IAT 884 – Week 1 – Workshop 1

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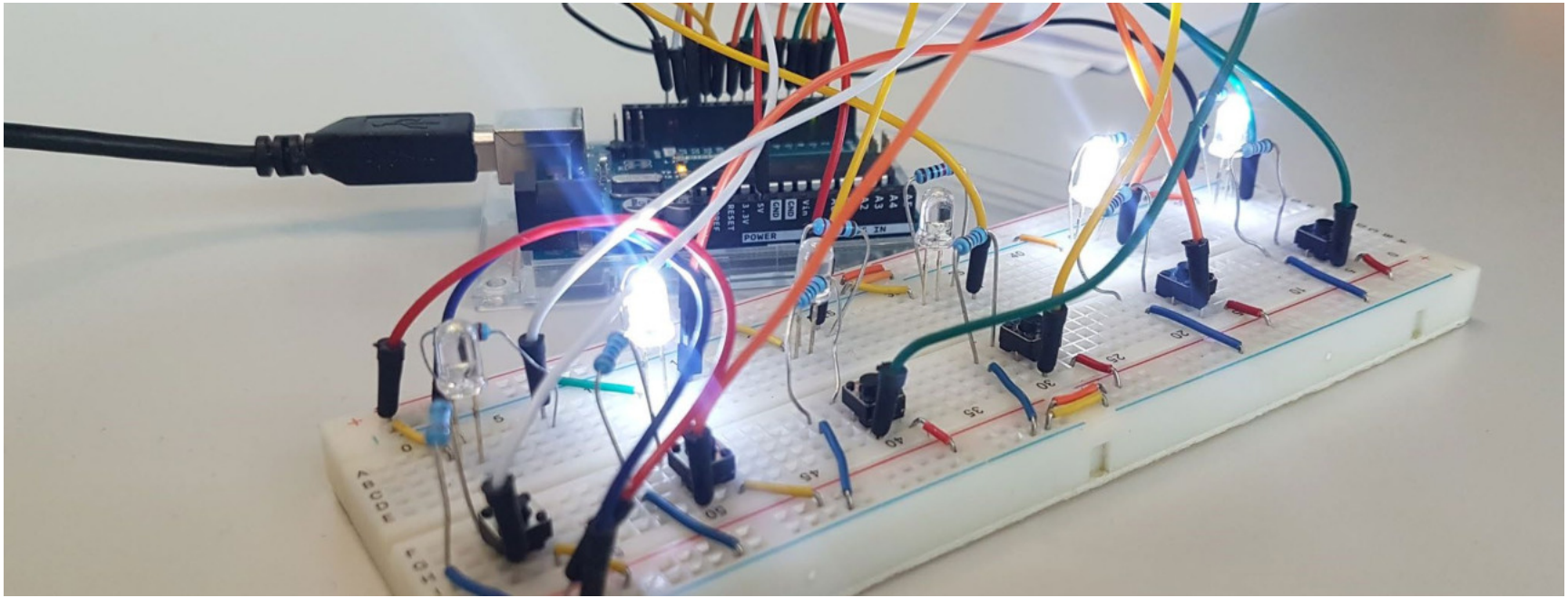


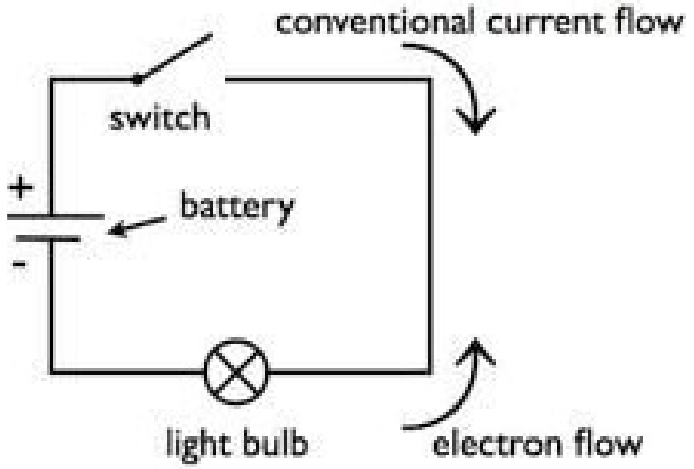
Basic Electronics

Basic Electronics

Circuit: A closed loop of conductors through which current can travel

You need a source of electrical energy and a load

Represented by *circuit diagrams*

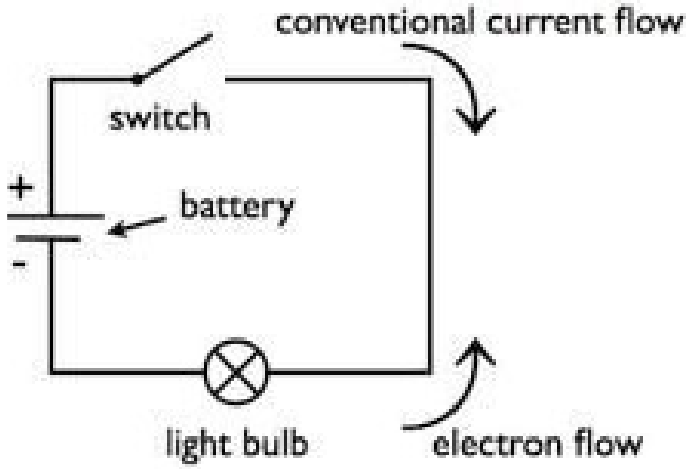


Basic Electronics

The flow of electricity

Conventional Flow: Current is viewed as flowing from positive (+) to negative (-) terminals. This is how engineers talk about electricity

Electron Flow: In actuality, electrons move from greater electrical energy to lesser electrical energy.

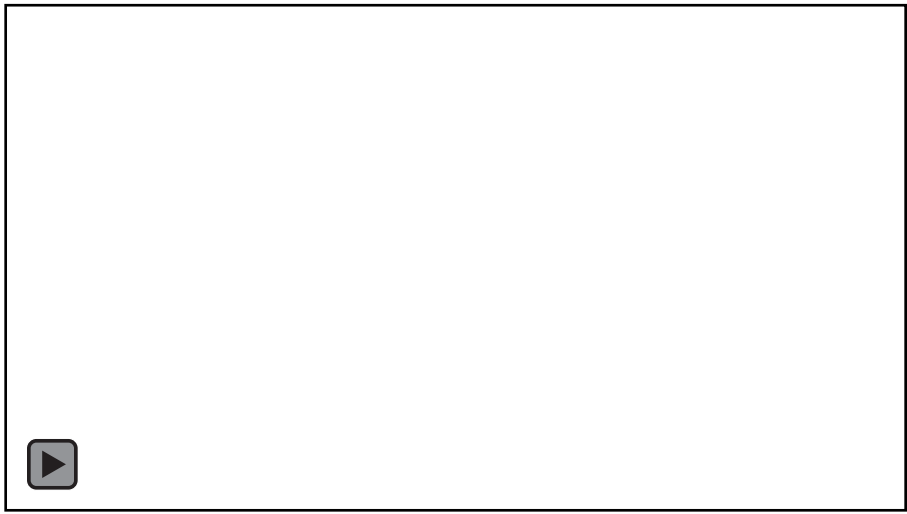


Electronics circuits

Short circuits

A circuit with no load is called a short circuit

Avoid short circuits!



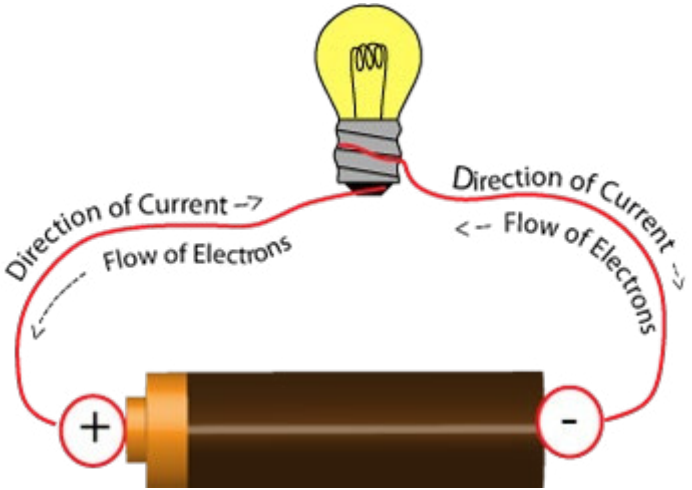
Video. by Outstanding Professor

Electronics circuits

Current

Amount of electrical energy passing through any point in the circuit

S.I. Unit: Ampere (A)



Source: build-electronic-circuits.com

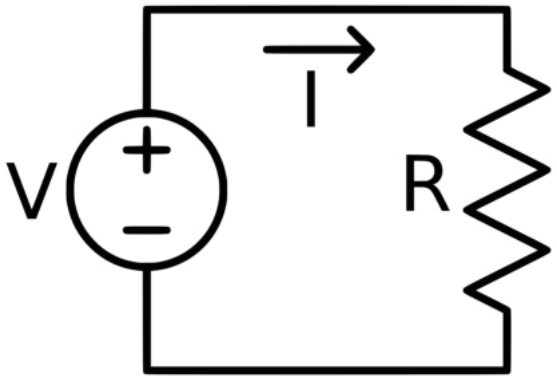
Electronics circuits

Voltage

Relative level of electrical energy between any two points in the circuit (e.g.: power and ground)

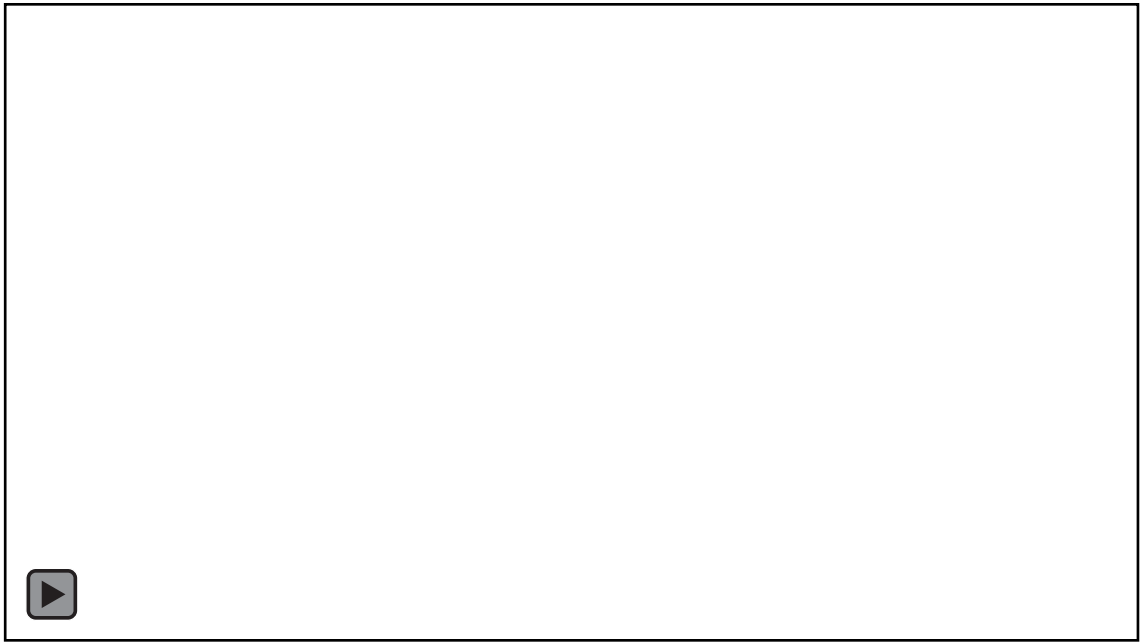
Each component lowers the voltage

S.I. Unit: Volts (V)



Electronics circuits

Difference between Voltage and Current



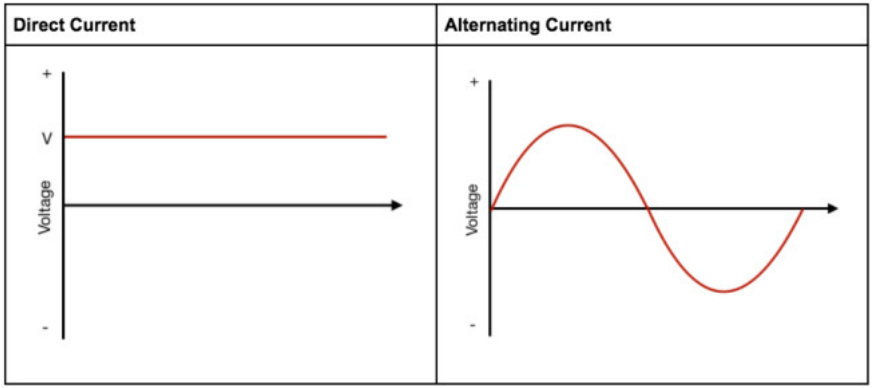
Video. By MadgeTech, Inc.

Electronics circuits

AC vs. DC Current

Alternating Current (AC): An electrical current whose magnitude and direction vary cyclically.
This is the power we plug things into at home. 120V 60HZ

Direct Current (DC): An electrical current in which the electric charges flow in the same direction.
The kind of current produced by batteries



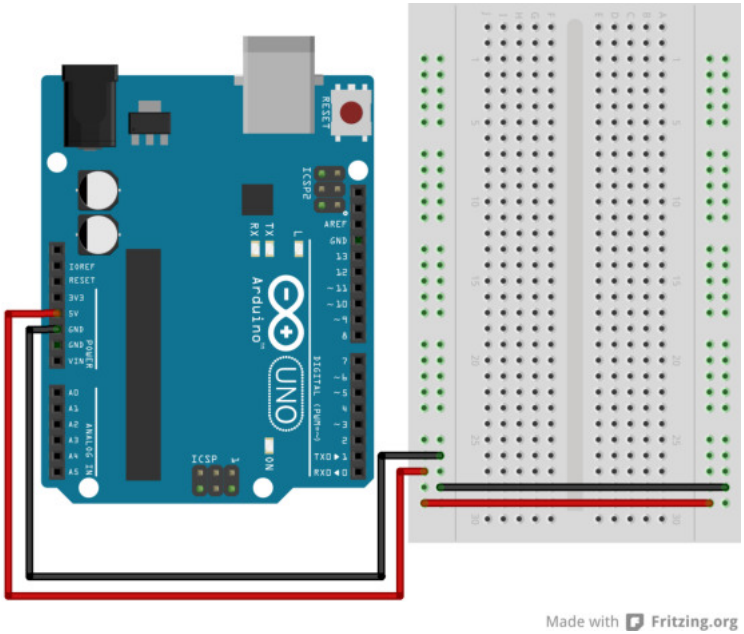
Electronics circuits

DC voltage source

Generates constant voltage

On Arduino:

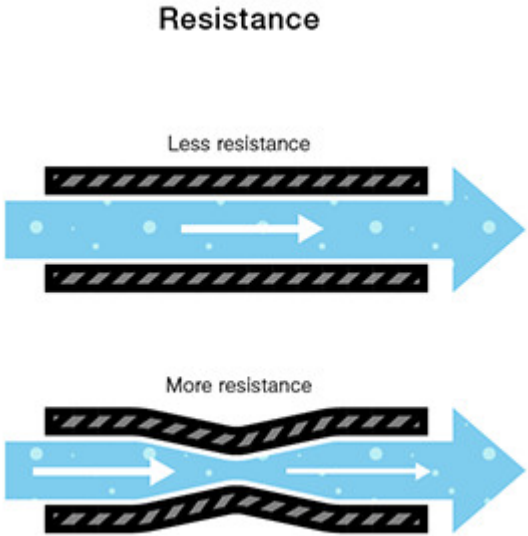
- 5V is positive
- GND is negative



Electronics circuits
Resistance

The amount that a component resists the flow of current

S.I. Unit: Ohm (Ω)



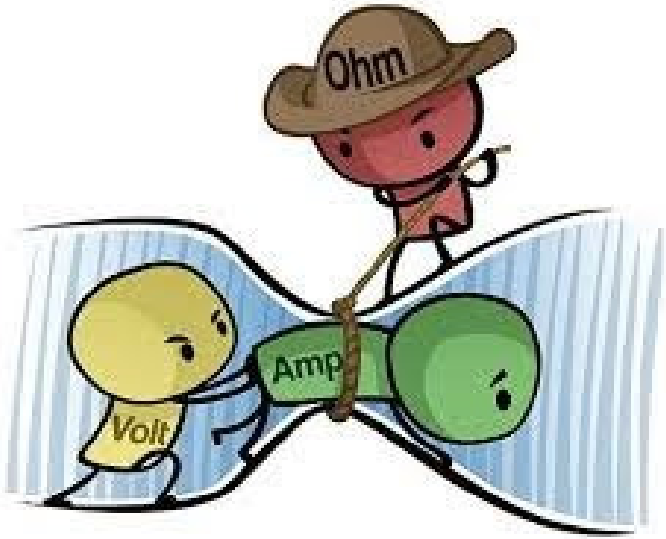
Source: learn.sparkfun.com

Electronics circuits

Ohm's Law

$$I = \frac{V}{R}$$

One **amp** of current will flow through a resistance of one **ohm** if one **volt** of electrical force is applied to the circuit



Source: build-electronic-circuits.com

Components

Components

Resistance of materials

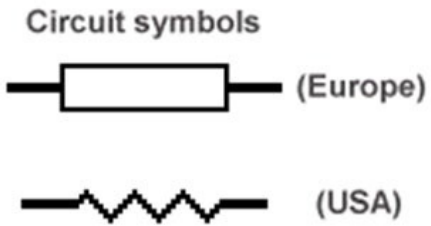
- Insulators: High resistance
  - example: air
- Conductors: Low resistance
  - example: wire
- Semiconductors: In between
  - example: silicon or resistors

Source: http://www.electronicsandyou.com/uses-of-silicon-in-electronics.html

Components
Carbon resistors

It resists but doesn’t block.

S.I. Unit: Ohm (Ω)

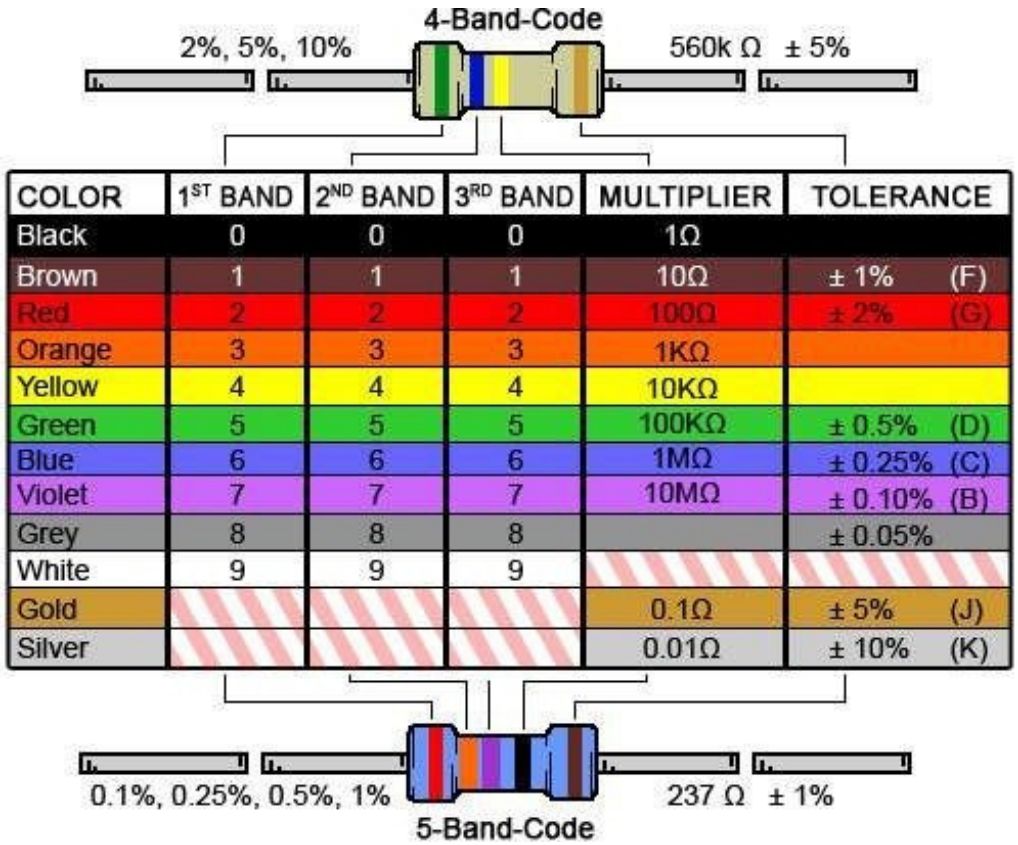


Components

Carbon resistors –

Color coding

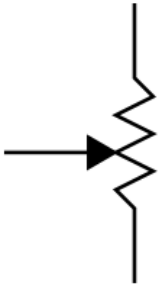
Colour, Colour x 10 ^{colour} in Ohm's (Ω's)



COLOR	1ST BAND	2ND BAND	3RD BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	± 0.5% (D)
Blue	6	6	6	1MΩ	± 0.25% (C)
Violet	7	7	7	10MΩ	± 0.10% (B)
Grey	8	8	8		± 0.05%
White	9	9	9		
Gold				0.1Ω	± 5% (J)
Silver				0.01Ω	± 10% (K)

Components
Potentiometers

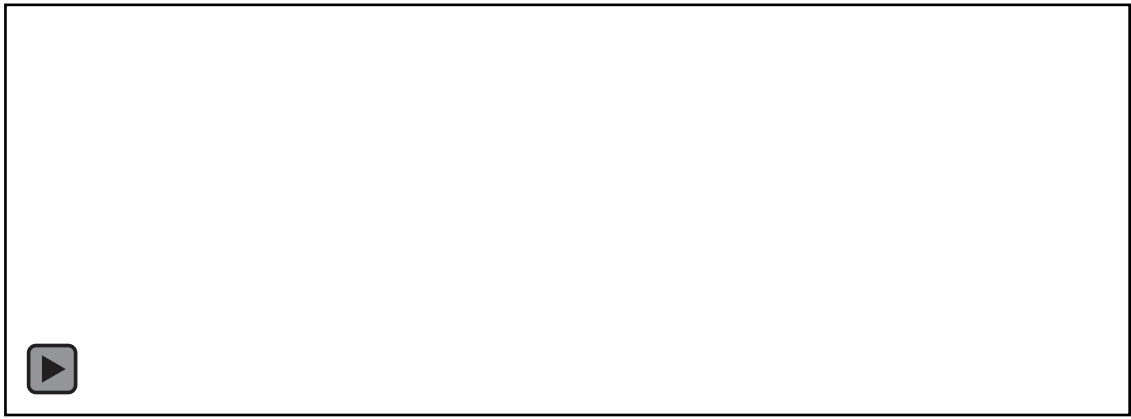
A resistance that can change its value



Components
Potentiometers

A resistance that can change its value

Resistance is changed when the knob is moved

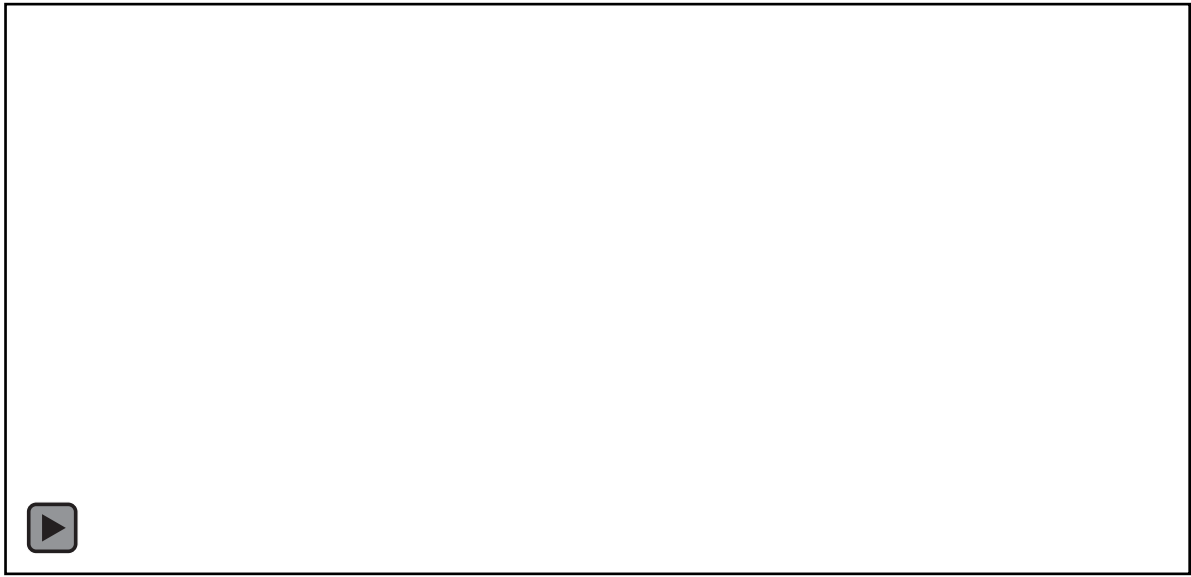


Video. Animation by Jon Froehlich

Components
Potentiometers

A resistance that can change its value

Resistance is changed when the knob is moved

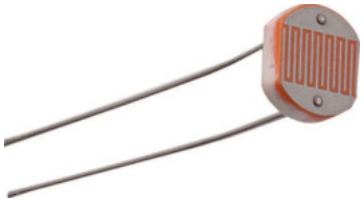


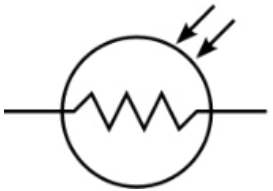
Video. Animation by Jon Froehlich

Components

Photosensitive resistor (LDR)

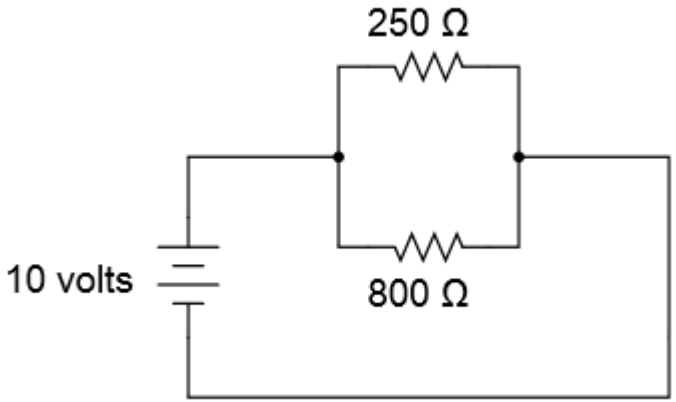
A photosensitive resistor (LDR) is a variable resistor which produces a resistance proportional to the amount of light it senses.
This is a type of sensor.





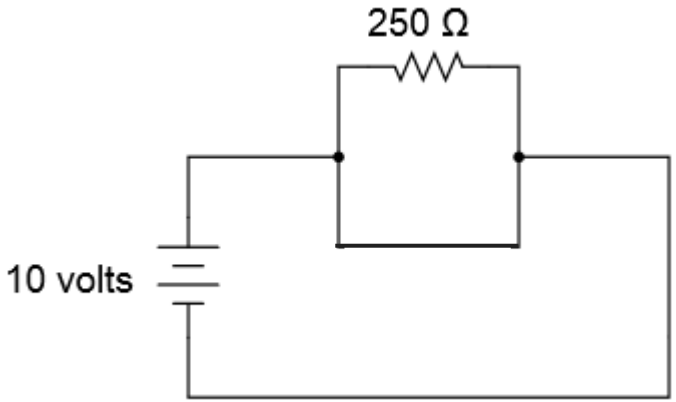
Components
Resistors

Current follows the path of least resistance to ground



Components
Resistors

Current follows the path of least resistance to ground



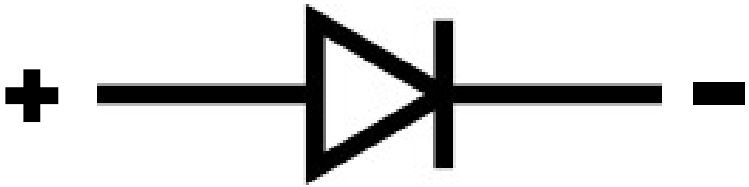
Components
Switch

Controls flow of current
across a junction

Components
Diode

A two-terminal electronic component that conducts current in one direction: *polarized*

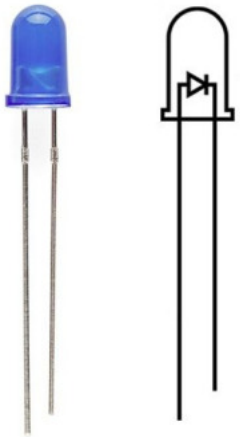
Anode: **+**
Cathode: **-**



Components
Light Emitting Diode (LED)

Special type of diodes that emits light when current passes through them

Anode (**+**): Longer leg
Cathode (**-**): shorter leg, connects to ground

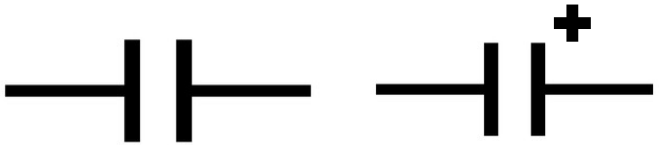


Components
Capacitors

Store up electricity while current is flowing into them, then release the energy when the incoming current is removed

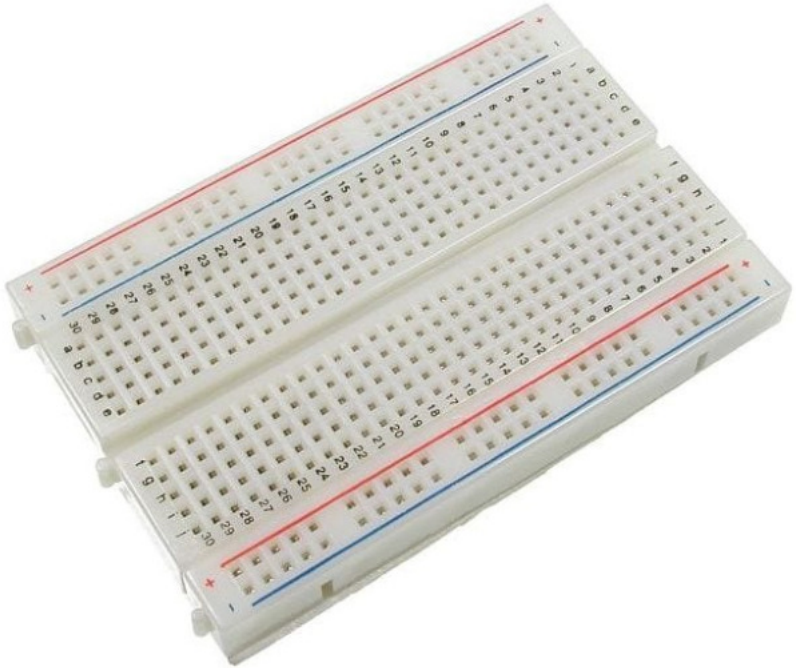
They are sometimes polarized

S.I. Unit: Farrad (F)



Components
Breadboard

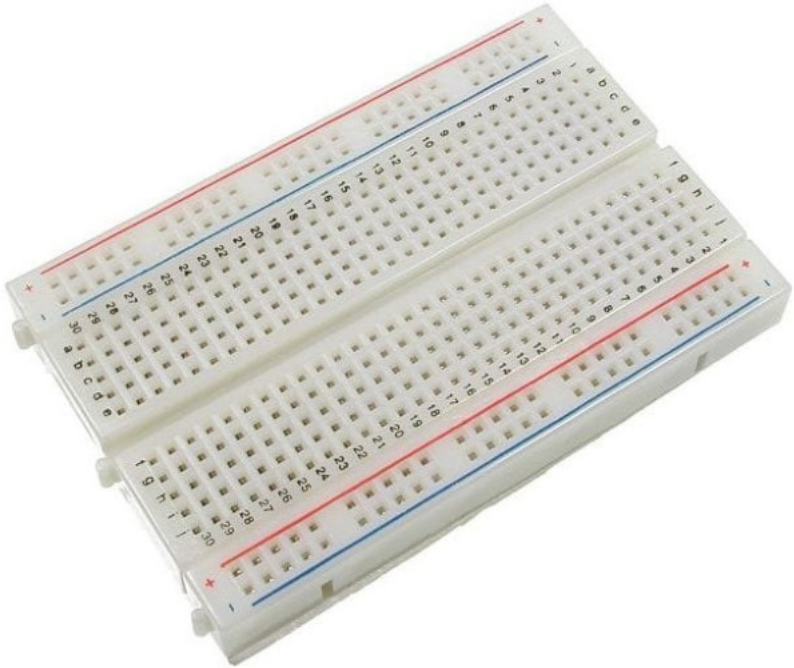
A breadboard is a solderless device for temporary prototype with electronics and test circuit designs



Components
Breadboard

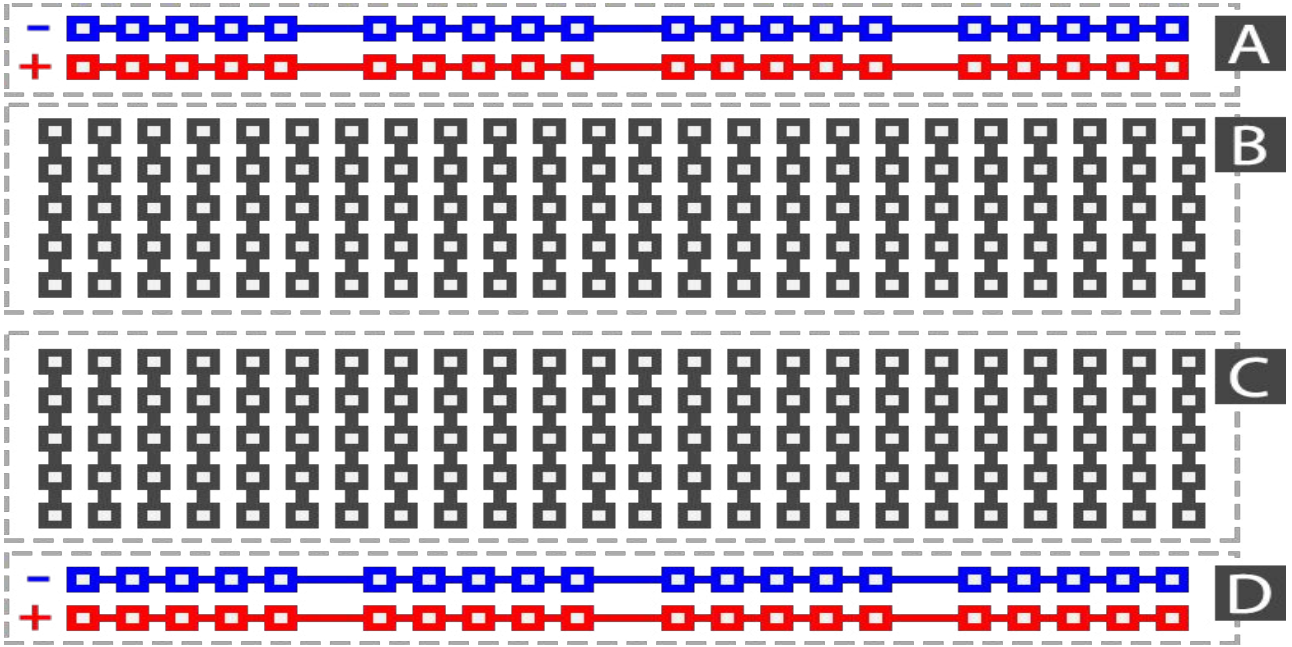
Avoid adding, removing, or changing components on the breadboard when the board is powered.

You could shock yourself or damage your components.



Components

Breadboard



Components
Overview

Breadboard: Simple way to connect components without using solder.

Wire: Passes current from one part of a circuit to another.

Power Supply: Supplies electrical energy.

Switch: An on-off switch allows current to flow only when it is closed (on).

Resistor (and Variable Resistors): Restricts the flow of current.

Capacitor: Stores electric charge. Base unit read Farad (uF).

Diode (General Purpose): Only allows current to flow in one direction.

LED (Light Emitting Diode): A transducer that converts electrical energy to light.

Transistor: Can be used as a switch or amplifier.

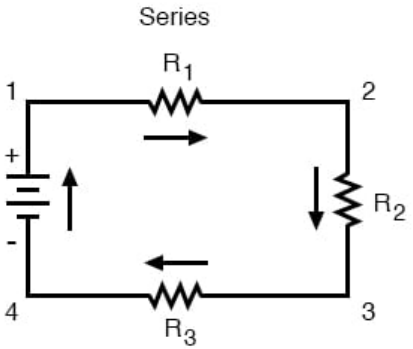
Relay: A switch that is controlled by another electrical circuit.

Voltage Regulators: Convert a higher voltage into a lower usable voltage.

Series and parallel

Series and parallel

Series circuit: An electrical circuit in which the components are connected end to end, so that the current flows through them all one after the other.



Resistance:

$$R_{tot} = R_1 + R_2 + R_3$$

Voltage:

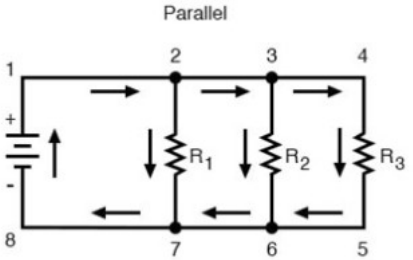
$$V_{tot} = V_1 + V_2 + V_3$$

Current:

$$I_{tot} = I_1 = I_2 = I_3$$

Series and parallel

Parallel circuit: An electrical circuit in which the components are connected side by side. The current flowing in the circuit is shared by the components.



Resistance:

$$R_{tot} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)^{-1}$$

Voltage:

$$V_{tot} = V_1 = V_2 = V_3$$

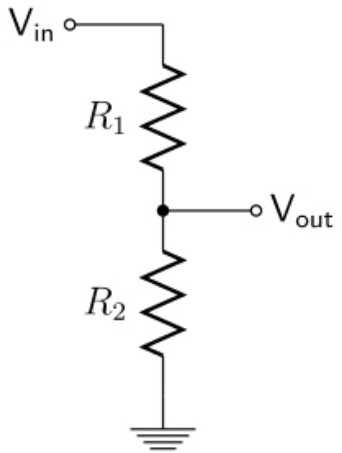
Current:

$$I_{tot} = I_1 + I_2 + I_3$$

Voltage divider

Voltage divider circuits are circuits that produce an output voltage (V_{out}) that is a fraction of its input voltage (V_{in}).

$$V_{out} = V_{in} \cdot \frac{R_2}{R_1 + R_2}$$



Exercises

Download the Week 1 Handout on the wiki.

Get as far as possible with the exercises during the lecture time. Complete them at home if you can't finish.

During remote learning: create the circuits through Tinkercad circuits.

Send a document with your name, screenshots of your circuits, and answers to the questions to ***ahv1@sfu.ca***.
Deadline: Sunday 11.59pm