Experiment – 1

AIM: - To study about different types of resistors and its color coding.

Apparatus: - Different types of resistors.

Theory:

This is the most common component in electronics. It is used mainly to control current and voltage within the circuit. Its function is to reduce the flow of electric current. Its value is designated in units called the "Ohm." A 1000 Ohm resistor is typically shown as 1K-Ohm. It is an electrical component with known specified value of resistance. The opposition to the flow of electric current is known as resistance. The resistance of resistor is given by

R=V/I; where R=resistance, V=voltage, I=current.

Types of resistors:

There are two types of resistors; 1) fixed resistor and 2) variable resistor Fixed resistor is one whose value remains stable within the limits of its specification. Variable resistors are the resistor whose resistance can be changed from zero to a certain maximum value.

There are two types of fixed resistors; 1) Linear and 2) Non linear. In linear resistor, there is linear relationship between resistance and temperature while in nonlinear resistor; there is non-linear relationship between resistance and temperature.

There are five types of linear resistors as under:

(1) Carbon composition
(2) Metal film
(3) Carbon film
(4) Wire wound

(5) Cernet

Specification of resistor:

The electrical specifications of resistor are its resistance value, tolerance, wattage, voltage and temperature coefficient.

The value of the resistor can be verified by the colour coding scheme.

The tolerance is the deviation from the real or actual value of resistance. For eg: if the resistance value of a resistor indicates 10 k ohm +/-10 % then the tolerance will indicate that the resistance value of the resistor lies between 9k ohm to 11 k-ohm.

Based on the tolerance value the resistors can be classified as general purpose resistors (+/-5%,+/-10%or +/-20%), semi-precision resistor (+/-5%to +/-10%), or precision resistors (+/-0.01to 10%)

Wattage rating is the maximum power in watts that the resistor can safely dissipate at ambient temperature (i.e. without excessive heat). Since it is the current which produces heat power ratings indicate the maximum current rating a resistor can safely carry. If the current exceeds this value more heat will be produced than that can be carried safely and the resistor will eventually burn out. For a given value of resistance greater the physical size higher is the power rating.

Voltage rating is given by sqrt(WR) where w is the wattage rating (in watts). Temperature co-efficient of resistance indicates the rate of change of nominal resistance value with function of temperature.

Color coding scheme of resistor:

There is two methods of find value of resistance.

1) Using color band

There are two common ways to know the value of a resistor, by measuring it using an Ohmmeter, or by reading the color code printed on it, which is much faster, when you get used to do it. The color coding method is explained as below.

Three band resistor:- They represent the value as per the color code. Absence of forth band means a resistance tolerance +/- 20%

Four band resistor:- Four band identification is the most commonly used color coding scheme on resistors. It consists of four colored bands that are painted around the body of the resistor. The first two bands encode the first two significant digits of the resistance value, the third is a power-of-ten multiplier or number of zeros, and he fourth is the tolerance accuracy, or acceptable error, of the value. The first three bands are equally spaced along the resistor; the spacing to the fourth band is wider.

For example, green-blue-yellow-red is 56X10000 = 560K Ohm +/- 2%.

Five band resistor:- It is used for higher precision (lower tolerance) resistors (1%, 0.5%) to specify a third significant digit. The first three bands represent the significant digits, the fourth is multiplier, and the fifth is the tolerance. Five-band resistor with a gold or silver 4^{th} band is sometimes encountered, generally on older or specialized resistors. The fourth band is tolerance and the 5^{th} the temperature coefficient.

1) Using Character

Here, character (E, K, M) are used for indication. When character comes between two decimal numbers, it acts as a decimal point.

E means – Ohm

K means – kilo ohm

M means – mega ohm

For example, 2E5 – 2.5 Ohm

3K9 – 3.9 kilo ohm

2M7 – 2.7 mega ohm

Conclusion:

Experiment - 2

AIM: To study the different types of capacitors and understand the different types of color coding schemes.

Apparatus: Different types of capacitors

Theory:

A capacitor is a passive electronic component consisting of a pair of conductors separated by an insulator. A capacitor is a physical device consisting of two pieces of conducting material separated by an insulating material. This insulating material is referred to as the Dielectric. Because the dielectric is an insulator, no current flows through the capacitor. If the dielectric breaks down and becomes a conductor, the capacitor can no longer hold a charge and is useless. The ability of a dielectric to hold a chare without breaking down is known as the dielectric strength. The measure of the ability of the dielectric material to store energy is called dielectric constant. It stores energy in the form of an electrostatic field. The dielectric can be anything from air to paper to plastic materials. In other words, a large value capacitor will have large plates separated by a very thin dielectric layer. Charging and discharging are the two main effects of capacitor.

Capacitance is measure of the ability to store the charge. Capacitance also depends on the dielectric constant of the dielectric material separating the plates. The unit of capacitance is Farad represented as F and named after Michael Faraday. The Farad is actually quite hue unit so it is more common to find capacitors value quoted as micro-farads, nano farads and Pico farads. When two metal conductors are separated by dielectric constitute capacitance. An electric field is formed between two charged plates with in the space between plates. Energy is stored in capacitor in this electric field.

Following are the characteristics of the capacitor:

Capacitor is the device:

- Which has the ability to store the charge which is neither a resistor nor an inductor can do.
- Oppose any change in voltage in the circuits in which it is connected.

- Block the passage of direct current through it.
- Capacitors are manufactured in various sizes, shapes types and values.
- Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass, in filter networks, for smoothing the output of power supplies, in the resonant circuits that tune radio to particular frequencies and for many other purposes.

Formula:

$C = q/v$

$C = E_o A / d$

Where A =area of plate in cm

D = distance between plates

E_o = permittivity (dielectric constant)

Types of capacitor

The capacitors are divided into two classes. *1) Fixed and 2) Variable.*

Fixed capacitors are further divided into *Electrolytic and Non-Electrolytic (Non Polarized).*

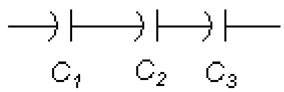
- A fixed capacitor is constructed in such a manner that it possesses a fixed value of capacitance which can not be adjusted.
- A variable capacitor is constructed in such a manner that its value can be varied. There are various types of capacitors in above said groups depending on different types of material used for dielectric electrode plates and method of their manufacturing and internal construction.

Electrolytic capacitors are of two types: 1) Aluminum and 2) Tantalum. Non-electrolytic capacitors are paper, Mica, Plastic, ceramic and glass.

- Aluminum Capacitor - A fixed type of electrolytic capacitor.
- Tantalum Capacitor – A fixed type of electrolytic capacitor.

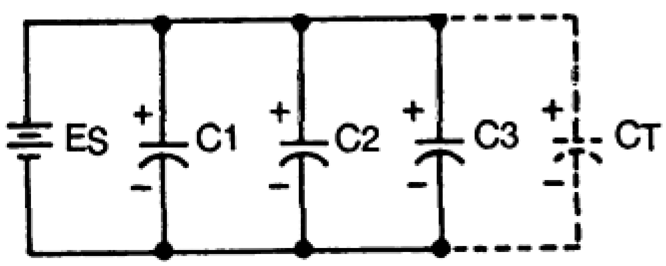
- Paper Capacitor – A variable type of non-electrolytic capacitor.
- Glass capacitor - A variable type of non-electrolytic capacitor.

<u>Capacitors in series</u> – The effect of wiring capacitors in series is to increase the distance between plates. This reduces the total capacitance of the circuit. Total capacitance for series connected capacitors may be connected by formula:



$$C_T = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \text{------} + \frac{1}{C_n}}$$

<u>Capacitors in parallel</u> - The effect of wiring capacitors in parallel are to increase the plate area of the capacitors. Total capacitance may be found using the formula:



$$C_T = C_1 + C_2 + C_3 + \text{------} + C_n$$

<u>Conclusion</u>:

EXPERIMENT- 3

Aim: To study about inductor & its types.

Theory:An **inductor** (also choke, **coil** or **reactor**) is a passive two-terminal electrical component that stores energy in its magnetic field. For comparison, capacitor stores energy in an electric field and a resistor does not store energy but rather dissipates energy as heat. An inductor is usually made from a coil of conducting material, like copper wire, that is then wrapped around a core made from either air or a magnetic metal.

While a capacitor does not like changes in voltage, an inductor does not like changes in current.

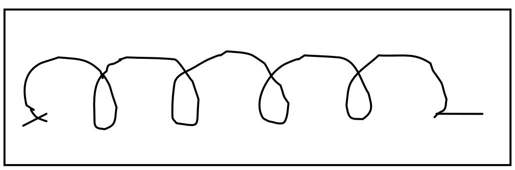
- **Inductor** is a device which can store energy in the form of magnetic field. Inductor opposes a sudden change in the flow of current. The function of an inductor is to provide opposition to a changing or varying current

$$E=L\ di/dt$$

E=E.M.F. induced,

di/dt =rate of change of current through coil,

Symbol:



Whenever a current change occurs within the coil windings, a voltage is induced across the ends of the coil. The polarity of the induced voltage is such that it opposes the current change occurring withinn the inductor. In more general terms, inductors are the opposite of capacitor, in that they are able to pass a dc current and block an ac current.

The basic unit of inductance is the Henry (H).

<u>Mutual inductance</u>:

Inductor store energy in form of magnetic field. This field of an inductor extends outside of inductor

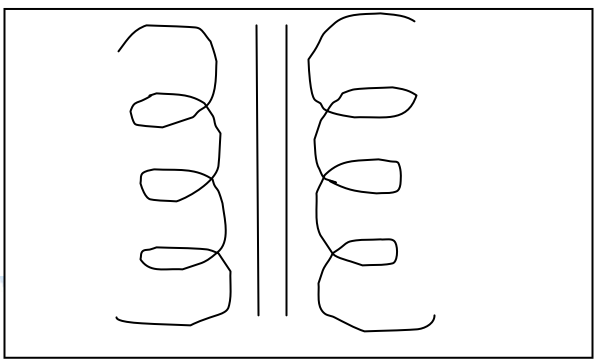
& can be affected another inductor close by.

$M = K\sqrt{L1 * L2}$ M= mutual inductance

L1, L2= inductance of 2 coils

K= Coefficient of coupling

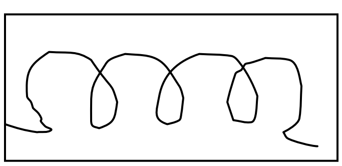
Which utilizes mutual inductance to alter voltage or current output is called transformer. Inductor that supplies current called as primary coil & inductor that picks up magnetic field is called secondary winding.



Types:

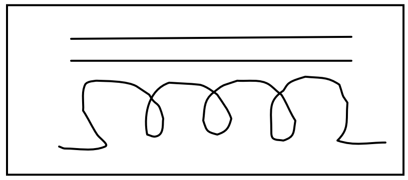
1. **Fixed inductors:**

- **<u>Air core inductor</u>:**
  It consist no. of turns of wire on ordinary card board former. Since there is air inside former. These are used in RF frequencies in turning coils.



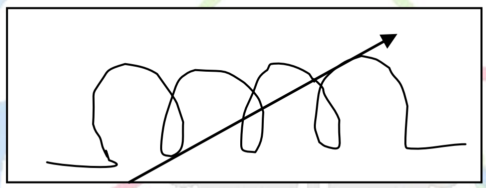
- **<u>Iron core inductor</u>**: The coil wounded over solid or laminated iron core.

This iron core is laminated pressed together but insulated from each other



2. Variable inductors:

They are used in tuning circuit for radio frequency. The winding is placed over a fiber or ceramic former & to change inductance, a ferrite core is employed. By changing position of screwed ferrite core inductance can be changed.



<u>Conclusion:</u>

Experiment– 4

AIM:- To study about semi-conductor devices.

THEORY:-

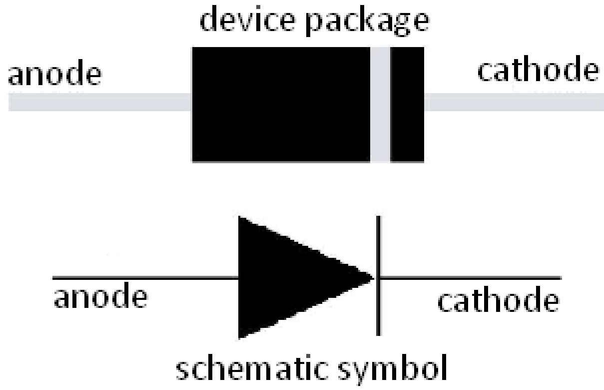
A semiconductor is a material, such as silicon and germanium, whose electrical properties lie between those of conductors and insulators.

Current conduction in a semiconductor occurs via free electrons and holes, collectively known as charge carriers. Doping a semiconductor such as silicon with a small amount of impurity atoms, such as phosphorous or boron greatly increases the number of free electrons or holes within the semi conductor. When a doped semiconductor contains excess holes, it is called"p-type" and when it contains excess free electrons it is known as "n-type". The junctions where n-type and p-type semiconductors join together are p-n junctions.

There are two types of semiconductors devices:

1) Single-junction device-semiconductor devices with only one P-N junction
2) Multi-junction device-semiconductor devices with only one or more P-N junctions

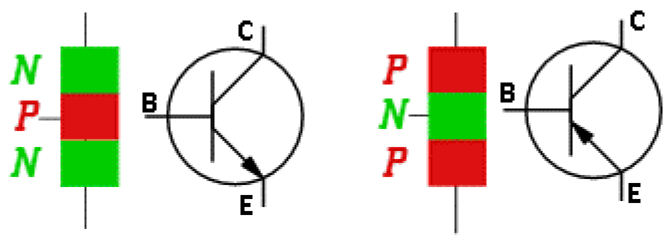
Diode: The diode is a device made from a single p-n junction. At the junction of a p-type and n-type semiconductor, there forms a region called depletion zone which blocks current conduction from the n-type region to the p-type region, but allows current to conduct from the p-type region to n-type region. Thus when the device is forward biased with p-side at higher electric potential, the diode conducts current easily; but the current is very small when the diode is reverse biased. The diode may be thought of as like a switch: "closed" when forward biased and "open" when reverse biased.



Diode operation:

(a) Current flow is permitted; the diode is forward biased.
(b) Current flow is prohibited; the diode is reverse biased.

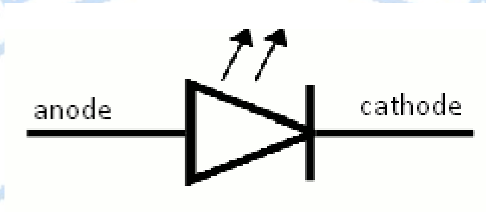
<u>Transistor</u>: The design of a transistor allows it to function as an amplifier or a switch. This is accomplished by using a small amount of electricity to control a gate on a much larger supply of electricity, much like turning a valve to control a supply of water.



Transistors are composed of three parts – a base, a collector and an emitter. The base is the gate controller device for the larger electrical supply. The collector is the larger electrical supply, and the emitter is the outlet for that supply. By sending varying levels of current from the base, the amount of current flowing through the gate from collector may be regulated. In this way, a very small amount of current may be used to control a large amount of current as in an amplifier. In this way the transistor is being used as a switch with a binary function: five volts – ON, less than five volts – OFF.

Junction transistor consists of a thin piece of one type of semiconductor material between two thicker layers of the opposite type. For example, if the middle layer is p-type, the outside layers must be n type. Such a transistor is called NPN transistor. One of the outside layers is called emitter and the other is known as the collector. The middle layer is the base. The places where the emitter joins the base and the base joins the collector are known as the junctions.

Light Emitting Diode (LED): A Light Emitting Diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. When a light emitting diode is forward biased (switch on) electrons are able to recombine with holes within the device releasing energy in the form of photons.



LEDs emit light when an electric current passes through them. LEDs must be connected the correct way round, the diagram may be labeled a or + for anode and k or – for cathode. The cathode is the short lead and there may be a slight flat on the body of round LED's. If you can see inside the LED the cathode is the larger electrode (but this is not an official identification method). LED's can be damaged by heat when soldering, but the risk is small unless the soldering process is done very slow. No specific precautions are needed for soldering most LED's.

Testing an LED: Never connect an LED directly to a battery or power supply. It will be destroyed almost instantly because too much current will passes through and burn it out. LEDs must have a resistor in series to limit the current to a safe value, for quick testing purposes a 1K resistor is suitable for most LEDs if your supply voltage is 12V or less.

Conclusion:

EXPERIMENT- 5

Aim: To study different types SMD components.

Theory: **Surface-mount technology** (**SMT**) is a method for constructing electronic circuits in which the components are mounted directly onto the surface of printed circuit boards (PCBs). An electronic device so made is called a **surface mount device** (**SMD**). In the industry it has largely replaced the through-hole technology construction method of fitting components with wire leads into holes in the circuit board.

An SMT component is usually smaller than its through-hole counterpart because it has either smaller leads or no leads at all. It may have short pins or leads of various styles, flat contacts, a matrix of solder balls or terminations on the body of the component

Advantages of SMT over the older through-hole technique are:

- Smaller components.
- Much higher number of components and many more connections per component.
- Simpler automated assembly.
- Small errors in component placement are corrected automatically
- Lower resistance and inductance at the connection
- Better mechanical performance under shake and vibration conditions.
- SMT parts generally cost less than through-hole parts.

DISADVANTAGES

- SMDs can't be used directly with breadboards.
- SMDs' solder connections may be damaged by potting compounds going through thermal cycling.

Why Use Surface Mount Technology?

SMDs have improved performance over through-hole components due to their smaller size, shorter internal leads, and smaller board layouts. These factors reduce the circuit's parasitic inductance and capacitance. SMDs can also be more cost effective than traditional through-hole components due to the smaller board size, fewer board layers, and fewer holes. SMDs can also be easier to replace than through-hole components on multilayer boards. This is because it is very difficult to heat the long hole on a multilayer board, but much easier to heat just the pad and component terminal of an SMD on the surface of a board.

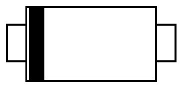
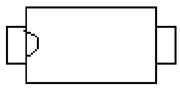
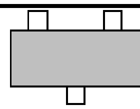
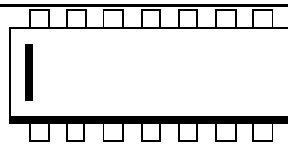
SMD components can be worked with in many different ways.

SMD Safety Precautions

Surface mount components are very small, and therefore special precautions (in additional to those required when working with through-hole components) must be taken:

Identifying SMDs

The general shape of some common SMDs are shown in Table.

Component	Shape	Markings
Chip resistor		Labeled with value (see Table 3)
Chip capacitor		Not marked
Polarized capacitor		Plus end marked with band, value marked
Diode		Cathode end marked with notch or band
SOT (Small Outline Transistor)		May be marked, unmarked, or house numbered
SOIC (Small Outline Integrated Circuit)		May be marked, unmarked, or house numbered. Pin one marked with beveled side, dot, band, or notch

Resistors are frequently marked with a three-digit number, the first two numbers are the significant digits of the value, and the last digit is the multiplier (the number of zeros to add to the first two digits).

Working with SMDs can be challenging, and mastering this technology takes a little patience and practice. Like the transition from point-to-point wiring to printed circuit boards, it is similar to traditional through-hole technology but requires some new skills.

Conclusion:

Experiment – 6

AIM: - To study characteristics and testing of different types of switches.

THEORY:-

An electrical switch is any device used to interrupt the flow of electrons in a circuit. Switches are essentially binary; they are either completely 'ON' or completely 'OFF'.

The simplest type of switches is one where two electrical conductors are brought in contact with each other by the motion of an actuating mechanism. Other switches are more complex, containing electronic circuit able to turn on or depending on some physical stimulus (such as light or magnetic field) sensed.

Any switch designed to be operated by a person is generally called a hand switch, and they are manufactured in several varieties.

Features for selecting a switch:

- Contacts (e.g. single or double pole, single or double throw)
- Ratings (maximum voltage / current)
- Method of operation (toggle, slide, key etc.)

Terms used for switch:

- **Pole**: - number of switch contact sets.
- **Throw**:- number of conducting positions, single or double
- **Way**:- number of conducting positions three or more
- **Momentary**:- switch returns to its normal position when released
- **Open**:- OFF position, contacts not conducting
- **Closed**:- ON position , contacts conducting

<u>STANDARD SWITCHES</u>:

1) SPST (Single pole single throw) Switch: - A simple ON-OFF switch. This is used to switch the power supply to a circuit either ON or OFF.
   E.g. Simple light, fan switch in house

SPST ON-OFF

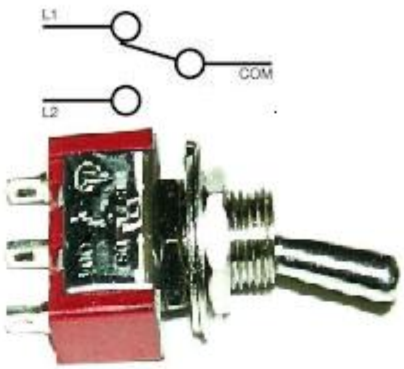
SPST (PUSH TO MAKE) ON-OFF

SPST (PUSH TO BREAK) ON-OFF

2) SPST Momentary (Push to make) switch: - A push to make switch returns to its normally OFF position when you release the button, this is shown by the brackets around ON.
   E.g. Standard Door-bell switch

3) SPST Momentary (Push to break) switch: - A push to break switch returns to its normally ON position when you release the button.

4) SPDT (Single Pole Double Throw): - This switch can be ON in both the positions, switching on a separate device in each case. It is often called a changeover switch. E.g. a SPDT switch can be used to switch on a red lamp in one position and a green lamp on another position. A SPDT toggle switch may be used as a simple ON-OFF switch by connecting to COM and one of the A or B terminals as shown in the figure.



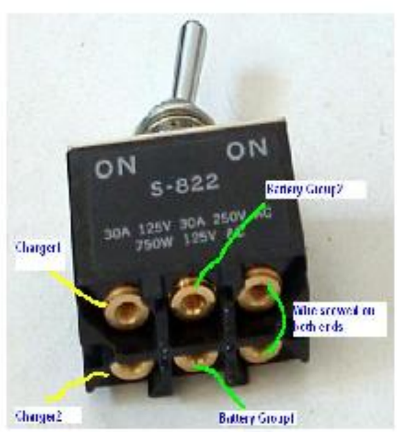
SPDT SWITCH (ON-ON)

SPDT CENTRE OFF

5) SPDT Centre OFF: - A special version of the standard SPDT switch. It has a third switching position in the centre which is OFF. Momentary ON – OFF – ON versions are also available where the switch returns to the central OFF position when released.

6) DPST (Double Pole Single Throw): - A pair of ON-OFF switches which operate together. A DPST switch is often used to switch mains electricity because it can isolate both the live and neutral connections.

DPST SWITCH



DPDT SWITCH

DPDT CCENTRE OFF SWITCH

7) DPDT (Double Pole Double Throw): - A pair of ON-ON switches which operate together. It can be wired up as a reversing switch for motor.

8) DPDT Center OFF: - It has a third switching position in the center which is OFF. This can be vey useful for motor control because you have forward, OFF and reverse positions. Momentary ON-OFF-ON versions are also available where the switch returns to the central OFF position when released.

SPECIAL SWITCHES:

1) PUSH-PULL Switch: - It looks like a momentary action push switch but it is a standard ON-OFF switch. PUSH once to switch ON, and PUSH again to switch OFF. This is called a latching.

2) MICRO Switch: - It is designed to switch fully OPEN or CLOSED in response to small movements. They are available with levers and rollers attached.

3) KEYSWITCH: - It is operated by a key. You can ON or OFF a switch using a key.

4) REED Switch: - The contacts of a REED switch are closed by bringing a small magnet near the switch. They are used in security circuits, for example to check that doors are closed or not.
   A reed switch refers to an electrical switch that functions through an applied magnetic field. The device is comprised of two contacts on ferrous metal reeds in a hermetically sealed glass enclosure. The contacts may be commonly left open and automatically closes when a magnetic field is close or usually closes and opens when a magnetic field is imposed. After the magnet is distanced away from the switch, the reed switch will return to its authentic placement.

   For e.g. it is used in a lift for checking whether the door is closed or not.

PUSH PULL

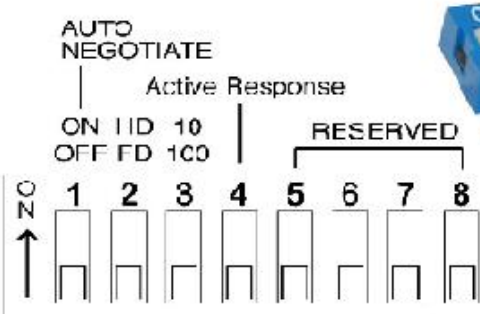
MICRO SWITCH

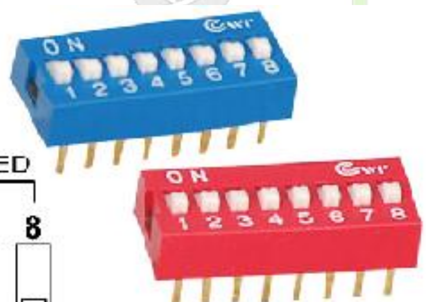
KEY SWITCH

REED SWITCH

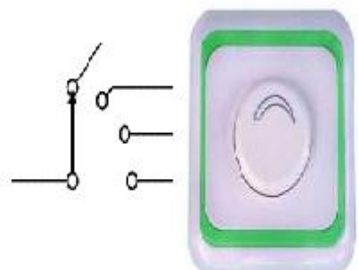
5) DIP (DUAL INLINE PARRALEL) switch: - This is a set of miniature SPST ON-OFF switches.

 for e.g. setting the code of a remote control or any other devices.





DIP (DUAL INLINE PARALLEL) SWITCH



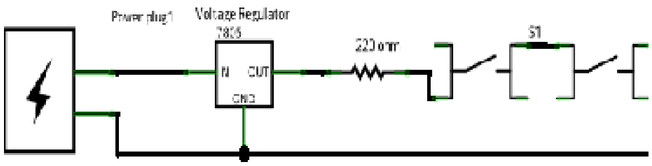
MULTIWAY SWITCH

6) Multi Way switch: - It has three or more conducting positions. They may have several poles. A popular type has a rotary action and it is available with a range of contact arrangements from 1 pole 2-way or 4 pole 3-way.

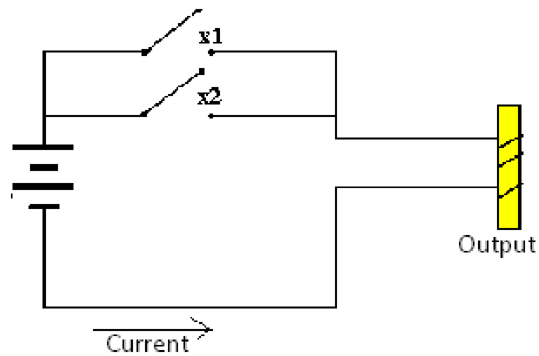
 For e.g. a rotary switch in fan regulator

SWICHES IN SERIES:

If several ON-OFF switches are connected in series, they all must be ON to complete the circuit. The below diagram shows a simple circuit with two switches connected in series to control a lamp.



switches in series



switches in parallel

SWICHES IN PARALLEL:

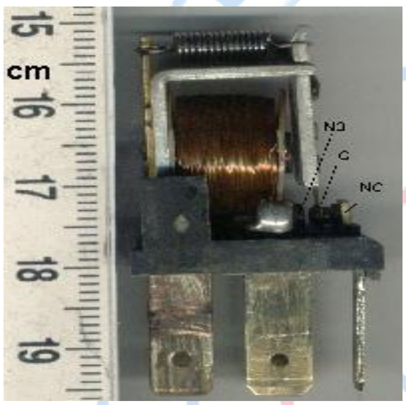
If several ON-OFF switches are connected in parallel, only one needs to be ON to complete the circuit. The above diagram shows a simple circuit with two switches connected in parallel to control a lamp.

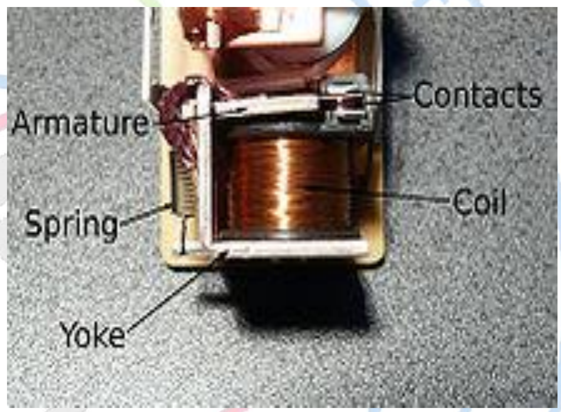
CONCLUSION:

EXPERIMENT- 7

Aim: To study different relays & fuses.

Theory: A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal or where several circuits must be controlled by one signal.





CONSTRUCTION

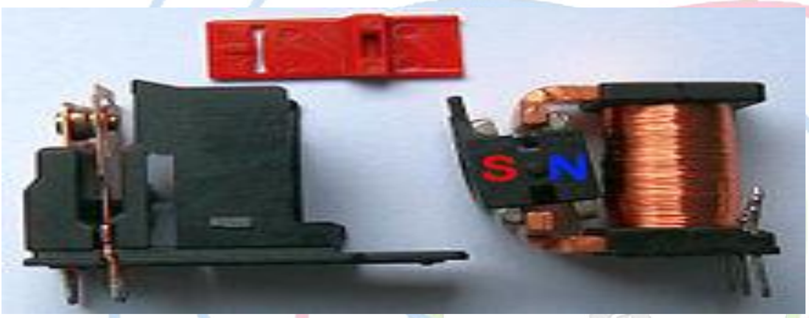
A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core, an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts the armature is hinged to the yoke and mechanically linked to one or more sets of moving contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Relay in picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, which is soldered to the PCB.

WORKING:

When an electric current is passed through the coil it generates a magnetic field that activates the armature, and the consequent movement of the movable contact either makes or breaks a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open.. In a low-voltage application this reduces noise; in a high voltage or current application it reduces arcing.

TYPES

Latching relay:



A latching relay has two relaxed states These are also called "impulse", "keep", or "stay" relays. When the current is switched off, the relay remains in its last state. by having two opposing coils with an over-center spring or permanent magnet to hold the armature and contacts in position while the coil is relaxed,. the first pulse to the coil turns the relay on and the second pulse turns it off. In the two coil example, a pulse to one coil turns the relay on and a pulse to the opposite coil turns the relay off. This type of relay has the advantage that one coil consumes power only for an instant, while it is being switched

REED RELAY

A reed relay is a reed switch enclosed in a solenoid. The switch has a set of contacts inside an evacuated or inert gas-filled glass tube which protects the contacts against atmospheric corrosion; the contacts are made of magnetic material that makes them move under the influence of the field of the enclosing solenoid. Reed relays can switch faster than larger relays, require only little power

from the control circuit, but have low switching current and
Voltage ratings.

Solid state relay :

It is a solid state electronic component that provides a similar function to an electromechanical relay but does not have any moving components, increasing long-term reliability .The minimum voltage drop for such a relay is equal to the voltage drop across one transistor (~0.6-2.0 volts),

Buchholz relay :
It is a safety device sensing accumulation of gas in large oil-filled transformers, which will alarm on slow accumulation of gas or shut down the transformer if gas is produced rapidly in the transformer oil.
[edit] Forced-guided contacts relay

* Normally-open (NO) contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive.
* Normally-closed (NC) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive
* Change-over (CO), or double-throw (DT), contacts control two circuits: one normally-open contact and one normally-closed contact with a common terminal.

APPLICATIONS

- Controlling a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers.
- Detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers.
- Isolate the controlling circuit from the controlled circuit when the two are

at different potentials.

- Time delay functions. Relays can be modified to delay opening or delay closing a set of contacts.
- Switching to a standby power supply.

FUSES

INTRODUCTION:

Fuse consists of a replaceable part and a fuse holder. The simplest fuse link is a length of wire. It is mounted by screw connections in a holder which partly encloses it. When an over current or short-circuit current flows, the wire starts to melt and arcing commences at various positions along it. The arc voltage causes the current to fall and once it has fallen to zero, the arcs are extinguished. Fuse element is made of zinc, copper, silver, aluminum. Melt quickly on a small excess. Fuse element may be surrounded by air, or by materials intended to speed the quenching of the arc. Silica sand or non-conducting liquids may be used.

TYPES OF FUSES

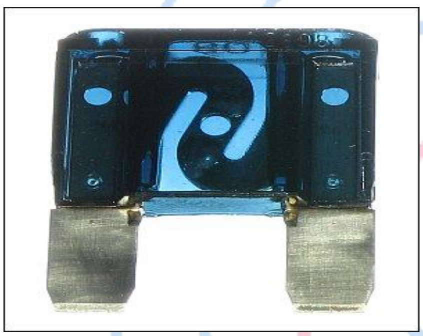
LOW VOLTAGE FUSES

Low voltage fuses can be further divided into two classes namely

I) Semi-enclosed or Re wire able type.

II) Totally enclosed or Cartridge type.

MAXI FUSE:
Fuse is generally inserted into an electrical circuit for 1 of 2 reasons, either to protect the power source which includes the wire that connects the power supply to the electrical device, or to protect the electronic equipment.



WHY FUSES ARE USED?

A fuse is designed to blow when a certain current is reached. It protects the circuit from being exposed to such an over-current condition which could cause a fire, destroy expensive components or generally cause a safety hazard.

CONCLUSION:

EXPERIMENT- 8

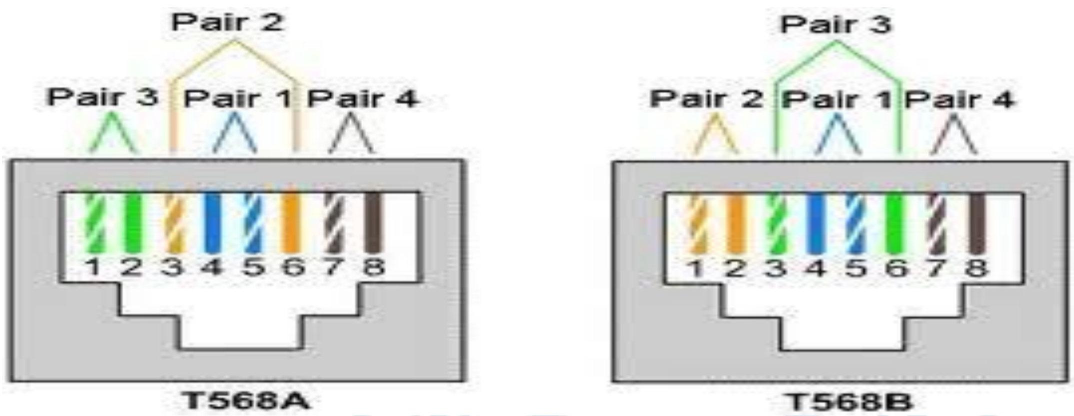
Aim: To study about wires & cables.

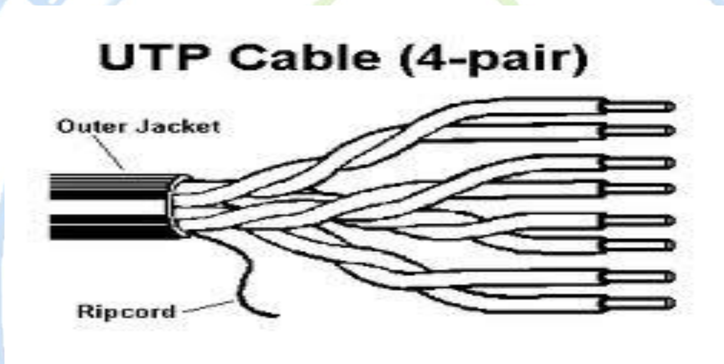
Theory: There are several types of cable which are commonly used with LANs. In some cases, a network will utilize only one type of cable, other networks will use a variety of cable types. The type of cable chosen for a network is related to the network's topology, protocol, and size.

Unshielded Twisted Pair (UTP) Cable, Shielded Twisted Pair (STP) Cable Coaxial Cable, Fiber Optic Cable Wireless LANs Cable Installation Guides Unshielded Twisted Pair (UTP) Cable Twisted pair cabling comes in two varieties: shielded and unshielded.

Unshielded twisted pair (UTP)

It is most popular and is generally best option for school networks the cable has four pairs of wires inside the jacket. Each pair is twisted with a different number of twists per inch to help eliminate interference from adjacent pairs and other electrical devices. The tighter the twisting, the higher the supported transmission rate and the greater the cost per foot.





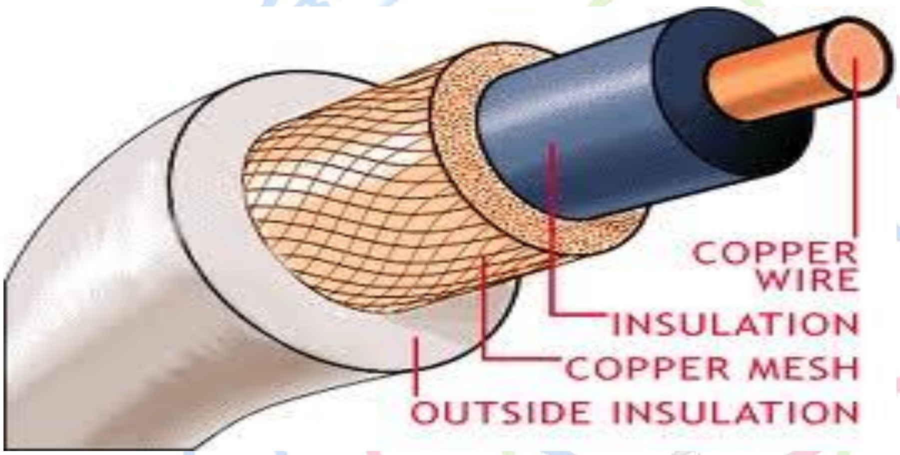
Unshielded Twisted Pair Connector The standard connector for unshielded twisted pair cabling is an RJ-45 connector. This is a plastic connector that looks like a large telephone-style connector A slot allows the RJ-45 to be inserted only one way.

UTP is that it may be susceptible to radio and electrical frequency interference.

Shielded twisted pair (STP) is suitable for environments with electrical interference; however, the extra shielding can make the cables quite bulky.

Coaxial Cable:

Cabling has a single copper conductor at its center. Plastic layer provides insulation between the center conductor and a braided metal shield the metal shield helps to block any outside interference from fluorescent lights, motors, and other computers.



Coaxial cabling is difficult to install, it is highly resistant to signal interference. In addition, it can support greater cable lengths between network devices than twisted pair cable. The two types of coaxial cabling are thick coaxial and thin coaxial.

Connectors on the cable are the weakest points in any network. To help avoid problems with your network, always use the BNC connectors that crimp, rather than screw, onto the cable. Fig. 4. BNC connector Fiber Optic Cable Fiber optic cabling consists of a center glass core surrounded by several layers of protective materials It transmits light rather than electronic signals eliminating the problem of electrical interference. This makes it ideal for certain environments that contain a large amount of electrical interference. Fiber optic cable has the ability to transmit signals over much longer distances than coaxial and twisted pair.

FIBER OPTIC CABLE:

It consist of centre glass core surrounded by several layers of protective materials,

It transmits lights rather than electronic signals eliminating problem of electrical interference. This makes it ideal for certain environments that contains large amount of electrical interference.

It has ability to transmit signal over long distance than coaxial & twisted pair.It has capability to carry information at vastly greater speeds. Cost otf this cable is comparable to copper cabling

2 types:

Single mode, multi mode

Applications:

Video conferencing & interactive services

Multi core

A *multi core cable* is a generic term for an electrical cable that has multiple cores made of copper wire. The term is normally only used in relation to a cable that has more cores than commonly encountered. For example, a four core mains cable is never referred to as multi core, but a cable comprising four coaxial cables in a single sheath would be considered multi core.

The term **snake cable** is frequently used in the professional audio recording industry to refer to an audio multi core cable.

Multi Stranded Copper Wire:

This copper wire rope is high tolerance Wires that compensate for vibration, expansion. Being highly flexible, these Copper wires can be used as connectors. This copper wire rope can be developed in different specification and material as per client's requirement.

Stranded Copper Wire rope: are developed in different specification and material as per client's requirement. The rope-type construction of these **Copper Wires** is specially designed for extra strength, flexibility and easy handling. These are kink-free and can be tied in a knot like rope patterns at the insulator.

CONCLUSION:

Experiment - 9

AIM: To conduct the characteristic study of different types of Connectors.

Theory:

- ✓ Wires and cables are responsible for connecting the network and for carrying the information &relevant data.
- ✓ Connectors also play equally important role for network connections.
- ✓ Connectors are broadly classified as coaxial RF connectors, BNC,TNC,Banana pin connectors, D connectors, FRC connectors , Relimate ,Burg Strip ,Edge connectors, Power connectors, SMA connectors ,RJ- 45, connectors,RJ-11 connectors, and JACK pin connectors – Mono stereo.
- ✓ Let us discuss some of them into necessary details

1. BNC Connectors: These are most widely used connectors and are mostly found on the electronic measuring testing equipment, etc. There nominal impedance is 50 Ω and the working voltage is 500 V. They possess Bayonet coupling which works on the principle of locking. The locking of contacts is achieved by applying axial force against a latching spring (same as that in CRO).
2. TNC Connectors: The coupling mechanism here is threaded coupling instead of Bayonet coupling. They also have impedance of 50 Ω and the frequency can extend up to 11GHZ.
3. UHF Connectors: They are threaded coupling – type RF connectors that can work up to 300MHz. There application includes electronic test and measuring instrument, communication equipments, RADAR, TV, etc.
4. N- type Connectors : They are widely used in RF test and measurement equipment having nominal impedance of 50 Ω, voltage of 1000Vrms and frequency can extend up to
11 GHz.

5. SMA Connectors: There have the best RF performance with low frequency VSWR at frequency grater than 20 GHz. They find wide use in microwave communications.
6. Crimp Connectors: They are the ones that use crimping - type contacts rather than solder – type contacts. A crimp contact is produced by either indenting or compressing the contact tail against or around the wire to lock or retain the wire within the contact tail. Crimp- type connectors are extensively used for military and aerospace applications due to environmental worthiness and greater strength joint.
7. Receptacle Connectors: It is a connector having either pin or socket – type contacts. It is permanently mounted on the panel chasis.
8. Plug Connectors: A connector attached to a cable or connector is called Plug – type Connector. It can have pin or socket – type contacts.

Important Terms Related to various types of Connectors:

Bayonet Coupling: It is the coupling technique where pin – type
Contacts on one connector shall mate with spiraled grooves of other shell. The locking of contacts is achieved by applying axial
Force against the latching spring and giving a partial turn to the bayonet ring. Bayonet coupling is very common circular.BNC connector belong to this class. Most of he circular connectors used for military and aerospace applications have Bayonet coupling.

Polarization: It means contact arrangement or shell configuration of a connector that ensures that the mating connectors are guided into proper alignment during mating.

Threaded Coupling: It is used on circular connectors and contact engagement is achieved by several turns on threaded part. In some circular connectors, the engagement takes place by applying an axial force and connector locking is done by giving several turns on threaded receptacle.

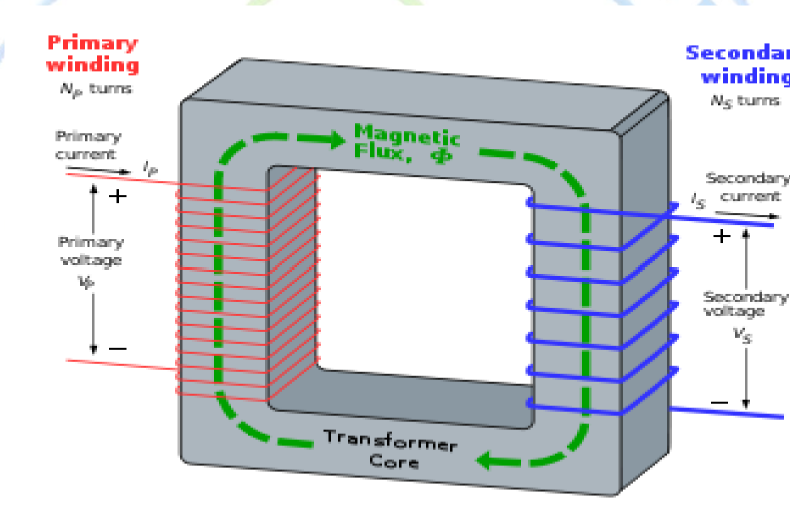
Socket Contacts: It is hollow and usually cylindrical contact that has been designed to mate with pin contact. Socket contacts are preferably used on a connector use on the source side of the circuit.

CONCLUSION:

EXPERIMENT- 10

Aim: To conduct the characteristic study of different types of transformers.

Theory: Essentially, Transformer is a component that consists of 2 or more than 2 coils wound on an air core or a magnetic material that are electrically isolated but magnetically coupled. It does job of transforming 1 or more parameters to be transformed could be voltage, current, impedance, phase & so on. It may even provide isolation between alternating current circuits or may be used for precise measurements of current & voltage.



Step-up & Step down Transformers

- Transformer works on principle of mutual inductance.
- There is primary winding inductance & secondary winding inductance. The purpose of transformer Is to step up or down or to isolate .primary & secondary are not connected to each other .power in primary is connected with secondary by magnetic field linking 2 windings.
- By having more or fewer turns in LS compared with LP, transformer can step up or down.
- Steady DC voltages cannot be step up or down by transformer because, steady current can't produce induced voltage. It depends on **TURN-RATIO=Np/Ns**
  Where: Np=no. of turns in primary, Ns=no. of turns in secondary.

- Turns -ratio is also related to voltage –ratio in same proportion **Vp/Vs=Np/Ns**
- When secondary has more voltage then primary, voltage is said to be **stepped-up.**
- When secondary has fewer turns, voltage is said to be **stepped –down.**

Example of Step-up Transformer: A power Transformer has 100 turns for Np & 600 turns for Ns .

Turns –ratio=Np /Ns=100/600=1:6, **Voltage –ratio**=Vp/Vs=Np/Ns,

120/Vs=1/6, Vs=6*120=720v, Vp is stepped up by factor 6, such

Vs=720v.

Example of Step-down Transformer: A power transformer has 100 turns for Np & 5 turns for Ns .

Turns –ratio=Np/Ns=100/5=20:1, **Voltage –ratio**=Vp/Vs=Np/Ns,

120/Vs=20/1, Vs=120/20=6v ,Vp is stepped down by factor 20,such

Vs=6v.

Center-Tapped Transformer:

- In this, primary voltage is 120 v, secondary voltage is 12.5-0-12.5 indicates 12.5 v is available between center-tapped connection. total secondary voltage is 12.5*2=25v.
- Rated value is specified under full load condition with rated primary voltage applied. A transformer is considered fully loaded when rated current is drawn from secondary.

Pulse Transformer:

- Name suggests it transforms pulses from 1 ckt .The transformed or coupled pulse is either exact replica of original pulse or it has undergone a change in its amplitude or polarity or both.

Auto Transformer:

- Conventional transformer, primary & secondary winding are only magnetically coupled is an auto transformer they are both electrically & magnetically coupled.
- typical application is that of coupling audio signal present at output of final stage of audio amplifier to speaker.

Conclusion:

Experiment – 11

AIM: - To study different kinds of measuring equipments. (1) CRO and (2) DMM.

THEORY:-

Cathode Ray Oscilloscope:

Cathode ray oscilloscope is a very useful general purpose electronics instrument for testing and developing electronics circuit system and instruments. Using a CRO the shape, amplitude and frequency of ac signal is measured. CRO is also useful l in determining the amplitude of dc signal. The electron beam generated in the CRO is deflected by a given electrical signal and when the deflected electron beam strikes the screen of CRO because of phosphorescence effect, a visible trace is produced exactly in the same shape as the given electrical signal.

Block diagram of CRO

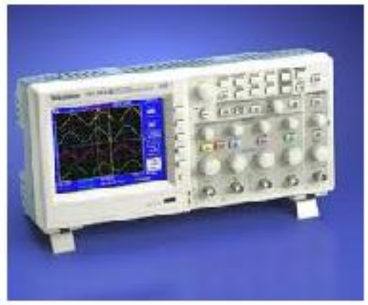
The heart of CRO is a cathode ray tube (CRT).here the electron beam is generated, accelerated and deflected in accordance with the input signal and a visible trace is produced on the phosphor screen. For the illumination on the screen to be bright, the velocity of the electron beam impinging on the screen and the kinetic energy must be high

Vertical amplifier: This is also called a Y-amplifier. The electron beam deflection in the Y-direction or the vertical direction is also proportional to the signal amplitude given to the Y-input or the vertical plates.

HV and LV supplies – To accelerate and sweep the electron beam, a large voltage in kilovolts is required. This is generated by the high-voltage power supply circuits. Vcc and other low voltages required are generated in the low-voltage power supply circuits.

CRT – A CRT is a heart of a CRO. Here the electron beam is generated and made to strike the fluorescent screen to the give thee visual display of the electrical input signal electrical input signal given to the vertical or the Y-plates.

Horizontal Amplifier – The purpose of this circuit is to amplify an externally applied signal to the horizontal or X-planes.



Different Controls in a CRO

AC	When AC signal is given as Y-input, the CRO is kept in this mode. DC is blocked.
DC	When DC signals are given as Y-input, the CRO is kept in this mode. Both AC and DC are seen
GND	Zero V or ground potential is applied to the Y-plated. Therefore no deflection is seen on the CRO screen. The electron beam will be at the zero axis, along the x-axis.
Intensity	The brightness of the electron beam can be varied.
X-Shift	The signal can be moved or shifted in the X-direction on the screen.
Y-Shift	The signal can be moved or shifted in the Y-direction on the screen.
Focus	Electron beam focusing can be adjusted.
Time Base	ms/div, Ms/div: The frequency of the internal saw-tooth waveform (time base) can be varied.
Y-input vertical input	The signal to be observed on the screen is applied to the vertical deflecting plates.
X-input Horizontal	Saw tooth waveform is applied in the INT mode to deflect the beam in he X-input direction.

Digital Multi Meter (DMM):

Multi meters are available in two forms which are as follows:

- Analog multimeter: - Analog multimeter uses pointer and scale to display the measured value.
- Digital multimeter:- DMM uses LCD or LED for displaying the measured value.

Mainly there are two types of DMM: (1) Table Top type and (2) Hand held type

ANALOG METER

TABLE TOP DMM

HAND HELD TYPE DMM

- Digital multimeters use digital display for representing the measured values.
- All digital meters contain a battery to power the display so they use virtually no power from the circuit under test.
- Basically DMM is used to measure the low D.C. voltage. For measuring such voltages four different circuits are used. Voltage multiplier circuits are used and if required A.C. voltage is rectified to convert it into its respective D.C. equivalent value.
- DC means direct current. In any circuit which operates from a steady voltage source, such as a battery, current flow is always in the same direction.
- AC means alternating current. In an electric lamp connected to the domestic mains electricity, current flows first one way and then the other. That is, the current reverses or alternates, in direction.
- For safety reasons, you must never connect a multimeter to the mains supply.

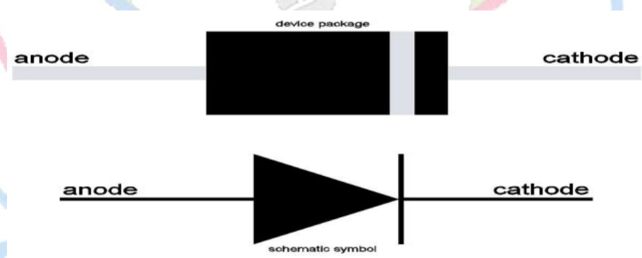
- There are DMMs available in market which provide facility to measure the capacitance and also has a feature to verify whether a given transistor is in working condition or not.

Measurement using DMM:

(a) Resistance measurement:

- Set the meter to a resistance range greater than you expect resistance value.
- Touch the meter probes together and check that the meter reads zero. If it does not read zero, turn the switch to ‘Set zero’ if your meter has this and try again.
- Put the probes across the component and check the value displayed on the DMM screen. Avoid touching more than one contact at a time or your resistance will upset the value.

(b) Diode testing



- Touch the red (+) lead to the anode and the black (-) to the cathode. In this condition diode comes forward bias so it should conduct and meter will display a voltage value (usually the voltage across the diode in mV) which is the potential difference across the diode.
- Reverse the connections and in this condition diode should not conduct this way so the meter will display “off the scale” (usually blank except for a 1 on the left).

CONCLUSION: -

Experiment – 12

AIM: - To study printed circuit board.

Theory:

- Printed circuit board is a copper clad board.
- It has copper tracks connecting the holes where the components are placed.
- It is used in virtually all but the simplest commercially-produced electronic devices.
- PCB's have insulating material produced from laminates.
- The different types of laminates are phenolic laminates, epoxy paper, and glass.

Types of PCBs: - Basically there are following types of PCBs that can be used or various applications.

1) Single-sided board:

- A single-sided board is comprised of just one substrate with a fairly straight-forward set of components.
- An extremely thin layer of conducting material is applied to the board and electronic components are soldered to a set of interconnecting circuits.

2) Double-sided board:

- As its name implies, an increase in application complexity may make it necessary for additional electronic components to be soldered to the other side of the substrate.
- Now that there are circuits on each side of the board, the components are connected via a series of strategically placed through-holes.
- The holes must therefore be coated with a conductive material to allow the PCB to work correctly.

3) Multi-layered board:

- In multi layered board PCBs, several track layers are incorporated into a single board laminated together with insulating layers between each copper layer.
- The planted through holes can be used for either component terminal connection or purely as electrical connection.
- Thirty of so layers typically made into 2mm thickness, and the maximum limit may extend up to 60 layers.
- The multi layered boards consists of certain number of thin PCB's stacked together and adhesively joined with insulation to form one rigid board.
- Electrical connection between the different conductive layers is done with plate through holes; the conductor width is increased to slightly more than the whole diameter.

Application of multi-layered PCBs: - Layered PCBs are used where

- The use of a double sided PCB is not feasible.
- Reduction in electronic component weight and volume is of prime concern.
- De-coupling and shielding of interconnection is important for the function of electronic circuits.

Conclusion:

Experiment - 13

AIM: To perform the wiring & testing of total resistance in the series combination & parallel combination of resistors on bread board set-up.

APPARATUS: Breadboard, Power supply, Resistors, Multi-meter

THEORY:

A series circuit provides only one path for circuit flow. Example of a series circuit containing two resistors is shown in fig. a. The electrons have only one path to follow, as they leave the negative terminal of the applied voltage flow through resistances R1 & R2 return to the positive terminal of Battery.

There is no other path through which current can flow.

Any number of resistors can be used; still the current is same in the series connection – no matter how many components are arranged. Even though the current is the same through each resistor in a circuit, the voltage across each resistor can be different.

The reason is Ohm's Law according to which V = I*R. Since the value of current is same through each resistor, the larger value resistors will have a greater voltage drop.

PROCEDURE:-

(1) Series connection :-

- Place the resistors on the breadboard as shown in figure to establish series connection.
- Connect a regulated power supply to the two extreme terminals of the resistors connection, so as to close the circuit.
- Switch on the power supply.
- Note down the individual resistance measured through a multimeter. Calculate the total resistance of the circuit.

- Now note down the individual & total voltage drop across the resistors.
- Verify the measured resistance and the calculated value of the total resistance.

(2) Parallel Connection :-

A Parallel circuit is formed when two or more components are connected across the same two points. In this case the voltage across each component must be the same. Each component provides a separate path or the branch for current flow. The individual branch current are calculated using the Ohm's Law as :

Since V=I*R I = V/R when V is the same across all the branches

Hence, the total current is equal to the sum of the individual current passing through different paths on a parallel circuit.

PROCEDURE:-

- Place the resistor on the board as shown in the figure below to establish parallel connection.
- Connect a regulated power supply to the extreme terminals of the resistor connections, so as to close the circuit.
- Switch on the power supply.
- Note down the individual resistance measured through the multimeter and also the total resistance of the circuit.
- Note down the individual and total voltage drop across the resistors. Verify the measured value and the calculated value.

CONCLUSION:-

Experiment – 14

AIM: - To study soldering and desoldering techniques.

THEORY:

Soldering Iron: - For electronics work the best type is one powered by mains electricity, it should have a heatproof cable for safety. The iron's power rating should be 15 to 25W and it should be fitted with a small bit of 2 to 3 mm diameter.

Soldering iron stand: - You must have a safe place to put the iron when you are not holding it. The stand should include a sponge which can be damped for cleaning the tip of the iron.

Desoldering pump: - A tool for removing solder when desoldering a joint to correct a mistake or replace a component.

Solder remover wick: - This is an alternative to the desoldering pump.

What is solder?

It is an alloy (mixture) of tin and lead, typically 60% tin and 40% lead. It melts at a temperature about 200'C. Coating a surface with solder is called 'tinning' because of the tin content of solder. Lead is poisonous and you should always wash your hands after using solder.

Solder for electronics use contains tiny cores of flux, like the wires inside a mains flex. The flux is corrosive, like an acid, and it cleans the metal surfaces as the solder melts. This is why you must melt the solder actually on the joint, not on the iron tip. Without flux most joints would fails because metals quickly oxidize and the solder itself will not flow properly onto a dirty, oxidized, metal surface.

The best size of solder for electronics is 22swg. (swg = standard wire gauge)

Desoldering: - At some stage you will probably need to desolder a joint to remove or re-position a wire or component. There are two ways of removing solder:

1) <u>With a desoldering pump : -</u>

- Set the pump by pushing the spring loaded plunger down until it locks.
- Apply both the pump nozzle and the tip of your soldering iron to the joint.
- Wait a second or two for the solder to melt.
- Then press the button on the pump to release the plunger and suck the molten solder into the tool.
- Repeat if necessary to remove as much solder as possible.

2) <u>With solder remover wick (copper braid) :-</u>

- Apply both the end of the wick and the tip of your soldering iron to the joint.
- As the solder melts most of it will flow onto the wick, away from the joint.
- Remove the wick first, then the soldering iron.
- Cut off and discard the end of the wick coated with solder.

After removing most of the solder from the joints you may be able to remove the wire or component lead straight away. If the joint will not come apart easily apply your soldering iron to melt the remaining traces of solder at the same time as pulling the joint apart, taking care to avoid burning yourself.

<u>To reduce the risk of burns :</u>

- Always return your soldering iron to its stand immediately after use.
- Allow joints and components a minute or so to cool down before you touch them.
- Never touch the element or tip of a soldering iron unless you are certain it is cold.

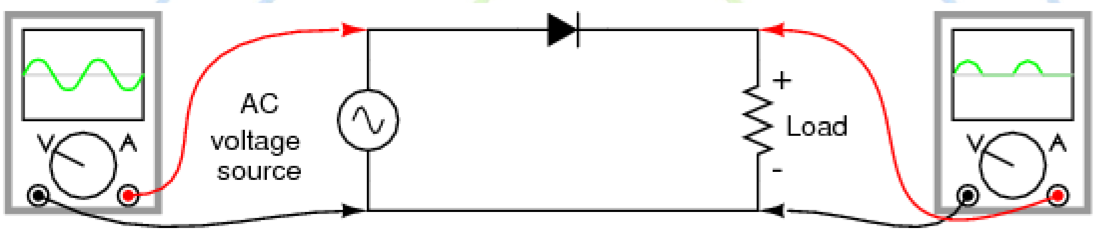
<u>CONCLUSION :-</u>

Experiment – 15

AIM: - To study Diode as a Rectifier Circuit.

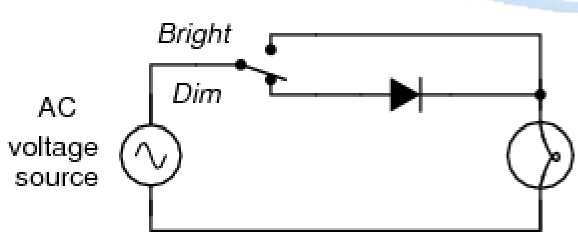
THEORY:

Now we come to the most popular application of the diode: *rectification*. Simply defined, rectification is the conversion of alternating current (AC) to direct current (DC). This involves a device that only allows one-way flow of electrons. As we have seen, this is exactly what a semiconductor diode does. The simplest kind of rectifier circuit is the *half-wave* rectifier. It only allows one half of an AC waveform to pass through to the load. (Figure below)



Half-wave rectifier circuit.

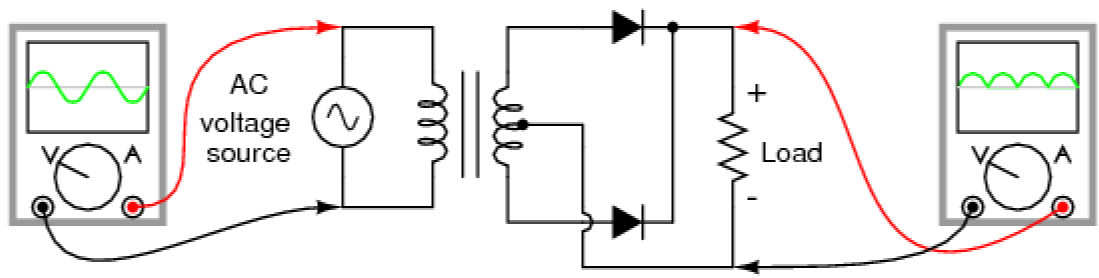
For most power applications, half-wave rectification is insufficient for the task. The harmonic content of the rectifier's output waveform is very large and consequently difficult to filter. Furthermore, the AC power source only supplies power to the load one half every full cycle, meaning that half of its capacity is unused. Half-wave rectification is, however, a very simple way to reduce power to a resistive load. Some two-position lamp dimmer switches apply full AC power to the lamp filament for "full" brightness and then half-wave rectify it for a lesser light output. (Figure below)



Half-wave rectifier application: Two level lamp dimmer.

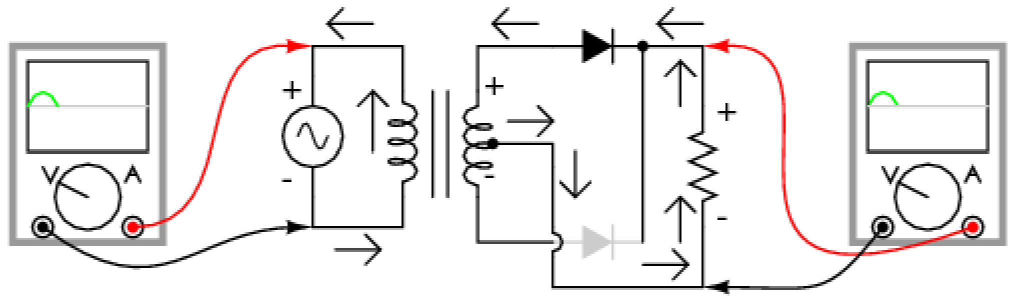
In the “Dim” switch position, the incandescent lamp receives approximately one-half the power it would normally receive operating on full-wave AC. Because the half-wave rectified power pulses far more rapidly than the filament has time to heat up and cool down, the lamp does not blink. Instead, its filament merely operates at a lesser temperature than normal, providing less light output. This principle of “pulsing” power rapidly to a slow-responding load device to control the electrical power sent to it is common in the world of industrial electronics. Since the controlling device (the diode, in this case) is either fully conducting or fully nonconducting at any given time, it dissipates little heat energy while controlling load power, making this method of power control very energy-efficient. This circuit is perhaps the crudest possible method of pulsing power to a load, but it suffices as a proof-of-concept application.

If we need to rectify AC power to obtain the full use of *both* half-cycles of the sine wave, a different rectifier circuit configuration must be used. Such a circuit is called a *full-wave* rectifier. One kind of full-wave rectifier, called the *center-tap* design, uses a transformer with a center-tapped secondary winding and two diodes, as in Figure below.



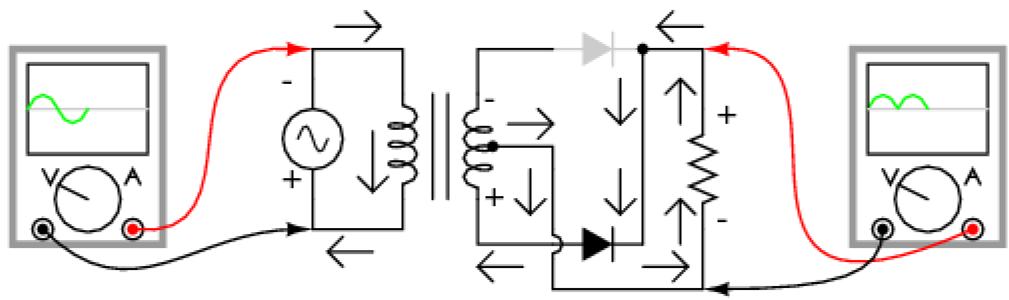
Full-wave rectifier, center-tapped design.

This circuit's operation is easily understood one half-cycle at a time. Consider the first half-cycle, when the source voltage polarity is positive (+) on top and negative (-) on bottom. At this time, only the top diode is conducting; the bottom diode is blocking current, and the load “sees” the first half of the sine wave, positive on top and negative on bottom. Only the top half of the transformer's secondary winding carries current during this half-cycle as in Figure below.



Full-wave center-tap rectifier: Top half of secondary winding conducts during positive half-cycle of input, delivering positive half-cycle to load.

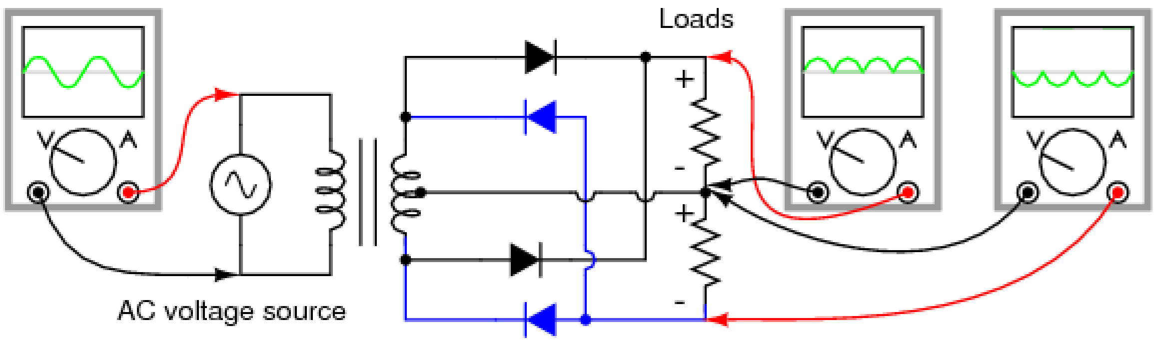
During the next half-cycle, the AC polarity reverses. Now, the other diode and the other half of the transformer's secondary winding carry current while the portions of the circuit formerly carrying current during the last half-cycle sit idle. The load still "sees" half of a sine wave, of the same polarity as before: positive on top and negative on bottom. (Figure below)



Full-wave center-tap rectifier: During negative input half-cycle, bottom half of secondary winding conducts, delivering a positive half-cycle to the load.

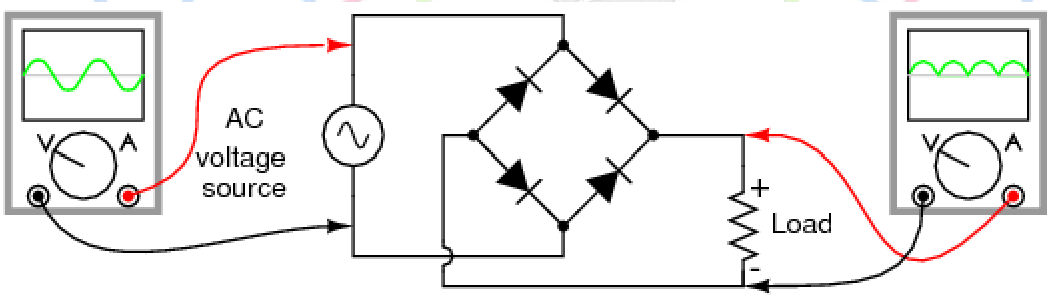
One disadvantage of this full-wave rectifier design is the necessity of a transformer with a center-tapped secondary winding. If the circuit in question is one of high power, the size and expense of a suitable transformer is significant. Consequently, the center-tap rectifier design is only seen in low-power applications.

The full-wave center-tapped rectifier polarity at the load may be reversed by changing the direction of the diodes. Furthermore, the reversed diodes can be paralleled with an existing positive-output rectifier. The result is dual-polarity full-wave center-tapped rectifier in Figure below. Note that the connectivity of the diodes themselves is the same configuration as a bridge.



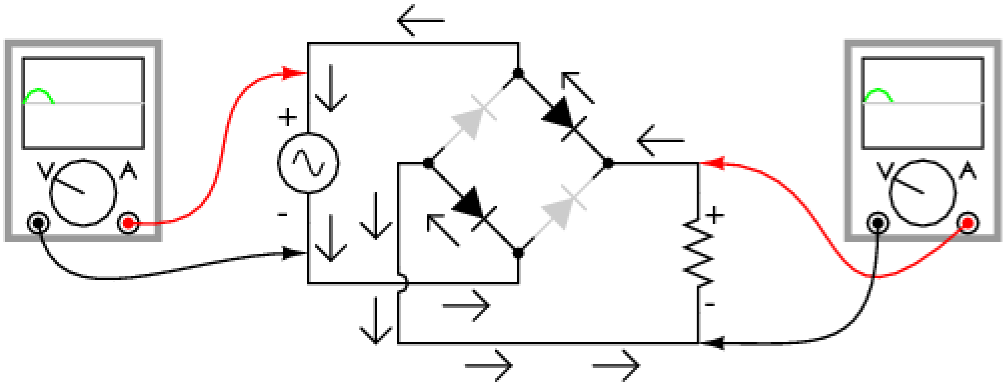
Dual polarity full-wave center tap rectifier

Another, more popular full-wave rectifier design exists, and it is built around a four-diode bridge configuration. For obvious reasons, this design is called a *full-wave bridge*. (Figure below)

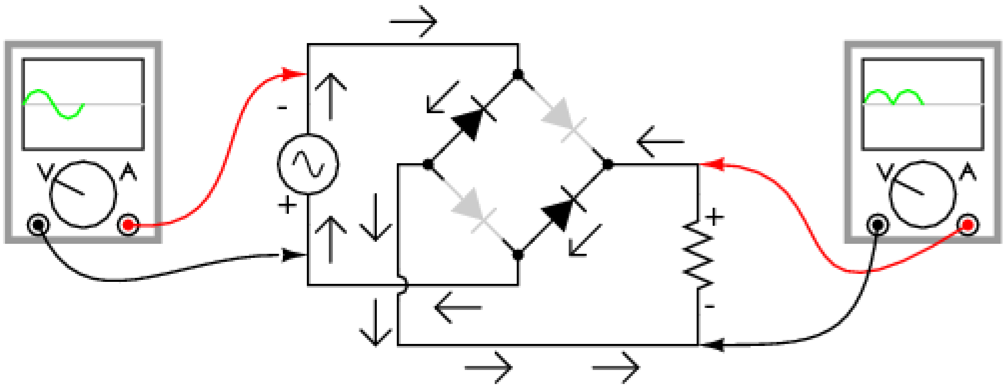


Full-wave bridge rectifier.

Current directions for the full-wave bridge rectifier circuit are as shown in Figure below for positive half-cycle and Figure below for negative half-cycles of the AC source waveform. Note that regardless of the polarity of the input, the current flows in the same direction through the load. That is, the negative half-cycle of source is a positive half-cycle at the load. The current flow is through two diodes in series for both polarities. Thus, two diode drops of the source voltage are lost (0.7·2=1.4 V for Si) in the diodes. This is a disadvantage compared with a full-wave center-tap design. This disadvantage is only a problem in very low voltage power supplies.



Full-wave bridge rectifier: Electron flow for positive half-cycles.



CONCLUSION :-