Solar for Hams 101

KK4BHS

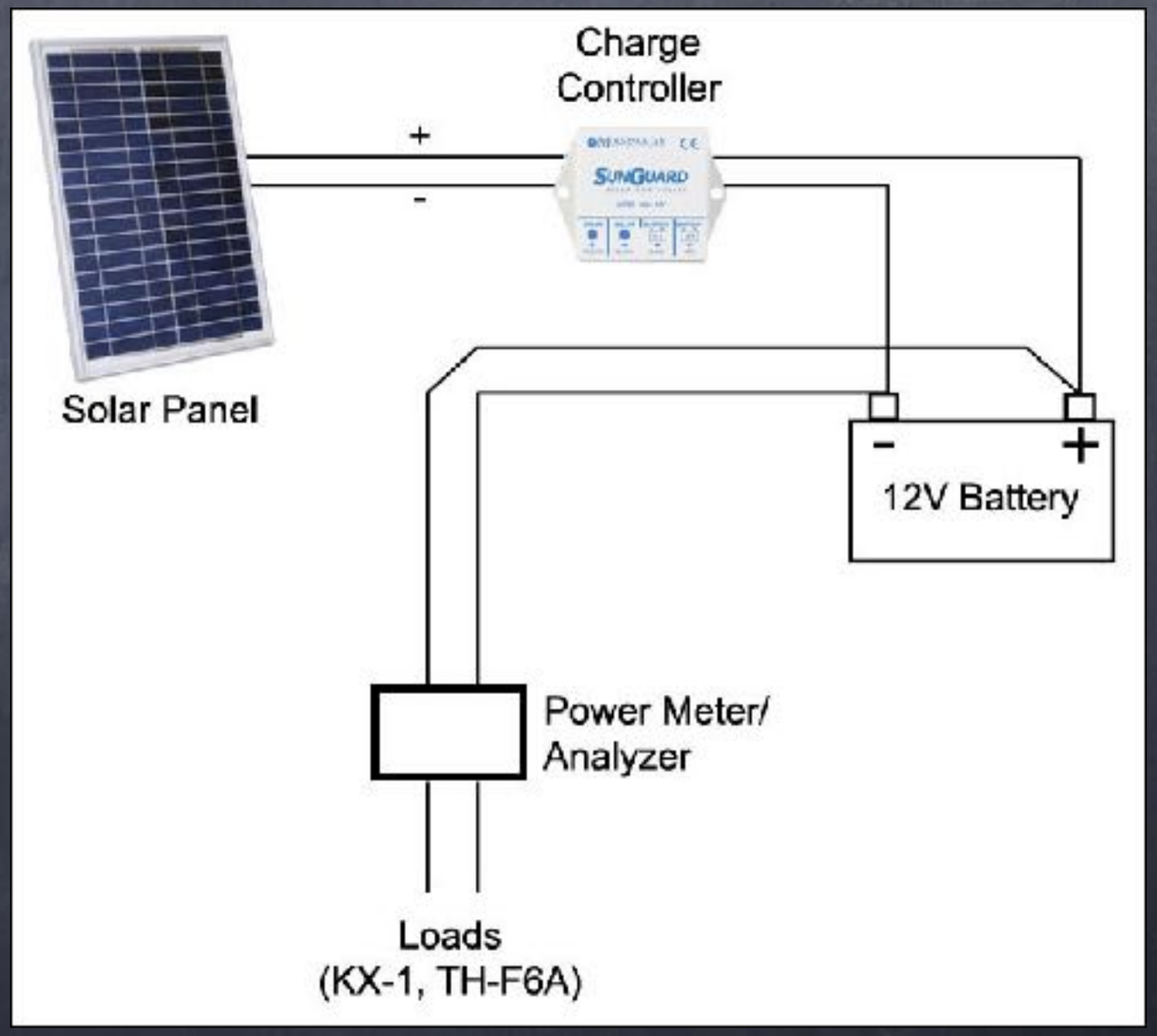
I am not an electrician

Dont try this at home kids. I am not responsible if you burn your ham shack down.


DANGER
DO NOT TOUCH ANYTHING,
TURN ANY KNOBS,
SIT ON ANY EQUIPMENT, ETC
I HAVE LOST SEVERAL VISITORS BY
ELECTROCUTION IN THE PAST SEVERAL WEEKS

Basic Solar Ham Setup

- Solar Panel
- Charge controller
- Battery
- Power meter
- Load / Radio



"Types of Solar Panels"

Since there are many types of panels we will mainly discuss 12 volt panels since that's what our Ham gear runs on.

3 Main Types of Panels

Single Crystalline
Silicon - PV Module

Polycrystalline
Silicon - PV Module

Amorphous Silicon
Thin Film - PV Module

	Monocrystalline modules	Polycrystalline modules	Thin layer modules
Efficiency rate	16 - 20 %	14 - 18 %	6 - 14 %
Low-light behavior	Losses under diffuse lighting	Losses under diffuse lighting	Only low losses
Thermal behavior	Losses at high temperatures	Losses at high temperatures	Only low losses
Costs	More expensive than polycrystalline &Thin layer modules	cheaper than monocrystalline modules	cheaper than monocrystalline & polycrystalline modules
Long-term test	very high performance stable, high durability	High performance, stable high durability	average performance shorter durability
Weight per m^2	Higher	Higher	Lower
Susceptibility to failure	Very low	Very low	low

Types of Charge Controllers

And why do you need them?

- PWM Pulse Width Modulation
- Smaller and typically cheaper
- Can be had for as little as 10 dollars
- Can't handle larger voltages and amperage's
- Usually noisy on hf lots of RF hash

- MPPT Maximum Power Point Tracking
- Larger and typically more expensive
- Can handle much larger voltages and amperage's
- Usually much quieter on hf

Why do I need a charge controller

- They take the much higher 18 volts coming from the solar panel and control it down to something the battery can accept
- They also control if a cloud were to cover the panel or bright sun comes out it works to regulate the power
- They can make sure you don't over charge the battery and can float or trickle charge if need be

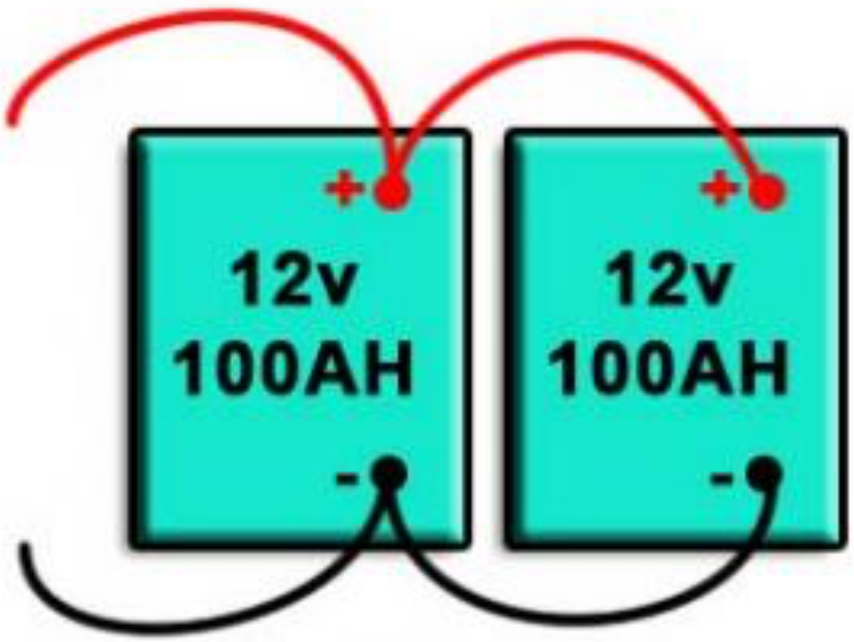
Batteries

And how to hook them up

Batteries In Parallel

Voltage remains the same

AmpHour capacity doubles



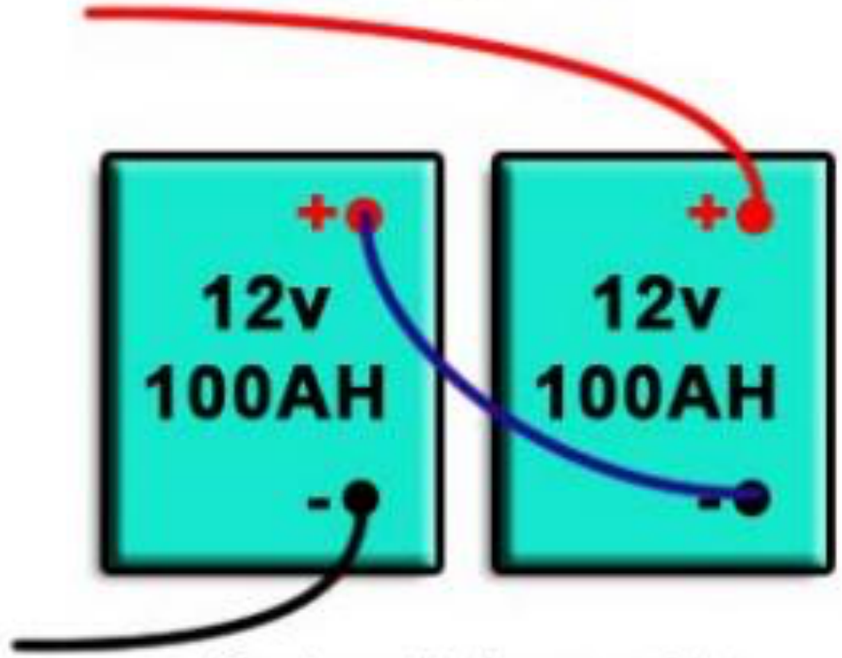
System Voltage = 12v

AmpHour Capacity = 200AH

Batteries In Series

Voltage doubles

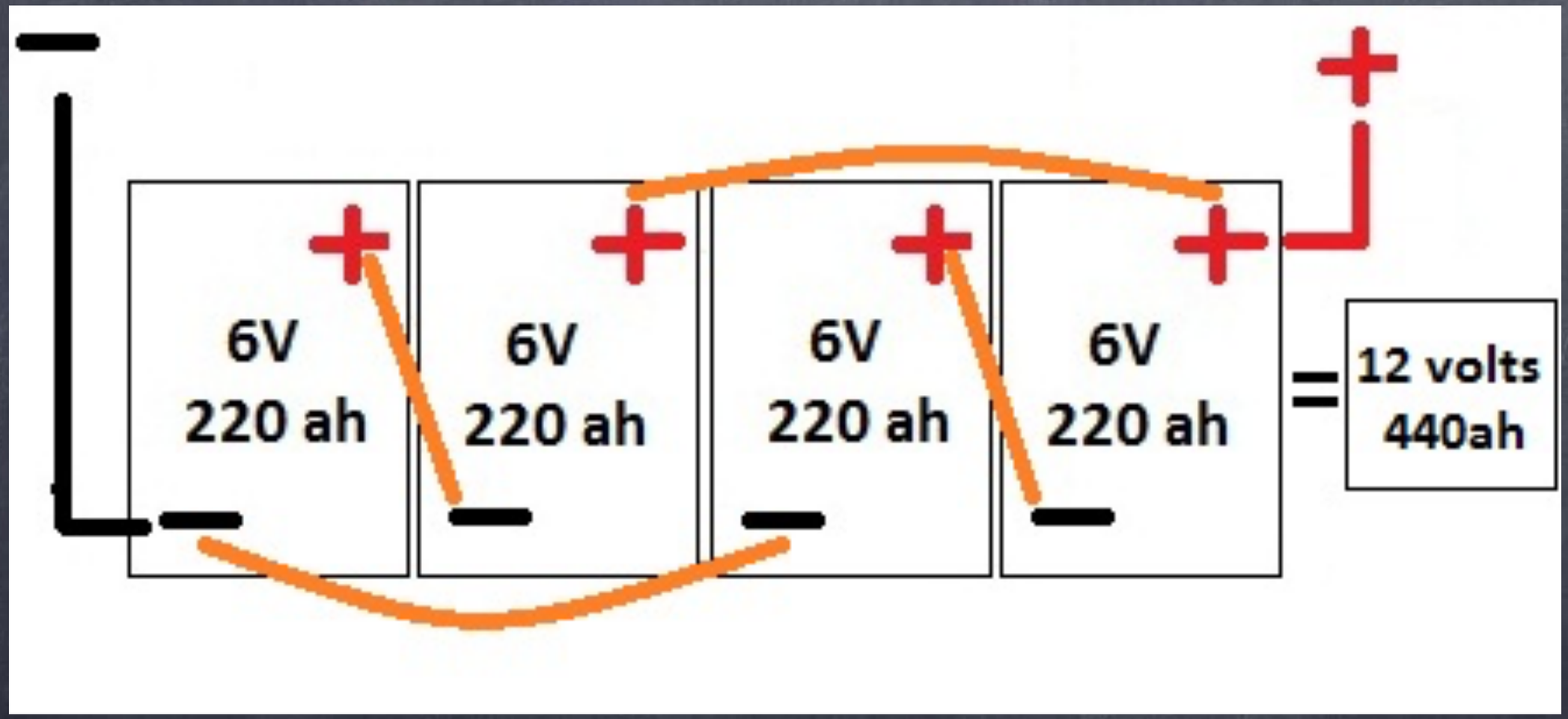
AmpHour capacity stays the same



System Voltage = 24v

AmpHour Capacity = 100AH

- Series Parallel



Things to remember

- Dont mix voltage and amperage of batteries since they wont charge the same causing problems
- There are various chemical components of batteries NiCad Nickel Cadmium, Nickel Metal Hydride, NIMh, Lithium Ion Phosphate LiFePo4, Lead Acid, Nickel Iron Phosphate, and many more. When purchasing a Charge Controller make sure it is capable of charging the chemical make up of battery you are purchasing.

Safety with batteries

- Many battery chemicals are corrosive, poisonous or both. if leakage occurs, either spontaneously or through accident, the chemicals released may be dangerous.
- Make sure nothing metal can fall across both the positive and negative terminals
- Fuse EVERYTHING

How Much Battery Capacity do I Need?

- Radios Current Draw on Receive
- Radios Current Draw on Transmit
- Percentage you will do either
- How long do you intend to operate
- Will I operate any other equipment such as laptops, led lights, fans, etc? These must take into account their amperage usage.

- Lets say 2Ah on receive
- 20 Ah on transmit
- 50% receive 50 % transmit
- 4 hours operation

Since I'm in receive mode half the time, and consume 2Ah on receive, that means I'll consume 1 amp in receive mode per hour.
Since I'm in transmit half the time, and consume 20Ah on transmit, that means I'll consume 10 amps in transmit mode per hour.
My hourly current draw is the sum of those two, or 11 amps.
If I'm going to operate for 4 hours per day then I need 44Ah of capacity.
Expressed as a formula, it looks like this:
((Pr * Ir) + (Pt * It)) * Ho
Pr = Percentage of an hour in receive mode, expressed as a decimal from 0 to 1
Ir = Current draw in receive mode, in amps
Pt = Percentage of an hour in transmit mode, expressed as a decimal from 0 to 1
It = Current draw in transmit mode, in amps
Ho = number of hours of operation
Using our example of 44Ah of needed capacity, let look at batteries. The following chart is from solarnavigator.net:

Battery State of Charge	Battery Voltage
100%	12.7
90%	12.5
80%	12.42
70%	12.32
60%	12.20
50%	12.06
40%	11.9
30%	11.75
20%	11.58
10%	11.31
0%	10.5

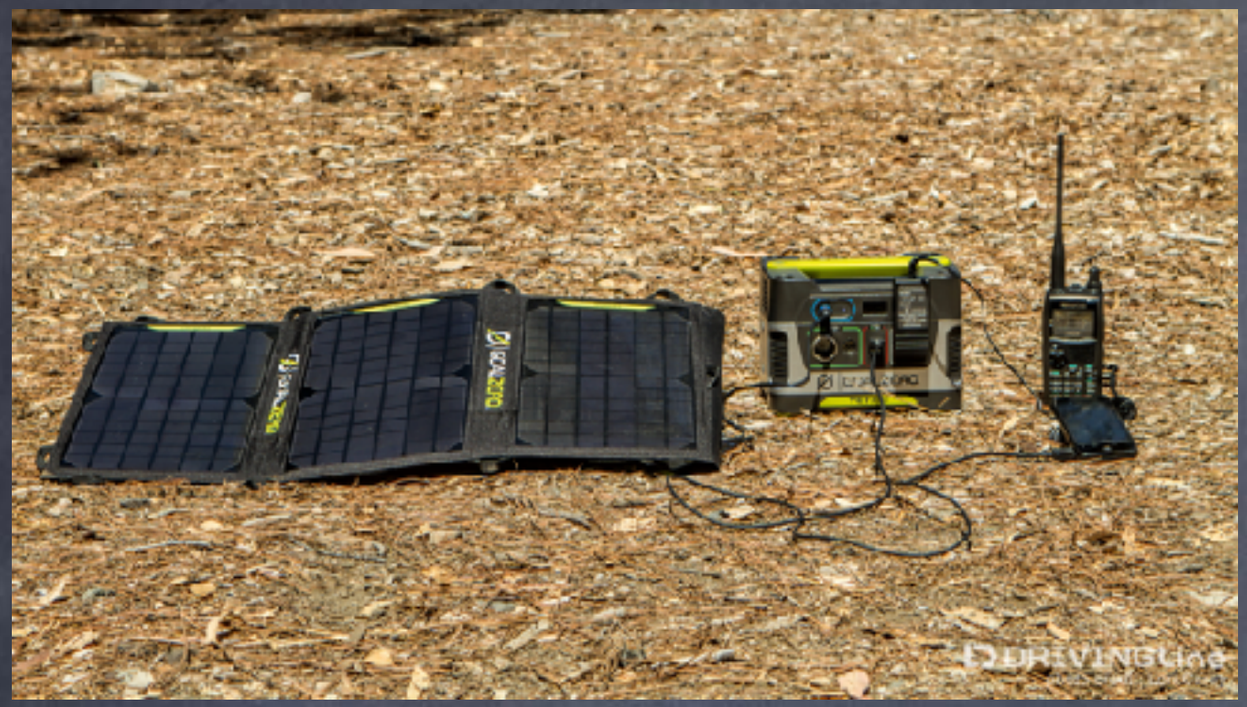
What this chart says is that if your battery's voltage is 12.2V then it contains 60% of its rated capacity. It's important to note however that if you use up 100% of the battery's rated capacity you have killed it, meaning you have drastically shortened its life. In fact, to preserve battery life you never want to get into the yellow zone in the above chart. This means that if it says 20Ah on the side of the battery it really means that you can use only 14.4Ah (the top 60%) without permanently damaging it.

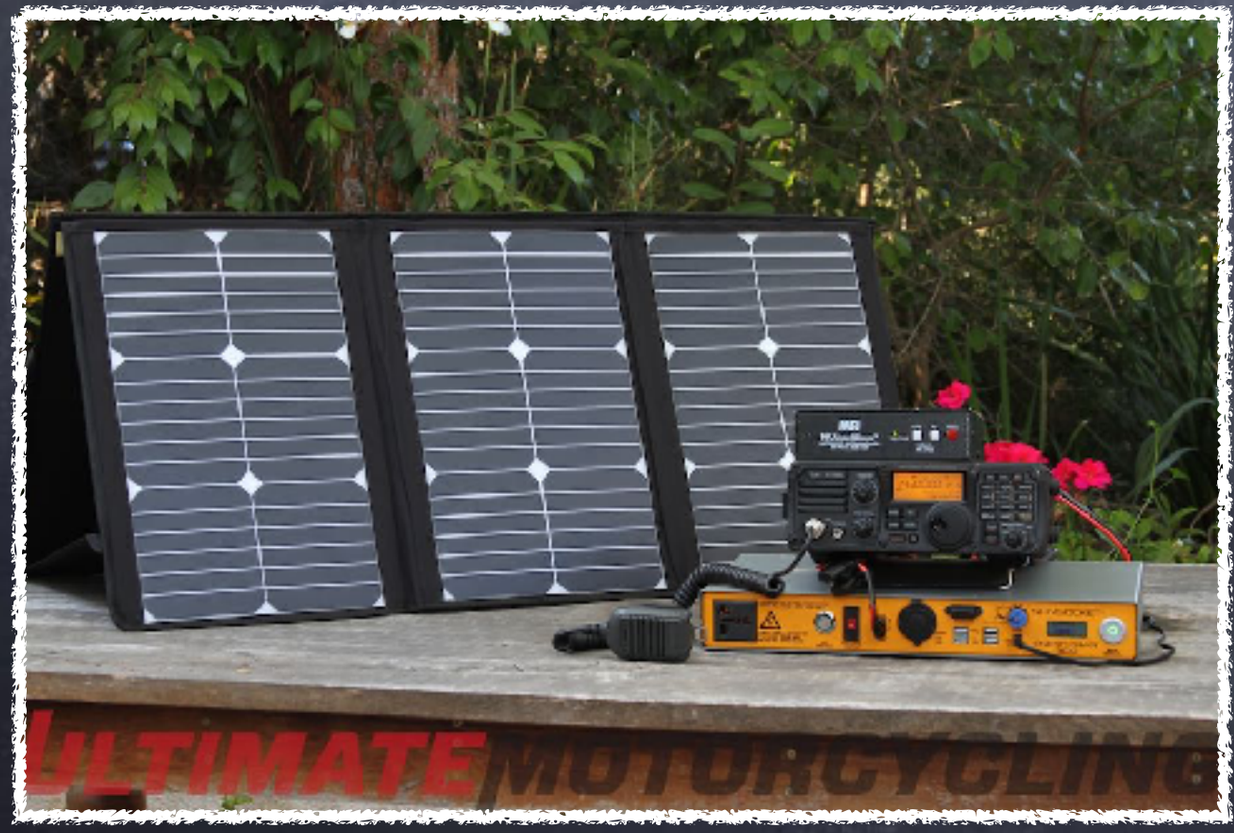
How do I save my battery

Power Meters

Power Meters

- Attach between the battery and your radio to tell you amps, voltage, usage, etc.
- Useful in determining charge of battery and when to shut off radio




ULTIMATE MOTORCYCLING


The End