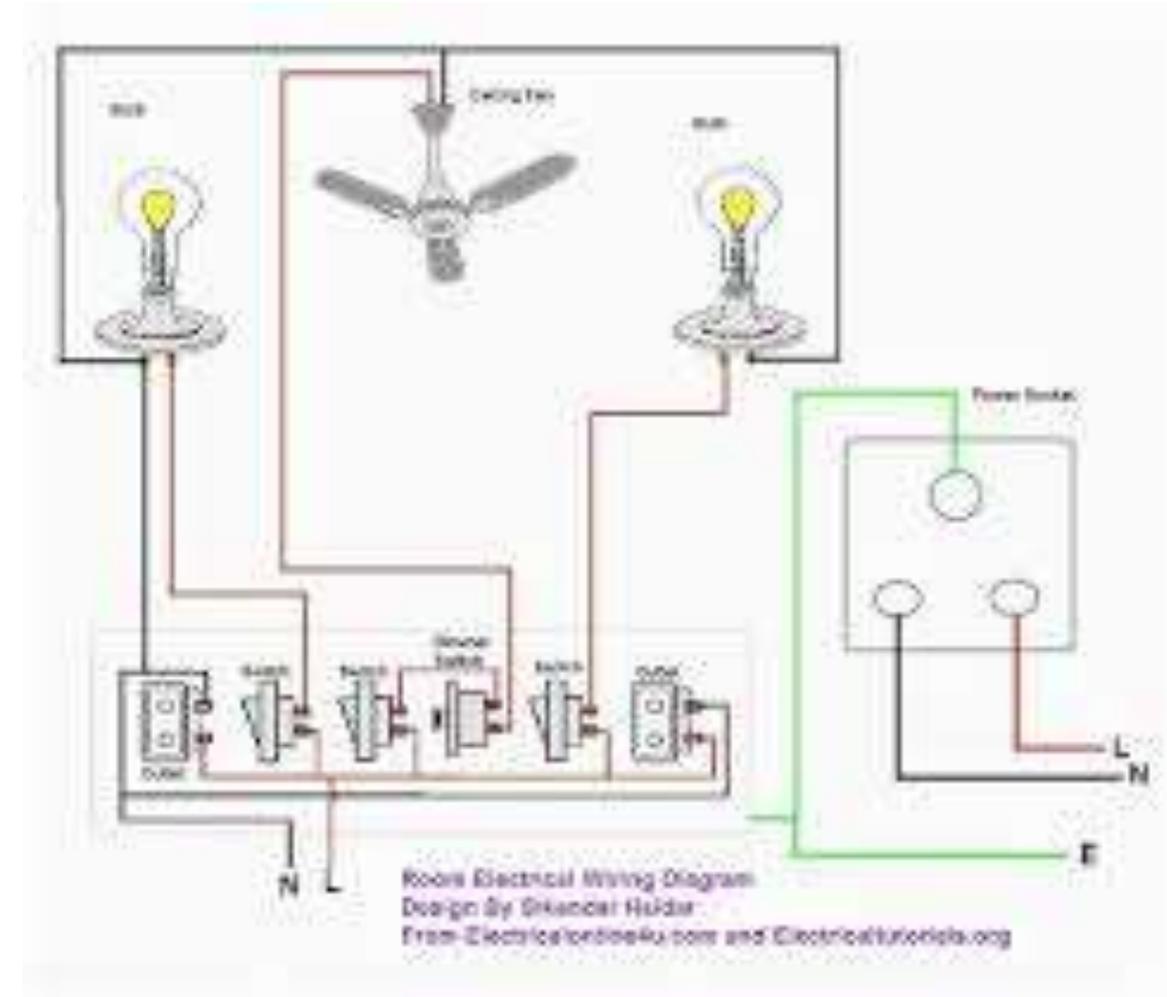


BASIC CONCEPT OF HOUSE WIRING

For Age Group > 15 years

PGSC conducts “Assistant Electrician”
Skill development Course
under
Pradhan Mantri Kaushal Vikas Yojna.
Interested candidates may contact
Harinder Pal Singh (81465 68350)



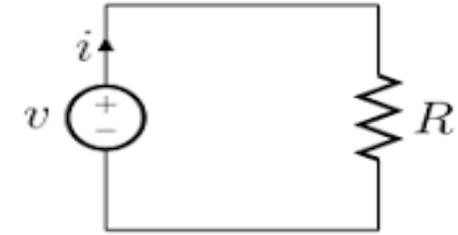
By Harinder Pal Singh, MMS



Some basics :

What is Electricity ?

- ❑ Electricity is a form of energy resulting from the existence of charged particles (such as electrons or protons)
- ❑ An electric **current** is the rate of flow of electric charge past a point or region. In electric circuits this charge is often carried by electrons moving through a wire.
- ❑ **Voltage**, also called electromotive force, is the potential difference in charge between two points in an electrical field
- ❑ **It results in Current**
- ❑ There are two **types of current** used widely:
 - **Direct current (DC)**, in which electrons flow in one direction. **DC** power is widely **used in** low voltage applications such as charging batteries, automotive applications, aircraft applications and low current applications. Solar panels produce **DC** power
 - **Alternating current, (AC)** in which the electric charge changes direction periodically. **Household** outlets are Alternating Current



Importance of Electricity

- Electricity has many uses in our day to day life. It is used for lighting rooms, working fans and domestic appliances like using electric stoves, AC and more.
- In factories, large machines works on electricity.
- One cannot imagine comfort without electricity. All hospitals, agriculture, cinema houses, educational institutes, railways, business, entertainments and many more depends upon electricity.
- Hence, electricity plays a wide role in the progress of any nation.



Some common terms used

- > **Volts** : Electromotive force or potential difference, expressed in volts(V)
- > **W: Watt** is the unit of power. One **watt** is defined as the energy consumption rate of one joule per second. $1W = 1J / 1s$. One **watt** is also defined as the current flow of one ampere with voltage of one volt.
It is named after James **Watt**, the inventor of the steam engine.
- > **kW: 1000 Watt**
- > **kWh**: The **kilowatt-hour** is a unit of energy equal to 3600 kilojoules (3.6 megajoules). 1 **kWh** equals one hour of electricity usage at a rate of 1 **kW**, and thus the 2 **kW** appliance would consume 2 **kWh** in one hour, or 1 **kWh** in half an hour.
- > The equation is simply **kW** x time = **kWh**
- > The **kilowatt-hour** is commonly used as a billing unit for energy delivered to consumers by electric utilities.

Some common terms used

MCB: Miniature circuit breaker : It automatically switches off electrical circuit during an abnormal condition or overload of the network. Nowadays we use an **MCB** in low voltage electrical network instead of a fuse

SP-MCB:A **Single Pole Breaker** is used with a typical 120v circuit, having one hot wire and one neutral wire.

DP-MCB : However, a **Double Pole Breaker** is used with a typical 220v circuit (like for a dryer or heater) having two hot wires. If there is a short circuit to either hot wire, both poles are ganged together so both trip together

Based on the number of poles, the breakers are classified as : **SP** –Single Pole, **SPN** – Single Pole and Neutral, **DP** – Double pole, **TP** – Triple Pole, **TPN** – Triple Pole and Neutral, **4P** – Four Pole.

ELCB: An **Earth-Leakage Circuit Breaker (ELCB)** is a safety device used in electrical installations with high Earth impedance to prevent shock. It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected.

PSPCL: Punjab State Power Corporation Limited, the agency which supplies electric power in Punjab



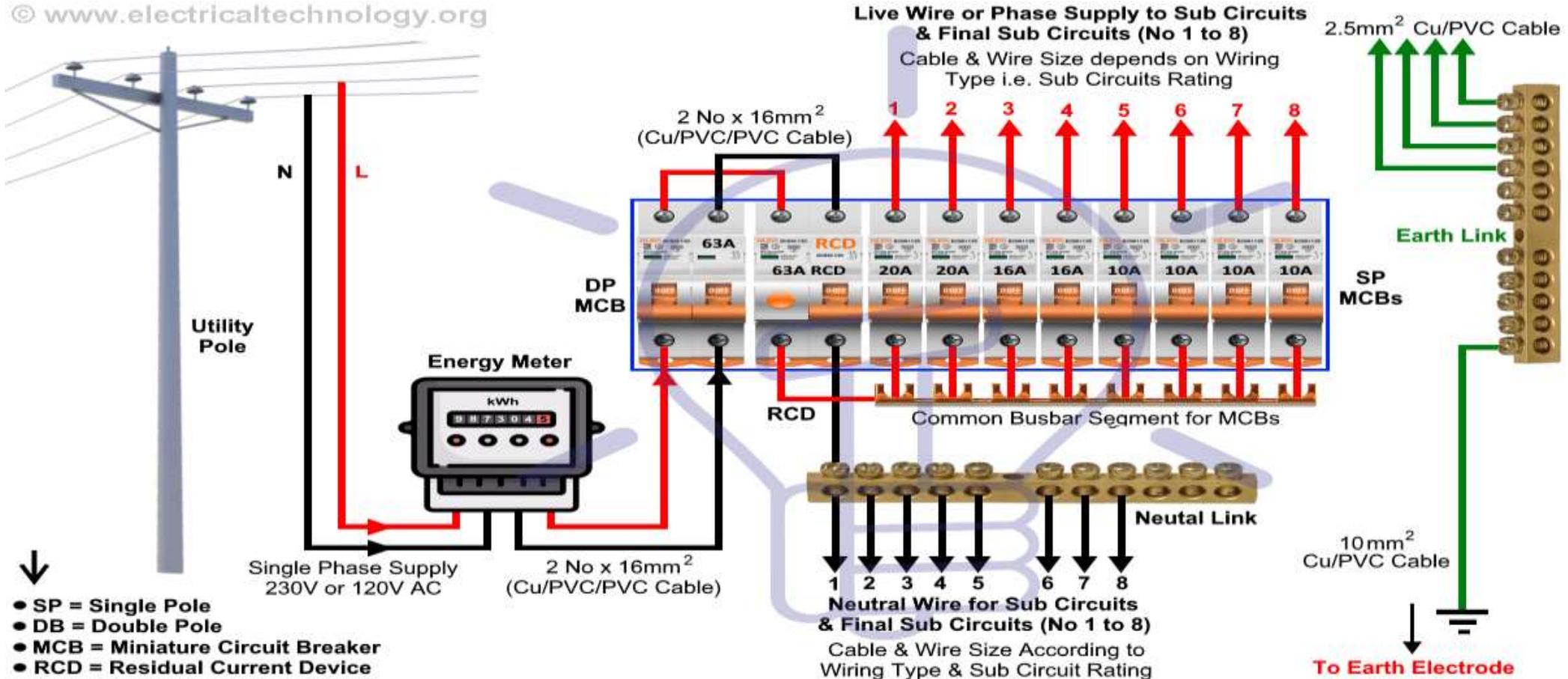
House Wiring (Single Phase)

- Single phase supply consists of one phase wire called hot wire and one neutral wire connected in Energy meter by PSPCL as input supply 220V.
- The output 220V supply is taken from Energy meter to MCB distribution box.
- ELCB, DP MCB / Isolator are used as main control.
- Number of SP-MCBs are installed in MCB Box to provide phase to individual switch board of rooms etc. in a house.
- Neutral wire from MCB Box neutral link is connected to each switch board socket and other loads.
- Switches are installed on switch board of each room to operate its respective load i.e. fan, light and TV, fridge, press, washing machine etc. through sockets.
- Any load (single phase) when connected with 220 V supply duly controlled by switch is called a circuit.



House Wiring (Single Phase) Wiring Diagram

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- SP = Single Pole
- DB = Double Pole
- MCB = Miniature Circuit Breaker
- RCD = Residual Current Device

Wiring of the Distribution Board with RCD (Single Phase Supply)
(From Utility Pole & Energy Meter to the Consumer Unit)



Circuit

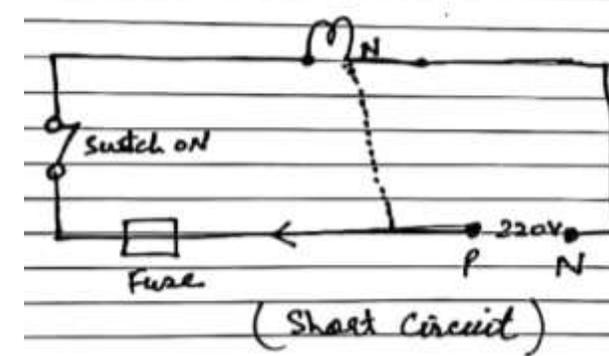
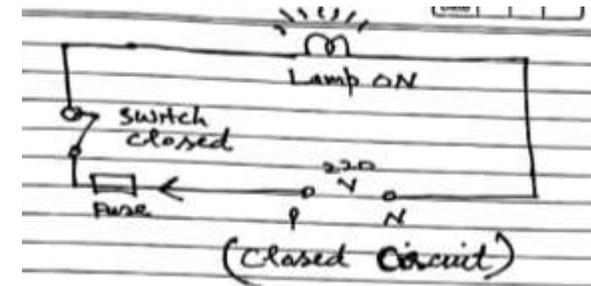
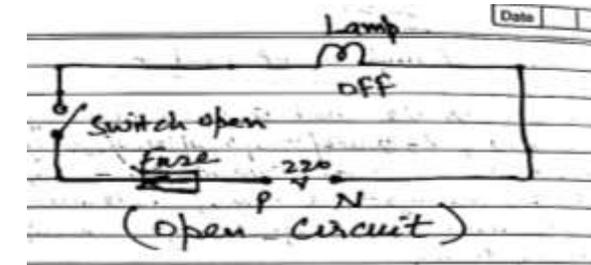
- Following load point are usually provided in each room:
 - Tube lights
 - Fan
 - Lamp Point/s
 - Sockets
 - TV
 - AC etc.

Each load / point (on/off) is controlled by its switch connected through wire/s, MCB / fuse, etc. which makes a circuit.



Types of Circuit

- **Open circuit:** Circuit is open when the switch is not closed, lamp is OFF in this circuit.
- **Closed circuit:** Circuit is closed when the switch is closed, now lamp is ON
- **Short circuit:** When any (+) wire or (-) wire breaks and it gets connected with opposite polarity, the circuit is called short circuit. It is abnormal condition and not desired to happen in any electric circuit. Without proper selection of safety, it may cause damage to costly items, wire, switches, etc.



General Items required as per load

- PVC wires: Generally 4.0 mm², 2.5 mm², 1.5 mm², 1.0 mm², 0.75
- MCB distribution Board: 6 Way, 8W, 10W, 12W, 16W
- MCB's: 6 AMP, 10A, 16A, 20A, 25A, 32A, (SP/SPN)
- RCCB or ELCB: 16A, 25A, 32A
- Switches: 6Amp, 16 Amp, 20 Amp
- Sockets: 5 Pin 6 Amp, 6 Pin-16Amp, 20A, 25A, 32A
- Bell Switch: 6Amp
- 2-Way Switch: 6 Amp
- Various loads in rooms
- DP Isolator, etc.



Functions of different items used in house wiring

- **Energy meter:** The meter is installed by PSPCL to charge electricity being consumed by consumer. The unit rate is fixed by Govt., units are consumed by consumer as per their load / requirements and has to pay to Govt.

1 Unit = 1000 Watt x 1 hr. OR 1 kwh

E.g. if we operate the following per day

▪ Ceiling fans – (5Nos. x 100W each) x 8 hrs.	=	4000 Wh
▪ Geyser - (1 No. x 1500 W) x 1 hr.	=	1500 Wh
▪ Tube Lights – (10 Nos. x 40 W each) x 8 hrs.	=	3200 Wh
▪ Total	=	8700 Wh
		OR 8.7 kwh OR 8.7 units

- Say Unit Rate is Rs.10/-

Per day Expense: (8.7 units x Rs.10/-) = Rs.87.00

Monthly Expense: (Rs.87.00 x 30 days) = Rs.2610/-



Residual Current Circuit Breaker (RCCB)/ Earth Leakage Circuit Breaker (ELCB)



- Residual Current Circuit Breaker (RCCB) is a device which provides protection in an electric circuit in case of overload, short circuit and earth fault. Usually, it is to be used as a main in the MCB distribution board.
- Earth Leakage Circuit Breaker (ELCB) is a protection device and used for protection of electric circuit and humans from electric shock. e.g. when any item / equipment body comes in contact with hot line or due to any insulation failure.
- There is a coil, bimetal and hammer arrangement inside this device, which operates at its designed value without interrupting the circuit under normal condition.



- When some fault arises, the circuit becomes abnormal and more current passes through the coils, bimetal strips etc. The nature of bimetal is to expand when it gets hot. So when, more current from the designed valve passes through it, it expands and operates hammer due to which the matched contacts get stuck to each other. Thus, the circuit is opened which provides protection to circuit / human, etc.
- It is important to note that 'Earthing' must done in house wiring and wiring should be of good quality to protect humans from electric shock.
- Deaths due to shock from electrical appliances like, cooler, press, washing machine and other apparatus being used in normal life has been observed many times. To prevent this wiring should be of good quality and high standard.



Double Pole (DP) or Single Pole and Neutral Miniature Circuit Board (SPN MCB)

- DP MCB can be used for 2-Phase supply or One pole for phase and other pole for neutral
- DP/SPN MCB can be used for phase and neutral.
- DP/SPN MCB can be used as main switch in MCB Distribution Board.
- Actually MCB is a modern device and has replaced the use of fuse in electric circuit due to more safety. MCB and fuse are protection devices.
- There were limitations and lack of knowledge to select the proper size fuse wire to meet the required protections while replacing burnt fuse wire. MCBs have overcome this limitation and there is no need to put any fuse wire because MCB trips (off) when there is any short circuit / over loading in the circuit.
- It does not restart (get ON) until fault is removed, thus protecting circuit.
- One should be careful to select proper rating of devices used in the CKT to achieve protection in electric circuit.
- Single Pole(SP) MCBs have the same role, it is used for single phase supply.



DP Isolator

- It looks like a DP-MCB and is commonly used as a main switch in a house MCB D Box.
- As its name is isolator, it can switch ON & OFF load just like ordinary switches do.
- There is no tripping arrangement in this device, so no protection can be achieved from this.
- Being much cheaper from DP MCB, it is commonly used as a main switch of house, as independent MCB's(SP) are always available roomwise / loadwise in the MCB Box.
- DP Isolator is available in the rating 16A, 20A, 25A,32 A and 63 Amp.
- A proper selection of DP Isolator is required to meet the load requirement.



Poly Vinyl Chloride (PVC) Wires

- Generally PVC copper flexible wires are used in wiring. PVC is an insulating material covering copper thin wires inside it.
- Generally, 220 V is available for single phase supply and wire insulation is rated for minimum 660 V or 1100 V.
- Good quality wires are of FR/FRLS, which are fire retardant and super quality wires are both, fire retardant and low smoke.
- Now-a-days, flexible PVC wires copper are used in the sizes 0.75 mm², 1.0 mm², 1.5 mm², 2.5 mm², 4.0 mm².
- For economical wiring, it is desired to calculate total load of house, rooms, etc. to select proper size of wire to be used.
- Normally, 0.75 mm² wire is used as Earth wire. 1.0 mm² can be withstand 1KW load (6 Amp.). 1.5 mm² can be used for 1.5 KW load (7-8 Amp.) and 2.5 mm² for 2.5 KW load (16-17 Amp.).



Contd.



Poly Vinyl Chloride (PVC) Wires

- In past , PVC copper wire stranded type conductor was used for wiring and their sizes were 3x22 SWG, 7x16 SWG, 3x20 SWG, 1x18 SWG.
- 3x22 SWG means 3 wire copper, each of 22 Gauge covered with PVC insulation.
- Being not flexible, it was difficult to draw them through concealed conduit pipes and also, its replacement was very difficult. So, flexible PVC copper wires are now widely used.
- Current carrying capacity of flexible wires is more, hence, it does not heat up.
- It is suggested to use always branded, ISI marked wires only and cheap wires should not be used.



PVC Conduit Pipes

- In these pipes, PVC wire is drawn to various locations of house through roof ceiling, walls, ground etc.
- Generally, 25 mm heavy duty (ISI marked) pipe should be laid in Lanter during construction. If ignored, the pipe may cracked and civil (cement, sand, concrete, etc.)material being used during construction of lanter may enter the pipe and block its path for drawing wires.
- For walls, medium weight pipe can be used to reduce the expense.
- All concealed light boxes, fan boxes and other boxes should be properly tied after laying pipes with steel wires with bars. All unwanted holes should be covered with polythene etc.
- It is always suggested to use 60-65% diameter pipe for laying/ drawing wires through it for long life of system while making provision for future use, if required.
- The concealed layout of pipes through lanter should be according to the size of room where one should know how many fans, lights, etc. shall be in use by owner.
- Fan boxes with heavy hooks should be used always.
- All switch boxes should be placed / fixed at relevant locations in the rooms at proper height generally, 1.2M from floor level and should be connected with pipe.
- On walls, chipping should be done so that the pipe is approx. 1” deep and covered with plaster, otherwise, cracks will appear on plaster covering the pipe.



Accessories

- 6A switch, 6 Amp. 5 pin socket, 16A/20A switch, 16/20 Amp. 6-pin socket, AC plug point, Fan regulator, Dummy, plates, cover plate, etc., 2 way switch 6Amp / 16 Amp are used generally.
- 6A switch is used for all light points, fan points, etc.
- 6A 5-pin socket is used for refrigerator, Iron, washing machine, tulu pump, LED TV, chimney, exhaust fan, charging mobile, etc.
- 16A/20A switch and 16A/20A 6-pin socket is used for geyser point, heavy washing machine, AC load etc..
- Fan regulator is used to control the speed of fan.
- Cover plate is used to cover all the switches, sockets, etc. with matching colour of walls.
- 2way switches are used for stair case light control and entry gate lights.



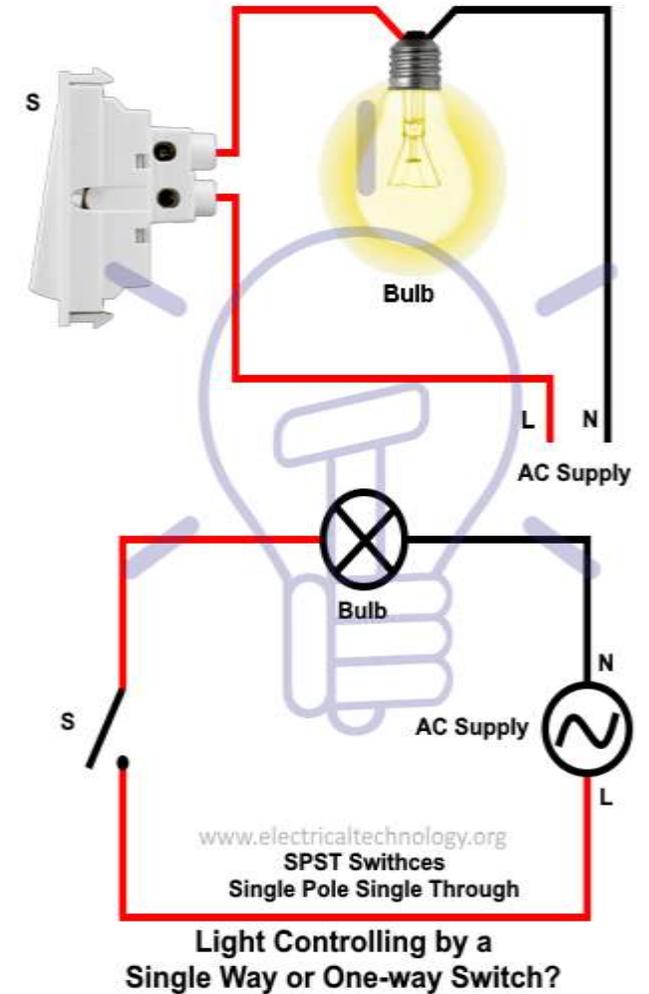
Accessories

- All accessories should be of ISI marked, branded bearing good look and as per choice of owner.
- After completing all wiring connections, it should be checked again for any loose connection. Operation of all points, MCB tripping and ELCB operation should also be checked.
- Undesired nails, screws, cut piece of wires should be removed to avoid any injury.
- Each metal & switch box should be earthed for human safety.
- Joints should be always avoided.
- Mark room wise location on the MCB-DB-MCB's.



Single line diagram for circuits (Single Phase)

- In series wiring, switch is in series with phase and load is always connected in parallel so that phase is given to any load through switch and neutral is connected to its N-point.
- When switch is pressed, phase will reach to load and thus it works. This is the way to connect loads in houses / industries, etc.
- If loads are connected in series in house, total voltage V will be divided in connected loads as per their wattage and current will flow as per maximum wattage of load from the connected loads and so less wattage loads may burnt.
- Voltage should be remain same i.e. 220 volt for all loads to work properly as all single phase lamps, tubes, fridge, iron, geyser, etc. are always rated at 220 volt.
- In parallel wiring, we can switch ON/OFF any load as per our requirement.

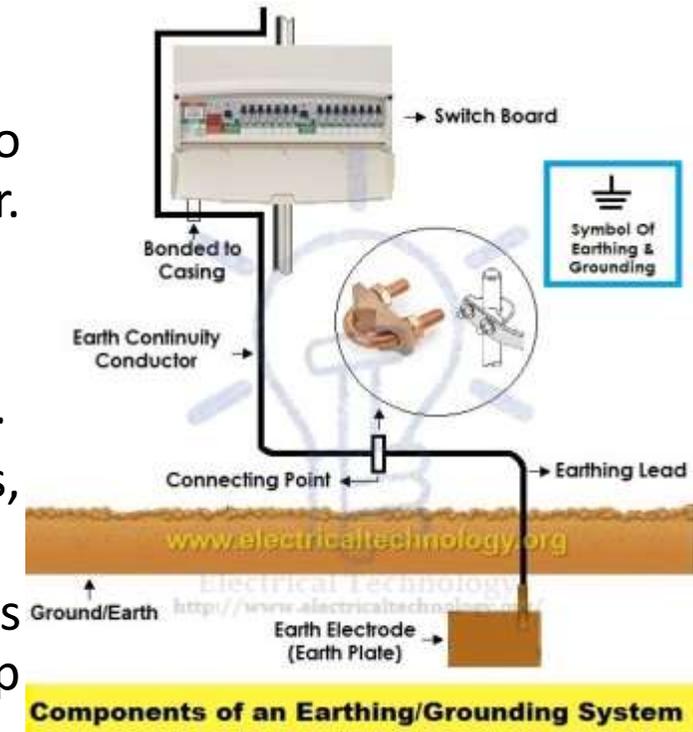


Earthing

- Earthing is very important and compulsory work required to be done during house wiring. It is very useful to protect the human from electric shock.

Procedure

- Digging should be done up to the level of observing wet clay.
- Lay G.I. Pipe or copper plate / copper strip deep in to the ground up to floor level. Fill bore with salt, charcoal, kalmi shora etc. and pour water. This will maintain moisture for long duration.
- A funnel / or pipe mouth may be used for filling water periodically.
- Pit should be connected with MCB Box using copper earth wire / G.I.wire .
- From MCB Box, earth wire should be laid upto all switch boxes, fan boxes, metal boxes, all power sockets, etc.
- During any current leakage, phase contact with any metal box/ apparatus etc, ELCB in MCB Box will sense and will trip the main supply. ELCB can trip at 30 mA to 100 mA current.
- Supply cannot be switched on unless fault is removed.



Tools Used

- Hammer
- Hacksaw & Blade
- Chiesel
- Groove Cutter
- Plier
- Screw Driver/s
- Nose Plier
- Cutter wire
- Cramping tool
- Wire sheather
- Multimeter
- Voltmeter
- Ampere meter
- Megger
- Earth tester
- Bocky
- Lamp Tester
- Testing Pen
- Drill (Hilty Type) M/c Handheld
- Slow speed hand drill machine
- Level Check (water level)
- 30 M tape roll
- 5 M tape roll
- Knife
- Steel Wire
- Continuity Tester
- Safety belts
- Helmet
- Safety Shoes
- Insulating Gloves
- Goggles
- Mask
- Tool Box
- Adjustable Wrench



Some Important Tips

- Tools should be kept neat and clean.
- Tools should be kept in proper way / sections. PVC sleeves on the handles of plier should not be used if found cracked.
- Tips ends of screw driver should be proper.
- Never use test pen on high voltage, for tightening of screws, etc..
- Do not believe on test pen indicator, please use test lamp to ascertain the supply.
- Do not use plier as a hammer.
- Do not give / bypass tools from front to subordinates, it may hurt.
- Use proper tools for proper work.
- Do not gossips, be cool, do not hurry up while doing electric works.
- Use simple words, signals with one another to seek help, instruction, guidance, etc.
- Do not be over confident, check your work and if any doubt, please clear and get help from someone.



Contd.

Some Important Tips

- Do not use mobile earphones / mobile phones frequently.
- Do not use poor condition ladder, tools etc.
- Use safety belts for more heights.
- Use safety shoes. Do not use old shoes, that may become slippery.
- Do not wear loose clothes.
- Always discuss with one another, make plan and act according to plan.
- Do not throw your tools.
- Clean work place and your hands, etc.



Calculation of Current and Selection of Items

- All electrical/electronic appliances needs to display voltage and current rating compulsory e.g
Voltage: 220 V, Power: 9Watt/15W/40W/100W/250W/1500W/2500W, Frequency: 50HZ, Rated Current-In: as per load, Manufacturer name / Trade mark: ISI mark with CM/L No., Power Factor: 0.8 or 0.9, Made in India.
- The selection of wires, switches, MCB's, Main MCB, plug tops etc. depends upon the current to be drawn by load. E.g.

Power	:	1500W (AC load)			
Voltage	:	220 Volt			
Current	:	$\frac{\text{Power}}{\text{Voltage} \times \text{P.F.}}$	=	$\frac{1500}{220 \times 0.8}$	= 8.5 Ampere

- Use of items for AC load based upon its current is as under:
 - Switch : 16A - 220V
 - Socket : 16A – 220V
 - Plug Top : 16A – 220V
 - MCB/SPN : 16A – 220V
 - PVC wires : 2.5 mm²



Calculation of Current and Selection of Items

- Load used in the houses are as under:
 - LED Lamps : 0.2W to 40 W are available for houses
 - Fans : 50 W to 100W
 - Geyser : 1500 W to 3000 W
 - AC's : 1500 W to 2500 W
 - Press : 200 W to 300
 - Fridge : 190 W to 300 W



THANKS



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