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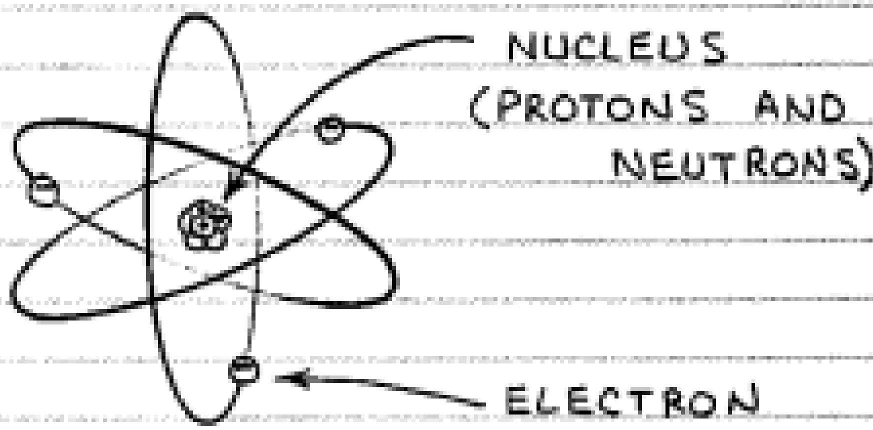
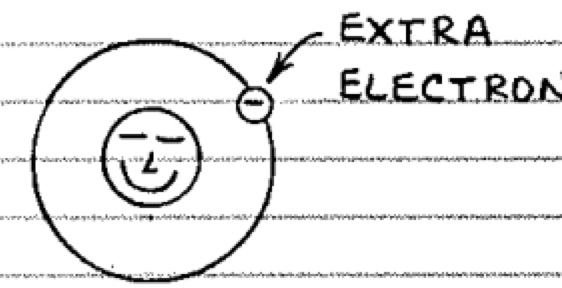
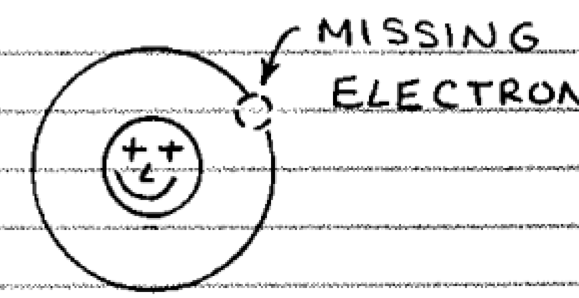
Principles of Electronics



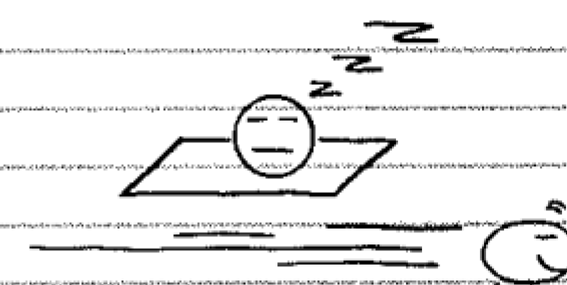
LITHIUM ATOM



NEGATIVE ION



POSITIVE ION



A circuit

What is a circuit?

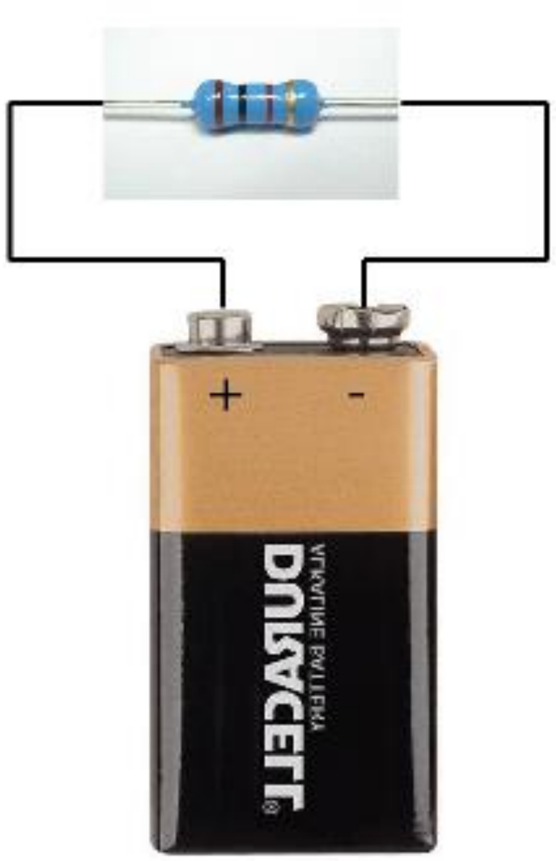
It’s a **CLOSED LOOP** that electrons can travel in.

Electrons flow = Current

How can I generate a current?

The simplest circuit is

BATTERY + RESISTOR



Battery

The battery is the power supply of out circuit.

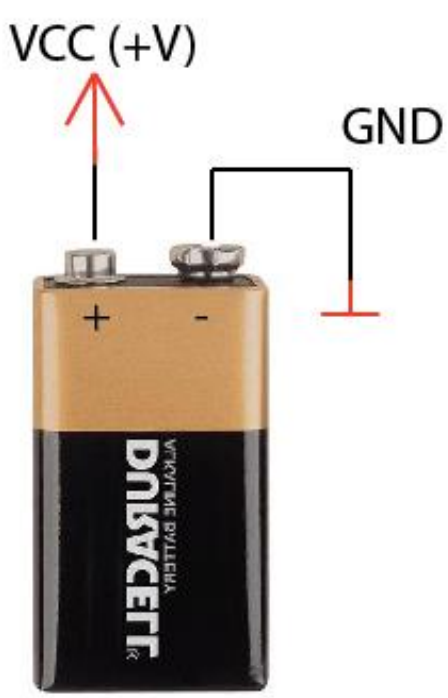
It has two sides:

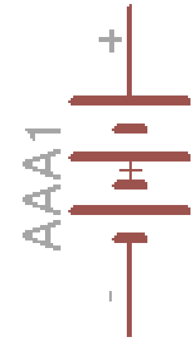
+ / plus: VCC, V+, +V

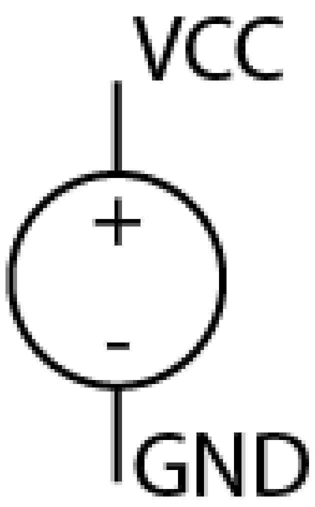
- / minus: GND

Unit of measure: Volt (V).

Voltage:
It's the difference between two points







Batteries & power supplies

VCC = 9V

1.5V

3V

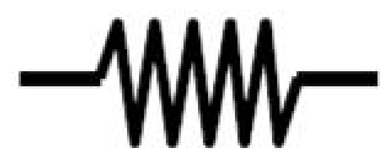
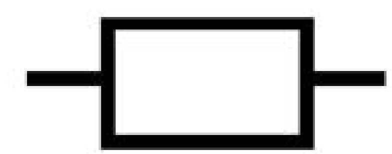
From the grid (220V) to 12V (the output that be different), VCC = 12V.

DC Voltage

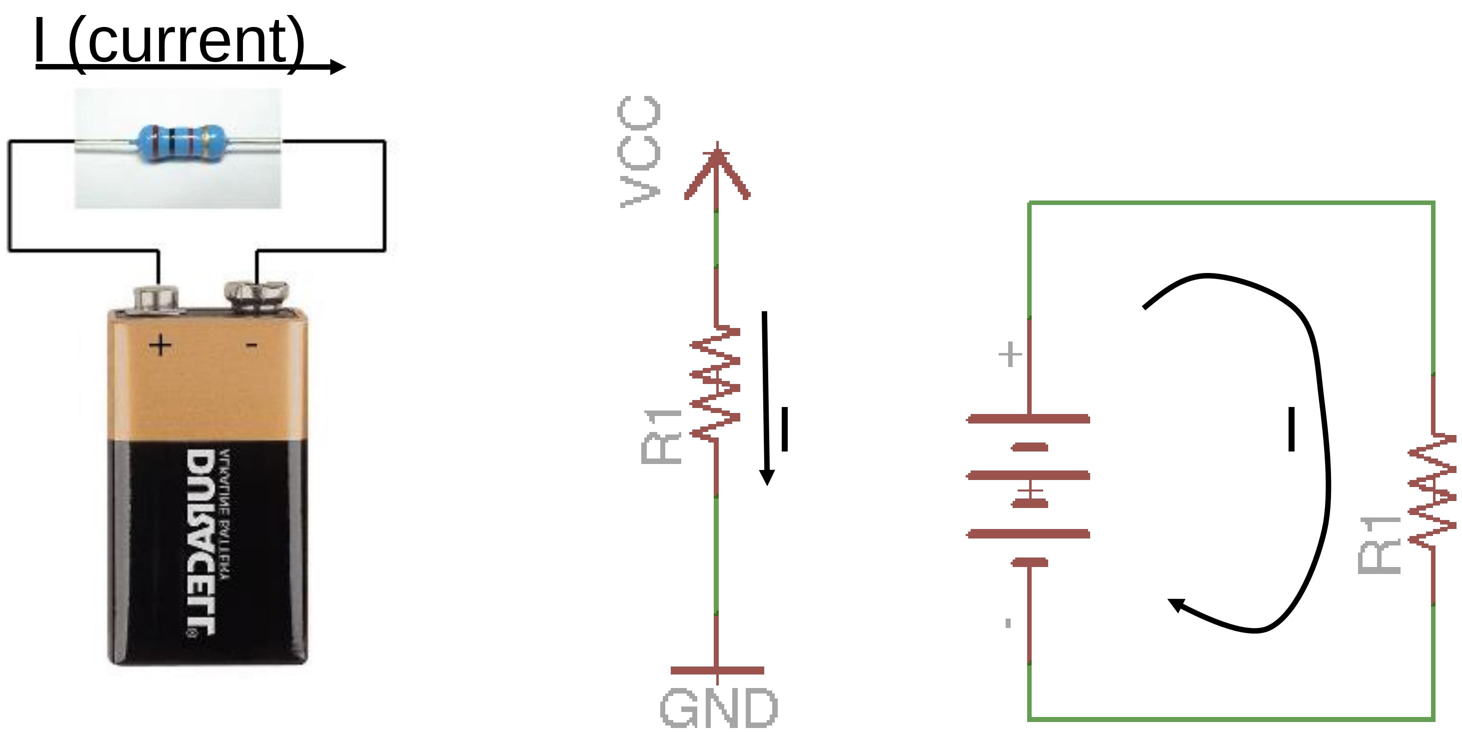
AC Voltage

Resistor

It has two sides, it doesn’t matter the orientation.
Unit of measure: Ohm (Ω).

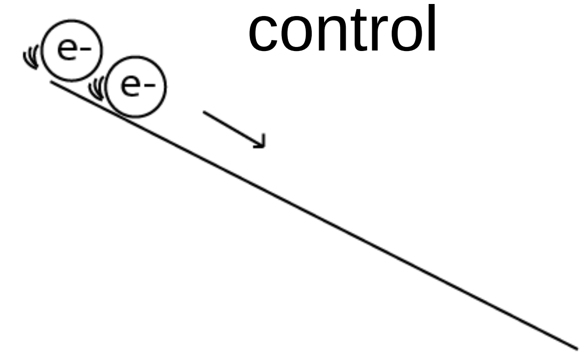
The simplest circuit



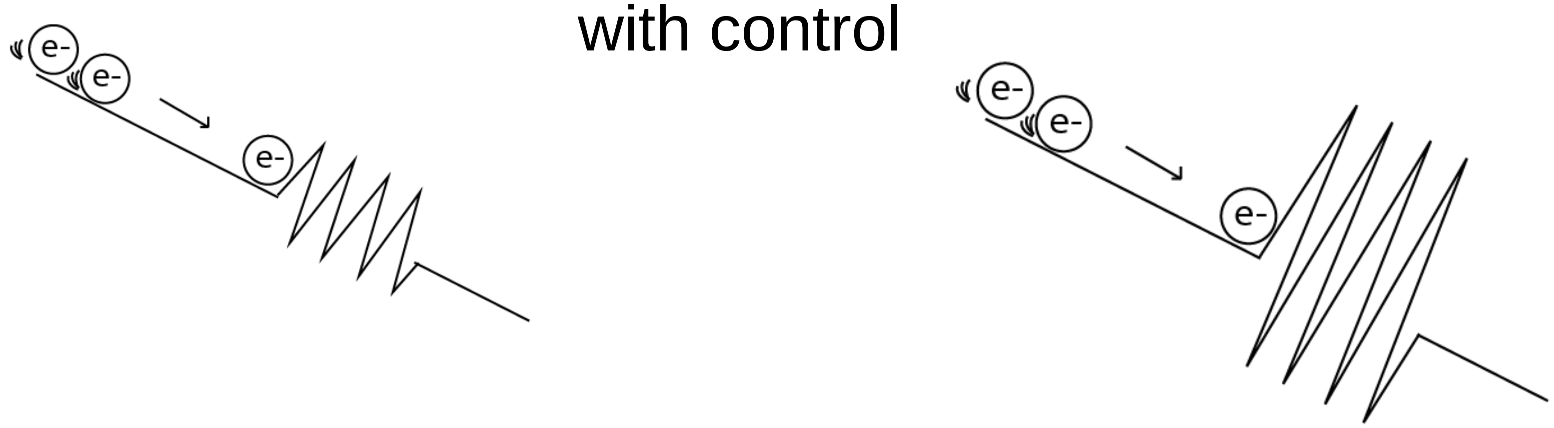
Voltage: is the difference in charge between two points.
Current: is the rate at which charge is flowing.
Resistance: is a material's tendency to resist the flow of charge (current).

1) No Slope = No Motion

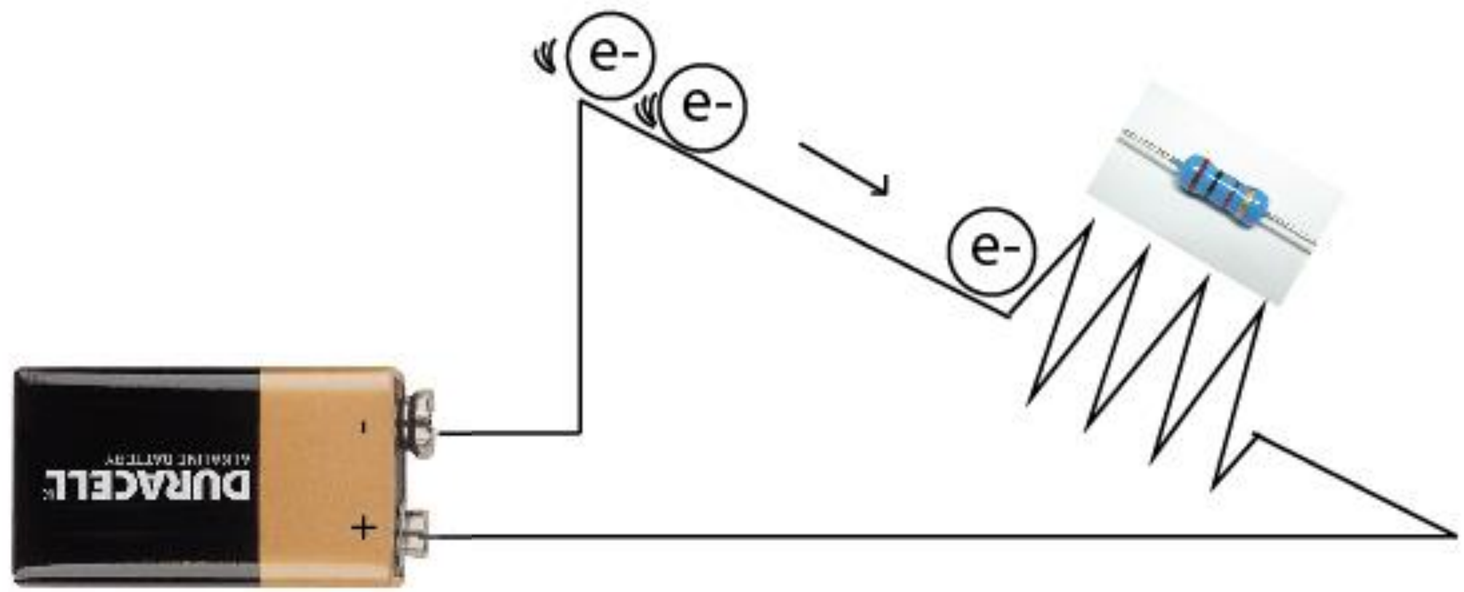
2) Slope = Motion without control

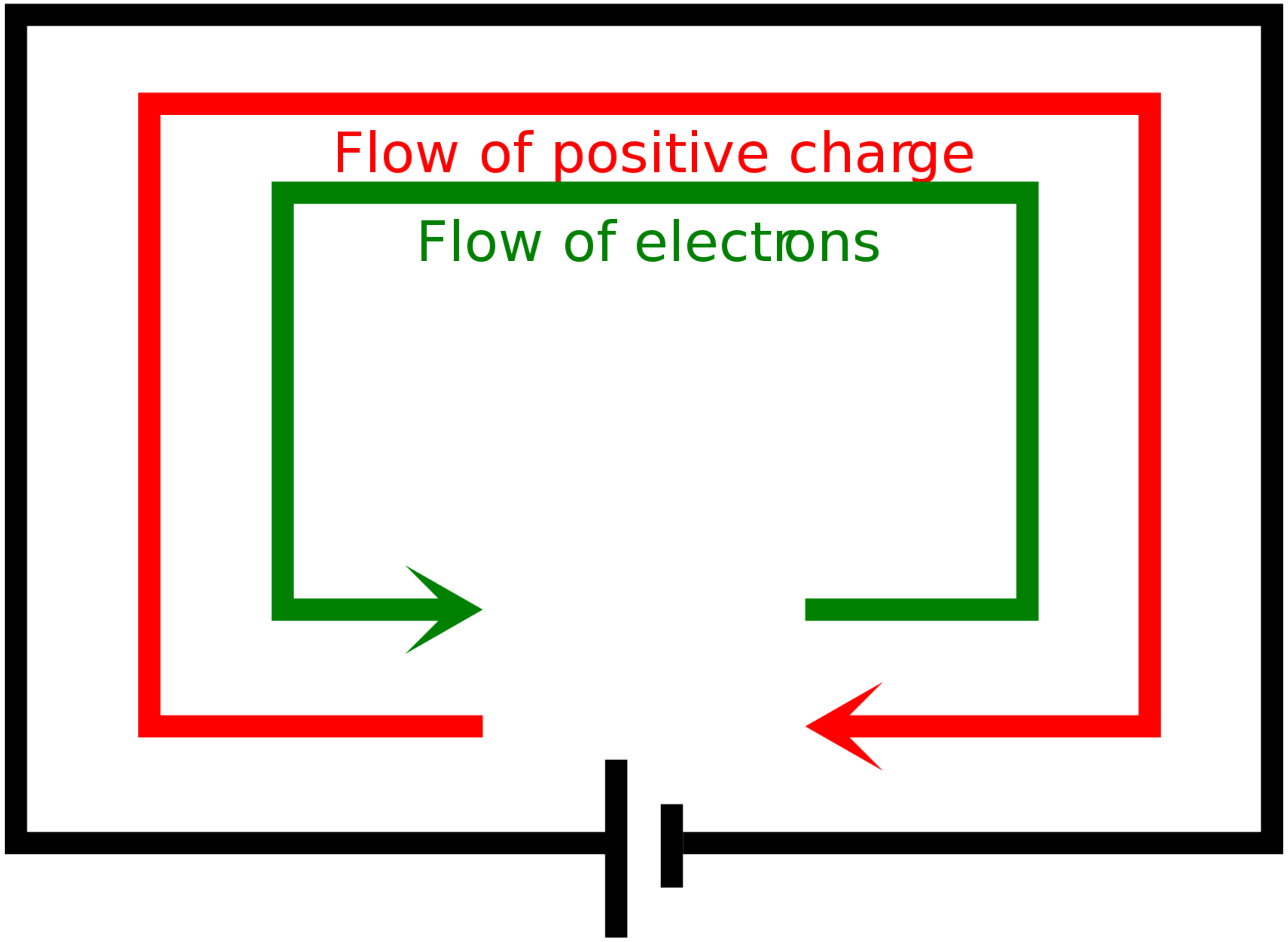


3) Slope + Obstacle = Motion with control

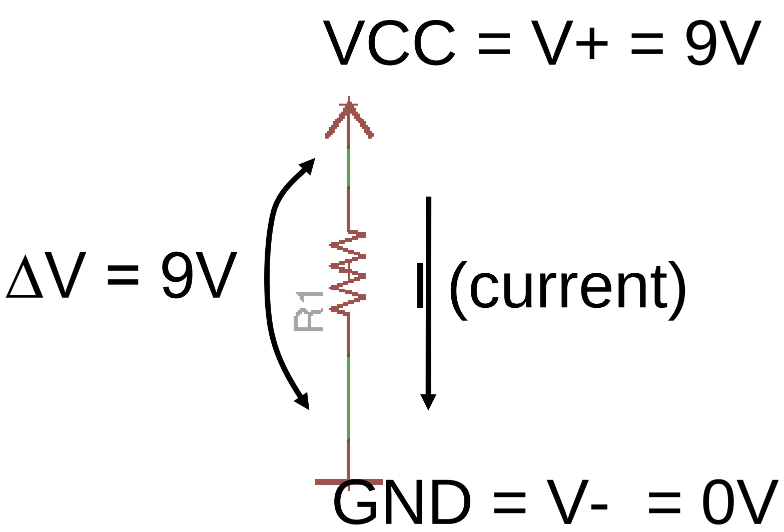


The simplest circuit




Flow of positive charge
Flow of electrons

The simplest circuit – OHM'S LAW



Ohm's Law

$\Delta V = (V+) – (V-) = R*I$

$V = RI$

$V = RI$ => $I = V/R$

$R = V/I$

Ex 1: Calculate Current you need

V = 9V

R1 = 1kΩ = 1000Ω

→ I = V/R = (VCC – GND) / I = (9V – 0V)/1000Ω = 0.009 A (= 9 mA)

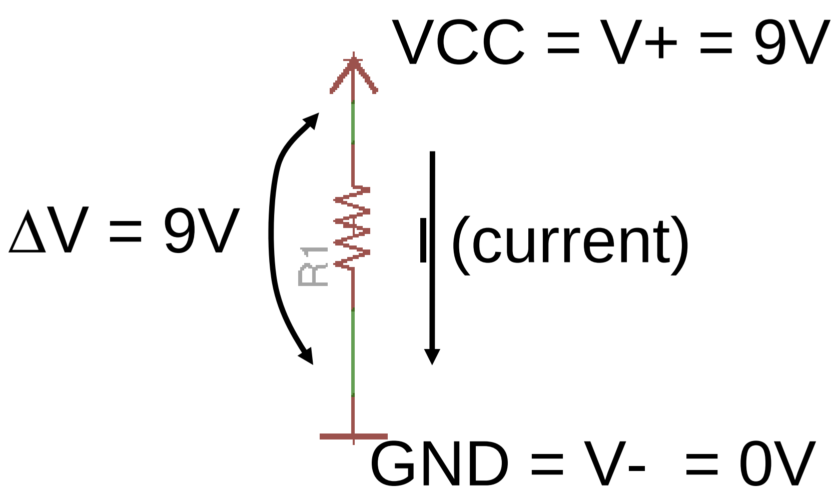
Ex 2: Calculate Resistor you need

V = 3V

I = 20mA

→ R = V/I = 3V/20mA = 3V/0.02A = 150Ω

The simplest circuit - POWER



Power
Unit of measurment: Watt (W)

$P = VI$

$V = RI \Rightarrow$ $P = (R*I)*I = R*I^2$

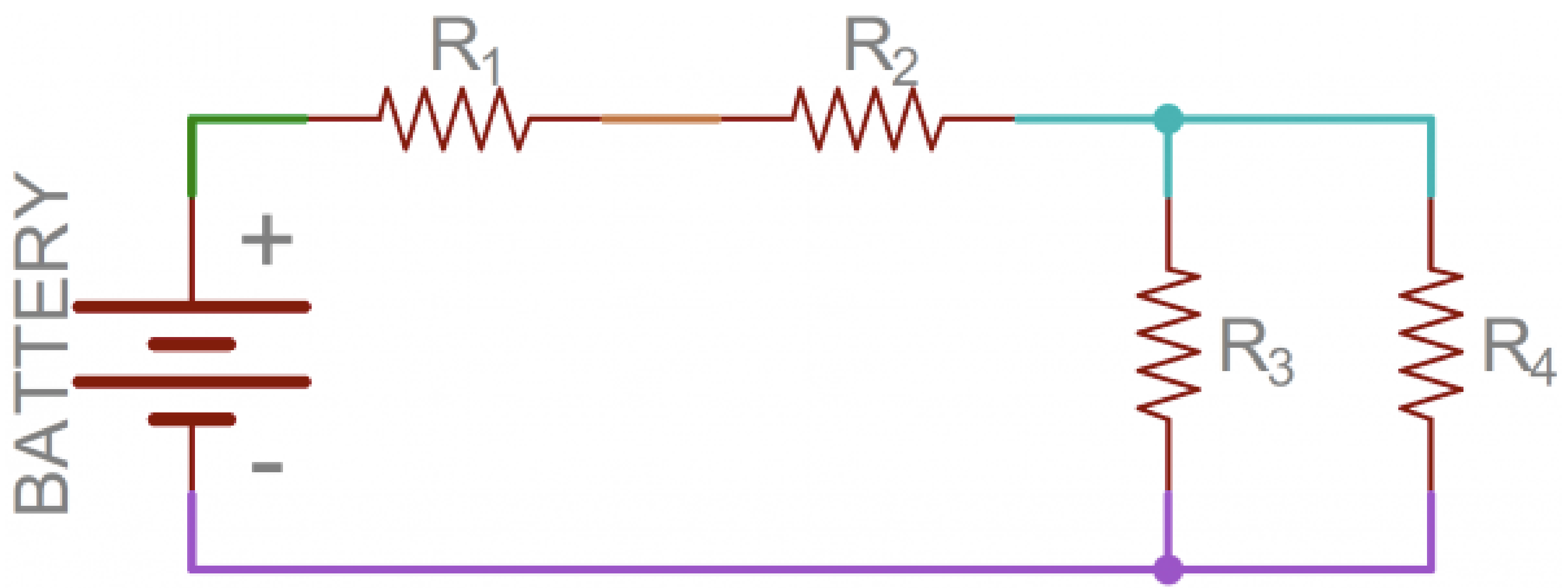
When the power is higher then the power specified in the specs of the component:
The device burns.

Ex:
$P = 9\ V * 0.05\ A = 0.45\ W$

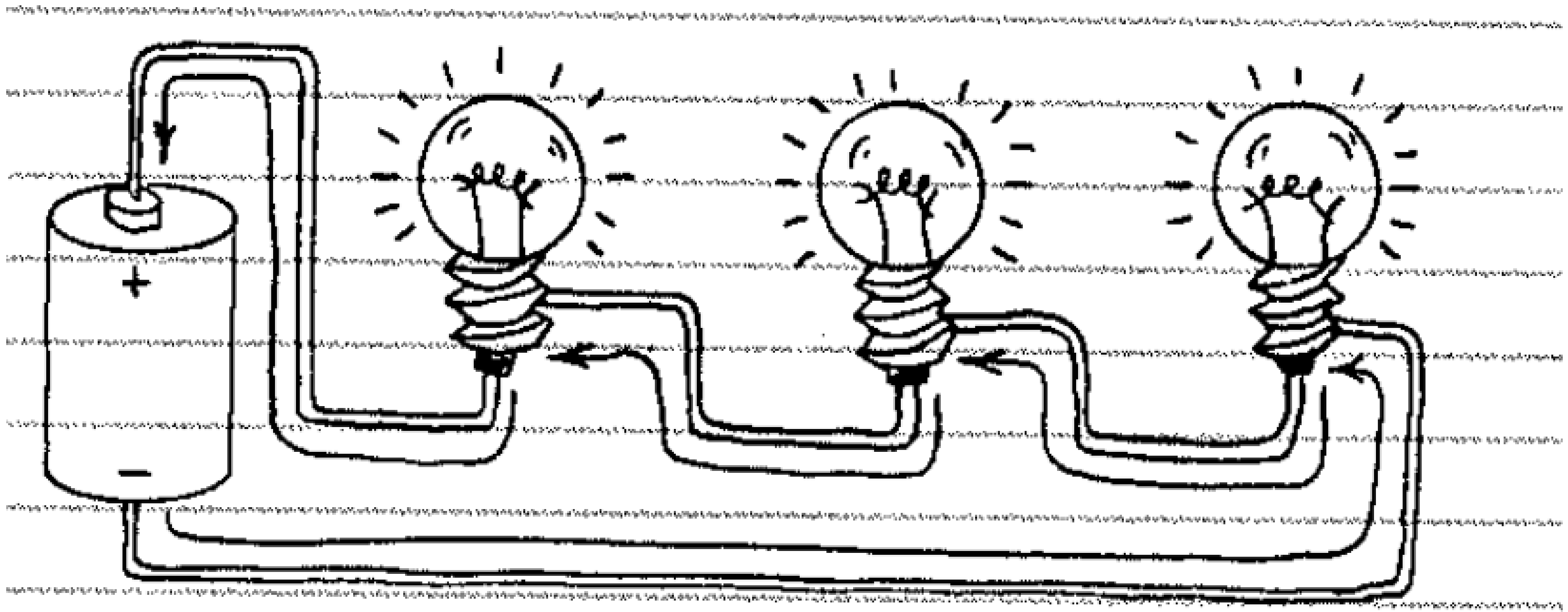
($I = 5mA \Rightarrow R = 9V / 0.005A = 1800\ \Omega = 1.8\ k\Omega$)

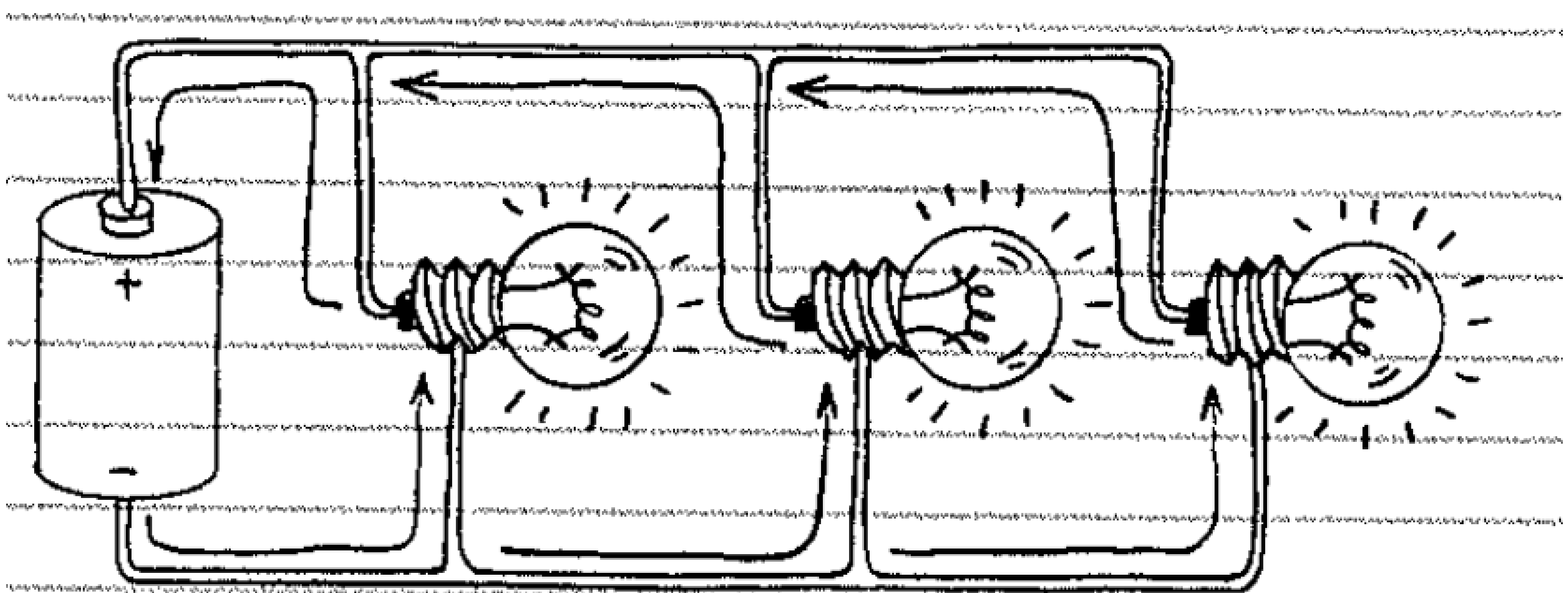
Datasheets	Chip Resistor Marking RC Series, L Suffix Datasheet
Product Photos	1206 Chip Resistor, SMT
Product Training Modules	Chip Resistor
PCN Other	RC/AC 0603/0805/1206 22/Jan/2013
Standard Package	1
Category	Resistors
Family	Chip Resistor - Surface Mount
Series	RC1206
Packaging	Cut Tape (CT)
Resistance (Ohms)	10k
Tolerance	±1%
Power (Watts)	0.25W, 1/4W
Composition	Thick Film
Features	Moisture Resistant

The simplest ciruit Plus – KIRCHOFF'S LAW



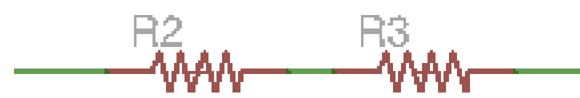
Example schematic with four uniquely colored nodes.





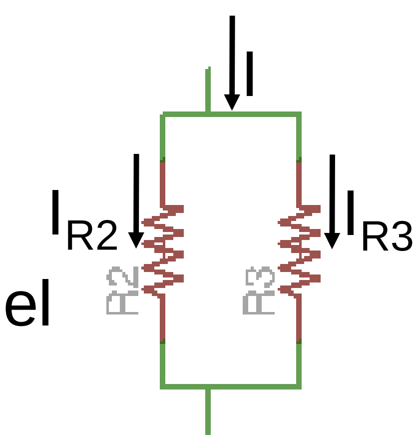
In Series – In Parallel

In Series



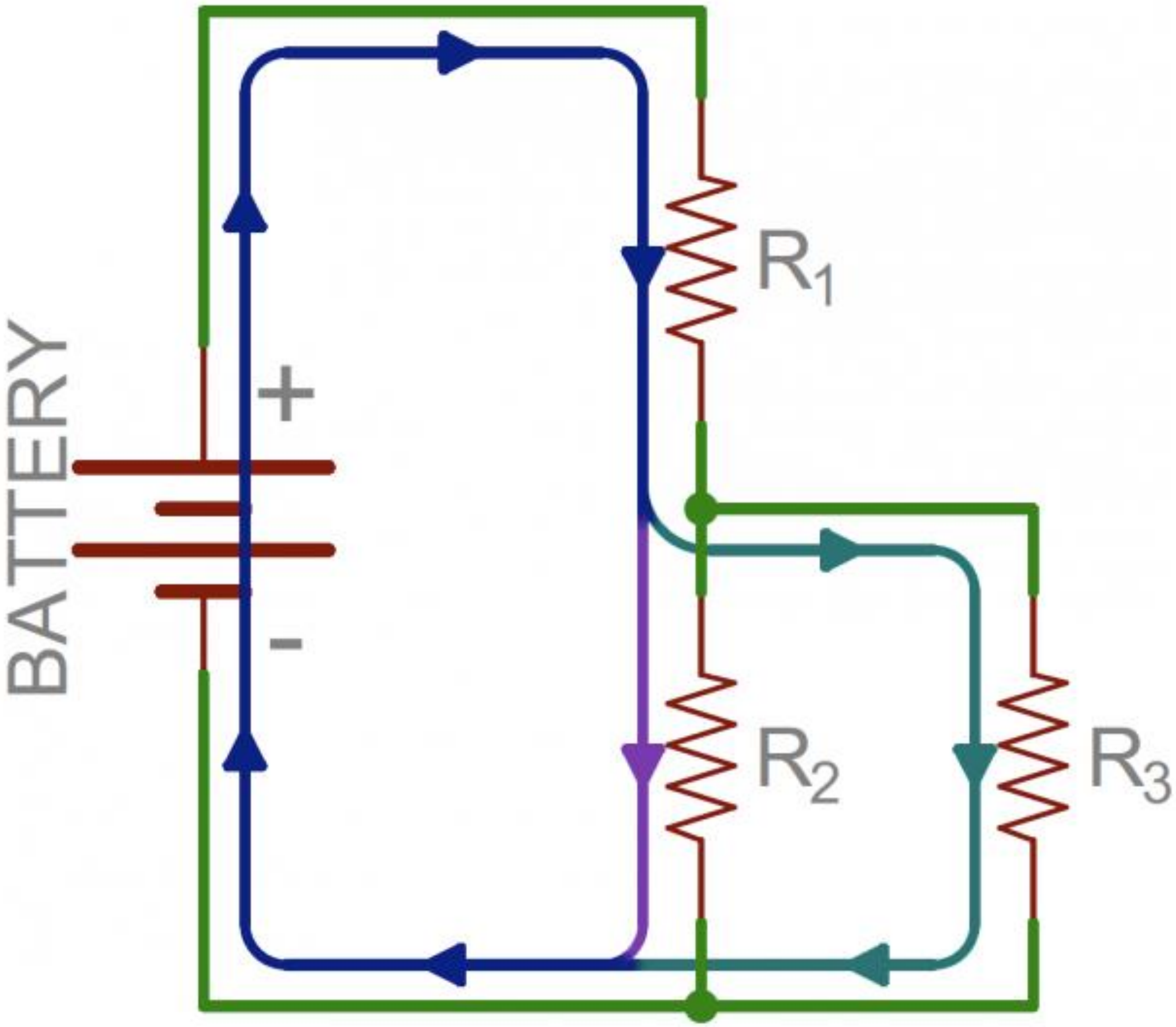
R = R2 + R3

In Parallel



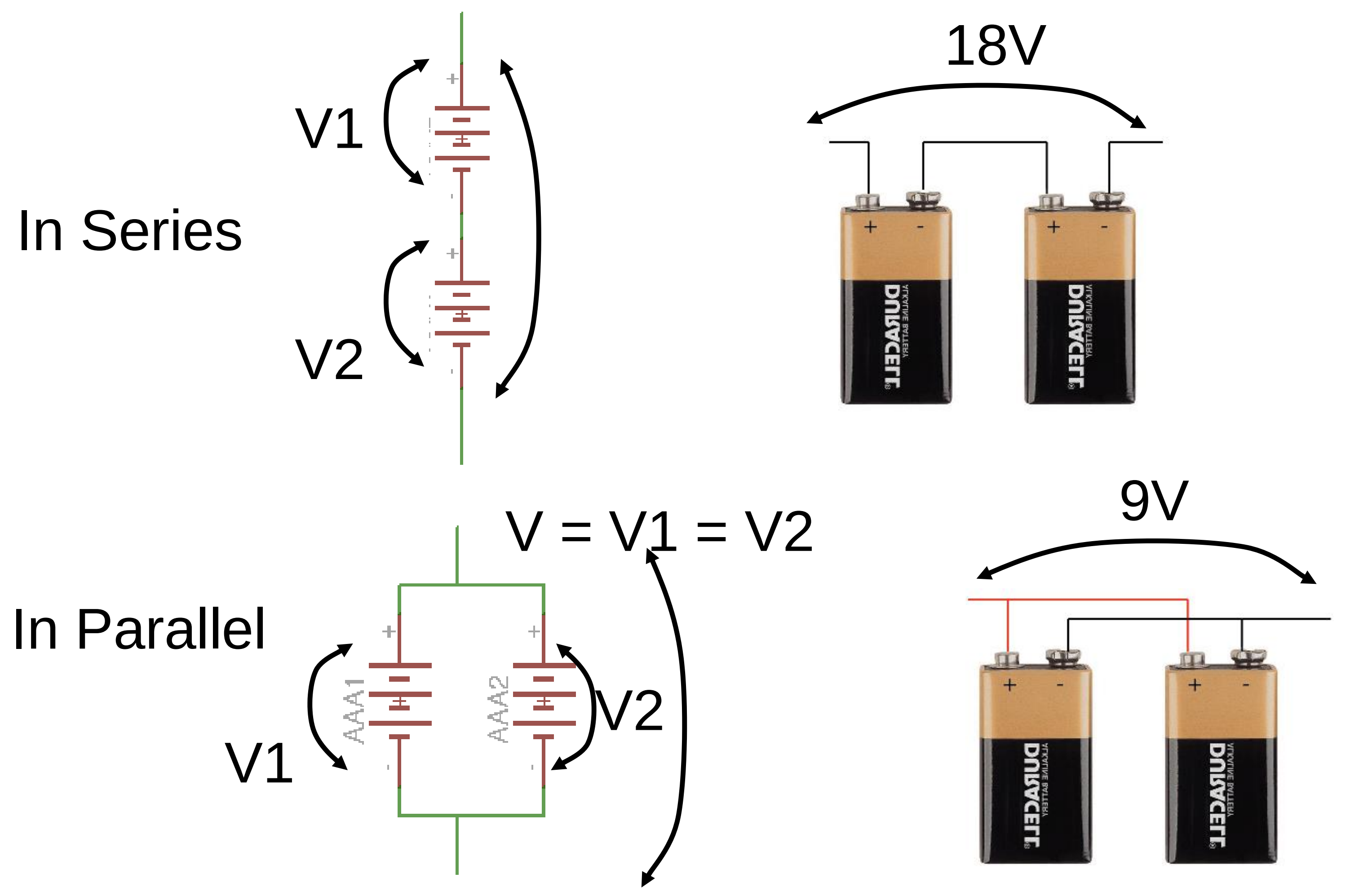
R = (R2 * R3)/(R2 + R3)

$I = I_{R2} + I_{R3}$



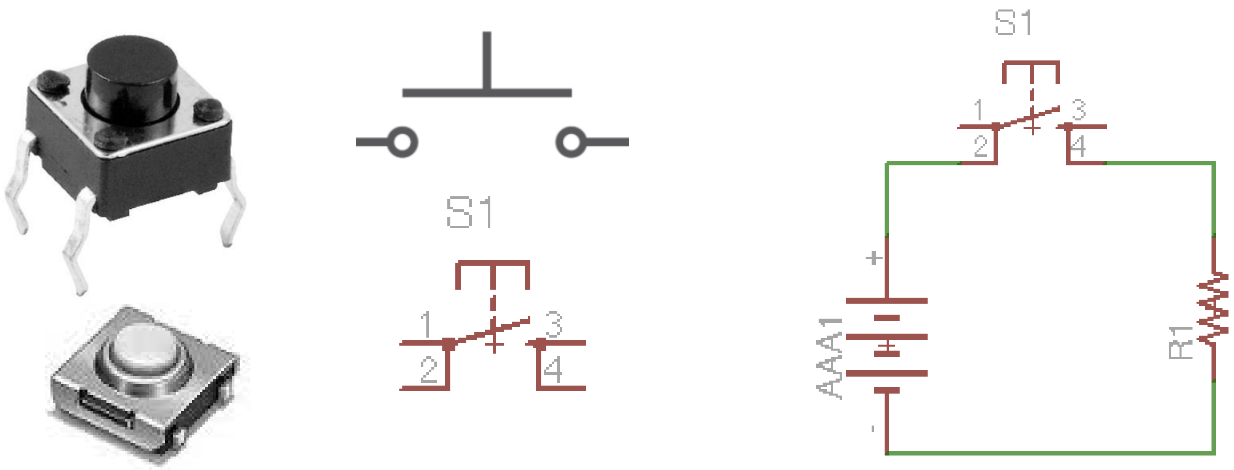
BATTERY
+
-
R1
R2
R3

In Series – In Parallel

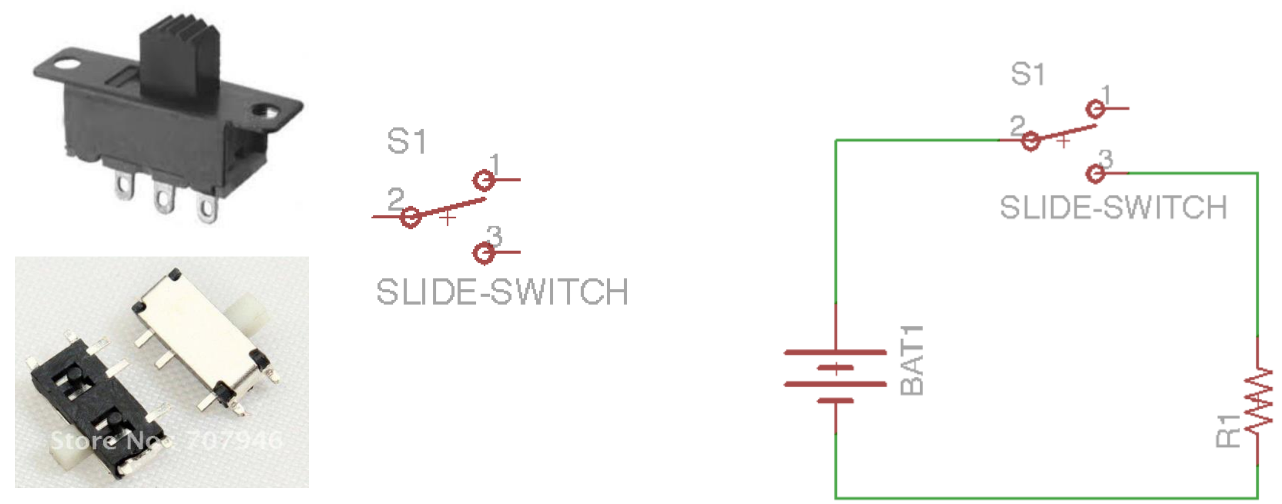


The simplest circuit + Switch

Tact Switch

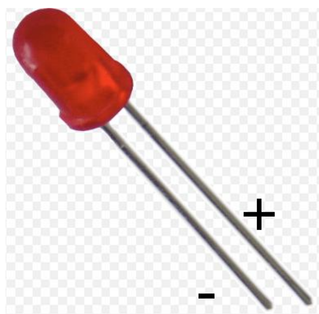


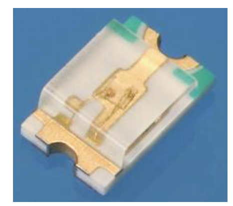
Slide Switch

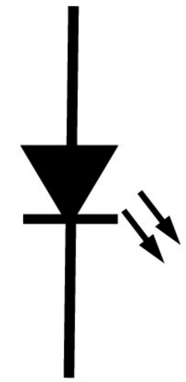


Note: place the switch to the high Voltage

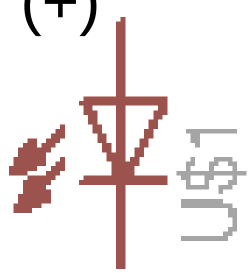
The simplest circuit + LED







Anode (+)



Cathode (-)

Ohm's Law doesn't work!

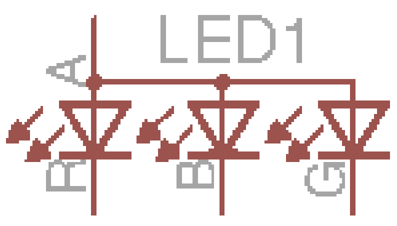
Forward Voltage (Vf)
Is the voltage at the sides of the LED when there is currer through it.

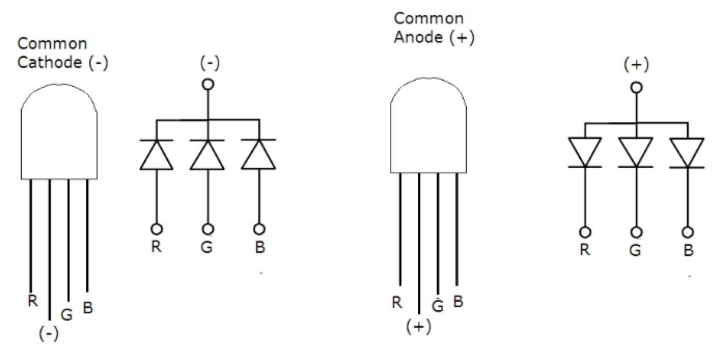
Voltage - Forward (Vf) (Typ)	1.8V
Current - Test	10mA

Forward Current (If)
It's the maximum current that you fix.

RGB LED

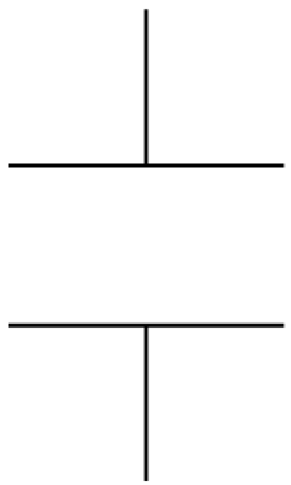
Three LEDS in one

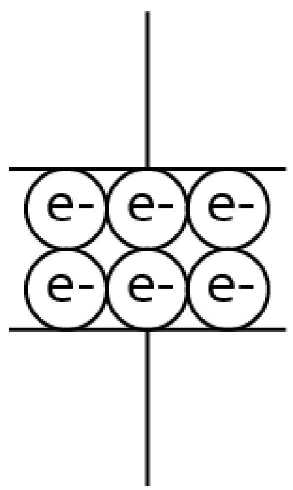


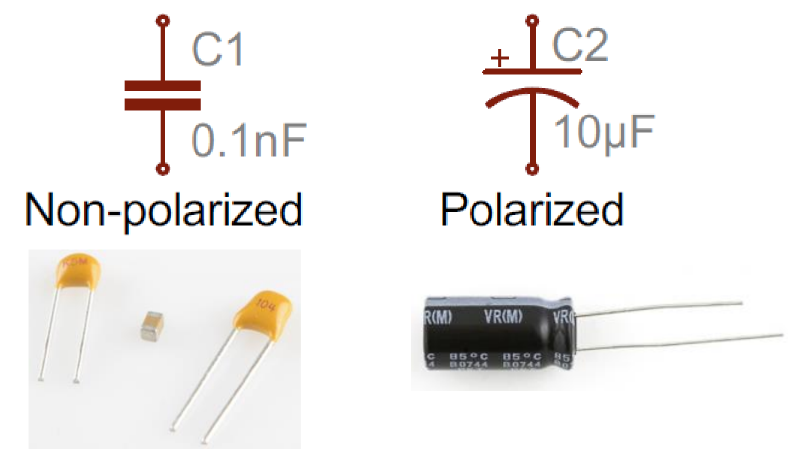


Components – Capacitor

Capacitor: energy storage. The current doesn't flow through the capacitor.

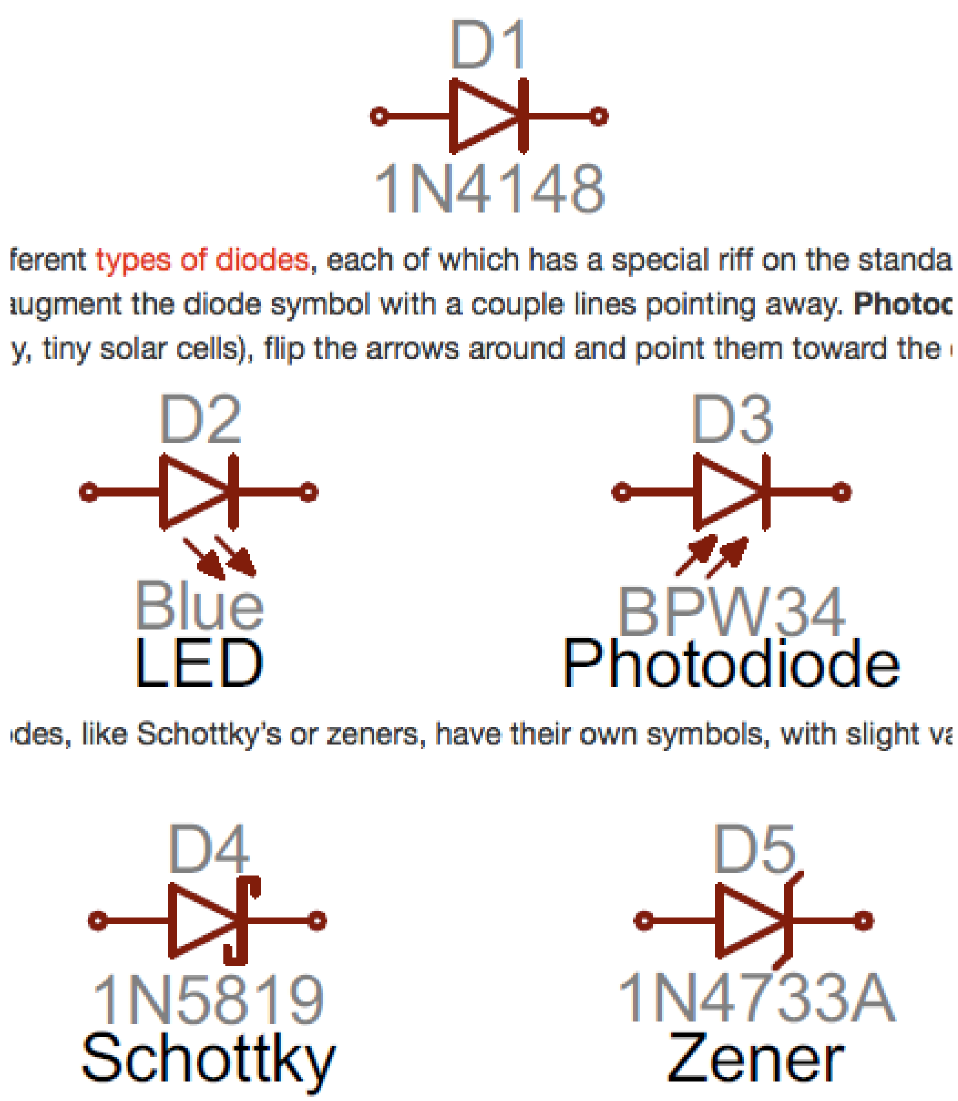






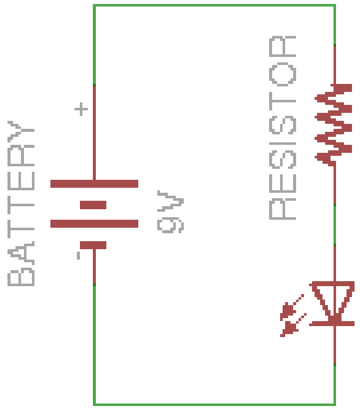
Prefix Name	Abbreviation	Weight	Equivalent Farads
Picofarad	pF	10^{-12}	0.000000000001 F
Nanofarad	nF	10^{-9}	0.000000001 F
Microfarad	µF	10^{-6}	0.000001 F
Milifarad	mF	10^{-3}	0.001 F
Kilofarad	kF	10^{3}	1000 F

Components - Diode



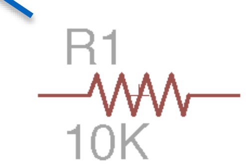
Schematic

The schematic is the symbolic representation of a circuit



How to read a Schematic

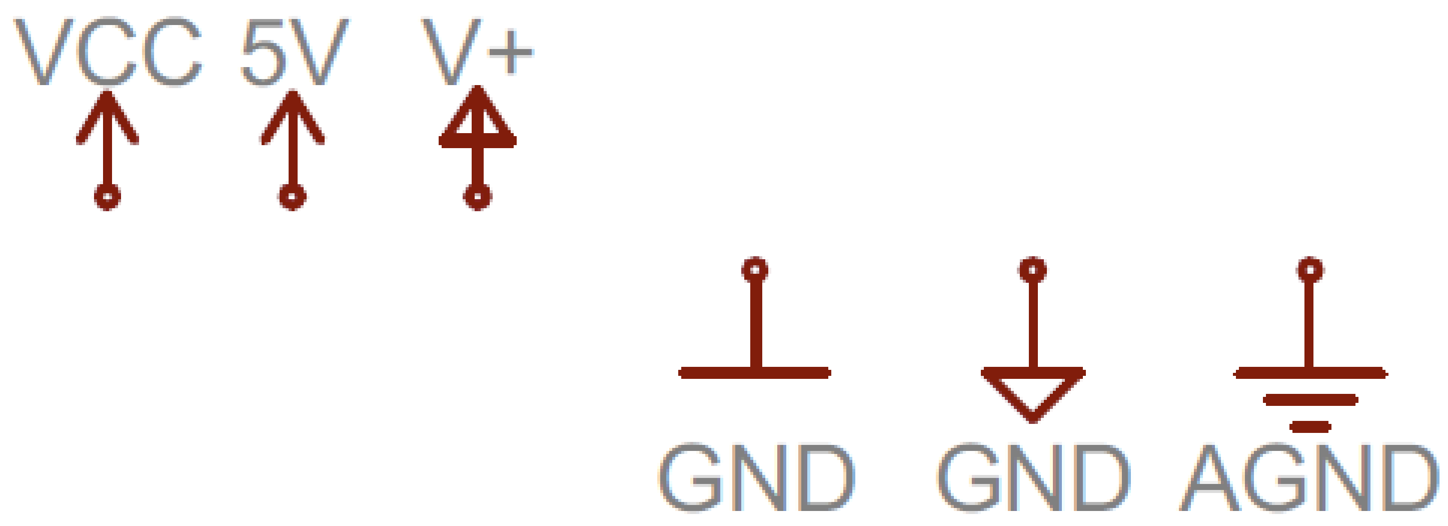
Names: Component names are usually a combination of one or two letters and a number. Ex: R1, R2.
The prefixes of names are pretty well standardized.



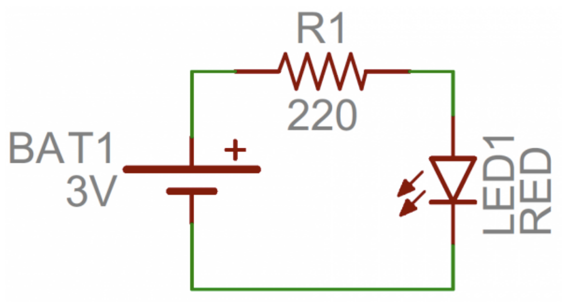
Values: help define exactly what a component is.

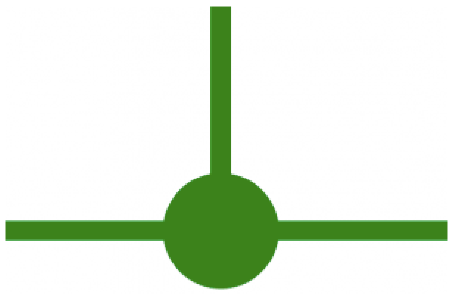
Name Identifier	Component
R	Resistors
C	Capacitors
L	Inductors
S	Switches
D	Diodes
Q	Transistors
U	Integrated Circuits
Y	Crystals and Oscillators

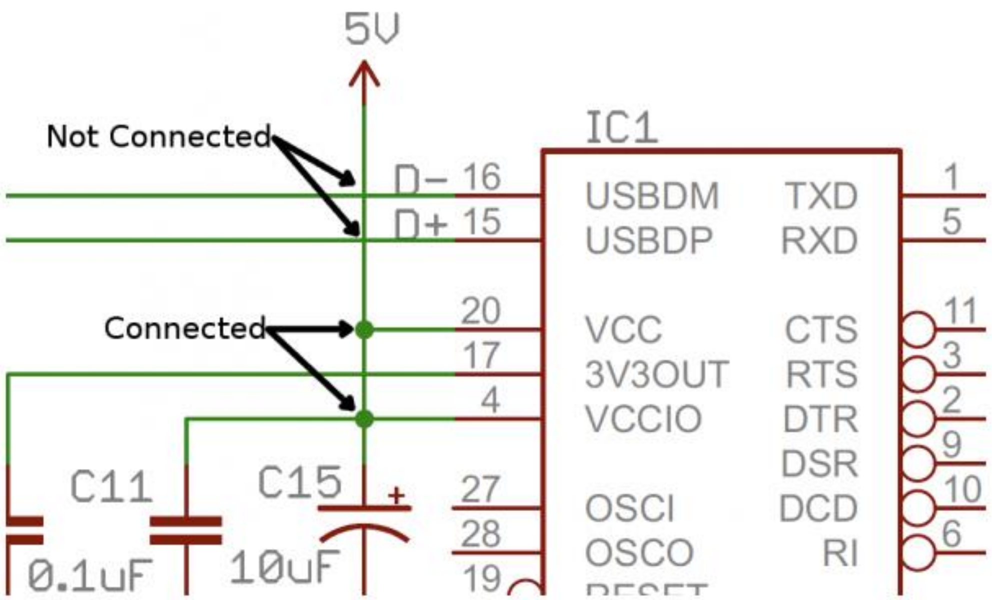
How to read a Schematic – Voltage Nodes



How to read a Schematic – Nets & Junctions







Tinkering Time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