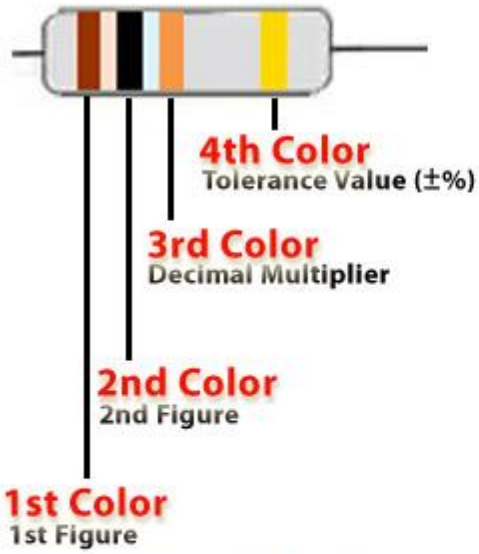
Electrical Engineering:

1. **Resistors:**

   Remember resistors are components designed to limit the flow of electrons through an electrical circuit.

   Resistors are usually indicated with a colour code, as shown in the diagram and table below.

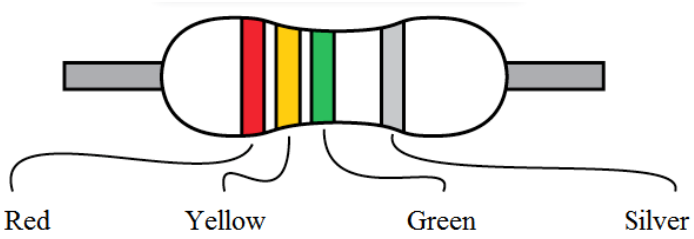


Color Name	Value As Figure	As Decimal Multiplier	Tolerance ±
Black	0	x 1	±20%
Brown	1	x 10^{1}	±1%
Red	2	x 10^{2}	±2%
Orange	3	x 10^{3}	-
Yellow	4	x 10^{4}	±5%
Green	5	x 10^{5}	±0.5%
Blue	6	x 10^{6}	±0.25%
Violet	7	x 10^{7}	±0.1%
Grey	8	x 10^{8}	±0.05%
White	9	x 10^{9}	±10%
Golden	-	x 10^{-1}	±5%
Silver	-	x 10^{-2}	±10%

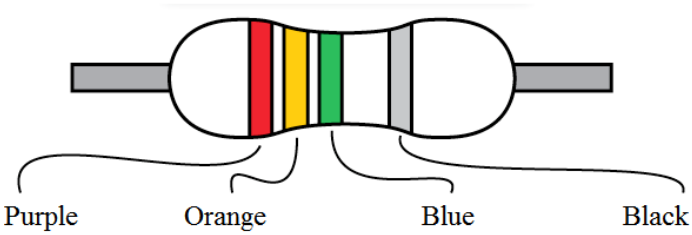
Examples:

1. Calculate the resistance of the following resistors:

a)



b)



2. A resistor has the value of $22 \times 10^4 \pm 20\ \%\ \Omega$.

   a) Between which values does this resistor fall?

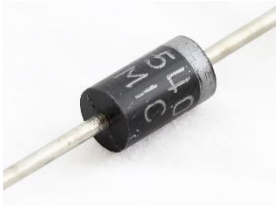
   b) What are the colour bands of this resistor?

3. A resistor has the value of $0.4 \pm 0.1\ \%\ \Omega$.

   a) Between which values does this resistor fall?

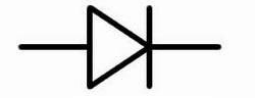
   b) What is the colour band of this resistor?

2. Diodes: a device that allows electric current to flow in only one direction.



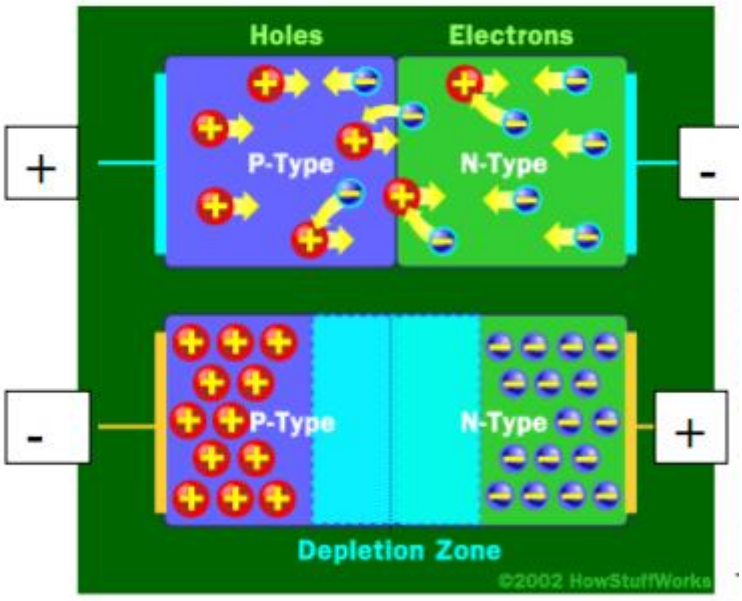
- Used to protect fragile electronic parts inside the circuit. For example, in remote controls, diodes prevent the electrons from moving when the user installs the battery upside down.

- LEDs light are **L**ight **E**mitting **D**iodes, which gives off light when current flows through them.



symbol

A solid state diode consists of p-type(missing an electron) and n-type semiconductors(has extra electron) placed side by side. Diodes only allow electricity to flow in one direction through them. In the top part of the above diagram we see that if the negative end of the battery is attached to the n-type side of the diode, incoming electrons will dislodge the crystal's extra electrons towards the junction between the p-type and type materials. Meanwhile, as the electrons from the p type material move towards the positive end of the battery, they leave a trail of positive holes. At any given moment, at the junction we now have electrons on the n-side, and holes on the p-side. Electricity will flow. If we reverse the polarity (see bottom part of diagram), the holes will be "moving " towards the (-) end of the battery as the electrons move towards the junction. Meanwhile, the extra electrons from the n-material will move towards the (+) end of the battery. A depletion zone is created at the junction, and the diode will not conduct.



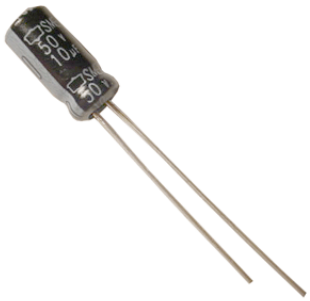
Applications of Diodes

If you have the right material when electrons form n-type material meet up with those of the p-type materials, they release most of the energy they gained in the form of light.

LED= light emitting diodes; very energy –efficient; used in tablets, smartphones, TVs, indoor bulbs, Christmas lights,traffic signs, in-dash indicators, vehicle headlights and tail lights.

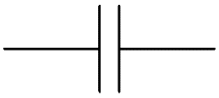
Example: Although the physics are more complicated, what does the mechanism of an LED remind you of?---- think back to models of the atom.

3. **Capacitors**: A device made with two metal plates separated by an insulating material. The device can store electrical charge.

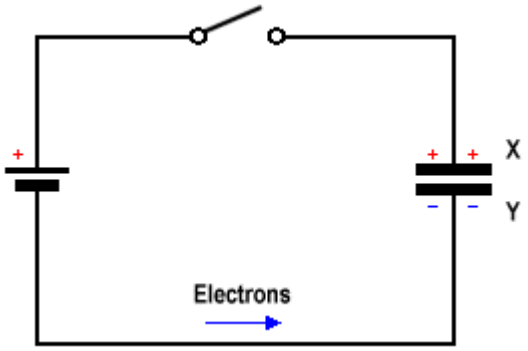


- It's similar to a battery, but a capacitor releases all of its energy in a fraction of a second and cannot generate new electrons.

- The power supply is connected to a battery. The metal plate that is connect to the negative end of the battery will accept electrons from the battery and become negatively charged. The metal plate that is connect to the positive end of the battery will lose electrons and become positively charged, because the positive end of the battery will attract the negatively charged electron from the metal plate.



symbol



- The insulating material is called a *diaelectic* and can be made of ceramic, plastic or even air.

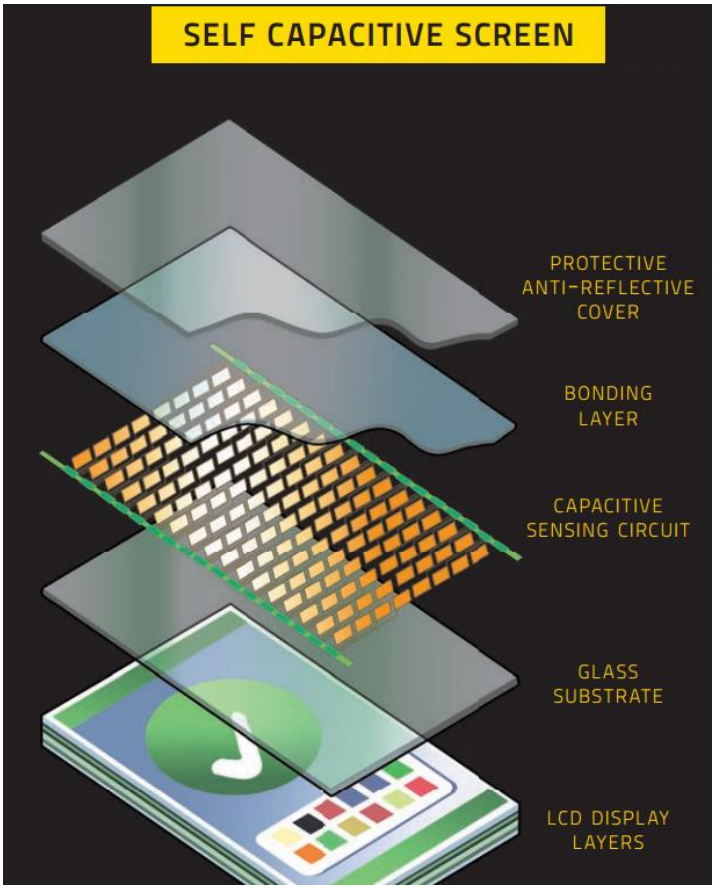
- Unit of capacitance: Farad (F)

Uses of capacitors:

- To provide an extra strong charge in a short period of time.
  (1) If you're taking a flash photograph, for example, you need your camera to produce a huge burst of light in a fraction of a second. A capacitor attached to the flash charges up for a few seconds using energy from your camera's batteries.

  (2) Touch screens make use of capacitors: **Capacitive touch screens** use a layer of capacitive material (In,Sn,O mixture) to hold an electrical charge; touching the screen changes the amount of charge at a specific point of contact.

  Example: How does the touch of your finger close the loop between the capacitor and the circuit it's attached to?

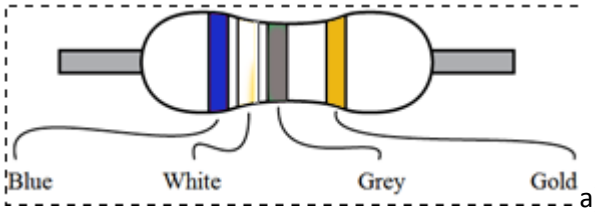


- Stabilizing the power supply.

  Example: capacitors used in power lines can release their charges when the power voltage drops too low, and recharge when the voltage is too high, so that the amount of voltage given from the power supply is always the same. This is imporatn in devices like TVs

Exercises:

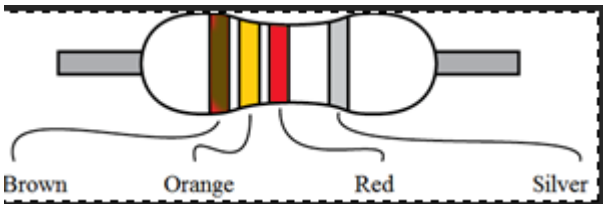
1. Calculate the resistance of the following resistors:



a)

$69 \times 10^8 \pm 5\%$

b)



$12 \times 10^3\ \Omega \pm 10\ \%$

2. A resistor has the value of $67 \times 10^3\ \Omega \pm 10\ \%\ \Omega$.

   a) Between which values does this resistor fall?

0.10(67000) = 6700 Ω, so add and subtract that number from 67 000 to get between 60 300 and 73 700 Ω

   b) What is the colour band of this resistor?

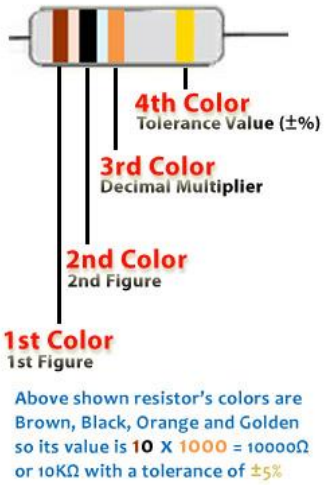
Blue-violet-orange- silver

3. A resistor has the value of 0.06 $\pm$ 0.5 % Ω.

   a) Between which values does this resistor fall?

Between 0.0597 and 0.0603 Ω.

   b) What is the colour band of this resistor?



Above shown resistor's colors are Brown, Black, Orange and Golden so its value is 10 X 1000 = 10000Ω or 10KΩ with a tolerance of ±5%

Color Name	Value As Figure	As Decimal Multiplier	Tolerance ±
Black	0	x 1	±20%
Brown	1	x 10^{1}	±1%
Red	2	x 10^{2}	±2%
Orange	3	x 10^{3}	-
Yellow	4	x 10^{4}	±5%
Green	5	x 10^{5}	±0.5%
Blue	6	x 10^{6}	±0.25%
Violet	7	x 10^{7}	±0.1%
Grey	8	x 10^{8}	±0.05%
White	9	x 10^{9}	±10%
Golden	-	x 10^{-1}	±5%
Silver	-	x 10^{-2}	±10%

If you think of 0.06 as 60 X 10^{-3} to get two digits, you'll get stuck: there is no -3 as multiplier. So use 06 X 10^{-2} black-blue-silver green. What's also accepted is removing the first band altogether ----blue-silver-green

4. The resistor has 4 bands. Yellow, Brown, Brown, Gold. Which answer is correct?

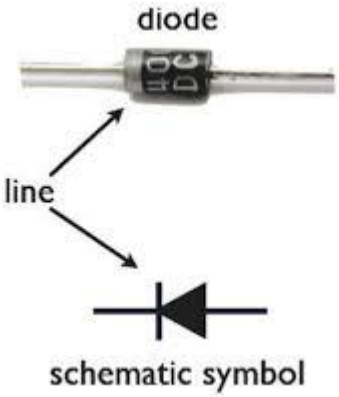
   A. 110k Ohms with a 5% Tolerance and a 11k Ohm tolerance range
   B. 410 Ohms with a 10% Tolerance and a 82 Ohm tolerance range
   C. 110k Ohms with a 10% Tolerance and a 22k Ohm tolerance range
   D. 4.1k Ohms with a 10% Tolerance and a 820 Ohm tolerance range
   E. 410 Ohms with a 5% Tolerance and a 41 Ohm tolerance range

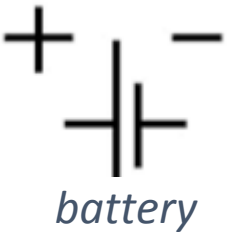
(notice that 5% of 410 = 20.5, so the range is from 389.5 to 430.5. if you subtract the highest and lowest, you get the full tolerance range of 41 or simply double the converted uncertainty.

5. The resistor has 4 bands: Brown, Black, Red, Silver. Which answer is correct?

   A. 100 Ohms with a 1% Tolerance and a 2 Ohm tolerance range
   B. 1000 Ohms with a 5% Tolerance and a 100 Ohm tolerance range
   C. 10k Ohms with a 5% Tolerance and a 1K Ohm tolerance range
   D. 1000 Ohms with a 10% Tolerance and a 200 Ohm tolerance range
   E. 100 Ohms with a 20% Tolerance and a 40 Ohm tolerance range

6. Draw both the symbol of a diode, capacitor and battery cell.





7. List two ways by which a capacitor differs from a battery.

   A battery releases its charge slowly; the capacitor releases it quickly. A capacitor is like a bursting dam; the battery is a steady stream.

   A battery generates (-)'s that were not originally there; a capacitor just releases what was stored.

8. What two materials are needed to make a diode?

   An n-type (electron rich) semiconductor material and a p-type material

9. Does a touchscreen make use of diodes or capacitors?
   CAPACITORS

10. Does a tablet or smartphone make use of LED's?
    Yes in the display

11. What is the difference between a diode and an LED?

    They're almost the same thing except that the LED is a diode with the right materials that will release light when the electron moves from the n-type to p-type material.

12.How does an LED work?

The LED is a diode which emits light when activated. When a suitable voltage is applied to the leads, electrons from the n-type material are able to recombine with electron holes(p-type material) within the device, releasing energy in the form of visible light.