



**Asia-Pacific
Economic Cooperation**

Rooftop Solar PV System Designers and Installers

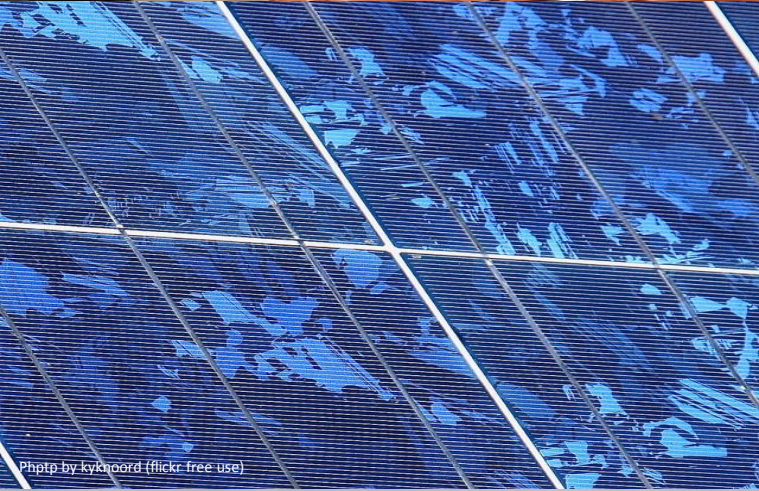
Training Curriculum

APEC Secretariat

March 2015



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Basics of Electricity

Training of PV Designer and Installer



**Asia-Pacific
Economic Cooperation**



**International Copper
Association**
Copper Alliance



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Contents

A. Basic terminology

B. Electricity



A. Basic terminology

- **Source**

Any source of electrical energy, example: a battery, an electrical generator, or some sort of electronic power supply

- **Load**

Any device or circuit powered by electricity. It can be a light bulb or as complex as a modern high-speed computer

- **Electricity**

The flow of charged particles

- **Direct Current**

An electrical current that travels in one direction

- **Alternating Current**

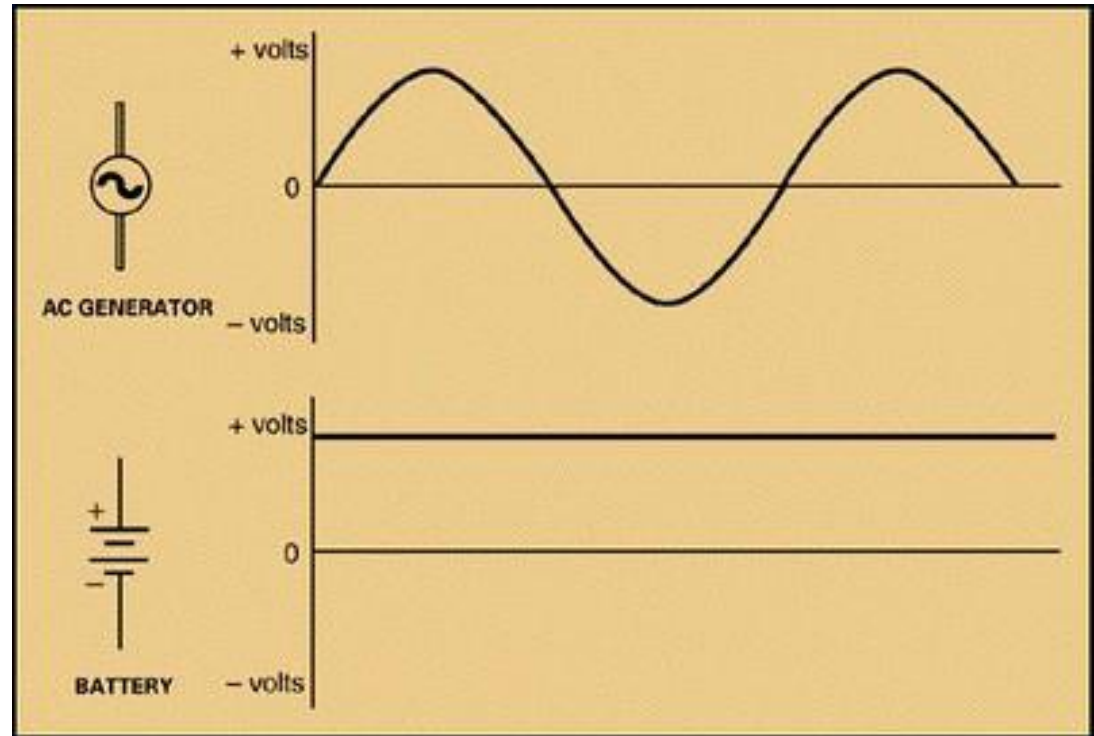
An electrical current that periodically reverses direction. Its direction is reversed 60 times per second.



B. Electricity

A.C. Alternating Current

D.C. Direct Current



The Electrical Components of Ohm's Law

Voltage

Also known as electromotive force (emf).

It is measured in volts (V)

Power

The amount of current times the voltage.

It is measured in wattage or watts (W)

Resistance

That characteristic which opposes the flow of electrical current through itself.

It is measured in ohms (Ω)

Current

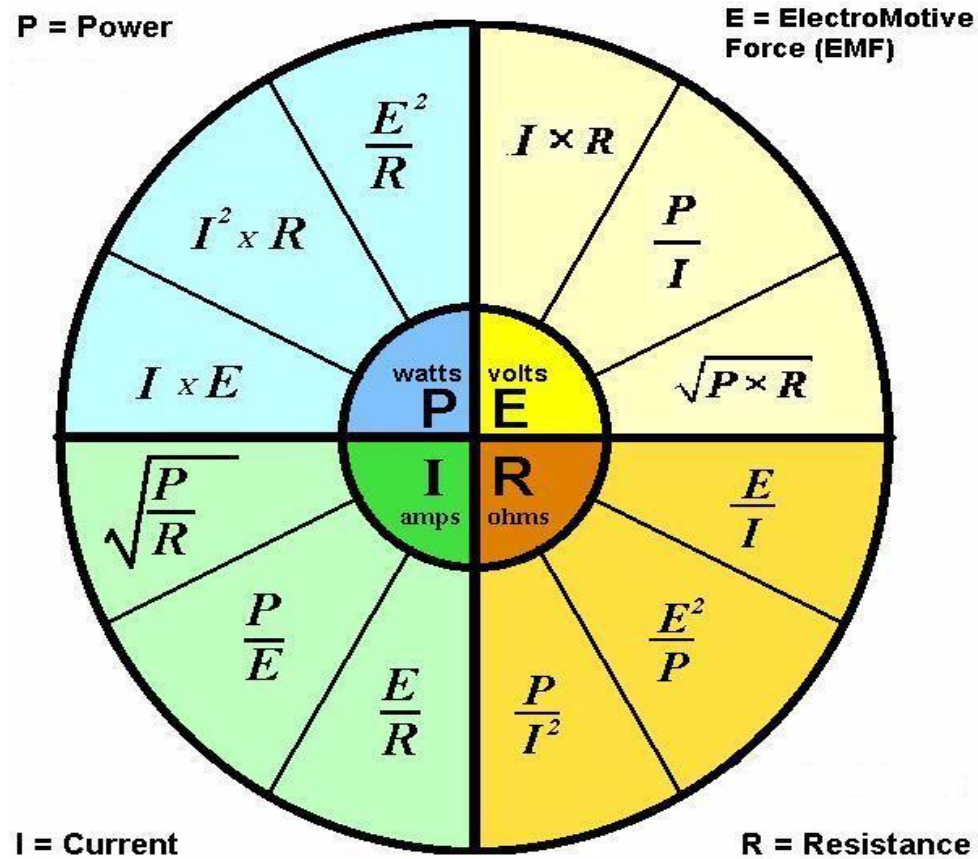
The amount of electrical charge moving past a given point in an electrical circuit per unit of time.

It is measured in amperes (A)



B. Electricity

Ohm's Law formula wheel



Kirchoff's Laws

Kirchoff's Voltage Law (KVL)

- The sum of voltages around each loop is zero
- Σ voltage drops - Σ voltage rises = 0
- Or Σ voltage drops = Σ voltage rises

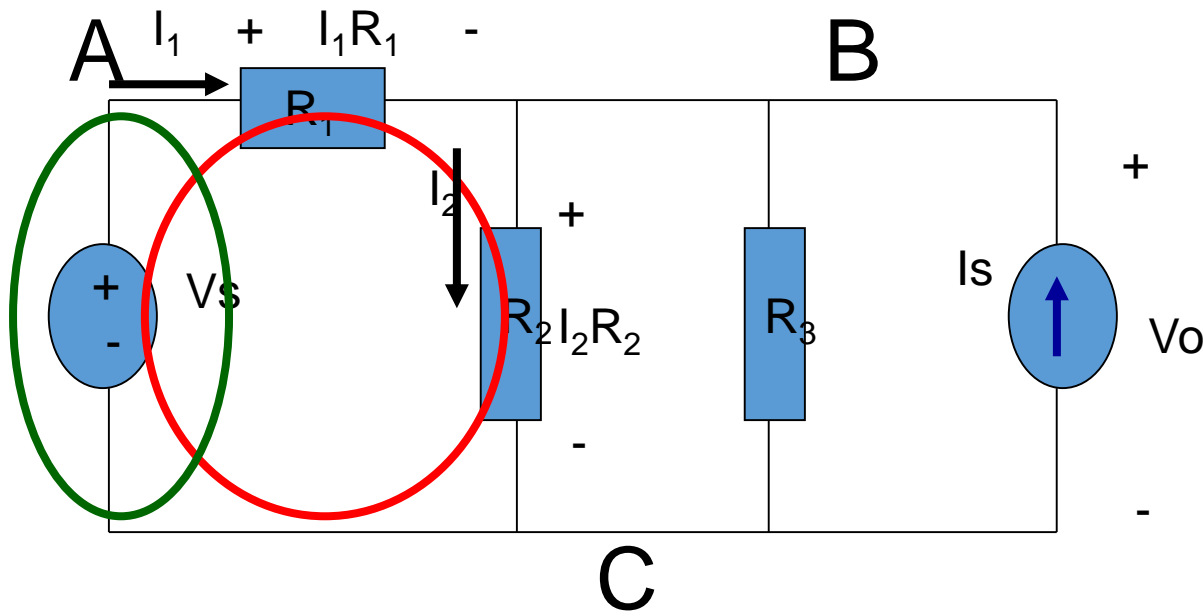
Kirchoff's Current Law (KCL)

- The sum of currents entering a node is zero
- Σ currents in - Σ currents out = 0
- Or Σ currents in = Σ currents out



B. Electricity

- Kirchoff's Voltage Law around 1st Loop

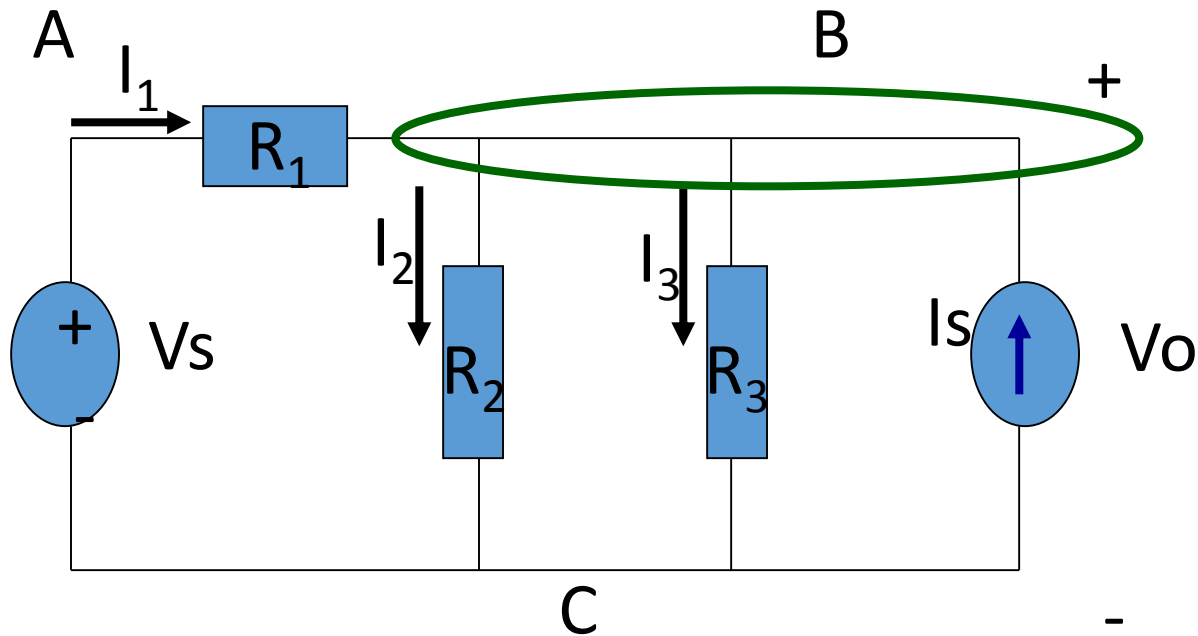


$$V_s: + I_1 R_1 + I_2 R_2 - V_s = 0$$



B. Electricity

- Kirchoff's Current Law at B



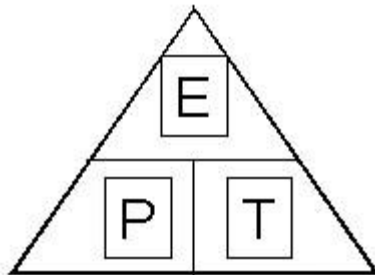
$$I_1 - I_2 - I_3 + I_s = 0$$



B. Electricity

Power

- Power is the rate of doing work
 $\text{Power} = \text{Work}/\text{time}$
- Power is measured in **watts (W)**
- One watt = One joule per second

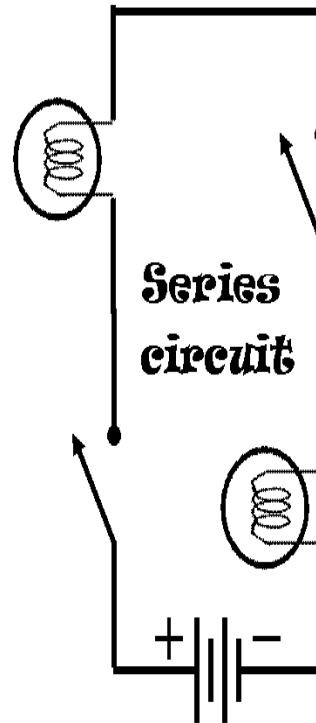
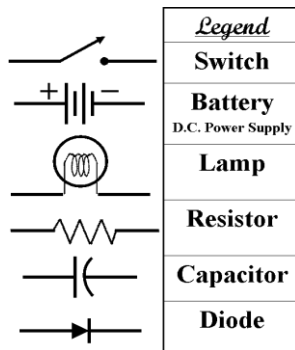
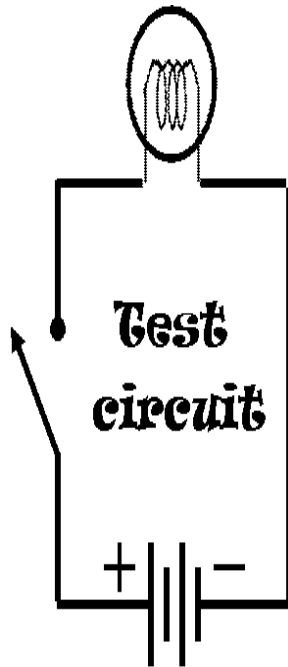


Energy

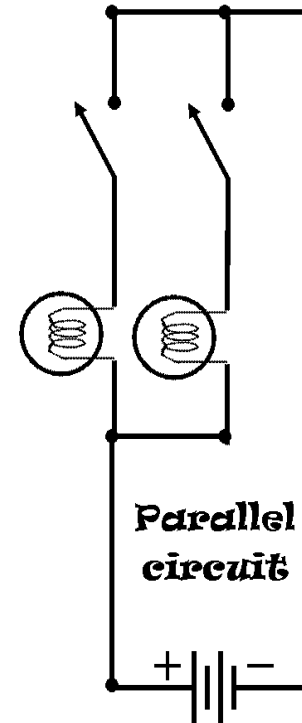
- Energy = Power \times time
- Units are Watt-hours or kilowatt-hours



B. Electricity



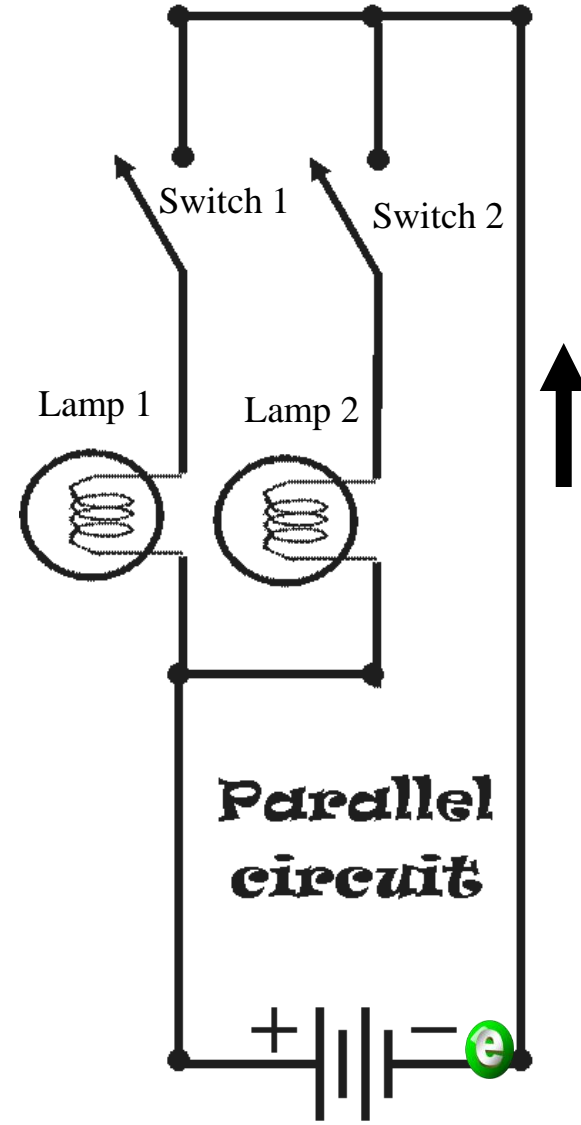
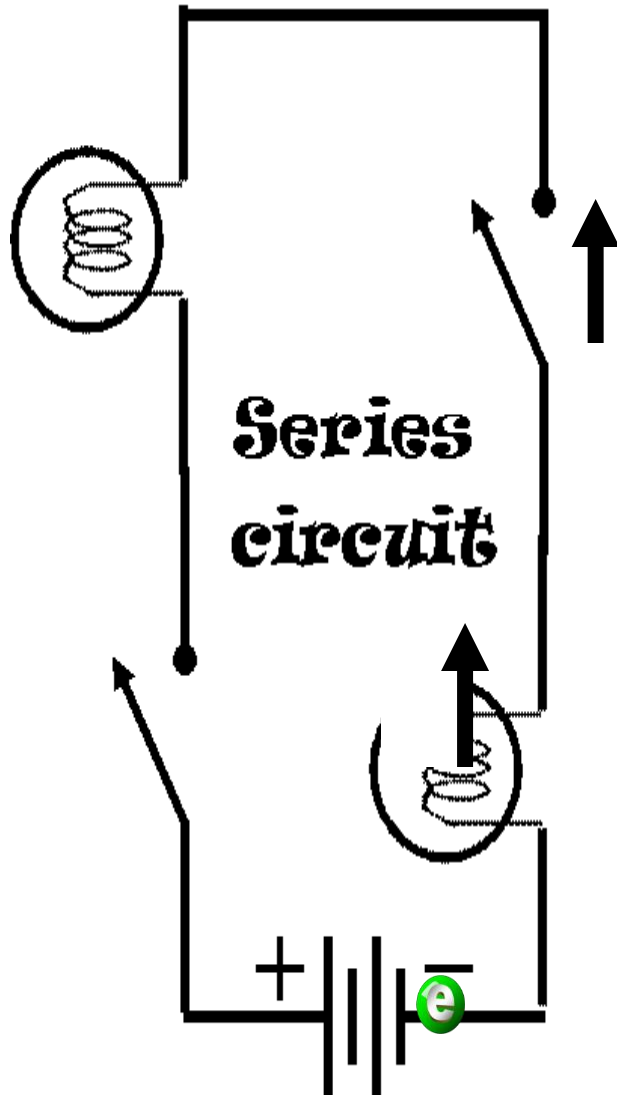
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Off	Off	X	X
On	Off	X	X
Off	On	X	X
On	On	✓	✓



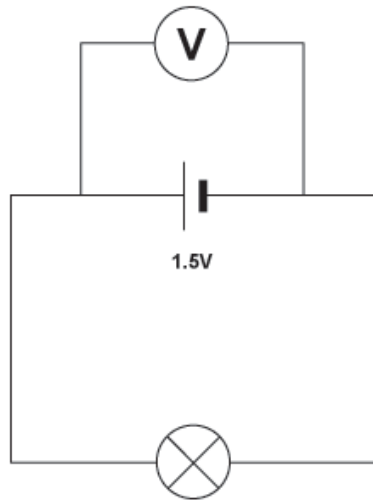
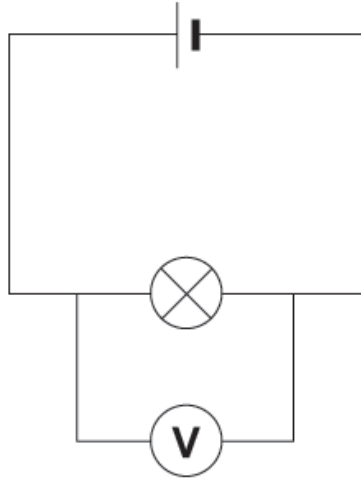
Switch 1	Switch 2	Lamp 1	Lamp 2
Off	Off	x	x
On	Off	✓	x
Off	On	x	✓
On	On	✓	✓



B. Electricity



B. Electricity

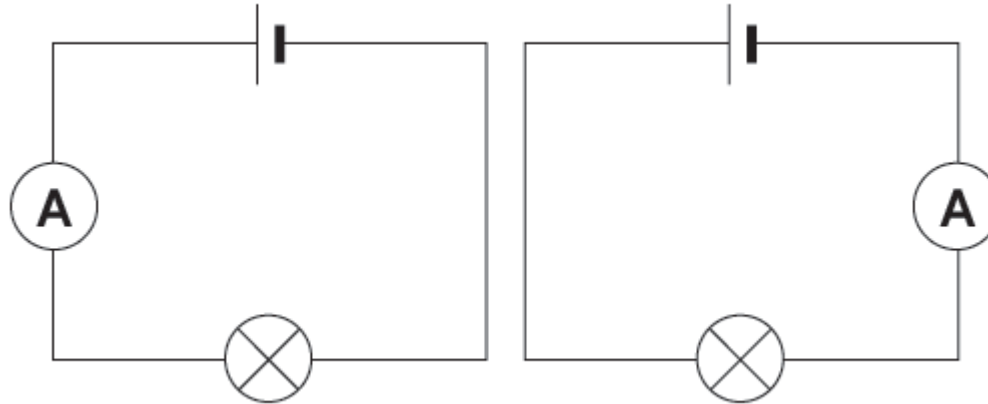


Measuring Voltage

- Voltmeter in parallel with the device/source
- Can be done across the load
- Can be done across the voltage source



B. Electricity



Measuring Current

- Ampere meter (ammeter) in series with the circuit to be measured
- Another common measuring tool is a clamp meter



B. Electricity

There will be a hands on session on measurement methods on the field relevant to solar PV installation activities



B. Electricity

Note to training institutions:

Add or subtract from this presentation as appropriate to the level of education of participants

This training session must be adjusted to the expected level of knowledge of the participants. Even if the participants are well educated, this lecture session is important so that everyone knows the definition of the electrical terms that will be used by the particular training institution for the rest of the training.





Asia-Pacific Economic Cooperation

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