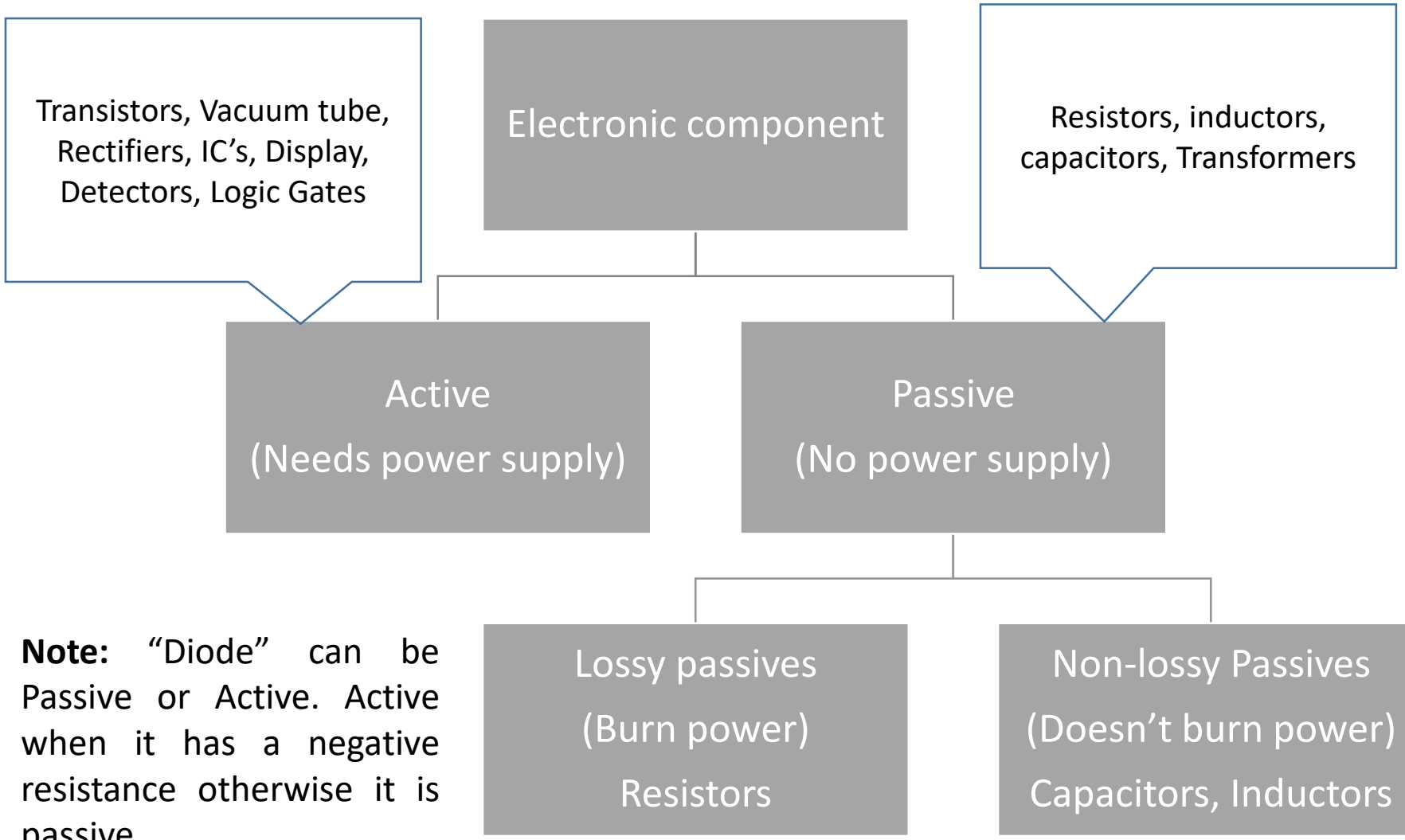
Basic Electronic components

List of basic Electronics Components

- Resistors
- Potentiometers
- Capacitors
- Diode
- Transistors
- Breadboard
- Multi-meter

Types of Electronics Components



Note: "Diode" can be Passive or Active. Active when it has a negative resistance otherwise it is passive.

Types of Electronics Components

Active Components:
Those devices or components which required external source to their operation is called Active Components.
For Example: Diode, Transistors, etc…
Explanation and Example: Diode is required an External Source to its operation.

Because, If we connect a Diode in a Circuit and then connect this circuit to the Supply voltage., then Diode will not conduct the current Until the supply voltage reach to 0.3(In case of Germanium) or 0.7V(In case of Silicon)

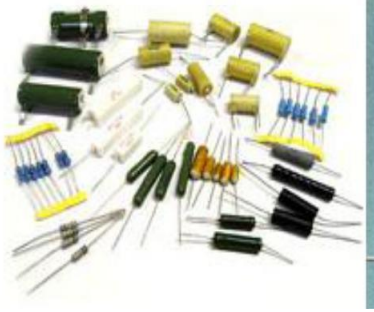
Passive Components:
Those devices or components which do not required external source to their operation is called Passive Components.
For Example: Resistor, Capacitor, Inductor etc…
Explanation and Example: Passive Components do not require external source to their operation.

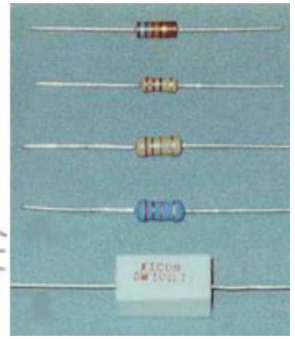
Like a Diode, Resistor does not require 0.3 or 0.7 V. I.e., when we connect a resistor to the supply voltage, it starts work automatically without using a specific voltage.

Basic Electronics Components

Resistors

- Resistor is passive-two electrical component that implements electrical resistance as a circuit element.
- Resistors are used to reduce current flow and act lower voltage levels within circuit
- Registers are also used to adjust signal levels, divide voltage, terminate transmission lines.
- Values specified in ohms (Ω), kilo-ohms (K), or mega-ohms (M)





Basic Electronics Components

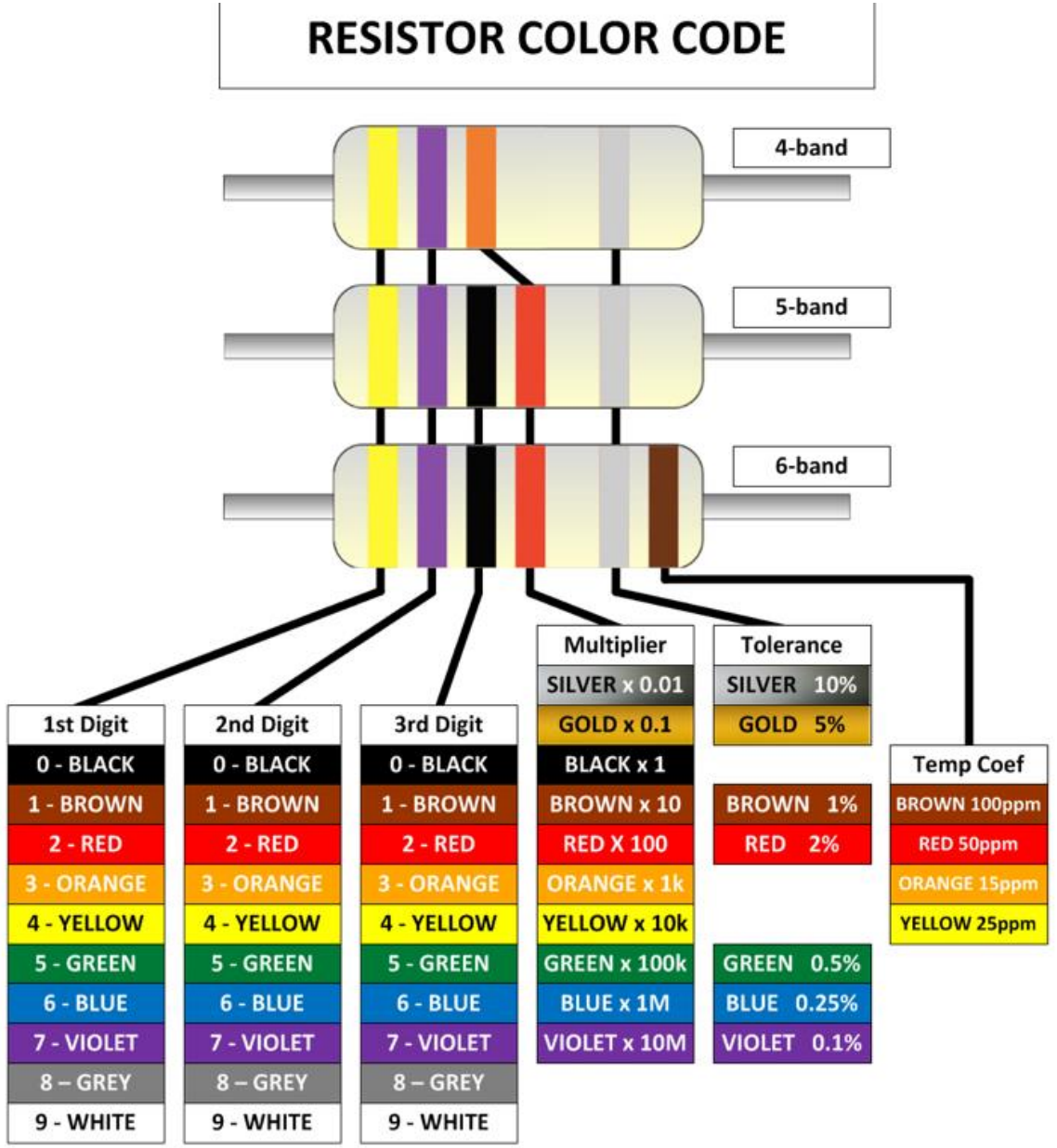
Resistors

Example:

Band 1=RED, Band 2=VIOLET
Band 3=ORANGE, Band 4=GOLD

The value of this resistor would be:

2(Red) 7(Violet) x 1000 (Orange)
= 27 x1000
=27000 with a 5% Tolerance (Gold)
=27k ohms



Basic Electronics Components

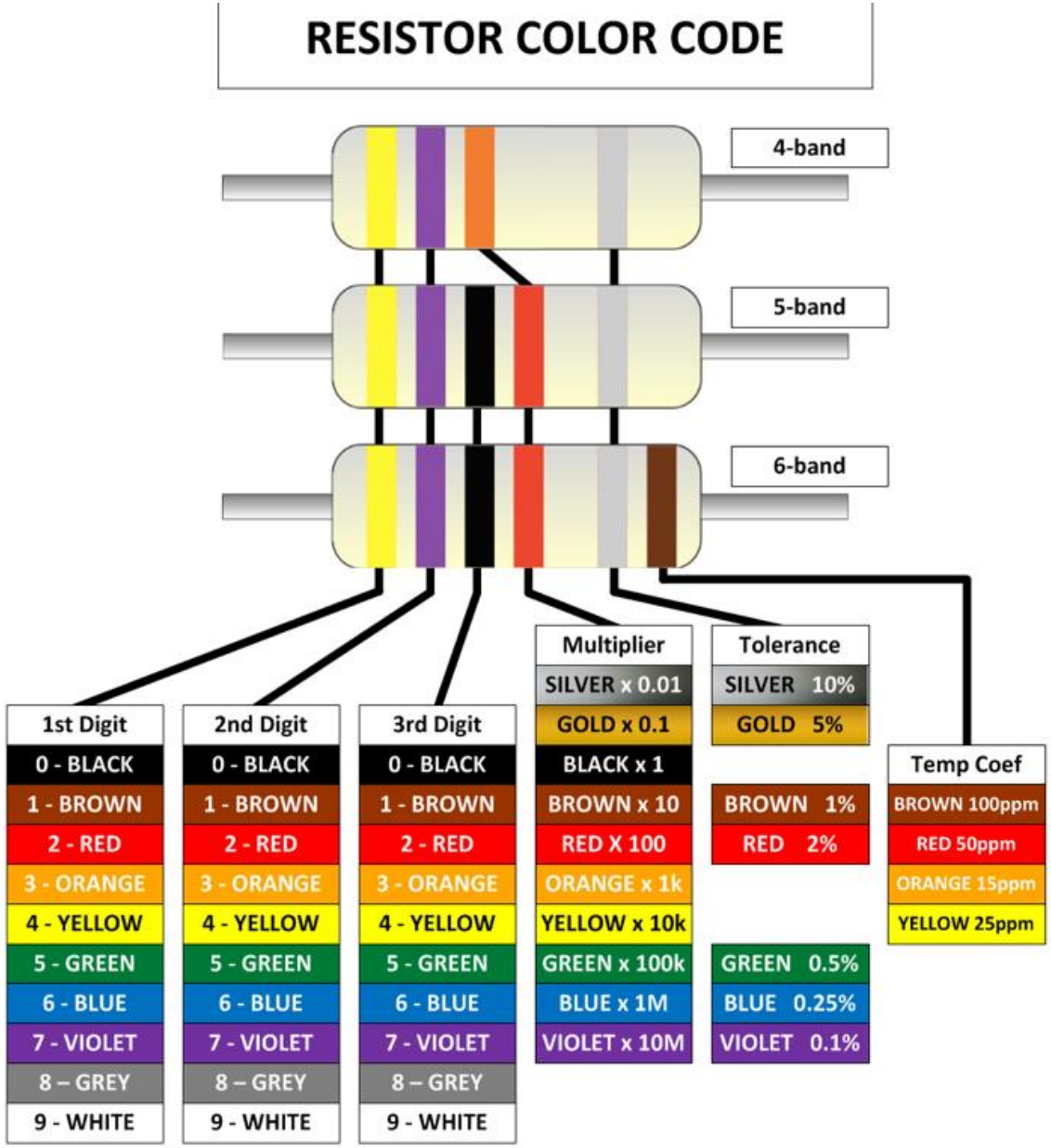
Resistors

Example:
Calculate the value of Resistors:

1st Band	2nd Band	Multiplier x	Value
Brown	Black	Yellow	
Green	Blue	Brown	
Brown	Grey	Yellow	
Orange	White	Black	

Answer:

100k ohms
560 ohms
180k ohms
39 ohms



Basic Electronics Components

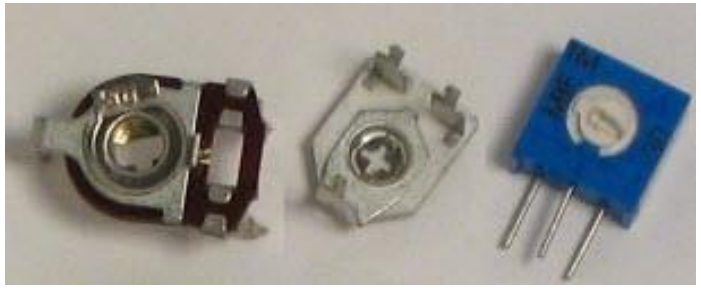
Resistor handling and installation

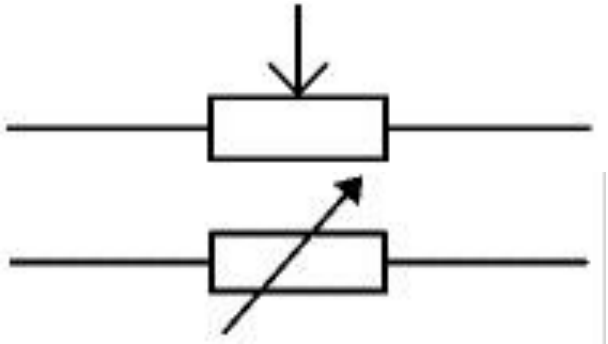
- Resistors are not polarized and may be installed in either direction
- Resistors are not generally responsible to ESD damage, so special precautions are not required
- Mechanical stress due to lead bending should be minimized

Basic Electronics Components

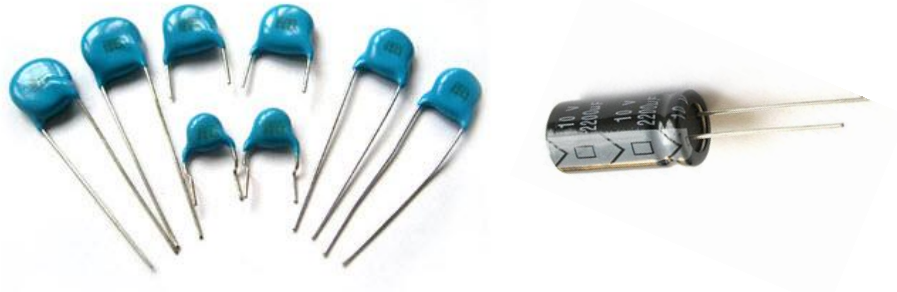
Potentiometers

- A potentiometer is an electrical component with a variable resistance.
- They normally have their value marked with the maximum value in “ohms”.
- 3-digit code where the first 2 digits are significant, and the 3rd is the multiplier.
- For example, code 104 = 10 followed by four 0’s = 100000 Ohms = 100K Ohms
- It is used as volume knob in music systems, as fan regulators etc..





Basic Electronics Components



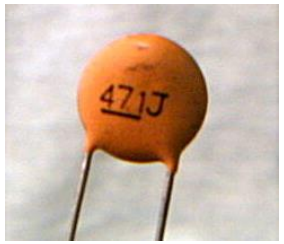
Capacitor

- A capacitor is a passive electronic component that stores energy in the form of an electrostatic field.
- The capacitor is made of 2 close conductors (usually plates) that are separated by a dielectric material.
- One plate of the capacitor is positively charged while other has negative charge.
- The capacitance is a measure of the amount of charge a capacitor can store. This is determined by the capacitor geometry and by the kind of determine between the plates.
- The capacitance is directly proportional to the surface areas of the plates, and is inversely proportional to the separation between the plates.

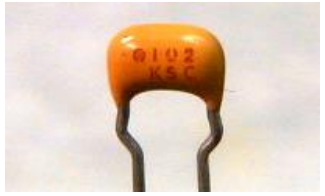
- Capacitance also depends on the dielectric constant of the substance separating the plates
- Capacitance is usually measured in microfarads (abbreviated uF or mfd) or picofarads (pF).
- Marked with actual value or a numeric code
- Some varieties are +/- polarized
- Types of Capacitors: Ceramic or Electrolytic

Basic Electronics Components

- **Applications:**
  - Computer memory
  - All electrical circuits
  - Used to minimize the voltage fluctuation
  - Flash bulb for a camera

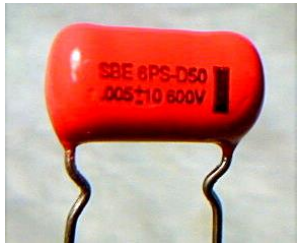


Ceramic disk

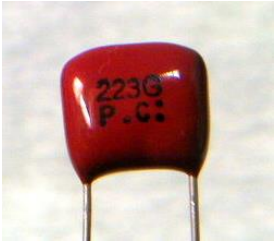


Monolithic ceramic

Dipped siver-mica



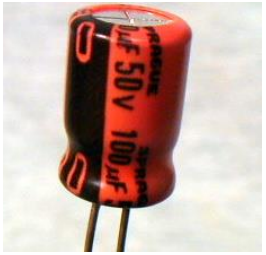
Mylar



Mylar

Types of Capacitors

Solid tantalum, polarized



Radial aluminum electrolytic

Axial aluminum electrolytic

Basic Electronics Components

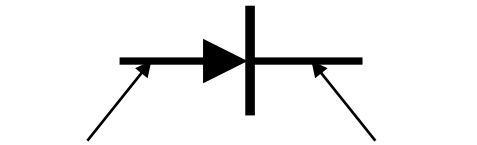
Capacitor handling and installation

- Most capacitors are not polarized and may be installed in either direction.
- Electrolytic capacitors ARE polarized and MUST be installed with proper polarity, else catastrophic failure!
- Capacitors are not generally susceptible to ESD damage, so special precautions are not required.
- Mechanical stress due to lead bending should be minimized.

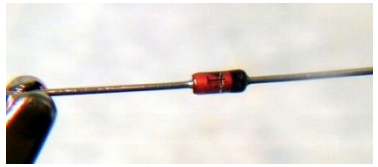
Basic Electronics Components

Diode

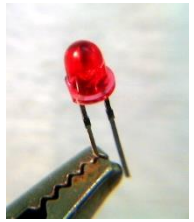
- A diode is a two-terminal electronic component (anode and cathode) that conducts electric current in only one direction.
- Most diodes made with semi-conductor material such as silicon, germanium or selenium. Some diode filled with a pure elemental gas at low pressure.
- Diode is considered as *passive* since they do not contribute any amplification or *gain* to a circuit.
- Diode can be used as rectifiers, signal limiters, voltage regulators, switches etc..
- Semiconductor diodes can be designed to produce direct current (DC) when visible light, IR, or ultraviolet (UV) energy strikes on them. These diodes are known as photovoltaic cells.
- LED it self is family of diode



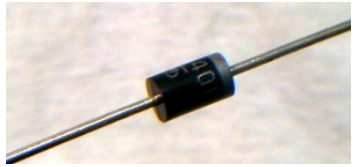
Anode (+) **Cathode (-)**



Small signal detector or switching diode



Light-emitting diode (LED)



Rectifier diode

Basic Electronics Components

Diode handling and installation

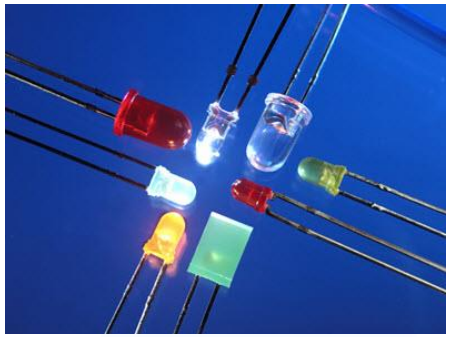
- Diodes are polarized and must be installed in with correct orientation.
- Many diodes are modestly susceptible to ESD damage, so normal ESD precautions should be taken.
- Mechanical stress due to lead bending should be minimized.

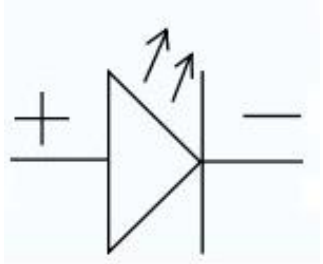
Basic Electronics Components

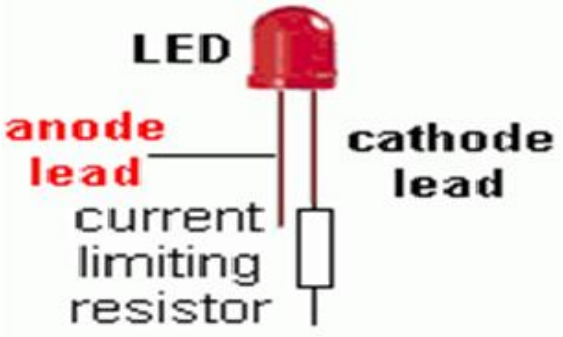
Light Emitting Diode (LED)

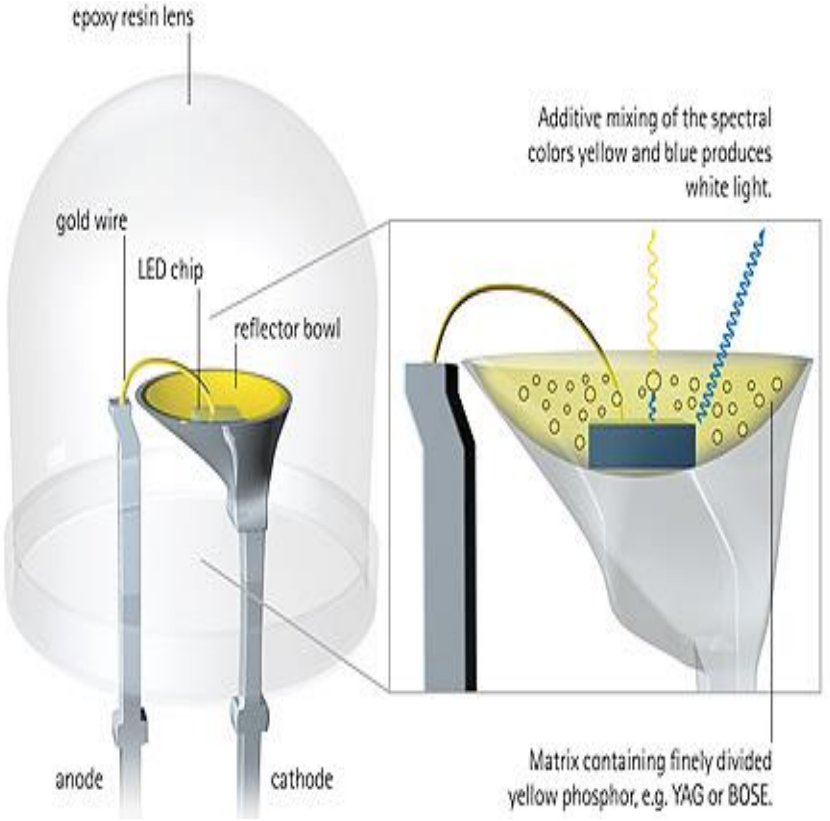
- A Light emitting diode is simply a diode that lights up when current flows through one direction

- Uses: (General lighting, Displays, Traffic and street lights, Decorative purposes)









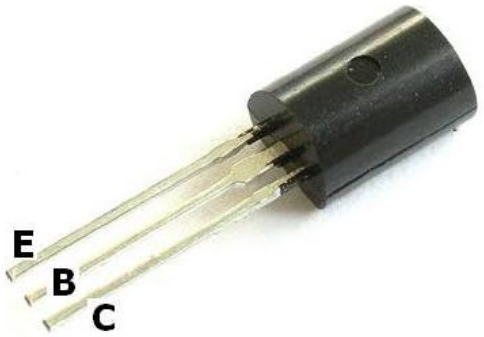
Basic Electronics Components

Active Components

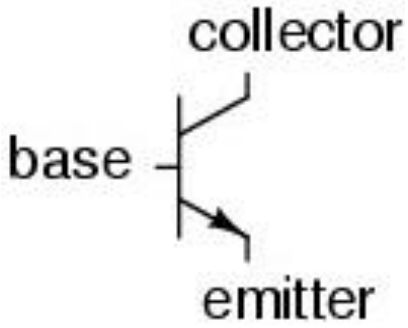
Basic Electronics Components

Transistors

- Transistors is a semi-conductor device.
- The transistor is like an electronic switch. It can turn a current on and off. A transistor is similar to a relay in the sense that you can use it to turn something ON and OFF.
- There are different types of transistors. A very common one is the “bipolar junction transistor” or “BJT”. And it usually looks like this:



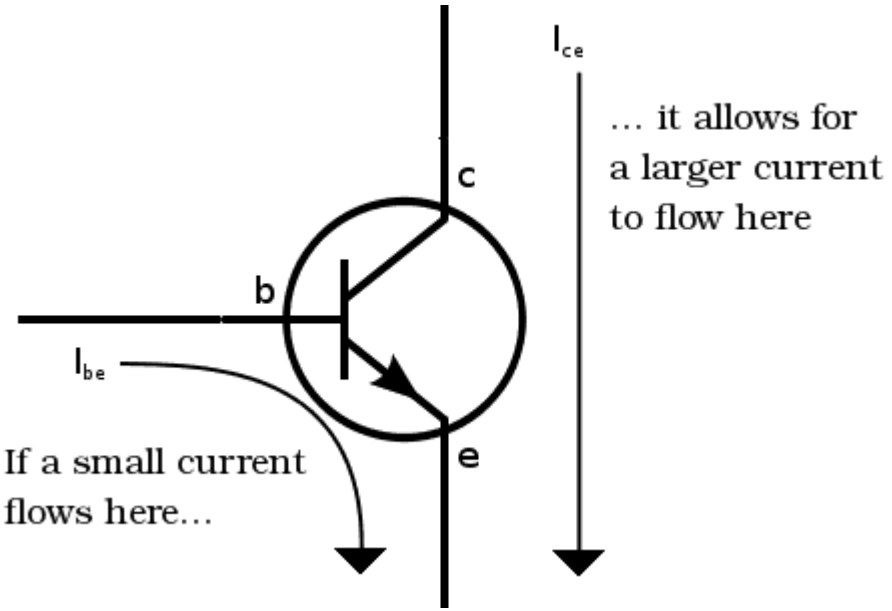
It has three pins: **Base (b), collector (c) and emitter (e)**. And it comes in two versions: NPN and PNP. The schematic symbol for the NPN looks like this:

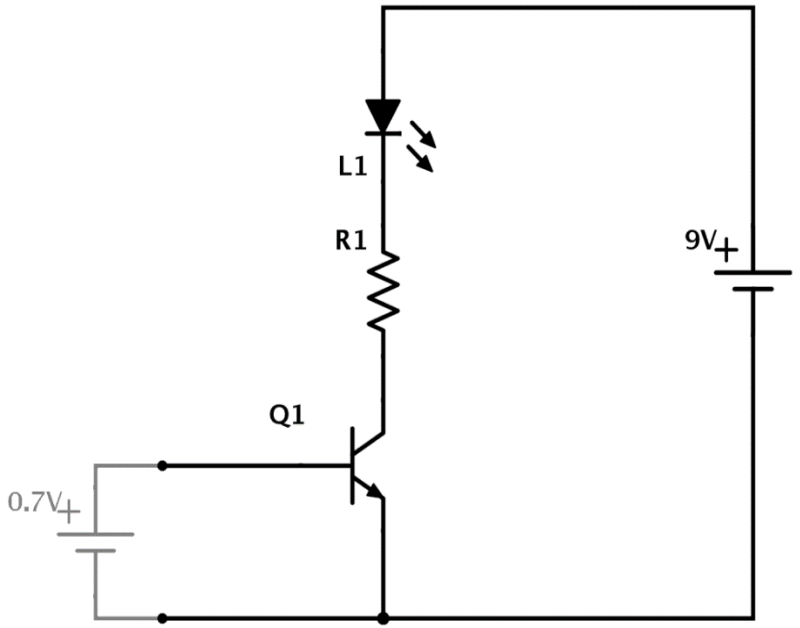


Basic Electronics Components

Transistors

A current flowing from the base to the emitter “opens” the flow of current from the collector to the emitter.



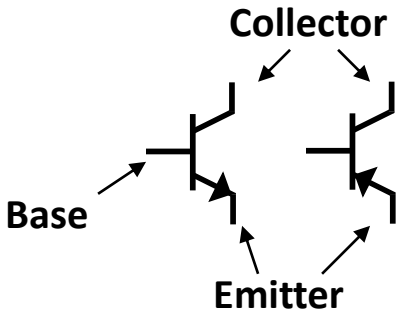


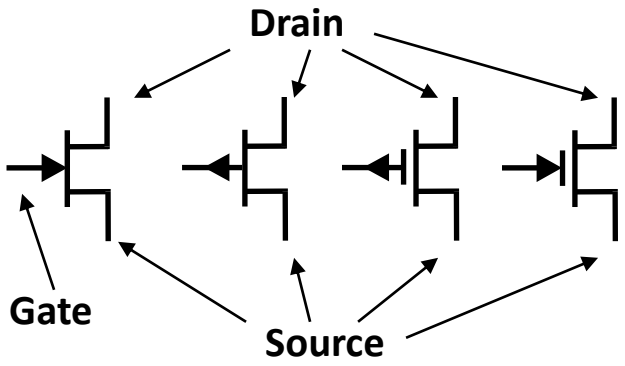
Example: 9V battery connects to an LED and a Resistor. But it connects through the transistor. This means that no current will flow in that part of the circuit until the transistor turns ON. To turn the transistor ON you need to apply 0.7V from base to emitter of the transistor. When you apply the 0.7V battery from base to emitter, the transistor turns ON. This allows current to flow from the collector to the emitter. And thereby turning the LED ON!

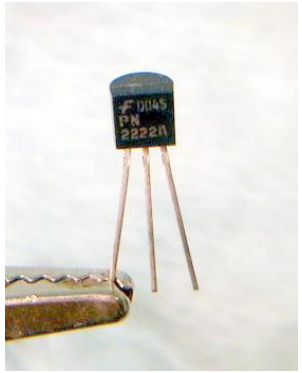
Basic Electronics Components

Transistors

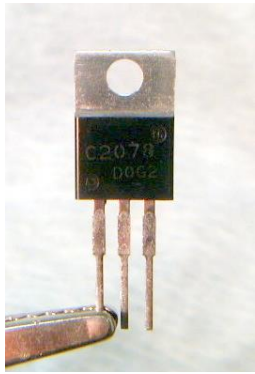
Terminal Designations and packaging styles



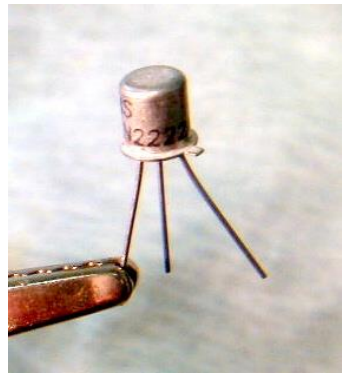




2N2222 in a TO-92 package



2SC2078 in a TO-220 package



2N2222A in a TO-18 package

Basic Electronics Components

Transistors handling and installation

Transistors are polarized and must be installed in with correct orientation.

Most BJT transistors are modestly susceptible to ESD damage, so normal ESD precautions should be taken.

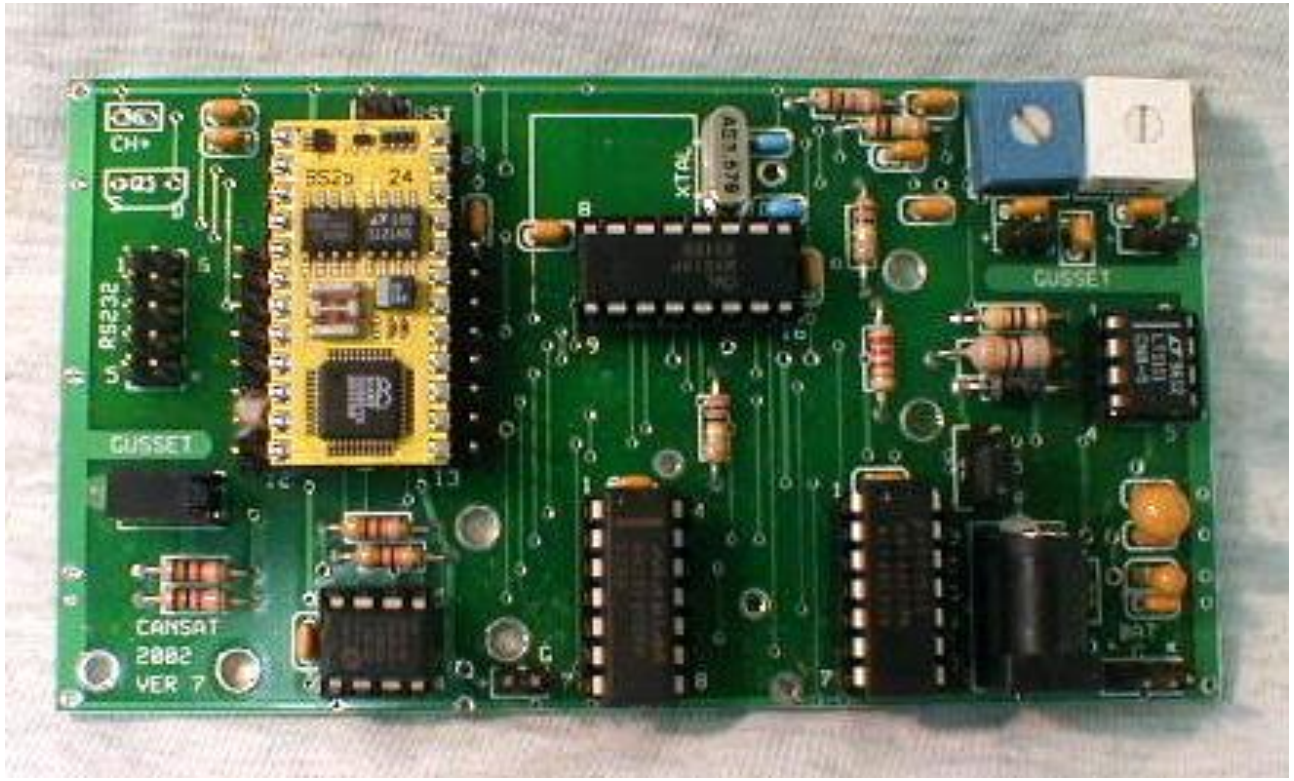
MOSFET (IGFET) transistors are ***very susceptible*** to ESD damage, so rigorous precautions should be taken.

Mechanical stress due to lead bending should be minimized.

Basic Electronics Components

Integrated Circuits (IC)

Integrated circuits (ICs) are multi-terminal devices that provide an array of functions and applications far to numerous to list here.



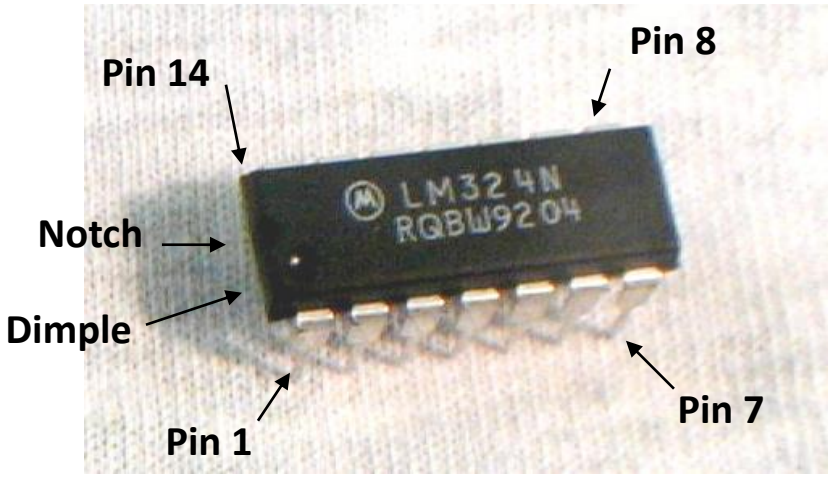
Basic Electronics Components

Pin identification and numbering convention

Pins are numbered sequentially in a counterclockwise direction.

Pin 1 is often identified with a dot or a dimple.

The pin 1 end of the chip is often identified with a notch.



Basic Electronics Components

IC handling and installation

ICs are polarized and must be installed with correct orientation. Observe pin 1 location on sockets or circuits.

Treat all ICs as if they are ***very susceptible*** to ESD damage (very many actually are), so rigorous precautions should be taken.

Leads generally should not be bent.

Basic Electronics Components

Electrostatic Discharge (ESD) Protection

Ground your work surface

- Use an anti-static mat

Ground your tools (i.e., soldering iron)

- Many irons are constructed with a grounded tip

Ground yourself

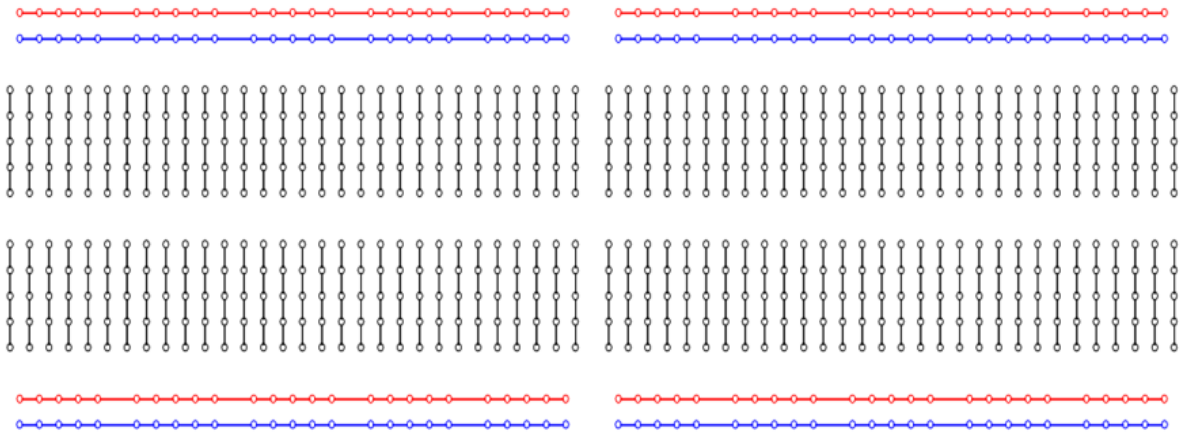
- Use a wrist or ankle strap, ***but always include a series resistor of high value to avoid any shock hazard.***

Touch a grounded object before handling static sensitive components.

Basic Electronics Components

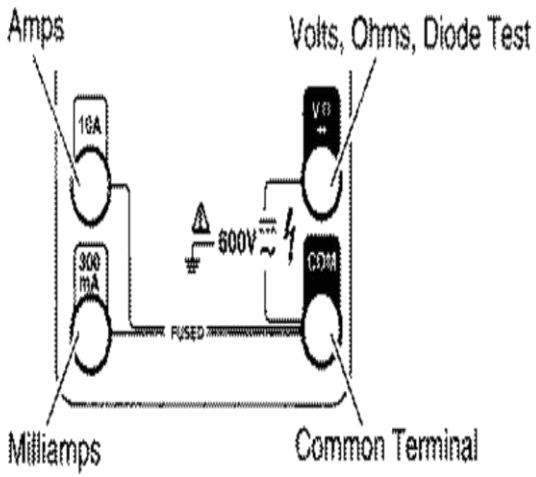
BREADBOARD

A solder less breadboard is an essential tool for rapidly prototyping electronic circuits.
Components and wire push into breadboard holes.
Rows and columns of holes are internally connected to make connections easy.
Wires run from the breadboard to the I/O pins on the Arduino board or raspberry PI.



Multimeter

- A Multimeter is an electronic device that is used to make various electrical measurements, such as AC and DC **voltage**, AC and DC **current**, and **resistance**.
- It is called a Multimeter because it combines the functions of a voltmeter, ammeter, and ohmmeter.
- Multimeter may also have other functions, such as diode test, continuity test, transistor test, TTL logic test and frequency test.



Parts of Multimeter

- A Multimeter has three parts: **Display, Selection Knob, Ports**
- The **display** usually has four digits and the ability to display a negative sign.
- A few multimeters have illuminated displays for better viewing in low light situations.
- The **selection knob** allows the user to set the multimeter to read different things such as milliamps (mA) of current, voltage (V) and resistance (Ω).
- Two probes are plugged into two of the **ports** on the front of the unit.
- COM stands for common and is almost always connected to Ground or '-' of a circuit.
- The COM probe is conventionally black but there is no difference between the red probe and black probe other than color.
- 10A is the special port used when measuring large currents (greater than 200mA)

Ohms Law

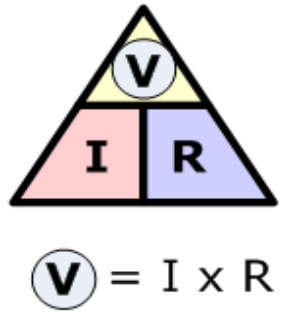
- Georg Ohm found that, at a constant temperature, the electrical current flowing through a fixed linear resistance is directly proportional to the voltage applied across it, and also inversely proportional to the resistance.
- **Ohms Law** describes the direct relationship between the Voltage (V), Current (I) and Resistance (R).

$$Current\ (I) = \frac{Voltage\ (V)}{Resistance\ (R)} \text{ in Amperes (A)}$$

- By knowing any two values of the Voltage, Current or Resistance quantities we can use **Ohms Law** to find the third missing value.

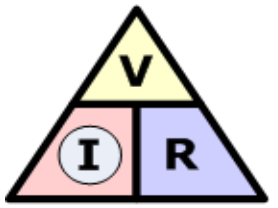
Ohms Law

- **Ohms Law** is used extensively in electronics formulas and calculations so it is "very important to understand and accurately remember these formulas".
- **To find the Voltage, (V)**
  - ❖[V = I x R] V (volts) = I (amps) x R (Ω)



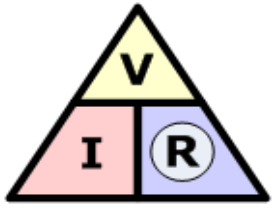
$V = I \times R$

- **To find the Current, (I)**
  - ❖[I = V ÷ R] I (amps) = V (volts) ÷ R (Ω)



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

- **To find the Resistance, (R)**
  - ❖[R = V ÷ I] R (Ω) = V (volts) ÷ I (amps)



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

Electrical Properties

Ohms Law

$$V = I R$$

Voltage (V)

- Defined as the amount of potential energy in a circuit.
- Units: Volts (V)

Current(I)

- The rate of charge flow in a circuit.
- Units: Amperes (A)

Resistance(R)

- Opposition to charge flow in a circuit.
- Units: Ohms (Ω)

Current Flow Analogy

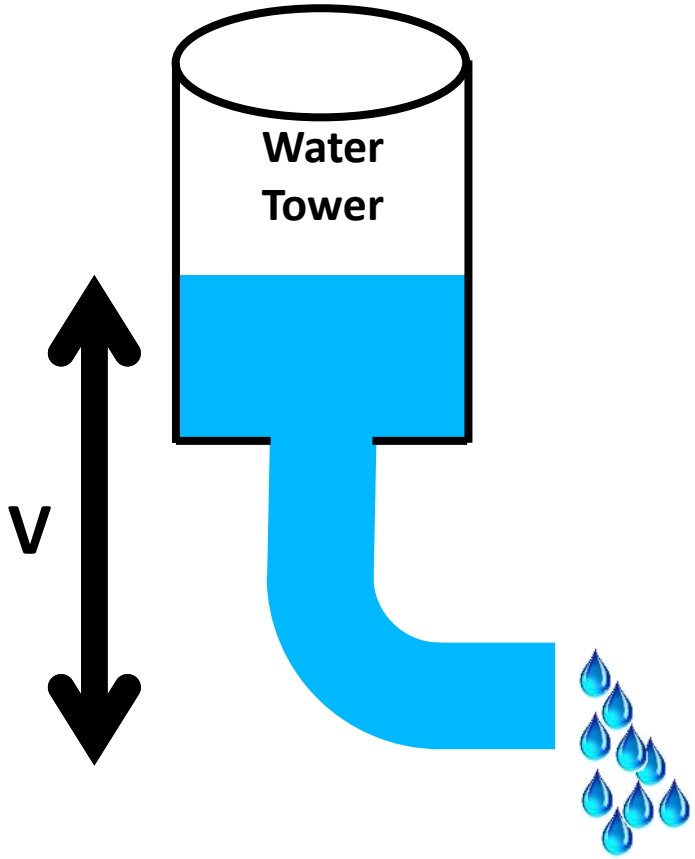
$$V = I R$$

High Current

Low Current

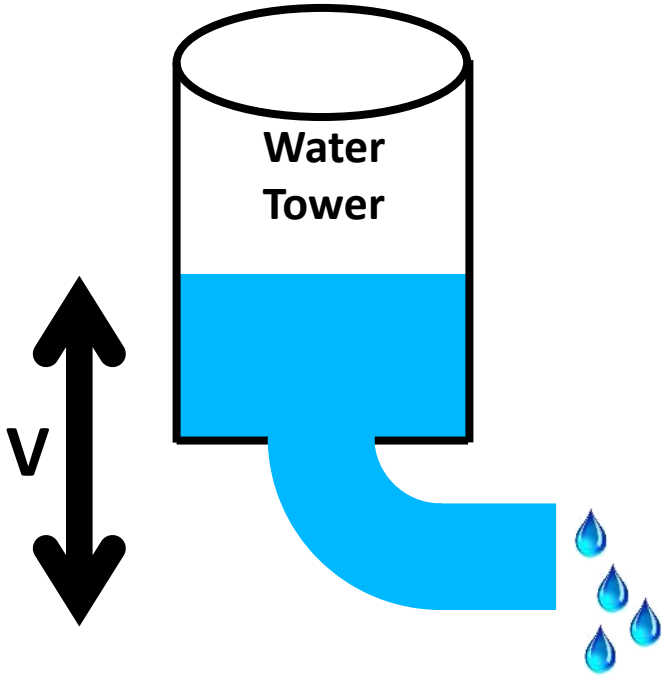
Voltage Analogy

$$V = I R$$



More Energy == Higher Voltage

$$V = I R$$

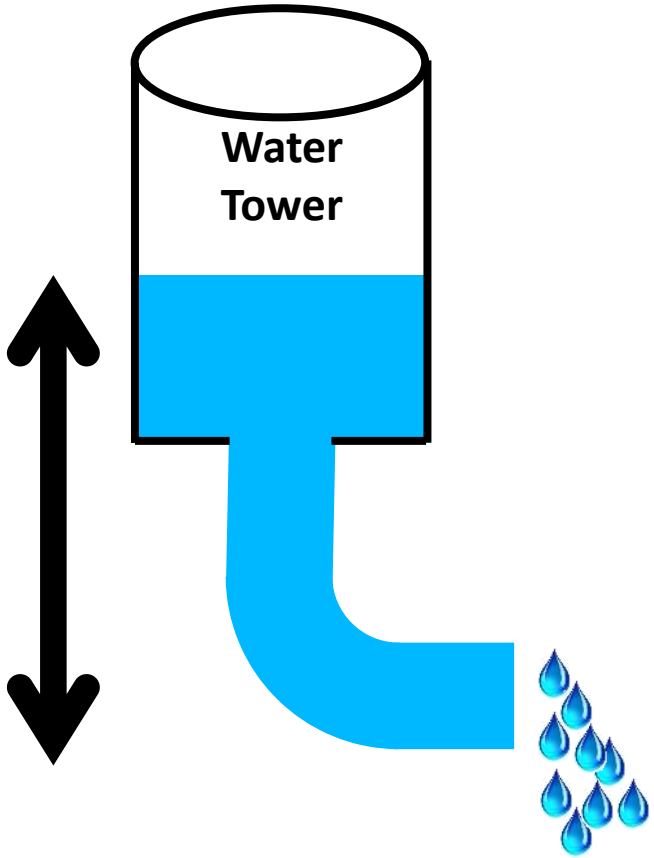


Less Energy == Lower Voltage

$$V = I R$$

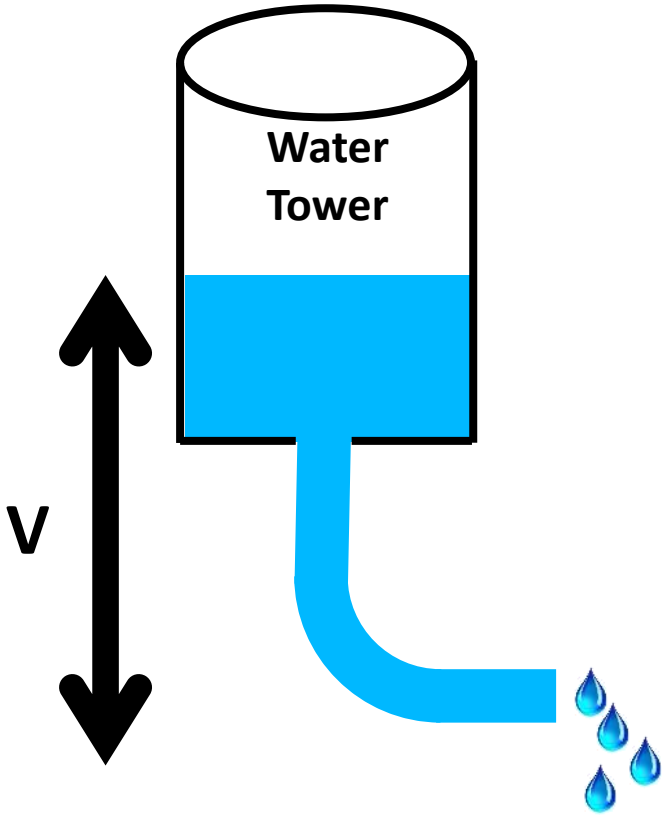
Resistance Analogy

$$V = I\ R$$



Big Pipe == Lower Resistance

$$V = I\ R$$



Small Pipe == Higher Resistance

$$V = I\ R$$

We can use ohm's Law in the exact same way to determine the resistor value that will give us the desired current value.

$$V = I \cdot R$$

therefore:

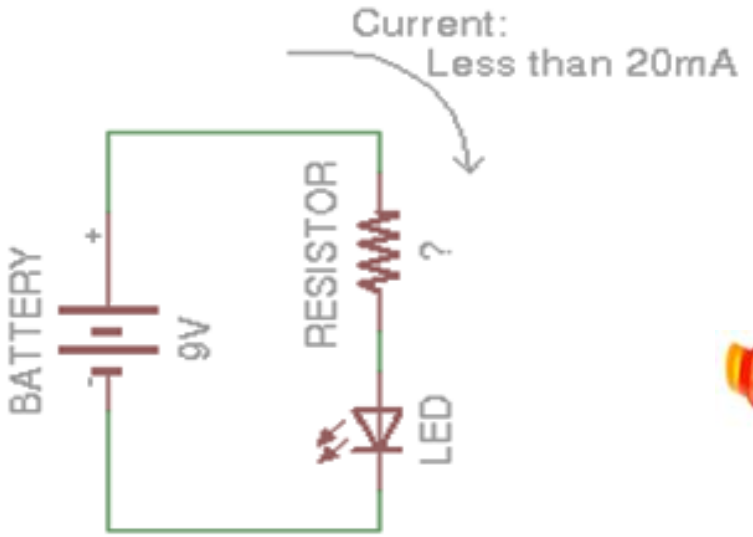
$$R = \frac{V}{I}$$

plugging in our values:

$$R = \frac{9V}{0.018A}$$

solving for resistance:

$$R = 500\Omega$$



So, we need a resistor value of around 500 ohms to keep The current through the LED under the maximum current Rating.

Voltage Dividers

A **voltage divider** is a simple circuit which turns a large voltage into a smaller one. Using just two series resistors and an input voltage, we can create an output voltage that is a fraction of the input.

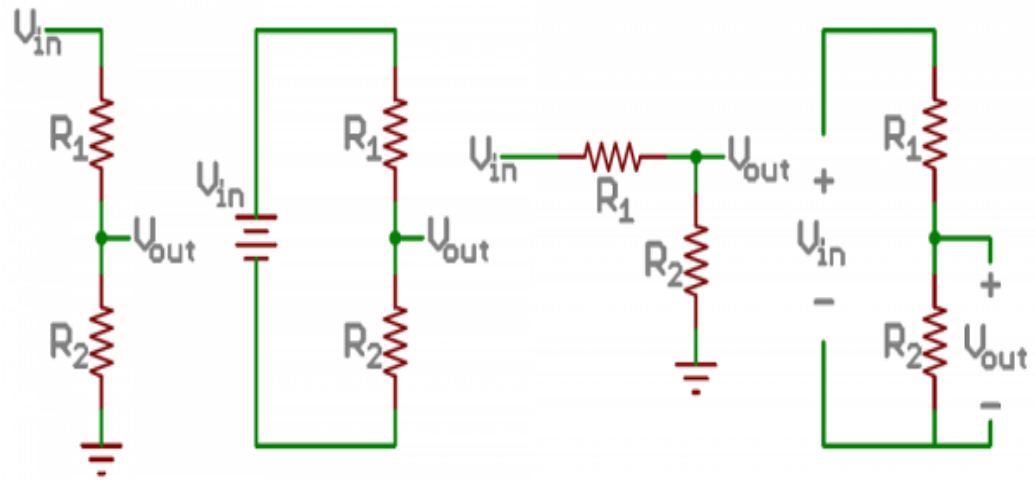
Voltage dividers are one of the most fundamental circuits in electronics.

There are two important parts to the voltage divider:

the circuit and the equation.

Voltage Dividers

- **The Circuit**
- A voltage divider involves applying a voltage source across a series of two resistors. You may see it drawn a few different ways, but they should always essentially be the same circuit.
- *Examples of voltage divider schematics. Shorthand, longhand, resistors at same/different angles, etc.*
- We'll call the resistor closest to the input voltage (V_{in}) R_1, and the resistor closest to ground R_2. The voltage drop across R_2 is called V_{out}, that's the divided voltage our circuit exists to make.



Voltage Dividers

- **The Equation**
- The voltage divider equation assumes that you know three values of the above circuit: the input voltage (V_{in}), and both resistor values (R_1 and R_2). Given those values, we can use this equation to find the output voltage (V_{out}):

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

- This equation states that the output voltage is **directly proportional** to the **input voltage** and the **ratio of R_1 and R_2**