# Electrical Installation

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# What is fuse?

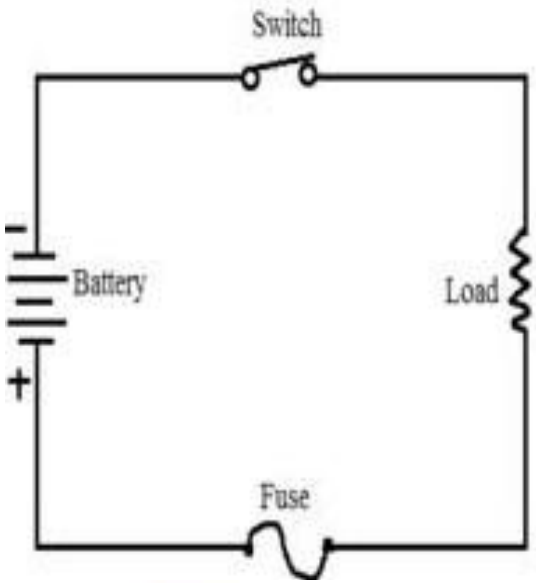
- Fuses are a type of over-current protection device. The essential component is a metal wire or strip that melts when too much current flows, which interrupts the circuit in which it is connected. Short circuits, overloads or device failures are often the reason for excessive current.
- Fuses serve two main purposes: 1) To protect components and equipment from costly damage caused by over-currents. 2) To isolate sub-systems from the main system once a fault has occurred.
- There are thousands of different styles of fuses available in the world. The primary way to group them is by Low Voltage (Voltage Rating less than or equal to 1500V)or Medium Voltage (Voltage Rating between 1500V and 40.5kV).

# Working Principle of Fuse

The working principle of the fuse is “heating consequence of the current”. It is fabricated with a lean strip or thread of metallic wire. The connection of the Fuse in an electrical circuit is always in series.

When the too much current is produced due to the heavy flow of current in the electrical circuit, the fuse gets soften and it opens the circuit. The extreme flow of current may direct to the collapse of the wire and prevents the supply.

The fuse can be changed by the new fuse with an appropriate rating. It can be designed with the elements like Cu (copper), Zn (zinc), Al (aluminum) and Ag (silver). They also perform like a circuit breaker for breaking the circuit while the abrupt fault happens in the circuit. This works like a safety measure or protector for humans from risks. Like this, the fuse works.




# What is MCB?

A **Miniature Circuit Breaker** (**MCB**) is an automatically operated electrical switch used to protect low voltage electrical circuits from damage caused by excess current from an overload or short circuit. MCBs are typically rated up to a current up to 125 A.

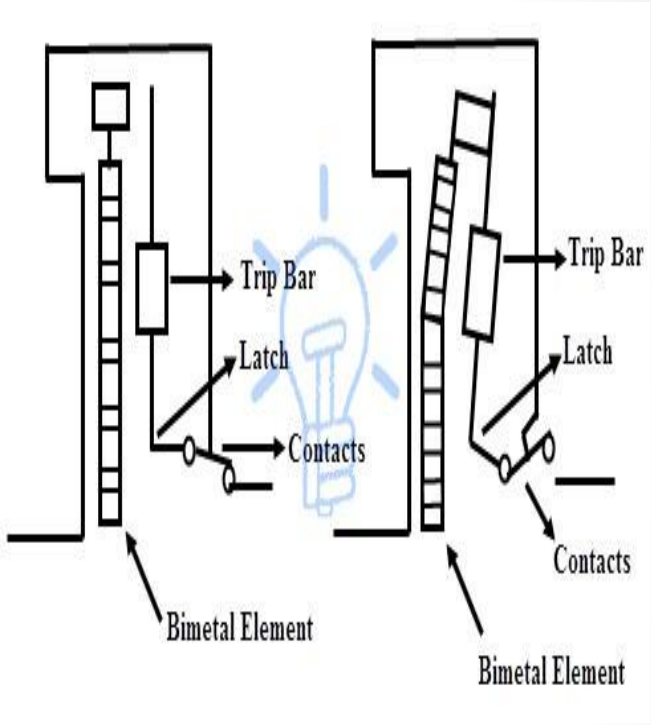
**Fuse vs MCB**

- MCB automatically switches off the electrical circuit during the abnormal conditions of the network (both overload and fault conditions).
- As the switch operating knob comes at its off position during tripping, the faulty zone of the electrical circuit can easily be identified. But in case of a fuse, the fuse wire should be checked by opening fuse grip or cutout from fuse base, for confirming the blow of fuse wire.
- Quick restoration of supply can not be possible in case of fuse, as fuses have to be rewirable or replaced for restoring the supply. But in the case of an MCB, quick restoration is possible by (literally) flipping a switch.
- The handling of an MCB is more electrically safe than a fuse.
- MCBs can be controlled remotely, whereas fuses can not.

# Working & Operation of MCB

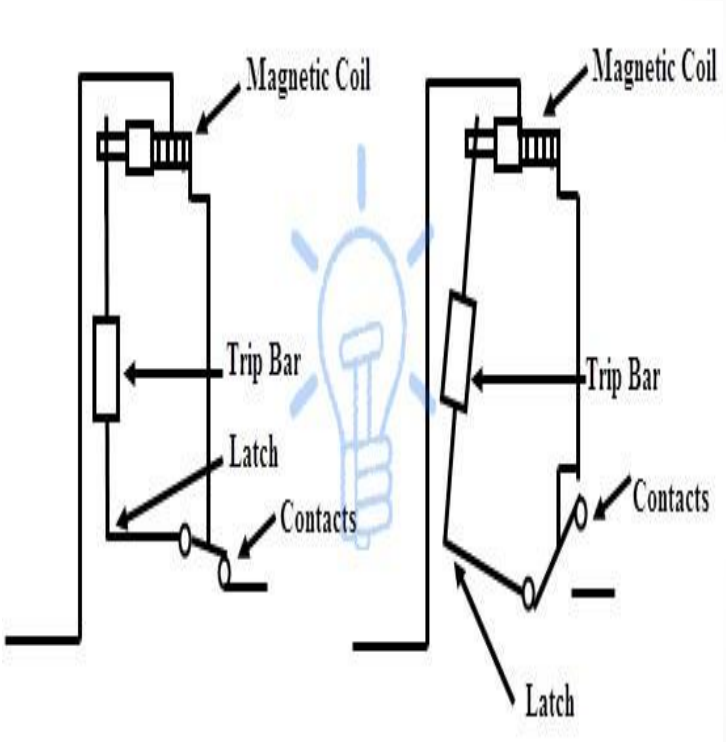
- Under normal working conditions, MCB operates as a switch (manual one) to make the circuit ON or OFF. Under overload or short circuit condition, it automatically operates or trips so that current interruption takes place in the load circuit. The visual indication of this trip can be observed by automatic movement of the operating knob to OFF position. This automatic operation MCB can be obtained in two ways as we have seen in MCB construction; those are magnetic tripping and thermal tripping.

- Under overload condition, the current through the bimetal causes to raise the temperature of it. The heat generated within the bimetal itself enough to cause deflection due to thermal expansion of metals. This deflection further releases the trip latch and hence contacts get separated. In some MCBs, magnetic field generated by the coil causes develop pull on bimetal such that it deflection activates the tripping mechanism.



# Working & Operation of MCB

- Under short circuit or heavy overload conditions, magnetic tripping arrangement comes into the picture. Under normal working condition, the slug is held in a position by light spring because magnetic field generated by the coil is not sufficient to attract the latch. When a fault current flows, the magnetic field generated by the coil is sufficient to overcome the spring force holding slug in position. And hence slug moves and then actuate the tripping mechanism.
- A combination of both magnetic and thermal tripping mechanisms are implemented in most of MCBs. In both magnetic and thermal tripping operations, an arc is formed when the contacts start separating. This arc is then forced into arc splitter plates via arc runner. These arc splitter plates are also called arc chutes where arc is formed into a series of arcs and at the same time energy extracted and cools it. Hence this arrangement achieves the arc extinction.



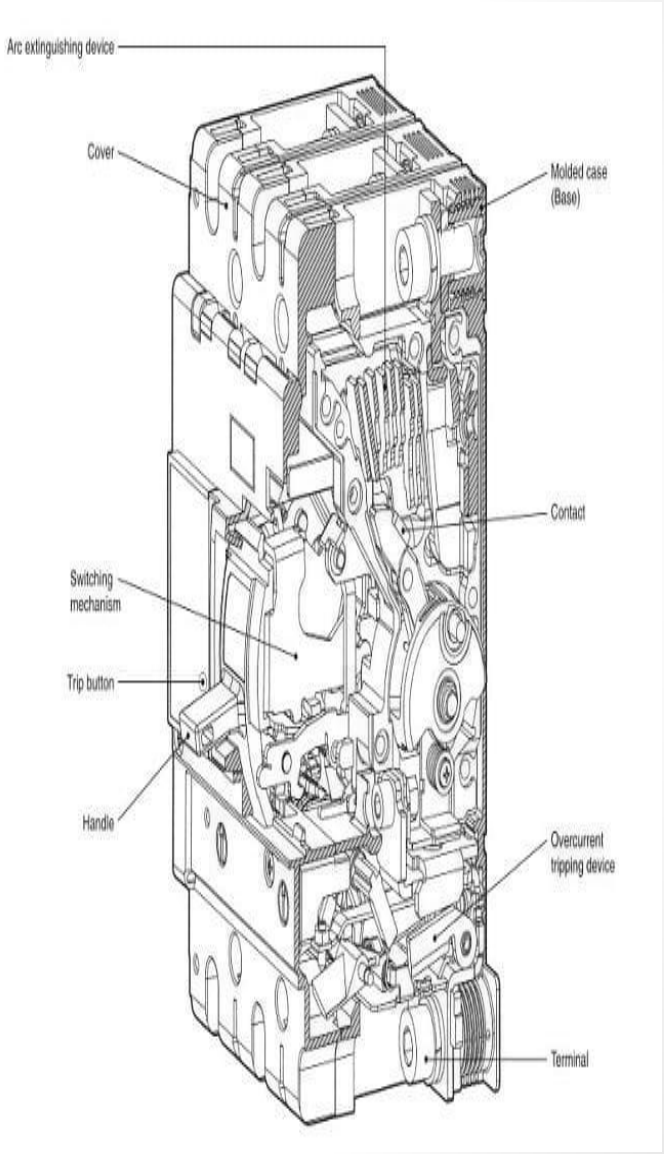
# Moulded Case Circuit Breaker (MCCB)

A moulded case circuit breaker (MCCB) is a type of electrical protection device that is used to protect the electrical circuit from excessive current, which can cause overload or short circuit. With a current rating of up to 2500A, MCCBs can be used for a wide range of voltages and frequencies with adjustable trip settings. These breakers are used instead of miniature circuit breakers (MCBs) in large scale PV systems for system isolation and protection purposes.

- The MCCB uses a temperature sensitive device (the thermal element) with a current sensitive electromagnetic device (the magnetic element) to provide the trip mechanism for protection and isolation purposes. This enables the MCCB to provide:
- Overload Protection,
- Electrical Fault Protection against short circuit currents, and
- Electrical Switch for disconnection.

# Construction of MCCB

**A Moulded case circuit breaker** generally have
a **thermal element for overcurrent** and
a **magnetic element for short circuit release** which has to operate faster.
Generally constructed of two pieces of heavy-duty electrically insulated plastic, these two halves are riveted together to form the whole. Inside the plastic shell is a series of thermal elements and a spring-loaded trigger.
When the thermal element gets too warm, from an overcurrent situation, the spring trips, which in turn will shut off the electrical circuit.
The major components of MCCB include
**a mechanism which makes and breaks a contact** through a toggle link mechanism having a spring which can store tripping force,
an **overcurrent trip device** which reacts with overcurrent and short circuit current and trips MCCB,
an **Arc extinguishing device** which extinguishes the arc generated upon current interruption,
**terminals** for connecting wires and conductors,
**contacts** which open and close the circuit and
a **moulded case** in which these componentS are integrated and compactly contained.



# Earth Leakage Circuit Breaker (ELCB)

An ECLB is one kind of safety device used for installing an electrical device with high earth impedance to avoid shock. These devices identify small stray voltages of the electrical device on the metal enclosures and intrude the circuit if a dangerous voltage is identified. The main purpose of Earth leakage circuit breaker (ECLB) is to stop damage to humans & animals due to electric shock.

For the protection of human body from the electric shock protective device like fuse or MCB are used. But generally this device are incapable of measuring small current flowing in human body, so requirement is to have a device which can sense small current and cut-off the supply instantly. The device used for this purpose is known as Earth Leakage Circuit Breaker (ELCB).

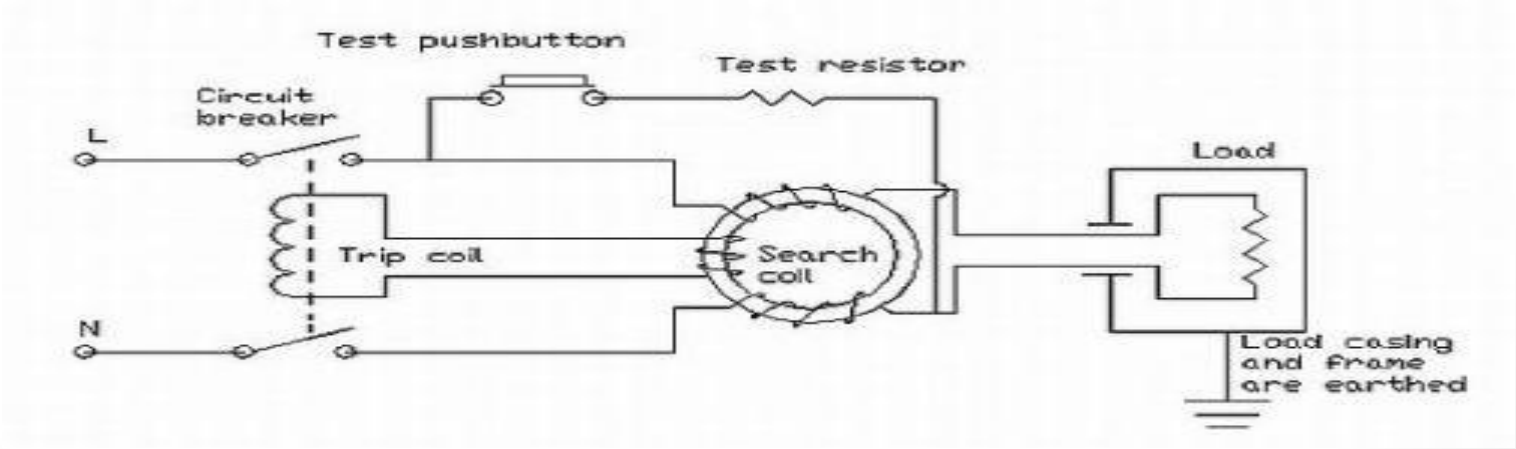
There are two types of Earth Leakage Circuit Breaker (ELCB)

- Voltage Operated ELCB
- Current Operated ELCB

# Working of ELCB

It is current operated device designed to operate when a leakage current exceeds the predefined value. It consists of a operating coil and a trip mechanism which operated the circuit when required. The coil is supplied through 1-Φ supply so current in phase & neutral wire will be same.

This current will produce flux linkages same in magnitude but of opposite direction. This will result zero net flux in tripping coil of relay. When fault or leakage current exceeds the limit higher current will flow in phase conductor than neutral current. Resultant flux now is out of balance in tripping coil of relay. Difference of flux will induce emf in the coil which opens the contact of ELCB and isolate the circuit from the supply.



# INTRODUCTION TO WIRES

- There are mainly 6 types of wires are there.
- vulcanised indian rubber wire (V.I.R)
- tough rubber sheathed wire (T.R.S)
- poly vinyl chloride wire (P.V.C.)
- Lead alloy sheathed wire
- weather proof wires
- flexible wire

# V.I.R (Vulcanised Indian Rubber) wires.

- A VIR wire mainly consists of a tinned conductor having rubber coating.
- Tinning of conductor prevents the sticking of rubber to the conductor.
- Thickness of rubber mainly depends on the operating voltage to which wire is designed.
- A cotton bradding is done over the rubber insulations to protect the conductor against the moisture.
- Finally the wire is finished with wax for cleanliness.
- Nowadays these wires are not used since a better quality wires are available at a cheaper rate.

# T.R.S. (Tough Rubber Sheathed) wires.

- This type of wire is a modification of V.I.R. wire. It consist of the ordinary rubber coated conductors with an additional sheath of tough rubber.
- This layer provides better protection against moisture and wear and tear. Also it provides an extra insulation.
- These wires are generally available in single conductor, two conductors or three conductors.

# P.V.C. (Poly Vinyl Chloride) wires.

- This is the most commonly used wire for wiring purpose.
- Conductor is insulated by poly vinyl chloride (insulating material).
- P.V.S. has following properties:
- 1. Moisture proof.
- 2.Tough.
- 3.Durable.
- 4.Chemically inert.
- But it softens at high temperatures therefore not suitable for connection to heating appliances.

# Lead alloy sheathed wires.

- The ordinary wires can be used only at dry places but for damp places these wires are covered with continuous lead sheaths.
- The layer of lead covering is very thin like 0.12 cm thick.
- These wires provides little mechanical protections to the wires.

# Weather proof wires.

- These types of wires are used outdoor i.e. providing a service connection from overhead line to building etc.
- In this type of wire the conductor is not tinned and the conductor is covered with three braids of fibrous yarn and saturated with water proof compound.

# Flexible wires.

- These wires consists of number of strands instead of a single conductor. (Strand is a very thin conductor).
- The conductor is insulated with P.V.C. material.
- These wires are very useful for household portable appliances where flexibility of wire is more important.
- Typical specifications
- 55/.01mm(55 strands of 0.1mm diameter), maximum current 6A,used for household purposes.

# Systems Of Wiring

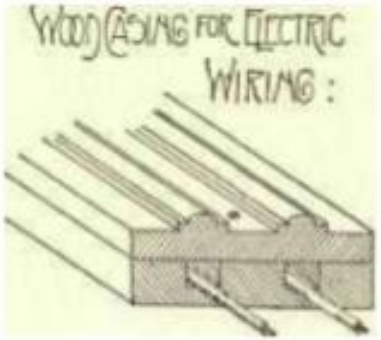
1. Cleat Wiring
2. Wooden casing and capping Wiring.
3. C.T.S OR T.R.S Wiring.
4. Lead sheathed or metal sheathed Wiring.
5. Conduit Wiring.

# Cleat Wiring

- Cleat wiring is normally used for temporary wiring purposes.
- As a permanent system of wiring, it is not preferred in domestic premises.
- It is quite suitable for taking a temporary connection, such as for function, marriages, etc.

# Wooden Casing and Capping Wiring

- This is one of cheapest types of wiring and is commonly used for house wiring.
- The cable used in this type of wiring is either V.I.R or P.V.C or any other approved insulated cables



# C.T.S or T.R.S Wiring

- This type of wiring is also used for house wiring and is quite cheap.
- Cab tyre sheathed wire or rubber sheathed wire is normally used as conductor for this wiring.
- The wires are run on the teak wooden battens which are fixed on the wall or the ceiling by means of screws and wooden pluge.

# Metal Sheathed Wiring

- This type of wiring is also adopted for low voltage installation.
- This system is more or less similar to C.T.S wiring except that the cable used is different in this wiring system.
- In this system conductors used are insulated with V.I.R and then covered with an outer sheath of lead aluminium alloy containing 95% lead and 5% aluminium.

# Conduit Wiring

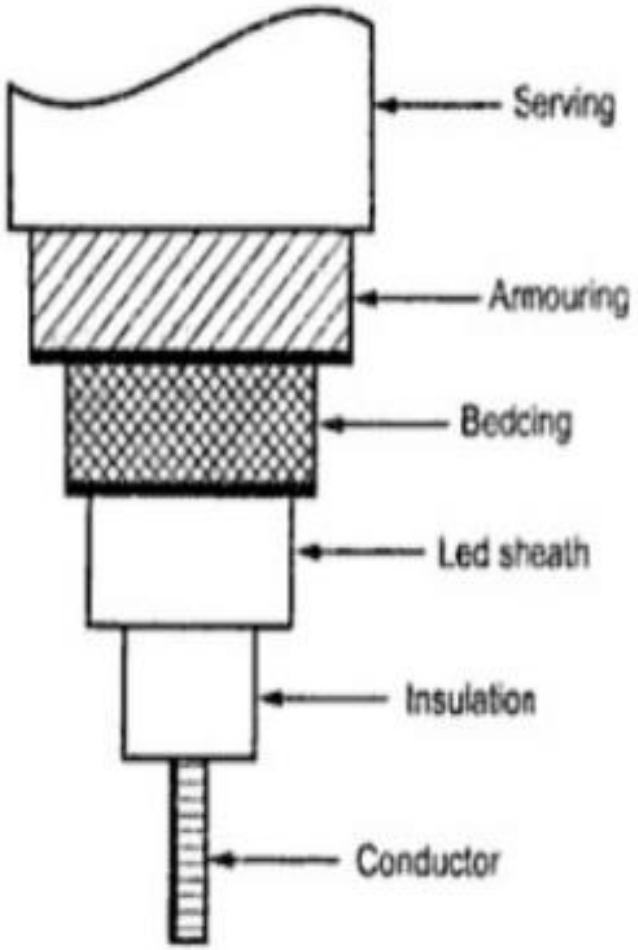
- Conduit wiring system is the best for domestic and commercial installations.
- It provides proper protection to the installation against fire hazards, shock, mechanical damage and dampness.
- The cable used in this system is either V.I.R or P.V.C insulated qand is run in mild steel or P.V.C pipes called as conduits.

# INRODUCTION TO CABLES.

- A power cable is an assembly of two or more electrical conductors, usually held together with an overall sheath. The assembly is used for transmission of electrical power. Power cables may be installed as permanent wiring within buildings, buried in the ground, run overhead, or exposed.
- Flexible power cables are used for portable devices, mobile tools and machinery.

# GENERAL CONSTRUCTION.

- 1. Conductor or Core.
- 2. Insulation.
- 3. Metallic Sheath.
- 4. Bedding.
- 5. Armouring.
- 6. Serving.



# Types of Cables

## On basis of conductors

- Single core cable
- Multi core cable

## On basis of no. of voltage grading

- 250/440 volt cables
- 650/1100 volt cables

## On basis of conductor used

- Copper conductor cables
- Aluminium conductor cables

## On basis of insulation

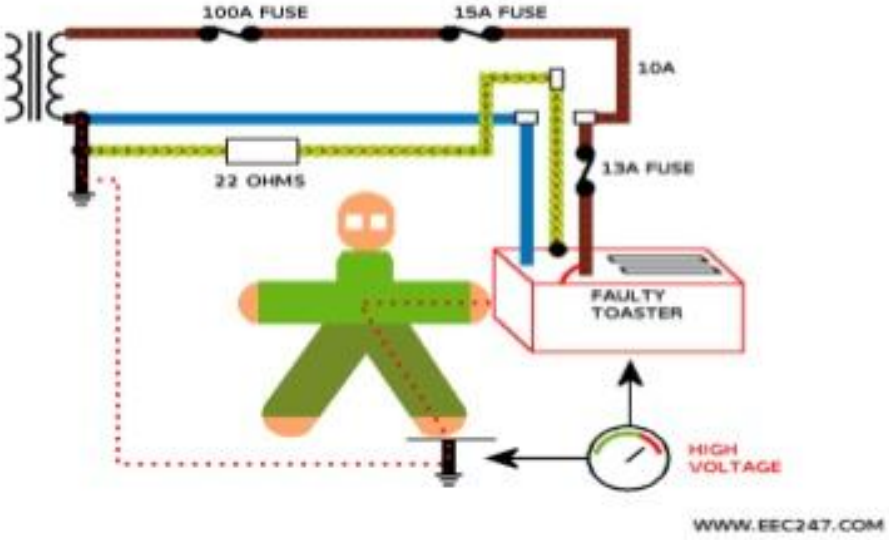
1 VIR insulated Cables
2 TRS/CTS Cables
3 Lead sheathed Cables
4 PVC Cables
5 Weather proof Cables
6 Flexible Chord Cables
7 XLPE Cables

# Concept of Earthing Systems

All the people living or working in residential, commercial and industrial installations, particularly the operators and personnel who are in close operation and contact with electrical systems and machineries, should essentially be protected against possible electrification. **To achieve this protection, earthing system of an installation is defined, designed and installed according to the standard requirements..**

# What Is Earthing

The process of connecting metallic bodies of all the electrical apparatus and equipment to huge mass of earth by a wire having negligible resistance is called Earthing.



# Purpose of Earthing

- To save human life from danger of electrical shock or death by blowing a fuse i.e. To provide an alternative path for the fault current to flow so that it will not endanger the user
- To protect buildings, machinery & appliances under fault conditions ie. To ensure that all exposed conductive parts do not reach a dangerous potential.
- To provide safe path to dissipate lightning and short circuit currents.
- To provide stable platform for operation of sensitive electronic equipments i.e. To maintain the voltage at any part of an electrical system at a known value so as to prevent over current or excessive voltage on the appliances or equipment .
- To provide protection against static electricity from friction

# Electric battery

A **battery** is a device consisting of one or more electrochemical cells with external connections for powering electrical devices such as flashlights, mobile phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode.

| Test Method | | Lead acid | Nickel-based | Li-ion | Primary battery |
|---|---|---|---|---|---|
| ANALOG | **Voltage** | Estimates SoC in open circuit condition. Temperature and active materials within a battery system may cause slight voltage variations. Performance evaluation is not possible. | | | |
| | **Ohmic test** | Identifies heat fail and other defects; cannot do capacity estimation | Correlation exists between resistance and capacity | Low capacity may not affect resistance | Resistance relates to SoC; unique for each battery type |
| | **Full Cycle** | Use sparingly on large batteries | Recommended for small batteries | | N/A |
| | **Rapid-test** | *Time domain* checks resistance, ion flow; *Frequency domain* reads capacity | Internal resistance correlates in part with SoH. | High efficiency enables time and frequency domain | Resistance check with lookup table for diverse batteries possible |
| | **BMS** | Voltage, current and temperature sense to monitor battery | Not practical due to inefficiencies | High efficiency enables coulomb counting | SoC by voltage |
| DIGITAL | **Coulomb counting** | Low charge and discharge efficiency makes this impractical | Not suitable due to low efficiency and high self-discharge | Good for most Li-ion. LiFePO has high self-discharge | Used for critical applications with good results |
| | **Read-and-charge** (RAC) | Not practical because of low charge and discharge efficiency, high self-discharge | | Enabled by high efficiency | N/A |
| | **SOLI** (State-of-life-indicator) | Estimates battery life based on delivered energy. A new battery starts at 100%. Drawing energy consumes the coulomb allotment, prompting battery replacement when zero. Can be applied to all batteries. | | | |

# THANK YOU