Government Girls' Polytechnic, Bilaspur

Name of the Lab**: Electronics Lab**

Practical: **Electronics Workshop Lab**

Class : **I Semester (ET&T) , III Semester (CSE)**
FOR ET&T
Teachers Assessment: 50 End Semester Examination:50
FOR CS
Teachers Assessment: 20 End Semester Examination:40

Experiment no 1

Objective : The various types of resistances and Find out the values from color bands on/written values

Material required: Various types of resistances

Theory: A resistor is a two-terminal passive electronic component which implements electrical resistance as a circuit element. When a voltage V is applied across the terminals of a resistor, a current I will flow through the resistor in direct proportion to that voltage. This constant of proportionality is called conductance, G. The reciprocal of the conductance is known as theresistance R, since, with a given voltage V, a larger value of R further "resists" the flow of current I as given by Ohm's law:

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

The behavior of an ideal resistor is dictated by the relationship specified in Ohm's law:

$$V = I \cdot R$$

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I) passing through it, where the constant of proportionality is the resistance (R).

Equivalently, Ohm's law can be stated:

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

In a series configuration, the current through all of the resistors is the same, but the voltage across each resistor will be in proportion to its resistance. The potential difference (voltage) seen across the network is the sum of those voltages, thus the total resistance can be found as the sum of those resistances:

$$R_{\mathrm{eq}} = R_1 + R_2 + \cdots + R_n$$

As a special case, the resistance of N resistors connected in series, each of the same resistance R, is given by NR.

Resistors in a parallel configuration are each subject to the same potential difference (voltage), however the currents through them add. Theconductances of the resistors then add to determine the conductance of the network. Thus the equivalent resistance (R_{eq}) of the network can be computed:

$$\frac{1}{R_{\mathrm{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}$$

The parallel equivalent resistance can be represented in equations by two vertical lines "||" (as in geometry) as a simplified notation. For the case of two resistors in parallel, this can be calculated using:

$$R_{\mathrm{eq}} = R_1 \| R_2 = \frac{R_1 R_2}{R_1 + R_2}$$

As a special case, the resistance of N resistors connected in parallel, each of the same resistance R, is given by R/N.

A resistor network that is a combination of parallel and series connections can be broken up into smaller parts that are either one or the other. For instance,

$$R_{\mathrm{eq}} = (R_1 \| R_2) + R_3 = \frac{R_1 R_2}{R_1 + R_2} + R_3$$

However, some complex networks of resistors cannot be resolved in this manner, requiring more sophisticated circuit analysis. For instance, consider a cube, each edge of which has been replaced by a resistor. What then is the resistance that would be measured between two opposite vertices? In the case of 12 equivalent resistors, it can be shown that the corner-to-corner resistance is $^5/_6$ of the individual resistance. More generally, the Y-Δ transform, or matrix methods can be used to solve such a problem.

One practical application of these relationships is that a non-standard value of resistance can generally be synthesized by connecting a number of standard values in series and/or parallel. This can also be used to obtain a resistance with a higher power rating than that of the individual resistors used. In the special case of N identical resistors all connected in series or all connected in parallel, the power rating of the individual resistors is thereby multiplied by N.

Power dissipation

The power P dissipated by a resistor (or the equivalent resistance of a resistor network) is calculated as: $P = I^2 R = IV = \frac{V^2}{R}$

The first form is a restatement of Joule's first law. Using Ohm's law, the two other forms can be derived.

The total amount of heat energy released over a period of time can be determined from the integral of the power over that period of time:

$$W = \int_{t_1}^{t_2} v(t) i(t) \, dt.$$

Measurement : The value of a resistor can be measured with an ohmmeter, which may be one function of a multimeter. Usually, probes on the ends of test leads connect to the resistor. A simple ohmmeter may apply a voltage from a battery across the unknown resistor (with an internal resistor of a known value in series) producing a current which drives a meter movement. The current flow, in accordance with Ohm's Law, is inversely proportional to the sum of the internal resistance and the resistor being tested, resulting in an analog meter scale which is very non-linear, calibrated from infinity to 0 ohms. A digital multimeter, using active electronics, may instead pass a specified current through the test resistance. The voltage generated across the test resistance in that case is linearly proportional to its resistance, which is measured and displayed. In either case the low-resistance ranges of the meter pass much more current through the test leads than do high-resistance ranges, in order for the voltages present to be at reasonable levels (generally below 10 volts) but still measurable.

Measuring low-value resistors, such as fractional-ohm resistors, with acceptable accuracy requires four-terminal connections. One pair of terminals applies a known, calibrated current to the resistor, while the other pair senses the voltage drop across the resistor. Some laboratory quality ohmmeters, especially milliohmmeters, and even some of the better digital multimeters sense using four input terminals for this purpose, which may be used with special test leads. Each of the two so-called Kelvin clips has a pair of jaws insulated from each other. One side of each clip applies the measuring current, while the other connections are only to sense the voltage drop. The resistance is again calculated using Ohm's Law as the measured voltage divided by the applied current.

Most axial resistors use a pattern of colored stripes to indicate resistance. Surface-mount resistors are marked numerically, if they are big enough to permit marking; more-recent small sizes are impractical to mark. Cases are usually tan, brown, blue, or green, though other colors are occasionally found such as dark red or dark gray.

Early 20th century resistors, essentially uninsulated, were dipped in paint to cover their entire body for color coding. A second color of paint was applied to one end of the element, and a color dot (or band) in the middle provided the third digit. The rule was "body, tip, dot", providing two significant digits for value and the decimal multiplier, in that sequence. Default tolerance was ±20%. Closer-tolerance resistors had silver (±10%) or gold-colored (±5%) paint on the other end.

Four-band resistors

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-zeroes, and the 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. Sometimes a fifth band identifies the thermal coefficient, but this must be distinguished from the true 5-color system, with 3 significant digits.

For example, green-blue-yellow-red is 56×10^4 Ω = 560 kΩ ± 2%. An easier description can be as followed: the first band, green, has a value of 5 and the second band, blue, has a value of 6, and is counted as 56. The third band, yellow, has a value of 10^4, which adds four 0's to the end, creating 560,000 Ω at ±2% tolerance accuracy. 560,000 Ω changes to 560 kΩ ±2% (as a kilo- is 10^3).

Each color corresponds to a certain digit, progressing from darker to lighter colors, as shown in the chart below.

Color	1st band	2nd band	3rd band (multiplier)	4th band (tolerance)	Temp. Coefficient
Black	0	0	$\times10^0$		
Brown	1	1	$\times10^1$	±1% (F)	100 ppm

Red	2	2	$\times 10^{2}$	±2% (G)	50 ppm
Orange	3	3	$\times 10^{3}$		15 ppm
Yellow	4	4	$\times 10^{4}$		25 ppm
Green	5	5	$\times 10^{5}$	±0.5% (D)	
Blue	6	6	$\times 10^{6}$	±0.25% (C)	
Violet	7	7	$\times 10^{7}$	±0.1% (B)	
Gray	8	8	$\times 10^{8}$	±0.05% (A)	
White	9	9	$\times 10^{9}$		
Gold			$\times 10^{-1}$	±5% (J)	
Silver			$\times 10^{-2}$	±10% (K)	
None				±20% (M)	

There are many mnemonics for remembering these colors.

Preferred values

Early resistors were made in more or less arbitrary round numbers; a series might have 100, 125, 150, 200, 300, etc. Resistors as manufactured are subject to a certain percentage tolerance, and it makes sense to manufacture values that correlate with the tolerance, so that the actual value of a resistor overlaps slightly with its neighbors. Wider spacing leaves gaps; narrower spacing increases manufacturing and inventory costs to provide resistors that are more or less interchangeable.

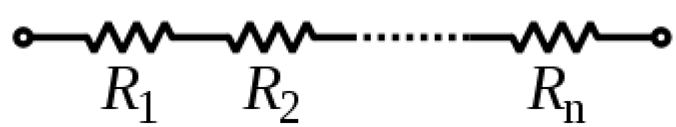
A logical scheme is to produce resistors in a range of values which increase in a geometrical progression, so that each value is greater than its predecessor by a fixed multiplier or percentage, chosen to match the tolerance of the range. For example, for a tolerance of ±20% it makes sense to have each resistor about 1.5 times its predecessor, covering a decade in 6 values. In practice the factor used is 1.4678, giving values of 1.47, 2.15, 3.16, 4.64, 6.81, 10 for the 1–10 decade (a decade is a range increasing by a factor of 10; 0.1–1 and 10–100 are other examples); these are rounded in practice to 1.5, 2.2, 3.3, 4.7, 6.8, 10; followed, of course by 15, 22, 33, … and preceded by … 0.47, 0.68, 1. This scheme has been adopted as the E6 series of the IEC 60063 preferred number values. There are also E12, E24, E48, E96 andE192 series for components of ever tighter tolerance, with 12, 24, 96, and 192 different values within each decade. The actual values used are in the IEC 60063 lists of preferred numbers.

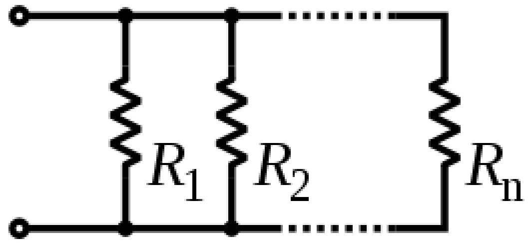
A resistor of 100 ohms ±20% would be expected to have a value between 80 and 120 ohms; its E6 neighbors are 68 (54-82) and 150 (120-180) ohms. A sensible spacing, E6 is used for ±20% components; E12 for ±10%; E24 for ±5%; E48 for ±2%, E96 for ±1%; E192 for ±0.5% or better. Resistors are manufactured in values from a few milliohms to about a gigaohm in IEC60063 ranges appropriate for their tolerance.

Earlier power wirewound resistors, such as brown vitreous-enameled types, however, were made with a different system of preferred values, such as some of those mentioned in the first sentence of this section.

5-band axial resistors 5-band identification is used for higher precision (lower tolerance) resistors (1%, 0.5%, 0.25%, 0.1%), to specify a third significant digit. The first three bands represent the significant digits, the fourth is the multiplier, and the fifth is the tolerance. Five-band resistors with a gold or silver 4th band are sometimes encountered, generally on older or specialized resistors. The 4th band is the tolerance and the 5th the temperature coefficient.

Circuit diagram :





Series and parallel resistors

Result: Identification completed

Precaution : 1. Resister or connectors use carefully

2. Take all reading carefully and handle all capacitor carefully

3.Use proper supply connection

Experiment no 2

Objective:- Identify the various types of Capacitances and Find out the values using Color Code/written values on them.

Materials required:- Capacitor

Theory:- capacitor have thin conducting plates (usually made of metal), separated by a layer of dielectric, then stacked or rolled to form a compact device.

Many types of capacitors are available commercially, with capacitance ranging from the picofarad, microfarad range to more than a farad, and voltage ratings up to hundreds of kilovolts. In general, the higher the capacitance and voltage rating, the larger the physical size of the capacitor and the higher the cost. Tolerances in capacitance value for discrete capacitors are usually specified as a percentage of the nominal value. Tolerances ranging from 50% (electrolytic types) to less than 1% are commonly available.

Another figure of merit for capacitors is stability with respect to time and temperature, sometimes called drift. Variable capacitors are generally less stable than fixed types.

The electrodes need round edges to avoid field electron emission. Air has a low breakdown voltage, so any air inside a capacitor - especially at plate edges - will reduce the voltage rating. Even closed air bubbles in the insulator or between the insulator and the electrode lead to gas discharge, particularly in AC or high frequency applications. Groups of identically constructed capacitor elements are often connected in series for operation at higher voltage. High voltage capacitors need large, smooth, and round terminals to prevent corona discharge.

Paper Capacitors Impregnated paper was extensively used for older capacitors, using wax, oil, or epoxy as an impregnant. Oil-Kraft paper capacitors are still used in certain high voltage applications. Has mostly been replaced by plastic film capacitors

Metalized Paper Capacitors Comparatively smaller in size than paper-foil capacitorsSuitable only for lower current applications. Has been largely superseded by metalized film capacitors

Aluminum Electrolytic Capacitors Very large capacitance to volume ratio, inexpensive, polarized. Primary applications are as smoothing and reservoir capacitors in power supplies

Variable capacitors Variable capacitors may have their capacitance intentionally and repeatedly changed over the life of the device. They include capacitors that use a mechanical construction to change the distance between the plates, or the amount of plate surface area which overlaps, and variable capacitance diodes that change their capacitance as a function of the applied reverse bias voltage.

Variable capacitance is also used in sensors for physical quantities, including microphones, pressure and hygro sensors.

On capacitors that are large enough (e.g. electrolytic capacitors) the capacity and working voltage are printed on the body without encoding. Sometimes the markings also include the maximum working temperature, manufacturer's name and other information.

Circuit diagram :

various types of capacitors

Paper capacitor

capacitors

A typical electrolytic capacitor

Result : The various capacitors are studied.

Precautions : 1.Take all connection carefully

2.Take all reading carefully and handle all capacitor carefully

3.Use proper supply connection.

Experiment no 3

Objective: Identify the type of Components and find out the values using LCR-Meter.

Material Required: LCR- meter, ammeter, voltmeter.

Theory : A LCR meter is a piece of equipment used in the testing of radio frequency circuits. It has been largely replaced in professional laboratories by other types of impedance measuring device, though it is still in use among radio amateurs. It was developed at Boonton Radio Corporation in Boonton, New Jersey in 1934 by William D. Laughlin [1].

A Q meter measures Q, the quality factor of a circuit, which expresses how much energy is dissipated per cycle in a non-ideal reactive circuit:

$$Q = 2\pi \times \frac{\text{Peak Energy Stored}}{\text{Energy dissipated per cycle}}.$$

This expression applies to an RF and microwave filter, band pass LC filter, or any resonator. It also can be applied to an inductor or capacitor at a chosen frequency. For inductors

$$Q = \frac{X_L}{R} = \frac{\omega L}{R}$$

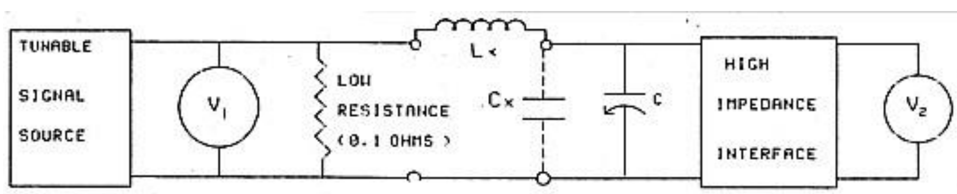
Where X_L is the reactance of the inductor, L is the inductance, ω is the angular frequency and R is the resistance of the inductor. The resistance R represents the loss in the inductor, mainly due to the resistance of the wire.

For LC band pass circuits and filters:

$$Q = \frac{F}{BW}$$

Where F is the resonant frequency (center frequency) and BW is the filter bandwidth. In a band pass filter using an LC resonant circuit, when the loss (resistance) of the inductor increases, its Q is reduced, and so the bandwidth of the filter is increased. In a coaxial cavity filter, there are no inductors and capacitors, but the cavity has an equivalent LC model with losses (resistance) and

Circuit diagram:



Basic Q Meter

Result : Identify the type of Components is done successfully.

Precautions : 1. Take all connection carefully

2.Take all reading carefully and handle all capacitor carefully

Experiment no 4

Objective:. Identify the terminals of a Diode and its Polarity.

Material Required: Diode, multimeter, connecting wire

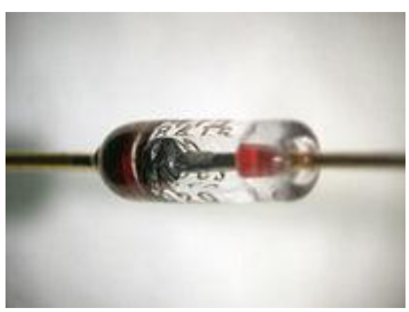
Theory: In electronics, a diode is a two-terminal electronic component that conducts electric current in only one direction. The term usually refers to a semiconductor diode, the most common type today. This is a crystalline piece of semiconductor material connected to two electrical terminals.[1] A vacuum tube diode (now little used except in some high-power technologies) is a vacuum tube with two electrodes: a plate and a cathode.

The most common function of a diode is to allow an electric current to pass in one direction (called the diode's forward direction), while blocking current in the opposite direction (the reverse direction). Thus, the diode can be thought of as an electronic version of a check valve. This unidirectional behavior is called rectification, and is used to convert alternating current to direct current, and to extract modulation from radio signals in radio receivers.

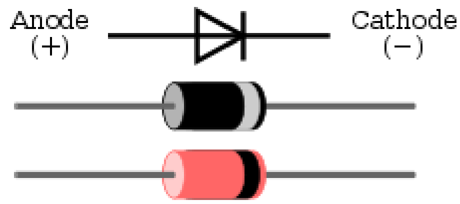
However, diodes can have more complicated behavior than this simple on-off action. This is due to their complex non-linear electrical characteristics, which can be tailored by varying the construction of their P-N junction. These are exploited in special purpose diodes that perform many different functions. For example, specialized diodes are used to regulate voltage (Zener diodes), to electronically tune radio and TV receivers (varactor diodes), to generate radio frequency oscillations (tunnel diodes), and to produce light (light emitting diodes). Tunnel diodes exhibit negative resistance, which makes them useful in some types of circuits.

Diodes were the first semiconductor electronic devices. The discovery of crystals' rectifying abilities was made by German physicist Ferdinand Braun in 1874. The first semiconductor diodes, called cat's whisker diodes, developed around 1906, were made of mineral crystals such as galena. Today most diodes are made of silicon, but other semiconductors such as germanium are sometimes usedFor a diode, the terminals are different and it matters how you connect the diode in the circuit. So you need to identify the anode (+) and the cathode(-) terminals. The diode package is marked to identify the terminals but in this activity you will use the DMM to identify the terminals. The diode allows current to flow into the anode (+), just like current flows into the higher voltage side of the resistor.

Circuit Diagram :



Close-up of a diode, showing the square shaped semiconductor crystal (black object on t).



Typical diode packages in same alignment as diode symbol. Thin bar depicts the cathode.

Result: : Identify the terminals of a Diode and its Polarity is done

Precautions : 1. All the connection take should be carefully

2. take all reading carefully and handle all capacitor carefully

3. Use proper supply connection

Experiment no 5

Objective. Identify the terminals of a Transistor and its Type (n-p-n or p-n-p)

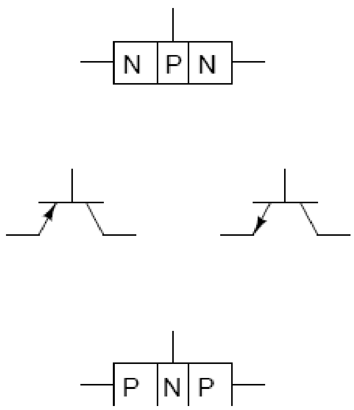
Material Required: Transistor multimeter, connecting wire

Theory: There are two types of standard transistors, NPN and PNP, with different circuit symbols. The letters refer to the layers of semiconductor material used to make the transistor. Most transistors used today are NPN because this is the easiest type to make from silicon. This page is mostly about NPN transistors and if you are new to electronics it is best to start by learning how to use these first. The leads are labeled base (B), collector (C) and emitter (E). These terms refer to the internal operation of a transistor but they are not much help in understanding how a transistor is used, so just treat them as labels! A Darlington pair is two transistors connected together to give a very high current gain.In addition to standard (bipolar junction) transistors, there are field-effect transistors which are usually referred to as FETs. They have different circuit symbols and properties and they are not (yet) covered by this page. The diagram shows the two current paths through a transistor. You can build this circuit with two standard 5mm red LEDs and any general purpose low power NPN transistor (BC108, BC182 or BC548 for example). The small base current controls the larger collector current. When the switch is closed a small current flows into the base (B) of the transistor. It is just enough to make LED B glow dimly. The transistor amplifies this small current to allow a larger current to flow through from its collector (C) to its emitter (E). This collector current is large enough to make LED C light brightly. When the switch is open no base current flows, so the transistor switches off the collector current. Both LEDs are off. A transistor amplifies current and can be used as a switch. This arrangement where the emitter (E) is in the controlling circuit (base current) and in the controlled circuit (collector current) is called common emitter mode. It is the most widely used arrangement for transistors so it is the one to learn first.
Most Digital Multi-Meters (DMM's) have a diode test function the symbol looks something like this >| (picture the greater than sign as a black triangle pointing to and touching the redline). Initially you should practice on a known good transistor, so you'll be able to tell if you have a bad one.

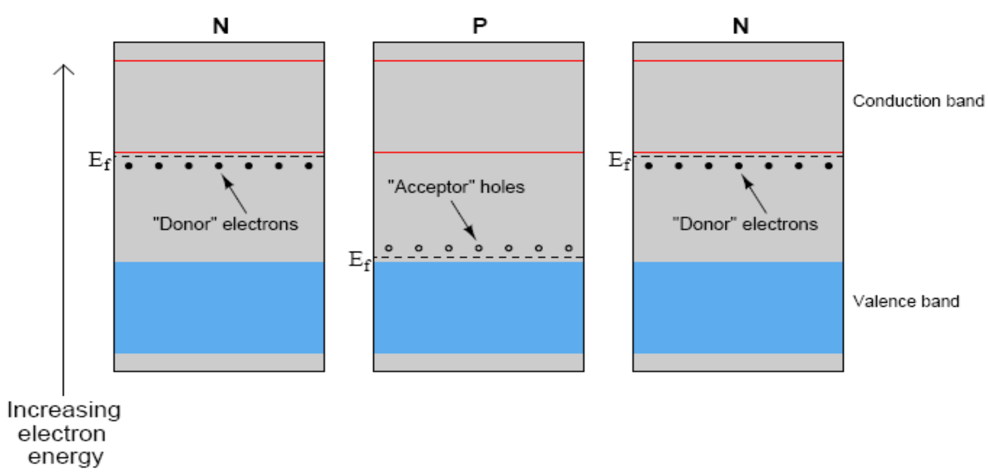
1) Ensure the transistor is out of circuit.
2) Set the DMM to the diode function.
3) Touch the positive (red) and negative (black) probes to any two leads on the transistor until you get a reading other than infinity.
4) Once you get a reading leave one of the probes on one of the leads (it doesn't matter which one).
5) Take the other probe and touch the third lead. If you don't get a reading other than infinity go back to step 4, this time leave the other probe on the lead it was originally on, when you got the reading other than infinity.
6) Now take the other probe and touch it to the third lead, you should get a reading other than infinity. If not, go back and repeat steps 3-6, but start with 2 different leads, until you can leave 1 lead in place and get a reading other than infinity on the other 2 leads.
7) If you kept the Positive lead in place you have an NPN transistor. If you kept the Negative lead in place you have a PNP transistor.
8) The probe you left in place denotes the Base.
9) On the probe that you swapped, the lead with the lower reading is the Collector and the lead with the higher reading is the Emitter.

With the help of multimeter Sanwa we can identify P-N-P and N-P-N transistor, Irj"this process, by putting multimeter in 1Q range, we measure resistance between emitter-base and base-collector.We connect Black prob of multimeter to transistor's base and connect red prob to emitter and collector respectively, if needle of meter shows low resistance (i.e. gives large indication) then transistor is N-P-N transistor.When we connect red prob to base and connect black prob to emitter and collector respectively and if meter shows low resistance (means large indication) then transistor will be P-N-P transistor.Each transistor will be either P-N-P type or N-P-N type. So meter shows low resistance only for one checking.

Circuit Diagram :



following bipolar transistor illustrations to their respective schematic symbols:



Result : The polarity of diode is identified.

Precautions : 1. All the connection take should be carefully

2. Handle diode and transistor carefully

Experiment no 6

Objective: Check the continuity of a printed line on a PCB using Multi-meter.

Materials required:- Millimeter with fine-tip test leads

Theory: A printed circuit board (PCB) is made by etching the copper layer on the board. There are different methods of doing this, but the most common one is based on using ultraviolet light and chemicals. If this etching process is not done correctly, shorts between adjacent traces may develop. Sometimes the shorts are due to incorrect layout. Finding a short on a PCB can become quite challenging if the board is complicated and has very thin traces.

1)Thoroughly check the PCB traces under the microscope or magnifying glass. See if you can find any traces that look shorted. Mark suspicious places on the board with the marker. Try avoiding traces while placing marks. You can place marks on nearby components or on ground or supply planes

2)If a circuit diagram is available, find the traces you marked as suspicious on the diagram. Observe if the traces should be separate or connected. In some cases traces are deliberately connected. Go through all suspicious traces and eliminate the ones that are connected in the circuit diagram. If a circuit diagram is not available, skip this step.

Insert the red MultiMate lead plug into the "V" socket of the millimeters and the black lead plug into the "COM" socket

Set the multimeter knob to the continuity test position. This position generally has a sign with several small parallel lines.

Turn the multimeter on. Test the multimeter continuity tester by touching its two leads together. This should produce a beep. If it does not, you have not set the knob to the continuity tester position, or the tester battery may need to be replaced.

Touch the first of the suspicious traces with the two leads of the multimeter. It does not matter which lead is connected to which trace. You will have to press firmly to establish electrical connection between the multimeter leads and the traces. If a beep sounds, there is a short. Repeat this process for all suspicious traces

A PCB, or Printed Circuit Board, contains a large number of electronic components that are interconnected through thin copper traces. The distance between these traces is generally very small, on the order of less than 1/2 millimeter. Such a short distance makes the side-by-side traces prone to shorting, that is getting electrically connected with one another. An electrical short in a circuit may degrade its performance, make it nonfunctional or damage its one or more components.

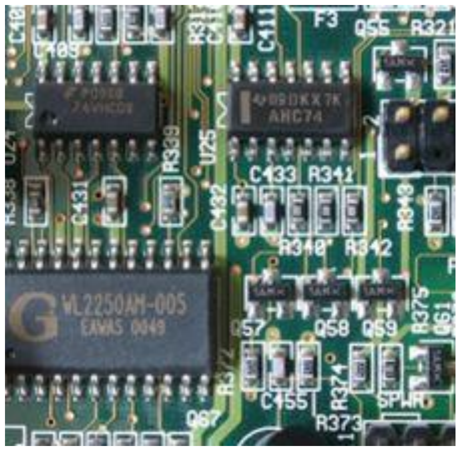
Instructions

Inspect the circuit board under a magnifying glass for shorts. Closely look at all traces and all component pins for any possible place where shorts could have occurred. Mark all the places on the board that you suspect of having electrical shorts with a marker.

Turn the multimeter on and set it to the continuity test mode. This can generally be done by turning its knob to a point labeled with three or four curly parallel lines. Insert the red multimeter lead in the socket labeled "V" and the black lead in the socket labeled "COM."

Place the tip of the black multimeter lead on one of the two conductors that you suspect of having short and place the tip of the red multimeter lead on the second conductor. If there is a short between the two conductors, you should hear a continuous beep sound from the multimeter. Repeat this process for all the conductors you

Circuit Diagram :



Testing printed line on a PCB can be challenging.

A multimeter can be used to find a short in a circuit.

Result : Check the continuity of a printed line on a PCB using Multi-meter done

Precautions: 1.All the connection take should be carefully

2. Handle diode and transistor carefully

Experiment no 7

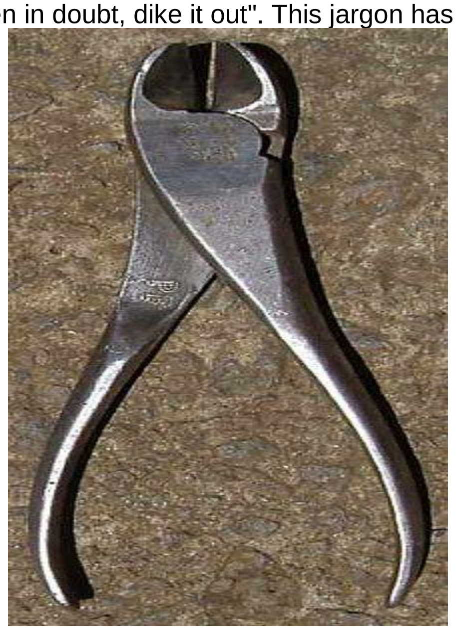
Objective: Identify the various tools & write down their uses.

Material required: various tools -Wire Cutter.Wire Stripper -Various types of Pliers-Vice.-Crimping Tools (RJ-11/RJ-45)

-Screw-Drivers

Theory: List of tools-Wire Cutter.-Wire Stripper.-Various types of Pliers.-Vice.-Crimping Tools (RJ-11/RJ-45) -Screw-Drivers

Wire Cutter.

Diagonal pliers (or wire cutters or diagonal cutting pliers) are pliers intended for the cutting ofwire (they are generally not used to grab or turn anything). They are sometimes called side cutting pliers or side cutters, although these terms are shared by other pliers designs, such aslineman's pliers, and may lead to confusion. The plane defined by the cutting edges of the jaws intersects the joint rivet at an angle or "on a diagonal", hence the name. Instead of using a shearing action as with scissors, they cut by indenting and wedging the wire apart. The jaw edges are ground to a symmetrical "V" shape; thus the two jaws can be visualized to form the letter "X", as seen end-on when fully occluded. The pliers are made of tempered steel and inductive heatingand quenching are often used to selectively harden the Diags or Dikes (a portmanteau of "**Di**agonal **C**utter**S**" is pronounced **"**dikes") – as in the phrase "a pair of dikes" or "hand me those dikes" – is jargon used especially in the electrical industry, to describe diagonal pliers. Dike can also be used as a verb, such as in the idiom "when in doubt, dike it out". This jargon has largely fallen out of use due to confusion with the 

Diagonal pliers with uninsulated handles

Applications

The handles of diagonal cutting pliers are commonly insulated with a dip-type or shrink fitelectrically-insulating material for comfort and some protection against electric shock.

Diagonal pliers are useful for cutting copper, brass, iron, aluminium and steel wire. Lower quality versions are generally not suitable for cutting tempered steel, such as piano wire, as the jaws are not hard enough. Attempting to cut such material will usually cause indentations to be made in the jaws, or a piece to break out of one or both jaws, thus ruining the tool. However higher quality side cutters can cut hardened steel, such as 2 mm piano wire.

For electronics work, special diagonal cutters that are ground flush to the apex of the cutting edge on one side of the jaws are often used. These flush-cutting pliers allow wires to be trimmed flush or nearly flush to a solder joint, avoiding the sharp tip left by symmetrical diagonal cutters. It is common for this type of diagonal cutter to be referred to by another name, such as "flush cutter" to distinguish it from symmetrical cutters.

wire stripper

A **wire stripper** is a small, hand-held device used to strip the insulation from electric wires.

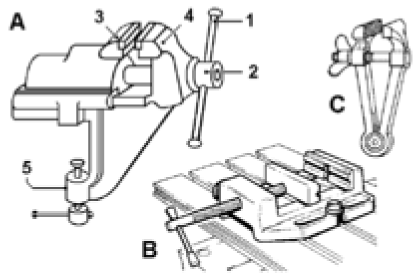
manual wire stripper

A simple manual wire stripper is a pair of opposing blades much like scissors or wire cutters. The addition of a center notch makes it easier to cut the insulation without cutting the wire. This type of wire stripper is used by rotating it around the insulation while applying pressure in order to make a cut around the insulation. Since the insulation is not bonded to the wire, it then pulls easily off the end. This is the most versatile type of wire stripper.

Another type of manual wire stripper is very similar to the simple design previously mentioned, except this type has several notches of varying size. This allows the user to match the notch size to the wire size, thereby eliminating the need for twisting. Once the device is clamped on, the remainder of the wire can simply be pulled out, leaving the insulation behind.

Banch Vice.

A **vise** or **vice** (see American and British English spelling differences) is a mechanical screwapparatus used for holding or clamping a work piece to allow work to be performed on it with tools such as saws, planes, drills, mills, screwdrivers, sandpaper, etc. Vises usually have one fixed jaw and another, parallel, jaw which is moved towards or away from the fixed jaw by the screw.



tree type of banch vice

Without qualification, "vise" usually refers to a bench vise with flat, parallel jaws, attached to a workbench. There are two main types: awoodworking vise and engineer's vise. The woodworker's bench vise main characteristic is its integration into the bench. An engineer's bench vise is usually clamped or bolted onto the top of the bench.

Woodworking vises

For woodworking, the jaws are made of wood, plastic or from metal, in the latter case they are usually faced with wood to avoid marring the work piece. The top edges of the jaws are typically brought flush with the bench top by the extension of the wooden face above the top of the iron moveable jaw. This jaw may include a dog hole to hold a bench dog. In modern metal woodworkers' vises, a split nut is often used. The nut in which the screw turns is in two parts so that, by means of a lever, it can be removed from the screw and the moveable jaw can be quickly slid into a suitable position at which point the nut is again closed onto the screw so that the vise may be closed firmly onto the work.

Engineer's vises

An engineer's vise, also known as a metalworking bench vise or fitter's vise, is used in metalworkingapplications. The jaws are made of soft or hard metal. The vise is bolted onto the top surface of the bench with the face of the fixed jaws just forward of the front edge of the bench. The bench height should be such that the top of the vise jaws is at or just below the elbow height of the user when standing upright. The vise may include other features such as a small anvilon the

The nut in which the screw turns may be split so that, by means of a lever, it can be removed from the screw and the screw and moveable jaw quickly slid into a suitable position at which point the nut is again closed onto the screw. The disadvantage to this system is lower precision, as compared to a solid screw system. Vise screws are usually either of an Acme thread form or a buttress thread. Those with a quick-release nut use a buttress thread. Some vises have a hydraulic or pneumatic screw, making setup not only faster, but more accurate as human error is reducedFor large parts, an array of regular machine vises may be set up to hold a part that is too long for one vise to hold. The vises' fixed jaws are aligned by means of a dial indicator so that there is a common reference plane.For multiple parts, several options exist, and all machine vise manufacturers have lines of vises available for high production work.

Jaws

There are two main types of jaws on engineer's vises: hard and soft. Hard jaws are available with either a coarse gripping surface or are ground flat and smooth to increase accuracy. The latter relies on pressure for gripping, instead of a rough surface. An unskilled operator has the tendency to over-tighten jaws, leading to part deformation and error in the finished workpiece.

Soft jaws are usually made from a soft metal (usually aluminum), plastic, or wood. They are used to either hold delicate workpieces or cut to hold specifically shaped workpieces. These specifically cut jaws are often used in place of fixtures and most commonly used in gang operations. They are also used for rapid change-over type set-ups since they can be easily engraved with the part number, the job number, or other information relevant to the job being run. Soft jaws are considered a consumable item, because they are discarded or recycled after multiple uses.

- The first step is a two clamp vise, where the fixed jaw is in the center of the vise and movable jaws ride on the same screw to the outside.
- The next step up is the modular vise. Modular vises can be arranged and bolted together in a grid, with no space between them. This allows the greatest density of vises on a given work surface. This style vise also comes in a two clamp variety.
- Tower vises are vertical vises used in horizontal machining centers. They have one vise per side, and come in single or dual clamping station varieties. A dual clamping tower vise, for example, will hold eight relatively large parts without the need for a tool change.
- Tombstone fixtures follow the same theory as a tower vise. Tombstones allow four surfaces of vises to be worked on one rotary table pallet. A tombstone is a large, accurate, hardened block of metal that is bolted to the CNC pallet. The surface of the tombstone has holes to accommodate modular vises across all four faces on a pallet that can rotate to expose those faces to the machine spindle.

- New work holding fixtures are becoming available for five-axis machining centers. These specialty vises allow the machine to work on surfaces that would normally be obscured when mounted in a traditional or tombstone vise setup.

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Pliers

Pliers are a hand tool used to hold objects firmly, for cutting, bending, or physical compression. Generally, pliers consist of a pair of metal first-class levers joined at a fulcrum positioned closer to one end of the levers, creating short jaws on one side of the fulcrum, and longer handles on the other side. This arrangement creates a mechanical advantage, allowing the force of thehand's grip to be amplified and focused on an object with precision. The jaws can also be used to manipulate objects too small or unwieldy to be manipulated with the fingers.

There are many kinds of pliers made for various general and specific purposes.

The basic design of pliers has changed little since their origins, with the pair of handles, the pivot (often formed by a rivet), and the headsection with the gripping jaws or cutting edges forming the three elements. In distinction to a pair of scissors or shears, the plier's jaws always meet each other at one pivot angle.

The materials used to make pliers consist mainly of steel alloys with additives such as vanadium or chromium, to improve strength and prevent corrosion. Often p iers have insulated grips to ensure better handling and prevent electrical conductivity. In some lines of fine work(such as jewellery or musical instrument repair), some specialized pliers feature a layer of comparatively soft metal (such as brass) over the two plates of the head of the pliers to reduce pressure placed on some fine tools or materials. Making entire pliers out of softer metals would be impractical, reducing the force required to bend or break them.

lineman plier, slip joint plier,Daigonal plier.Nose plier

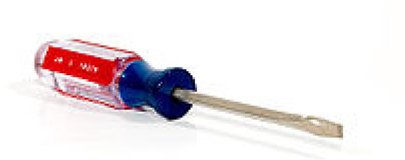
Crimping

Crimping is joining two pieces of metal or other malleable material by deforming one or both of them to hold the other. The bend or deformity is called the crimp.

crimping plier for coaxial cable

Crimping is most extensively used in metalworking. Crimping is commonly used to join bullets to theircartridge cases, and for rapid but lasting electrical connectors. Because it can be a cold-working technique, crimping can also be used to form a strong bond between the workpiece and a non-metallic component. Sometimes, a similar deformity created for reasons other than forming a join may also be called a crimp.[1][2][3]

screwdriver



slotted screwdriver

A **screwdriver** is a tool for driving screws and rotating other machine elements with the mating drive system. The screwdriver is made up of a head or tip, which engages with a screw, a mechanism to apply torque by rotating the tip, and some way to position and support the screwdriver. A typical hand screwdriver comprises an approximately cylindrical handle of a size and shape to be held by a human hand, and an axial shaft fixed to the handle, the tip of which is shaped to fit a particular type of screw. The handle and shaft allow the screwdriver to be positioned and supported and, when rotated, to apply torque. Screwdrivers are made in a variety of shapes, and the tip can be rotated manually or by an electric motor or other motor.

A screw has a head with a contour such that an appropriate screwdriver tip can be engaged in it in such a way that the application of sufficient torque to the screwdriver will cause the screw to rotate.

.**Result :** The study of various tools is carried out.

Precautions : work with tools care fully.

Experiment no 8

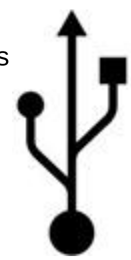
Objective: Identify the various type of connector used in various Gadgets & Instruments/Equipments

Material Required : usb connector and cable .

Theory: various type of connector 1. USB Cables and Connectors

What are USB cables used for - You can use USB cables to connect most new devices to your computer including flash memory sticks, portable media players, internet modems and digital cameras.

Computer accessories like mice, keyboards, webcams, portable hard-drives, microphones, printers, scanners and speakers can also be connected to the computer through USB ports. Additionally, USB cables are also used for charging a variety of gadgets including mobile phones or for transferring data from one computer to another.



How to recognize USB Cables - The standard USB connector, USB-A, is a rectangular connector. The USB-A end is present on every USB cable as it is the end that connects to your computer.

The other end of the USB cable may have different connectors including USB-B (a square connector commonly used with printers, external hard drives, and larger devices) or smaller connectors such as the Mini-USB and Micro-USB that are commonly used with portable devices such as media players and phones.

Additionally, many other connectors have USB-A connectors at the end that connects to the computer, and a device-specific connector at the other end (e.g. the iPod or a Zune). Then you have USB Male to Female connectors for extending the length of a USB cable.

Many other non-USB cables can also connect to your computer via a USB converter; these cables have the standard USB-A connector on one end while the other end could have connections for other ports such as Ethernet or audio.

2. Audio Cables and Connectors

1 - 3.5mm headphone jack

The most common audio cable is the standard headphone jack, otherwise known as a TSR connector. It is available in several sizes, but the most common ones used with computers are the 3.5 mm or 1/8" mini audio jack.

Most speakers and microphones can connect to the computer with these audio cables. The microphone port on your computer is usually pink while the speaker port, where you insert the stereo audio cable, is colored green. Some computers have additional TSR audio ports colored black, grey, and gold; these are for rear, front, and center/subwoofer output, respectively.

A larger variety of the TSR connector, 1/4″ TRS, is commonly used in professional audio recording equipment and it can be connected to a computer using an 1/4" to 1/8" converter (pictured right).

2 - Digital Optical Audio

For high-end audio, like when you want to connect the output of a DVD player or a set-top box to a Dolby home theater, you need the TOSLINK (or S/PDIF) connector.

These are fiber optic cables and can therefore transmit pure digital audio through light. Some laptops and audio equipment have a mini-TOSLINK jack but you can use a converter to connect it to a standard TOSLINK (Toshiba Link) port.

3. Video Cables

One of the most common video connectors for computer monitors and high-definition TVs is the VGA cable. A standard VGA connector has 15-pins and other than connecting a computer to a monitor, you may also use a VGA cable to connect your laptop to a TV screen or a projector.

Converter cables are lso available to let VGA monitors connect to newer computers that only output HDMI or DVI signals. A smaller variant of VGA, Mini-VGA, is available on some laptops but with the help of a converter, you can connect any standard VGA monitor to a Mini-VGA port of your laptop.

If you have purchased a computer in the recent past, chances are that it uses DVI instead of VGA. The new breed of "thin" laptops use the smaller variants of DVI like the Mini-DVI and Micro-DVI (first seen in MacBook Air).

A DVI cable has 29 pins, though some connectors may have less pins depending on their configuration. DVI's video signal is compatible with HDMI, so a simple converter can allow a DVI monitor to receive input from an HDMI cable.

Additionally, DVI to VGA converters are also available for connect your new graphics card to old monitor that supports only VGA mode.

S-Video cables, otherwise known as Separate Video or Super Video cables, carry analog video signals and are commonly used for connecting DVD players, camcorders, older video consoles to the television.

Standard S-Video connectors are round in shape and may have anywhere between 4-9 pins.

4. Audio and Video Cables

1 - RCA Connector Cables

RCA connector cables are a bundle of 2-3 cables including Composite Video (colored yellow) and Stereo Audio cables (red for right channel and white or black for the left audio channel).

Sometimes additional cables may be included, offering additional audio channels and/or component video instead of composite. Component video offers better picture than composite because the video signal is split in different signals while in the case of composite, everything is transferred through a single yellow plug.

Uses of RCA Connectors - The RCA cables are usually used for connecting your DVD player, stereo speakers, digital camera and other audio/video equipment to your TV. You can plug-in an RCA cable to the computer via a video capture card and this will let you transfer video from an old analog camcorder into your computer's hard drive.

2. HDMI Cables

HDMI is the new standard that provide both audio and video transmission through a single cable. HDMI support a maximum resolution of 4096×2160p (HD is only 1920×1200) with up to 8 channels of digital audio and are used for connecting Blu-Ray players to an HDTV.

Standard HDMI cables can be up to 5 meters long, but higher quality ones can be up to 15 meters long, and the length can be further increased with amplifiers. HDMI is backwards compatible with DVI so you can use a converter to watch video on a DVI device through the HDMI cable though you will have to use another cable for the audio.

3 - Display Port

A combined digital video and audio cable that is more commonly used in computers is Display Port and the smaller derivative Mini Display Port. Both support resolutions up to 2560 × 1600 × 60 Hz, and additionally support up to 8 channels of digital audio.

Mini Display Port connector is currently used in Mac Books but we could them in other computers as well in the near future.

Standard Display Port cables can be up to 3 meters long, but at a lower resolution cables can be up to 15 meters long. DisplayPort connectors are available to connect VGA, DVI video, or HDMI video and audio with a DisplayPort cable or connection. Additionally, converters are available to convert Mini DisplayPort into standard DisplayPort.

5. Data Cables

1 - Firewire IEEE 1394

Firewire, otherwise known as IEEE 1394, I. LINK, or Lynx, is a faster alternate to USB and is commonly used for connecting digital camcorders and external hard drives to a computer. It is also possible to ad-hoc network computers without a router over FireWire.

Firewire typically has 6 pins in its connector, though a 4 pin variety is common as well.

2 - eSATA Cables

While SATA cables are used internally for connecting the hard drive to the computer's motherboard, eSATA cables are designed for portable hard drives, and can transfer data faster than USB or FireWire.

However, the eSATA cable cannot transmit power, so unlike USB, you cannot power an external hard drive with eSATA. The eSATA cable is somewhat different from the internal SATA cable; it has more shielding, and sports a larger connector.

6. Networking Related Cables

1 - Phone RJ11 Cable

The telephone cable, otherwise known as RJ11, is still used around the world for connecting to the Internet through DSL/ADSL modems. A standard phone cable has 4 wires and the connector has four pins.

The connector has a clip at the top to help maintain a tight connection.

2 - Ethernet Cable

Ethernet is the standard for wired networking around the world. The Ethernet cable, otherwise known as RJ45, is based on Cat5 twisted pair cable and is made from 8 individual wires.

Result: Identification of various connectors has been successfully done .

Precautions: 1. All the connection take should be carefully

2. Handle diode and transistor carefully

Experiment no 9

Objective. Solder the joint connection of wires and check it. De-solder it and Re-solder.

Materials required: soldering iron. Solder wire

Theory: The soldering procedure is carried with following precautions

First a few safety precautions:

1.Never touch the element or tip of the soldering iron. They are very hot (about 400°C) and will give you a nasty burn.

2.Take great care to avoid touching the mains flex with the tip of the iron.
The iron should have a heatproof flex for extra protection. An ordinary plastic flex will melt immediately if touched by a hot iron and there is a serious risk of burns and electric shock.

3.Always return the soldering iron to its stand when not in use. Never put it down on your workbench, even for a moment!

4.Work in a well-ventilated area. The smoke formed as you melt solder is mostly from the flux and quite irritating. Avoid breathing it by keeping you head to the side of, not above, your work.

5.Wash your hands after using solder. Solder contains lead which is a poisonous metal. .

Preparing the soldering iron:

1.Place the soldering iron in its stand and plug in. The iron will take a few minutes to reach its operating temperature of about 400°C.

2.Dampen the sponge in the stand. The best way to do this is to lift it out the stand and hold it under a cold tap for a moment, then squeeze to remove excess water. It should be damp, not dripping wet.

3.Wait a few minutes for the soldering iron to warm up. You can check if it is ready by trying to melt a little solder on the tip.

4.Wipe the tip of the iron on the damp sponge. This will clean the tip.

5.Melt a little solder on the tip of the iron. This is called 'tinning' and it will help the heat to flow from the iron's tip to the joint. It only needs to be done when you plug in the iron, and occasionally while soldering if you need to wipe the tip clean on the sponge.

Steps for soldering :

1.Hold the soldering iron like a pen, near the base of the handle. Imagine you are going to write your name! Remember to never touch the hot element or tip.

2.Touch the soldering iron onto the joint to be made.
Make sure it touches both the component lead and the track. Hold the tip there for a few seconds and...

3.Feed a little solder onto the joint.
It should flow smoothly onto the lead and track to form a volcano shape as shown in the diagram. Apply the solder to the joint, not the iron.

4.Remove the solder, then the iron, while keeping the joint
Allow the joint a few seconds to cool before you move the circuit board.

5.Inspect the joint closely. It should look shiny and have a 'volcano' shape. If not, you will need to reheat it and feed in a little more solder. This time ensure that both the lead and track are heated fully before applying solder.

Soldering Advice for Components

It is very tempting to start soldering components onto the circuit board straight away, but please take time to identify all the parts first. You are much less likely to make a mistake if you do this!

Stick all the components onto a sheet of paper using sticky tape.

1.Identify each component and write its name or value beside it.

2.Add the code (R1, R2, C1 etc.) if necessary.
Many projects from books and magazines label the components with codes (R1, R2, C1, D1 etc.) and you should use the project's parts list to find these codes if they are given.

3.Resistor values can be found using the resistor colour code which is explained on our Resistors page. You can print out and make your own Resistor Colour Code Calculator to help you.

4.Capacitor values can be difficult to find because there are many types with different labelling systems! The various systems are explained on our Capacitors page.

Some components require special care when soldering. Many must be placed the correct way round and a few are easily damaged by the heat from soldering. Appropriate warnings are given in the table below, together with other advice which may be useful when soldering.

For more detail on specific components please see the Components page or click on the component name in the table.

Solder

Solder is an alloy (mixture) of tin and lead, typically 60% tin and 40% lead. It melts at a temperature of 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.

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 to remove the solder:

1. With a desoldering pump (solder sucker)

1. Set the pump by pushing the spring-loaded plunger down until it locks.

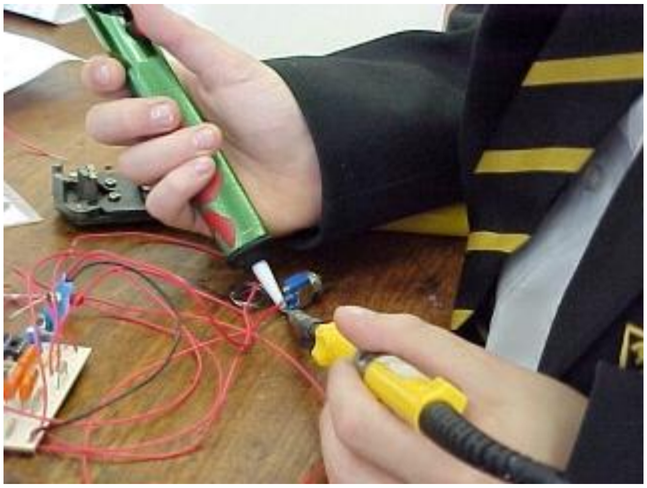
2. Apply both the pump nozzle and the tip of your soldering iron to the joint.

3. Wait a second or two for the solder to melt.

4. Then press the button on the pump to release the plunger and suck the molten solder into the tool.

5 .Repeat if necessary to remove as much solder as possible.

6. The pump will need emptying occasionally by unscrewing the nozzle.



Using a desoldering pump (solder sucker)

Result: soldering and soldering is done

Precaution : 1. Clean all joints before solder

2 .Use carefully of solder iron

3. Stick all the components onto a sheet of paper using sticky tape.

4 .Allow the joint a few seconds to cool before you move the circuit board.

Experiment no 10

Objective: Identify the various types of Copper-Clads and write down their application

Material Required : Copper clads.

Theory: Copper-clad steel (CCS), also known as copper-covered steel or the trademarked name Copperweld is a bi-metallic product, mainly used in the wire industry that combines the high mechanical resistance of steel with the conductivity and resistance to corrosion of copper.

Its main purpose is to be used as a drop wire of telephone cables, and inner conductor of coaxial cables, including thin hookup cables like RG174, and CATV cable.

Copper-clad sheet

In metallurgy, stainless steel, also known as inox steel or inox from French "inoxydable", is defined as a steel alloy with a minimum of 10.5 or 11% chromium content by mass.Stainless steel does not stain, corrode, or rust as easily as ordinary steel, but it is not stain-proof.[3] It is also called corrosion-resistant steel or CRES when the alloy type and grade are not detailed, particularly in the aviation industry. There are different grades and surface finishes of stainless steel to suit the environment the alloy must endure. Stainless steel is used where both the properties of steel and resistance to corrosion are required.

Stainless steel differs from carbon steel by the amount of chromium present. Unprotected carbon steel rusts readily when exposed to air and moisture. This iron oxide film (the rust) is active and accelerates corrosion by forming more iron oxide. Stainless steels contain sufficient chromium to form a passive film of chromium oxide, which prevents further surface corrosion and blocks corrosion from spreading into the metal's internal structure.

Passivation only occurs if the proportion of chromium is high enough.

Use

Grounding, union of ground rods to metallic structures, meshes, substations, power installations and lightning arrestors. This material has proven its aptitude for these purposes. More than 60 years of installations all around the world certify the excellence of this type of installation.

Properties :The main properties of these conductors include:

- Good corrosion resistance of copper
- High tensile strength of steel
- Resistance against material fatigue
- Decreased electrical resistance compared to steel
- Much lower impedance at high frequencies than that of steel wire alone

Advantages : Because the outer layer of the conductor is low-impedance copper, and the higher impedance steel is central, the skin effect gives copper-clad RF transmission lines impedance at high AC frequencies similar to that of a solid copper conductor.

Tensile strength of copper-clad steel conductors is greater than that of ordinary copper conductors permitting greater span lengths than with copper.

Another advantage is that smaller diameter copper-clad steel conductors may be used in coaxial cables, permitting higher impedance and smaller cable diameter than with copper conductors of similar strength.

Due to the inseparable union of the two metals, it is theft-resistant, since copper recovery is impractical and thus has very little scrap value. Thus the frequent thefts common with pure copper conductors are avoided.

Installations with copper-clad steel conductors are generally recognized as fulfilling the required specifications for a good ground. For this reason it is used with preference by utilities and oil companies when cost is a concern.

Copper-clad aluminum wire, commonly abbreviated as CCAW or CCA, is a conductor composed of an inner aluminum core and outercopper cladding.

Uses :The primary applications involve of this conductor revolve around weight reduction requirements. These applications include high-quality coils, such as the voice coils in headphones, portable loudspeakers or mobile coils; high frequency coaxial applications; such as RF antennas; CATV distribution cables; and power cables.

CCA was also used in mains cable for domestic and commercial premises. The copper/aluminium construction was adopted to avoid some of the problems with aluminium wire, yet retain some of the cost advantage. But, solid copper is most commonly used in internal residential 120v or 240v wiring in the US.

Properties :The properties of copper-clad aluminum wire include:

1.Lighter than pure copper.

2.Higher conductivity than pure aluminum.

3.Higher strength than aluminum.

4.Better solderability than aluminum, due to the lack of the oxide layer which prevents solder adhesion when soldering bare aluminum.

5.Less expensive than a pure copper wire.

6.Typically produced as a 10% or 15% by copper volume product

Result: The various copper clads are studied.

Precautions : 1 The copper clads should be handled with care.

2.The various connections should be checked carefully.

Experiment no 11

Objective: Find out the value of a resistance with the help of Color-Bands & by use of Multimeter and the difference in values.

Material required: Various types of resistances, multimeter.

Theory: A resistor is a two-terminal passive electronic component which implements electrical resistance as a circuit element. When a voltage V is applied across the terminals of a resistor, a current I will flow through the resistor in direct proportion to that voltage. This constant of proportionality is called conductance, G. The reciprocal of the conductance is known as theresistance R, since, with a given voltage V, a larger value of R further "resists" the flow of current I as given by Ohm's law:

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

Ohm's law

The behavior of an ideal resistor is dictated by the relationship specified in Ohm's law:

$$V = I \cdot R$$

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I) passing through it, where the constant of proportionality is the resistance (R).

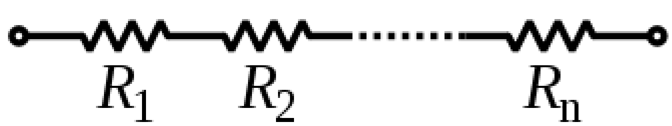
Equivalently, Ohm's law can be stated:

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

Series and parallel resistors

Main article: Series and parallel circuits

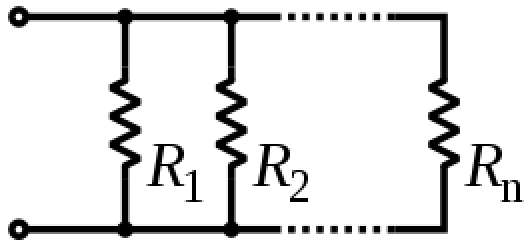
In a series configuration, the current through all of the resistors is the same, but the voltage across each resistor will be in proportion to its resistance. The potential difference (voltage) seen across the network is the sum of those voltages, thus the total resistance can be found as the sum of those resistances:



$$R_{eq} = R_1 + R_2 + \cdots + R_n$$

As a special case, the resistance of N resistors connected in series, each of the same resistance R, is given by NR.

Resistors in a parallel configuration are each subject to the same potential difference (voltage), however the currents through them add. Theconductances of the resistors then add to determine the conductance of the network. Thus the equivalent resistance (R_{eq}) of the network can be computed:



$$\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}$$

The parallel equivalent resistance can be represented in equations by two vertical lines "||" (as in geometry) as a simplified notation. For the case of two resistors in parallel, this can be calculated using:

$$R_{\text{eq}} = R_1 \| R_2 = \frac{R_1 R_2}{R_1 + R_2}$$

As a special case, the resistance of N resistors connected in parallel, each of the same resistance R, is given by R/N.

A resistor network that is a combination of parallel and series connections can be broken up into smaller parts that are either one or the other. For instance,

$$R_{\text{eq}} = (R_1 \| R_2) + R_3 = \frac{R_1 R_2}{R_1 + R_2} + R_3$$

However, some complex networks of resistors cannot be resolved in this manner, requiring more sophisticated circuit analysis. For instance, consider a cube, each edge of which has been replaced by a resistor. What then is the resistance that would be measured between two opposite vertices? In the case of 12 equivalent resistors, it can be shown that the corner-to-corner resistance is $^5\!/_6$ of the individual resistance. More generally, the Y-Δ transform, or matrix methods can be used to solve such a problem.

One practical application of these relationships is that a non-standard value of resistance can generally be synthesized by connecting a number of standard values in series and/or parallel. This can also be used to obtain a resistance with a higher power rating than that of the individual resistors used. In the special case of N identical resistors all connected in series or all connected in parallel, the power rating of the individual resistors is thereby multiplied by N.

[edit]Power dissipation

The power P dissipated by a resistor (or the equivalent resistance of a resistor network) is calculated as: $P = I^2 R = IV = \frac{V^2}{R}$

The first form is a restatement of Joule's first law. Using Ohm's law, the two other forms can be derived.

The total amount of heat energy released over a period of time can be determined from the integral of the power over that period of time:

$$W = \int_{t_1}^{t_2} v(t) i(t) \, dt.$$

The value of a resistor can be measured with an ohmmeter, which may be one function of a multimeter. Usually, probes on the ends of test leads connect to the resistor. A simple ohmmeter may apply a voltage from a battery across the unknown resistor (with an internal resistor of a known value in series) producing a current which drives a meter movement. The current flow, in accordance with Ohm's Law, is inversely proportional to the sum of the internal resistance and the resistor being tested, resulting in an analog meter scale which is very non-linear, calibrated from infinity to 0 ohms. A digital multimeter, using active electronics, may instead pass a specified current through the test resistance. The voltage generated across the test resistance in that case is linearly proportional to its resistance, which is measured and displayed. In either case the low-resistance ranges of the meter pass much more current through the test leads than do high-resistance ranges, in order for the voltages present to be at reasonable levels (generally below 10 volts) but still measurable.

Measuring low-value resistors, such as fractional-ohm resistors, with acceptable accuracy requires four-terminal connections. One pair of terminals applies a known, calibrated current to the resistor, while the other pair senses the voltage drop across the resistor. Some laboratory quality ohmmeters, especially milliohmmeters, and even some of the better digital multimeters sense using four input terminals for this purpose, which may be used with special test leads. Each of the two so-called Kelvin clips has a pair of jaws insulated from each other. One side of each clip applies the measuring current, while the other connections are only to sense the voltage drop. The resistance is again calculated using Ohm's Law as the measured voltage divided by the applied current.

Resistor Marking : Most axial resistors use a pattern of colored stripes to indicate resistance. Surface-mount resistors are marked numerically, if they are big enough to permit marking; more-recent small sizes are impractical to mark. Cases are usually tan, brown, blue, or green, though other colors are occasionally found such as dark red or dark gray.

Early 20th century resistors, essentially uninsulated, were dipped in paint to cover their entire body for color coding. A second color of paint was applied to one end of the element, and a color dot (or band) in the middle provided the third digit. The rule was "body, tip, dot", providing two significant digits for value and the decimal multiplier, in that sequence. Default tolerance was ±20%. Closer-tolerance resistors had silver (±10%) or gold-colored (±5%) paint on the other end.

Four-band resistors

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-zeroes, and the 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. Sometimes a fifth band identifies the thermal coefficient, but this must be distinguished from the true 5-color system, with 3 significant digits.

For example, green-blue-yellow-red is 56×10^4 Ω = 560 kΩ ± 2%. An easier description can be as followed: the first band, green, has a value of 5 and the second band, blue, has a value of 6, and is counted as 56. The third band, yellow, has a value of 10^4, which adds four 0's to the end, creating 560,000 Ω at ±2% tolerance accuracy. 560,000 Ω changes to 560 kΩ ±2% (as a kilo- is 10^3).

Each color corresponds to a certain digit, progressing from darker to lighter colors, as shown in the chart below.

Color	1st band	2nd band	3rd band (multiplier)	4th band (tolerance)	Temp. Coefficient
Black	0	0	$\times10^0$		
Brown	1	1	$\times10^1$	±1% (F)	100 ppm

Red	2	2	$\times 10^{2}$	±2% (G)	50 ppm
Orange	3	3	$\times 10^{3}$		15 ppm
Yellow	4	4	$\times 10^{4}$		25 ppm
Green	5	5	$\times 10^{5}$	±0.5% (D)	
Blue	6	6	$\times 10^{6}$	±0.25% (C)	
Violet	7	7	$\times 10^{7}$	±0.1% (B)	
Gray	8	8	$\times 10^{8}$	±0.05% (A)	
White	9	9	$\times 10^{9}$		
Gold			$\times 10^{-1}$	±5% (J)	
Silver			$\times 10^{-2}$	±10% (K)	
None				±20% (M)	

There are many mnemonics for remembering these colors.

Early resistors were made in more or less arbitrary round numbers; a series might have 100, 125, 150, 200, 300, etc. Resistors as manufactured are subject to a certain percentage tolerance, and it makes sense to manufacture values that correlate with the tolerance, so that the actual value of a resistor overlaps slightly with its neighbors. Wider spacing leaves gaps; narrower spacing increases manufacturing and inventory costs to provide resistors that are more or less interchangeable.

A logical scheme is to produce resistors in a range of values which increase in a geometrical progression, so that each value is greater than its predecessor by a fixed multiplier or percentage, chosen to match the tolerance of the range. For example, for a tolerance of ±20% it makes sense to have each resistor about 1.5 times its predecessor, covering a decade in 6 values. In practice the factor used is 1.4678, giving values of 1.47, 2.15, 3.16, 4.64, 6.81, 10 for the 1–10 decade (a decade is a range increasing by a factor of 10; 0.1–1 and 10–100 are other examples); these are rounded in practice to 1.5, 2.2, 3.3, 4.7, 6.8, 10; followed, of course by 15, 22, 33, … and preceded by … 0.47, 0.68, 1. This scheme has been adopted as the E6 series of the IEC 60063 preferred number values. There are also E12, E24, E48, E96 andE192 series for components of ever tighter tolerance, with 12, 24, 96, and 192 different values within each decade. The actual values used are in the IEC 60063 lists of preferred numbers.

A resistor of 100 ohms ±20% would be expected to have a value between 80 and 120 ohms; its E6 neighbors are 68 (54-82) and 150 (120-180) ohms. A sensible spacing, E6 is used for ±20% components; E12 for ±10%; E24 for ±5%; E48 for ±2%, E96 for ±1%; E192 for ±0.5% or better. Resistors are manufactured in values from a few milliohms to about a gigaohm in IEC60063 ranges appropriate for their tolerance.

Earlier power wire wound resistors, such as brown vitreous-enameled types, however, were made with a different system of preferred values, such as some of those mentioned in the first sentence of this section.

5-band axial resistors

5-band identification is used for higher precision (lower tolerance) resistors (1%, 0.5%, 0.25%, 0.1%), to specify a third significant digit. The first three bands represent the significant digits, the fourth is the multiplier, and the fifth is the tolerance. Five-band resistors with a gold or silver 4th band are sometimes encountered, generally on older or specialized resistors. The 4th band is the tolerance and the 5th the temperature coefficient.

Circuit diagram

Result: Identification completed

Precaution : 1.Resister or connectors use carefully

2.Take all reading carefully and handle all capacitor carefully

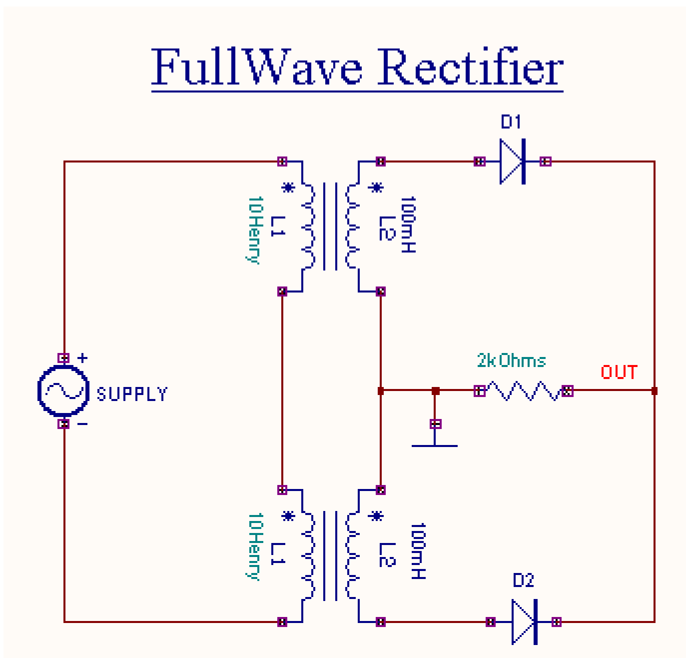
3.Use proper supply connection

Experiment no12

Objective: Draft a design lay-out for a FW-Rectifier (On Paper/Graph) using Pen/Pencil/Drafting Aid.

Material required : Transformer, Diode Ac voltage source ,Ground.

Theory : A Full Wave Rectifier is a circuit, which converts an ac voltage into a pulsating dc voltage using both half cycles of the applied ac voltage. It uses two diodes of which one conducts during one half cycle while the other conducts during the other half cycle of the applied ac voltage. During the positive half cycle of the input voltage, diode D1 becomes forward biased and D2 becomes reverse biased. Hence D1 conducts and D2 remains OFF. The load current flows through D1 and the voltage drop across R_L will be equal to the input voltage.



During the negative half cycle of the input voltage, diode D1 becomes reverse biased and D2 becomes forward biased. Hence D1 remains OFF and D2 conducts. The load current flows through D2 and the voltage drop across R_L will be equal to the input voltage.

Ripple Factor

The ripple factor for a Full Wave Rectifier is given by

$$\gamma = \sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1}$$

the average voltage or the dc voltage available across the load resistance is

$$V_{dc} = \frac{1}{\pi}\int_0^{\pi} V_m \sin \omega t \, d(\omega t)$$

$$= \frac{V_m}{\pi}\left[-\cos \omega t\right]_0^{\pi} = \frac{2V_m}{\pi}$$

$$I_{dc} = \frac{V_{dc}}{R_L} = \frac{2V_m}{\pi R_L} = \frac{2I_m}{\pi} \quad and \quad I_{rms} = \frac{I_m}{\sqrt{2}}$$

RMS value of the voltage at the load resistance is

$$V_{rms} = \left[\frac{1}{\pi}\int_0^{\pi} V_m^{\,2} \sin^2 \omega t \, d(\omega t)\right]^{1/2} = \frac{V_m}{\sqrt{2}}$$

$$\therefore \gamma = \sqrt{\left(\frac{V_m/2}{2V_m/\pi}\right)^2 - 1} = \sqrt{\left(\frac{\pi}{8}\right)^2 - 1} = 0.482$$

Efficiency

Efficiency, η is the ratio of the dc output power to ac input power

$$\eta = \frac{dc\,output\,power}{ac\,input\,power} = \frac{P_{dc}}{P_{ac}}$$

$$\frac{V_{dc}^{\,2}/R_L}{V_{rms}^{\,2}/R_L} = \frac{\left[2V_m/\pi\right]^2}{\left[V_m/\sqrt{2}\right]^2} = 8/\pi^2 = 0.812 = \underline{\underline{81.2\%}}$$

The maximum efficiency of a Full Wave Rectifier is 81.2%.

Transformer Utilization Factor

Transformer Utilization Factor, TUF can be used to determine the rating of a transformer secondary. It is determined by considering the primary and the secondary winding separately and it gives a value of 0.693.

Form Factor

Form factor is defined as the ratio of the rms value of the output voltage to the average value of the output voltage.

$$Form\ factor = \frac{rms\ value\ of\ output\ voltage}{average\ value\ of\ the\ output\ voltage}$$

$$= \frac{\left(V_m/\sqrt{2}\right)}{\left(2V_m/\pi\right)} = \frac{\pi}{2\sqrt{2}} = \underline{\underline{1.11}}$$

Peak Factor

Peak factor is defined as the ratio of the peak value of the output voltage to the rms value of the output voltage.

$$Peak\ factor = \frac{peak\ value\ of\ the\ output\ voltage}{rms\ value\ of\ the\ output\ voltage} = \frac{V_m}{\left(V_m/\sqrt{2}\right)} = \underline{\underline{\sqrt{2}}}$$

Peak inverse voltage for Full Wave Rectifier is $2V_m$ because the entire secondary voltage appears across the non-conducting diode.

This concludes the explanation of the various factors associated with Full Wave Rectifier.

Rectifier with Filter

The output of the Full Wave Rectifier contains both ac and dc components. A majority of the applications, which cannot tolerate a high value ripple, necessitates further processing of the rectified output. The undesirable ac components i.e. the ripple, can be minimized using filters.

Result: The full wave rectifier is studied.

Precautions : 1. connections should be tight.

2. power supply should be switched on after checking circuit.