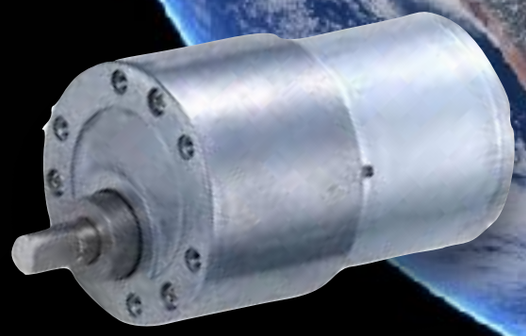
Feddersen
Energy NYU/ITP

How do we connect these levels?

10 W



Feddersen
Energy NYU/ITP

TW GW MW kW W

18,000,000,000,000 W

18TW

Feddersen
Energy NYU/ITP

TW GW MW kW W

18,000,000,000,000

(1.21 GW)

18TW

Feddersen
Energy NYU/ITP

WAIT – WHAT'S A WATT?

EVERYTHING WE NEED TO KNOW ABOUT ELECTRICITY TODAY

CURRENT

Current is easy! How many electrons flow past a point? Which direction? (steady in one direction ‘direct’ or ‘alternating’)

Label for current is “I”, unit is Amps (A, or mA, etc)

VOLTAGE

Voltage is a little harder - it measures the potential between two points for current to flow. Unit is Volts (V). Analogous with pressure.

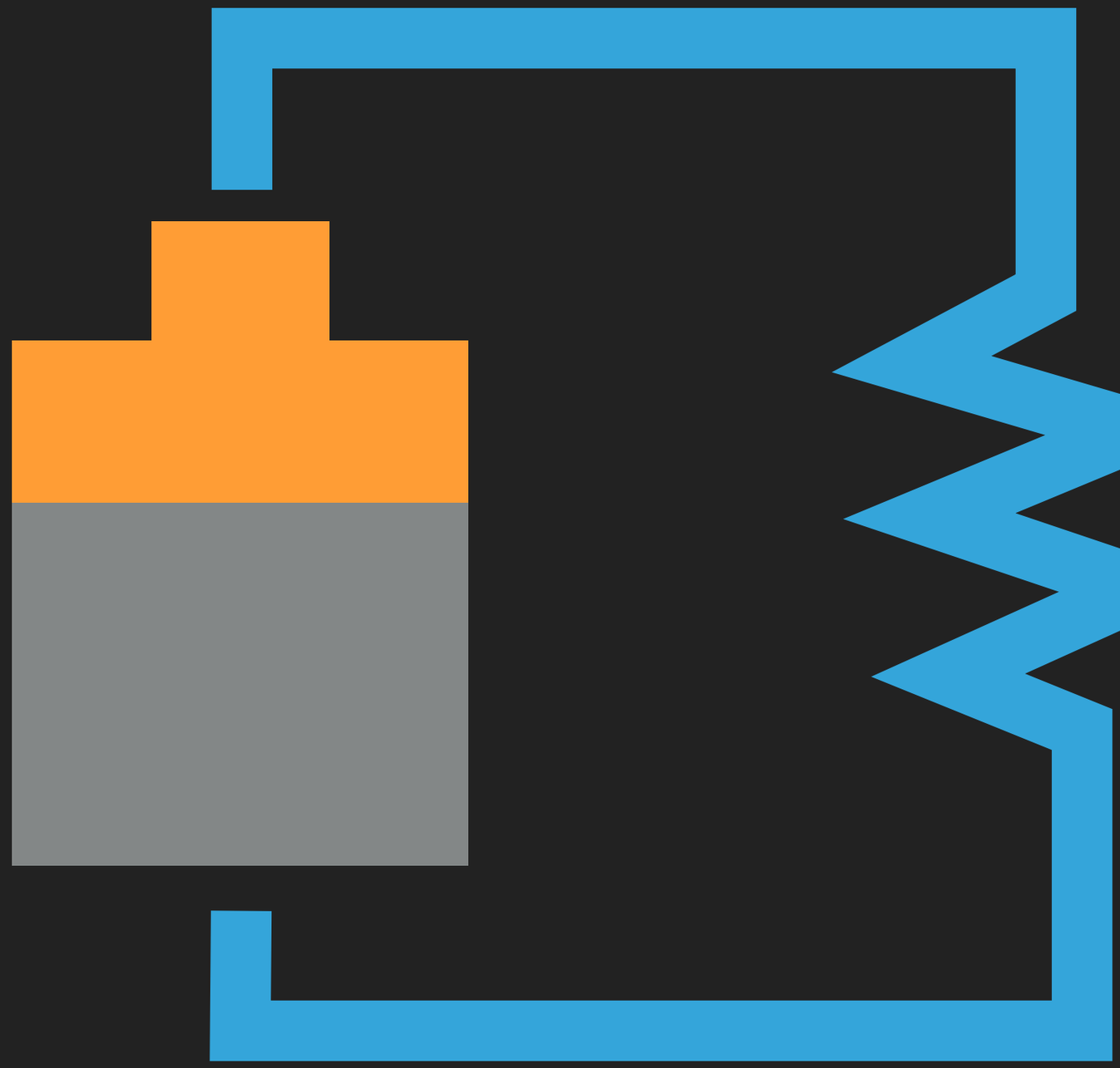
How much current flows between two points depends on the path between them.

POWER

Electrical power (in Watts) is the product of Volts x Amps.

EVERYTHING WE NEED TO KNOW ABOUT ELECTRICITY TODAY

Voltage potential exists between two points, like the ends of a battery



Current will flow depending on the path between the points

Power = Volts x Amps

W = V x I

1 Volt * 1 Amp

1 Watt

OK – WATTS MEASURE POWER, BUT WHAT ABOUT ENERGY?

POWER IS THE RATE AT WHICH ENERGY IS ‘USED*’

POWER = ENERGY / TIME

AND

ENERGY = POWER x TIME

*Transferred or converted, but not consumed. Energy isn’t created or destroyed, but changed

A FEW UNITS OF ENERGY:

- Joule (the SI Unit)
- watt-hour, kilowatt-hour, etc
- BTU, Quad, TOE
- Erg, Electronvolt
- etc. etc. etc…

1 Volt * 1 Amp

1 Watt

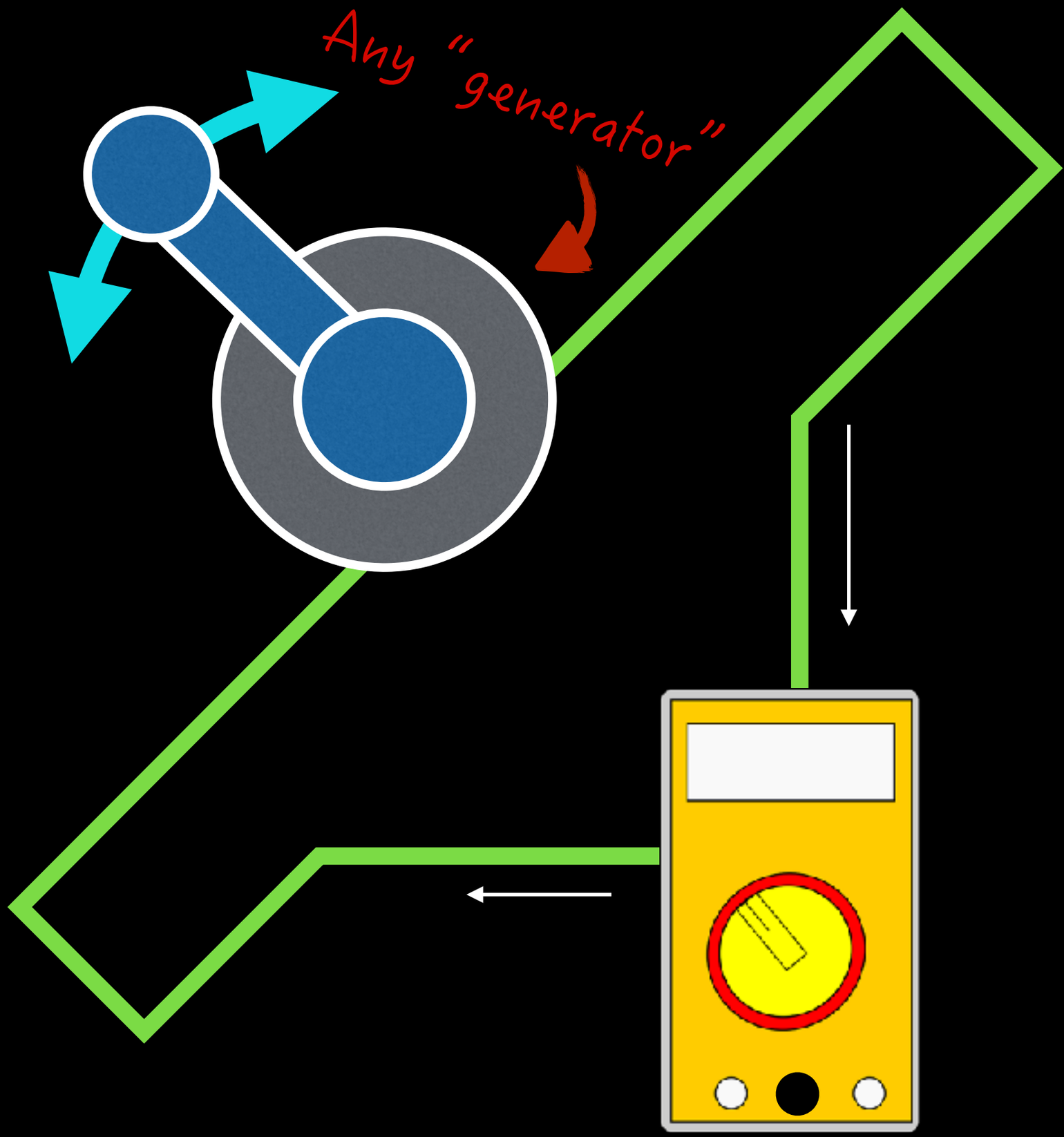
Rate

1 Joule / second

SI Energy Unit!

Time

What this means: We have a way to measure things with our multimeters that share units with every energy phenomenon in the universe



1W (electric) =
1V * 1A

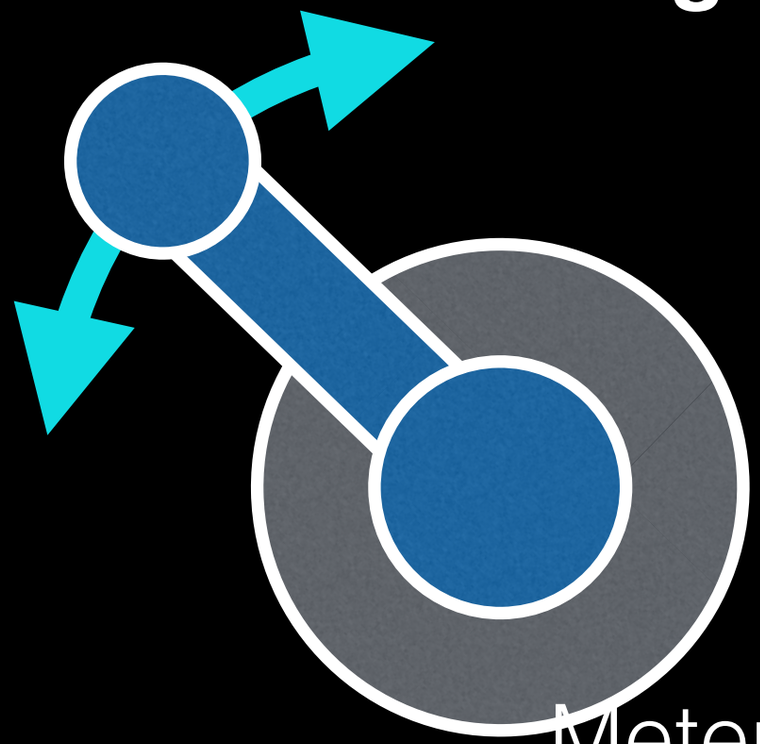
Easily
We can measure

Open Circuit Voltage

and

Short Circuit Current

Open Circuit Voltage (OCV)



Meter on **DC Volts**

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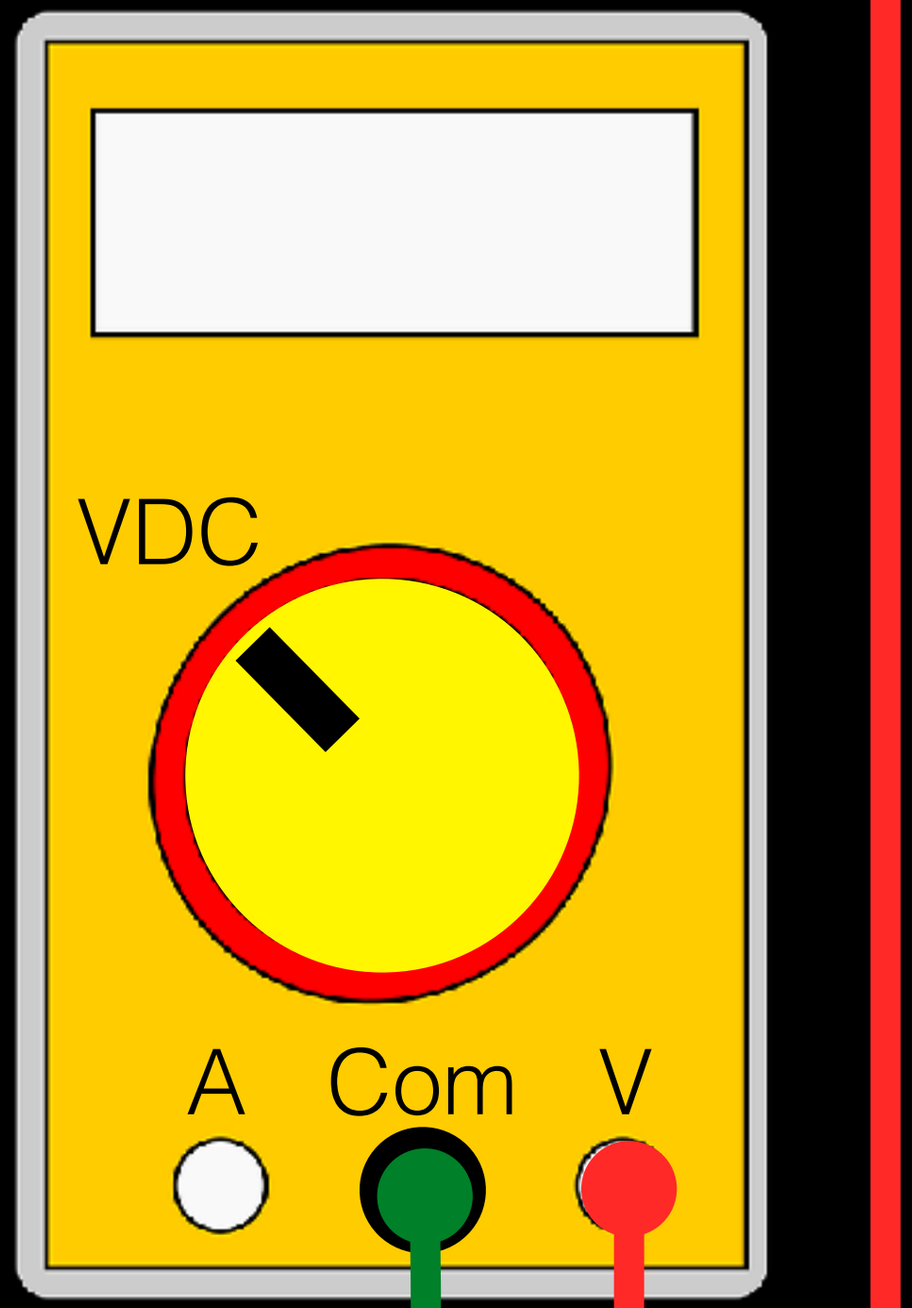
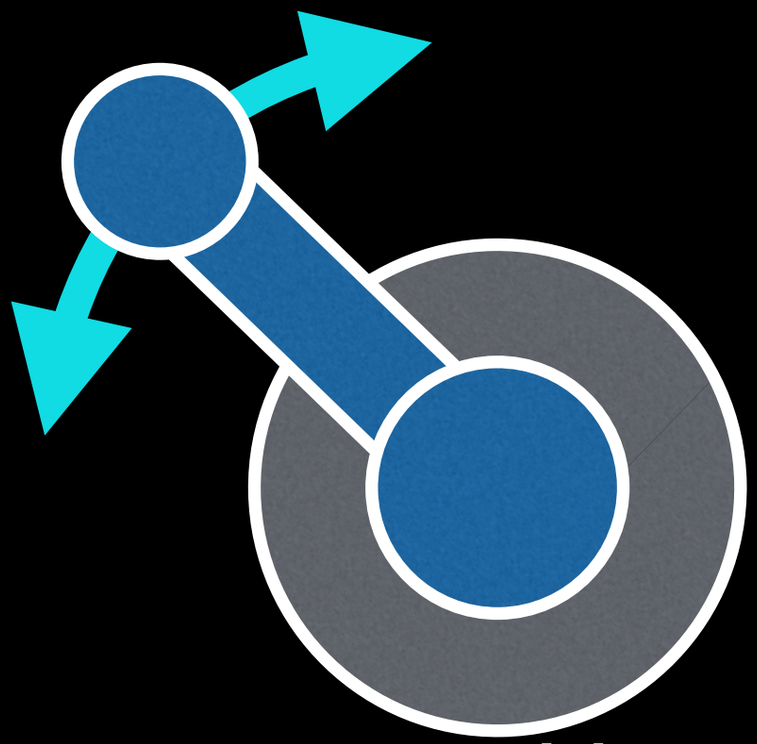
Reading shows
panel voltage with
No Load
and thus the highest
voltage the device will
produce



Short Circuit Current (SCC)



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Meter on **DC Amps**

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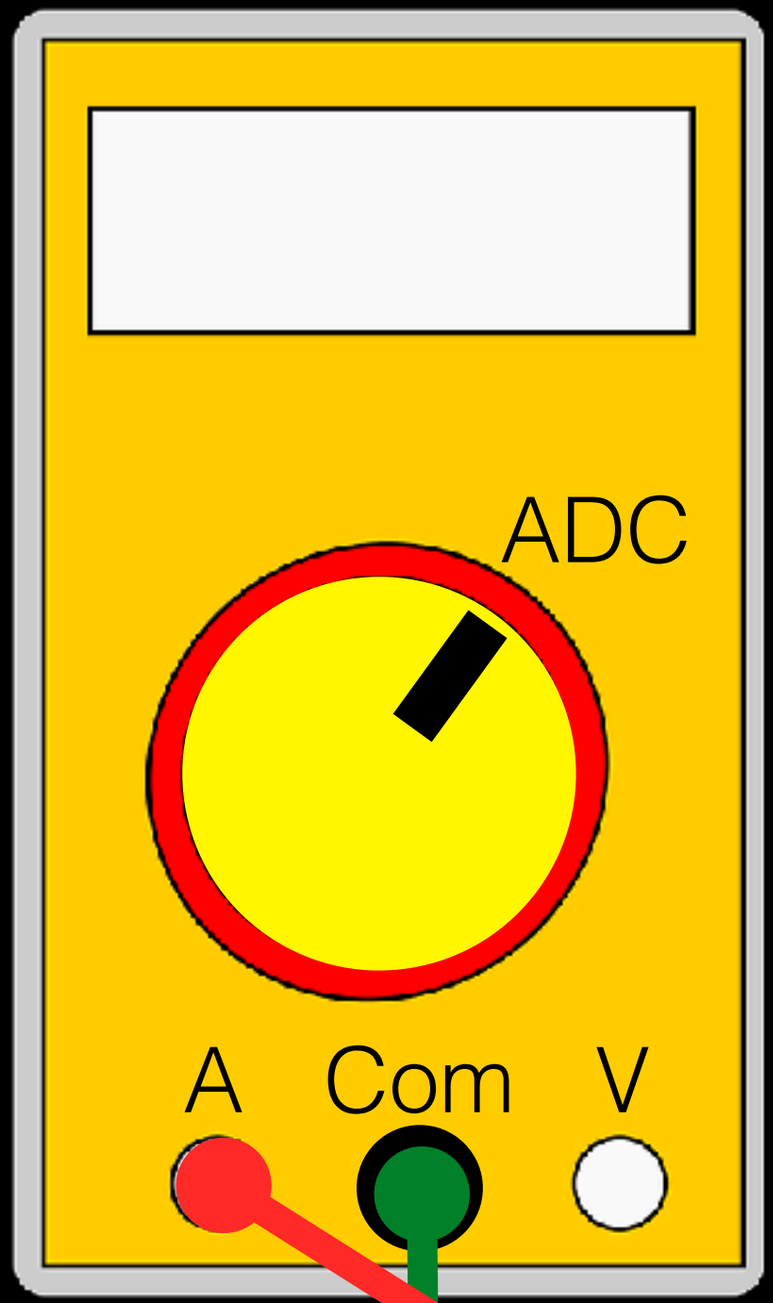
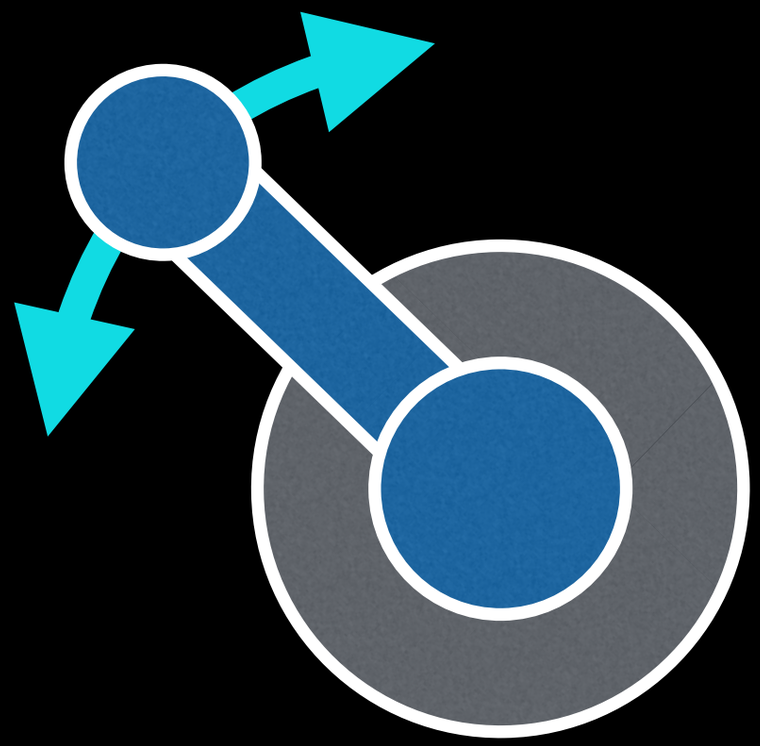
Reading shows current through no resistance **(short circuit)** and thus the highest current the device will produce





An open circuit and short circuit can’t occur at the same time - in real world applications we’d see voltages and currents below these limits.

However, we can use SCC and OCV to calculate an approximate **upper limit** for electrical power we could convert from our generator.

Power < SCC * OCV

Hands-on activity: Find magnets and coils and try to measure OCV and SCC

If small DC motor: Challenge is spinning fast enough, long enough, to measure. Improvise a mechanism (e.g. pull-cord wound around motor shaft), try using scope for voltage measurements.

If DC gearmotor: Gearbox solves issue above, so this is the easiest. Create handle for shaft

If stepper motor: Output is AC. Measure with Meter set to AC Volts and AC current if it has that. Add rectification circuit (4 diodes)