Unit III

Electrical Installations and Illumination

Electrical Wiring system: A network of wires connecting various accessories for distribution of electrical energy from the supplier meter board to the numerous electrical energy consuming devices such as lamps, fans and other domesti c appliances through contriolling and safety devices is known as a wiring system. A typical house wiring circuit is shown in the fig.-1.

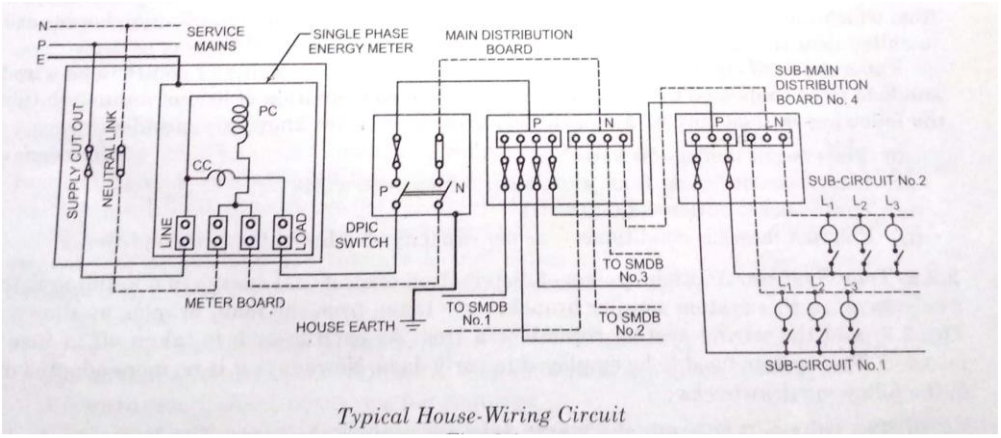


Fig.-1

Systems of distribution of electrical energy: Since as per recommendation of Indian Standards the maximum number of points of lights, fans and 5A socket outlet that can be connected in one circuit is 10 and the maximum load that can be connected in such a circuit is 800 W, in case more load or points are required to be connected to the supply, then it is to be done by having more than one circuit.

Distribution Board System: In distribution board system, which is most commonly adopted for distribution of electrical in a building, the fuses of various circuits are grouped together on a distribution board, sometimes simply known as fuse board. Connections necessary for connecting two or more than two circuits, each consisting of 10 or less number of lamps is shown in fig.-2.

The two copper strips known as bus bars fixed in a distribution board of hardwood or metal case are connected to the supply mains through a double pole iron clad (DPIC) switch so that the installation can be switched off. A fuse is inserted in the positive or phase pole of each circuit so that each circuit is connected up through its own particular fuse. The number of circuits and sub-circuits is decided as per number of points to be wired and load to be connected to thesupply system.

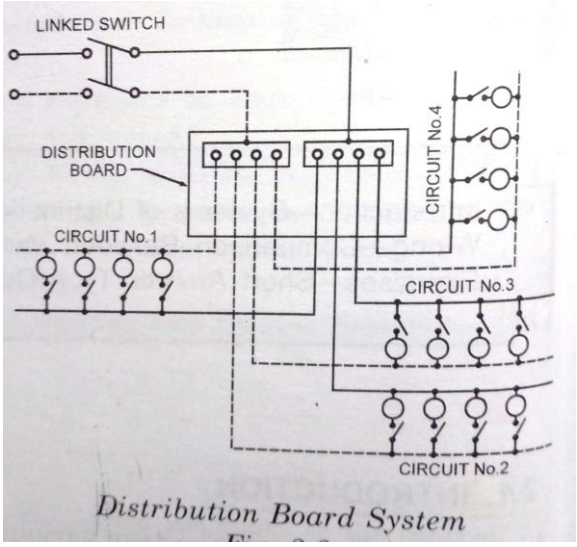


Fig.-2

Tree system: Another system of distribution of electrical energy in a building is a tree system. In this system smaller branches are taken from the main branch as shown in fig.-3 and the wiring system resembles a tree. As each branch is taken off, a fuse is inserted. This system used to be employed in early days. Now a days it is no more adopted due to the following drawbacks.

(i) The voltage across all the lamps does not remain the same.

(ii) A number of joints are involved in every circuit.

(iii) Fuses are scattered.

(iv) In case of occurrence of faults all the joints have to be located.

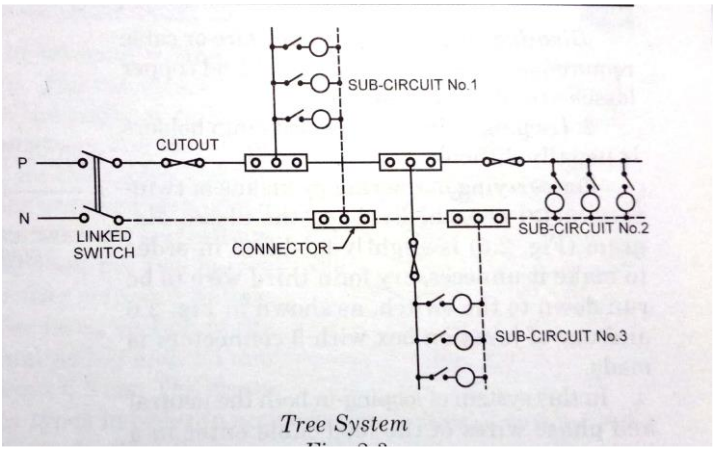


Fig.-3

Methods of Wiring: There are two **methods** of wiring known as joint box system (or Tee system) and loop in system.

(i) **Joint Box or Tee System:** In joint box system the connections to the lamps are made through joints made in joint box by means of suitable connectors or joint cutouts. In this method though there is a saving in the quantity of wire or cable required but the same is offset by the extra cost of joint boxes. The other disadvantage I sthe number of 'T' connection made in wiring system results in weakness if not properly made. Now a days the use of this system is limited to temporary installations only as its cost is low.

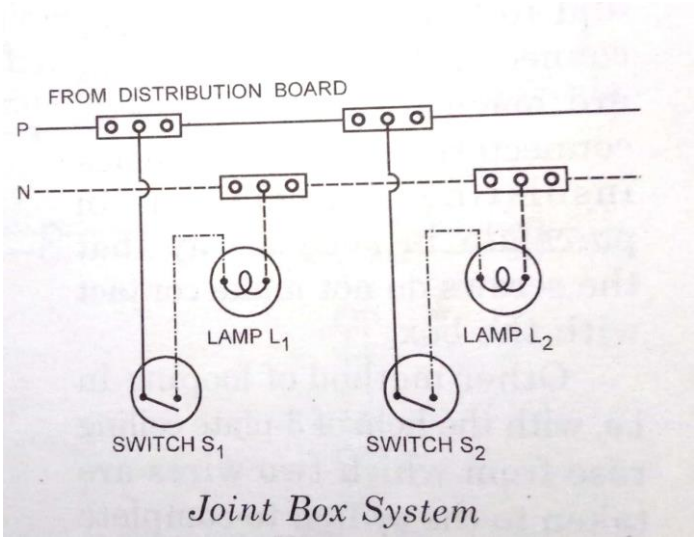


Fig.-4

(ii) **Loop-in System:** this system is universally used for connections of various lamps or other appliances in parallel. In this system when a connection is required at a light or switch, the feed conductor is looped in by bringing it direct to the terminal and then carrying it forward again to the next point to be fed as shown in fig.-4. The switch and light feeds are carried round the circuit in a series of loops from one point to another until the last point on the circuit is reached.

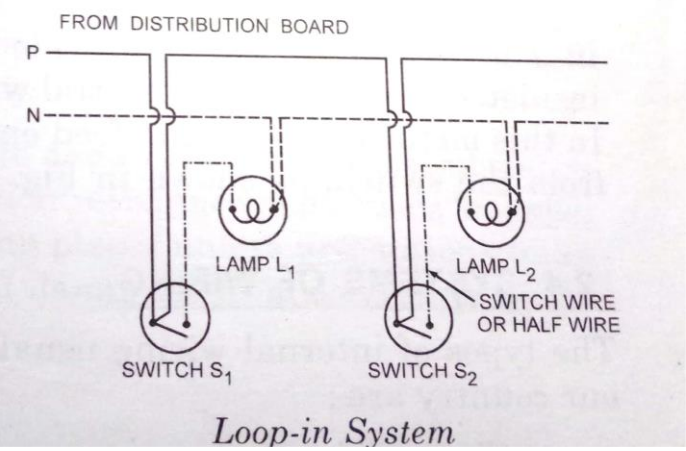


Fig.-5

The phase or line conductors are looped either in switch board or box and neutrals are looped either in switch board or from light or fan. Line or phase should never be looped from light or fan.

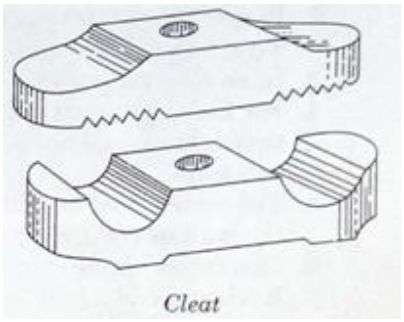
Selection or choice of wiring system:

(i) Safety
(ii) Durability
(iii) Appearance
(iv) Mechanical protection
(v) Accessibility
(vi) Low initial cost
(vii) Low maintenance cost

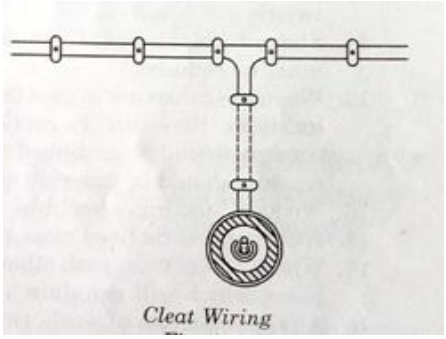
Types of Electrical wiring systems:

(1) Cleat wiring system
(2) TRS wiring system
(3) Lead sheathed wiring system
(4) Wooden batten wiring system
(5) Plastic Casing-capping system
(6) Conduit wiring system
    (i) Conduit surface wiring
    (ii) Concealed conduit wiring

1. **Cleat wiring system: I**n this system of internal wiring the cables used are either vulcanized Indian Rubber (VIR) of Polyvinyl chloride (PVC) type. The cables are held by porcelain cleats about 6 mm above the walls or ceiling. The cleats are made in two halves, one base and the other cap. The base is grooved to accommodate the cables and the cap is put over it and the whole of it is then screwed on the wooden plugs (gutties) previously cemented into the wall and ceiling. The cleats used are of different sizes and different types in order to accommodate cables of various sizes and different number of cables respectively. The cleats are of three types; one groove, two grooves and thre grooves to accommodate one, two and three cables respectively.



Cleat



Cleat Wiring

Advantages:

(i) It is the cheapest system of internal wiring.

(ii) Its installation and dismantlement is easy and quick.

(iii) Material is recoverable after the dismantlement.

(iv) Inspection, alterations and additions can be easily made.

(v) Skilled labour required is little.

Disadvantages:

(i) It is not good looking.

(ii) The wires are exposed to mechanical injury.

(iii) Oil and smoke are injurious to VIR insulation.

(iv)

2. **Casing-Capping wiring system:** This is one of the simplest form of electrical wiring system. This is little bit old/conventional wiring system. Now a days, we often use this wiring system. PVC insulated cables are placed in plastic casing and covered with cap. The casing is of rectangular cross section.

   The colour of casing channel and cap are normally white or grey. The casing channel and cap are normally made of plastic. The casing channels and caps are available in market in standard sizes.

   Advantages:

   (i) It is the cheapest wiring system as compared to concealed wiring system.

   (ii) It is strong and long lasting wiring system.

   (iii) Replacement and alteration of defective wire is easy.

   (iv) It provides protection against mechanical damage.

   (v) It is safe from oil, steam, smoke and rain.

   (vi) No risk of electric shock due to covered wires and cables in casing and capping.

   Disadvantages:

   (i) Since it requires better workmanship, the labour cost is high.

   (ii) This type of wiring can be used only on surface and cannot be concealed in plaster.

   (iii) Internal condensation of moisture may cause damage to the insulation.

3 Conduit wiring system: In this system of wiring steel tubes or PVC pipes known as conduits are installed on the surface of wall by means of saddles or buried under plaster and VIR or PVC cables are drawn afterwards by means of GI wire.

Advantages:

(i) It provides protection against mechanical damage.

(ii) It provides complete protection fire due to short circuit.

(iii) The whole system is waterproof.

(iv) Replacement and alteration of defective wiring is easy.

(v) Its life is long.

(vi) It is shocked proof also if earthing is properly done**.**

Disadvantages:

(i) It is very costly system of wiring.

(ii) Its eraction is not easy and required time.
(iii) Experienced and highly skilled labour is required for carrying out the job.

Conductor materials used in cables: The function of conductor usually known as core in cable is to carry electrical current. Copper and aluminium are the materials used as conductors in power and lighting cables.

Copper: Though silver is the best conductor of heat and electricity but due to its high cost it is rarely used. The next bets conductor is copper. It is cheaper as compared to silver. The electrical conductivity of copper is comparatively high. The resistivity of pure copper is $1.786 \times 10^{-8}\ \Omega - m$. It is mechanically strong, hard, extremely tough, durable and ductile. It is highly resistive to corrosion, oxidation etc. it can be easily soldered and welded. The specific weight of copper is 8900 kg/m^3 at 20^oC or 9.9 g/cm^3. Its melting point is 1083 ^{o}C.

Aluminium: Aluminium is frequently used in place of copper for electric cables used for long distance power distribution. The electrical conductivity of aluminium is about 60% of copper (resistivity being $2.87\times 10^{-8}\ \Omega - m$ at 20 ^{o}C) so for same resistance for a given length, the aluminium required will be 1.61 times that of copper in volume and 1,26 times that of copper in diameter. The only application of aluminium cables for wiring in the buildings is for the 'continous busbar' system of distribution.

Classification of cables: The cables employed for internal wiring of building my be divided into different groups.
According to:

(i) Conductor used
(ii) Number of cores
(iii) Voltage grading
(iv) Types of insulation used.

(i) According to conductor:
  (a) Copper conductor cable
  (b) Aluminium conductor cable

(ii) According to number of cores:
  (a) Single core cable
  (b) Two core cable
  (c) Three core cable

(iii) According to voltage Grading:
  (a) 250/440 V cable
  (b) 650/100 v cable

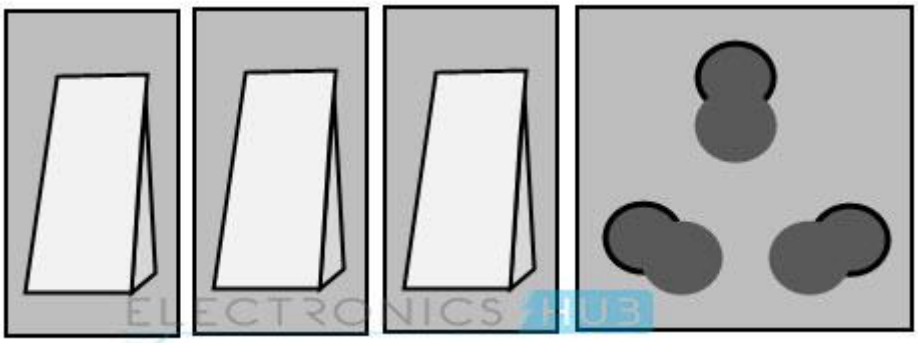
(iv) According to type of insulation:
  (a) Vulcanized Indian rubber (VIR) cable
  (b) Polyvinyl chloride (PVC) cable
  (c) Lead sheathed cable
  (d) Weather proof cable
  (e) Flexible cable
  (f) Cross linked polyethylene (XLPE) cable
  (g) Tough rubber sheathed (TRS) cable

Insulating Materials: the conductor is covered with insulating material so that it may prevent leakage of current from the conductor i.e. the insulating material should be extremely high resistive to the flow of electric current through it. The insulating materials used in electric cables should possess the following properties:

(i) High insulation resistance to avoid the leakage current.
(ii) High dielectric strength to avoid electrical breakdown of the cable.
(iii) High mechanical strength to withstand the mechanical handling of cables.
(iv) Non-hygroscopic

Introduction

The Electrical Wiring Systems are mostly standardized with several rules, regulations and laws. Electrical Wiring must be installed correctly and safely in accordance with electrical regulations and standards. If the electrical wiring is carried out incorrectly or without confirming to any standard, then it may lead to incidents like short circuits, electric shocks, damage the device / appliance or leads to the malfunctioning of device which further causes for the reduction of device life.



Several factors have to be considered before the actual installation work to be done for residential, commercial or industrial wiring. These factors include type of building construction, type of ceiling, wall and floor construction, wiring methods, installation requirements, etc.
Let us discuss some electrical wiring basics, i.e., the concept of electrical wiring, steps involved, methods followed and common types of electrical wiring in brief.

Distribution of Electricity

The Electricity Board / Department provides the electric supply up to the outside the consumer's premises (either residential, commercial or industrial). The consumer has to take the connection from that point to the main distribution board / switchboard at home.

From the main switchboard / distribution board, various types of electrical loads such as fans, lights, room coolers, and refrigerators are connected through respective circuits and electrical wiring.

There are different types of wirings used for connecting the loads to the mains, which can be used for house electrical wiring as well as industrial electrical wiring. Some of these are discussed below.

Types of Electrical Wiring Systems

Electrical Wiring is an important part of a building, be it a residential building (individual houses or apartments), large commercial spaces (office buildings) or industries (factories). There are several methods and systems of Electrical Wiring, which are used for lighting and other power circuits.

The type of Electrical Wiring plays a major role in the overall cost of the installation. So, it is very important to understand what type of Electrical Wiring Systems are suitable for a particular job.

Some common factors to be considered while choosing a particular Electrical Wiring System are:

- Cost of the Wiring System
- Type of Wires / Cables used
- Quality of the Wires
- Type of load (light, HVAC, motors etc.)
- Safety of the Wiring System
- Possibility of future modifications / extensions
- Life of installation
- Construction of the building (wooden, concrete, brick and mortar, etc.)
- Fire safety

Irrespective of the type of Wiring and the choice of Wire, the Electrical Wiring System should be able to protect against regular mechanical wear and tear under normal operating conditions.

Usually, the type of wire determines the Electrical Wiring Systems (or at least their classification). Some of the commonly used Electrical Wiring Systems in Residential, Commercial, Industrial, Auditoriums, etc. are:

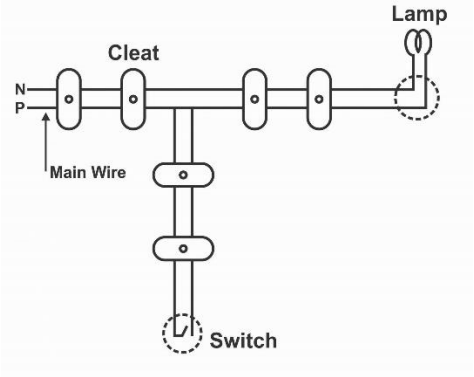
- Cleat Wiring
- Casing and Capping Wiring
- Batten Wiring (CTS or TRS)
- Conduit Wiring (Surface or Concealed)
- Lead Sheathed Wiring

Let us now take a look at these Wiring Systems / Installations one by one.

Cleat Wiring

In this, porcelain, wood or plastic cleats are fixed to walls or ceilings at regular intervals, i.e., 0.6 m between each cleat. PVC insulated cables are taken through the holes of each cleat and hence, the cleat supports and holds the wire.

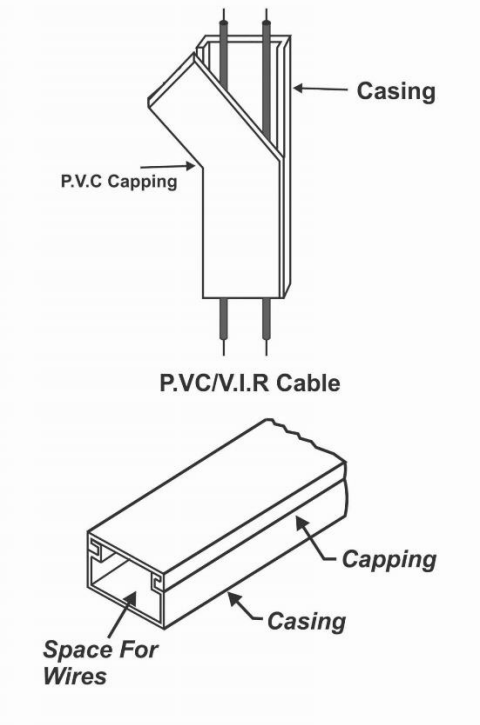
This is an inexpensive method of wiring and is used for temporary installations. Therefore, it is not suitable for home electrical wiring and also it is an outdated method.



Casing and Capping Wiring

In this, cable is run through a wooden casing having grooves. The wood casing is prepared in such a way that it is of a required fixed length with parallel grooves that accommodates the cables. The wooden casing is fixed to the walls or ceiling with screws.

After placing the cables inside the grooves of casing, a wooden cap with grooves is placed on it to cover the cables. This is also a cheap wiring system, but there is a high risk of fire in case of short circuits.



Batten Wiring

In this, insulated wires are run through the straight teak wooden battens. The wooden battens are fixed on the ceilings or walls by plugs and screws. The cables are fitted onto the battens by using tinned brass link clips.

These clips are fixed to the battens with rust-resistant nails. This wiring installation is simple and cheap as compared to other electrical wiring systems also takes less time to install. These are mainly used for indoor installations.

In this type of wiring, Cabtyre Sheathed Wire (CTS) or Tough Rubber Sheathed Wire (TRS) is generally used as the electrical conductor.

Conduit Wiring

In this wiring, PVC cables are taken through either PVC conduit pipes or through steel conduit pipes. This conduit wiring can be either surface conduit wiring or concealed conduit wiring.

If the conduit pipes are run on surface of the walls and ceilings, it is called a surface conduit wiring. If the conduits are run inside the surface of the walls and ceilings and are covered with plastering, it is called as concealed conduit wiring.

Surface conduit wiring is used in industries to connect the heavy motors. On the other hand, concealed wiring is the most popular and common method of wiring the residential buildings. The conduit wiring is the safest method of wiring and also looks beautiful (concealed conduit wiring).

Lead Sheathed Wiring

This wiring method is also similar the CTS / TRS Wiring except for the type of wire / cable. In this, the electrical conductor is first insulated with Vulcanized Indian Rubber and then it is covered with a sheath of Lead-Aluminum alloy (95% Lead and 5% Aluminum).

Similar to the Batten Wiring, this wiring is also run on wooden batten and are fixed with tinned clips.

Types of Electrical Wiring

We know that electrical circuit is a closed path through which electricity flows from phase or hot wire to the device or apparatus and then back the source though neutral wire.

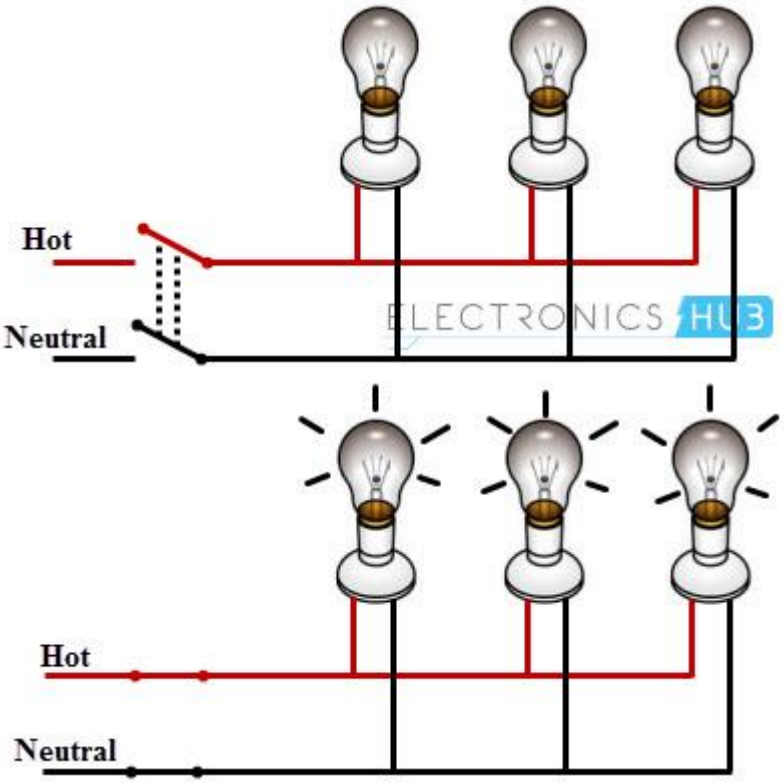
Along the way, the electricity path may consist of fixtures, switches, receptacles, junction boxes, etc. So, the wiring may be routed through these elements before actually making connections with apparatus or device.

The wiring is divided into two types depending on how the devices are powered or connected to the supply. They are:

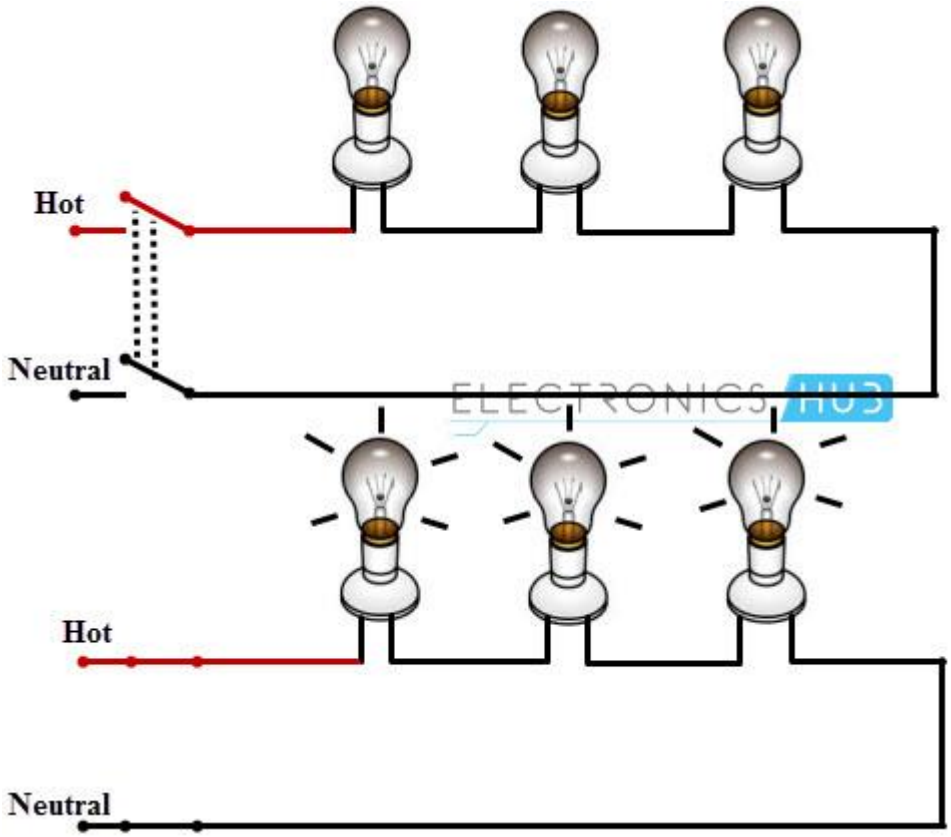
- Parallel Wiring
- Series Wiring

In Parallel Wiring, several devices on the installation are powered on a single circuit. It is the most accepted wiring in homes and industries, in which devices are connected in parallel with the supply source as shown in figure.

In this, both phase (or hot) and neutral cables are routed through the electrical boxes (junction boxes) from which individual receptacles, fixtures, and devices are branched.



The Series Wiring is the rarely used wiring in which hot wire is routed through the several devices and then last device terminal is connected to the neutral wire. It is like an old Christmas lights or serial lights wiring in which one light burnout leads to the shutdown of the entire network.

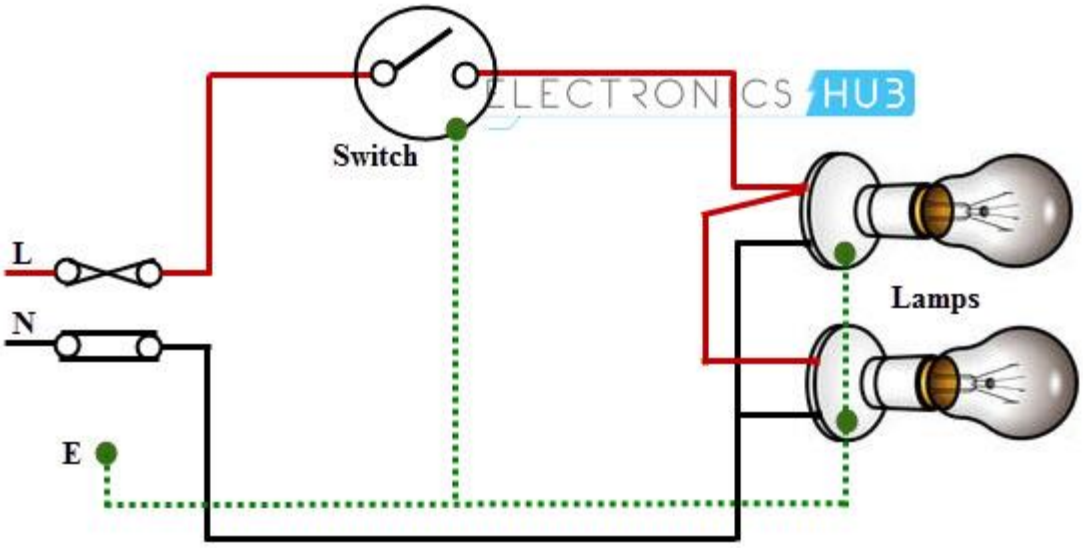


Examples of Electrical Wiring

For a better understanding of the wiring concept, here we are giving some examples of the wiring circuits, which are commonly used in our homes / offices.

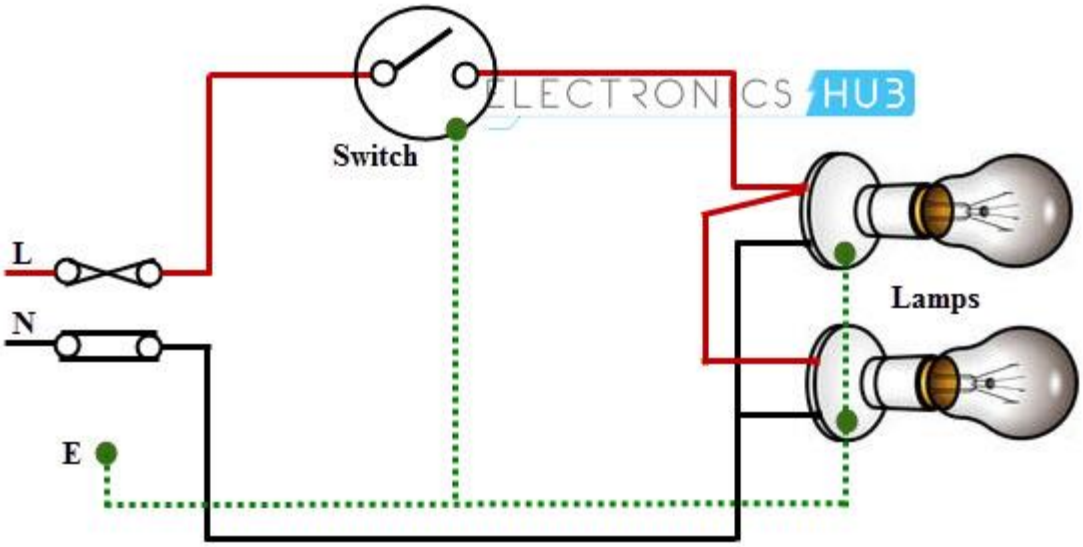
Single Bulb (or any other load) Controlled by a One Way Switch

In this, hot wire is connected to the one terminal of the switch and other terminal of the switch is connected to the bulb positive terminal, then bulb negative terminal is connected to the neutral wire as shown in figure.



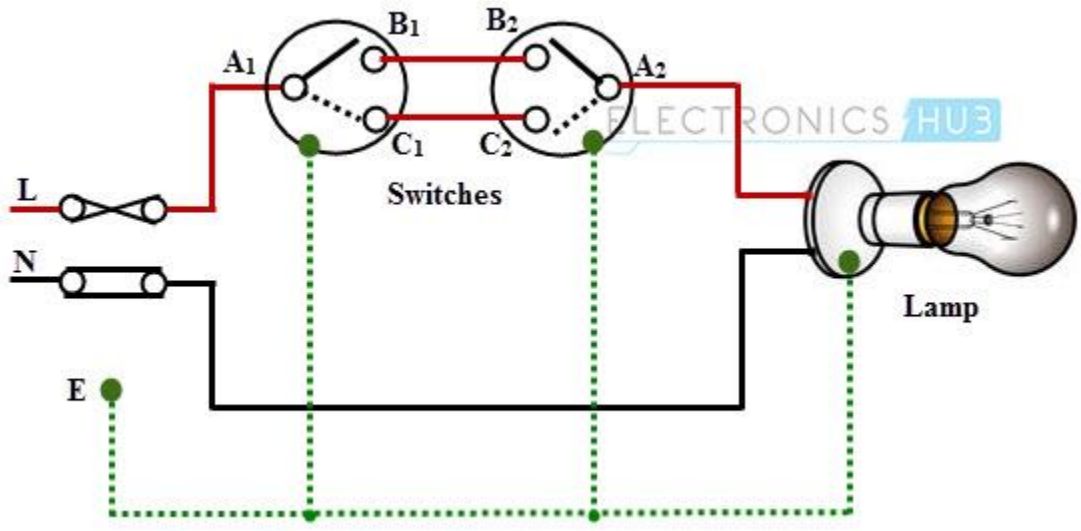
Two Blubs Controlled by a One Way Switch

In this, two bulbs are connected in parallel with the supply wires (phase and neutrals), which are routed by single one-way switch as shown in figure.



Single Blub Controlled by Two Way Switches

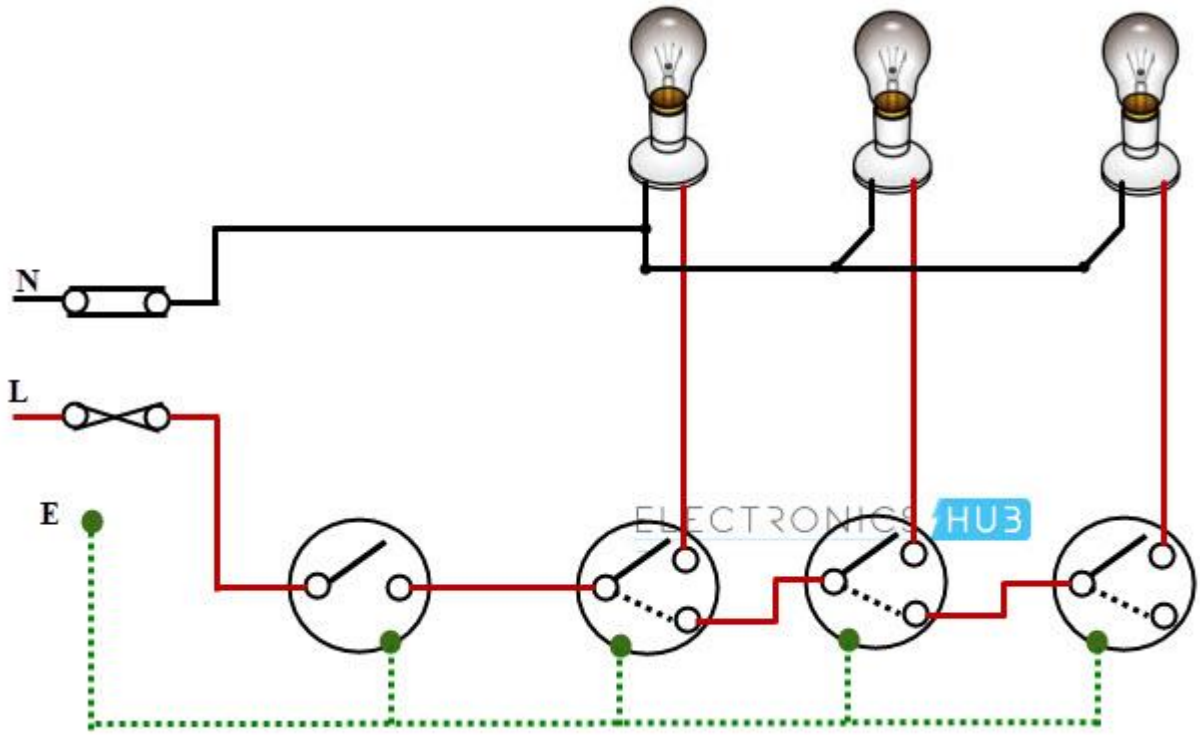
This wiring is also called as Staircase Wiring. In this, a light bulb / lamp is controlled from two different places / sources by using two two-way switches. This type of wiring is used in bed rooms to switch ON/OFF the lamp from two sources (at the bed side and at switchboard). The connection of switches with the lamp is shown below.



Warehouse Wiring

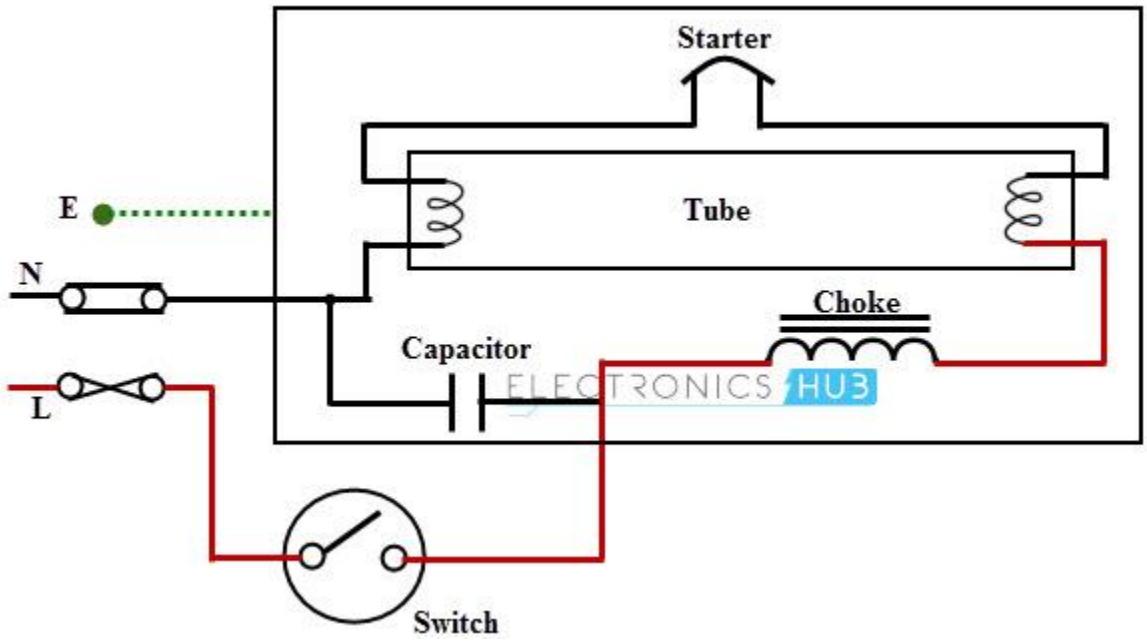
This type wiring is used in big godowns, long passages, warehouses and tunnel like structures having many rooms or portions. It follows the linear sequence for switching the lights from one end to the other.

When a person leaves one room and enters the next, turning the light switch makes previous room's lamp to be switched OFF, while the present room lamps to be switched ON. It turns OFF one lamp while switching ON the another. The schematic wiring diagram for warehouse wiring is shown in below.



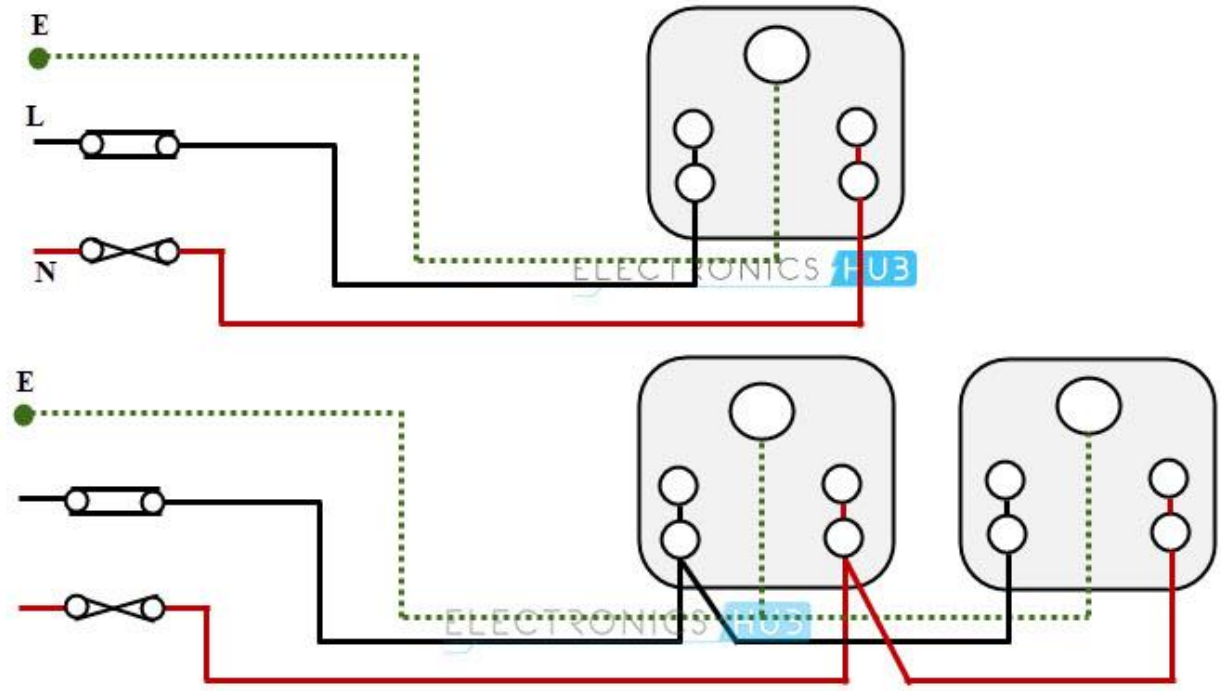
Fluorescent Lamp Controlled by a One-Way Switch

The switching of fluorescent lamp with single one-way switch through ballast and capacitor is shown in below figure. In this, phase wire is connected to the one end of the switch and another end of the switch is connected to the choke (or ballast). One electrode of the lamp is connected to the choke and other to neutral terminal as shown in figure.



Socket Outlet Wiring

The outlet holds a plug and passes the current through it when the power is routed to the socket through a switch. The single socket connection and radial socket connection are shown in below figure.



Switches and Circuits

The switch is an electrical device that is used to break or make an electrical circuit manually or automatically. The working principle of switch depends on ON/ OFF mechanism. Various electrical or electronic circuits use switches to control or trigger the owl circuit. The types of switches depend on the connections of the circuit they make. Two essential components such as pole and through can confirm what types of connections a switch can make. These two components are also used to define variations of switch contact.

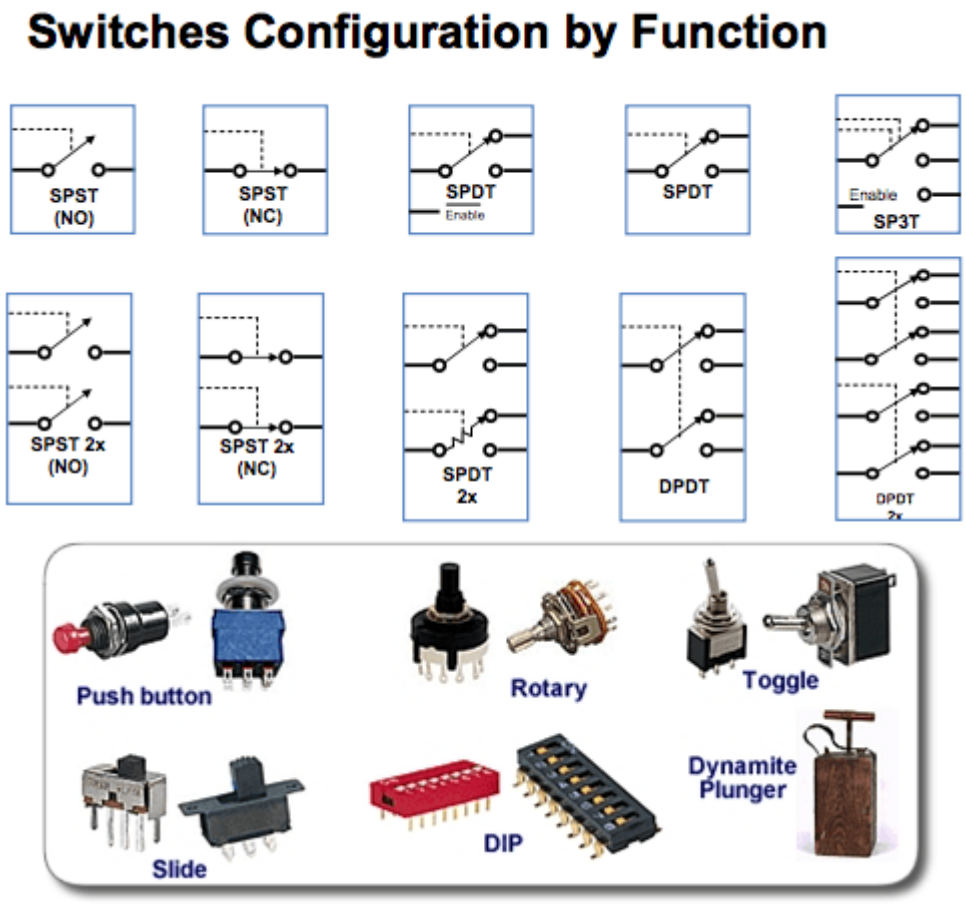
Here, the poles and throws can be defined as; when the number of circuits is controlled by a switch is called poles, whereas throws can be defined as the number of positions that the switch can adopt. A single throw switch consists one pair of contacts like open or close. A double throw switch

includes a contact, which can be connected to two other contacts. When the switch is activated, then the current flows through between the two terminals of the switch. When the switch is OFF, then the current doesn't flow between the two terminals of the switch.

Types of Switches

The types of switches are classified into four types namely:

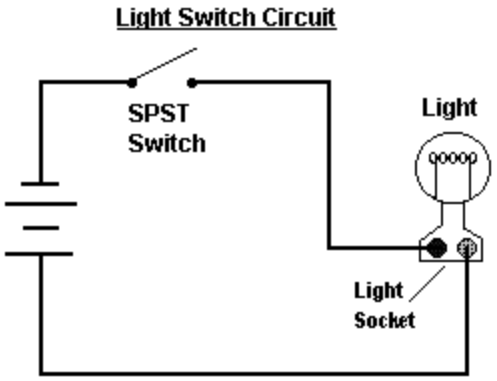
- SPST (Single Pole Single throw)
- SPDT (single pole double throw)
- DPST (double pole, single throw)
- DPDT (double pole double throw)



SPST (Single Pole Single Throw)

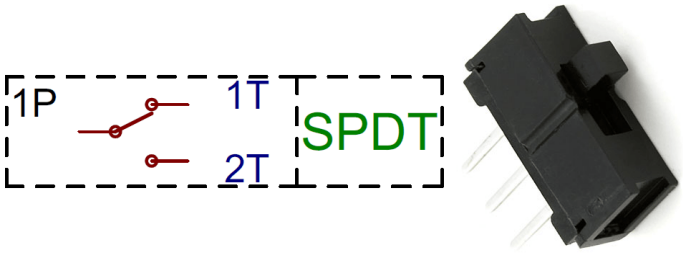
The SPST is a basic ON/OFF switch, that is used to connect or break the connection between two terminals. The power supply for the owl circuit is given by this switch. A simple PST switch is shown below.

The application of SPST switch is light switch given below and it is also called as a toggle switch. This type of switch has one input and one output. This light switch circuit controls one wire and makes one connection. This is an ON/OFF switch, when the switch in the below circuit is ON or closed, then the current flows through the two terminals and the bulb in the circuit will blink. When the switch is OFF or open, then the current doesn't flow through the two terminals.

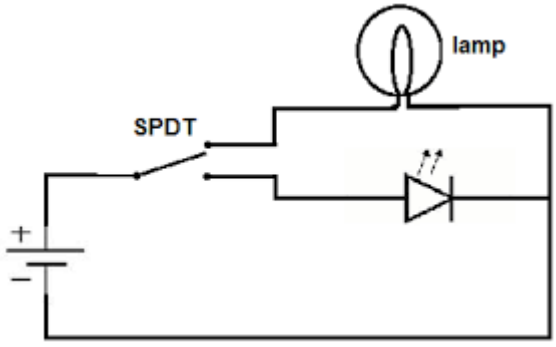


SPDT (Single Pole Double Throw)

The SPDT switch is a three terminal switch, one terminal is used as input and remaining two terminals are used as outputs. It joins a mutual terminal to one or the other of two terminals. In the SPDT switch, instead of other terminals, just use COM terminal. For example, we can use COM & A or COM & B.

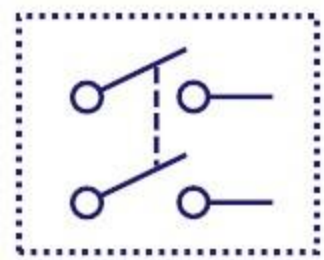


The application of SPDT switch is mainly involved in a three-way circuit to turn ON/OFF a light from two locations like from the top & bottom of a stairway. In the circuit below, when the switch A is closed, then the current flows through the terminals, but only light A will glow and light B will OFF. When the switch B is closed, then the current flows through the terminals and only light B will glow and light ‘A’ will OFF. Her two circuits will be controlled through one source or one way.

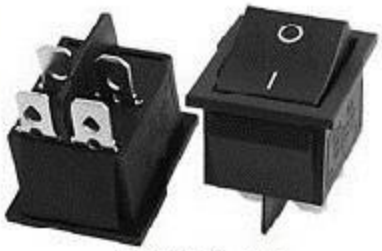


DPST (Double Pole, Single Throw)

The DPST switch consists of two poles that means it includes two identical switches located on side by side. This switch is operated by one single toggle, which means that two discrete circuits are controlled at a time through one push.



Symbol

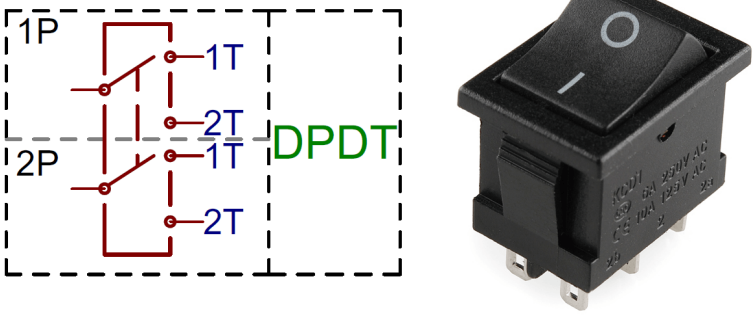


DPST Switch

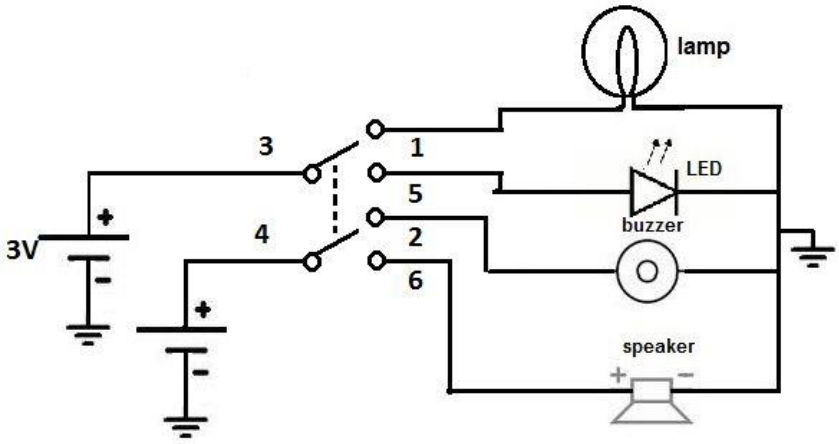
This switch is used to turn two circuits ON/OFF and it consists of four terminals namely two inputs and two o/ps. The main purpose of this switch is to regulate a 240V appliance, where both supply voltages must be ON whereas the unbiased wire may be always connected. When this switch is ON then the current starts flowing through two circuits and when it is turned OFF then it is turned OFF.

DPDT (Double Pole Double Throw)

This switch is equal to two SPDT switches, it means two separate circuits, connecting two inputs of each circuit to one of two outputs. The switch position controls the number of ways and from the two contacts each contact can be routed.



When it is in ON-ON mode or ON-OFF-ON mode they work like two discrete SPDT switches worked by the similar actuator. At a time only two loads can be ON. A DPDT switch can be used in any application that needs an open & closed wiring system.



The best example of this is, modeling of the railroad, that makes use of small scaled railways and trains, cars and bridges. The closed permits for the system to be switched at all times, whereas open permits for extra piece to be switched ON or triggered through the relay. From the following circuit, A, B and C connections from one pole of the switch and D, E and F connections from the other pole of the switch. Connections B and E are mutual in each of the poles.

If the +Vs enters at connection B & the switch is fixed to the top most position, then the connection A becomes +ve and the motor will rotate in one direction. If the switch is set to the lowest position,

the power supply is inverted and connection D becomes +ve then the motor will rotate in the opposite direction. In the middle position, the power supply is not linked to the motor and it does not rotate. This kind of switch is mainly used in several motor controllers where speed of that motor is to be inverted.

2 Way Switch

The 2-way switch acts as 2 switches that can control a single appliance. This is a 2 switch for a single appliance. You might ask a question here why we want or need 2 switches for a single appliance while we have one.

The two-way switches are generally used for staircase case lightning and other lightning systems where we want to control appliances from two locations. Suppose you are on the top of stairs and want to turn on the light above the stairs then using the 2 way switch you can turn on/off the same light with two different areas or locations. Here you can turn on the stairs light either from top of the stairs or from the bottom stairs using the two way switch. You can use the two way switch either on stairs, garage or in the garden where you can switch the garden light either while in the garden or when inside the hall or in home.

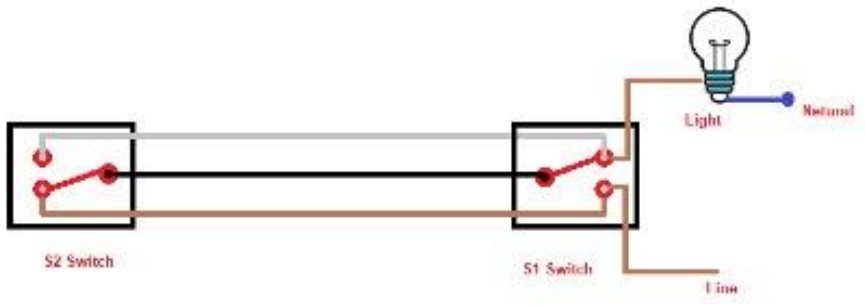


Fig 1: 2 Way switch connection

Wiring Of 2 Way Switch

As you can see in the pic below Common wiring that goes in the middle is the common pin of two switches and the Line L1 and L2 pin on both switches that carry the live current of the power source. When the first switch plunger moves down it makes the connection with line wire and then on the other side of the second switch is in up position making contact with bulb live wire and making a close circuit to light the bulb. Now suppose if we move the switch plunger to up then it discontinues the connection even if the first switch plunger in up position so the light connection is open and hence the light get turned off.

Switch Fuse Unit (SFU): Switch fuse is a combined unit and is known as an iron clad switch, being made of iron. It may be double pole for controlling single phase two-wire circuits or triple pole for controlling three-phase, 3-wire circuits or triple pole with neutral link for controlling 3-phase, 4-wire circuits.

Switch Fuse Unit (SFU)

MCB

MCB stands for Miniature Circuit Breaker. It automatically switches OFF electrical circuit during any abnormal condition in the electrical network such as overload & short circuit conditions. However, fuse may sense these conditions but it has to be replaced though MCB can be reset. The MCB is an electromechanical device which guards the electric wires &electrical load from overcurrent so as to avoid any kind of fire or electrical hazards. Handling MCB is quite safer and it quickly restores the supply.When it comes to house applications, MCB is the most preferred choice for overload and short circuit protection. MCB can be reset very fast & don’t have any maintenance cost. MCB works on bi-metal respective principle which provides protection against overload current&solenoidshort circuit current.

MCCB

MCCB stands for Molded Case Circuit Breaker. It is another type of electrical protection device which is used when load current exceeds the limit of a miniature circuit breaker. The **MCCB** provides protection against overload, short circuit faults and is also used for switching the circuits. It can be used for higher current rating and fault level even in domestic applications. The wide current ratings and high breaking capacity in MCCB find their use in industrial applications. **MCCB** can be used for protection of capacitor bank, generator protection and main electric feeder distribution. It offers adequate protection whenever an application requires discrimination, adjustable overload setting or earth fault protection.

Difference between MCB and MCCB

S.No	MCB	MCCB
1	It stands for Miniature Circuit Breaker.	It stands for Molded Case Circuit Breaker.
2	Rated current not more than 125 Ampere.	Rated Current up to 1600A
3	Its interrupting current rating is under 10KA	Their interrupting current ranges from around 10KA -85KA
4	Judging from their power capacities, MCB is mainly used for low Breaking capacity requirement mainly domestic.	MCCB is mainly used for both low and high Breaking capacity requirements mainly industrial.
5	Its trip characteristics are normally not adjustable since they basically cater to low circuits.	Its trip current may be fixed as well as adjustable for overload and magnetic setting.

Electrical Earthing

Earthing is defined as **"the process in which the instantaneous discharge of the electrical energy takes place by transferring charges directly to the earth through low resistance wire."**

Low resistance earthing wire is chosen to provide the least resistance path for leakage of fault current. Let us know more about earthing and its types in this article. The process of transferring the immediate discharge of the electrical energy directly to the earth by the help of the low resistance wire is known as the electrical earthing. Mostly galvanised iron is used for earthing. Earthing provides simple path to the leakage current. Earthing is an important component of electrical systems because of the following reasons: •It keeps people safe by preventing electric shocks •It prevents damage to electrical appliances and devices by preventing excessive current from running through the circuit •It prevents the risk of fire that could otherwise be caused by current leakage.

Principle of Operation: The action of a fuse is based upon the heating effect of the electric current. In normal operating conditions, when the current flowing through the circuit is within safe limits, the heat developed in the fuse element carrying this current is readily dissipated into the surrounding air, therefore, fuse element remains at a temperature below its melting point. However, when some fault such as short circuit occurs or when the load connected in a circuit exceeds its capacity, the current exceeds the limiting value, the heat generated due to this excessive current cannot be dissipated fast enough and the fusible element gets heated, melts and breaks the circuit.

How is Earthing Done?

To ensure safety, earthing can be done by connecting the electrical appliance to earthing systems or electrodes placed near the soil or below the ground level.

The electrode or earthing mat equipped with a flat iron riser is installed under the ground level. It helps to connect all the non-current-carrying metallic parts of the equipment.

This picture below shows the earthing system incorporated into an electrical system.

The primary purpose of earthing is to avoid or minimize the danger of electrocution, fire due to earth leakage of current through undesired path and to ensure that the potential of a current carrying conductor does not rise with respect to the earth than its designed insulation.

When the metallic part of electrical appliances (parts that can conduct or allow passage of electric current) comes in contact with a live wire, maybe due to failure of installations or failure in cable insulation, the metal become charged and static charge accumulates on it. If a person touches such a charged metal, the result is a severe shock.

To avoid such instances, the power supply systems and parts of appliances have to be earthed so as to transfer the charge directly to the earth. This is why we need Electrical Earthing or Grounding in electrical installation systems.

Below are the basic needs of Earthing.

- To protect human lives as well as provide safety to electrical devices and appliances from leakage current.
- To keep voltage as constant in the healthy phase (If fault occurs on any one phase).
- To Protect Electric system and buildings form lighting.
- To serve as a return conductor in electric traction system and communication.
- To avoid the risk of fire in electrical installation systems.

Types of Earthing

There are three types of earthing, they are:

- Pipe earthing
- Plate earthing
- Strip earthing

Pipe earthing is the best and most efficient way of earthing and is also easily affordable. Pipe earthing uses 38mm diameter and 2 meters length pipe vertically embedded in the ground to work as earth electrodes.

In plate earthing, an earthing plate made of copper or G.I. is buried into the ground at a depth more than 3 metres from the ground level. This earthing plate is embedded in an alternative layer of coke and salts.

Strip earthing is used in transmission processes. Strip electrodes of cross section not less than 25mm X 1.6mm of copper or 25 mm X 4mm of G.I. or steel are buried in horizontal trenches of a minimum depth of 0.5m.