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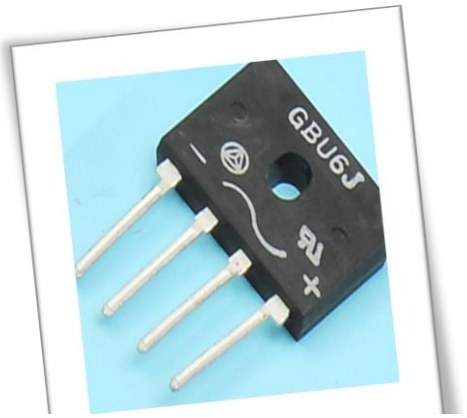
SATCOM INSTITUTE OF TECHNOLOGY

Basic Electronics Lecture Guide



By: ABAY' M

2010 E.C

The Three Basic Parameters Of Electricity

1. VOLTAGE(V)

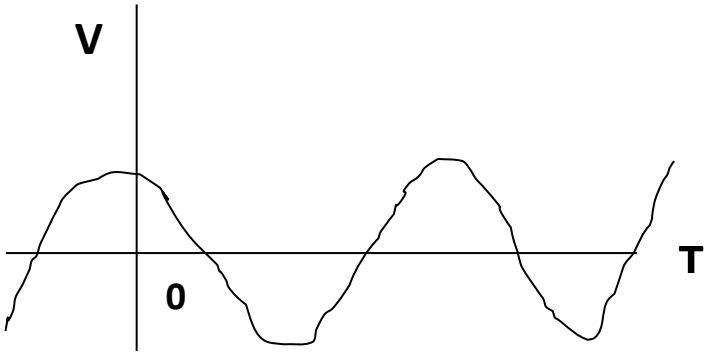
Voltage is the source of energy or power since there is a Potential Difference exists between two charges. This difference in a potential causes the movement of charges or electrons and this movement of electronics is known as current. The result of charges movement results electricity. The unit of voltage is volt(V) and it is measured by voltmeter.

Types of voltage

- AC
- DC

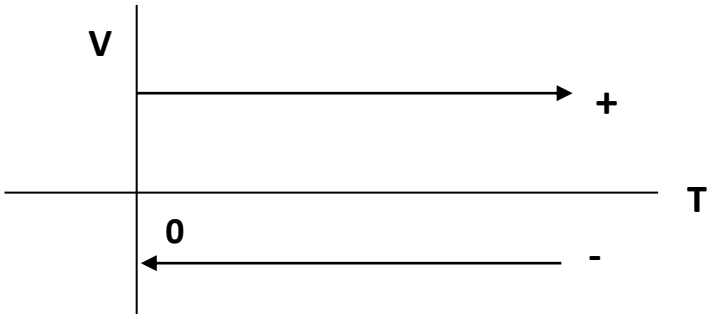
AC voltage (Alternate Current):-

- Non polarized
- Sources (main lines, EEPCO, Generator, solar energy …. etc)
- Continuously varying amplitude & changing direction



DC voltage (Direct Current):-

- Polarized (+,-)
- Sources (Charges, adaptors, battery…. etc)
- Constant through time



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2. CURRENT (I)

Current is the flow or movement of electrons (negative charges) through a conductor in the same direction. The current flowing through the system mainly depends up on the amount of voltage applied. the symbol is represented by A.

3. RESISTANCE (R)

Resistance is the opposition to the flow of electrons or current through a conductor. The unit of resistance is ohm's (Ω).All conductors have some opposition to the flow of current. A material or a component is designed to limit or control the amount of current flowing through a system is known as a **resistor**.

Ohm's Law: The current flowing through a conductor is directly proportional to the applied voltage & inversely proportional to the resistance of the resister.

Measuring instruments & tools used

Measuring Instruments

In maintenance no matter how you have experience or knowledge without measuring instruments and tools it is difficult to search the trouble and repair the fault. So to measure basic parameters; voltmeter for voltage, ammeter for current, ohmmeter for resistance and etc. but now a day most maintenance technicians/engineers use **Multimeter.** Generally measuring instruments can be classified as **analog** and **digital** whenever saying digital and analog it is based on way of displaying the result. So currently **digital multimeters**are mostly applicable. As the name implies digital multimeter is a meter used to measure many parameters. Like current, voltage, resistance and capacitancein digital way. So before trying to do anything by using **digital multimeter** (**DMM**) it is advisable to understand the usage, because improper use of it may be cause for damage.

Tools used

- ★ Different type of screw driver mostly having magnetic characteristics are preferable.
- ★ Sucker used to suck melt lead
- ★ Soldering Iron used to melt the lead back of printed circuit board
- ★ Blower used to reheat digital circuit like, computer mother board, mobile board, receiver main board, DVD player mother board and DC boards for different office machines

General techniques of Troubleshooting

- Good observation of symptom
  - Dead
  - Reduce output
  - Over output
- Analysis of the symptom
  - Check power source
  - Physical inspection
    - Visual/burn
    - Smile/snaf
    - Touch/heat
- Limit your fault by testing
  - Cold test
    - Continuity test
    - Resistance test / Ohm's
  - Hot test
    - Voltage test

Electronic components

Passive and Active Component:-

Even though maintenance is international profession the way of maintenance is differ from country to country and maintenance field. Basically there are two aspects to maintain:-

- ✓ **Part level maintenance** i.e. replacing the defective part totally
- ✓ **Component level maintenance** i.e. maintaining the defective part by replacing the defective components

So in our country component level maintenance is applicable to do such type of maintenance it is mandatory to understand each and every components. Especially a maintenance technician must understand component type physically, function, testing, failure and way of repairing

Passive components:-

A device which can be used to complete a circuit with voltage and current sources for active components is known as passive components. These components are called passive because they by themselves are not capable of amplifying or processing any electrical signal. However, these components are as important as active components. Without the aid of these components, for example, a transistor cannot be made to amplify signals. Passive components are:

- ✂ Resistor
- ✂ Capacitor
- ✂ Inductor
- ✂ Transformer

Active components:-

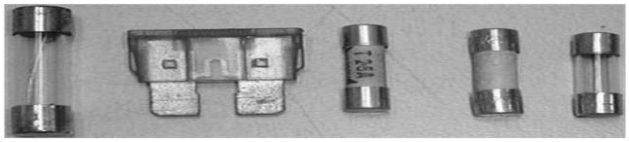
A device which can be used for performing tasks such as amplification, switching, regulating etc is known as active component. It rectifies or changes energy from one form to another to processes electronic signal. For example, LED converts electrical energy into light energy. Active components are:

- ✂ Transistors
- ✂ Diodes

FUSE

Before trying to understand the basic electronic components it is better to know fuse.

A Fuse Symbol 



Fuse is a very thin wire which either melts or vaporizes when current flow through it exceeded the fuse rating. Mostly rating indicated by ampere (A) Like 3.15A, 5A, 7A, 9A etc. The thin wire of fuse may be made of aluminum, tin-coated copper or nickel. The resulting open in the circuit stops current to flow which in turn protects the circuit from damage

Resistor

The material that opposes the flow of current is known as resistor and their resistances symbolized by R. Power rating in watts, (W). Resistors are available in a very wide range of R values from a fraction of an ohm to many mega ohms. The power rating may be as high as several hundred watts or as low as 1/8 watt. Resistor is used to limit current, Drop voltage, divide voltage & current

Types of resistors

- ★ Fixed value resistor
  - ♣ Color coded resistor
  - ♣ Choke resistor
- ★ Special types of resistor
  - ♣ Thermistor
    - ♠ NTC
    - ♠ PTC
  - ♣ VDR
  - ♣ SMD
- ★ Variable value resistor

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Color coded resistor

Most color coded resistors are carbon resistors and they are small physically. The color band is the identity of the resistor and also used to calculate the resistance or ohm's value.

To calculate resistance value of color coded resistors it is mandatory to understand color values orally

	Value	Multiplier	Tolerance
Black	0	1	-
Brown	1	10	+1%
Red	2	100	+2%
Orange	3	1000	-
Yellow	4	10000	-
Green	5	100000	+0.5%
Blue	6	1000000	+0.25%
Violet	7	10000000	+0.1%
Grey	8	-	+0.05%
White	9	-	-
Gold	-	0.01	+5%
Silver	-	0.1	+10%
No Colour	-	-	+20%

Calculating resistance value by using color code of resistors

Most color coded resistors have:-

- **♥ 4 Band color coded resistor**
- **♥ 5 Band color coded resistor**

4 Band color coded resistor:-

the first two colors indicate values(digits) the third color indicates how many zeros must be added (multipliers) and the last color indicates the tolerance of the resistor. Tolerance mean by how many percent the resistance value increase or decrease in order to be functional.

Example 1:- If a given resistor has four colors (Red, Violet, Red and Gold) calculate resistance value?

The first band is red for 2 and the next band is violet for 7 so the digits are 27. The red Multiplier in the third band means add two zeros to 27. The result can be **2700Ω** with tolerance +5%. Therefore, 5 percent of 2700 is (5/100*2700) =**135** so tolerable values can be calculated as (2700-135)- (2700+135) i.e. between 2565Ω and 2835Ω.

Example 2:- If a given resistor has four colors (Orange, Orange, Black and Gold) calculate resistance value?

The first band is orange for 3 and the next band is orange for 3 so the digits are 33. The black Multiplier in the third band means add no zeros to 33. The result can be 33Ω with tolerance +5%. Therefore, , 5 percent of 33 is (5/100*33) =1.65 so tolerable values can be calculated as (33-1.65)- (33+1.65) i.e. between 31.6Ω and 34.65Ω.

Example 3:- If a given resistor has four colors (green, blue, orange, and silver) calculate resistance value?

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The first band is green for 5 and the next band is blue for 6 so the digits are 56. The orange Multiplier in the third band means add 3 zeros to 56. The result can be 56000Ω with tolerance +10%.
Therefore, , 10percent of 56000 is (10/100*56000) =5600 so tolerable values can be calculated as (56000-5600)- (56000+5600) i.e. between 50400 Ω and 61600Ω.

5 Band color coded resistor

In case of five band resistors the first 3 colors are values or digit the forth color is multiplier and the fifth or the last color is tolerance

Example 1:- If the resistor has five bands as follow calculate the resistance value?
(Red, orange, green, red and gold)

the first 3 color bands are values red=2, orange=3, green=5, red=2, and silver 10% so 235 digits and two zeros must be added i.e. 23500 is exact value and 5% tolerance
Therefore, , 5 percent of 23500 is (5/100*23500) =1175 so tolerable values can be calculated as (23500-1175)- (23500+1175) i.e. between 22325Ω and 24675Ω.

Example 2:- If the resistor has five bands as follow calculate the resistance value?
(yellow, red, brown, orange and silver)

the first 3 color bands are values yellow=4, red=2,brown=1,orange=3, and silver 10% so 421 digits and 3 zeros must be added i.e. 421000 is exact value and 10% tolerance
Therefore, , 10 percent of 421000 is (10/100*421000) =42100 so tolerable values can be calculated as (421000-42100)- (421000+42100) i.e. between 378900Ω and 463100Ω.

Fusible resistors

Such type of resistors has very low resistance value their value can be maximum of 9.9Ω for band resistor and 99Ω for five band resistors and physically they have gold or silver color at third band for four band resistors and at fourth band in case of five band resistors.

Example: red, red, gold, gold

To calculate resistance value the first two colors are values or digits 22 and the third color is divider not multiplier for gold divide by 10 and for silver divide by 100. So calculated exact resistance value is 22/10=2.2Ω and 5% tolerance.

- **Testing**----- continuity must give sound if it is open the resistor is fail.

Color coded resistor facts

- Color coded resistors are no polarity
- If the resistance value is very low or very high, check by removing one legs of the resistor to justify the failure of the resistor.

Chock Resistors

It is the second type of fixed value resistor. It has very low resistance value but has high wattage rating it is not common in many boards like color coded resistors used for over load protector, chock resistor drop over voltage through heat.
To calculate chock resistor there tolerance is (G+2%, H+3%, I+4%, J+5%, K+10%, M+20%)

Example 1:- the text on the resistor is 5W1K00J (its resistance value is 1KΩ, J tolerance is 5%)

Example 2:- the text on the resistor is 10W6K7J (its resistance value is 6.7KΩ, J tolerance is 5%)

Example 3:- the text on the resistor is 20W39ΩJ (its resistance value is 39Ω, J tolerance is 5%)

Special Types of Resistor

Thermistors

As the name implies these types of resistors resistance value is depends on Temperature. Found in primary power area of the component.
They are two types of thermistors:-

NTC
PTC

NTC(Negative Temperature coefficient):-

It is used to control change in current or a surge or unwanted current in power supply. Its resistance value decrease as temperature increase. Make sure that NTC always connected in series so being open directly causes the equipment to dead.

- **Testing**---------- continuity must give **sound** if it is **open** NTC is fail.

PTC (Positive Temperature Coefficient):-

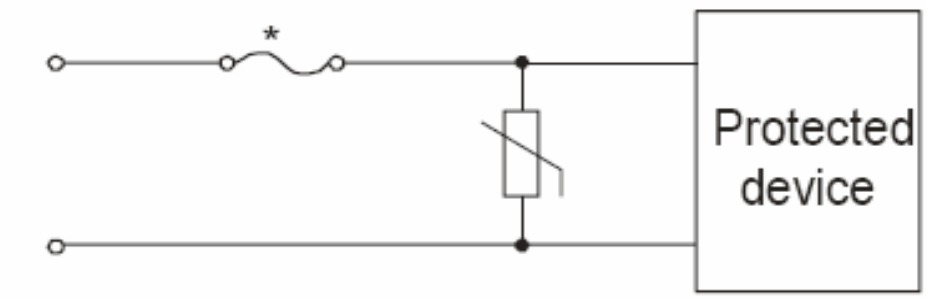
Most commonly known as posistor; it's used to avoid magnetic effect in cathode ray tube (CRT) monitor and television. It is mostly found in power supply part entry. To split AC power and supply to degaussing coil for demagnetizing purpose as current passes through it for moment resistance value increase and become open .

- Testing---------- continuity must give sound if it is open PTC is fail.

Voltage dependent resistors (VDR) or varistor

Most common type of varistor is the **metal-oxide varistor** (MOV). They are often used to protect circuits against excessive transient voltages by incorporating them into the circuit in such a way that, when triggered, they will shunt the current created by the high voltage away from sensitive components. In other word they protect over voltage Follow-through current as a result of a strike may generate excessive current that completely destroys the **VDR.**

- **Testing**---------- continuity must open if it is sound VDR is fail.



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Surface Mounted Resistors (SMD) Resistors

Most commonly known as Surface Mount Device and used in digital circuit like computer mother board, mobile board and LCD equipment main board. SMD resistor is in black color with silver color to end to end.

How to know the resistance value of SMD Resistor?

Now, the resistors in the above image has 3 digit code (some resistor has 4 digit code also).so the first two digit represent the value and the last digit represent the number of zero's should be added after the value. they are six types of SMD calculation

Example 1:- the value on the resistor is **103,** it's resistance value is **10000Ω.**

Example 2:- the value on the resistor is **2512**, it's resistance value is **25100Ω.**

Example 3:- the value on the resistor is **0**, it is a **fusible SMD**

Example 4:- the value on the resistor is **000**, it is a **fusible SMD**

Example 5:- if there is no value on the resistor, it is a **fusible SMD**

Example 6:- if there is R on the value, R indicates the place of the decimal point

E.g ..the value on the resistor is **5R7,** it's resistance value is **5.7 Ω**

E.g ..the value on the resistor is **R22,** it's resistance value is **0.22 Ω**

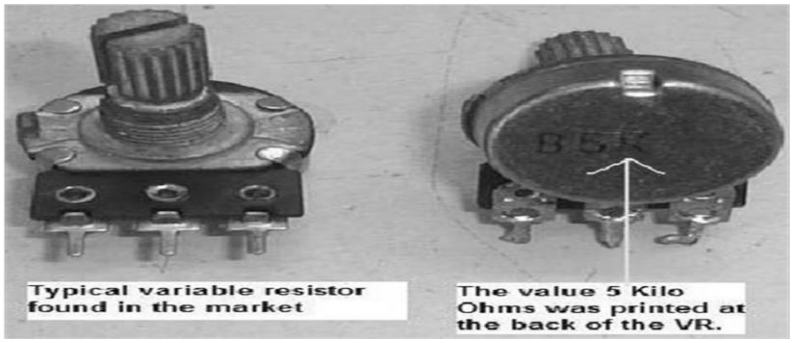
E.g ..the value on the resistor is **33R,** it's resistance value is **33 Ω**

- **Testing**---------- if the SMD resistor is fusible (0,000 & no value) check by continuity must sound if there is no sound the resistor is fail. If the resistance value is three or four digit calculate by its ohm's value.

Variable Value Resistor

Potentiometer

It is variable resistor which can be varied by manually. It is used to increase the amount of voltage or decrease the voltage value. You can change the resistance by turning the knob



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Testing of resistors

By visual inspection:-sometimes resistor become very damaged even their color disappear in other way they become ash so in such occasion no doubt replace it. What may challenge at the time of replacement is that knowing the color that already disappear so there are two options to refer the color by using the same board or by downloading the circuit diagram of the board from internet

By continuity test:-this test does use to measure all resistors rather resistors with low resistance value like, fusible resistors, thermistor, posistor, third band color coded resistors, and choke resistor can be checked by continuity test.

By ohmic test:-resistors except mentioned above by measuring its resistance value so in this case first measure the resistance value of the resistor by digital multimeter and calculate the resistance value as mentioned above so measured value must be in the range of calculated value. Always that is better to by disconnecting the leg from the board.

Defects (failures) in Resistors

Normally if a resistor fails they will either increase in value or open up at all (open circuit). Mostly happened defects in resistors are:

Open (most frequently happened) it can be happened due to over current or heat.

Improper resistance value: - their value may be decrease or increase so there must be some tolerable range if it is out of range it is mandatory to replace it

Inductor (coil)

Inductor is wound of coil that store electrical energy in form of electromagnetic force.

Inductance- is property of inductor that oppose any change or fluctuation of current / the ability to block high frequency is called inductance. System international unit is Hennery (H) usually mH. In general, an inductor consists of many turns of wires wrapped around a common core. The core could be made of iron or even air. It is label as "L" on circuit board. When an electric current passes through the coil, a magnetic field is produced.

Types of inductor

Inductor can be classified as fixed value inductor and variable value inductor

Fixed value- they are used line AC filter mostly with combination with mica capacitor in power supply.

$$XL=2\pi fL$$

Where XL=inductance reactance (blocking ability), 2π=constant i.e. 2*3.14=6.28, F=frequency and L=inductance (constant for a given inductor)

So, as frequency increases blocking ability increases that means inductor blocks high frequency signals in other word inductor blocks AC and fully allow DC to pass.

Variable value – they are used as IF (intermediate frequency) coils in radio receiver. Inductance can be varied by moving the upper part of the inductor. By varying inductance value it is possible to change frequency range mostly such type of inductors fit for SW, MW and FM.

Function of inductor

AC Filter: - naturally almost all signals are analog. These signals have a chance to passing through a cable so whenever plugging in power cable many signals like **heat**, **sound(hash),spark** etc can be entered with electrical signal.

- ✓ Inductor used as line current filter
- ✓ over current protection switch

So by rotating the upper part frequency level can be adjusted. They have different colors for FM and AM (amplitude modulation).

Testing of inductors

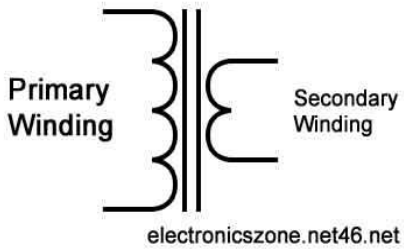
Inductor can be tested as follows:

1. **By visual inspection-** if it is burn
2. **By continuity test-** the same side of the cable must sound, if it is open the inductor is fail

Transformer

Transformers used to step up or down voltage according to your need you may need high or low voltage so you can use step-down transformer or step up transformer. The input and output of any transformer is AC voltage but it may be sinusoidal, square (pulse) wave or triangular (saw tooth) type of AC voltage.

Transformer is a capable of two sections (primary winding & Secondary winding)



$$\frac{VP}{VS} = \frac{NP}{NS}$$

Transformer calculation VP/VS=NP/NS

Example 1 :- (VP=220, NP=10, NS= 5, VS=?) the result= **110V** is called step down voltage

Example 2 :- (VP=220, NP=10, NS= 50, VS=?) the result= **1100V** is called step up voltage

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Types of transformer

- ✪ Center taped transformer
- ✪ Chopper transformer
- ✪ Fly back transformer

✪ **Center taped transformer:-** this type of transformer is formerly used in most electronic equipment but now it is used in radio receiver and CD players. For step up & down voltage.

✪ **Chopper transformer:-** in modern electronics most electronic equipment's use chopper transformer in their power supply rather than center tapped chopper transformer. These types of transformers divide the output and supply to the secondary section of power supply.
For step down voltage.

✪ **Fly back transformer:-** is used in CRT equipments like TV, Moniter & oscilloscopes to generate high voltage output up to (for screen voltage 400V-600V, for focus voltage 6000V-8000V, for heater voltage 6V-12V….) for step up voltage.

Testing of transformers

- ★ **Visual inspection** (may be burned)
- ★ **Continuity test (**terminals in the same side are continuous and opposite side terminals are open)
- ★ **Hot test** measuring the output voltage (specially center tapped transform)

Capacitor

Capacitor, also known as condenser, is one of the most essential components in designing an electronic circuit. Radio, television and monitor circuits use a number of capacitors. Capacitor has a tendency to store electrical charge and then release it as current in the circuit where it is connected. So the use of capacitor is to store and then release electrical charge. the capacitor is combined with other components in filter or timing circuits. Capacitor is symbolized by a letter C.

Capacitance:- the ability of capacitor to store electrical energy. Capacitance measured in farads (F). Practically farad is a large unit. The smaller units are microfarads, nanofarads, picofarads, Microfarad can be written as MFD, MF or µF or simply M. Nanofarad is written as NF. Picofarad is written as PF. Capacitors rated in microfarads are found in RF and high frequency circuits.

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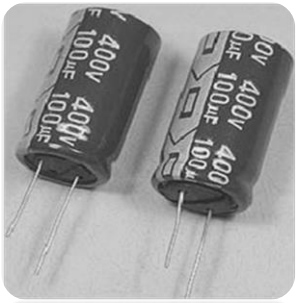
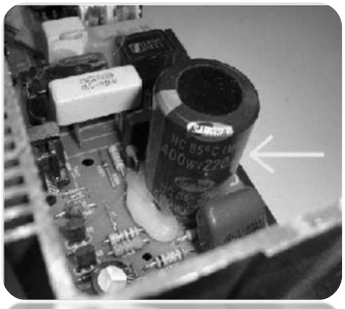
TYPES OF CAPACITORS

- ✪ **Fixed value capacitors**
  - ➲ Electrolytic Capacitor /Polarized
  - ➲ Mica capacitor /Non polarized
  - ➲ Disk & Ceramic capacitor /Non polarized
- ✪ **Variable value capacitors**
  - ➲ Gang Capacitor

➲ Electrolytic Capacitor

These are polarized capacitors means they have positive and negative terminals (+,-) and they have cylindrical shape. Polarized Capacitors: Polarized capacitors must be inserted in the Proper orientation with respect to applied voltage.





Function of Electrolytic capacitor:- **DC filter** rectified signal by diodes isn't pure it has ripple. Capacitors avoid these ripple electronic capacitors avoid these ripple.

Testing of Electrolytic capacitors

- ★ **Visual inspection (**electrolytic capacitors may blown out)
- ★ **By continuity test (**in normal circumstance capacitors read increasingly and returns to 1)
- ★ **By hot test (**measuring the voltage DC voltage that capacitors store)
- ★ **Measuring capacitance value** the best way but difficult due to cost of capacitance meter

Defects in Electrolytic capacitors

- ✓ **May be blown automatically change**
- ✓ **Leakage** it reads under 2/3 DC voltage

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➲ Mica capacitor

This type of capacitor is used for line filter current usually in the combination inductor. As known at the entry there are so many types of signals like heat, sound (hash), spark but they aren't in for electrical components. So inductor avoids high frequency signal unwanted signals and capacitor unwanted low frequency signals.

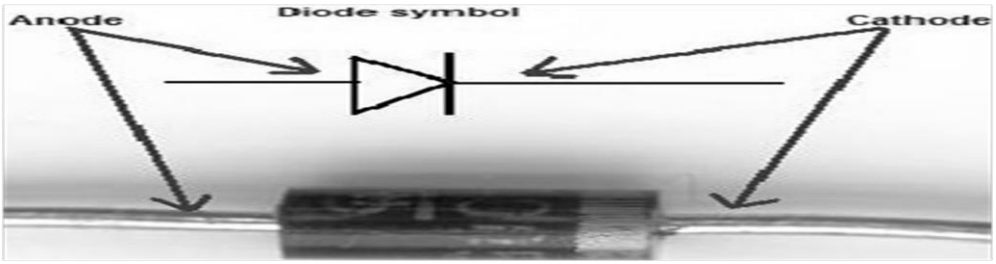
- ► **Testing**---------- continuity must open if it is sound mica cap is fail.

➲ **Disk & Ceramic capacitor**

➲ **Gang capacitor:-** These types of capacitors which are normally used as tuning in radio receiver.

Diodes

Diodes are two terminal components. Diodes are mostly used to convert AC to DC i.e. rectification. This is due to diodes block the flow of voltage from cathode to anode. Diodes mostly have two terminals that is cathode and anode diodes are polarized component that anode (+) and cathode (-) terminal.

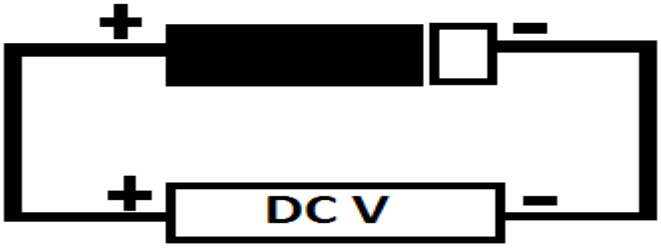


Biasing of diodes

Biasing is applying DC voltage. Applying dc voltage specifically to diodes has two options

Forward Biasing:-applying positive (+) DC to anode and (-) DC to cathode

In this case by principle of charge attraction i.e. like charges repeal and unlike charges attract positive charge of battery repeals anode of diode in other way negative charge of battery repeals cathode of diode in turn making the gap narrower. So current can flow.



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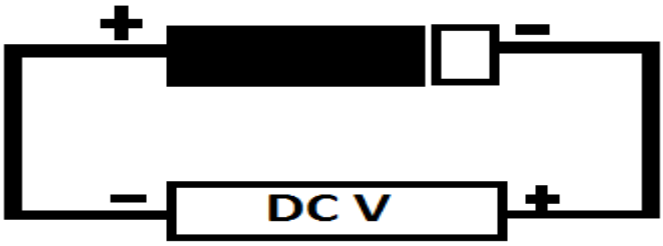
Reverse Biasing:- applying positive (+) DC to cathode and (-) DC to anode so in this case positive charge of battery attract anode of diode in other way negative charge of battery attract cathode of diode in turn making the gap wide. So current can not flow.

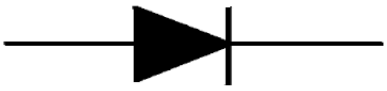


Types of diodes

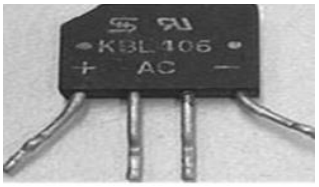
1. Rectifier/Power diode/Bridge IC
2. Zener diode
3. LED diode
4. Photo diode
5. Laser diode

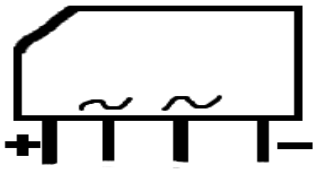
1. Rectifier diodes / Power diodes

Rectifier diodes are used in power supplies to convert alternating current (AC) to direct current (DC), a process called **rectification**. They are also used elsewhere in circuits where a large current must pass through the diode. All rectifier diodes are made from silicon and therefore have a forward voltage drop of 0.7 V.



N.B-Now a day most electronics devices **using Bridge IC** specially brand devices use bridge IC. if there is no 4 diodes to convert AC to DC it uses bride IC for rectification.





As shown bridge IC can be used instead of four diodes. The two inner terminals are where AC signals input where as the end two legs are terminal where rectified output obtained.

Testing of Rectifier/Power Diode

- ★ **By physical inspection:** -check whether the terminal disconnected or not or any problem.
- ★ **By continuity test:**- Forward bias (300-900) , Reverse bias (open)
- ★ **By using Hot test:**- checking bridge diode AC input 220V, DC output around 380V

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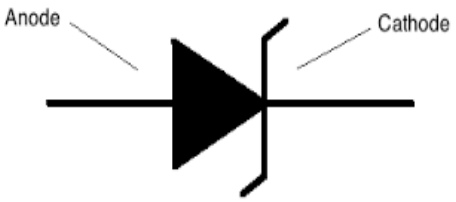
2. Zener diodes

They are used to regulate voltage. The black terminal is negative whereas the positive terminal is red ended.



Testing of Zener Diode

- ★ **By physical inspection:** -check whether the terminal disconnected or not or any problem
- ★ **By continuity test:**- Forward bias (300-900) , Reverse bias (open)

3 Light emitting diodes/LED :-

This types of diodes can be used to covert electrical energy to light energy. Mostly these types of diodes are not applicable but used in display system to indicate the functionality of the system. Light emitting diode (LED) is a diode that produces light when current flows through it,

Testing of LED Diode

- ★ **By continuity test:**- Forward bias (ON) , Reverse bias (OFF)

3. Photo diode:-

this types of diodes can be used to covert light energy to electrical energy. Mostly these types of diodes are found in solar system.

4. Laser diode:-

this types of diodes can be used to covert electrical energy to laser beam. Mostly these types of diodes are found in projector

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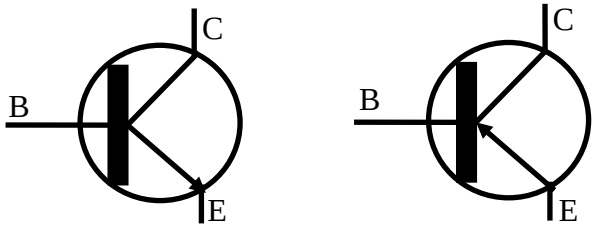
TRANSISTORS

Transistors are solid –state devices similar in some way to the diodes you have studied. , they appear as two back-to-back diodes when tested. Transistors are more complex and can be used in many more ways. They are very important and can be found in almost all modern electronic equipment. Transistor is made up of two diodes by connecting back to back. Unlike a diode, a transistor has three leads or terminals. The three transistor leads are designated as Base (B), Collector (C), and Emitter (E). A transistor is sometimes referred to as BJT (Bi-polar Junction Transistor) to distinguish it from other types of transistor such as Field Effect transistor

BJT (Bipolar Junction Transistor)



NPN **PNP**

There are two configurations for a common **BJT** transistor: NPN (negative-positive-negative) and PNP (positive-negative-positive).Notice the difference symbols for NPN and PNP transistor. The emitter arrow points away from the transistor body for an NPN and toward the transistor body for PNP.

MOSFET (Metal Oxide Semiconductor Field Effect Transistor)

MOSFET stands for **Metal Oxide Semiconductor Field Effect Transistor** or we just called it FET. Switch mode power supply and many other circuits use FET transistors as part of a circuit. Mosfet failure and leakage are quite high in a circuit and you need to know how to accurately test it. FET is label as "Q" in circuit board.

TRANSISTOR HEAT SINK:

The heat generated by current flowing between the collector and emitter junctions of a transistor causes its temperature to rise. This heat must be conducted away from the transistor otherwise the temperature rise may be high enough to irreparably damage the P-N junctions inside the transistor. Power transistors produce a lot of heat, and are therefore usually mounted to a piece of aluminum with fins, called a **heat sink**.

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The heat sink draws heat away from the transistor, allowing the transistor to handle more power than if there were no heat sink. Low power signal transistor; do not normally require heat sinking. Some transistors have a metal body thus a mica sheet has to be used to prevent the body from touching the heat sink.

TRANSISTOR'S FUNCTION:

The main operational characteristic of a transistor is that a small voltage placed on one of the three leads can control a large amount of current flow through the other two leads. This enables a transistor to perform two basic functions:

Switching: A transistor can act as an electronic switch, turning current flow ON and OFF. They can be used in pulse generating which can be used as input for chopper transformer this basic function of transistors that add new feature in any electronic equipment those switching transistors in any power supply are switching transistors.

Amplification: A transistor can amplify a signal, making it larger in amplitude.
Since the transistor is capable of amplifying a signal, it is said to be an active components. Devices such as resistors, capacitors, inductors and diodes are not able to amplify and are therefore known as passive components. Either type transistor, NPN or PNP, can perform essentially the same function in an electronic circuit. The main difference between an NPN and a PNP transistor in a circuit is the direction in which electrons flow between emitter and collector.

Testing of transistor

Let's say their terminals A, B, C by continuity test there are three option in measuring AB, AC, BC from these option

- ✓ No reading must be 000
- ✓ One reading must open
- ✓ Two reading must be 100- 800

Conclusion: If you measure base (black probe) and collector (red probe) it should have reading.

- ➢ If you measure base (black probe) and emitter (red probe) it should have reading.
- ➢ If you measure collector (black probe) and base (red probe) it should have no reading.
- ➢ If you measure collector (black probe) and emitter (red probe) it should have no reading
- ➢ If you measure emitter (black probe) and base (red probe) it should have reading.
- ➢ If you measure emitter (black probe) and collector (red probe) it should have reading.

Defects in transistor Transistor can fail in a number of different ways. Transistors have forward and reverse current and voltage ratings like diodes do. Exceeding either rating can destroy a transistor. A bad transistor may short-circuit from the "base" to the "collector" or from the "base" to the "emitter". Sometimes a transistor is damaged so badly that short circuits develop between all three of the leads. A short-circuit often allows a large current to flow, and causes the faulty transistor to heat up. The transistors also can developed open circuit between "base" to "collector" or "base" to "emitter".

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