सत्यमेव जयते

PARTICIPANT HANDBOOK

Information and Communications Technology

Language: English

COMPUTER HARDWARE ASSISTANT

N·S·D·C National Skill Development Corporation

Orion Edutech®
ISO 9001:2015 CERTIFIED
Funded Partner of NSDC

COMPUTER HARDWARE ASSISTANT

কম্পিউটার হার্ডওয়্যার সহায়ক

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Welcome Note

Dear Participant,

Welcome to the "Computer Hardware Assistant" training programme. After completion of the training, Participants would be able to:

1. Plan and prepare for installation
2. Install software/equipment/device system
3. Plan and prepare for diagnosis of faults of computer systems
4. Diagnose faults of computer systems
5. Repair defects in computer systems
6. Test systems
7. Plan and prepare for configuration
8. Configure computer systems
9. Inspect and test configured computer systems
10. Plan and prepare for the maintenance of computer systems
11. Maintain computer systems
12. Inspect and test configured/repaired computer system

Read each module, log in your key learnings and attempt the worksheet questions in the end.

General Instructions to Trainee

1. Greet your instructor and the other participants when you enter the class.
2. Always be punctual for every class.
3. Be regular. Candidates who fall short of the required attendance will not be certified.
4. Inform your instructor if, for any reason, you need to miss class.
5. Pay attention to what your instructor is saying or showing.
6. If you do not understand something, put up your hand and seek clarification.
7. Make sure you do all the exercises at the end of each module in this book. It will help you understand the concepts better.
8. Practice any new skills you have learnt as many times as possible. Seek the help of your Trainer or co-participant for practice.
9. Take all necessary precautions, as instructed by your Trainer, while working with electricity and with tools.
10. Make sure you are neatly attired and presentable at all times.
11. Participate actively in all the activities, discussions and games during training.
12. Always take bath, wear clean clothes and comb your hair before you come to class.

The three most important words you must always remember and use in your daily conversation are PLEASE, THANK YOU and SORRY.

TABLE OF CONTENTS (COMPUTER HARDWARE ASSISTANT)

CHAPTER - 1
BASIC CONCEPTS OF ELECTRICITY

LEARNING OUTCOMES: 

- Punctuality and Discipline expected of trainees. Course duration, methodology and structure of the training program.
- About the institute and infrastructure.
- Safety in moving and shifting heavy and delicate equipment.
- First aid.
- Artificial respiration.
- Electrical safety.
- Identify specification of types of fuses.
- Identification and specification of type of switches.
- Identification of meter types and measuring range.
- Measure voltage and current using multi-meter (analog-digital).
- Measure DC and AC power using V-I method and using power meter.

PRE-SESSION ACTIVITY

- The Trainer will take the trainees to workshops, labs, offices, stores etc., of the institute for :
  1. Demonstration of safety precaution.
  2. Demo of first aid practice.
  3. Demo of artificial respiration and practice.
  4. Demo of electrical safety precautions.
- The Trainer will show a video session to the Trainees on different types of fuses and switches. After the video session the Trainer will show pictures of different fuses and ask the Trainees to name them.

✓ **About the Institute and Infrastructure:**

Orion stands tall as one of India's largest vocational centres with updated training methodologies and effective course modules. It plays a pivotal role in building sustainable industry-ready quality capacity across urban, suburban, rural, underdeveloped and hill areas not only in India but in various other countries too. Orion Edutech, an NSDC partnered and ISO 9001:2015 certified company, has expansive presence, made-to-order training prospects and curriculum proficiency to cater to both IT and non IT sectors as well as the sectors of Electronics, Travel & Tourism, Retail, Networking, Hospitality, Agriculture, Mobile Laptop Repairing, Healthcare, Apparel Manufacturing and Designing, Hospitality and more.

Safety in moving and shifting heavy and delicate equipment

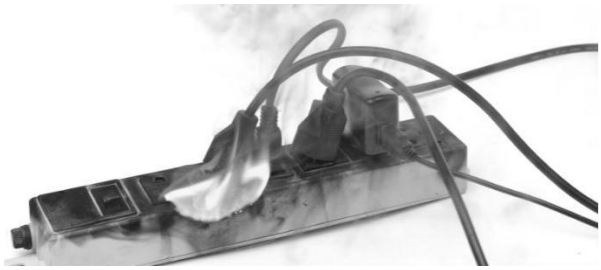
- Avoid lifting materials from the floor or while seated.
- Make use of available handling aids.
- Refrain from using sudden or jerky movements.
- Never lift a load over an obstacle.
- Perform lifts in areas with adequate footing, space and lighting.
- Modify objects and redesign jobs to make moving easier.
- Seek assistance from co-workers.
- Stay in good physical shape.
- Begin lifts close to the body.
- Use containers made of lighter materials.
- Reduce load sizes when possible.
- Do not twist or bend while lifting objects.
- Ensure repetitive, heavy and bulky lifts are not performed.
- Keep lifts between shoulder and knuckle height.
- Use conveyors, slides or chutes to eliminate pushing or pulling.

First aid:

Part of the safety program should be to make sure that all the students are aware of the following:

- Location of the first aid kit.
- Who in the institute is certified to administer first aid?
- Where the closest medical facility is.
- Where to locate the victim's personal information such as emergency contact, allergies, and other pertinent personal information.
- How to give artificial respiration when required.

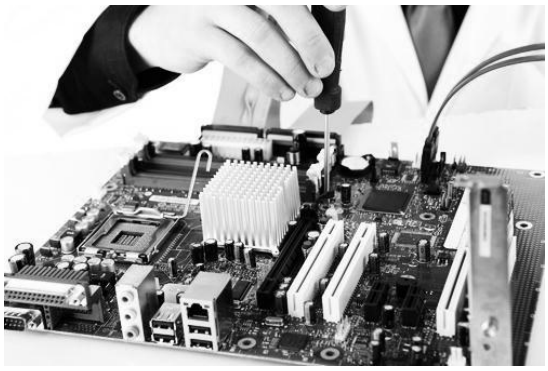
To protect against electrical incidents:



- Even when using a surge protector, make sure the electrical load is not too much for the circuit.
- Avoid overloading outlets with too many appliances. Never plug in more than one high-wattage appliance at a time.
- Unplug appliances when not in use to save energy and minimize the risk of shock and fire.
- Inspect electrical cords once a month to ensure they are not frayed, cracked or otherwise damaged.
- Do not run electrical cords through high-traffic areas, under carpets or across doorways.
- Consider having a licensed electrician install additional outlets where needed, rather than relying on extension cords and power strips.
- Ensure all electrical equipment is certified by a nationally recognized laboratory, and read all manufacturers' instructions carefully.

INTRODUCTION

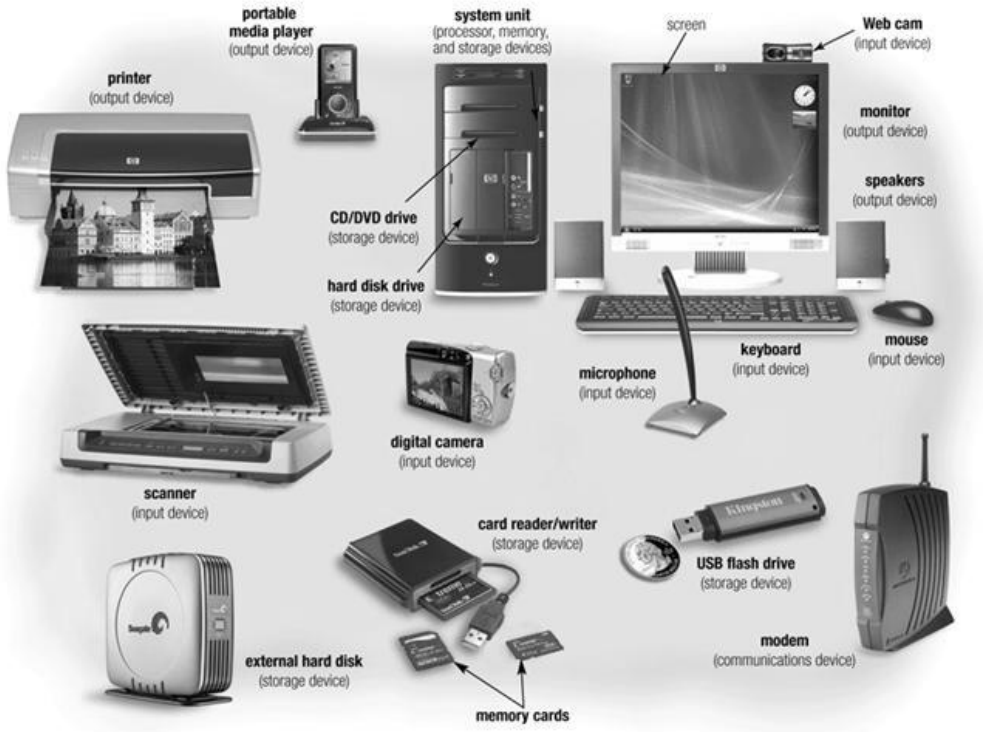
Hardware of a Computer:



The physical elements of a computer are called the Hardware. This is also sometimes called the machinery or the equipment of the computer. Examples of hardware in a computer are the keyboard, the monitor, the mouse and the central processing unit. Computer's hardware cannot be seen as it is not an external element of the computer, but rather an internal one, surrounded by the computer's casing. A computer's hardware is comprised of many different parts, but perhaps the most important of these is the **Motherboard**.

In comparison to software, *hardware is a physical entity*. Hardware and software are interconnected, without software the hardware of a computer has no function. Without the hardware to perform tasks directed by software with the help of the central processing unit, software would be useless.

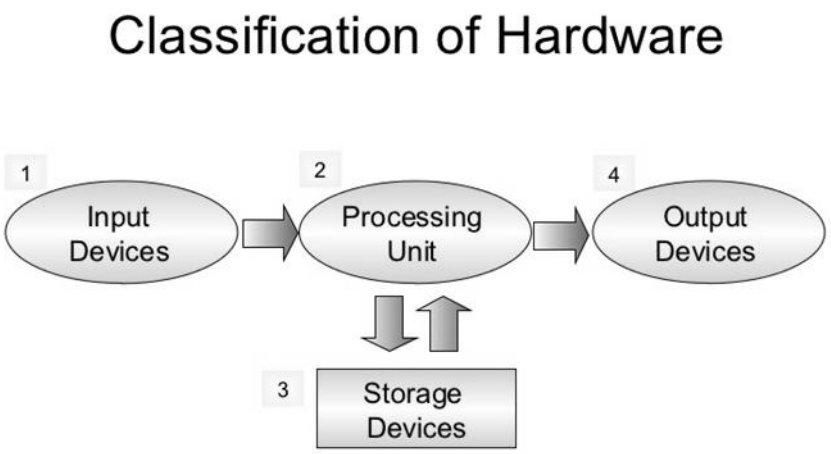
What is the basic architecture of a personal computer?



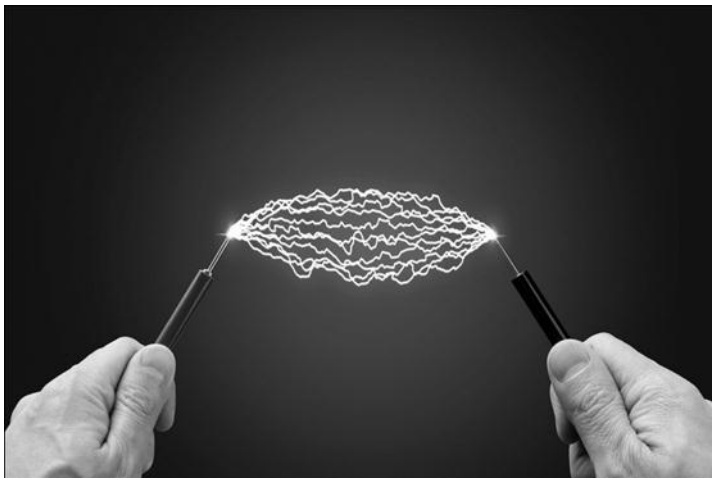
Computer architecture:

Main components of a computer	Multimedia devices	Other peripheral devices
1) computer 2) monitor 3) hard disk/ hard drive 4) keyboard 5) mouse / trackball / touch pad	1) CD-ROM / DVD drive 2) video card 3) soundcard 4) speakers 5) headphones / headset 6) microphone	1) printer 2) scanner 3) CD- burner (CD-recorder, CD-R/CD-RW drive) 4) modem 5) USB flash drive 6) webcam 7) digital camera 8) digital voice recorder 9) camcorder

What are the Classifications of Hardware?



Basic Concepts of Electricity



1.1 What is Electricity?

In the modern world, Electricity is all around us – through the workings of cell phones, computers, lights, soldering irons, and air conditioners etc... Even if you try to escape electricity, it is still at work throughout nature, from the lightning in a thunderstorm to the inside of our body.

Electricity is a natural phenomenon that occurs throughout nature and takes many different forms. Electricity is briefly defined as the flow of electric charge.

1.2 Concept of current and voltage:

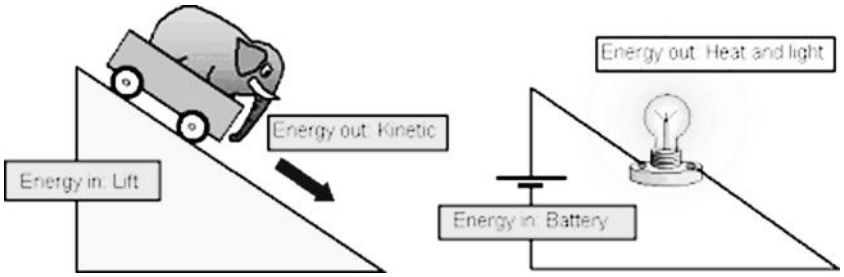
All basic electrical or electronic circuits consist of three different, but very much related electrical quantities which are:

Voltage, (v),

Current, (i) and

Resistance (Ω).

1.2.1 Electrical Voltage:



Voltage, (V) is the potential energy of an electrical supply stored in the form of an electrical charge. Voltage can be thought of as the force that pushes electrons through a conductor and the greater the voltage the greater is its ability to "push" the electrons through a given circuit. As energy has the ability to do work this potential energy can be described as the work required in joules to move electrons in the form of an electrical current around a circuit from one point or node to another.

What is joules?

*(*the standard unit of work or energy in the International System of Units (SI), equal to the work done by a force of one Newton when its point of application moves through a distance of one meter in the direction of the force: equivalent to 10^7ergs and one watt-second. ... Also called Newton-meter)

The difference in voltage between any two points, connections or junctions (called nodes) in a circuit is known as the **Potential Difference**, (p.d.) commonly called the **Voltage Drop**.

The Potential difference between two points is measured in **Volts** with the circuit symbol V, or lowercase "v", although **Energy**, E lowercase "e" is sometimes used to indicate a generated emf (electromotive force). Then the greater the voltage, the greater is the pressure (or pushing force) and the greater is the capacity to do work.

A constant voltage source is called a **DC Voltage** while a voltage that varies periodically with time is called an **AC voltage**. Voltage is measured in volts, with one volt being defined as the electrical pressure required forcing an electrical current of one ampere through a resistance of one Ohm. Voltages are generally expressed in Volts with prefixes used to denote sub-multiples of the voltage such as **micro volts** (μV = 10^{-6} V), **millivolts** (mV = 10^{-3} V) or **kilovolts** (kV = 10^{3} V). Voltage can be either positive or negative.

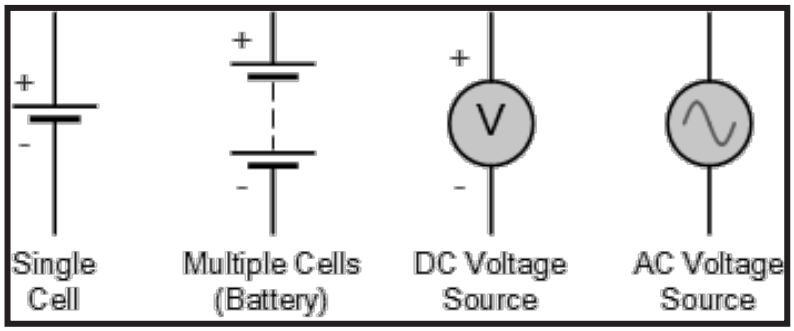
Batteries or power supplies are mostly used to produce a steady D.C. (direct current) voltage source such as 5v, 12v, 24v etc in electronic circuits and systems. While A.C. (alternating current) voltage sources are available for domestic house and industrial power and lighting as well as power transmission.

What is an Ohm?

(The ohm is the standard unit of electrical resistance in the International System of Units (SI). Ohms are also used, when multiplied by imaginary numbers, to denote reactance in alternating-current (AC) and radio-frequency (RF) applications. Reduced to base SI units, one ohm is the equivalent of one kilogram meter squared per second cubed per ampere squared (1 kg times m 2 • s -3 • A -2 . The ohm is also the equivalent of a volt per ampere (V/A))

General electronic circuits operate on low voltage DC battery supplies of between 1.5V and 24V DC. The circuit symbol for a constant voltage source usually given as a battery symbol with a positive, +, and negative, – , sign indicating the direction of the polarity. The circuit symbol for an alternating voltage source is a circle with a sine wave inside.

Voltage Symbols

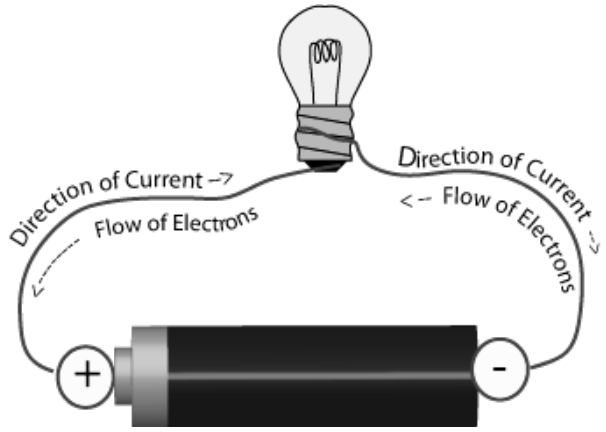


Voltage is always measured as the difference between any two points in a circuit and the voltage between these two points is generally referred to as the "**Voltage drop**".

Note that

Voltage can exist across a circuit without current, but current cannot exist without voltage and as such any voltage source whether DC or AC likes an open or semi-open circuit condition but hates any short circuit condition as this can destroy it.

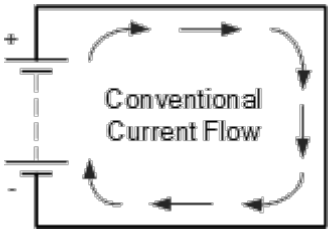
1.2.2 Electric Current



Electrical Current (I) is the movement or flow of electrical charge and is measured in **Amperes**, symbol **i**, for ***intensity***). It is the continuous and uniform flow (called a drift) of electrons (the negative particles of an atom) around a circuit that are being "pushed" by the voltage source. In reality, electrons flow from the negative (-ve) terminal to the positive (+ve) terminal of the supply and for ease of circuit understanding conventional current flow assumes that the current flows from the positive to the negative terminal.

Generally in circuit diagrams, the flow of current through the circuit usually has an arrow associated with the symbol, I, or lowercase "i" to indicate the actual direction of the current flow. However, this arrow usually indicates the direction of conventional current flow and not necessarily the direction of the actual flow.

Conventional Current Flow



In a way, this is the flow of positive charge around a circuit, being positive to negative. The diagram shows the movement of the positive charge (holes) around a closed circuit flowing from the positive terminal of the battery, through the circuit and returns to the negative terminal of the battery. This flow of current from positive to negative is generally known as conventional current flow.

This was the convention chosen during the discovery of electricity in which the direction of electric current was thought to flow in a circuit. In all circuit diagrams, the arrows shown on symbol for components such as diodes and transistors point in the direction of conventional current flow.

What is diode?

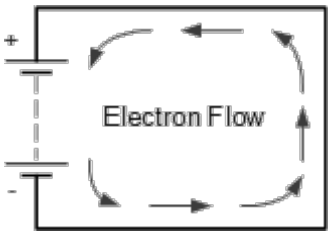
(A semiconductor device with two terminals, typically allowing the flow of current in one direction only)

What is transistor?

(A semiconductor device with three connections, capable of amplification in addition to rectification)

Then **Conventional Current Flow** gives the flow of electrical current from positive to negative and which is the opposite in direction to the actual flow of electrons.

1.3 Electron Flow



The flow of electrons around the circuit is opposite to the direction of the conventional current flow being negative to positive. The actual current flowing in an electrical circuit is composed of electrons that flow from the negative pole of the battery (the cathode) and return back to the positive pole (the anode) of the battery. This is because the charge on an electron is negative by definition and so is attracted to the positive terminal. This flow of electrons is called **Electron Current Flow**.

What is cathode?

(The cathode is the negatively charged electrode.)

What is anode?

(The anode is the positively charged electrode.)

Electrons actually flow around a circuit from the negative terminal to the positive.

Current is measured in **Amps** and an amp or ampere is defined as the number of electrons or charge (Q in Coulombs) passing a certain point in the circuit in one second, (t in Seconds).

Electrical current is generally expressed in Amps with prefixes used to denote **micro amps** ($\mu A = 10^{-6}A$) or **milliamps** ($mA = 10^{-3}A$).

Note that electrical current can be either positive in value or negative in value depending upon its direction of flow.

1.4 AC current and DC current

- Current that flows in a single direction is called **Direct Current**, or **D.C.** and
- Current that alternates back and forth through the circuit is known as **Alternating Current**, or **A.C.**

  Whether AC or DC, current only flows through a circuit when a voltage source is connected to it with its "flow" being limited to both the resistance of the circuit and the voltage source pushing it.

Current sources are the opposite to voltage sources in a way, short or closed circuit conditions but hate open circuit conditions as no current will flow.

Note that current cannot exist without voltage so any current source whether DC or AC likes a short or semi-short circuit condition but hates any open circuit condition as this prevents it from flowing.

1.4.1 Difference between AC current and DC current

	Alternating Current (AC)	*Direct Current (DC)*
Amount of energy that can be carried	Safe to transfer over longer city distances and can provide more power.	Voltage of DC cannot travel very far until it begins to lose energy.
Cause of the direction of flow of electrons	Rotating magnetism along the wire	Steady magnetism along the wire
Frequency	The frequency of alternating current is 50Hz or 60Hz depending upon the country.	The frequency of direct current is zero.
Direction	It reverses its direction while flowing in a circuit.	It flows in one direction in the circuit.
Current	It is the current of magnitude varying with time	It is the current of constant magnitude.
Flow of Electrons	Electrons keep switching directions - forward and backward.	Electrons move steadily in one direction or 'forward'.
Obtained from	A.C Generator and mains.	Cell or Battery.
Passive Parameters	Impedance.	Resistance only.
Power Factor	Lies between 0 & 1.	It is always 1.
Types	Sinusoidal, Trapezoidal, Triangular, Square.	Pure and pulsating.
Direction of flow of electrons	Bidirectional	Unidirectional
Polarity	It has polarity (+, -)	It does not have polarity.
Type of load	Their load is resistive, inductive or capacitive.	Their load is usually resistive in nature.
Convertible	Easily convert into direct current	Easily convert into alternating current
Substation	Few substation is required for generation and transmission	More substations are required for generation and transmission
Hazardous	Dangerous	Very dangerous
Application	Factories, Industries and for domestic purposes	Electroplating,Electrolysis, Electronic Equipment etc.

1.4.2 Fuses

Fuses are used in electronic circuits to protect them from electric overload. They have a protective function.

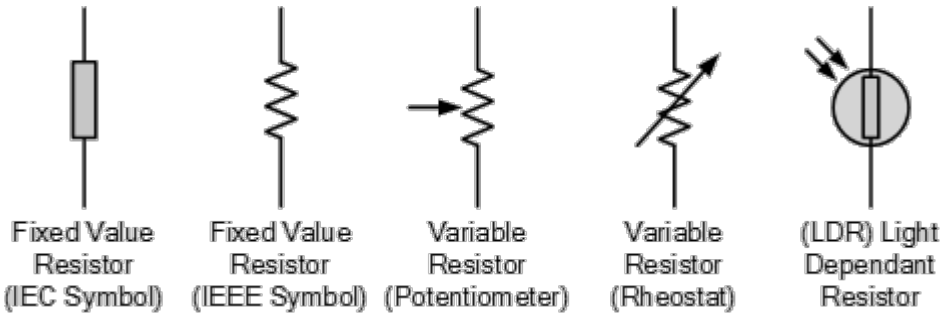
A fuse is made of a low resistance metallic wire placed in a noncombustible material. In the event of a short circuit, over current or mismatched load connection, the thin wire inside the fuse melts. This is caused by the heat generated by the heavy current flowing through it. The power supply is disconnected from the electrical system supplying current. Fuses do not affect the regular operation of the system that is connected to the power supply. Fuses are available in two types: AC fuses and DC fuses.

1.5 Resistance

Resistance, (R) is the capacity of a material to resist or prevent the flow of current or, more specifically, the flow of electric charge within a circuit. The circuit element which does this perfectly is called the "Resistor".

Resistance is a circuit element measured in Ohms, Greek symbol (Ω, Omega) with prefixes used to denote Kilo-ohms (kΩ = 10^3Ω) and Mega-ohms (MΩ = 10^6Ω). Note that resistance cannot be negative in value, only positive.

Resistor Symbols

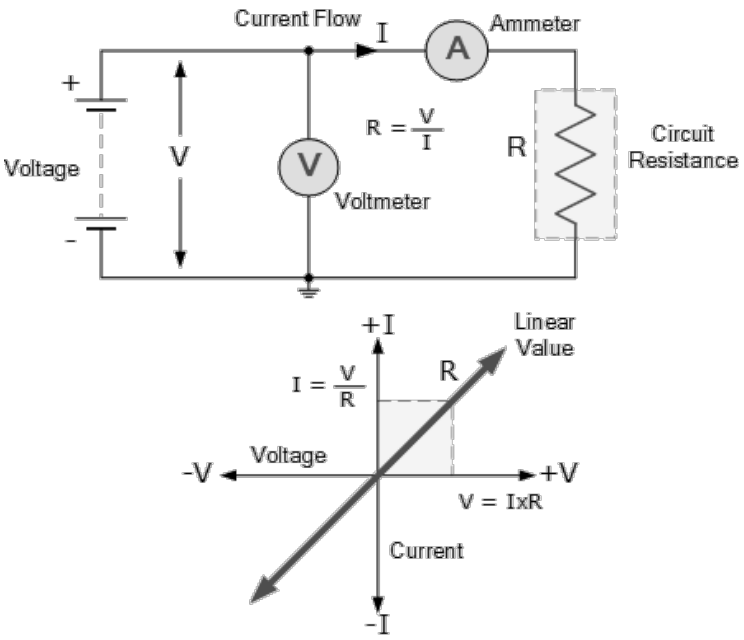


The amount of resistance in a resistor is regulated by the relationship of the current through it to the voltage across it which determines whether the circuit element is a "good conductor" – low resistance, or a "bad conductor" – high resistance. Low resistance, for example 1Ω or less implies that the circuit is a good conductor made from materials such as copper, aluminum or carbon while a high resistance, 1MΩ or more signifies the circuit is a bad conductor made from insulating materials such as glass, porcelain or plastic.

A resistor is classed as a passive circuit element and as such cannot deliver power or store energy. Instead resistors absorbed power that appears as heat and light.

Power in a resistance is always positive regardless of voltage polarity and current direction

The relationship between Voltage, (v) and Current, (i) in a circuit of constant Resistance, (R) would produce a straight line i-v relationship with slope equal to the value of the resistance is shown in the figure below:



The three units can be summarized as:

Voltage or potential difference is the measure of potential energy between two points in a circuit and is commonly referred to as its “volt drop “.

When a voltage source is connected to a closed loop circuit the voltage will produce a current flowing around the circuit.

In DC voltage sources the symbols +ve (positive) and -ve (negative) are used to denote the polarity of the voltage supply.

Voltage is measured in” Volts” and has the symbol” V” for voltage or” E” for energy.

Current flow is a combination of electron flow and whole flow through a circuit.

Current is the continuous and uniform flow of charge around the circuit and is measured in “Amperes” or “Amps” and has the symbol “I” .

Current is Directly Proportional to Voltage ($I \propto V$)

The effective (rms) value of an alternating current has the same average power loss equivalent to a direct current flowing through a resistive element.

Resistance is the opposition to current flowing around a circuit.

Low values of resistance imply a conductor and high values of resistance implies an insulator.

Current is Inversely Proportional to Resistance (I 1/∝ R)

Resistance is measured in “Ohms “and has the Greek symbol” Ω” or the letter” R “.

Quantity	Symbol	Unit of Measure	Abbreviation
Voltage	V *or* E	Volt	V
Current	I	Ampere	A
Resistance	R	Ohms	Ω

1.5.1 Types of resistors

There are two basic types of resistors.

Linear Resistors

Non Linear Resistors

1. Linear Resistors:

Those resistors, which values change with the applied voltage and temperature, are called linear resistors. In other words, a resistor, whose current value is directly proportional to the applied voltage, is known as a linear resistor.

Generally, there are two types of resistors which have linear properties.

Fixed Resistors

Variable Resistors

Fixed Resistors

As the name tells everything, fixed resistor is a resistor which has a specific value and the value of fixed resistors cannot be changed.

Types of Fixed Resistors

Carbon Composition Resistors

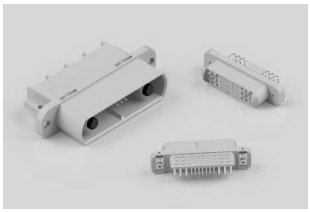
Wire Wound Resistors

Thin Film Resistors

Thick Film Resistors

1.6 Types of connectors

- **Blind mate connectors** ensure that even when your line of sight to the mating connector is limited or when physical access to the mating connector area is inhibited, you can still safely and easily mate them.



- **D-sub connectors** are named after their distinctive D-shaped metal shell, and they are used in a variety of applications.

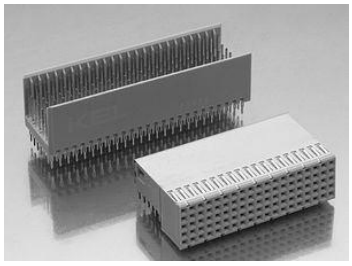
- **Hot swap connectors** allow technicians to safely add, remove, or replace components under load without shutting down the entire system or risking damage to the equipment.

- **IP67 connectors** prevent the ingress of dust or water, making them perfect for harsh environments and rugged applications.

- **Military connectors** are designed to meet the military's high standards with regard to durability, reliability, and precision, and they serve specific functions within the equipment of the armed forces.

- **Modular connectors** can be configured to fit a customer's goals and an application's requirements by using pre-existing building blocks to arrange unique contact arrangements.

- **Power connectors** deliver electronic devices electrical power from either an A/C or D/C source. In addition to the power contacts, signal contact clusters are used for system control and communication.



- **Press-fit connectors** are designed to press through a printed circuit board's plated-through holes (PTH) versus being soldered.

- **Space connectors** with their low out gassing, non-magnetism and extreme reliability, can withstand the extremely harsh environmental conditions that characterize the spaceflight environment.

1.7 Switch types

Different types of switches are used for different applications, and so it is better to use the correct type of switch for a given application.

Rotary switch: This type of switch is operated by rotation. Rotary switches are used when more than two positions are required, for example when changing bands on a radio receiver. The rotary switch type consists of a spindle or rotor and there is an array of terminals that the circular contactor makes contact with dependent upon the position of the spindle.