

MPPT

ECE 4803

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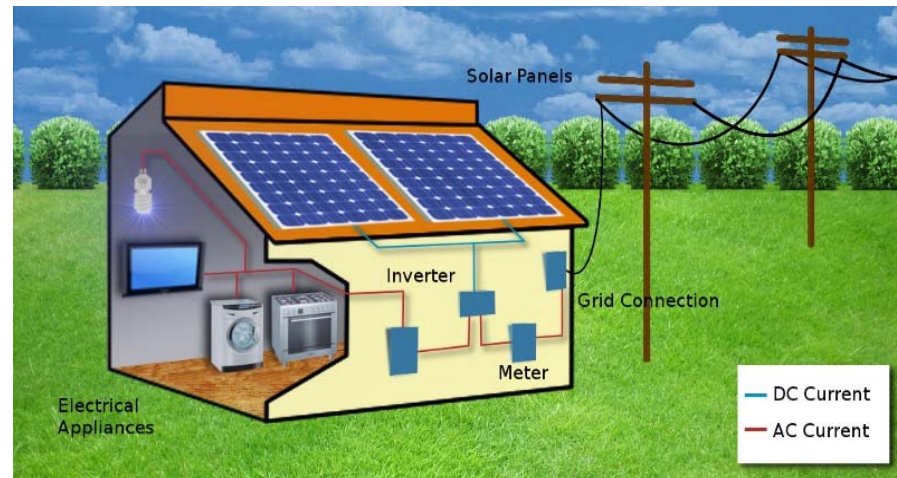
What is it?

- Maximum Power Point Tracker
- Series vs Parallel Solar Cells
- Cell Voltages



Common Uses for MPPT

- Grid connected PV system (usually part of the inverter)
- Battery charger
- Large scale battery arrays for night time use
- Almost always these are used when you need to convert from one energy medium to another



Why do we need this?

- Hypothetical: Suppose you are trying to use a solar array to charge batteries to use for your house later at night.
- What if the battery voltage is lower than your PV array?
- Batteries only care about current. If the charging voltage is over the battery voltage the batteries don't care. (In theory)
- But lets put some numbers to this and find out



Hypothetical

- Your battery array is in parallel and sitting at 12 volts.
- Your PV array is at 46 volts and outputting 12 amps.
- $46V * 12A = 552$ Watts
- But you are only using $12V * 12A = 144$ Watts
- This is an abysmal 26% of what you could be using to charge your batteries
- You are wasting 408 Watts!
- You may as well not even try



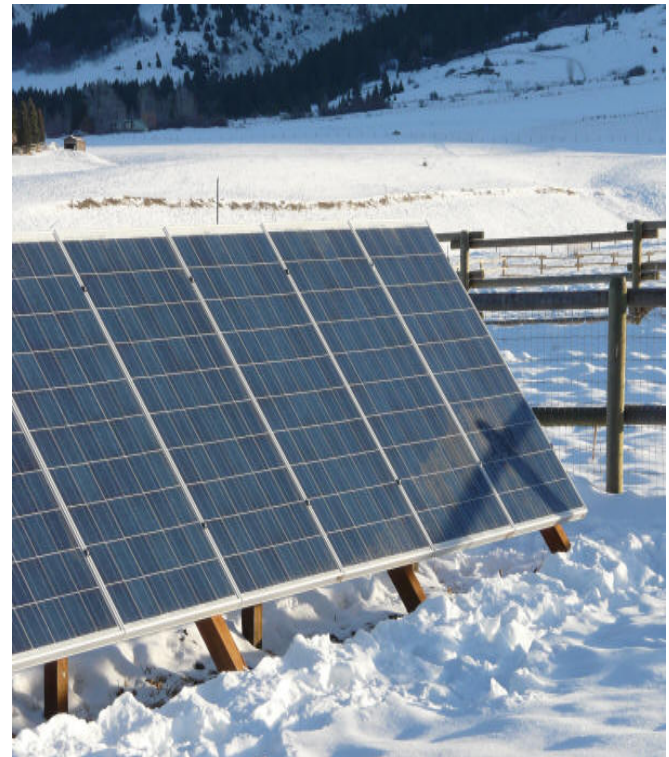
Hypothetical Cont.

- Wasting 408 Watts is bad enough, but what if you are under voltage?
- What if your battery voltage is 370V like the Tesla Model S?
- It is impossible to charge a 370V battery with a 46V source, so no charge will flow at all



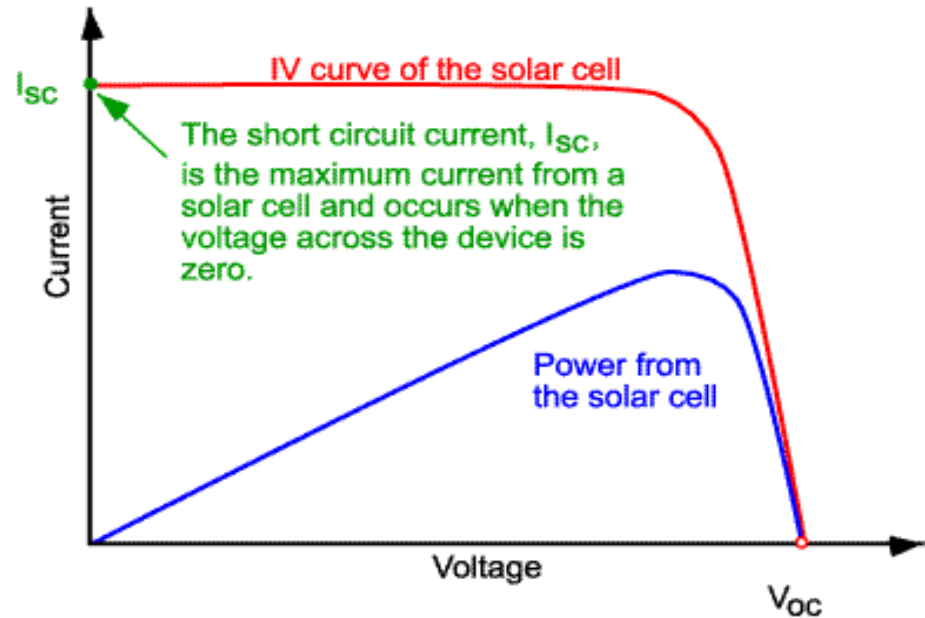
Hypothetical Cont.

- Why don't we just connect the PV system in series to raise its voltage so we can charge anything?
- Raising a cell voltage to 300V levels can be dangerous is there is any shade at all on any part of the array ever!
- Partially shaded array



IV Curve Characteristics

- Current vs Voltage
- Goal is to maximize power



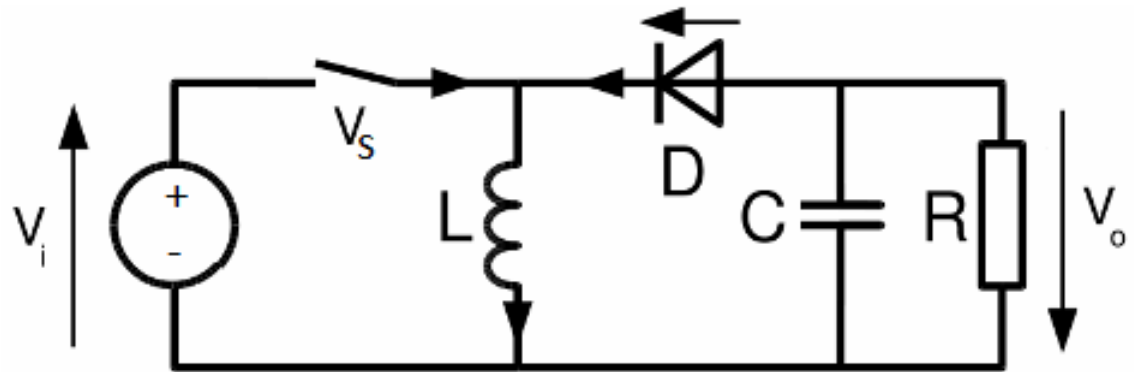
How does it work?

- MPPT works to keep the voltage just above the target voltage and provide the maximum amount of current
- By providing the maximum amount of current the most power is used to charge batteries or provide current to a grid connected system.



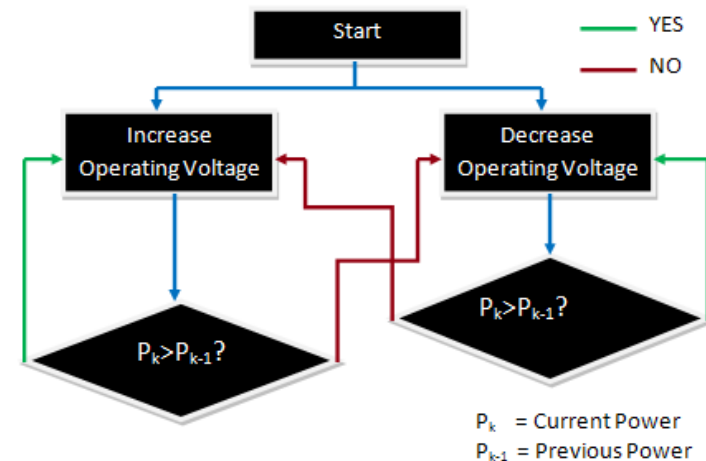
Buck Boost Converter

- In order to keep the voltage just above the target charge voltage a buck boost converter is needed to move the voltage either up or down.



Perturb and Observe

- To control the converter (usually coupled with an inverter for AC power) is a microcontroller
- The MC uses a method called “perturb and observe”
- This method is a Feedback system in which the voltage is varied slightly then the power is measured. If the power goes up, the voltage is again changed in the same direction
- If the power goes down the voltage is changed in the other direction



Types of MPPTs

- MPPTs are not usually standardized and instead are typically made for specific applications.
- There are some “off the shelf” brands that can be bought but most are uniquely built
- This is for reasons of efficiency
- They are fairly complex and not easily built, they require specialized knowledge to get them right.
- Getting them wrong can be disastrous.



Questions?

References

- <http://www.sungreensol.com/index/grid-connected-pv-systems>
- bryanwbuckley.com
- www.builditsolar.com