

Basic Electronics



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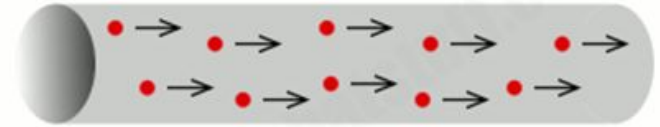
2019

Electricity

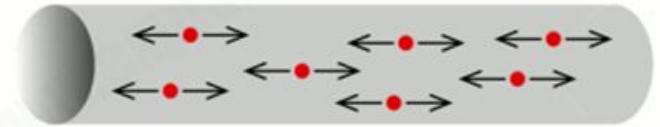
- Flow of electrons
- Two types of electrical signals
 - alternating current (AC) – wall socket supply
 - direct current (DC) – battery
- Conductors Vs. Insulators
 - an electrical conductor allows the flow of electricity through it (metal)
 - an insulator prevents the flow of electricity through it (rubber, plastics, wood)
- Circuit
 - a complete and closed path through which electric current can flow
 - closed circuit vs. open circuit

Direct current (DC)

www.explainthatstuff.com

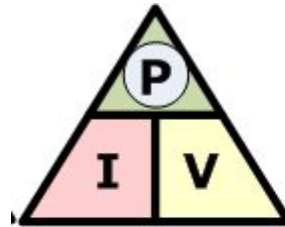


Alternating current (AC)

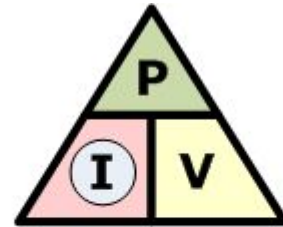


Voltage and Current

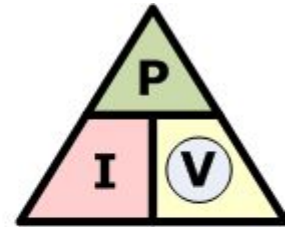
- Electricity is typically defined as having
 - V: voltage – Volts (V)
 - I: current rating – Amps (A)
- Voltage, also called electromotive force, is the potential difference in charge between two points in an electrical field.
 - How fast?
- Current is a flow of electrical charge carriers.
 - How much?
- P: *Power=Voltage×Current*
 - $P = VI$



$$\textcircled{P} = I \times V$$



$$\textcircled{I} = \frac{P}{V}$$

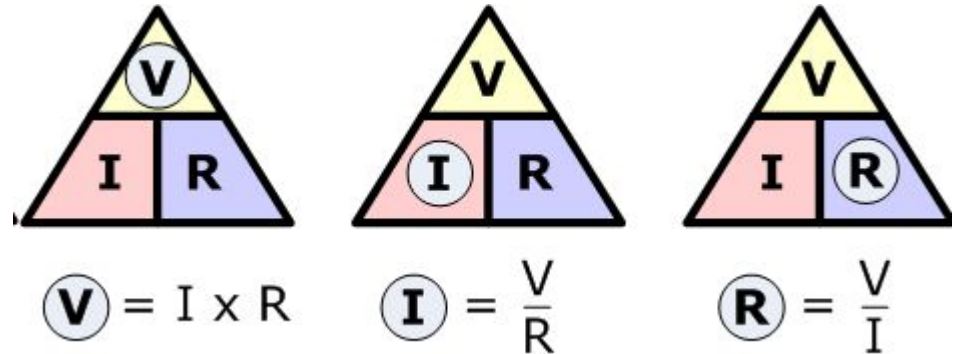


$$\textcircled{V} = \frac{P}{I}$$

Resistance

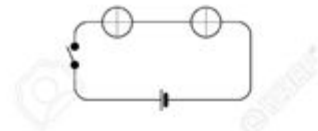
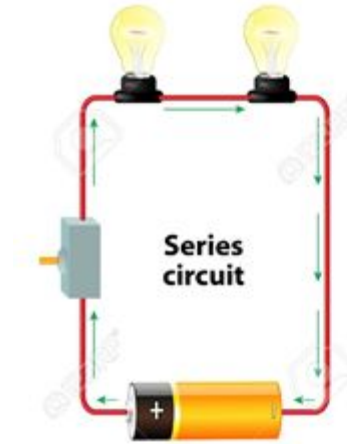
- R: Resistance
 - The opposition that a substance offers to the flow of electric current.
 - Ohm – unit of resistance
 - Ω – symbol (uppercase Greek letter omega)
- Ohm's Law
 - mathematical relationship among electric current, resistance, and voltage
 - $V = IR$
 - $I = V/R$
 - $R = V/I$

- <https://www.youtube.com/watch?v=-jX3dezzMg>
- https://www.youtube.com/watch?v=F_vLWkkOETI

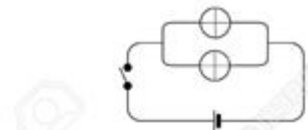
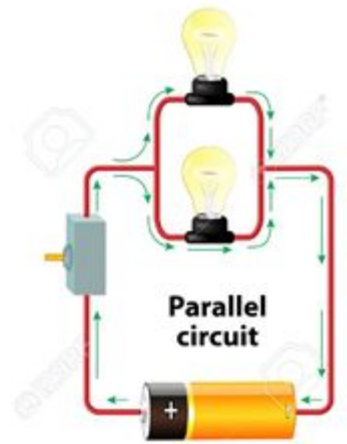


Series vs. Parallel

- Series
 - things are wired one after another
 - electricity has to pass through one thing, then the next thing
- Parallel
 - things are wired side by side
 - electricity passes through all of them at the same time, from one common point to another common point



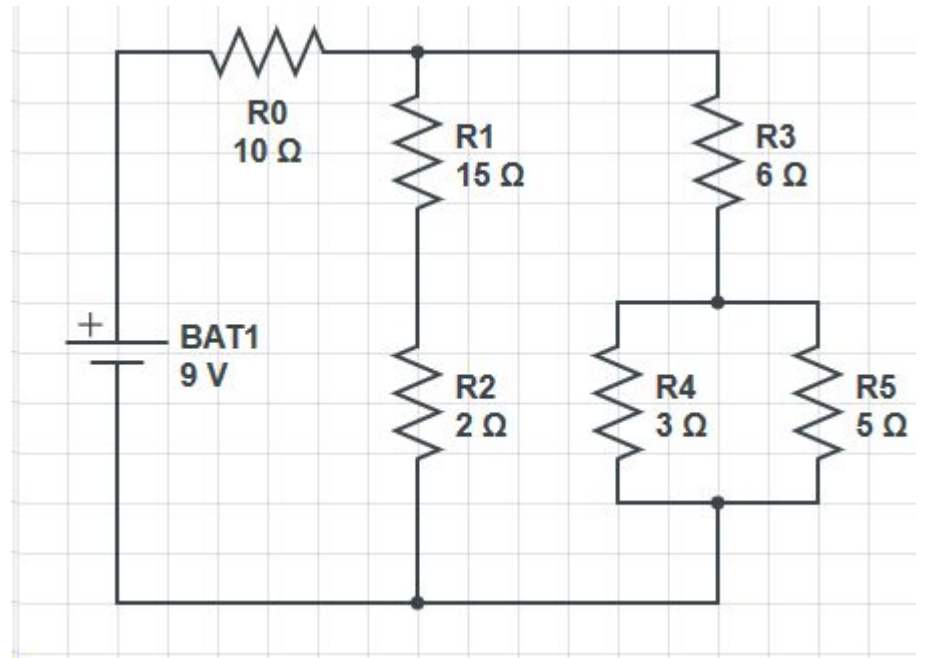
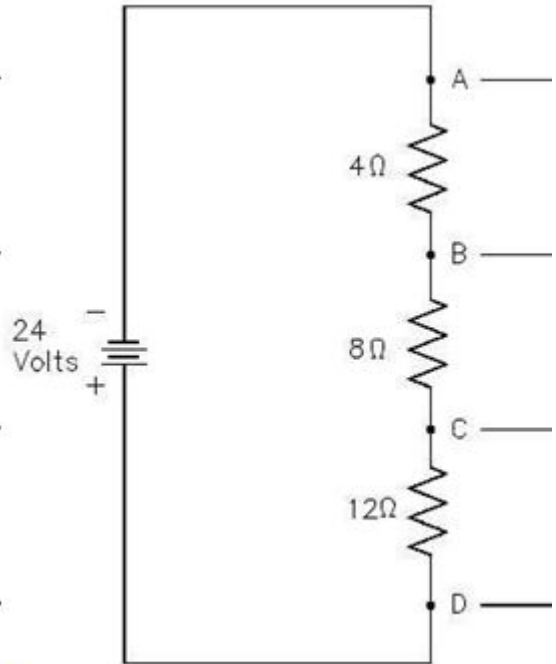
$$R_S = R_1 + R_2$$



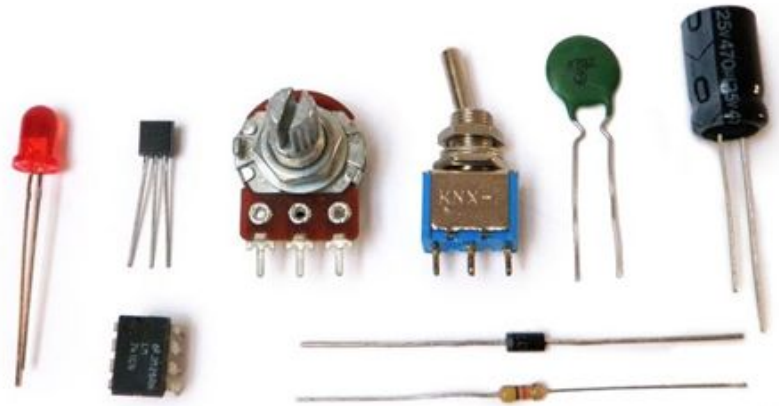
$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$$

Exercise

- Calculate voltage and current for each resistor.



Basic Components

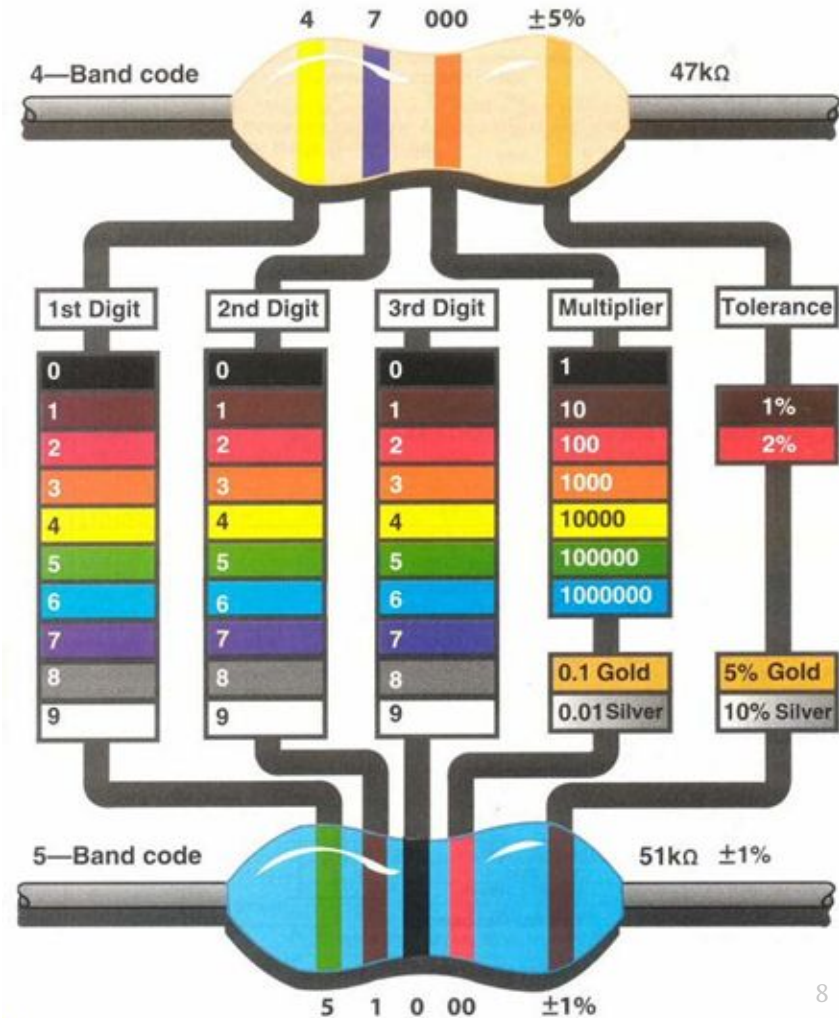


Resistors

- Resistors add resistance to the circuit and reduces the flow of electrical current
- Measured in ohm

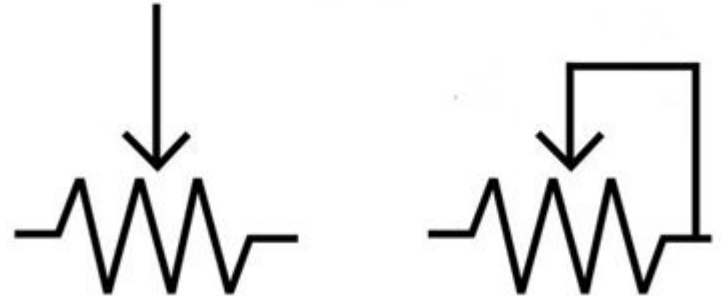


- <https://www.youtube.com/watch?v=7w5I-KbJISg>



Potentiometers

- Potentiometers are variable resistors.
- They have some sort of knob or slider that you turn or push to change resistance in a circuit.



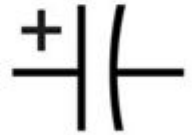
- <https://www.youtube.com/watch?v=DsdjHtIkJXM&t=9s>

Capacitors

- Stores electricity and then discharges it into the circuit when there is a drop in electricity.
- Measured in Farads, typically picofarad (pF), nanofarad (nF), and microfarad (uF)
- Ceramic disc capacitors are non-polarized. Electrolytic capacitors are typically polarized.
- <https://www.youtube.com/watch?v=otQGdPLyF3w>



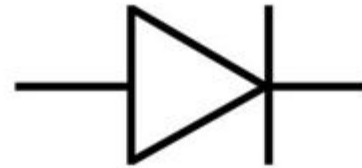
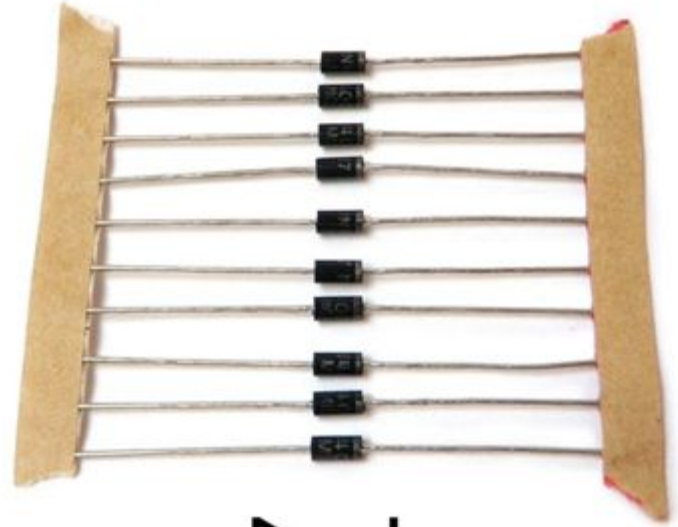
.047uF



470uF

Diodes

- Diodes are components which are polarized.
- They only allow electrical current to pass through them in one direction.
- Terminals:
 - Ring side: connects to ground – Cathode
 - Other side: connects to power – Anode
- <https://www.youtube.com/watch?v=JNi6WY7WKAI>



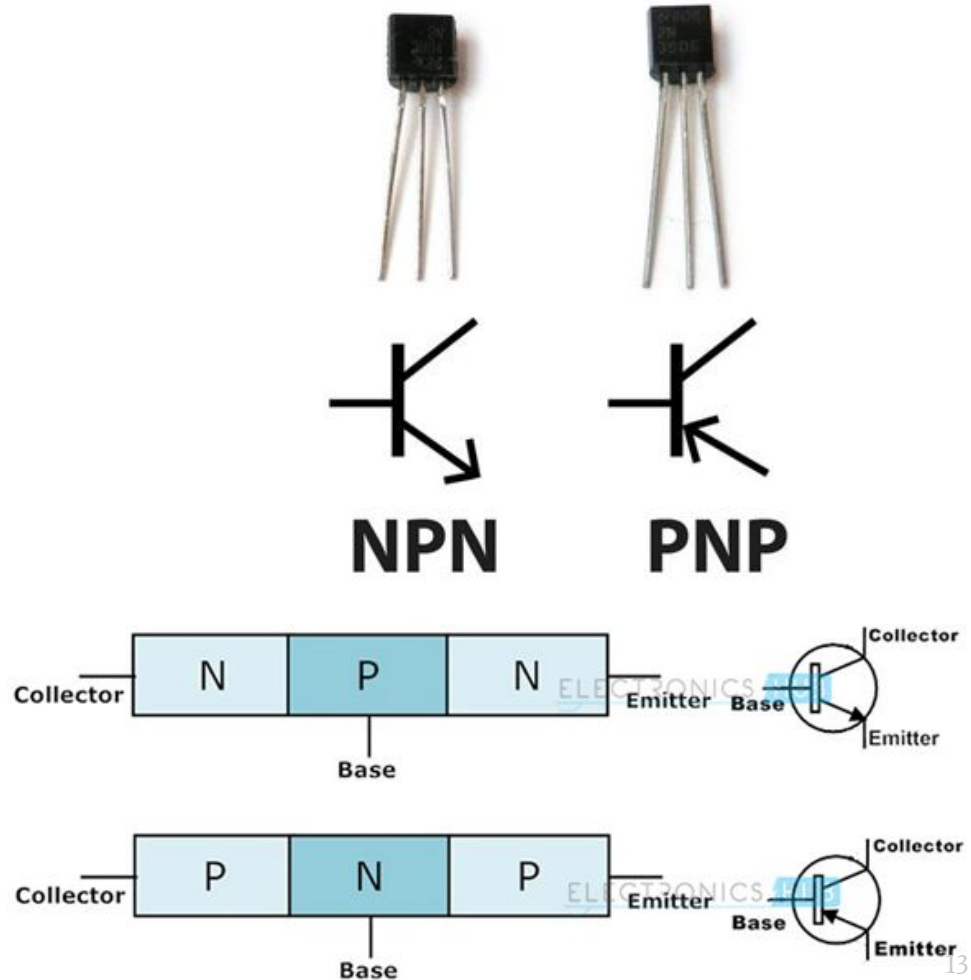
Light Emitting Diode (LED)

- A special type of diode that lights up when electricity passes through it.
- LEDs typically do not add much resistance.
- In order to prevent the circuit from shorting, you need to add a resistor in series.
- <https://www.youtube.com/watch?v=Qlayua3yjuE>



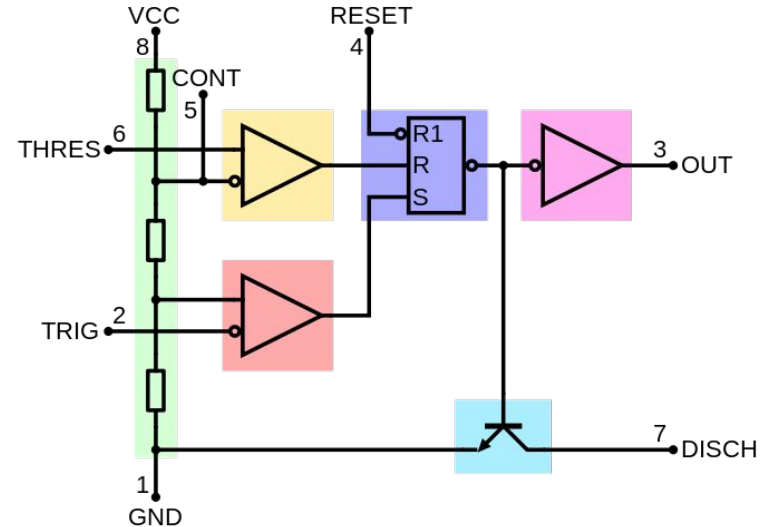
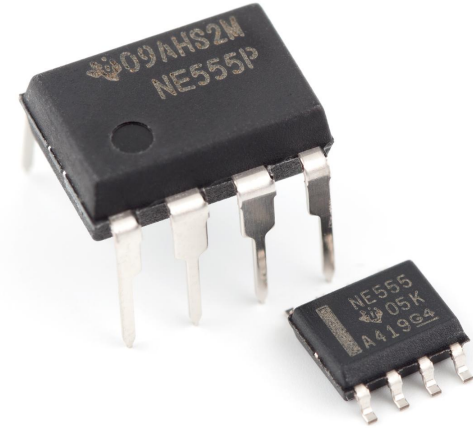
Transistors

- Takes in a small current at base pin and amplifies it such that a much larger current can pass between collector and emitter pins.
- The amount of current that passes between these two pins is proportional to the voltage being applied at the base pin.
- <https://www.youtube.com/watch?v=7ukDKVHnac4>

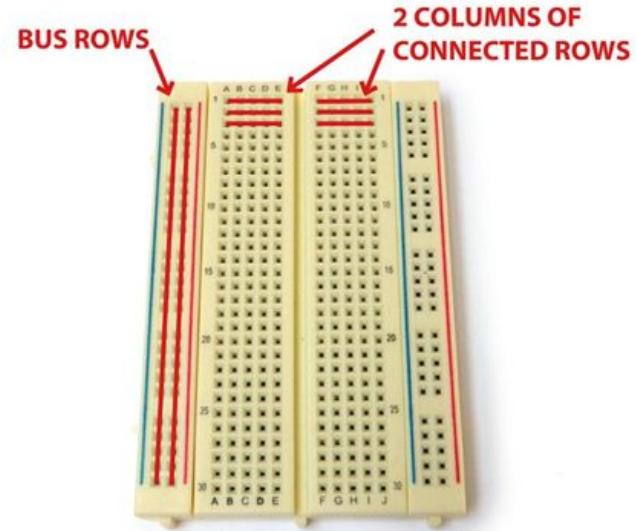


Integrated Circuits

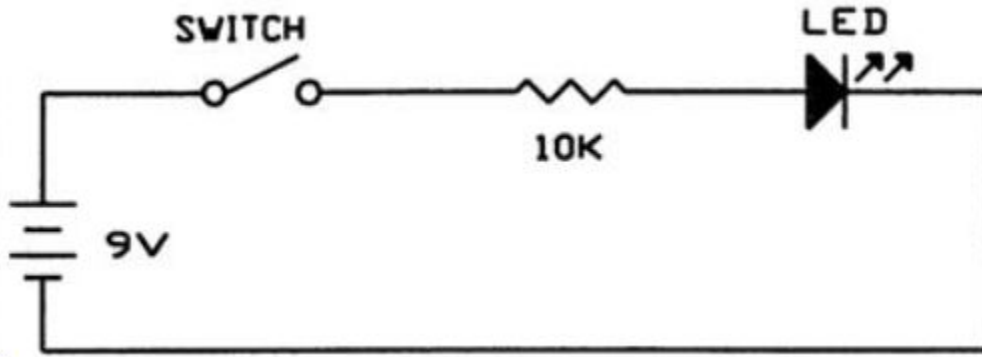
- An entire specialized circuit that has been miniaturized and fit onto one small chip



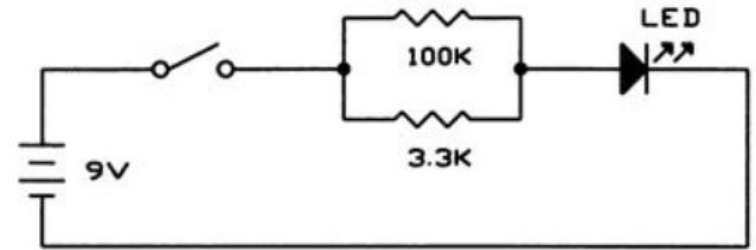
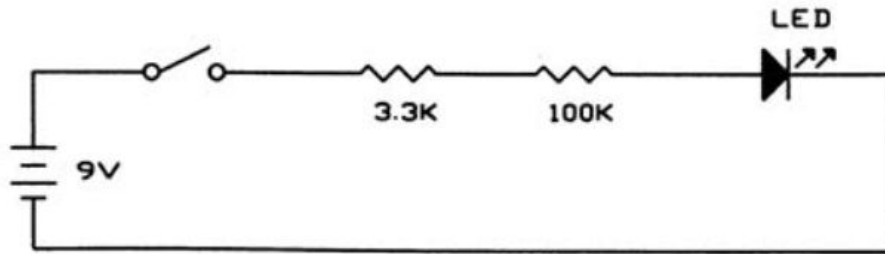
Some more components



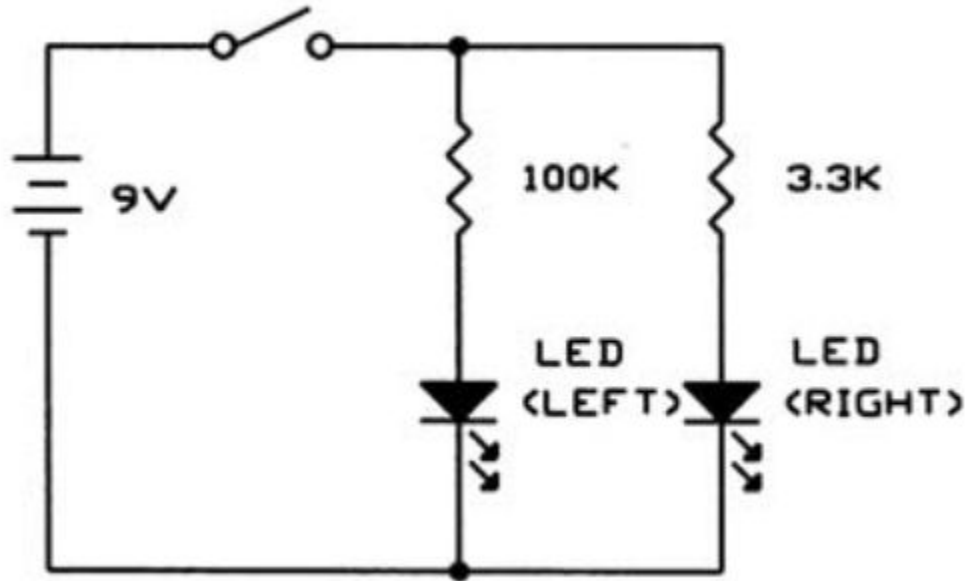
Experiment #1



Experiment #2A, #2B

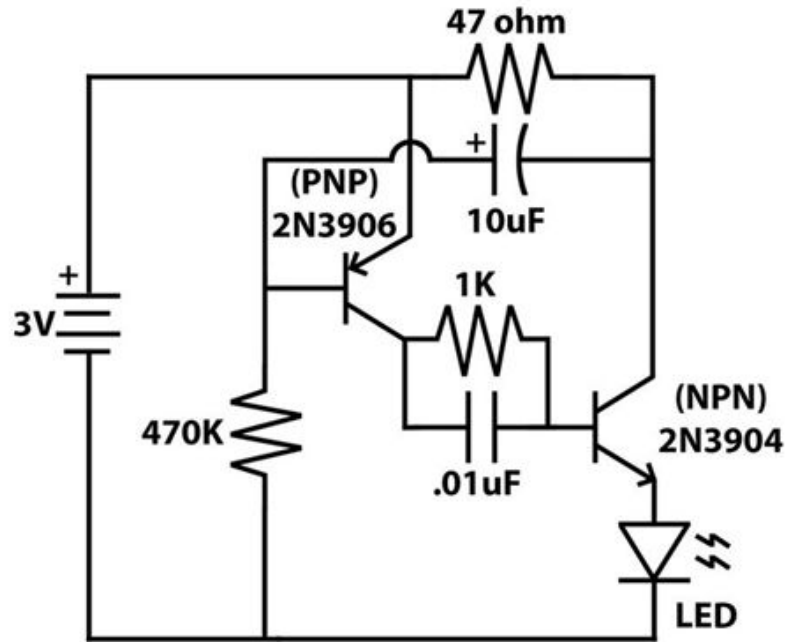


Experiment #3



- Replace the 100k Ω resistor with several values (such as 1k Ω , 10k Ω) and observe.

Experiment #4



Experiment #5

