Name : Archit Agrawal
Student ID : 202052307

EC160 : Experiment No. 1

In this experiment, different components used in electronics are discussed; such as resistors, capacitors etc.

▸ **Resistors** :- A resistor is a passive two-terminal electrical component that does not allow electric current to flow through it freely in a circuit, i.e. it creates resistance to the flow of electric current. The unit of resistance produced by a resistor is Ohm, denoted by Ω.

Electrical and Physical relationship for resistor

The Ohm's law states that the current through a resistor is directly proportional to the voltage difference across resistor; i.e.

$$V \propto I$$

removing proportionality sign gives

$$V = IR,$$

where R is resistance of the resistor.

This is the electrical relationship of resistor in a circuit.
The resistance of resistor depends upon the specific resistance or resistivity(ρ) of the material by which it is made, length of resistor (l) and its cross-sectional area(A).

The resistance is given by;

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

This is the physical of resistor with its dimensions.

Series and Parallel Combination of Resistors

Series Combination :- If there are n resistors with resistances $R_1, R_2 \dots, R_n$ ~~are~~ connected in series, then the net resistance of the combination is given by R_{eq},

$$R_{eq} = R_1 + R_2 + \dots\dots + R_N.$$

- In series combination, the current through each resistor is same.

Parallel Combination :- If there are n resistors with resistances $R_1, R_2 \dots R_n$ connected in parallel, then the net resistance of the combination is given by R_{eq},

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_N}$$

- In parallel combination, the voltage drop across each resistor is same.

Type your text

Materials used for making resistors :-

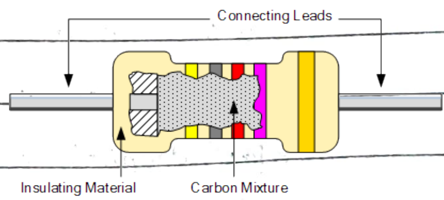
Different materials are used for making different type of resistors. Most commonly used are carbon, metals such as Nickel and Chromium and metal oxides such as Ruthenium Oxide (RuO_2), Lead Oxide (PbO) etc. Apart from these, some complex oxides such as Bismuth Ruthenate ($Bi_2Ru_2O_7$) and Bismuth Iridate ($Bi_2Ir_2O_7$).
To insulate the resistive material; ceramic, plastic and paints are used.

Types of Resistors and their Applications :-

1. Fixed Resistor :- Value of resistance of the resistor can not be changed.
It contains several types of resistors. Few of them are described below

a) Carbon Composition Resistor :-

Structure :- Consist of solid cylindrical resistive element with embedded wire leads or metal end caps to which wires are attached. The body is protected using plastic or paint.

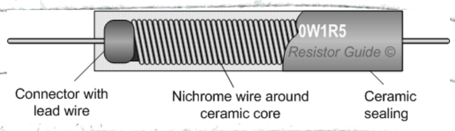


Composition :- Mixture of finely powdered carbon and insulating material.

Range :- Fraction of an ohm to 22 Megaohms.

Applications :- In power supplies and welding controls.

b) Wire Wound Resistors :-

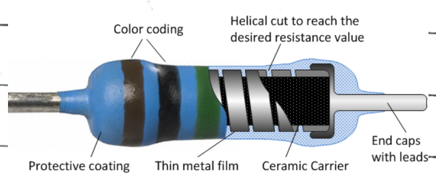


Structure :- Commonly made by winding a metal wire, usually nichrome, around a ceramic, plastic or fiberglass core. These resistors are designed to withstand temperatures upto 450°C.

Range :- 1 Ω to 10 kΩ.

Applications :- Used in telecommunication, transducers, current sensing, defense and space etc.

c) Metal Film Resistors :-



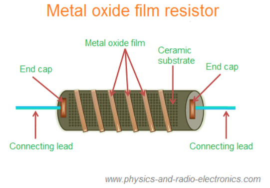
Structure: Metal film resistors are axial resistors with a thin metal film as resistive element. The thin film is deposited usually on a ceramic body.

Composition :- Often Ni-Cr alloy but other alloys are also used such as Sn-Sb, Au-Pt alloy etc.

Range :- Commonly 10Ω to 1 MΩ, but upto 50 GΩ are also available.

Applications :- They are used in active filters or bridge circuits due to good characteristics for tolerance and stability.

d) Metal Oxide Film Resistors :-



Structure : They are made of ceramic rod that is coated with a thin film of metal oxide, such as tin oxide etc.

Range: less than 1 Ω to around 10 MΩ.
Applications: They are used just similarly with metal film resistors as they have almost similar properties.

2. Variable Resistors -: The resistance value of such resistors can be changed. There are different types of variable resistors, some are discussed below,

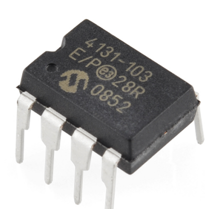
a) Potentiometer -: Potentiometer is a manually adjustable, variable resistor with three terminals. Two terminals are connected to a resistive element, the third terminal is connected to an adjustable wiper. The position of wiper determines the output voltage.

Applications -: In Amplifier gain control and tuning of circuits and much more.

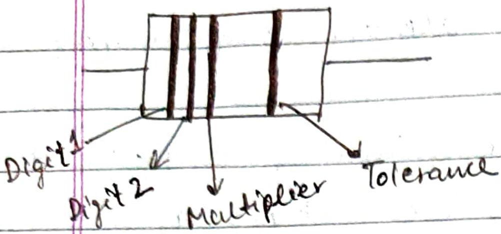
b) Rheostat -: Rheostats are used as variable resistance and they use only two terminals

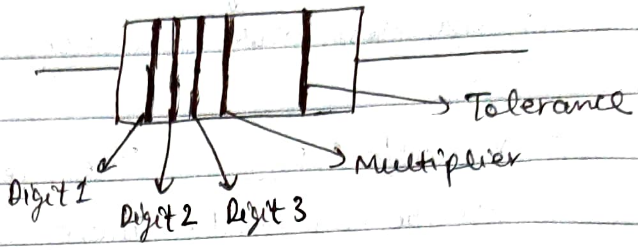
Applications -: In the past rheostats were used as power control devices in series with the load,

c) Digital Resistors -: The resistance in such resistors is not changed by mechanical movement but by electronic signals. They can change resistance in discrete steps.



How to Read the Value of a resistor





Resistors are too small to print the resistance values on them. Hence they are color coded.

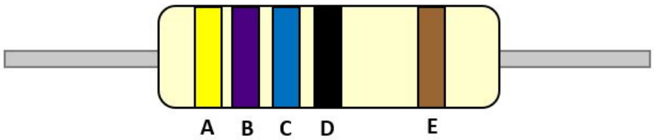
- In general, there are 4 or 5 color bands, with one band seperated at a greater distance from others.
- In a 4 band resistor, the first colour gives first digit, the second colour gives second digit of the resistance value, the third band gives the multiplier and the last band gives the tolerance of resistor.
- In a 5 band resistor, first three bands provide the first three digits, fourth band gives the multiplier and last band gives tolerance.

for 5 bands

Color	1st Band	2nd Band	3rd Band	4th Band	Tolerance
	1st digit	2nd digit	3rd digit	Multiplier	
Black	0	0	0	$\times 10^0$	
Brown	1	1	1	$\times 10^1$	+/- 1 %
Red	2	2	2	$\times 10^2$	+/- 0.2 %
Orange	3	3	3	$\times 10^3$	
Yellow	4	4	4	$\times 10^4$	
Green	5	5	5	$\times 10^5$	+/- 0.5 %
Blue	6	6	6	$\times 10^6$	+/- 0.25 %
Violet	7	7	7	$\times 10^7$	+/- 0.1 %

Grey	8	8	8	$\times 10^8$	+/- 0.05%
White	9	9	9	$\times 10^9$	
Gold				$\times 10^{-1}$	+/- 5%
Silver				$\times 10^{-2}$	+/- 10%

Ex.



The first colour is yellow, hence first digit is 4.
Second band colour is violet, hence second digit is 7
third band colour is blue, hence third digit is 6
fourth band colour is black, hence multiplier is 10^0.
last band colour is brown, hence tolerance is +/- 1%.

- **Capacitors** :- A capacitor is a passive two terminal component which stores electrical energy in an electric field. The effect of a capacitor is known as capacitance. The SI unit of capacitance is Farads (F).

Electrical and Physical relationship for capacitor

The charge stored by a capacitor is given by

$$q = CV$$

where C is its capacitance and V is the voltage difference across its terminals.

This is the electrical relationship of capacitor in a circuit.

The capacitance of a capacitor depends upon physical properties such as permittivity and shape. For example, for a parallel plate capacitor, capacitance is given by

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

where, A is cross-sectional area of parallel plates, ε is permittivity of the material between the plates, and d is distance between the plates.

For different types of capacitor, the physical relationship differs.

Series and Parallel Combination of capacitors

Series Combination :- If n capacitors with capacitances $C_1, C_2, \ldots, C_n$ are connected in series, then the equivalent capacitance C_{eq} is given by,

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots + \frac{1}{C_n}$$

- charge stored in each capacitor is equal in series combination.

Parallel Combination :- If n capacitors are connected in parallel with capacitances $C_1, C_2 \ldots C_n$, the equivalent capacitance C_{eq} is given by,

$$C_{eq} = C_1 + C_2 + \cdots + C_n$$

- potential drop across each ~~resistor~~ capacitor remains same in parallel combination.

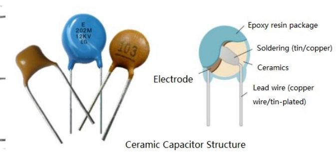
Materials Used for making capacitors

Generally, the plates of a capacitor are made of Aluminium. Other metals such as tantalum and silver are also used. The two plates of a capacitor are seperated by some distance which contains either air or some dielectric material such as glass, ceramic, mica etc.

Different types of capacitors and their Applications

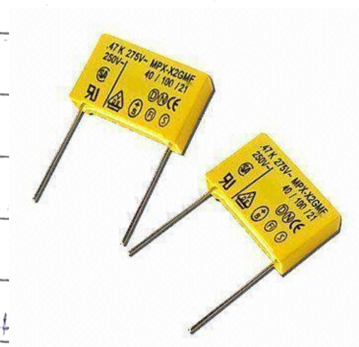
1) Unpolarized Capacitors -: Non polarized capacitors are capacitors without positive or negative polarity. There are so many types of non-polarized capacitors. Some of them are discussed below.

a) Ceramic Capacitors -: It is a fixed value capacitor where the ceramic material acts as a dielectric. It is constructed of two or more alternating layers of Ceramic and a metal layer acting as the electrodes. These are the most used capacitors in electronic equipments.



Range -: varies from picofarads to few microfarads
Applications -: They are used in transmitter stations, induction furnaces, power circuit breakers etc.

b) Polyester (PET) film capacitors -: These capacitors use dielectric made of thermoplastic polar polymer material Polyethylene terephthalate (PET). They are manufactured both as metallized wound and stack versions. The polyester film adsorbs very little moisture and do not need further coating.



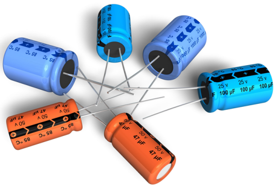
Applications: These are mainly used for general purpose applications or semi-critical circuits with operating temperatures upto 125°C.

c) Polypropylene (PP) film capacitors-: These capacitors have a dielectric made of thermoplastic, non-polar organic and partially crystalline polymer material Polypropylene.

Applications-: PP film capacitors have lowest dielectric absorption, which makes them suitable for applications such as VCO timing capacitors, sample and hold applications and audio circuits.

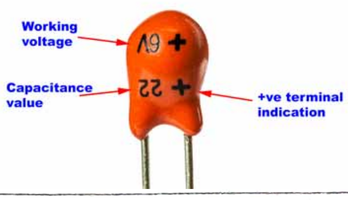
2. Polarized Capacitors-: Polarized capacitors have positive and negative electrode. Some of the polarized capacitors are described below.

a) Electrolytic Capacitor-: It is a capacitor whose anode is made of metal that forms an insulating oxide layer through anodization. This oxide layer acts as dielectric of the capacitor. A solid, liquid or gel electrolyte covers the surface of this oxide layer, serving as the cathode.



Applications: Generally used in DC power supply circuits due to their large capacitances to help reduce the ripple voltage or for coupling and decoupling applications.

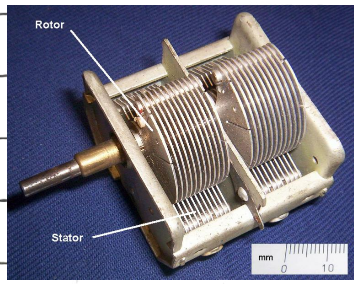
b) Tantalum Capacitor-: A tantalum capacitor consists of pellet of pourous tantalum metal as anode, covered by an insulating oxide layer that forms the dielectric, surrounded by liquid or solid



electrolyte as cathode.
Applications :- Commonly used for power supply filtering on computer motherboards and cell phones due to their small size and long term stability.

3. Variable Capacitor :- A capacitor whose capacitance may be, intentionally and repeatedly, changed mechanically or electronically.

a) Mechanically Controlled Capacitors :- In such capacitors the distance between the plates, or the amount of plate surface area which overlaps, can be changed. Examples include butterfly capacitor which has a set of two stator plates opposing each other, and a butterfly shaped rotor arranged so that turning the rotor will vary the capacitances.



b) Electronically Controlled Capacitance :-
In Voltage tuned capacitor, the thickness of depletion layer of a reverse biased diode varies with DC voltage and changes the capacitances. Such capacitors are also called as Varactors.
Their use is limited to low signal amplitudes to avoid obvious distortions as the capacitance would be affected by change of signal voltage.

How to Read the value of a Capacitor

If only three digits and alphabets are written on capacitor, the first two digits are first two digits of capacitance and third digit is number of zeroes to be put after the digits.
The alphabets are code for tolerance,

B	± 0.1%
C	± 0.25%
D	± 0.5%
F	± 1%
G	± 2%
J	± 5%
K	± 10%
M	± 20%

This gives value in picofarads.
Ex.

the first two digits are 3 and number of zeroes is 1 and tolerance is ± 5%.
∴ C = 330 pF ± 5%.

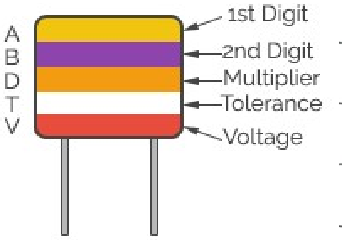
In some capacitors '4.7' is written as 4R7.

Colour Coding is also used for capacitors.
In 5 band colour code, the first two band represent digits, third band represents multiplier and fourth band represents the tolerance. The fifth band represents the max operating voltage of capacitor.

Result is in pF.

Color	1st Band 1st digit	2nd Band 2nd digit	3rd band Multiplier	4th Band Tolerance >10pF	 tolerance <10pF	5th band Voltage for L type
Black	0	0	10^0	±20%	±2pF	–
Brown	1	1	10^1	±1%	±0.1pF	100
Red	2	2	10^2	±2%	±0.25pF	250
Orange	3	3	10^3	±3%	–	–
Yellow	4	4	10^4	±4%	–	400
Green	5	5	10^5	±5%	±0.5pF	–
Blue	6	6	10^6	–	–	630
Violet	7	7	10^7	–	–	–
Grey	8	8	10^8	+80%, -20%	–	–
White	9	9	10^9	±10%	±1pF	–
Gold				±5%	–	–
Silver				±10%	–	–

Ex.



1st digit corresponds to yellow, hence 4.
2nd digit corresponds to violet, hence 7.
Multiplier corresponds to orange, hence 10^3.
Tolerance corresponds to white, hence ±10%.
max voltage corresponds to red, hence 250V.

$\therefore\ C = 47 \times 10^3\ pF = 47\ nF \pm 10\%$.

and maximum operating voltage is 250 V.

- **Inductor** :- Inductor is a passive two terminal electrical component that stores energy in a magnetic field when electric current changes through it. An inductor typically consists of an insulate wire wound into a coil. The effect that inductor produces is known as Inductance (L). SI Unit of inductance is Henry. It is also known as choke or reactor.

Electrical and physical relationship for inductors

When the current flowing through an inductor changes, the time varying magnetic field induces an electromotive force (voltage) in the inductor, described by Faraday's Law. According to Lenz's Law, the induced voltage has a polarity which opposes the change in current that created it. The emf induced is given by

$$\mathcal{E} = -L\frac{di}{dt}$$, i is time-varying current

This is the electrical relationship for an inductor.

The inductance of an inductor is determined by following factors -

(i) No. of turns of wire wound around the coil
(ii) Cross-sectional Area of the coil
(iii) The material type of coil i.e. permeability of material.
(iv) The length of the coil.

This is physical relationship for an inductor.

Series and Parallel Combination of Inductors

Series Combination -: If n inductors with inductance $L_1, L_2 \dots L_n$ are connected in series, the equivalent inductance Leq is given by,

$$L_{eq} = L_1 + L_2 + \dots + L_n$$

- the rate of change of current across each inductor is equal in series combination.
- Neglecting any mutual inductance.

Parallel Combination -: If n inductors with inductances $L_1, L_2 \dots L_n$ are connected in parallel, the equivalent inductance is given by

$$\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2} + \dots + \frac{1}{L_n}$$

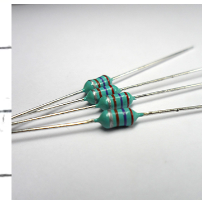
- voltage drop across each inductor is equal in parallel combination.
- Neglecting any mutual inductance.

Materials used for making Inductors

An inductor usually contains a coil of conducting material, commonly copper wire, wrapped around a core either of plastic or of a ferromagnetic material (called as iron-core inductors) such as steel, solid ferrite etc.

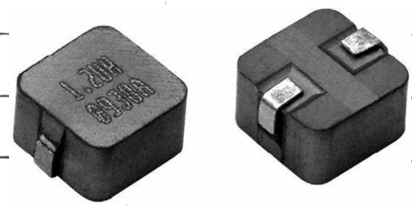
Different types of Inductors and their Applications

1. **Axial Inductors** -: It consists a very thin wire is wrapped around a dumb-bell shaped ferrite core, and two lids are connected at the top and bottom of dumbbell core.



Applications: It is used as a line filter, in filtering design and in boost converters etc.

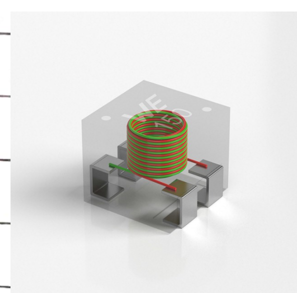
2. **Shielding Surface Mount Inductor** -: It is built by winding a length of wire in cylindrical bobbin and securing it in a specially made ferrite housing forms a shielded surface mount inductor.



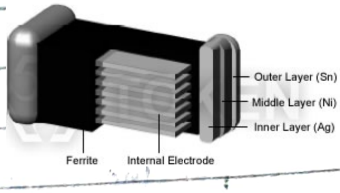
Applications -: Used in PDA/notebook/desktop/server applications, in high current POL converters and in battery powered devices.

3. **Coupled Inductor** -: Winding two wires in a common core forms a coupled inductor.

Applications -: Purpose designed coupled inductors are used in a variety of conversion circuits such as flyback, SEPIC and Cuk converter.

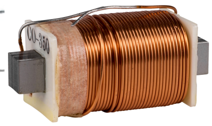


4. Multilayer Chip Inductors -: It consists of multilayers. It is built by using thin plates made out of ferrite.



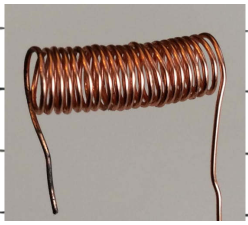
Applications -: It is used in wireless LAN's, bluetooth, SBCs and motherboards.

5. Laminated Core Inductor : The elements of a laminated core inductor consist of a bobbin, a laminated core and a coil which is wrapped around the bobbin.



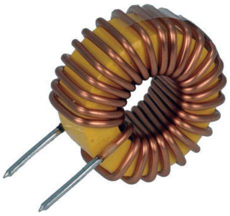
Applications -: It is used as line and noise filter and as an onboard charger for electric vehicles

6. Air Core Inductor -: It is made by wrapping a wire around a cylindrical wire, and taking the coil of wire out. The core material is air, hence it has lower permeability.



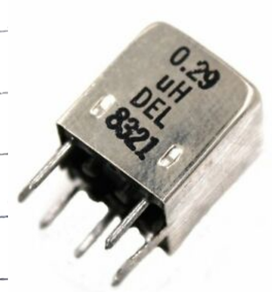
Applications: It is used for constructing radio frequency tuning coils and in filter circuits.

7. Toroidal Core Inductor -: A length of wire wrapped around a donut shaped core is commonly known as toroidal core inductor. The core material is ferrite.



Applications -: It is used in medical devices, switching regulators, industrial controllers etc.

Q. <u>Shielded Variable Inductor</u> :- By wrapping a length of wire around a hollow cylinder bobbin, and by placing and moving the core of ferromagnetic material, the value of inductor can be changed.



Applications: It is often used in antennas, radio applications and electronics.

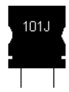
How to read value of an Inductor

If only three digits and ~~an~~ alphabets are written, the first two digits represent first two digit of inductance value (even if there is alphabet b/w them), the third digit refers to its multiplier (number of zeroes to put ahead). The result is in μH.
If R appears, it means a decimal point.
Other alphabets are used for tolerance as,

H	± 3%
J	± 5%
K	± 10%
L	± 15%
M	± 20%
V	± 25%
N	± 30%

Ex.

330µH



100µH +/- 5%

a) first and second digit is 3 and number of zeroes is 1. Hence $L = 330\ \mu H$.

b) first and second digits are 1 and 0 and multiplier is 10^1. Hence $L = 100\ \mu H$, and letter J gives tolerance to be $\pm 5\%$.

Colour coding is also used

4 band -! Results in μH X X X

Color	1st band (1st digit)	2nd band (2nd digit)	3rd band (Multiplier)	4th band (tolerance)
Black	0	0	10^0	$\pm 20\%$
Brown	1	1	10^1	Military $\pm 1\%$
Red	2	2	10^2	Military $\pm 2\%$
Orange	3	3	10^3	Military $\pm 3\%$
Yellow	4	4	10^4	Military $\pm 4\%$
Green	5	5		
Blue	6	6		
Violet	7	7		
Grey	8	8		
white	9	9		
None				Military $\pm 20\%$
Gold			10^{-1}	Both $\pm 5\%$
Silver			10^{-2}	Both $\pm 10\%$

Ex.

First digit corresponds to red $\therefore$ 2
Second digit corresponds to Violet $\therefore$ 7
Multiplier corresponds to brown, hence 10^1
tolerance corresponds to black, hence $\pm 20\%$.
$\therefore L = 270\ \mu H \pm 20\%$.

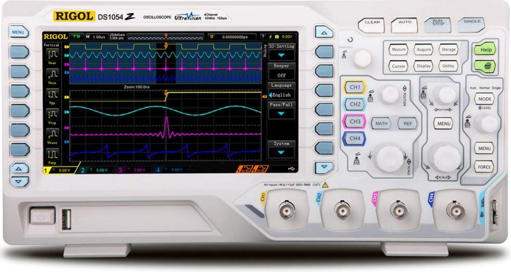
▶ Equipments :-

i) Oscilloscope :- An oscilloscope is a type of electronic test instrument that graphically displays varying signal voltages, usually as a calibrated two dimensional plot of one or more signals as a function of time.

Different types of Oscilloscopes

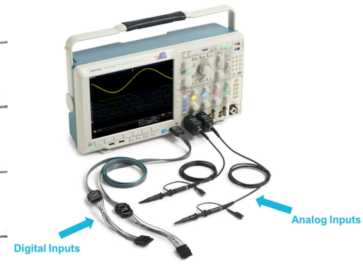
i) Cathode Ray Oscilloscope :- It ~~was~~ is the first oscilloscope. It consists of a cathode ray tube, a vertical amplifier, a time base, a horizontal amplifier and a power supply. These are now called 'analog' scopes to distinguish them from 'digital' scopes.

(ii) Digital Oscilloscopes :- It stores and analyses the signals digitally rather than using analog techniques. It uses advanced trigger, storage, display and measurement features.



(iii) Dual Beam Oscilloscope :- The dual beam oscilloscope can display two signals simultaneously. A special dual beam CRT generates and deflects two seperate beams.

(iv) Mixed Signal Oscilloscope :- A mixed signal oscilloscope has two kinds of inputs, a small number of analog ~~ty~~ channels and a large number of digital channels. It provides the ability to accurately time - correlate analog and digital channels.



(v) Digital Sampling Oscilloscope :- A digital sampling oscilloscope is intended for very high frequency operation. They are used for looking at repetitive signals which have a higher frequency than the sample rate of scope.

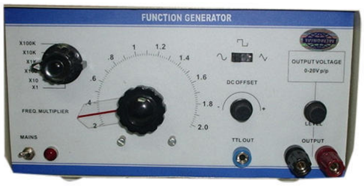
Applications of Oscilloscopes

Oscilloscopes are used in the sciences, medicine, engineering, automotive and the telecommunication industries. General purpose instruments are used for maintenance of electronic equipment and laboratory work. Special purpose oscilloscopes may be used to analyze an automotive ignition system or to display the waveform of the heartbeat as an electrocardiogram, for instance.

(ii) Function Generators :- A function generator is a signal source that has capability of producing different waveforms as its output signal. The frequencies of such waveforms may be adjusted from a fraction of Hertz to several hundred kHz.

Different Types of Function Generators :-

a) Analogue Function Generator :- This was the first function generator to be developed. Despite the fact that they use analogue technology, these offer a number of advantages, such as



- they are cost effective
- easy to use
- maximum frequencies

b) Digital Function Generator :- These use digital technology to generate the waveforms. There are a number of ways in which this can be done, but the most widely used technique is to use Digital Synthesis System.

Digital function generators offers high level of accuracy because the clock for the system is crystal controlled. Also digital function generator provide a high spectral purity and low phase noise. It can also be swept over a much wider frequency range than an analogue function generator. But they are more expensive than analogue function generators.

c) <u>Sweep Function Generator</u> :- A sweep function generator is simply one that can sweep its frequency. Typically, the more versatile sweep function generators utilise digital technology, but it is also possible to use analogue versions as well.

Speed of sweep in such generators is important. Another feature that may be of importance is whether the sweep is linear or logarithmic. Some sweep function generators may have a switch for this.

<u>Applications of Function Generators</u>

A function generator can be used to :

- Create clock signals to digital circuits
- test communication circuits.
- Send pulses to circuits to trigger events
- vary pulse width to control a motor's speed
- ~~to~~ generate sine waves, triangular waves, square and sawtooth waves.
- generate signals to send to integrator or differentiating circuits to test their outputs.

(iii) Multimeters :- A multimeter, also known as volt-ohm meter, is a ~~analog~~ handheld tester used to measure electrical voltage, current, resistance and other values. They are one of the tools preferred by electricians for troubleshooting electrical problems on motors, appliances, circuits, power supplies and wiring systems.

Different types of Multimeters

1. Analog Multimeter :- It is constructed using a moving coil meter and a pointer to indicate the reading on the scale.

Advantages of Analog Multimeter are that it is inexpensive, doesn't require a battery and it can measure fluctuations in the readings.

2. Digital Multimeters :- A digital multimeter is a test tool used to measure two or more electrical values - principally voltage (volts), current (amps) and resistance (ohms).

There are three types of digital multimeters -

a) Fluke Digital Multimeter :- The fluke multimeters are protected against the transient voltage. The multimeter has multi selectors to select the desired function.

The fluke multimeter automatically ranges to select most measurements. This means the magnitude of signal does not have to be known or determined to take an accurate reading, it directly moved to the appropriate part.

b) Clamp Digital Multimeter:- Unlike a fluke DMM, a clamp DMM is used to measure the basic flows of electricity in your battery, machine or HVAC equipment. The clamp DMM can read measurements such as flow of electricity, voltage, power consumption, wattage and current.

c) Autoranging Multimeter:- This is a type of multimeter that automatically measures the readings you are trying to gauge. There are far fewer knobs and settings to play with, leaving us with an almost hands-free device.

Applications of Multimeters

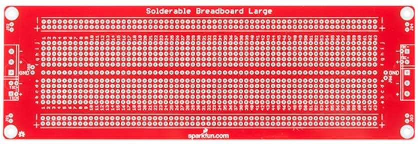
The applications of multimeters are not confined to the measurement of voltage, current, resistance and other electrical quantities. A multimeter can also be used to test continuity in a circuit and to measure capacitance (depending on the model). With most models batteries, diodes and transistors can be tested. Also it is used to distinguish between DC and AC current.

(iv) Breadboards :- A breadboard is a ~~solderless~~ device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through jumper wires.

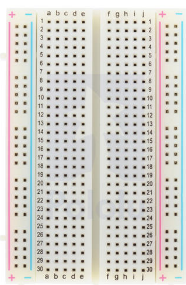
Different types of breadboards

There are two basic types of breadboards :

a) Solder Breadboards :- Solderable breadboards are boards on which the components need to be soldered. These are most of your standard circuit boards, and if you flip one over you'll notice that all the connections are soldered on the board.



b) Solderless Breadboards :- These breadboards do not require soldering of components. One just needs to pin the component in the holes of breadboard. Connections are made using jumper wires. These come in generally three



different sizes. The connection of metal strips in a bread board are shown.

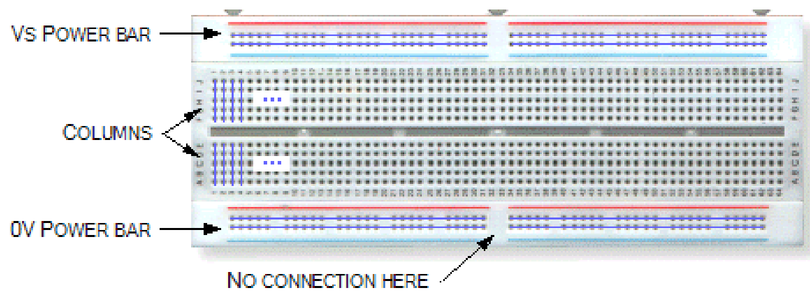


Figure 1: How the holes in a breadboard are connected electrically

Applications of Breadboards :-

It is easier and faster to work with breadboards to lay out circuits than it would be to try to wire components without it, so they're useful for quickly testing and prototyping electronic ideas. Breadboards can also be used without soldering, which makes it easy to remove components and reuse them when the experiment is done.

Familiarisation with Resistor

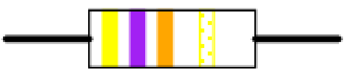
THEORY (#) QUIZ (#) REFERENCES (#)

Quiz

Color Code for Resistor

COLOR	DIGIT	MULTIPLIER	TOLERANCE %	COLOR BAND
Black	0	$10^{0}\ \Omega$		
Brown	1	$10^{1}\ \Omega$	1	
Red	2	$10^{2}\ \Omega$	2	
Orange	3	$10^{3}\ \Omega$ (1 KΩ)		
Yellow	4	$10^{4}\ \Omega$ (10KΩ)		
Green	5	$10^{5}\ \Omega$ (100KΩ)	0.5	
Blue	6	$10^{6}\ \Omega$ (1MΩ)	0.25	
Violet	7	$10^{7}\ \Omega$ (10MΩ)	0.1	
Grey	8	$10^{8}\ \Omega$ (100MΩ)	0.05	
White	9	$10^{9}\ \Omega$ (1GΩ)		
Gold		$10^{-1}\ \Omega$	5	
Silver		$10^{-2}\ \Omega$	10	
None			20	

1.

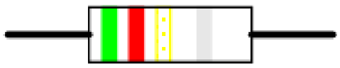


Enter the resistance value: 47 KOhm

Enter the tolerance : +/− 5 %

Correct Resistance Value
Correct Unit Value
Correct Tolerance Value
check

2.



Enter the resistance value: 5.2 Ohm

Enter the tolerance : +/− 10 %

Correct Resistance Value
Correct Unit
Correct Tolerance Value
check

3.

Enter the resistance value: 97 Ohm

Enter the tolerance : +/− 20 %

Correct Resistance Value
Correct Unit
Correct Tolerance Value
check

4.

Enter the resistance value: 3.3 KOhm

Enter the tolerance : +/− 0.1 %

Correct Resistance Value
Correct Unit
Correct Tolerance Value
check

5.

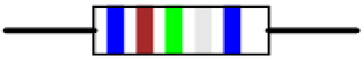
Enter the resistance value: 1.58 Ohm

Enter the tolerance : +/− 2 %

Correct Resistance Value
Correct Unit
Correct Tolerance Value

check

6.



Enter the resistance value: 6.15 Ohm

Enter the tolerance : +/- 0.25 %

Correct Resistance Value
Correct Unit
Correct Tolerance Value

check

Familiarisation with Capacitor

THEORY (#) QUIZ (#) REFERENCES (#)

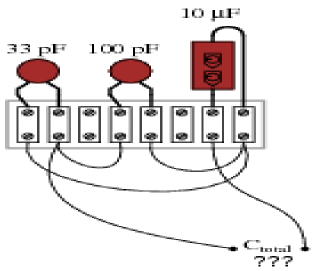
Quiz

Test Your Knowledge!!

✓ 1. Two 33 µF capacitors are connected in series with each other. What will their combined capacitance be in Farads?

- 16.5 µF
- 120 µF
- 66 µF
- 200 µF

✓ 2. Calculate the total capacitance in this collection of capacitors, as measured between the two wires:



Calculate total capacitance given the values of inductors C1, C2, and C3

- 130.990 pF
- 200.8 pF
- 130 pF
- 132.998 pF

✓ 3. A 10µF capacitor is charged to a voltage of 20 volts.How many coulombs of electric charge are stored in this capacitor?

- 20µC of charge
- 120µC of charge
- 20mC of charge
- 200µC of charge

✓ 4. Two 470µF capacitors connected in series are subjected to a total applied voltage that changes at a rate of 200 volts per sec. How much current will there be through these capacitors?
(Hint :The total voltage is divided evenly between the two capacitors.)

- 47 mA
- 470 mA
- 94 mA
- 940 mA

✓ 5. Two capacitors 470μF capacitors connected in parallel are subjected to a total applied voltage that changes at a rate of 200 volts per sec.How much total current will there be through these capacitors?

- ○ 47 mA
- ○ 18 mA
- ◉ 188 mA
- ○ 18.8 mA

Submit

Familiarisation with Inductor

THEORY (#) QUIZ (#) REFERENCES (#)

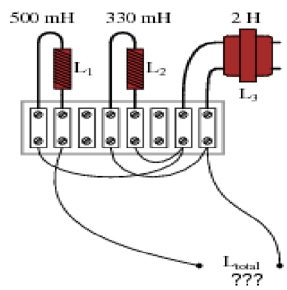
Quiz

Test Your Knowledge!!

✓ 1. . Two 50 mH inductors are connected in parallel with each other. What will their combined inductance be in Henrys?

- 200 mH
- 50 mH
- 100 mH
- 25 mH

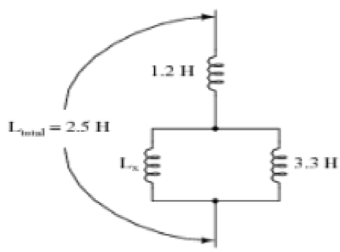
✓ 2. Calculate the total inductance in this collection of inductors, as measured between the two wires:



calculates total inductance given the values of inductors L1, L2, and L3.

- 700 mH
- 783.26 mH
- 689.09 mH
- 583.26 mH

✓ 3. How large must Inductor Lx be in order to provide a total inductance of 2.5 H in this network of inductors?



- 214.5 H
- 2.145 H
- 1.245 H
- 12.45 H

✓ 4. Two 5 H inductors connected in series are subjected to an electric current that changes at a rate of 4.5 amps per sec.How much voltage will be dropped across the series combination?

- (●) 45 V
- ( ) 22.5 V
- ( ) 11.25 V
- ( ) 90 V

✓ 5. Two 5 H inductors connected in parallel are subjected to an electric current that changes at a rate of 4.5 amps per sec.How much voltage will be dropped across the series combination?(Hint: The total current is divided evenly between the two inductors).

- ( ) 45 V
- ( ) 22.5 V
- (●) 11.25 V
- ( ) 90 V

Submit