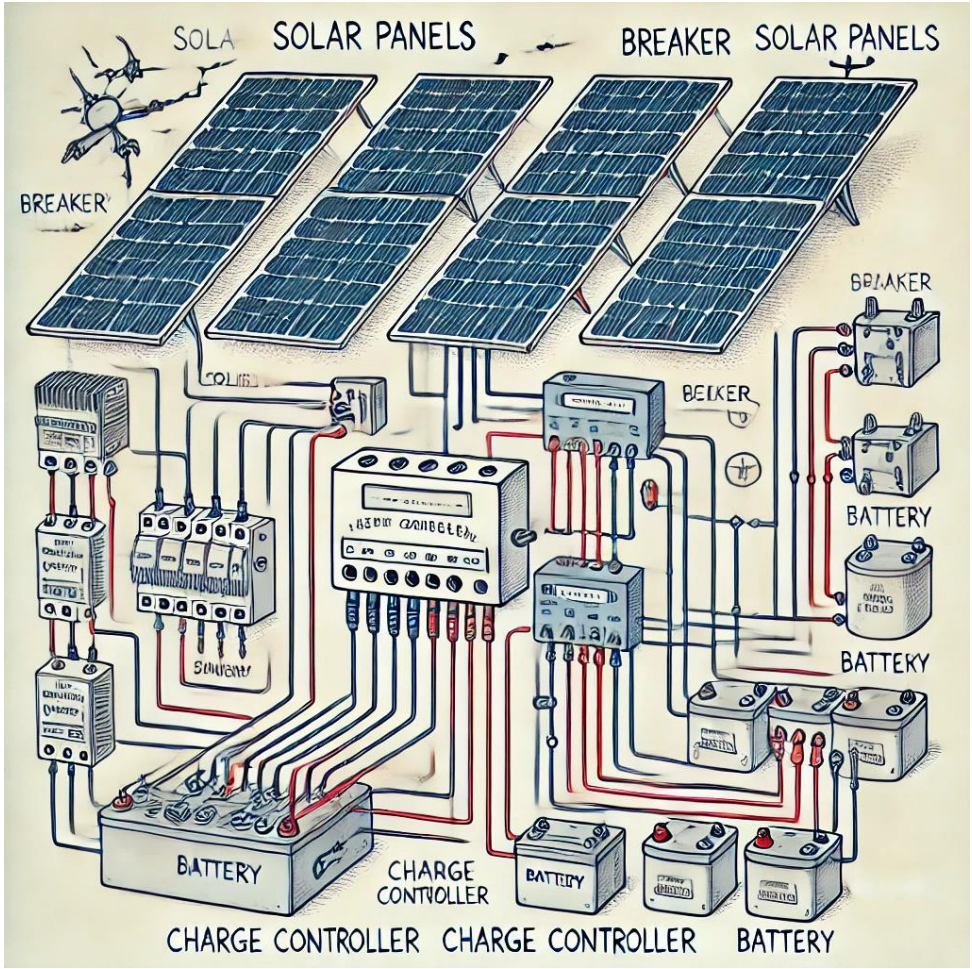
https://www.victronenergy.com/
BlueSolar 30A - PWM 40$
SmartSolar 30A - MPPT 120$

Renogy

https://www.renogy.com/
Wanderer 30A - PWM 35$
Rover Series 20A - MPPT 90$

Outtakes

Here is what ChatGPT generated for a Solar Panel Wiring Diagram


SOLAR PANELS
BREAKER
SOLAR PANELS
BREAKER
BATTERY
BATTERY
BATTERY
CHARGE CONTROLLER
CHARGE CONTROLLER
BATTERY

Questions?

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