CHAPTER - 2.

BASIC ELECTRONIC COMPONENTS

- Resistor
  fixed and Variable
- Colour coding of Resistors
- Capacitor
  fixed and variable
- Inductor
  air core and iron core
- Transformers
  step-up, stepdown & Turns ratio

Electronic Components

Electronic Ckts are set up using various Electronic Components. They are categorised into passive and active components

Active Components

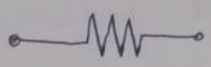
They ~~perform~~ are components used to process a signal passing through it. like Amplification, rectification, generation etc.

Passive Components

They themselves are not capable of processing a signal. They aid Active Components

- Components
  - Passive
    - Resistor
      - Carbon film
      - Carbon composition
      - metal film
      - wire wound
      - potentiometer
      - Rheostat
      - preset
      - Trimmer
    - Capacitor
      - Paper
      - Plastic
      - Electrolitic
      - Ceramic
      - mica
      - Trimmer
      - Padder
      - Air
    - inductor
      - Air core
      - ferrite core
      - Iron core
      - Transformer
  - Active
    - Diode
      - Varactor
      - zener
      - Tunnel
      - Shotkey
    - Transistor
      - BJT
      - FET
      - UJT
      - MOSFET
    - Thyristor
      - SCR
      - TRIAC
      - DIAC

Resistor

Symbol 

It is a passive component which offer ~~a certain~~ opposition to the current flow. ~~through~~

Resistance (R)

Ability to resist the flow of electric charges through a conductor.

Unit - ohm (Ω)

$$R = \rho \frac{l}{A}$$

Factors affecting Resistance

- Length of conductor (l) $l \propto R$
- Area of cross section (A) $\frac{1}{A} \propto R$
- Material
- Temperature.

~~Resistivity~~ or specific Resistance (ρ)

Resistivity of a ~~Resistance~~ of a material per Unit ~~Area~~ Volum ($1m^3$).

~~Unit = Ohm = Ohm Ohm m^{-1}~~

Resistivity or specific Resistance (ρ)

Resistivity is the electrical resistance of a conductor of unit cross sectional area and unit length.

Unit - Ohm-metre (Ωm)

Types of Resistors

Fixed (—WW—)

- Carbon Composition
- metal film
- wire wound

Variable

- Potentiometer —WW—
- Rheostat —WW—
- Preset —WW—

Fixed Resistors

- Carbon Composition Resistor

Resistive material used for this type is finely powdered carbon or graphite and ~~lastantly~~ insulating material.

Carbon film Resistor 

It is constructed by depositing a carbon film over an insulating core. There providing a helical groove. It decide the required resistance. It is widely used in low power application. It has better stability.

- Wire wound

This is made of metal resistance wire such as nichrome. This wire is wound around a ceramic, plastic ~~or~~ core. Ends of

wire are soldered or welded to two caps or rings.

Disadvantages- large size, high cost and poor frequency performance

Variable resistors

Variable resistors are resistors whose resistance value can be varried. It is used in electric ckts to adjust Voltage. They are used in volume knob of amplifiers, Brightness knob of TV, etc.

Potentio meter

It is also called POT. It is a special variable resistor with three terminals Two terminals are connected to two ends and the third is connected to sliding contact.

*) Mainly used to control signal voltage

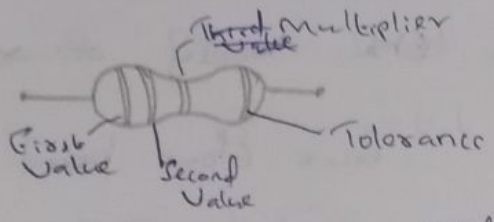
Rheostant

It is a variable resistor mainly used to control current becoz of its high power capacity. It is also known as coise cwound variable resistor. It is used to control speed of motors etc.

Pocsots

They are small constructions of variable resistors. PCB friendly. Require a screw driver to for adjustment.

Colour Coding of Resistors



Colour	1st band/ 2nd band value	3rd band multiplier value	4th band Tolerance
Black	0	- 1	
Brown	1	- 10	
Red	2	- 10^2	
Orange	3	- 10^3	
Yellow	4	- 10^4	
Green	5	- 10^5	

Blue	- 6	-10^6	
Violet	- 7	-10^7	
Grey	- 8	-10^8	
White	- 9	-10^9	
Gold	- —	$10^{-1} = 0.1$	$-\pm 5\%$
Silver	- —	$10^{-2} = 0.01$	$-\pm 10\%$
No colour	- —	—	$-\pm 20\%$

Colour Coding

On small size of Resistor it is difficult to print the value of resistance on their bodies, so we use colour code to represent values on the body of resistor we use four colour band for coding.

In this system, first 3-colour bands indicate the resistance value and the fourth one indicate the tolerance. where 1st band gives 1st digit and 2nd band gives 2nd digit. 3rd band

3rd gives multiplier and 4th band gives tolerance in %.

Ex:-

-> Brown Black Red Gold

1 0 $\times 10^2$ $\pm 5\%$

$= 1000\Omega \pm 5\%$

$= 1K\Omega \pm 5\%$

-> Yellow Green Green

4 5 $\times 10^5$ $\pm 20\%$

$45 \times 10^5 \Omega \pm 20\% =$ 4.5 $M\Omega \pm 20\%$

-> Brown Black Gold Gold

1 0 $\times 0.1$ $\pm 5\%$

$= 1\Omega \pm 5\%$

Calculating Tolerance (max & min values)

*) $110\Omega \pm 10\%$

$110 \times \frac{10}{100} = 11\Omega$

max value = $110 + 11 = 121\Omega$ //

min value = $110 - 11 = 99\Omega$ //

→ 200Ω ± 5%

$200 \times \frac{5}{100} = 10\Omega$

max = 200 + 10 = 210Ω

min = 200 − 10 = 190Ω

Specification of Resistance

*) Ohmic Value (Ω, KΩ, MΩ)

*) Tolerance (%)

*) Voltage rating

*) Power rating (Watt)

*) Temperature Co-efficient (+ve or −ve)

Find values of Resistance

1) Red, Violet Brown, silver

→ 2 7 × 10^1 ± 10%

= 270Ω ± 10%

2) Green . Black , Black Gold

5 0 $\times 10^0$ $\pm 5\%$

$= 50\Omega \pm 5\%$

3) Brown . Black , Gold , Gold

1 0 $\times 10^{-1}$ $\pm 5\%$

$1\Omega \pm 5\%$

4) Red . Green . silver

2 5 $\times 10^{-2}$ $\pm 20\%$

$0.25\Omega \pm 20\%$

Q write Colour codes of following Resistors

1) 10Ω = Brown . Black ~~Brown~~ Black

2) 100Ω = Brown , Black . Brown

3) 5Ω = Green Black Gold

4) $6.8M\Omega$ = Blue Grey Green.

Capacitance (C)

Ability to store electric charges.

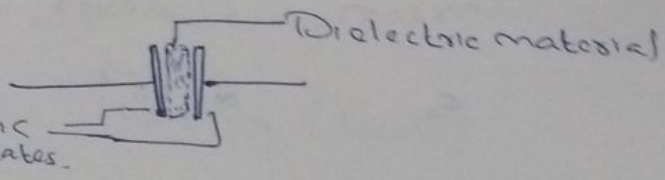
Unit - Farad.

$C = Q/U$ Q = charge, U - voltage.

Capacitors (⊣⊢):

Component used to store electric charge and discharge it for certain time period.

It is basically two metallic plate separated by an insulating plate (dielectric material).



Factors affecting capacitance -

a) Plate Area (A) → $C \propto A$

b) plate spacing (d) $(C \propto \frac{1}{d})$

$$C = \varepsilon \frac{A}{d}$$

where ε (epsilon) - Permitivity

Unit is F/m or Fm^{-1}

Permitivity (ε) :-

The ability of a dielectric material to store electric charges under the influence of an electric field.

Capacitive reactance (X_c)

The resistance offered by a capacitor is called capacitive reactance.

Unit - Ω (ohm)

$$X_c = \frac{1}{2\pi fc}$$

f = frequency
C = Capacitance

q Find the value of capacitive reactance of a capacitor with capacitance 10F and frequency is supply frequency

ans $f = 50Hz$ $C = 10F$

$$X_c = \frac{1}{2\pi fc}$$

$$\therefore X_c = \frac{1}{2\pi \, 50 \times 10} = \frac{1}{1000\pi} = \frac{1}{3140}$$

$$= 0.000318\,\Omega$$

Q ~~How~~ Why Capacitor block DC and pass AC.

ans for AC ~~f = +~~ f is greater than 1

$f \geq 1$.

$$X_C = \frac{1}{2\pi fc}$$

$2\pi fc$ will be a big value if frequency and capacitance is high. So X_C will so small, thus an AC signal can pass through a capacitor with little V/g drop.

As the frequency and capacitance decreases, X_C increases, so, ~~Capacitor~~ ~~total~~ V/g drop across capacitor also increases.

For DC, $f = 0$.

So, $X_C = \frac{1}{2\pi 0 \times C} = \frac{1}{0}$ (Not defined)

the X_C become ~~infinitly~~ a value which can't be defined. So, a capacitor will not conduct a DC signal when it is completly charged.

Types of Capacitors

fixed

Variable

1) Ceramic
2) paper
3) mica
4) plastic
5) Electrolytic

* Air gang
* Trimmer
* padder

Fixed capacitors

Electrolytic

2) polarised
1) High capacitance value (1μf to 10,000μf)
2) Aluminium foil - electrodes
3) Dielectric material. — oxides formed by a chemical reaction when supply is given.

Application —

filtering,

Paper Capacitor

constructed by rolling paper sheets within metal foil

Mica Capacitor

mica Capacitor consists mica sheets seperated by sheets of metal foil

Ceramic Capacitors.

dielectric materia - Ceramic

available in many size and shapes.

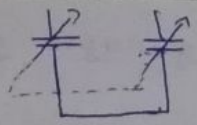
calculating Capacitance from Code

1) 104
   - 10 → No.
   - 4 → multiplier
   - pico ~~meter~~ farad
   - $10 * 10^4$ pf = 0.1 MF = 100 nf

2) 103 → $10 * 10^3$ pf = 10 nf = 0.01 MF

Variable Capacitors

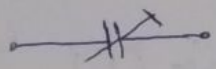
Capacitors whose value can be adjusted are called Variable Capacitors.

3) Air Gang Capacitor 

An Air gang Capacitor consists of a group of capacitors ganged together and the capacitance can be varied by means of common shaft.

It is a rotor-stator type capacitor. consists of two sets of metal plates ; ~~and~~ a fixed plates. The fixed plates are connected together to form a stator. The movable plates are connected together to form ~~stator.~~ rotor.

The capacitance is varied by ~~it~~ rotating the shaft.

4) Trimmer : 

It is a small variable units consisting of two metal plates usually separated by a thin piece of mica. Capacitance ~~Vari~~ is varied by means of a small screw that forces the plate close together. It is variable from 3pf to 30pf & 40pf to 70pf.

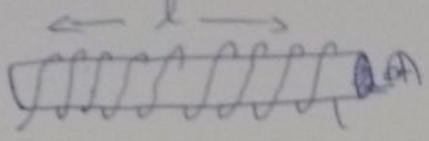
5) Padder -

Padder is similar to trimmer in appearance and ~~has~~ not much difference in construction too.

But padder is bigger in size and higher in capacitance value. It available from 40pf, 600, 750 and 1000pf

Inductor

It is a component used to store energy in a magnetic field when electric current flows through it. It basically consist an insulated copper wire cwound into a coil.



Self inductance (L)

The property of a electric coil to oppose the change in electric current flowing through it. The coil induces an emf called 'back emf' in itself to oppose such a change.

$$L = \frac{N\mu^2 A}{l}$$ unit = Henry (H)

factors depending on Inductance :

1) Number of turns (N)
2) Core material → (M - permeability)
3) Length of Core (l)
4) Cross Sectional area of Core.

Air - Core Inductor

- The coil is wound over a [rrrr] formers made thick cardboard.
- Low value of Inductance
- Suitable for radio frequency application.

Iron - Core Inductor

The coil is wound over a laminated iron core.
Suitable for audio - frequency applications.

Ferrite - Core Inductor

Coil is wound on a ferromagnetic material called ferrite.

→ In a variable type ferrite core inductors, the ferrite core is made movable.

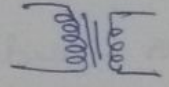
Specification of Inductors

- Value of Inductance (Henry)
- Current rating
- Tolerance
- Temp. coefficient
- Resistance
- Q - factor:

Dedends upon the value of inductance and losses of Inductor. The higher Q-factor, ~~the~~ better the quality of Inductor

$$Q = \frac{X_L}{R} = \frac{2\pi fL}{R}$$

Transformers



Transformer is a component containing two or more coils. It is used to ~~st~~ increase or decrease voltage without varying frequency and ~~not~~ without much power loss.

Working principle - Mutual Induction.

Mutual Induction

If two or more coils are placed close to each other in a certain range of distance, the change in current flowing through on coil will induce a voltage in the another coils. This pheromenon is known as Mutual Inducton.

Coefficient of Coupling (K)

It is a measure of how much flux from one coil cuts the winding of another coil.

$$K = \frac{LM}{L_1 L_2}$$

LM = Mutual inductance
L_1, L_2 - Self inductance of two coils.

Working of Transformer

A Transformer consists of two/more insulated wire wound on a core. Here the coil in which input signal is given is known as primary the coils which provide output is known as secondary. A Transformer can have more

than one Secondary coil, but only one primary.

Turns Ratio

It is the ratio b/w ~~primary coil turns~~ NP : o turns in primary to that in Secondary

$$M = \frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}$$

N_S = No turns in Secondary

N_P " " primary

V_S = Secondary voltage

V_P = ~~Secondary~~ primary voltage

I_S = Secondary Current

I_P = primary Current

$M > 1$ - Step up Transformer

$M < 1$ - Step down

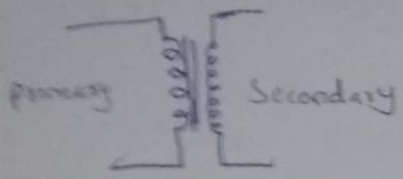
$M = 1$ Auto

Q Find Secondary Voltage if $N_P = 100$, $N_S = 200$ and $V_P = 50V$. And mention the type of transformer

Ans $V_P = 50V$ $N_P = 100$ $N_S = 200$

$\frac{V_S}{V_P} = \frac{N_S}{N_P}$ $V_S = \frac{V_P \times N_S}{N_P} = \frac{50 \times 200}{100} = 100V$

Step up Transformer



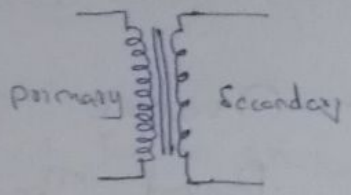
No of turns

primary < Secondary

$N_p < N_s$

$V_p < V_s$

Step-down Transformer

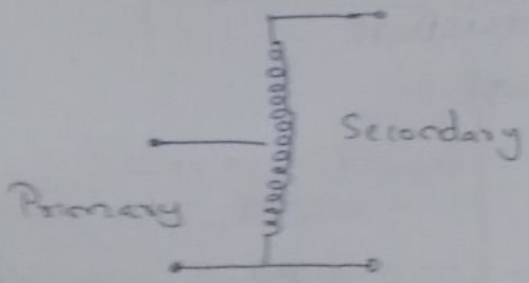


$N_p > N_s$

$V_p > V_s$.

Auto-Transformer

The Transformer with only one winding.



~~Set~~ Specifications of a Transformer

- Voltage Rating
- Current Rating
- Power Rating
- Frequency Range
- Regulation.