BASIC ELECTRICITY for PVs

Part One: Volts, Amps, Watts Series and Parallel Wiring

FLOW OF UNIT

- Volts
- Amps
- Watts
- Practice with Definitions and Power Formula
- Voc
- Isc
- Vmax
- Imax
- How to measure Voc and Isc

Volts, Amps, Watts



Courtesy Clay Atcheson

VOLTS

- Difference causes "force"
- Electromotive Force
- Water Analogy: "Pressure"

High Volts or Low Volts?



AMPERE (CURRENT)



Courtesy Clay Atcheson

AMPS

- Current, Flow of Electrical Charges
- Only measurable when circuit is closed (on)
- Water Analogy: GPM, volume

Can we measure Amps? Can we measure Volts?



Can we measure Amps now? <u>How about Volts?</u> How would you measure it?



Demonstration Volts and Amps

Describe this River in terms of Volts and Amps



Compare this same Waterfall in two different seasons in terms of Volts and Amps





Watts: Rate of Power

Watts: Unit of *electrical power*, the rate at which energy is being used or generated.

In Solar PV, the amount of power a module or an array can generate.



Watts is the Product of Volts and Amps

Volts x Amps = Watts

12 volts x 5 amps = 60 watts

Watts is the Product of Volts and Amps

Volts x Amps = Watts

Typical light bulb is 60 watts

120 volts x 0.5 amps = 60 watts 12 volts x 5 amps = 60 watts

PRACTICE

- Write Definitions for Volts, Amps, Watts. Include the Water analogy
- Solve the Power Formula Equations on the White board
- Share (and check) your answers with neighbor

Practice Using Power Formulas

•	2 volts x 2 amps =	watts
•	4 volts x 2 amps = $_$	watts
•	12 volts x 2 amps =	watts
•	12 volts x 10 amps =	watts
•	24 volts x 20 amps $=$	watts
•	500 volts x 10 amps	= watts

Part 2: Series and Parallel Wiring

Imagine the Pressure of One Cylinder of Water



If we double the height of the cylinder you can imagine that the pressure, or force of the water will double



In similar fashion when we double the battery in series, the voltage, or force of the circuit will double



In series wiring we wire the positive of one of the power sources to the negative terminal of the other power source. E.g. two batteries into a flashlight



In series wiring Volts add up and amps stay constant



Do Lab #2

The same holds true for wiring Solar Modules in Series



Four 0.5 volt modules in series will produce 4 x 0.5 volts = 2 volts The amperage will stay the same

The same holds true for wiring full-sized Solar Modules in Series



Four 36 volt modules in series will produce 4 x 36 volts = 144 volts The amperage will stay the same

Two Solar Modules wired In Series





Parallel Wiring

• In parallel wiring, we connect the positive lead of one source to the positive lead of a second power source. In parallel wiring, the voltage stays the same, but the amps add up.

Two Solar Modules wired in Parallel



Wiring Solar Modules in Parallel. Well, in systems you will sell, it won't be individual modules in prallel, rather series strings that are parallells together.



Now Go To Lab : Series and Parallel Wiring