



Participant Handbook

Sector
Electronics

Sub-Sector
**Consumer Electronics
and IT Hardware**

Occupation
After Sales Service

Reference ID: **ELE/3118, Version 1.0**
NSQF Level 4



**Multi Skill Technician
- Consumer Durables
(Elective 2)**



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Shri Narendra Modi
Prime Minister of India

“ Skilling is building a better India.
If we have to move India towards
development then Skill Development
should be our mission. ”



Certificate
COMPLIANCE TO
QUALIFICATION PACK - NATIONAL OCCUPATIONAL
STANDARDS

is hereby issued by the
Electronics Sector Skills Council of India
for
SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
Job Role/ Qualification Pack: "Multi Skill Technician - 'QP No. ELE/Q3118, NSQF Level 4
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Acknowledgements

The need for having a standard curriculum for the Job Role based Qualification Packs under the National Skills Qualification Framework was felt necessary for achieving a uniform skill based training manual in the form of a Participant Handbook.

I would like to take the opportunity to thank everyone who contributed in developing this Handbook for the QP Multi Skill Technician - Consumer Durables.

The Handbook is the result of tireless pursuit to develop an effective tool for imparting the Skill Based training in the most effective manner.

The preparation of this Handbook would not have been possible without the Industry's support. Industry feedback has been extremely encouraging from inception to conclusion and it is with their input that we have tried to bridge the skill gaps existing today in the Industry. This handbook is dedicated to the aspiring youth who desire to achieve special skills which will be a lifelong asset for their future endeavours.

About this book

This Participant Handbook is designed to enable training for the specific Qualification Pack (QP). Each National Occupational (NOS) is covered across Unit/s.

This book is designed to enable a candidate to acquire skills that are required for employment. The content of this book is completely aligned to the National Occupation Standards QP/NOS and conform to the National Skills Qualification Framework (NSQF).

The Qualification pack of Multi Skill Technician - Consumer Durables, Level 4 includes the following NOS's which have all been covered across the units -

Compulsory NOS:

1. **DGT/VSQ/N0102:** Employability Skills (60 Hours)

Elective 2:

2. **ELE/N3168:** Installation and Repair of Television
3. **ELE/N3167:** Installation and Repair of Microwave
4. **ELE/N3166:** Installation and Repair of Water Purifier
5. **ELE/N3165:** Installation and Repair of basic refrigerator and washing machine
6. **ELE/N3164:** Installation and Repair of OLED/ Monitor

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS. The symbols used in this book are described below.

Symbols Used



Key Learning
Outcomes



Steps



Exercise



Notes



Unit
Objectives

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1. Introduction to the role of Multi skill Technician - Consumer Durables

Unit 1.1 – About Electronics Industry

Unit 1.2 – Basics of Electricity and Electronics

Unit 1.3 – Role of Multi skill Technician - Consumer Durables System in Industry



Key Learning Outcomes



At the end of this module, participants will be able to:

1. Describe about electronics industry
2. List applications of electronics industry
3. Describe trends and challenges in electronics industry
4. Describe electric circuits
5. Describe voltage, current and resistance
6. Define Ohm's law
7. Explain the difference between alternating current (AC) and direct current (DC)
8. Describe active and passive components
9. Identify colour coding in different electrical components
10. List role and responsibilities of a Multi Skill Technician

UNIT 1.1: About Electronics Industry

Unit Objectives



At the end of this unit, participants will be able to:

1. Describe about electronics industry
2. List applications of electronics industry
3. Describe trends and challenges in electronics industry

1.1.1 Introduction

The electronics industry is the economic sector that produces electronic devices. It emerged in the 20th century and is today one of the largest global industries. Contemporary society uses a vast array of electronic devices built-in automated or semi-automated factories operated by the industry.

Electronics industry, the business of creating, designing, producing, and selling devices such as radios, televisions, stereos, computers, semiconductors, transistors, and integrated circuits etc. The electronics industry transformed factories, offices, and homes, emerging as a key economic sector that rivalled the chemical, steel, and auto industries in size.

The electronics sector produces electronic equipment and consumer electronics and manufactures electrical components for a variety of products. Common items in the electronics sector include mobile devices, televisions, and circuit boards. Industries within the electronics sector include telecommunications, networking, electronic components, industrial electronics, and consumer electronics.

Growth in the Electronics Sector

The electronics sector is growing rapidly as a result of increasing demand from emerging market economies. As a result, many countries are increasingly producing more electronics, and investment in the foreign production of electronics has increased dramatically.

Electronics sector growth is accelerated by increased consumer spending around the world. As developing economies grow, consumer demand for electronics also grows. Countries that produce electronics now have strong consumer bases that can afford new electronic products. At the same time, increased competition is driving the costs of electronics production down, making products even cheaper for individuals.

The supportive role of the electronics sector in providing equipment and components for other industries is also a factor of growth as consumers demand more automobiles, energy-efficient homes, and medical technologies.

1.1.2 Application of Electronics in Different Fields

The various electronics applications are:

- **Consumer Electronics:** The devices and equipment meant for daily use are known as customer electronics; this industry is widely applicable to the common people. Some of its applications included office gadgets like computers, scanners, calculators, FAX machines, projectors etc.

It also includes home appliances like washing machines, refrigerators, microwaves, TVs, vacuum cleaners, video games, loudspeakers etc. and some advanced storage devices such as HDD jukebox, DVDs etc.

- **Industrial applications of electronics:** Electronics engineering has a huge impact on the smooth functioning of the industries as it is used in various systems, grids and processing units. For example, smart electric systems collect information from the communication technology department, and several machines use automation and motor control systems using electronics; also, it is used in extracting 3D images from 2D using image processing systems.
- **Robotics and artificial intelligence:** Apart from image processing that involves computer graphics, electronic systems are also used in artificial intelligence and robotics technologies for inspection, navigation and assembly. Virtual reality and face gesture recognition are computer-based, and these developments have been possible because of electronics engineering.
- **Medical applications:** For data recording and physiological analysis, advanced, sophisticated instruments are being developed using the latest technologies and electronics engineering, and these instruments are very useful in diagnosing diseases and for healing purposes.
Electronics play a vital role in the functioning of medical instruments; for instance, the stethoscope is used to listen to the inner sounds of the human or animal body, a glucose metre for checking sugar levels, a pacemaker for dropping and increasing heartbeat count and so on.
- **Defence and Aerospace:** Electronics technology has been used extensively in the defence and aeronautical systems, which include missile launching systems, cockpit controllers, military radars, aircraft systems, rocket launchers for space and many more.
- **Automobiles:** Electronics are widely used in the latest automobile technologies, like anti-collision units, anti-lock braking systems, traction controls, window regulators and several electronic control units.

1.1.3 Electronic Industry Trends and Challenges

The electronics sector appears to be overgrowing, owing to increased demand from developing countries. Before the virus outbreak, due to increased demand, electronics production skyrocketed, accompanied by a surge in investment.

The global electronic products market is expected to be worth nearly \$1,191.2 billion in 2020, with a Compound Annual Growth Rate (CAGR) of 5.4 percent since 2015. The increase is primarily due to the increasing demand for various electronic products as employees and students have transitioned to online.

Consumer Electronics Market size was valued at over USD 1 trillion in 2020 and is estimated to grow at a CAGR of more than 8% from 2021 to 2027. Rapidly increasing internet penetration across the globe will drive the market growth.

Consumer electronics are electronic equipment for non-commercial use. Consumer electronics include devices that provide one or more functionalities such as computers, laptops, mobile devices, smart wearables, television sets, refrigerators, smartphones, and home appliances.

Continuous investments by market players in R&D for the development of new consumer electronic products with enhanced features will fuel the industry growth of consumer electronics.

Challenges in the electronic industry

Regardless of its merits, the electronic industry faces disruptive forces that will test its business model and ability to survive and thrive.

The global electronic industries are the fastest-growing sector, worth trillions of dollars, and play a critical role in driving consumers to purchase innovative and smart electronic products. The global market for electronic components is expected to grow at a compound annual growth rate (CAGR) of about 4.8 percent from 2020 to 2025.

Electronic industries have always been at the forefront of the most recent technological innovations to reduce costs and improve efficiency with such a large future market potential. Many SMEs have found it challenging to keep up with the trends/changes as technology has advanced faster.

For example, top players such as Apple, Samsung, Microsoft, and Intel, to name a few, are investing heavily in new cutting-edge technology to expand their technological capabilities and remain competitive. They are the leading example of an IR4.0 (industrial Revolution 4.0) Eco-friendly system.

The integration of digital tools and technologies has increased revenue and productivity, improved product quality, reduced waste, and operational costs, and met the most recent customer/global demands.

Electronic Industry Trends

Here are some predictions for the specific trends that are likely to have the most significant impact in 2022. The most important trends in 2022 will likely focus on the convergence of technology trends as tools emerge that let us combine them in new and amazing ways.

1. **The 5G Optimization:** 5G is laying the groundwork for a fully digitalized and connected world. We have seen many new field trials and an increasing number of commercial rollouts over the last two years. Furthermore, we are seeing 5G being adopted in various industries, ranging from manufacturing to healthcare.

With its high output and ultralow latency, 5G can access many high-value areas such as 3D robotic control, virtual reality monitoring, and remote medical control that previous technologies could not. 5G is redefining and accelerating industries like automotive, entertainment, computing, and manufacturing. It will eventually change the way we work and live.

2. **Digitization, data, and virtualization:** Many of us witnessed the virtualization of our offices and workplaces in 2020 and 2021, as remote working arrangements were quickly implemented.

This was simply a crisis-driven acceleration of a much longer-term trend. In 2022, we'll be more familiar with the concept of a **"metaverse"** - persistent digital worlds that exist alongside the physical world we live in.

3. **Concentrate on Software Quality Standards:** The focus on quality will be the trend for 2022 and beyond. Software solutions will be integrated into our daily lives and the majority of the goods and appliances we use. As a result, software must meet the quality standards of the manufacturing industry.
4. **Teleworking:** Teleworking will continue to grow in 2022, bringing advances in software development. Companies worldwide will need to support hybrid forms of team management and collaboration to increase the productivity of their workforces. As the trend of conducting online meetings and video sales calls continues, this new standard will grow even more in 2022.
5. **Green, Clean, and Lean Energy:** Renewable energy was the only type of energy that saw an increase in use during the pandemic. As industries shut down and people stayed at home, global non-renewable energy consumption decreased, resulting in an 8% reduction in emissions. As a result, increased investment in renewable energy generation is expected in the coming years.

According to the International Energy Agency (IEA), 40% more renewable energy was generated and used in 2020 than the previous year. This trend is expected to continue through 2022. Overall, the cost of generating renewable energy from various sources, such as onshore and offshore wind, solar, and tidal, has decreased by 7 to 16%. This will be highly beneficial to countries and businesses attempting to meet emissions targets such as becoming carbon neutral or even carbon negative.

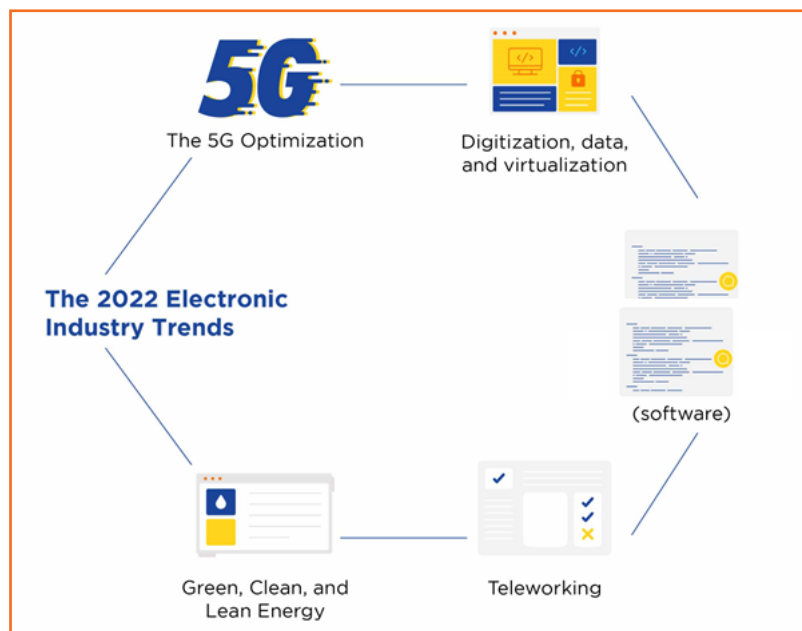


Fig 1.1.1: Trends in electronics industry

Electronics manufacturing trends for 2022

1. **Advanced Materials:** The semiconductor industry has been reliant on silicon for decades, but there is a limit to how far you can etch, lithograph, and pattern a silicon material. As a result,

innovation to increase the performance of integrated circuits is coming from new materials and architectures. Startups and scaleups are developing silicon alternatives and other semiconductor materials or composites for high performance and efficiency.

2. **Organic Electronics:** Organic Electronics offer massive advantages over traditional inorganic electronics. They are cost-effective, flexible, indissoluble, optically transparent, lightweight, and consume low power. In addition, the rise in awareness for sustainable development and eco-friendly manufacturing attracts manufacturers to opt for organic electronics. Designing circuits with microbial components or producing devices with biodegradable and recyclable materials is seen to be the next electronics manufacturing trend.
3. **Artificial Intelligence:** AI-powered solutions are gaining popularity in every sector. AI impacts the growth of semiconductor manufacturing in two ways, one is by building demand for innovative AI-capable electronics components, and two, enhancing the product manufacturing and design processes. The conventional methods have limitations to reshaping product development cycles, improving product design processes, and reducing defects. But the application of AI is solving all these limitations.
4. **Internet of Things:** The rapid growth of the Internet of Things represents an unprecedented opportunity for the electronics manufacturing industry. It re-evaluates the fabrication process and manages practices that are found to be difficult to achieve with conventional approaches. In other ways, the IoT enables electronic manufacturing machines to self-process and store data while being digitally connected. Continuous improvements in the fabrication of sensors are also required since sensors are the key components that enable IoT applications. Further, the transition to 5G-enabled devices requires flawless, innovative chips with more efficient architectures at lower costs.
5. **Embedded Systems:** Embedded systems are an unavoidable part of any electronic device nowadays and it has a crucial role in deciding the speed, security, size, and power of the devices. Since we are in the transition phase of a connected world, there is high demand for embedded systems. So the designing and manufacturing sector of such systems is undergoing numerous innovations to improve performance, security, and connectivity capabilities.
6. **Printed Electronics:** Printing electronics components on a semiconductor substrate is the most effective way to reduce the overall cost of the manufacturing process. So, manufacturers are always trying to tackle this challenge by searching for new technologies and advancements in conventional printing technologies. Unlike traditional semiconductors that use tiny wires as circuits, printed electronics rely on conductive inks and often flexible films. Further, the advancements in printing technologies allow the flexible hybrid electronics field to obtain enough momentum. Therefore, startups and scaleups are developing solutions for advanced printing technologies.
7. **Advanced IC Packaging:** In recent years, chip packaging has become a hot topic along with chip design. The traditional way to scale a device based on Moore's law has limitations nowadays. The other way to get the benefits of scaling is to put multiple complex devices in an advanced package. So, semiconductor manufacturers develop new advanced IC packaging technologies to provide greater silicon integration in increasingly miniaturized packages. This also enables manufacturers to offer customization and improve yields by vertically stacking modular components.

8. **Additive Manufacturing:** 3D Printing in electronics manufacturing eliminates the need for flat circuit boards. It enables new innovative designs and shapes that cannot be produced through conventional means. 3D printers also fabricate electronic components as a single, continuous part, effectively creating fully functional electronics that require little or no assembly. Consequently, the implementation of this electronics manufacturing trend speeds up prototyping, offers mass customization, and decentralizes parts production. In general, 3D printing technology made possible electronic components production in terms of 3D design and not only 2D, with new ways of stacking the circuits.

Notes



UNIT 1.2: Basics of Electricity and Electronics

Unit Objectives

At the end of this unit, participants will be able to:

1. Describe electric circuits
2. Describe voltage, current and resistance
3. Define Ohm's law
4. Explain the difference between alternating current (AC) and direct current (DC)
5. Describe active and passive components
6. Identify colour coding in different electrical components

1.2.1 Electric Circuits

An electric circuit is a path made by the interconnection of electrical components. Electrons from a voltage or current source flow along this path. The following figure lists the elements present in a basic electric circuit -



A source that provides electrical pressure known as voltage or Electromagnetic force (EMF) to electrical equipment to enable them to work.

Example: Battery



A device in a circuit which consumes electric power is called load.

Example: Bulb



A conductor that connects the supply source and the load.

Example: Wires

Fig 1.2.1 Electric circuit constituents

An electric circuit consists of two paths/loops, as shown in the following image -

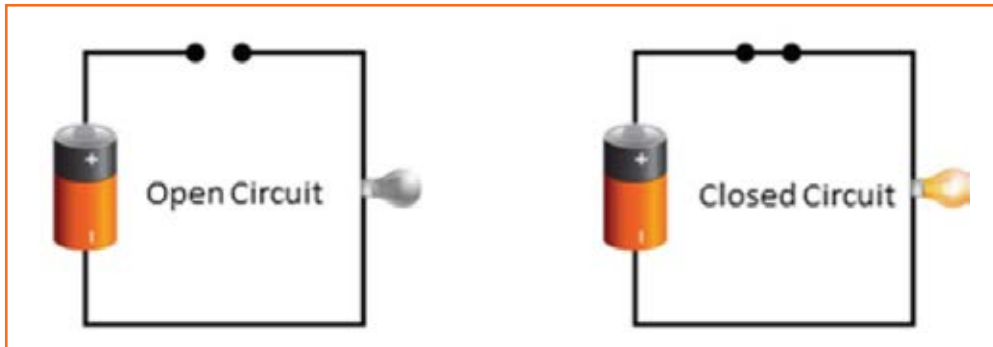


Fig 1.2.2 Closed and open path

In a typical circuit, a battery provides voltage for the load through wires. For example, the required voltage for a bulb to glow is provided by a battery. The following image shows such an electric circuit -

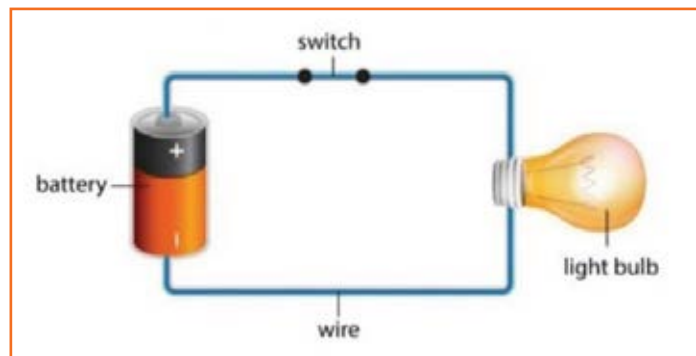


Fig 1.2.3 An electric circuit

1.2.2 Types of Electric Circuits

An electric circuit is classified into two types:

- Series circuit
- Parallel circuit

Series Circuit

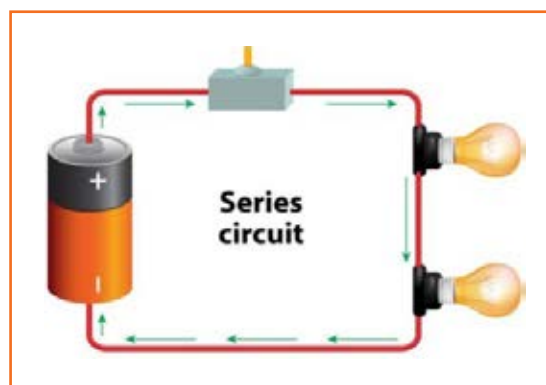


Fig 1.2.4 A series circuit

In this type of a circuit, all components are connected as a chain and the current flowing through each one of them is the same all over the circuit. There is a single route through which the current flows. So, the current passes through each and every component. Opening or breaking any point in a series circuit causes the whole circuit to stop functioning, which then needs to be replaced.

Parallel Circuit

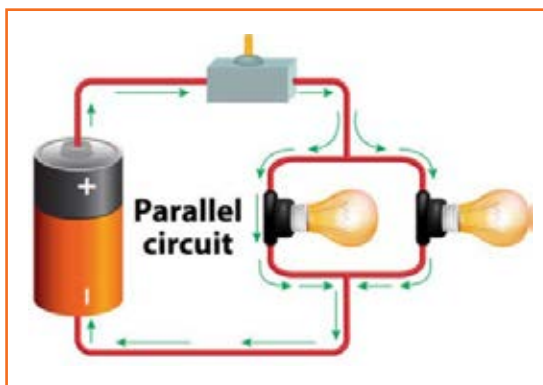


Fig 1.2.5 A parallel circuit

In this type of a circuit, two or more than two components are connected in parallel. In a parallel circuit, the components are of the same voltage. The current flow varies across the components. If any point of the circuit gets damaged, only that part needs to be replaced.

1.2.3 Parameters of Electric Circuit

Electricity comes into existence whenever there is a flow of electric charge between any two components. The main parameters associated with electricity are as follows -

Voltage

A force that causes electricity to move across a wire/cable is known as voltage. Volt is the unit of voltage and is denoted with letter V.

Current

Electric current, or simply current, is the flow of electric charge carried through electrons moving across wires. Ampere is the unit of current and is denoted with letter I.

AC and DC Current

The following figure lists the two types of current sources that are dependent on the direction in which the electrons flow -

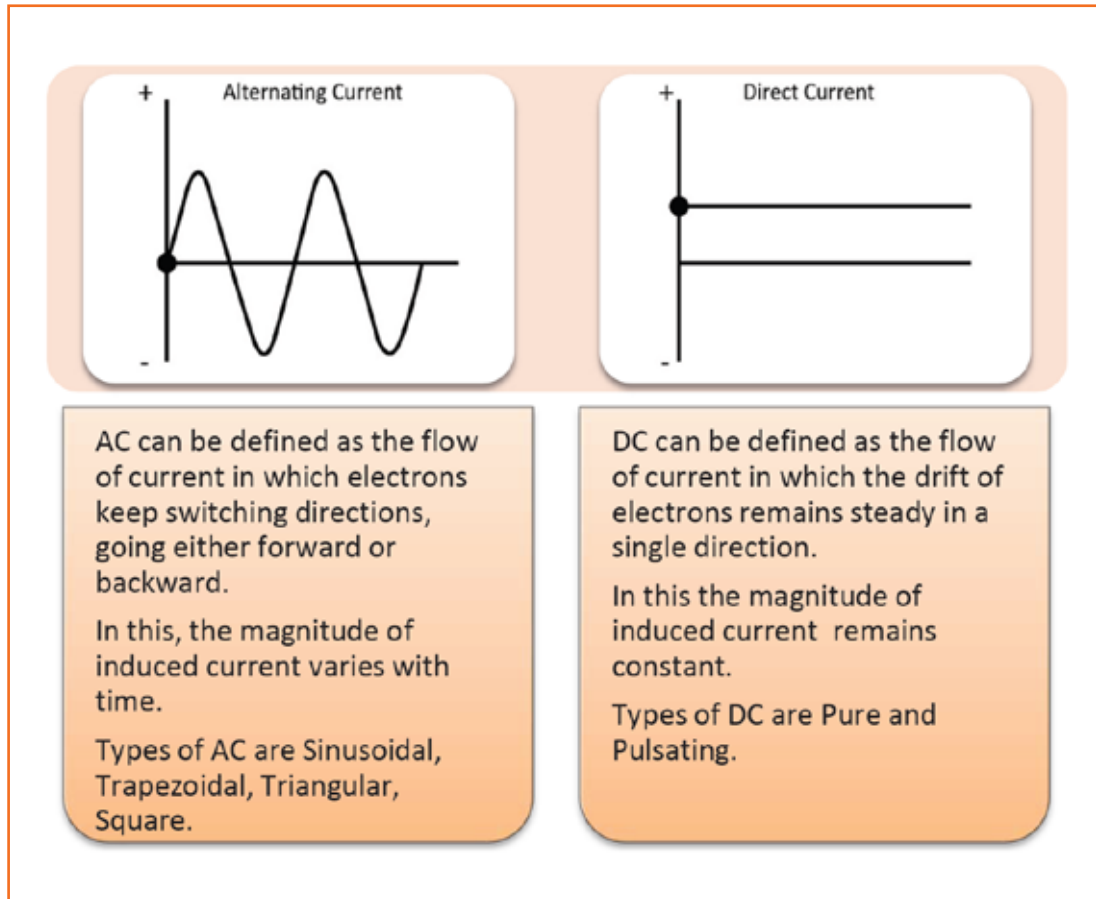


Fig 1.2.6 Difference between AC and DC current

Resistance

Resistance is an obstruction caused by a substance to the current flow. The unit of resistance is ohm and it is denoted with the symbol, Ω . According to Ohm's law, 1Ω resistance allows $1A$ of current to flow from one point to the other with a $1V$ voltage difference.

1.2.4 Ohm's Law

According to Ohm's law, the flow of current through a conducting material is directly proportional to the conductor's voltage. The mathematical equation of Ohm's law is as follows -

$$I = V/R$$

Where,

I is the current

V is the potential difference

R is the resistance

Ohm's law states that R in the preceding relation is constant and independent of the current flowing through it as shown in the following image -

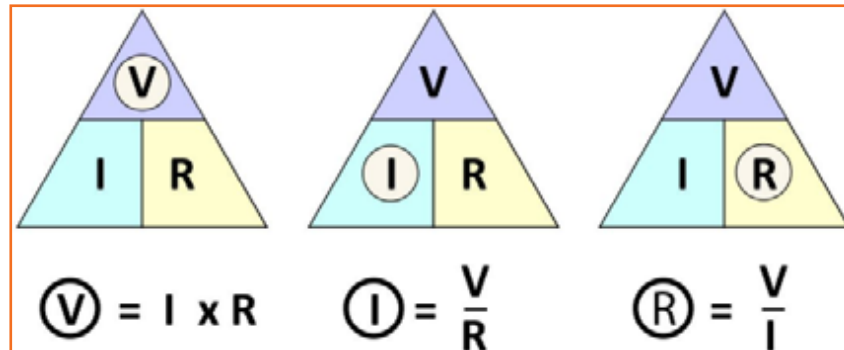


Fig 1.2.7 Ohm's law

1.2.5 Circuit Elements

A circuit consists of a number of components that may be electrical, electronic, mechanical and so on. The following figure shows various types of circuit elements or components that are used in a control panel -

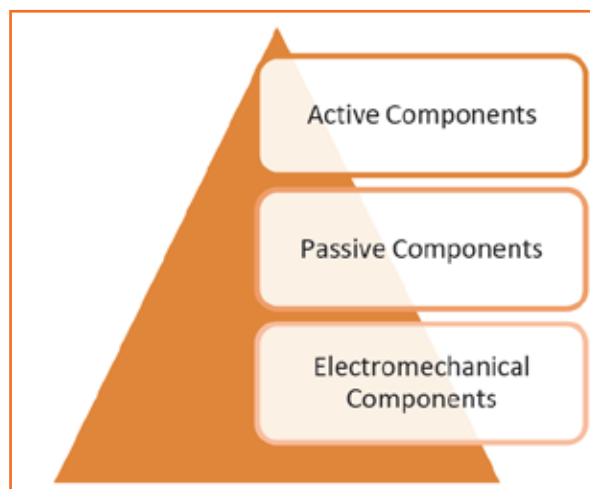


Fig 1.2.8 Circuit elements

Active Components

Active components depend on a source of energy to perform their functions. These components can amplify current and can produce a power gain.

The following figure lists the different types of active components in a circuit -

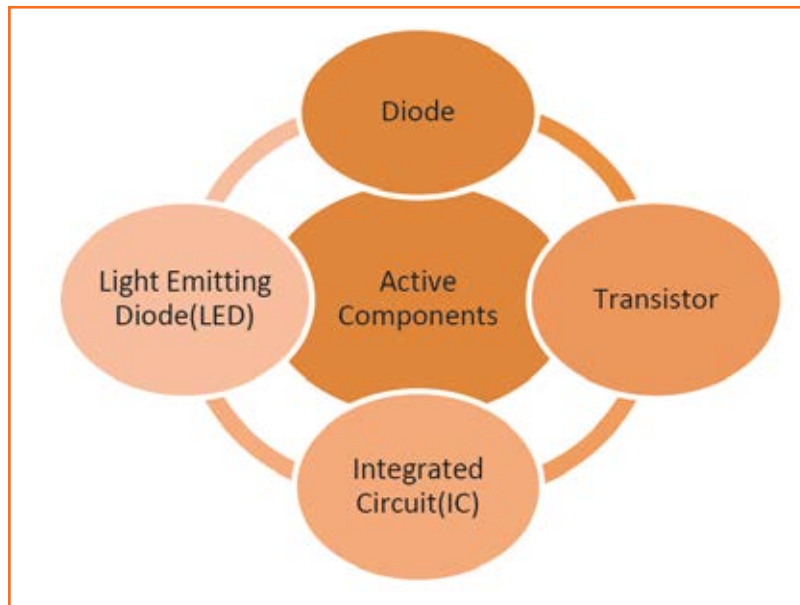


Fig 1.2.9 Active components

Passive Components

Passive components are those components which can perform their specific functions without any power source. These components are incapable of controlling current. The following figure lists the different types of passive components in a circuit -

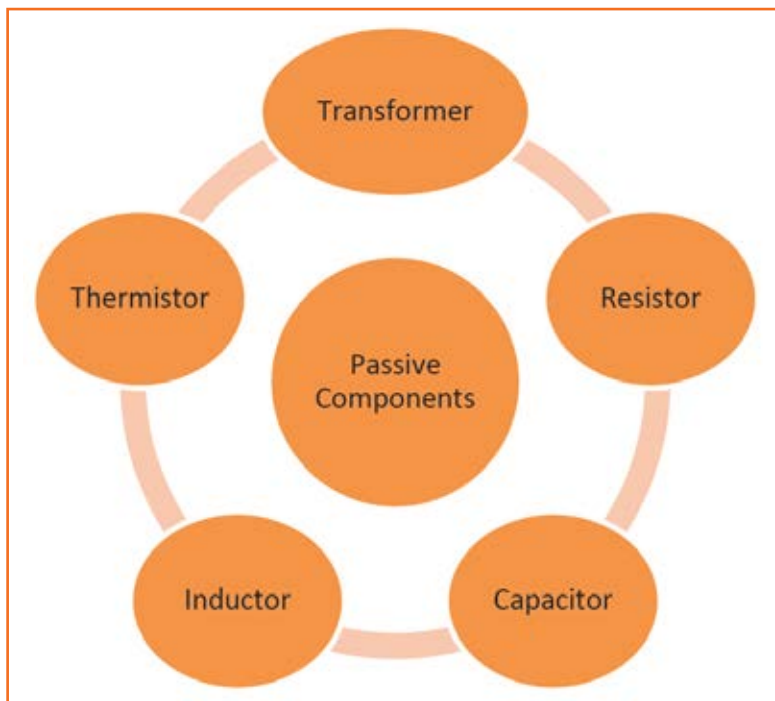


Fig 1.2.10 Passive components

Electromechanical Components

Electromechanical components convert electric energy into mechanical energy (mechanical movement) or vice versa for carrying out electric operations. The following figure lists various electromechanical components -

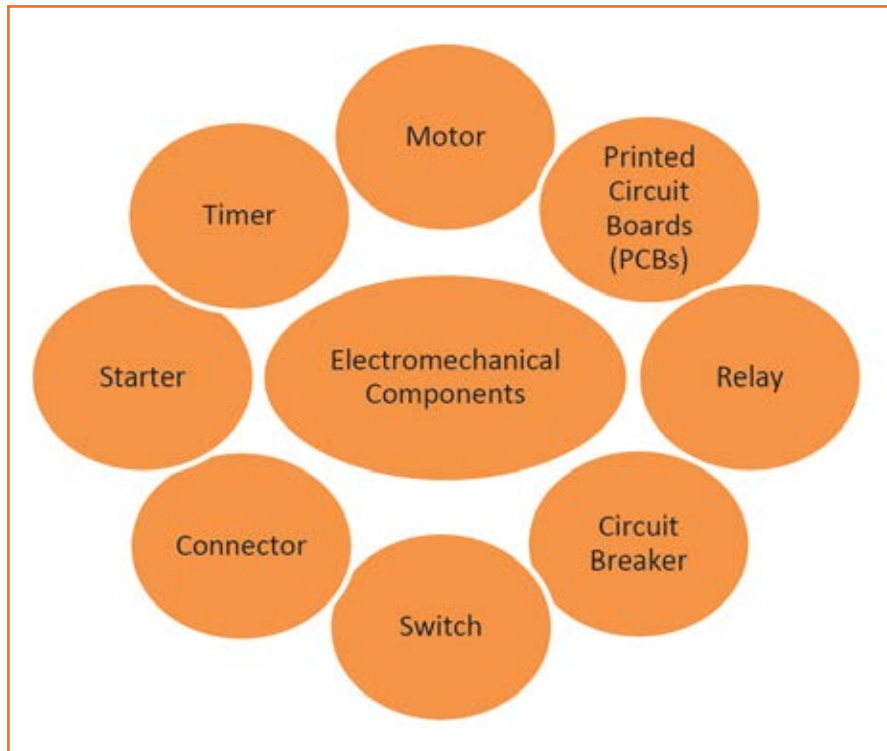


Fig 1.2.11 Electromechanical components

UNIT 1.3: Role of Multi skill Technician - Consumer Durables System in Industry

Unit Objectives



At the end of this unit, participants will be able to:

1. Describe role of Multiskill Technician in industry

1.3.1 Role of Multiskill Technician in Industry

A multiskill technician is responsible for installation, diagnose, troubleshoot and repair all consumer durables like refrigerator, TV, washing machine, water purifier, microwave etc. and communicate the Service Manager/Lead Mechanic regarding repair priorities and status.

Responsibilities of a multiskill technician are:

- Prepare the work area for installation and servicing activities
- Carryout installation of consumer durables like refrigerator, AC, washing machine, microwave, dish washer, TV etc.
- Demonstrate use and function of appliance after installation work
- Identify faults in the defective appliance
- Replace or repair the faulty component of the appliance
- Perform servicing and maintenance activities of appliance as per the requirement
- Maintain documents and records related to work

Exercise

1. Name this equipment



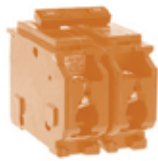
2. Electric tools should not be used in damp or wet locations.

(a) True

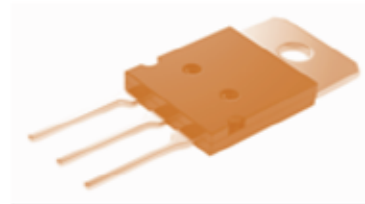
(b) False

3. Identify the different electronic components and write down their names in the boxes give below them:

1.



2.



3.



4.



5.



4. Perform categorisation of the following components as active or passive:

1. Resistor
2. Transistor
3. Capacitor
4. Diode
5. LED
6. Inductor
7. IC
8. Thermistor
9. Transformer

Notes





2. Install and Repair TV

Unit 2.1 – About Smart TV

Unit 2.2 – Installation and Operation of TV

Unit 2.3 – Troubleshooting and Repairing of TV



Key Learning Outcomes



At the end of this module, participants will be able to:

1. Describe use and function of smart TV
2. List parts of a TV
3. Demonstrate procedure of installing a TV
4. Demonstrate how to setup and use the features of TV
5. Demonstrate procedure of troubleshooting and repairing of faults in TV

UNIT 2.1: About Smart TV

Unit Objectives



At the end of this unit, participants will be able to:

1. Describe use and function of smart TV
2. List parts of a TV

2.1.1 Smart TV

Smart TV has brought a revolution to what we have looked towards Televisions so far. They are quite in demand and have heavily affected the traditional TV's market.

A Smart TV is a television set which connects to the internet and allows the users to use services like video streaming, web browsing / surfing or even gaming.

Smart TV allows access to traditional electronic media (regular television channels) along with online interactive media and 'Over The Top' (OTT) content. It also allows home networking solutions such that all devices can be interconnected and be operated with a single click.

Features of a Smart TV work

The focus of traditional TV software was to put pictures on the screen by tuning the tuner and decoding the broadcast signals. Smart TV has an added ability of being able to load / access extra content that comes from the internet. Smart TV is like a computer except you cannot write. Smart TVs are outfitted with extra hardware and connection types, as well as a TV operating system with a GUI. These adaptations allow viewers to access and control features for streaming content from Internet video services and connected devices. Smart TVs support Ethernet, Wifi, USB, Bluetooth and flash memory cards from digital cameras, as well as coaxial cable, HDMI and other audio-video connections. Along with the OS and apps, the connectors enable on demand video services and access to pictures, music and video on connected storage devices.

Smart TVs can access and deliver content (like photos or movies or music) from other connected devices through technology like that of LAN. Smart TV also provides access to internet-based services like Video-on-Demand (VOD), Electronic Advertising, Gaming, Social Networking and multimedia applications to name a few.

In Layman's terms, if you have a TV, a set-top box and an internet connection, you can integrate all three in a way that allows you to access internet-based content on television set.

Types of Smart TV

Smart TVs can be categorized by -

- **Resolution:** Resolution defines the number of pixels (dots) that make up the picture on your television. For any given screen size, the more dots in the picture, the higher the resolution and

the higher the overall quality of the picture. TV resolution is often stated as the number of pixels or dots contained vertically and horizontally in the picture.

Different Types of Resolutions in Smart TV



Fig 2.1.1 Types of resolutions in Smart TV

This level of resolution provides the liberty to sit close to the TV and enjoy the fully immersive experience, as opposed to regular televisions. This technology can upscale the existing HD content thereby making the images sharper.

Full HD is 1920 X 1080 px resolution. This resolution is high enough to allow an excellent viewing experience. It is possible watch Blu Ray movies on Full HD televisions, without any deterioration of picture quality.

- **Display Technology:** On the basis of Display Technology, Smart TVs may be categorized into LCD, LED and OLED Smart TVs.

In either case the screen of the Smart TV is LCD (Liquid Crystal Display). LED or Light Emitting Diodes, on the other hand, is the light source and is considered a great choice for all kinds of lighting conditions.

LED and OLED Display Technology



Fig 2.1.2 LED and OLED Display

OLED stands for Organic Light Emitting Diodes and it offers an extremely high degree of color accuracy. OLED technology allows a wider viewing angle and blur-free pictures as each of the millions of pixels is individually illuminated. This technology can be used to design extremely thin TV screens.

- **Software Platforms of Smart TV:** Software Platforms are also considered as key factor for categorizing Smart TVs. While there are certain aspects that are common, each manufacturer prefers to use their own software platform. The most common platforms are :
 - ❑ **LG Web OS:** This OS is well known for its speed. This software platform is compatible with Netflix, YouTube, Amazon Instant Video, and other similar content hubs. It is not easy to customize but it quite popular.
 - ❑ **Samsung Tizen:** This OS is quite like the Web OS in appearance but can be customized more easily. Navigation through Tizen is also easier. The roots of the OS lie in smartphones, the Tizen OS is compatible with wider variety of content hubs including i-Player and ITV Player.
 - ❑ **Firefox OS:** Firefox OS is available only on Panasonic TVs. Firefox OS, better known for colorful pop-up icons, is one of the easiest OS to customize. It is compatible with a large variety of apps like Netflix and YouTube among others.
 - ❑ **Android OS:** A large proportion of people in the world are comfortable with Android because of the use of this technology in smartphones. This OS is very easy to customize and navigate and is compatible with apps like Netflix and YouTube. Android OS is also most suited for gaming. Sony, uses this OS on its TVs.

Advantages of Smart TV

- **Access to a large amount of content:** Be it pre-saved or live streaming, availability of video-content is the key success of Smart TV. This therefore allows you to watch even the latest movies on OS based APPLICATIONS and OTT Platforms like NETFLIX, AMAZON PRIME, SONY LIV, HOTSTAR.
- **Customized search options:** With the help of the Global listings, you, the viewer can search programs and schedule their timings as per own suitability. Alexa, a recent development, allows voice search which lets you skip the search menu to identify the content you are looking for.
- **Universal Mobile Control:** The remote of the Smart TV is designed to control all connected devices.
- **Games:** Smart TV permits the access of a large variety of games that are compatible to the software platform on which the TV is based.

Disadvantages of Smart TV

- **Security:** As with any connected device there are concerns about the security as your viewing habits and practices are accessible to anybody searching for that information. Concerns about theft of personal data also looms large. Some other major concerns are related to the recording via camera and mic of happenings in the house. Coupled with facial recognition, Smart TV is likely to cause certain amount of worry among many.
- **Cost:** Smart TVs are also heavy on the pocket as most manufacturers operates on a value proposition currently.

- **Slow Response with Heavy Load:** Sometimes, the smart TV has slow response like that of Smart phones due to excessive load.
- **Dependency on Internet:** As updates for software and programs are being frequently generated, the smart TV needs regular updation for correct functioning.

2.1.2 Components of Smart TV

An LED TV is essentially an LCD TV. It's an LCD TV but with a different form of backlighting. The correct term for an LED TV is 'LED-backlit LCD TV', but that's just too much of a mouthful to say, so instead they're just called LED TVs.

Both types of TV use a liquid crystal display (LCD) panel to control where light is displayed on your screen. However, LED TVs use an array of smaller, more efficient light-emitting diodes (LEDs) to illuminate the screen – and there are a lot of advantages to having an LED TV, such as improved picture quality and colour display.

Not all LED TVs are exactly the same. Some will include more features than others depending on variables such as the style and the brand. However, fundamentally there are a few components that all LED TVs need to have in order to function effectively.



Fig 2.1.3 Components of LED TV

- **LEDs (LED Array):** The components that give this TV its namesake, LEDs are tiny little lights behind the TV screen. LEDs shine light from behind the screen, illuminating pixels to create an image.

They provide a vaster array of colours than TVs like LCDs that use cathode fluorescent tubes, resulting in a more vivid picture on screen.

- **LCD Screen:** An LCD screen is a sophisticated piece of technology, made up of polarised sheets of glass, a backlight and a grid layer of a responsive liquid crystal solution. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screens that are generally used in laptop computer screens, TVs, cell phones, and portable video games.



Fig 2.1.4 LCD Panel

Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes. LCD technology is used for displaying the image in a notebook or some other electronic devices like mini computers. Light is projected from a lens on a layer of liquid crystal. This combination of colored light with the grayscale image of the crystal (formed as electric current flows through the crystal) forms the colored image. This image is then displayed on the screen.

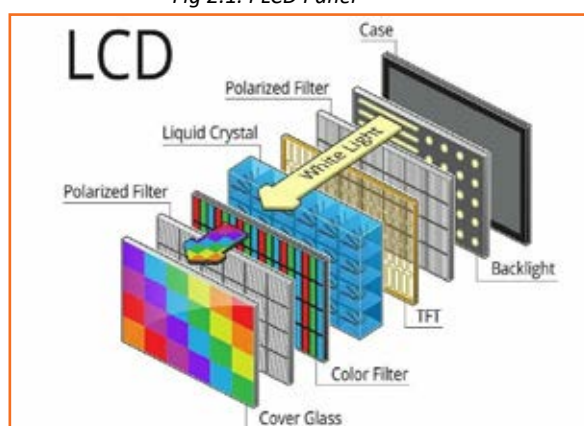


Fig 2.1.5 Layers of LCD Panel

- **Backlight:** The backlight is the layer that includes the LED lights. Backlights improve the contrast ratio of the picture quality and reduces power consumption by adjusting the LED light source's brightness depending on image input. There are two types of LED backlighting; edge lighting, which involves LEDs being placed along the edge of the panel, allowing the TV to be made incredibly thin, and direct lighting, where LEDs are placed behind the entire surface of the screen.
- **Reflective film:** The reflective film keeps all the light in the right place to give you a great picture.
- **Main board:** The main board component is the core part of signal processing in LCD TV, which is responsible for converting the external input signal into the digital signal recognized by the unified LCD under the action of the system control circuit. Input interfaces generally include - RF(TV TV) radio frequency signal, CVBS (AV) composite VIDEO signal, S-Video (S terminal), YPBPR component VIDEO, VGA (PC computer), HDMI, USB, CI card output interface - Headset, Coaxial (axial), extensible - DVD.
- **Power board:** The power supply module is the power supply, the function is to convert 220V mains power into a stable DC voltage, used for the whole other circuits (main board, backlit board, high pressure board, etc.) working voltage.



Fig 2.1.6 Main board



Fig 2.1.7 Power board

Liquid crystal power supply usually has +5V, +12V, +24V voltage output

The relationship between the power board and the motherboard is one that is independent and controlled by the motherboard.

- **T-con Board:** The T-Con Board is the smallest board found inside LCD TV and is usually only found in LCD TV's. The T-Con board is the central board of your TV. It is connected to the Main Board, but it is not directly connected to the LED Drivers or the Power Supply. The function of T-con board is to control logic signal of gate and source for driving TFT LCD. The T-Con Board is sometimes referred to other names, such as "Controller Board," or "Control Board."



Fig 2.1.8 T-con board

- **Key board components:** The key board assembly generally consists of seven functional keys. The user can operate the LCD TV conveniently through this component.
- **Remote receiver board (IP BOARD):** The remote receiving board assembly consists of a working indicator light and a remote receiving head. The user can operate the LCD TV conveniently and know the status of the LCD TV by using the remote control.
- **Speaker:** The function of a loudspeaker is to convert electrical signals into sound. The television usually uses a paper basin speaker. The paper basin loudspeaker is composed of permanent magnet, bracket, centering piece, copper wire voice coil, diaphragm folding ring cone type paper basin.
- **Array of liquid crystals:** Liquid crystals can be damaged in any way in the LCD screen itself. In this case, the result will usually be dead pixels (pixels that display consistently the same color, regardless of the picture).
- **WIFI/BT PCB:** A WIFI/BT PCB is a wireless terminal device used to enable internet connection through the wireless connection network under the coverage of a wireless local area network. Therefore, a WIFI/BT PCB installed on smart TV is used to enable wireless connectivity to the internet.



Fig 2.1.9 Wireless network card

- **LVDS:** LVDS is Low Voltage Differential Signaling system, it transmits two different voltages that are compared at the receiving end. LVDS uses the difference in voltage to encode the video signal. LVDS is a specification used to send and receive data with LCDs.

LVDS IC sends the video signal from the main board to the T-CON/LCD controller board. LVDS cable helps to connect a TV panel with a TV motherboard. Through this LVDS cable, the video signal goes into the panel from the TV motherboard. This means all the ODD and EVEN signals enter in the panel through this cable.

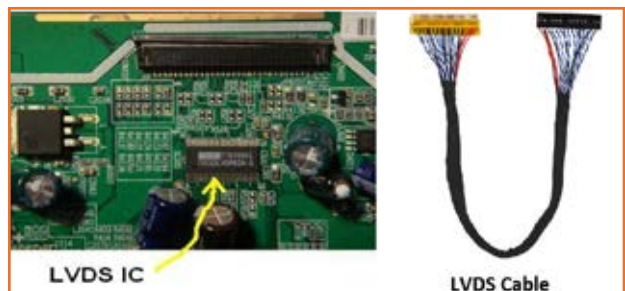


Fig 2.1.10 LVDS IC and cable

UNIT 2.2: Installation and Operation of TV

Unit Objectives



At the end of this unit, participants will be able to:

1. Demonstrate procedure of installing a TV
2. Demonstrate how to setup and use the features of TV

2.2.1 Site Requirements for Installation

The first step of an installation process is to conduct a site survey and ensure that it meets all the requirements. The selected site should comply with all the safety codes and should not interfere with normal movement of people.

The following are the site requirements of installing a LED/LCD TV:

- Select a well-ventilated place
- Place the TV away from direct sunlight
- Place the TV away from an area with high humidity such as a bathroom and area exposed to rain or wind
- Avoid installing near any heating appliance
- Place on a firm, level place

After checking the site requirements, the next step is to check the power supply at the location site.

The following are the power requirements for installation:

- Ensure that voltage and electrical wiring is appropriate
- Use a separate socket for TV
- Ensure wall socket is properly earthed
- Place the TV close to the electrical outlet
- Try to avoid use of an extension cord
- Avoid installing under the AC indoor unit. (It may cause to fall water inside the TV and TV parts will get damaged)

2.2.2 Installation Process

The installation process consists of unpacking the unit, disposing the packing material and installing the TV at the designated place.

Unpacking TV

To protect the TV from any kind of damage, it is properly packed and delivered. Once it is transported from the delivery truck, it needs to be carefully unpacked.

The following are the tools that are needed for unpacking and handling a TV:



Fig 2.2.1 Requirements for unpacking the TV

Steps for unpacking a TV:

1. Cut the binding strip of carton
2. Remove the adhesive tapes and open the top flaps



Fig 2.2.2 Unboxing TV

3. Remove the carton

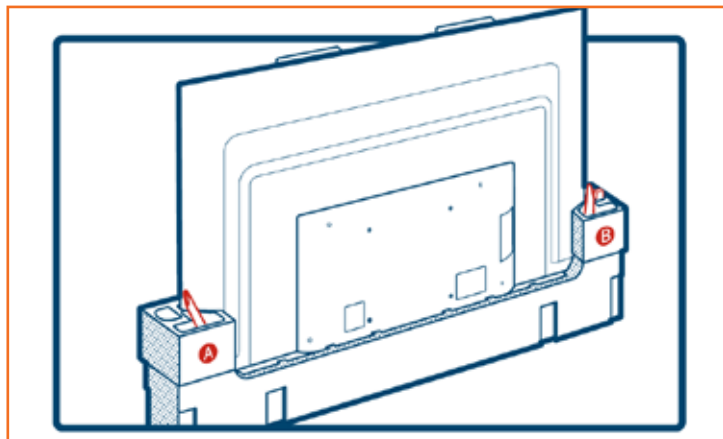


Fig 2.2.3 Removing TV from packing box

4. Remove the stands and accessories bag from packing. Take the manual, remote control, power cord, stand and screws out of the accessories bag.

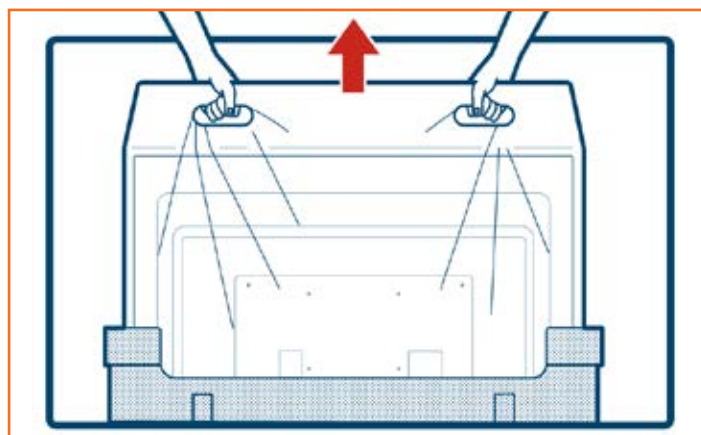


Fig 2.2.4 Removing accessories from packing box

5. Remove the TV set from the protector and place it on a flat surface with screen facing down.

Note:

- Accessory Items may vary depending upon model.

Check and understand the symbols on the package to know about the cautions and warnings related to the installation. The symbols along with their meanings are shown in the following images -



Fig 2.2.5 Safety warnings on packing box

Lifting and moving the TV

When moving or lifting the TV, follow the following to prevent the TV from being scratched or damaged and for safe transportation regardless of its type and size.

- It is recommended to move the TV in the box or packing material that the TV originally came in.
- Before moving or lifting the TV, disconnect the power cord and all cables.
- When holding the TV, the screen should face away from you to avoid damage.
- Hold the side and bottom of the TV frame firmly. Make sure not to hold the transparent part, speaker, or speaker grill area.



Fig 2.2.6 Wrong way of handling TV

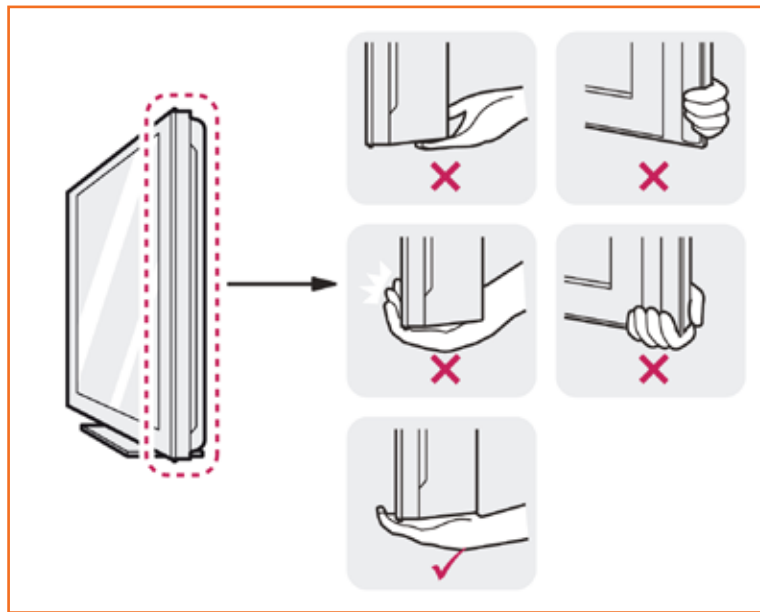


Fig 2.2.7 Way to handle TV

- When transporting a large TV, there should be at least 2 people.
- When transporting the TV, do not expose the TV to jolts or excessive vibration.
- When transporting the TV, keep the TV upright, never turn the TV on its side or tilt towards the left or right.
- Do not apply excessive pressure to cause flexing / bending of frame chassis as it may damage screen.
- When handling the TV, be careful not to damage the protruding buttons.

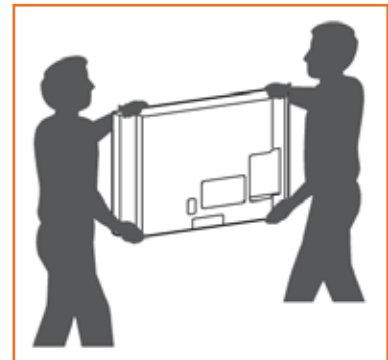


Fig 2.2.8 Way to handle TV

Caution

- Avoid touching the screen at all times, as this may result in damage to the screen.
- When attaching the stand to the TV set, place the screen facing down on a cushioned table or flat surface to protect the screen from scratches.

Educating customer for packing material disposal



Fig 2.2.9 Cleaning of packing material

After the TV has been unpacked, it is important to dispose of the packaging material properly. Most of the packaging materials are nowadays made of recyclable materials. Avoid disposing the packaging materials with domestic waste. Place them in recycling bin. Dispose the non-recyclable materials such as Styrofoam in proper disposal locations.

Setting up the TV

Place the TV on a pedestal stand and mount the TV on a table or wall as per the customer requirement.

2.2.2.1 Mounting on Table

If TV has to place on a table, use the following instructions:

1. Insert Stand Base to TV and fasten them using screws.

Note: Stand base type may be differ for different models and brands

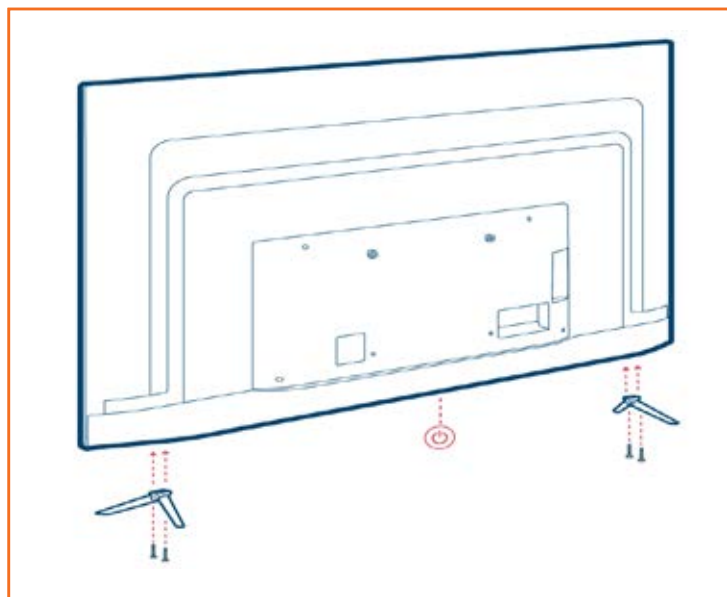


Fig 2.2.10 Inserting stand base to TV

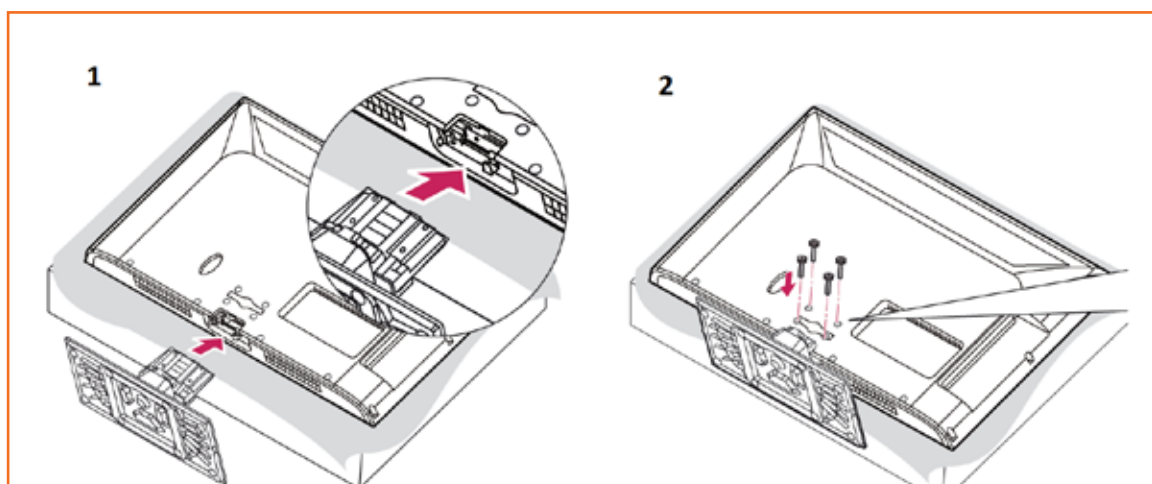


Fig 2.2.11 Inserting stand base to TV

2. Lift and tilt the TV into its upright position on a table.

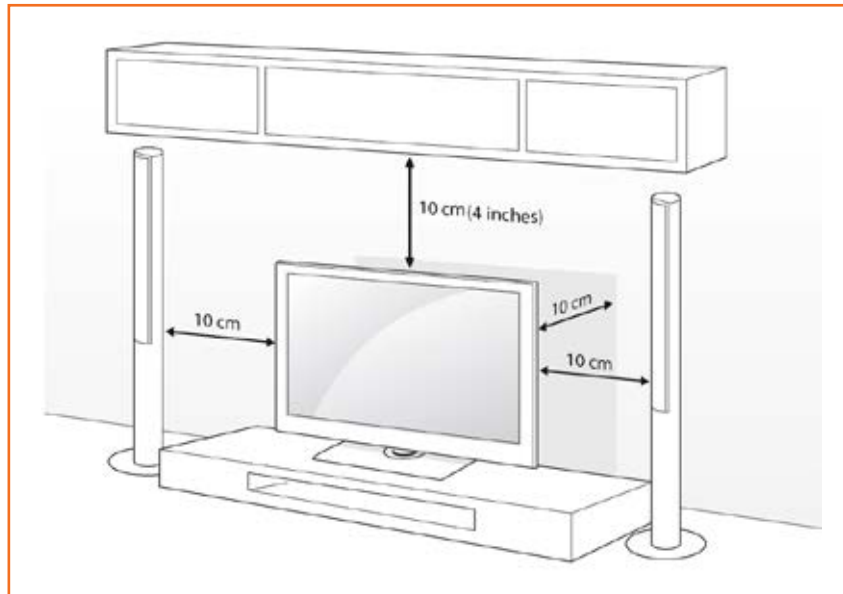


Fig 2.2.12 Placing TV on table

- ❑ Leave a 10 cm (4 inch) (minimum) space from the wall for proper ventilation.
3. Fix the TV to a table to prevent from tilting forward, damage, and potential injury. Mount the TV on a table, and then insert and tighten the supplied screw on the rear of the stand.

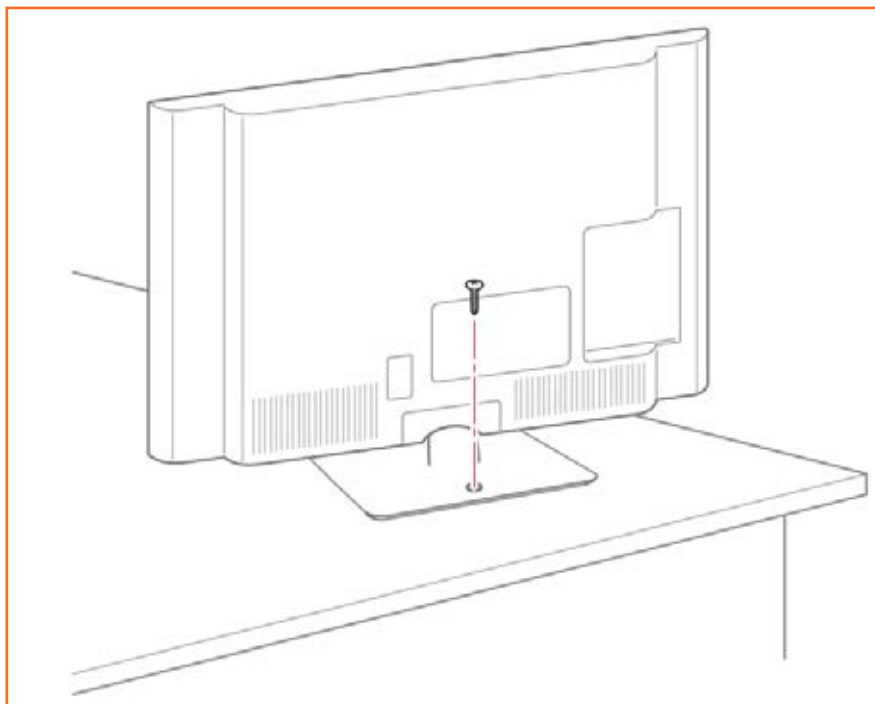


Fig 2.2.13 Fixing TV on table

4. Connect the power cord to a wall outlet.
5. Push the power button located at bottom of TV (or press power button on remote) to turn it On.
6. Follow screen instructions of quick start guide to setup TV.

2.2.2.2 Mounting on Wall

Before you get started on your TV mount installation, you need following tools and equipment:

- **Power drill:** You can try to mount the TV with a screwdriver, but you might be at it a while. We highly recommend using a power drill to speed things up for this project.
- **Various drill bits:**
 - ❑ **Carbide-tipped masonry bit:** Use this to make pilot holes in the drywall, which you'll drill your mounting screws into.
 - ❑ **Phillips head drill bit:** This is what you'll use to drive the mounting screws.
- **Level:** Use a level to make sure your newly mounted TV is, well, level. This can help you avoid both a crooked TV and unnecessary holes in your wall.
- **TV mount:** To mount TV on wall, you'll need a TV mount rated for the model of TV. Check TV manual for the VESA mount measurements and get a TV mount to match.
- **Painters tape (optional):** When you find wall studs, mark them with a little piece of painters tape. This is much easier to see than a pencil mark, and you won't have to write on wall.

If TV has to mount on wall, use the following instructions:

1. **Decide where to position the TV:** Viewing angles are often important for achieving the best picture quality, so consider the location carefully.

- ❑ First, decide the height at which you want to mount the TV.
- ❑ Note where the center of the TV lies. This is the point where the wall bracket should be installed.



Fig 2.2.14 Marking on wall



Fig 2.2.15 Marking and drilling on wall

2. **Mark and drill holes:** These are the small holes that will allow mounting screws to enter the wall.
 - ❑ Hold the wall bracket on the wall, make sure it is horizontal. Use a spirit bubble level to get a perfectly horizontal alignment. With a pencil make marks on the wall where the fasteners will be inserted.
 - ❑ Attach a masonry bit to drill, and drill holes where you marked using the mount.

- ❑ Keeping the width of the wall in mind, make the necessary holes.

3. **Attach the mounting bracket to the wall:** Hold mount to the wall and drill the mounting screws into the holes you made. Attach the mounting plate to the TV:

- ❑ Locate the mounting plate attachment holes on the back of the TV. These are sometimes covered with plastic or have screws already in them. If so, remove them.
- ❑ Place the mounting plate/arms on the back of the television and align them to the mounting holes. Screw the mount plate/arm in place.



Fig 2.2.17 Attaching brackets to TV

4. **Connecting the cables:** Before mounting the television, attach the necessary cables to the TV. Otherwise, if you have a fixed wall mount, it will get difficult to attach cables after mounting due to lack of space behind the TV.

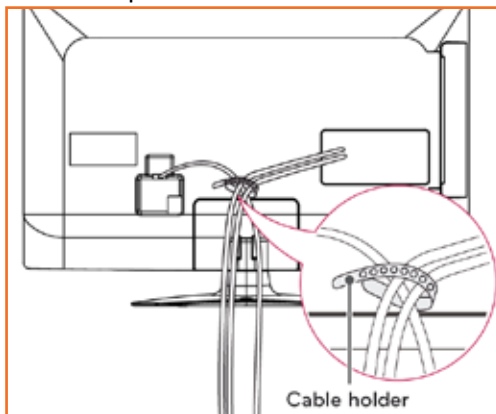


Fig 2.2.18 Binding TV cables



Fig 2.2.19 Fixing TV to bracket

5. **Mount TV to the wall:** Lift the TV carefully and line the mounting arm or plate on the TV up with the bracket on the wall and connect them following the manufacturer's instructions. Confirm a secure mount by giving the TV a slight shake.

Tidying cables

- Gather and bind the cables with the cable management clip or cable holder.
- Fix the cable management clip or cable holder firmly to the TV.

2.2.3 Setting up the TV

Making connections

Connect various external devices to the TV and switch input modes to select an external device.

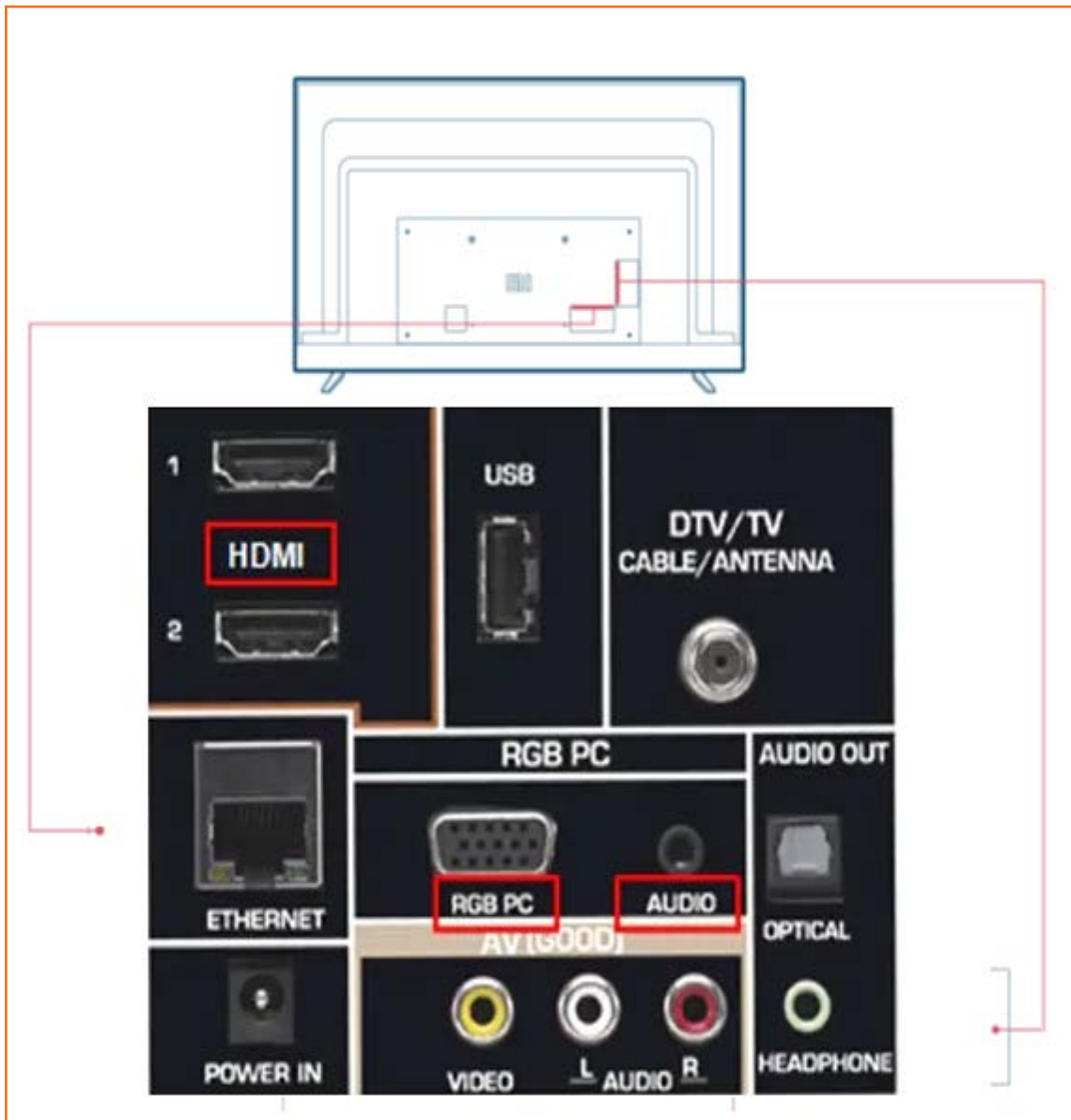


Fig 2.2.20 Input connections on TV

Connecting to an antenna or cable

Connect the TV to a wall antenna socket with an RF cable (75Ω).

- Use a signal splitter to use more than 2 TVs.
- If the image quality is poor, install a signal amplifier properly to improve the image quality.
- If the image quality is poor with an antenna connected, try to realign the antenna in the correct direction.
- An antenna cable and converter are not supplied.
- For a location that is not supported with Ultra HD broadcasting, this TV cannot receive Ultra HD

broadcasts directly.

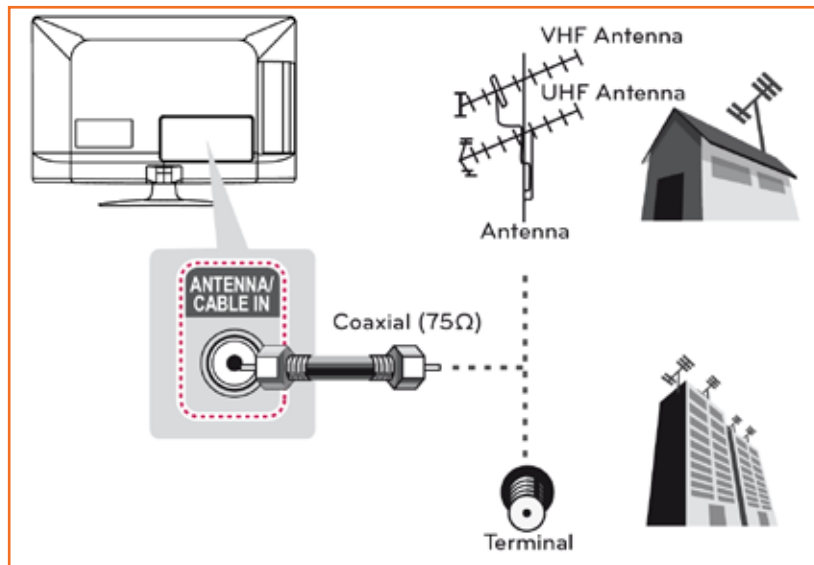


Fig 2.2.21 Antenna connections with TV

Connecting Set-top box, HD receiver, DVD, or sound system

Using HDMI port: HDMI is the best way to connect a device. It transmits the digital video and audio signals from an external device to the TV. Connect the external device and the TV with the HDMI cable as shown

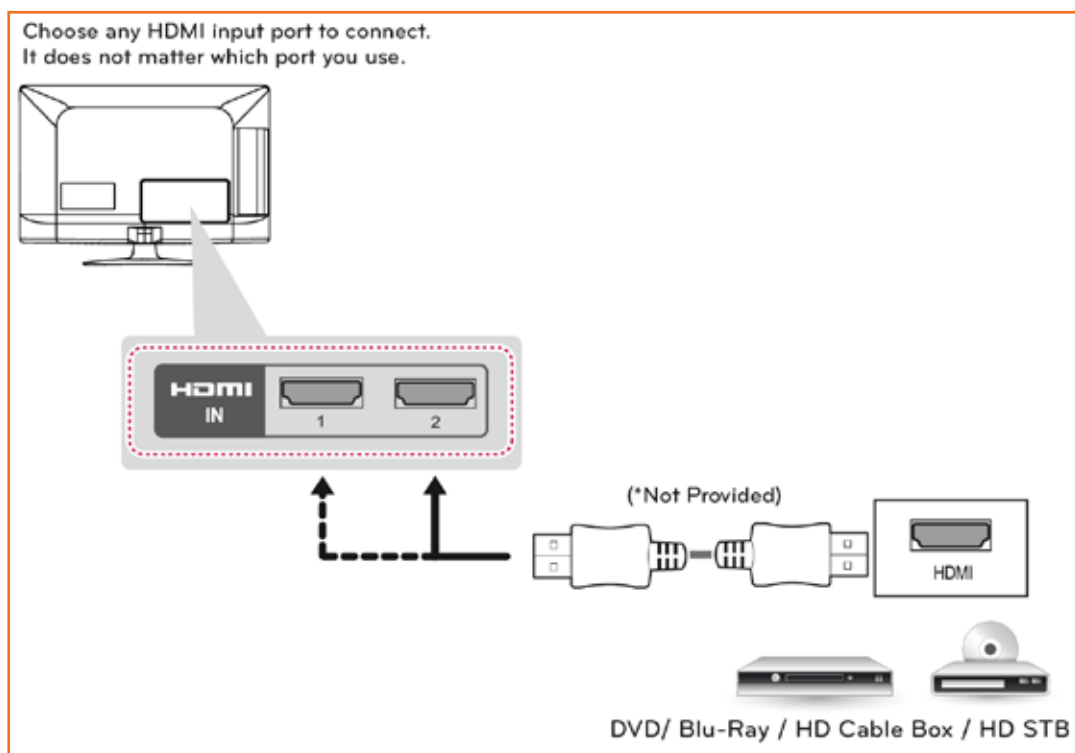


Fig 2.2.22 HDMI connections with TV

When connecting the HDMI cable, the product and external devices should be turned off and unplugged.

It can support HDMI versions 1.4, 2.0, 2.1 & 2.2 (Depending on model)

It supports HDMI Audio format (Depending on model): True HD (48 kHz),

Dolby Digital / Dolby Digital Plus (32 kHz, 44.1 kHz, 48 kHz), PCM (32 kHz, 44.1 kHz, 48 kHz, 96 kHz, 192 kHz)

- **Component Connection:** Transmits the analog video and audio signals from an external device to the TV. Connect the external device and the TV with the component cable as shown:

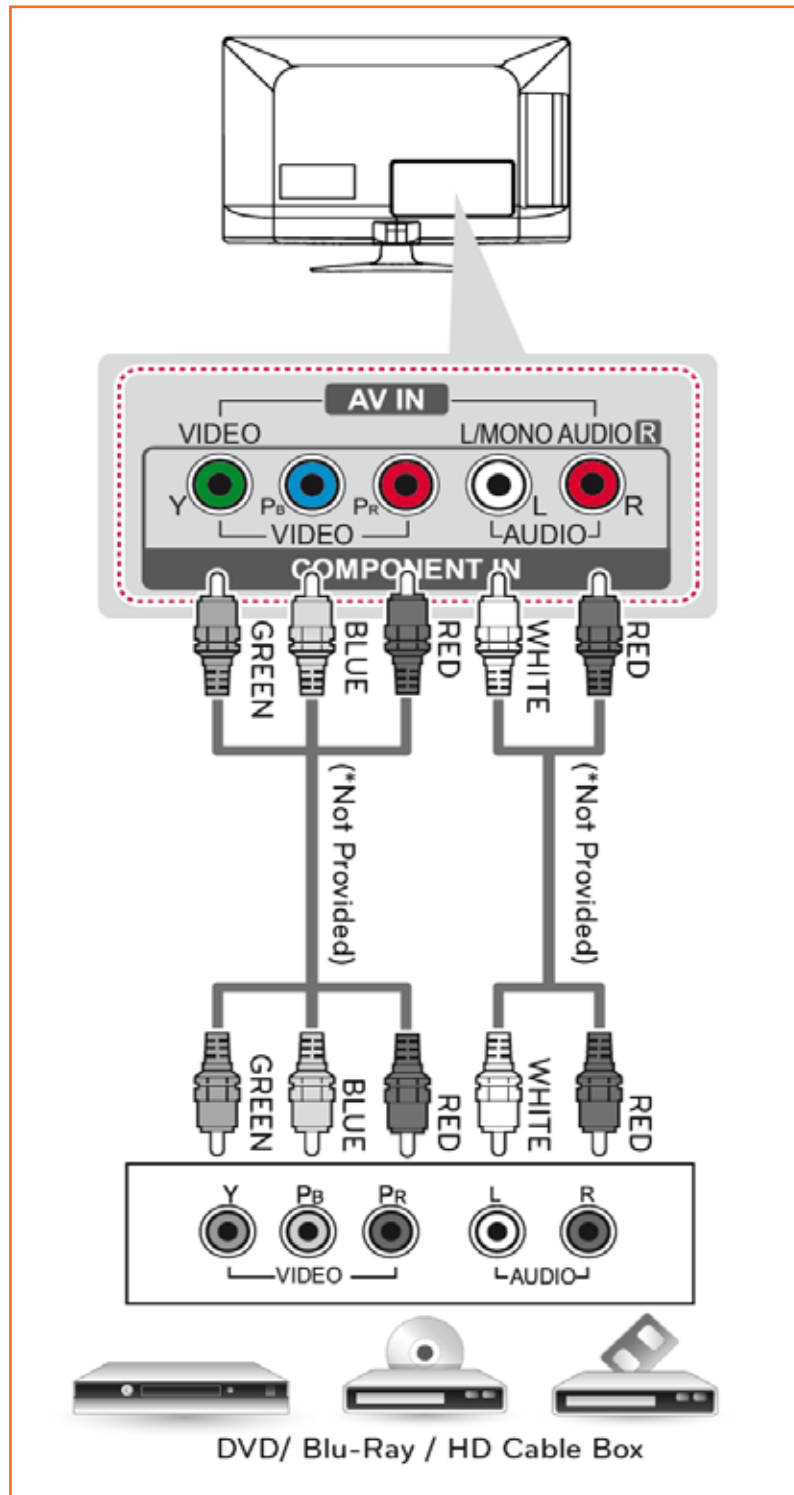


Fig 2.2.23 Component connection with TV

- **Composite Connection:** Transmits the analog video and audio signals from an external device to the TV. Connect the external device and the TV with the composite cable as shown:

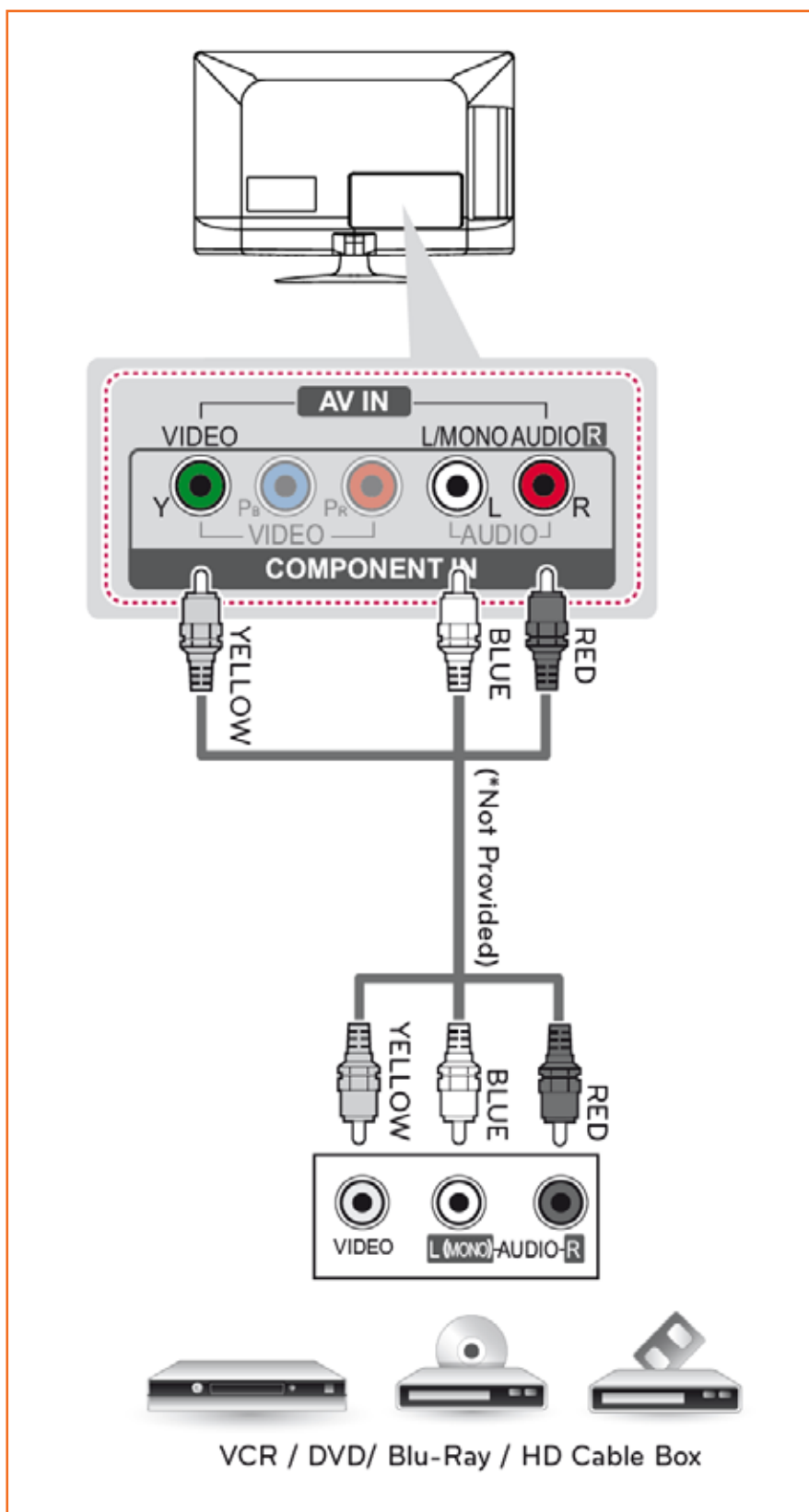


Fig 2.2.24 Composite connection with TV

Connecting to a USB

Connect a USB storage device such as a USB flash memory, external hard drive, or a USB memory card reader to the TV.

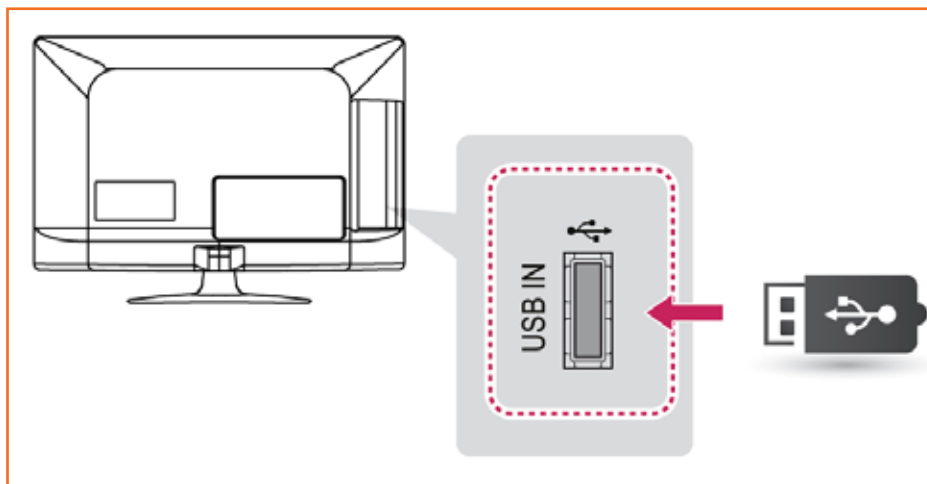


Fig 2.2.25 USB connection with TV

Compatible with USB versions also, like 2.0 3.0, 3.1 & 3.2 (depending on model)

2.2.4 Starting and Operating the TV

Steps for starting and operating the TV

1. Connect the AC Cord wire/Adaptor plug to the power input jack on the TV.
2. Connect the power cord to the AC/DC adapter first, then plug the power cord into the wall power outlet.

When you turn the TV on for the first time, the Initial setting screen appears. Select a language and customize the basic settings.

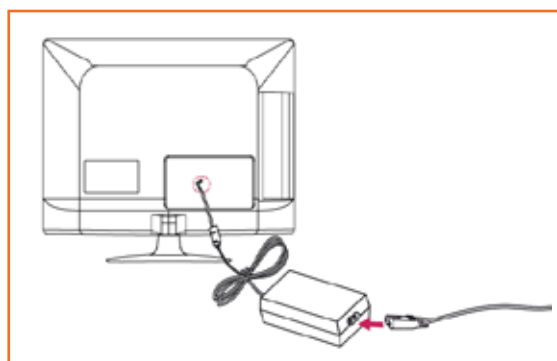


Fig 2.2.26 Connecting power cord of TV

1. Connect the power cord to a power outlet. The Power indicator turns red and the TV switches to Standby mode.
2. In Standby mode, press the power button on the remote control to turn the TV on. The Initial setting screen appears if you turn the TV on for the first time.
3. Follow the on-screen instructions to customize TV settings according to customer preferences.



Fig 2.2.27 Power button of TV

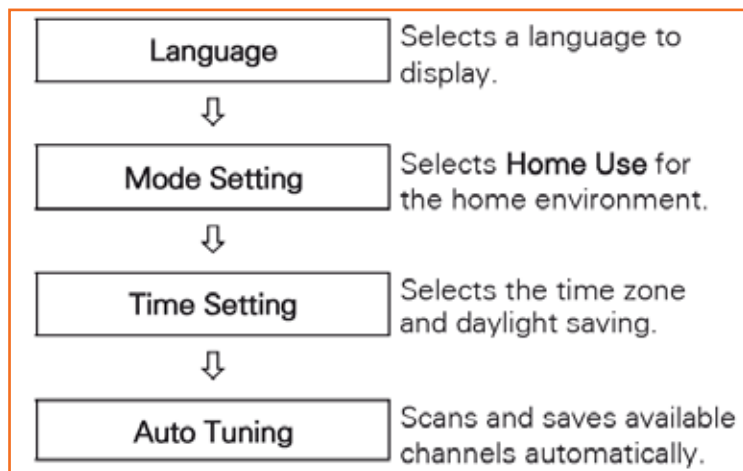


Fig 2.2.28 Making settings to start TV

4. When the basic settings are complete, press OK.
5. To turn the TV off, press the power button on the remote control.

Using the remote control

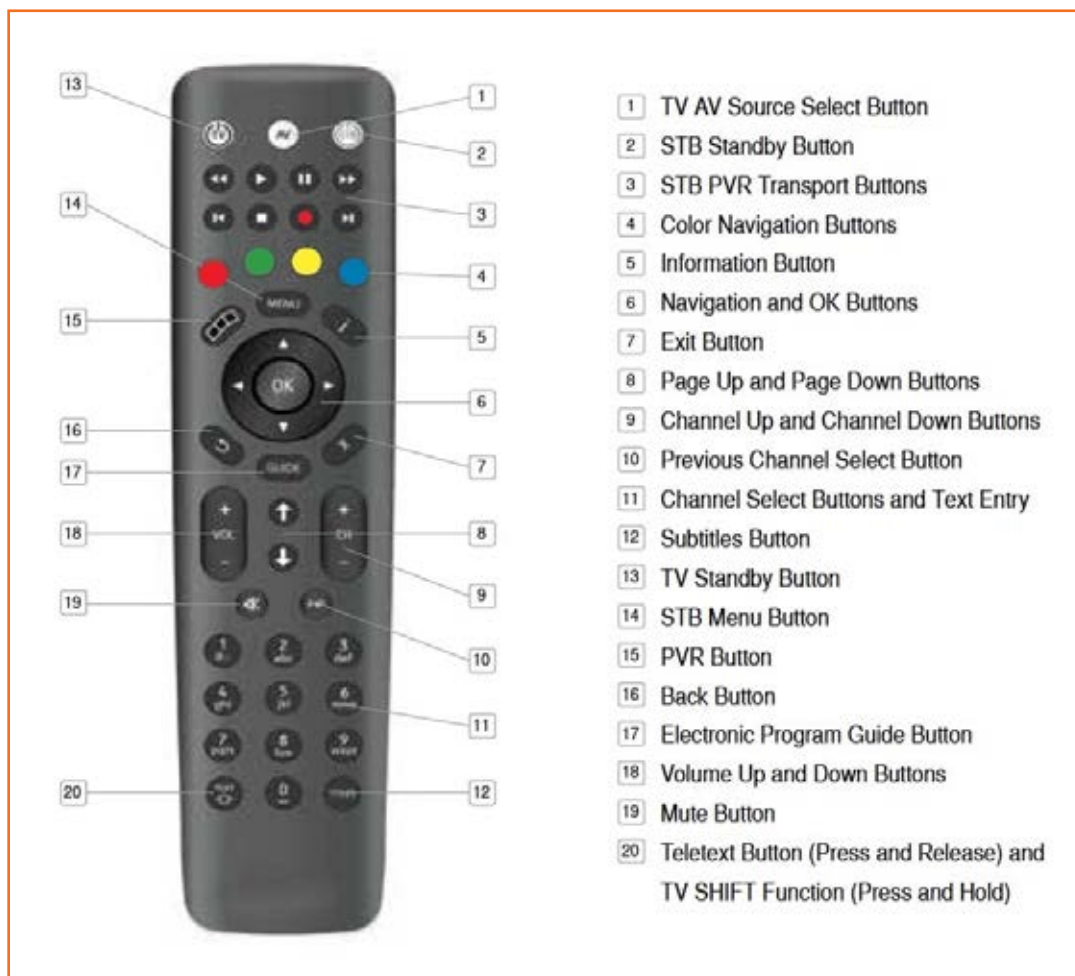


Fig 2.2.29 Remote control

2.2.5 Post-Installation Activities

Complete the Documentation

After completing the installation at the site, the technician should complete the documentation to record the details related to installation. Along with completing the documentation, the field technician should tell the customer about some do's and don'ts for using the TV. The technician should also tell the customer about important pages to be referred to from the owner's manual.

The following figure shows the installation documents -

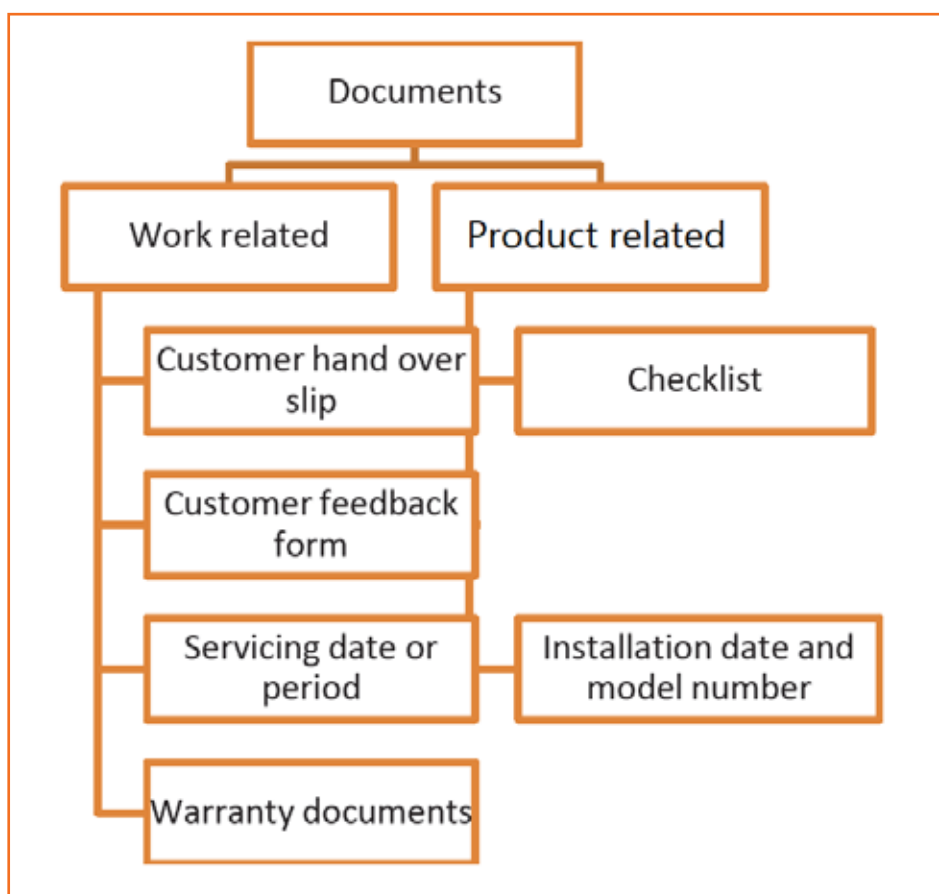


Fig 2.2.30 Documents need to maintain

Interact with Supervisor or Superior

A technician must communicate with the supervisor in case they face problem with the installation process. If there is any damage found in the product, the supervisor needs to be informed immediately. In addition, the technician needs to report to the senior about the task status and submit the documents collected from the customer's site. Listen carefully to the senior if he/she has any queries or any suggestions.

Achieve Productivity and Quality

To achieve productivity and quality as per company standards follow the working instructions given by the company.

The following figure lists some ways to achieve productivity and quality -



Scan the QR code or click on the link to watch related videos



<https://www.youtube.com/watch?v=ns0h-mQkiXU>
Installation of TV

UNIT 2.3: Troubleshooting and Repairing of TV

Unit Objectives

At the end of this unit, participants will be able to:

1. Demonstrate procedure of troubleshooting and repairing of faults in TV.

2.3.1 Troubleshooting and Repairing of Problems in TV

A Multiskill Technician should have the knowledge and skill to repair all kinds of TVs. He should be able to diagnose and troubleshoot the problem. He should carry out repairs according to the requirements of that particular model.

It is very important for a technician to correctly identify the fault in the TV. Wrong identification of fault will lead to waste of time and money and it can also cause damage to the equipment.

The following figure shows the steps for identifying the fault:

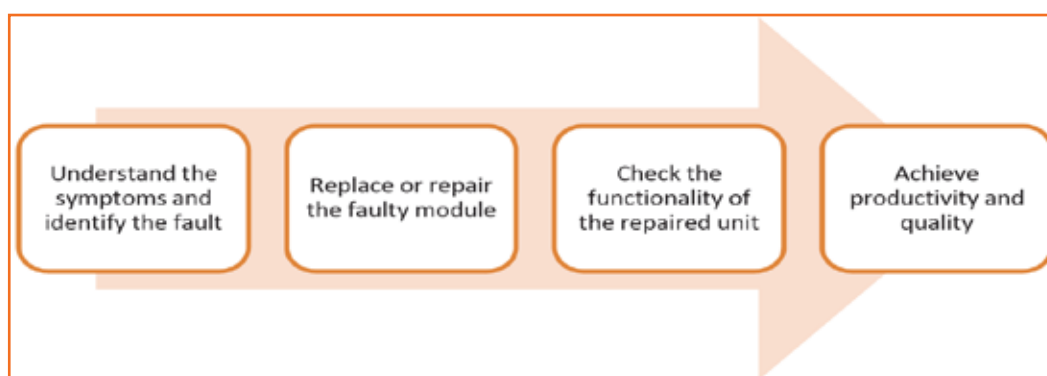


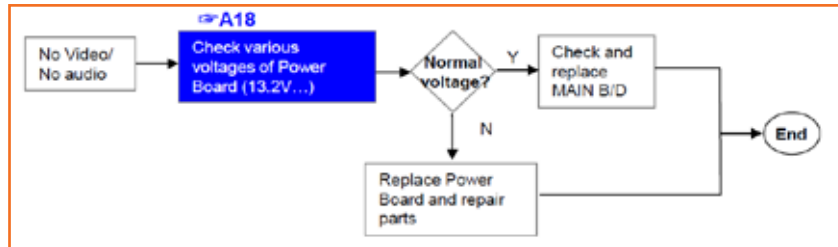
Fig 2.3.1 Steps for identifying fault

The following table represents the common problems in the working of a TV along with their solutions:

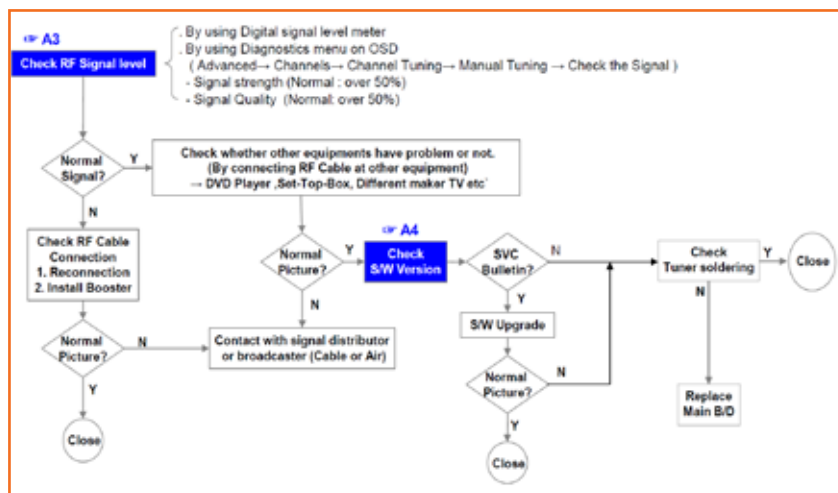
Problem and solution	
Video error	No video/Normal audio <pre> graph TD Start([No video Normal audio]) --> D1{Normal audio?} D1 -- Y --> A1[Check Back Light On with naked eye] D1 -- N --> Move[Move to No video/No audio] A1 --> D2{On?} D2 -- Y --> A18_1[Check Power Board 13.2V etc.] D2 -- N --> A18_2[Check Power Board 13.2V output] A18_1 --> D3{Normal voltage?} D3 -- Y --> ReplaceTcon[Replace T-con/Main Board or module] D3 -- N --> RepairPB1[Repair Power Board or parts] A18_2 --> D4{Normal voltage?} D4 -- Y --> ReplaceInv[Replace Inverter or module] D4 -- N --> RepairPB2[Repair Power Board or parts] ReplaceInv --> End((End)) RepairPB2 --> End </pre>

Problem and solution

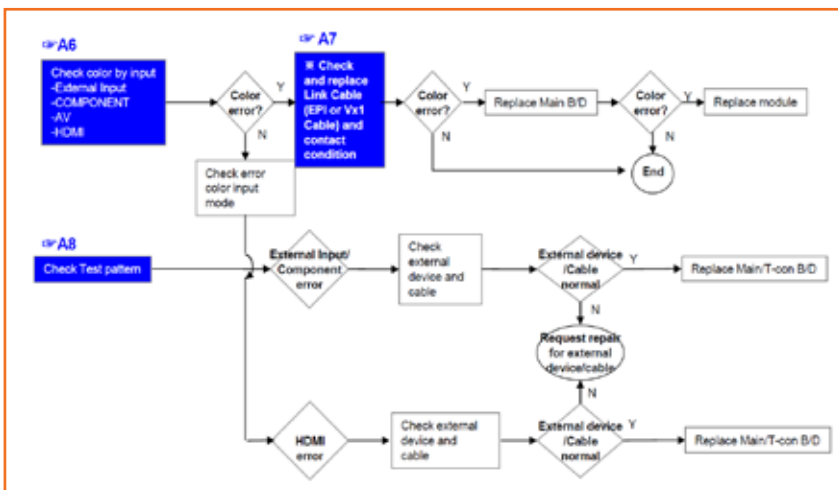
No video/No audio



Picture broken/Freezing

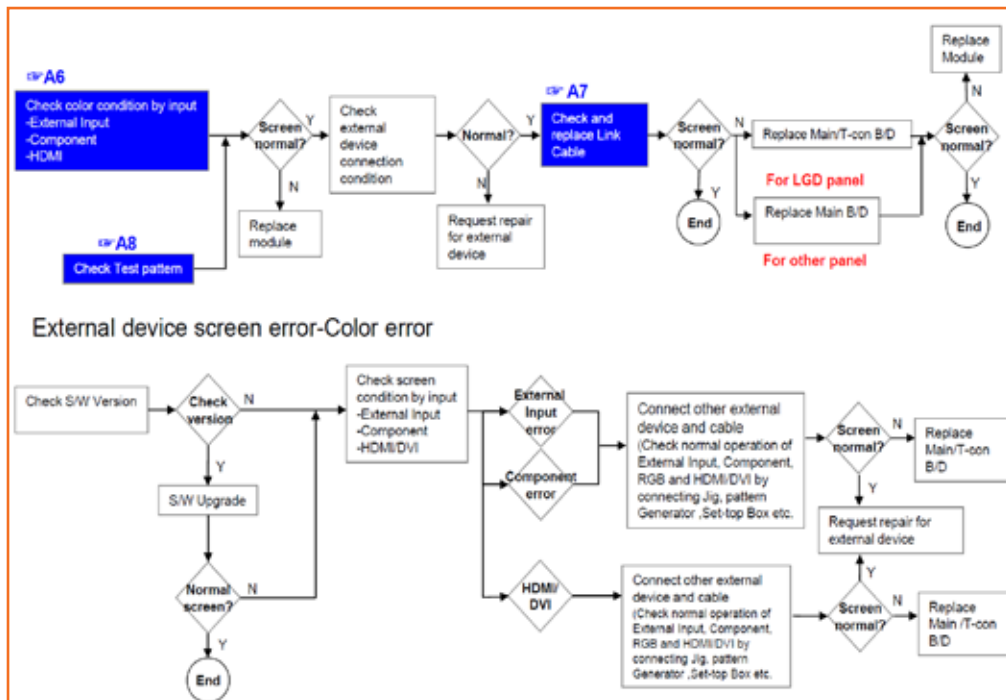


Color error



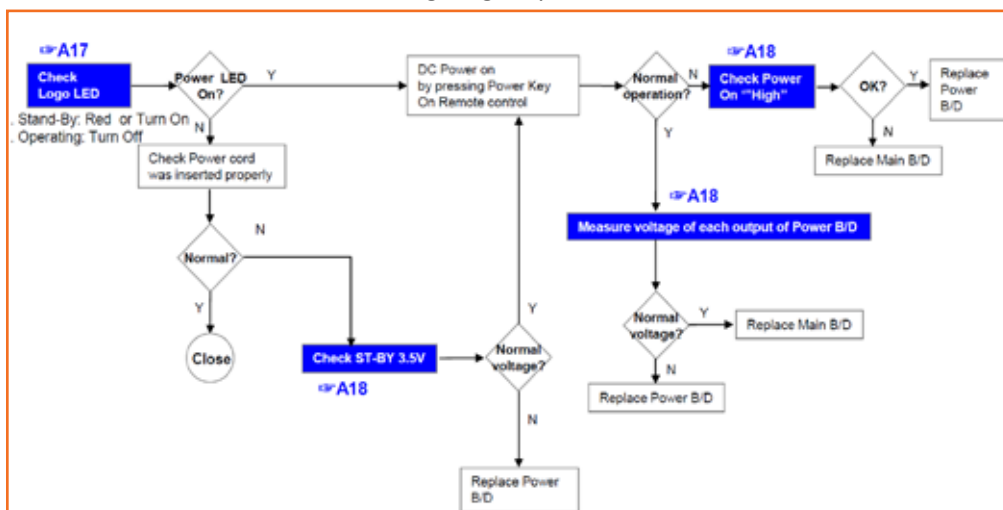
Problem and solution

Vertical/Horizontal bar, residual image, light spot, external device color error



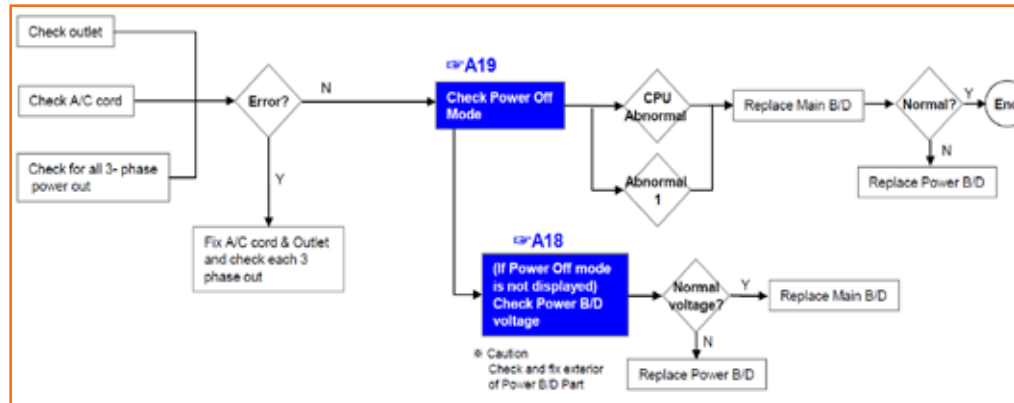
Vertical/Horizontal bar, residual image, light spot, external device color error

Power error

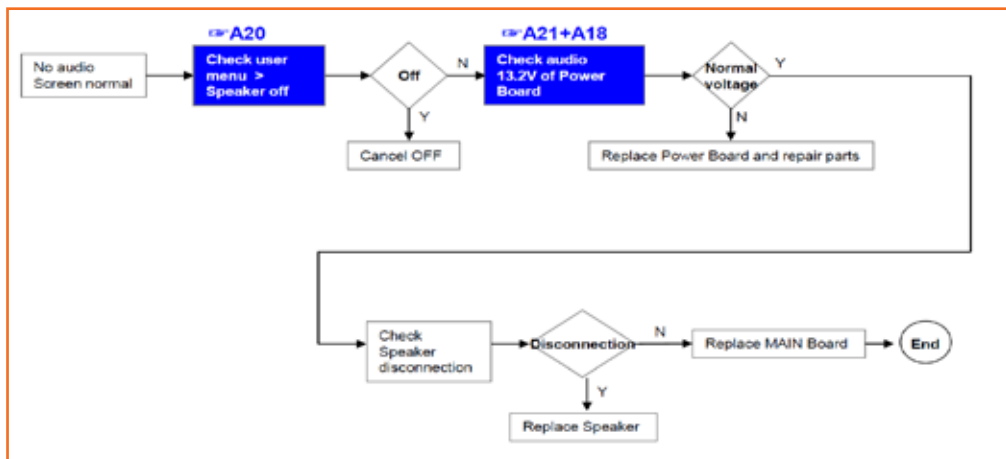


Problem and solution

Off when on, off while viewing, power auto on/off

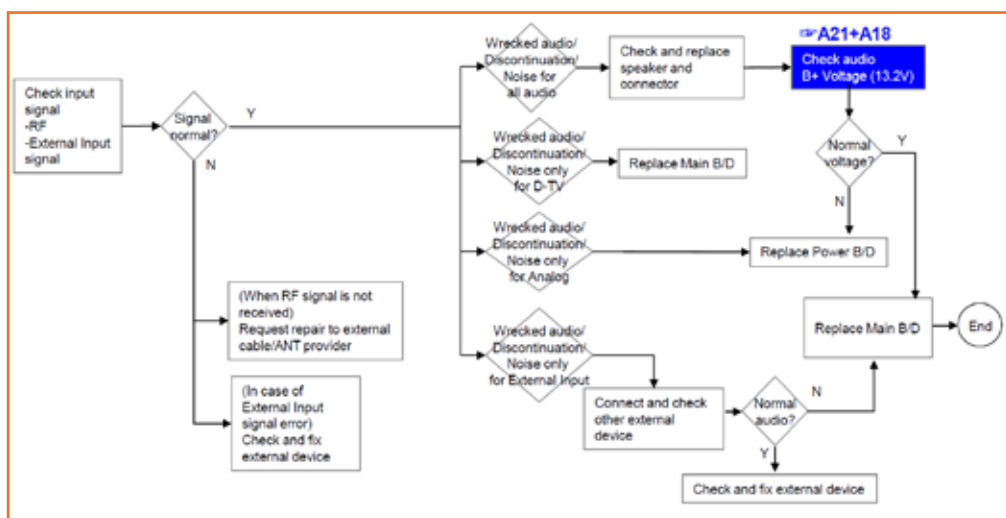


No audio/Normal video



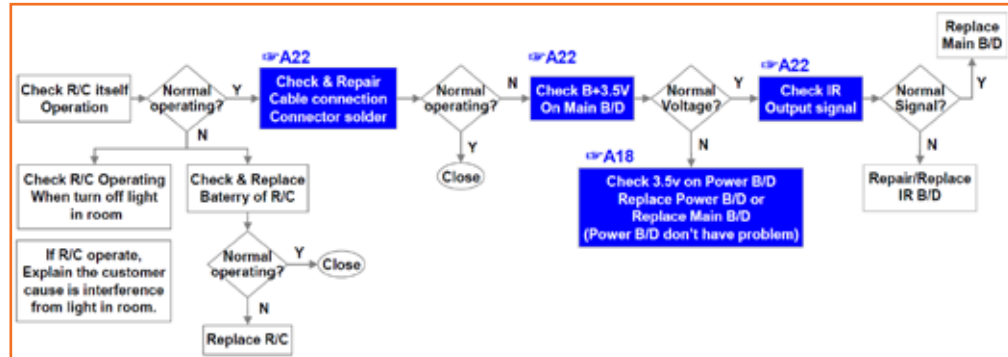
Audio error

Wrecked audio/discontinuation/noise

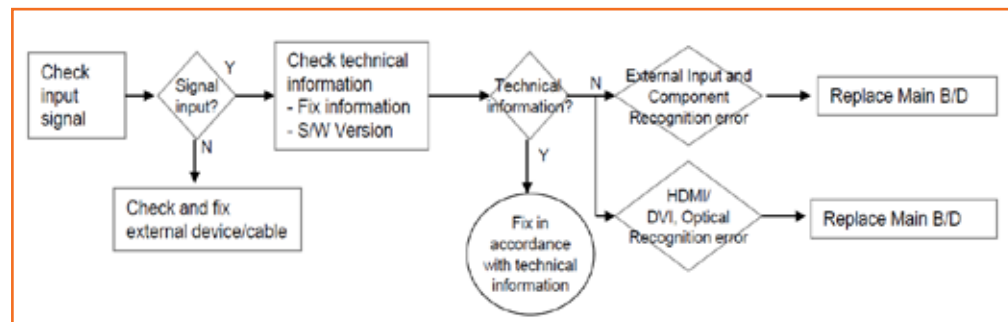


Problem and solution

Remote control & Local switch checking

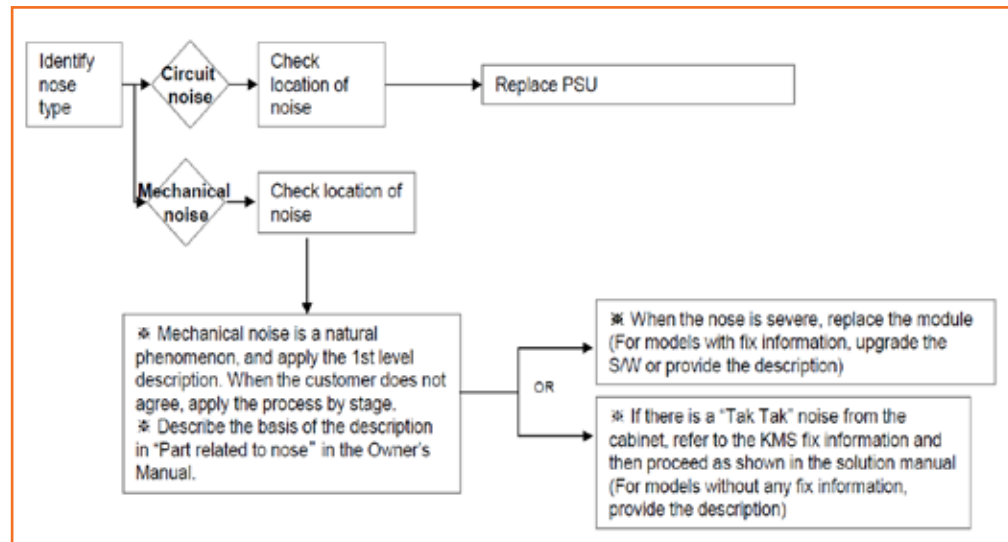
Function
error

External device recognition error



Noise

Circuit noise, mechanical noise



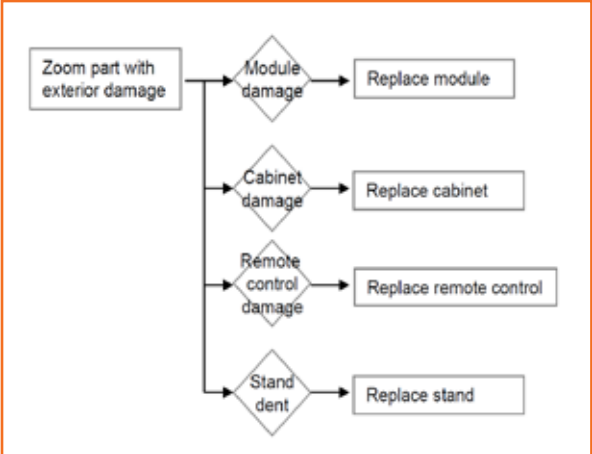
Problem and solution	
Exterior error	Exterior defect  <pre> graph LR A[Zoom part with exterior damage] --> B{Module damage} A --> C{Cabinet damage} A --> D{Remote control damage} A --> E{Stand dent} B --> F[Replace module] C --> G[Replace cabinet] D --> H[Replace remote control] E --> I[Replace stand] </pre>

Table 2.3.1 Common problems and their solutions in LED/LCD TV

Examples of Symptoms

Exchange Main Board



Abnormal Power Section



Abnormal Power Section



Solder defect, Short/Crack



Solder defect, Short/Crack



Fuse Open, Abnormal power section



Abnormal Display



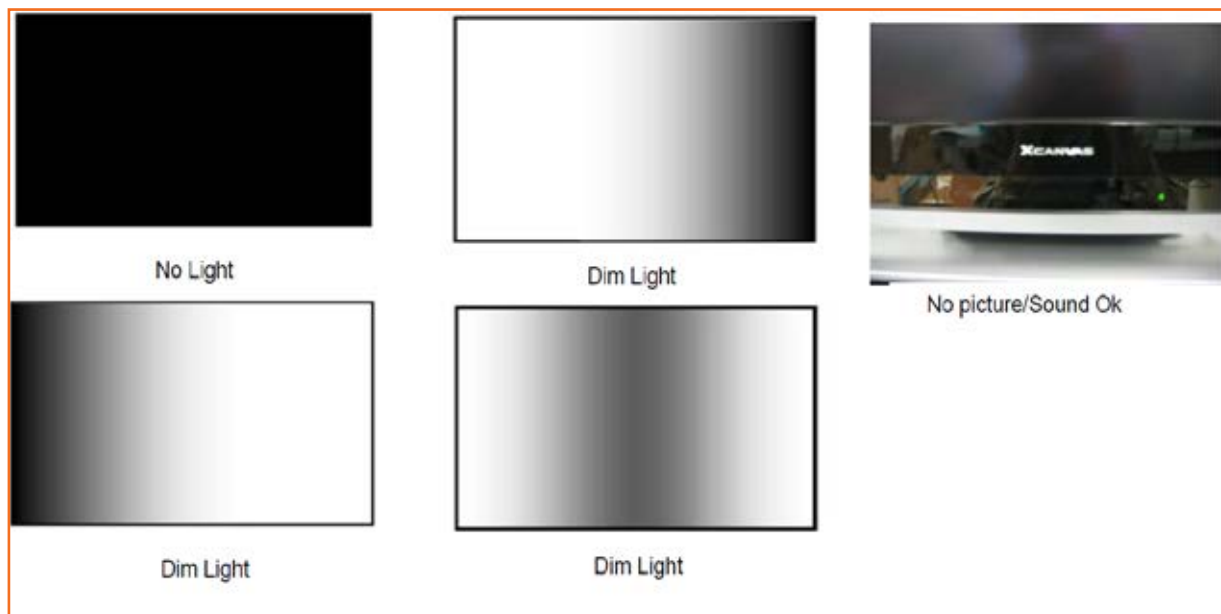
GRADATION



Noise



GRADATION

Exchange Power Board (PSU)**Power failure mode****Service and Design Data:**

This data is very important and useful for service personnel. Each Company provides its engineers with such data and its code. Using this data, an engineer can check and do many adjustments and resolve many issues in field without opening the back cover of the set. Same is true for CRT TVs and FPDs. Using this data engineers can check, adjust picture, contrast, brightness, backlight intensity etc. and can also check / load SW as in some cases data loading through USB can be done by first entering service data. However, before changing service data values, engineer should note the current data in his diary so that if the fault is not resolved by change of data, he should restore the original data.

We have shown above certain basic faults which can occur in any Company's any model FPD TV. However; there are certain faults which can be Company specific. These can be due to design, Quality Control issues, Model specific or solution / microprocessor specific, production issues, parts specific or Company's service policy or lack of technical expertise by the field technician. These can also be due to Inward Quality Control known as IQC or Outward Quality Control known as OQC. Many Times in some companies, if a specific part is not available, R&D / QC may allow use of an equivalent part. But if that part has not been tested and Service also has not been trained about its use, the part may fail in field. If ESD safety measures are not used in production, stores and service even then parts may totally fail or may fail and behave intermittently. In LCD / LED TV In LCD TV, such faults can occur due to

- **Panel Faults:** If a particular panel is chosen and the panels have some inherent defects
- **Software or Firmware Faults:** The firmware is Company specific and customized as per its requirements. The set may hang or function intermittently or behave erratically if there is a firmware fault.

Apart from this there can be different faults in LED, OLED and Plasma TV because of difference in power requirements of these sets and also because of different methods of backlighting eg. Edge lighting in LED TV while OLED and Plasma have their own light and do not use any backlight.

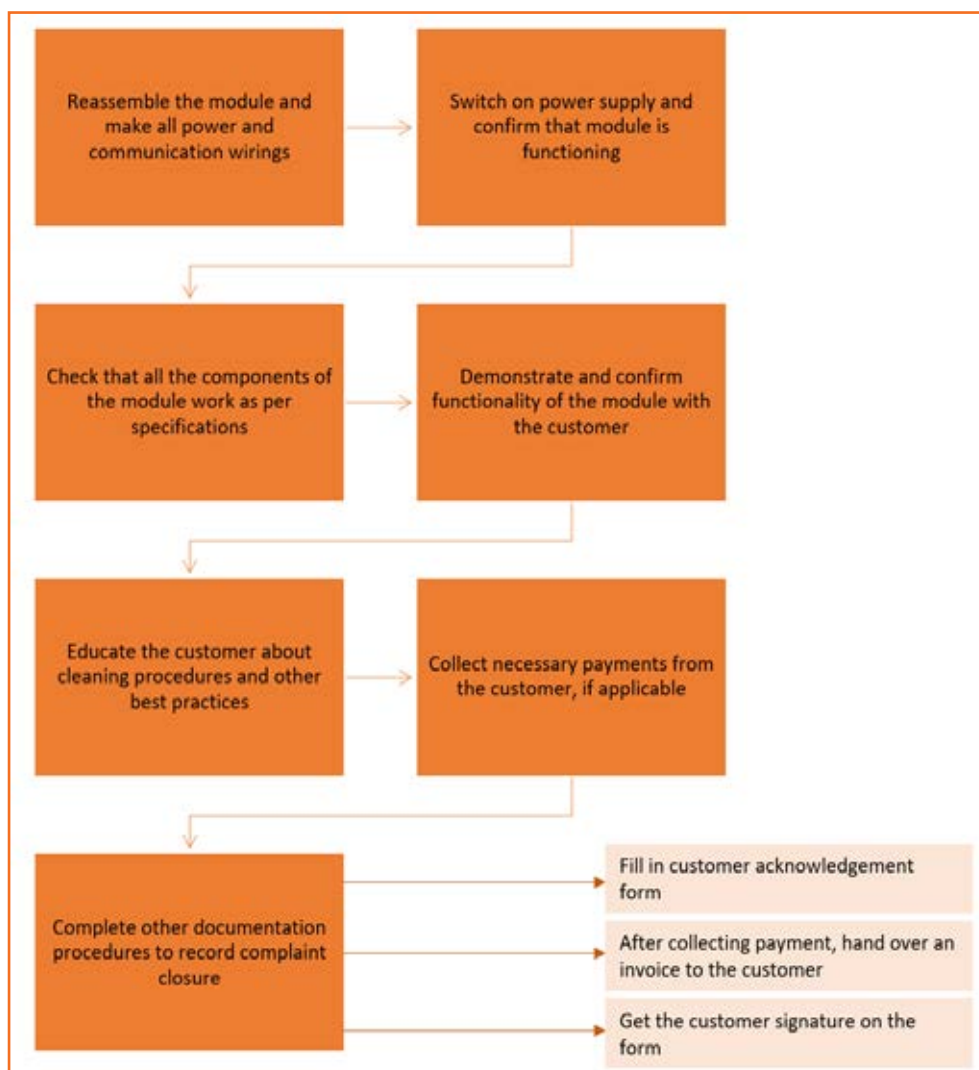
Replacing Faulty Module/Spare Parts

In case the technician is unable to repair the components or fix the fault, or if the components cannot be replaced at customer's site, then the faulty module/component is sent to the service centre. The field technician then collects the functional module from the service centre and replaces the defective component at the customer's site.

Confirming Functionality of the Repaired Module/Spare Parts

After the faulty module has been repaired or replaced, check the new module with testing equipment such as multimeter and ammeter. This is done to ensure that the module is working fine with the other parts of the TV.

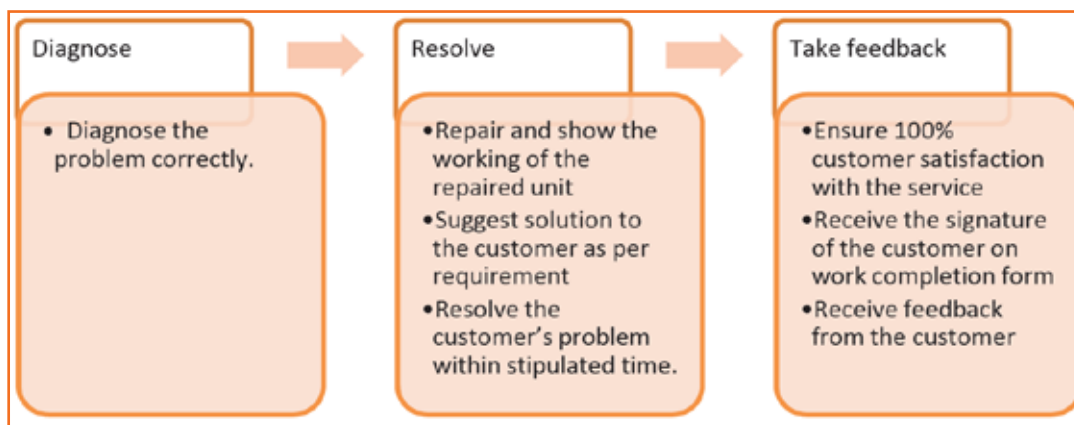
The following figure shows the steps for confirming functionality of the repaired module/spare parts -



Achieving Productivity and Quality as per Company's Norms

To achieve productivity and quality as per company standards, a technician should follow the working instructions given by the company.

The following figure shows the steps for achieving productivity and quality practice the following -



Exercise



1. Name the cards used in a LCD TV.
2. What are the main voltages in a LCD TV?
3. What is CCFL?
4. Which colours are used to produce all colours in a LCD TV?
5. How will you connect a Laptop having HDMI output to a LCD TV.
6. You have a pendrive and have saved a movie in it. Can you play it on a LCD TV/ How?
7. Can you use a detergent or Colin Spray to clean panel of a LCD TV?
8. What is the best height for mounting LCD on a wall?
9. A customer has a wooden partition in his room and asks you to mount the LCD TV on it? What will you do?

Notes



A large rectangular area with a thin orange border, containing 25 horizontal lines for writing notes.



3. Install and Repair Microwave

Unit 3.1 – About Microwave Oven

Unit 3.2 – Installation and Operation of Microwave Oven

Unit 3.3 – Troubleshooting and Repairing of Microwave Oven



Key Learning Outcomes



At the end of this module, participants will be able to:

1. Describe use and function of microwave oven
2. List parts of a microwave oven
3. Demonstrate procedure of installing a microwave oven
4. Demonstrate how to setup and use the features of microwave oven
5. Demonstrate procedure of troubleshooting and repairing of faults in microwave oven

UNIT 3.1: About Microwave Oven

Unit Objectives

At the end of this unit, participants will be able to:

1. Describe use and function of microwave oven
2. List parts of a microwave oven

3.1.1 Microwave Oven

A microwave oven is an electric oven that heats and cooks food by exposing it to electromagnetic radiation in the microwave frequency range. A microwave oven heats food by passing microwave radiation through it. Once these waves come in contact with food, water molecules in the food get excited; this generates heat and cooks the food.

A variant of the conventional microwave oven is the convection microwave oven. A convection microwave oven is a combination of a standard microwave oven and a convection oven. It allows food to be cooked quickly, yet come out browned or crisped, as from a convection oven. Convection microwave ovens are more expensive than conventional microwave ovens. Some convection microwave ovens—those with exposed heating elements—can produce smoke and burning odors as food spatter from earlier microwave-only use is burned off the heating elements. Some ovens use high speed air; these are known as impingement ovens and are designed to cook food quickly in restaurants, but cost more and consume more power.



Fig 3.1.1 Microwave oven

The difference between convection microwave ovens and microwaves is that the latter emits waves that bounce around in the microwave. Once these waves come in contact with food, water molecules in the food get excited; this generates heat and cooks the food.

On the other hand, in a convection microwave oven, the heating element is assisted by a fan that forces air movement around the oven and heats it up completely, thus cooking food evenly from the inside out.

Uses of Microwave Oven

- Reheating food
- Cooking
- Boiling water

3.1.2 Components of a Microwave Oven

The microwave parts diagram below shows the general parts of a microwave.



Fig 3.1.2 Components of microwave oven

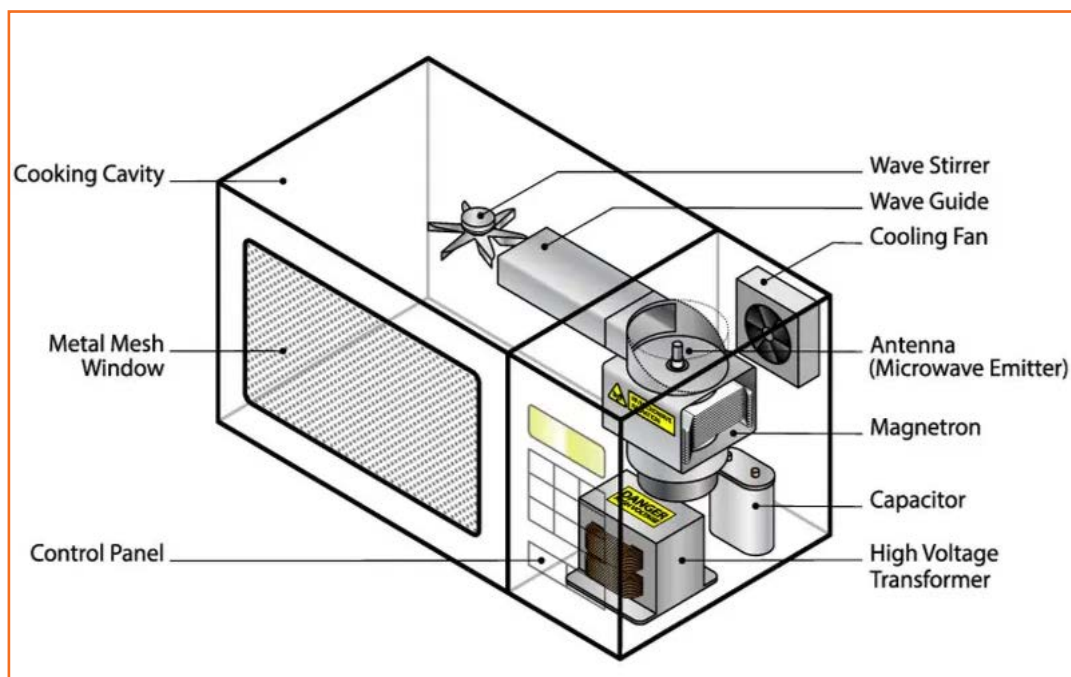


Fig 3.1.3 Components of microwave oven

There are several parts of a microwave, and they each have a specific role in heating your food. They consist of internal components that help cook the food and external pieces that prevent radiation from escaping.

The parts of a microwave are similar in all units but may vary to a degree. Each component performs a particular function to deliver thoroughly cooked meals safely and efficiently.

These include:

- **Internal parts:** Magnetrons, high-voltage transformer, high voltage capacitor, high voltage diode, waveguide, cooling fan, turntable, and cooking cavity.
- **External components:** Case, power cord, door, and control panel.

Turntable: The turntable is the round plate in the cooking cavity that rotates to help cook food evenly. Make sure the turntable is always securely in place before placing meals on it and using your microwave.



Magnetron: The magnetron produces the actual microwaves that reflect off the cooking cavity walls and flow through the turntable and cookware to the food. These waves interact with the food to produce heat and friction, which cooks your meals.



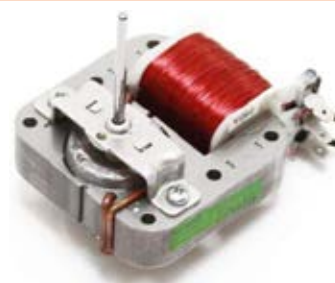
Voltage transformer: Since most electrical outlets use about 220 volts of electricity, a voltage transformer converts this into a higher voltage for fast heating and cooking. Typical home microwave transformer has TWO secondary windings. The low voltage winding provides 3.1 to 3.2 volts. While the high voltage winding provides 1800 to 2800 volts (average 2200 volts).



Waveguide: The waveguide directs the flow and transports the actual microwaves to the cooking cavity.



Cooling fan: A cooling fan keeps your microwave cool, and it automatically kicks on when you are using appliance. In some microwaves, this fan may also automatically cycle on and off to keep the microwave cool if you are using the cooktop below. These types of microwaves also have a separate vent fan that helps to remove moisture and odours from the cooktop below it.



Cooking cavity: The cooking cavity is the compartment inside microwave where you heat, defrost and cook meals. Regular cleaning the interior of microwave is key in order to keep it functioning optimally.



Power cord: No matter the type of microwave you have, the power cord gives it the ability to cook, re-heat, defrost and more. Most microwaves will need a grounded 3-pin outlet with a 220 volt and 15 to 20-amp electrical supply. Refer to your owner's manual for model-specific requirements.



Control panel: A microwave control panel is the exterior display that has buttons for using your microwave, like timed cooking, defrosting and convenient preset options for heating pizza, popcorn, frozen entrees and more. Some microwaves are equipped with Electronic Touch Controls and convenient Add 30 Seconds buttons for quick heating at 100% power.



Door: A microwave door has a window for you to view your food while it cooks and rotates on the turntable. In some microwaves, the appliance will not function if the door has been closed for five minutes or more without being started. If this occurs, a message will display on control panel. Simply open and close the door to reset.



Exterior Case: The outer case is the outer metal shell of the microwave that houses the inner components and cooking chamber. Waves stay inside the cavity when the sealed door creates a seal to protect you from radiation during the cooking cycle.

Table 3.1.1 Components of microwave oven

UNIT 3.2: Installation and Operation of Microwave Oven

Unit Objectives



At the end of this unit, participants will be able to:

1. Demonstrate procedure of installing a microwave oven
2. Demonstrate how to setup and use the features of microwave oven

3.2.1 Site Requirements for Installation

The first step of an installation process is to conduct a site survey and ensure that it meets all the requirements. The selected site should comply with all the safety codes and should not interfere with normal movement of people.

The following are the site requirements of installing a microwave oven:

- Select a well-ventilated place
- Place the microwave away from direct sunlight
- Place on a firm, level place

After checking the site requirements, the next step is to check the power supply at the location site.

The following are the power requirements for installation:

- Ensure that voltage and electrical wiring is appropriate
- Use a separate socket for microwave oven
- Ensure wall socket is properly earthed
- Place the microwave oven close to the electrical outlet
- Try to avoid use of an extension cord

3.2.2 Installation Process

The installation process consists of unpacking the unit, disposing the packing material and installing the microwave oven at the designated place.

Unpacking microwave oven

To protect the microwave oven from any kind of damage, it is properly packed and delivered. Once it is transported from the delivery truck, it needs to be carefully unpacked.

The following are the tools that are needed for unpacking and handling a microwave oven:



Fig 3.2.1 Requirements for unpacking microwave oven

Steps for unpacking and installing a microwave oven:

1. Cut the binding strip of carton
2. Remove the adhesive tapes and open the top flaps
3. Remove the carton
4. Unpack the microwave oven protector and place it on a flat surface of your choice with more than 85cm height but make sure there is at least 20 cm of space on the top and 20 cm at the rear & left & right for proper ventilation. The front of the oven should be at least 8 cm from the edge of the surface to prevent tipping.

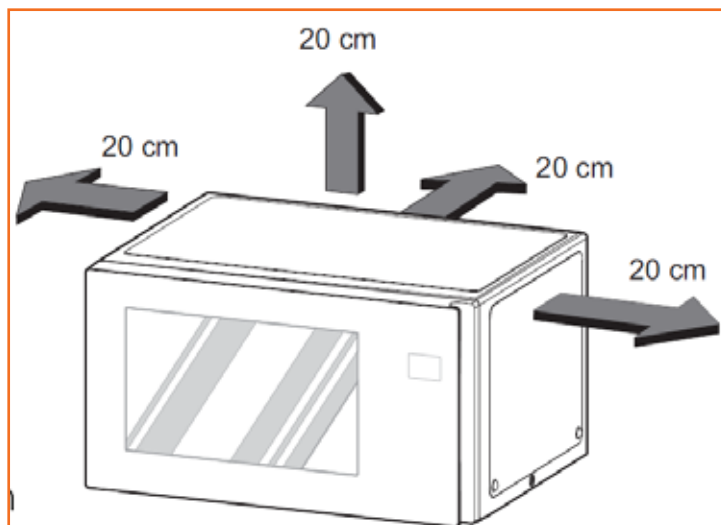


Fig 3.2.2 Area requirements for placing microwave oven

5. Take out the manual, power cord, turntable etc. out of the accessories bag.



Fig 3.2.3 Accessories in a microwave oven

Note: Accessory items may vary depending upon model.

6. Plug your oven into a standard household socket. Make sure oven is the only appliance connected to the socket. If oven does not operate properly, unplug it from the electrical socket and then plug it back in.
7. Open the oven door by pulling the door handle. Place the rotating ring inside the oven and place the glass tray on top.



Fig 3.2.4 Placing glass tray in oven

8. Press the STOP/CANCEL button, and press the START button one time to set 30 seconds of cooking time.
9. The DISPLAY will count down from 30 seconds. When it reaches 0 it will sound BEEPS. Open the oven door and test the temperature of the water. If oven is operating the water should be warm.

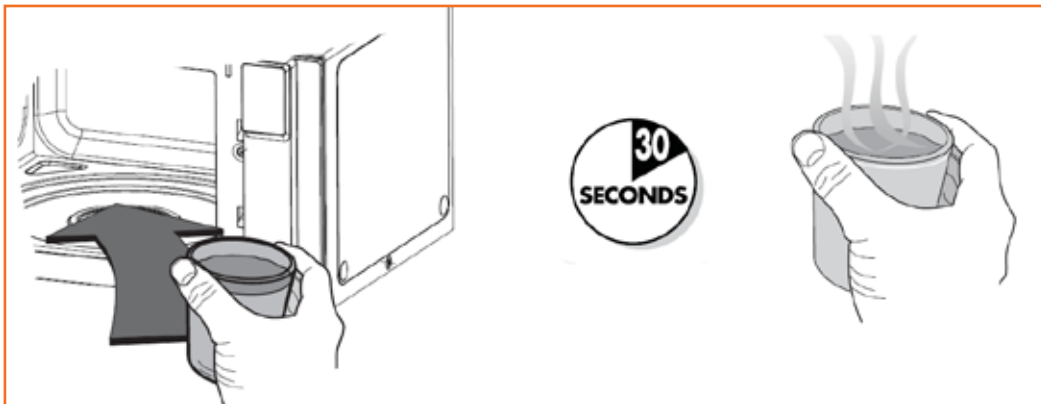


Fig 3.2.5 Checking working of oven

If oven gets overheated, then oven and its display will be turned off for safety purpose, give it some time to cool and then operate.

3.2.3 Operating Microwave Oven

After the installation process, technician has to explain the operation, security features and use of control panel for using different cooking functions of microwave oven.

Use of control panel

Icon	
	When operate Microwave, Show up the icon on the display.
	When operate Inverter Cook / Steam Cook, Show up the icon on the display.
	When operate Inverter Defrost, Show up the icon on the display.
	When you can set More/Less, Show up the icon on the display.
	When you can Cook Start, Show up the icon on the display.
	When you can set Output Power, Show up the icon on the display.
	When you can set Weight, Show up the icon on the display.

Fig 3.2.6 Icons on control panel

Setting the child lock

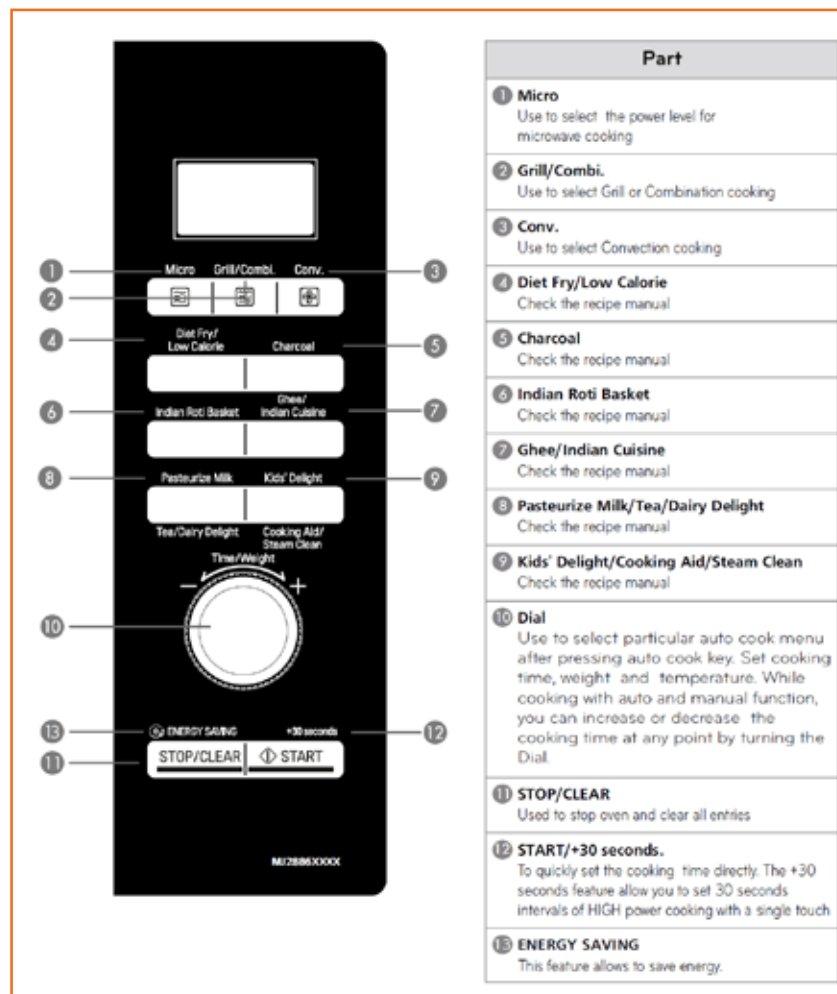


Fig 3.2.7 Operations on control panel of oven

1. Press and hold STOP/CLEAR
2. Press and hold STOP/CLEAR until “L” appears on the display and BEEP sounds.



Fig 3.2.8 Setting child lock

3. To cancel CHILD LOCK press and hold STOP/CLEAR until “L” disappears. You will hear BEEP when it is released.

Setting 2 minutes of cooking

1. Press and hold STOP/CLEAR
2. Press START/+30 seconds four times to select 2 minutes

Oven will start before you have finished the fourth press

3. During START/+30 seconds cooking, you can extend the cooking time up to 99 minutes 59 seconds by turning the Dial.

Micro Power cooking

In the following example, show how to cook some food on 720 W power for 5 minutes.

1. Press and hold STOP/CLEAR
2. Press Micro until display shows “720”
3. Turn Dial until display shows “5:00”
4. Press START/+30 seconds

Micro Power Levels in Oven

Different models have different micro power levels and settings.

Considering example of a microwave oven is equipped with 5 power levels to give you maximum flexibility and control over cooking. The table below shows the examples of food and their recommended cooking power levels for use with this microwave oven.

Power Level	Output	Use	Accessory
High	900 W	- Boil water - Brown minced beef - Cook poultry pieces, fish, vegetables - Cook tender cuts meat	Microwave safe plate/ Microwave safe bowl/ Microwave safe glass bowl

Power Level	Output	Use	Accessory
Medium High	720 W	• All reheating • Roast meat and poultry • Cook foods containing cheese and eggs	Microwave safe plate/ Microwave safe bowl/ Microwave safe glass bowl
Medium	540 W	• Bake cakes and scone • Prepare eggs • Cook custard • Prepare rice, soup	Microwave safe plate/ Microwave safe bowl/ Microwave safe glass bowl
Medium Low	360 W	• All thawing • Melt butter and chocolate • Cook less tender cuts of meat	Microwave safe plate/ Microwave safe bowl/ Microwave safe glass bowl
Low	180 W	• Soften butter & cheeses • Soften ice cream	Microwave safe plate/ Microwave safe bowl/ Microwave safe glass bowl

Operating auto cook or pre-programmed functions in a Microwave Oven

In the following table, you can find some examples of auto cook or pre-programmed functions operating methods.

Cook Functions	Diet Fry/ Low Calorie	Charcoal	Indian Roti Basket	Ghee/ Indian Cuisine	Pasteurize Milk/Tea/ Dairy Delight	Kids' Delight/ Cooking Aid/ Steam Clean
STEP-1	Press STOP/ CLEAR	Press STOP/ CLEAR	Press STOP/ CLEAR	Press STOP/ CLEAR	Press STOP/ CLEAR	Press STOP/ CLEAR

STEP-2	Press Diet Fry & twice for Low Calorie	Press Charcoal	Press Indian Roti Basket	Press Ghee & twice for Indian Cuisine	Press Pasteurize Milk & twice for Tea/Dairy Delight	Press Kids' Delight & twice for Cooking Aid/Steam Clean
STEP-3	Turn Dial to select the Menu (dF1-dF25 HP1-HP25 So1-So18 Co1 -Co24)	Turn Dial to select the Menu (CH1 -CH25)	Turn Dial to select the Menu (br1-br25)	Turn Dial to select the Menu (Gh1 IC1-IC26 SC1-SC15 rd1 -rd15 CC1-CC10)	Turn Dial to select the Menu (PS1 dd1 -dd5) PA1 CU1-CU2)	Turn Dial to select the Menu (CF1-CF25 bA1-bA15 UC1-UC12) SL 1)
STEP-4	Press START/+30 seconds	Press START/+30 seconds	Press START/+30 seconds	Press START/+30 seconds	Press START/+30 seconds	Press START/+30 seconds
STEP-5	Turn the dial to select the weight	Turn the dial to select the weight	Turn the dial to select the weight	Turn the dial to select the weight	Turn the dial to select the weight	Turn the dial to select the weight
STEP-6	Press START/+30 seconds	Press START/+30 seconds	Press START/+30 seconds	Press START/+30 seconds	Press START/+30 seconds	Press START/+30 seconds

Microwave-safe utensils

Materials that can be used in the microwave oven

- **Dinnerware:** Microwave-safe only. Do not use cracked or chipped dishes. Make sure there is no metallic elements or parts.
- **Glass jars:** Always remove the lid. Use only to heat up food until it is just about warm. Most glass jars are not heat-resistant and may break.
- **Glassware:** Heat-resistant oven glass ware only. Make sure there is no metallic elements or parts. Do not use cracked or chipped dishes.
- **Oven cooking bags:** Follow manufacturer's instructions. Do not close with metal tie.
- **Plastic:** Microwave-safe only. Follow the manufacturer's instructions. Should be labelled

“microwave safe “.

- **Plastic wrap:** Microwave-safe only.
- **Thermometers:** Microwave-safe only.

Materials to be avoided in the microwave oven

- **Aluminum tray:** may cause arcing. Transfer food into a microwave-safe dish.
- **Food carton with metal handle:** may cause arcing. Transfer food into a microwave-safe dish.
- **Metal or metal-trimmed utensils:** metal shields the food from microwave energy. Metal trim may cause arcing.
- **Metal twist ties:** may cause arcing and could cause a fire in the oven.
- **Paper bags:** may cause a fire in the oven.
- **Plastic foam:** plastic foam may melt or contaminate the liquid inside when exposed to high temperature.
- **Wood:** wood will dry out when used in the microwave oven and may split or crack.

Use of accessories in different cooking modes

Accessories	Name	Micro	Grill	Convection	Grill/Combi	Conv/Combi
	MWS Plastic bowl / MWS	●	✗	✗	✗	✗
	MWS* Glass Bowl	●	●	●	●	●
	High Rack/Low Rack	✗	●	●	●	●
	Metal Tray मेटल ट्रे	✗	●	●	●	●
	Rotisserie ^{##}	✗	●	●	●	●
	Steam Chef	●	✗	✗	✗	✗
	Milk Pasteurization Kit [#]	●	✗	✗	✗	✗

Fig 3.2.9 Accessories in different models of microwave oven

Note: Cooking functions, accessories, security features and control panel can be different for different models and brands.

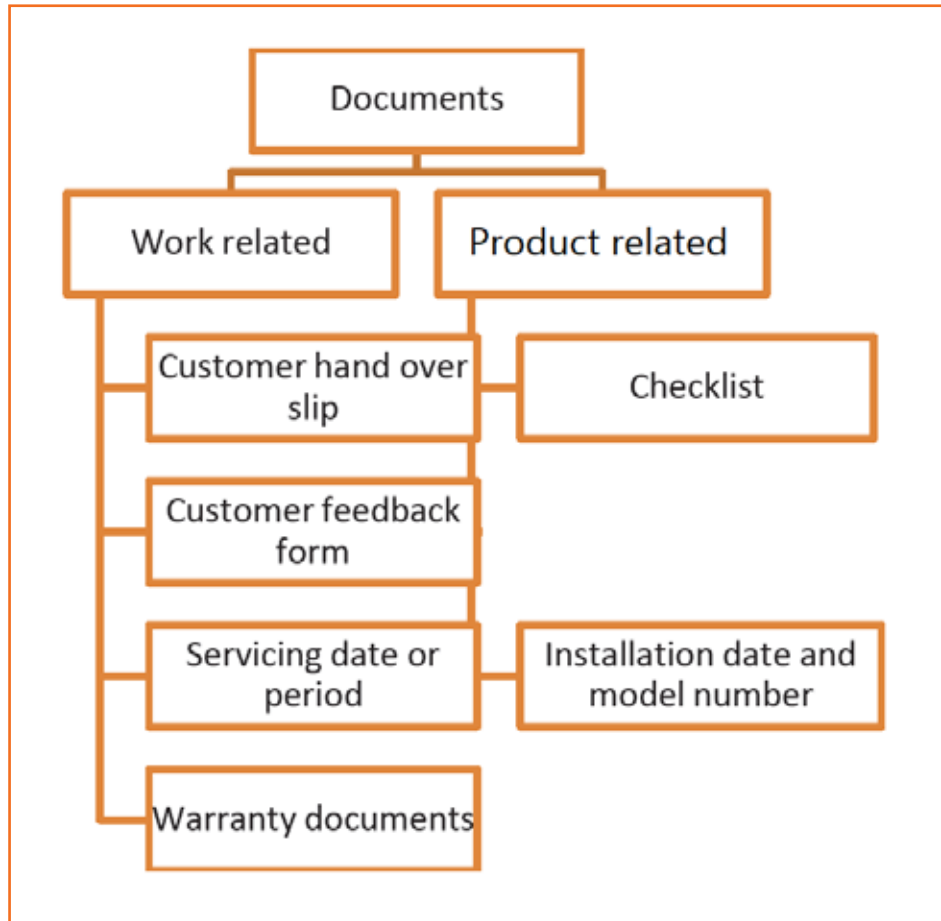
8.2.4 Post-Installation Activities

Complete the Documentation

After completing the installation at the site, the technician should complete the documentation to record the details related to installation. Along with completing the documentation, the field technician should tell the customer about some do's and don'ts for using the microwave oven such as, keep the product

clean and dry. The field technician should also tell the customer about important pages to be referred to from the owner's manual.

The following figure shows the installation documents:



Scan the QR code or click on the link to watch related videos



<https://www.youtube.com/watch?v=z9pHOc5kmbw>
Installation and operation of microwave oven

UNIT 3.3: Troubleshooting and Repairing of Microwave Oven

Unit Objectives

At the end of this unit, participants will be able to:

1. Demonstrate procedure of troubleshooting and repairing of faults in microwave oven.

3.3.1 Troubleshooting and Repairing of Faults

There are many different ways that a microwave would go wrong. Each issue has multiple possible causes. Let's take a look at the possible causes and solutions for the microwave problems.

Problem	Cause	Solution
Microwave Plate Won't Turn	Plate Guide Roller Coupler Drive Motor	If microwave plate won't spin, this relates to an entire spinning assembly designed for the purpose. First, check the plate. Then look at the wide guide-rollers underneath the plate. 1. Then check to see if the pronged coupler in the microwave center is cracked. 2. Finally, inspect the drive motor for current and coupling.
Microwave Won't Turn On	Wall Plug Door Latch Assembly Door Switch Thermal Fuse Ceramic Fuse	A microwave that seems to not turn on may be suffering from a number of failures. 1. Start by checking the wall plug to ensure the microwave is plugged into power. 2. Next, check the door switch and the door latch assembly. The microwave won't start if the appliance believes the door is open. 3. Next, check the two fuses, the thermal fuse, and the ceramic fuse, to see if they need to be replaced.

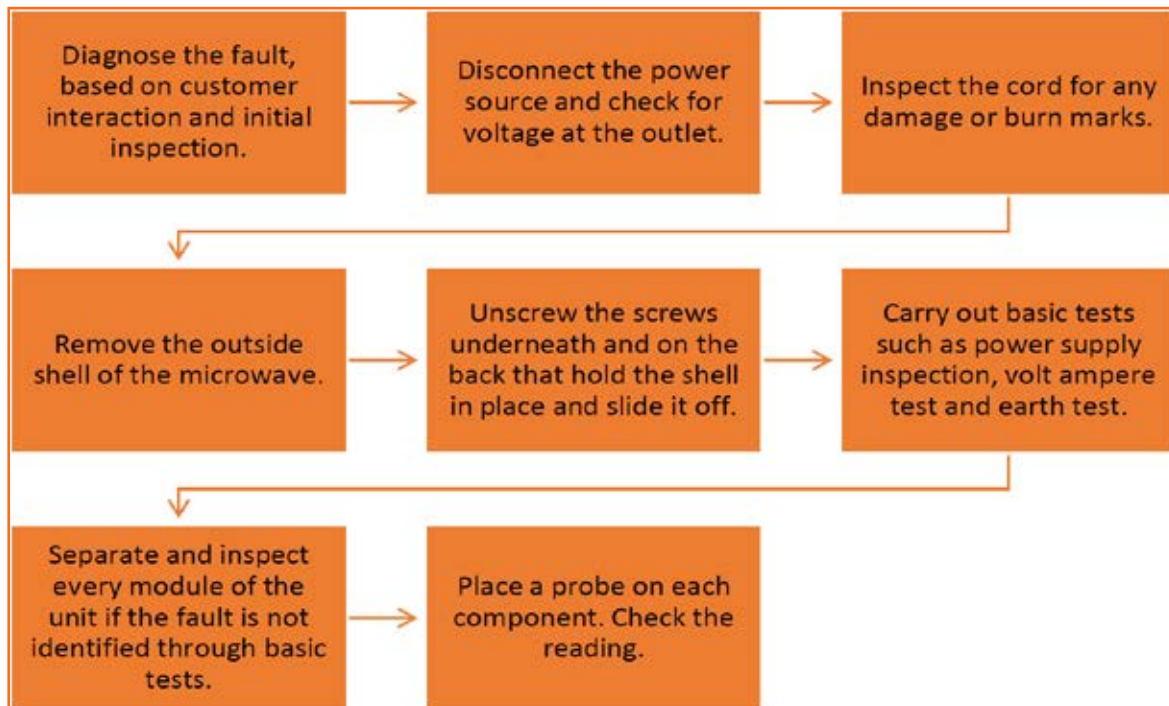
Microwave Door Not Closing Properly	Door Latch Assembly Hinges Torsion Springs	With older appliances, it's common for the door to stop hanging or closing properly over time. This often happens because the hinges or springs have come loose from their original factory tightened state. When the door doesn't close properly, heat and smells can escape the microwave while other malfunctions ensue. A microwave door that won't latch might be difficult to open or close, and the microwave may struggle to acknowledge the door as fully closed. Consider looking closely at the door latch assembly and the hinges, along with the torsion springs related to the hinges. Tighten loose screws and replace any damaged parts.
Microwave Door Stuck Closed	Microwave Latch Assembly Open Door Trick	Sometimes, a microwave door can become stuck closed. This is particularly common in microwaves that have a push release door switch. If microwave door is stuck closed, there can be at least one manual override so that the microwave door can be opened without the usual button or mechanism. Next, take a look at the latch assembly. This is most likely where you'll find the stuck door problem. You may have to repair the door handle and/or button release mechanism.
Microwave Doesn't Shut Off	Door interlock switch Smart Board	Another problem can be that your microwave doesn't stop running when the timer runs out. This alarming situation is surprisingly common and can do a lot more than overcook the meal. Look at the electronic parts that might be at fault. The door interlock switch might not be triggering. Or the microwave's smartboard which controls all of the microwave's functions is not working.
Microwave Not Heating	Door Switch Voltage Diode	If microwave is not heating, the first place to look is the door switch. Just in case the door isn't latching and therefore the cycle isn't starting, then check out the voltage diode.

Microwave Making Noise	Plate and Drive Motor Magnetron High Voltage Diode Cooling Fan	There are several different things that can cause microwave to be noisy. The easiest thing to diagnose and fix is a noisy microwave plate. If the plate is rattling, investigate the coupler and guide roller. If it's the drive motor or magnetron, these are among the most challenging to replace. It might also be the high voltage diode. Depending on the microwave, it might also be the cooling fan.
Microwave Touchpad Does Not Respond	Membrane Switch Control Board	One of the microwave malfunctions is when the touchpad stops responding. A microwave should at least beep when you push the buttons. If touchpad seems to be completely dead, it could be one of two things. 1. First, check out the membrane switch which can determine the responsiveness of each individual button. 2. If it's not the membrane switch, it might also be the control board that controls all responsiveness.
Microwave Exhaust Fan Not Working	Air Filter Grimy Moving Parts Exhaust Fan	For above-the-range microwaves, there may be an exhaust fan that helps keep the air clear above your stove. When the exhaust fan stops working, there are a few different things you can try. First, investigate the air filters. A charcoal or metal mesh filter can be changed out or washed and cleaned to restore them to usefulness. Sometimes, that's all it takes to get your exhaust fan working again. Next, take apart all the moving pieces, clean them, and put them back together. And if you find a broken part in the exhaust fan assembly, replace it.
Microwave Light is Out	Lightbulb Control Board	The microwave light lets you know when it's on and helps you to keep track of the food you're cooking. When the microwave light goes out, the ease that the bulb can be replaced depends on the model of microwave. But you may have to fully open up the case to replace microwave light. If you know the bulb is good, the problem might alternately be with/control board.

Table 3.3.1 Common problems and their solutions in microwave oven

Understand the Symptoms and Identify the Fault

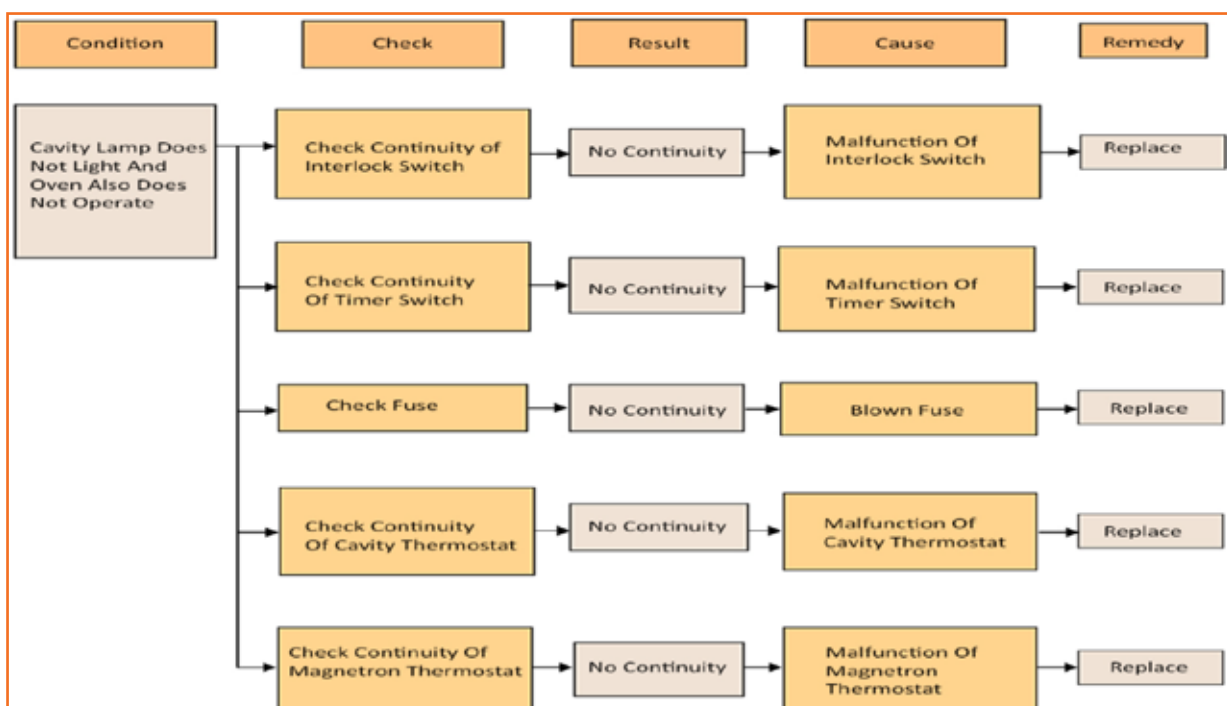
It is very important for a technician to identify the fault in the microwave oven. Wrong identification of fault will lead to waste of time and money and it can also cause damage to the appliance. Some basic steps which need to be followed during fault identification are:



Faults and Symptoms of Microwave Oven

It is important to understand the symptoms of the microwave oven for identifying the faults in it. The following flowchart represents the faults along with their potential causes and solutions:

Problem 1: Cavity lamp does not light and oven does not operate

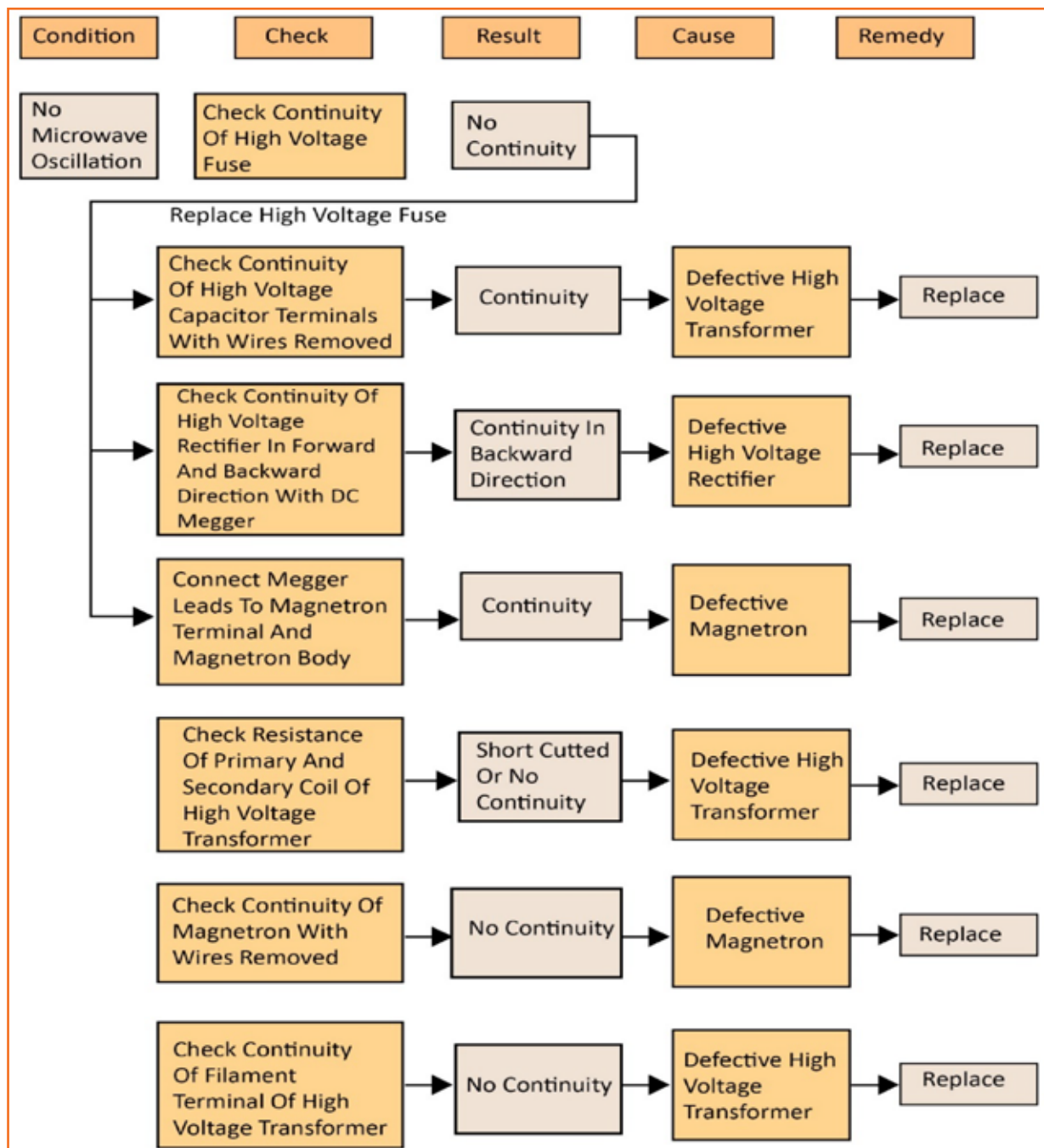


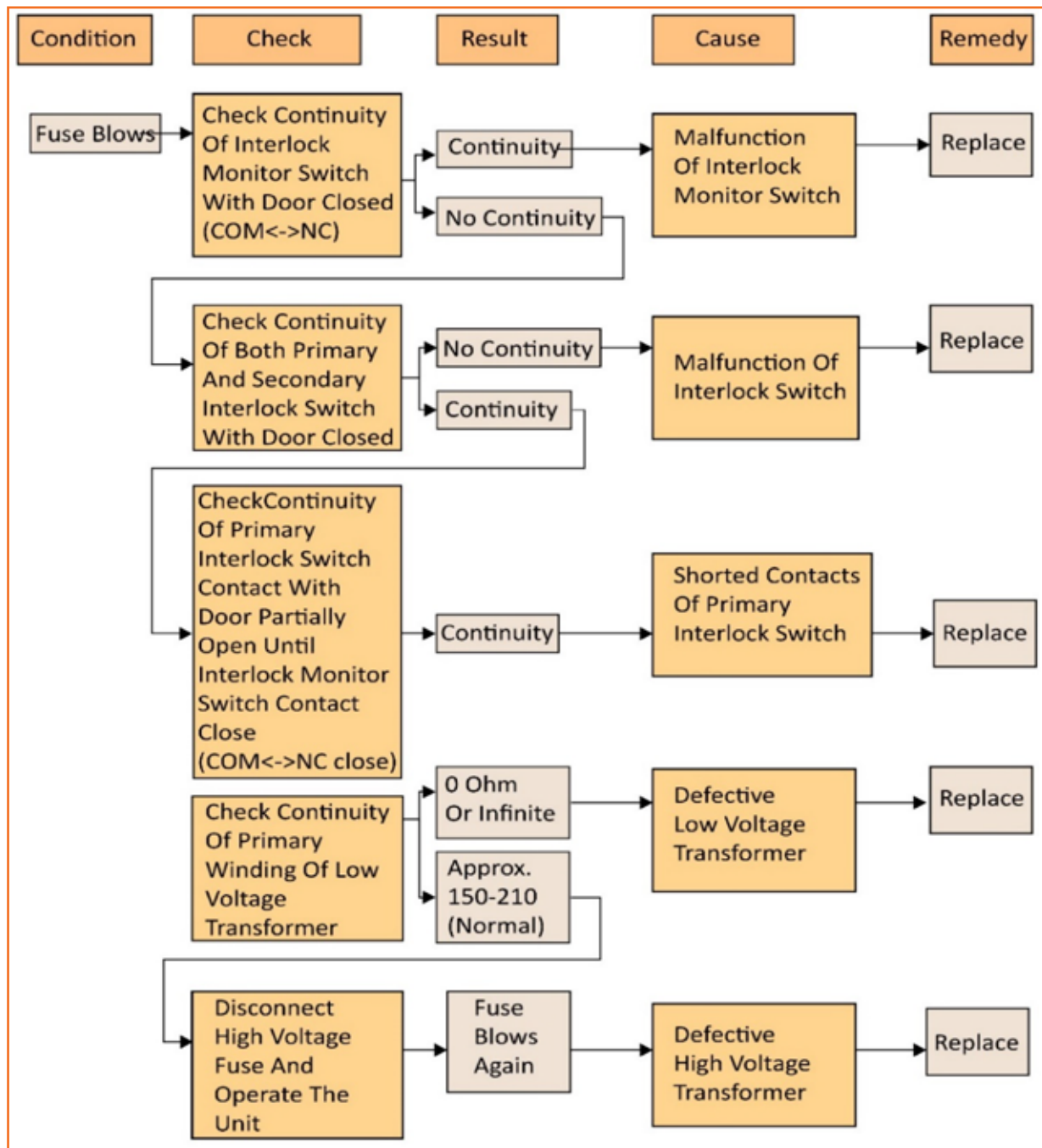
Problem 2: Oven does not operate but cavity lamp lights

Condition	Check	Result	Cause	Remedy
Oven Does Not Operate But Cavity Lamp Lights	Check Continuity Of Power Control Switch	No Continuity	Malfunction Of Interlock Switch	Replace
	Check Continuity Of HV Transfer Windings	Resistance Incorrect	Malfunction Of HV Transformer	Replace
	Check HV Diode And HV Fuse	Resistance Incorrect	Malfunction Of HV Diode Or/ And Fuse	Replace
	Check HV Capacitor	Resistance Incorrect	Malfunction Of HV Capacitor	Replace
	Check Magnetron	Resistance Incorrect	Malfunction Of Magnetron Thermostat	Replace

Problem 3: Oven operates for a few minutes and stops/Oven operates and does not stops/Output power is too low when cook is selected/Output power is high when defrost is selected.

Condition	Check	Result	Cause	Remedy
Oven Operates For A Few Minutes And Stops	Check Blower Motor	No Operation	Malfunction Of Blower Motor	Repair Or Replace
Oven Operates And Does Not Stop	Check Timer Motor	Resistance Incorrect	Malfunction Of Timer Motor	Replace
Output Is To Low When Cook Selected	Check Magnetron	Resistance Nearly Correct	Poor Oscillation Of Magnetron	Replace
	Check HV Capacitor	Resistance Nearly Correct	Poor Function Of HV Capacitor	Replace
Output Power Is On High Level When Defrost Is Selected	Check Power Control Switch	Shorted	Malfunction Of Timer	Replace

Problem 4: No microwave installation

Problem 5: Fuse blows**Repairing/Replacing of Dysfunctional Module in Microwave Oven**

Sometimes only the connections of microwave oven needs to be checked and fixed. This can be done by a home appliance repair technician. But at times, a specialized technical help/support is required to repair internal circuits or fix a fault. If the first level maintenance cannot rectify a fault, then a trained technician is called. If even the trained technician cannot solve the issue, then a specialized technician associated with third-party or vendor is called.

In such a case, the specialized technician removes and replaces the faulty module with a functional unit,

either on the second visit or as pre-identified.

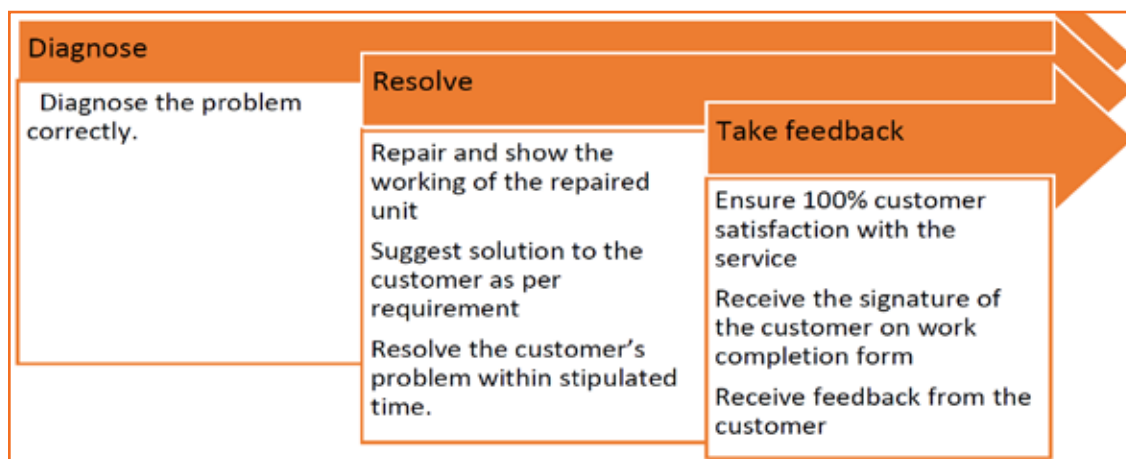
In case even the specialized technicians are unable to repair the components or fix the fault, or if the problem is such that cannot be fixed at customer's site, then the faulty module/component is sent to the service centre. The home appliance repair technician then collects the functional module from the service centre and fixes the microwave oven at the customer's site.

Confirmation of Functionality of the Repaired Module

Once the dysfunctional module has been repaired/replaced, check the new module with testing equipment such as multimeter and ammeter. This is done to ensure whether the module is working fine with the other parts of the microwave oven. After testing the connection, plug in the repaired oven to the power supply. Then, again check if the repaired unit is working properly or not.

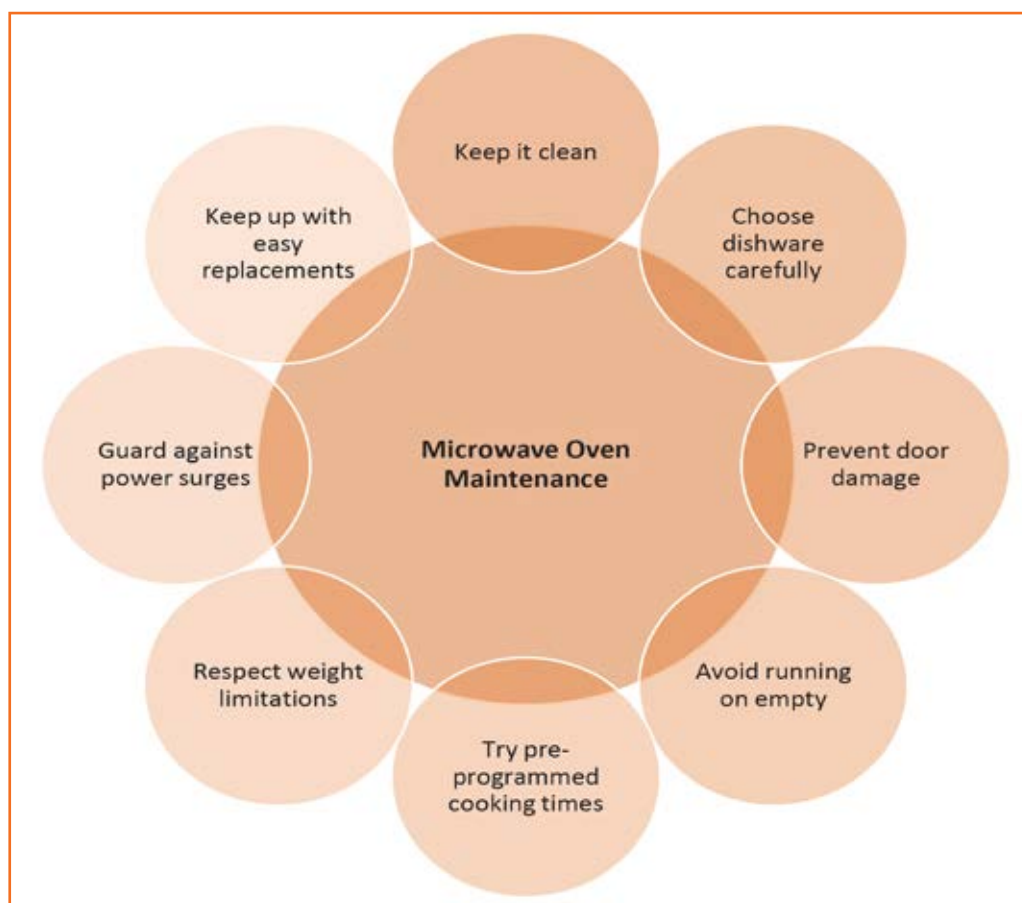
Achieve Productivity and Quality as per Company's Norms

To achieve productivity and quality as per company standards, a technician should follow the working instructions given by the company. To achieve productivity and quality practice the following:

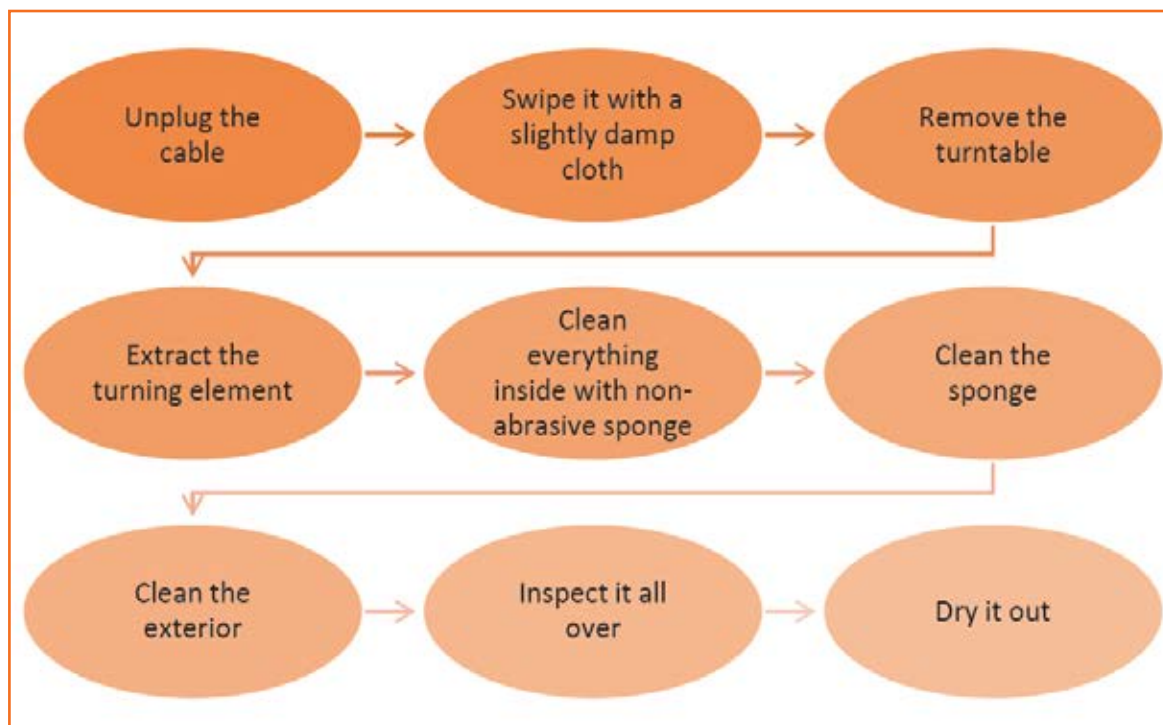


3.3.2 Educating Customer Cleaning and Maintenance Procedure

Nowadays use of microwave has become quite common but no one gives a second thought for its proper maintenance/cleaning. Cleaning should be the foremost thing to be performed as it leads microwave ovens long life. The following figure lists the guidelines for maintaining microwave oven -



The following figure lists the steps to clean the microwave oven -

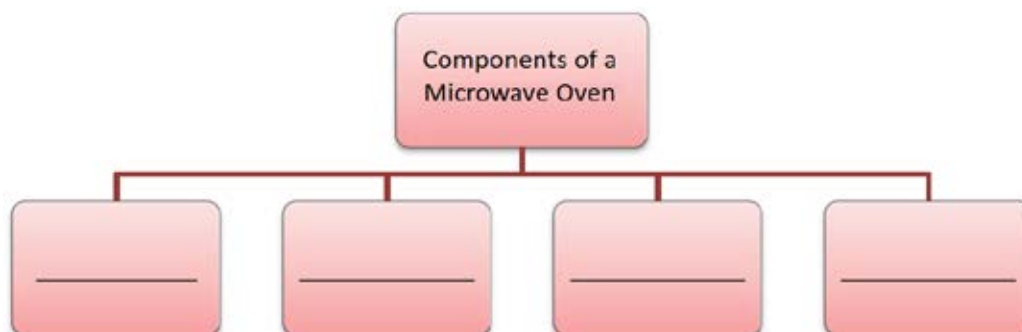


[illegible]

Exercise



1. Write the basic components of a microwave oven in the space provided in the following figure.



2. Identify the components of a microwave oven and write their names in the space given below their images.



3. Perform a check of unusual noise in a microwave oven.



4. Install and Repair Water Purifier

Unit 4.1 – About Water Purifier

Unit 4.2 – Installation and Operation of Water Purifier

Unit 4.3 – Troubleshooting and Repairing of Water Purifier



Key Learning Outcomes



At the end of this module, participants will be able to:

1. Describe use and function of water purifier
2. List parts of a water purifier
3. Demonstrate procedure of installing a water purifier
4. Demonstrate how to setup and use the features of water purifier
5. Demonstrate procedure of troubleshooting and repairing of faults in water purifier

UNIT 4.1: About Water Purifier

Unit Objectives



At the end of this unit, participants will be able to:

1. Describe use and function of water purifier
2. List parts of a water purifier

4.1.1 Water Purifier

Water purification is the process of removing undesirable chemicals, organic and inorganic materials, and biological contaminants from water so it is safe for use. A water purifier treats water using one or more purification methods to make it safe.

Clean water is essential for healthy living, and water purifiers are a great way to remove contaminants to improve the quality of your tap water. However, not all water purifiers are the same. Modern water purifiers come with a range of advanced technologies to remove organic and inorganic impurities present in water. There are several different types of water purification methods, and there's also filtration which is entirely different.

Depending on the water purification methods water purifiers are classified into 5 types.

1. RO Water Purifier

RO water purifiers are the most commonly used purifiers and are based on the principle of reverse osmosis. They make use of the membrane technology to eliminate contaminants such as salts, heavy metals and germs dissolved in water. The following image shows an RO water purification.

RO water purifier most effective to purify hard, salt water contains dissolved solids and chemicals. The only RO water purifier is

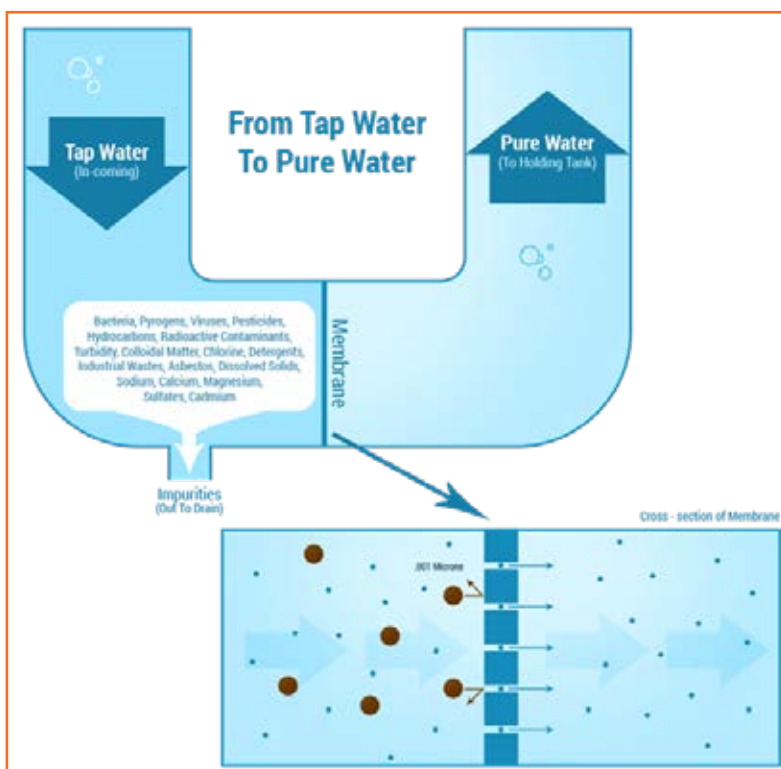


Fig 4.1.1 RO water purification

capable to remove metal particles like arsenic, fluoride, lead, chlorine, nitrates and sulphates.

Advantages of RO water purifier

- RO water purifier removes dissolved solids, metal particles like arsenic, fluoride and lead. Along with this RO water purifier is capable to remove waterborne diseases causing microorganisms like bacteria, viruses. Germs dead bodies are flushed out, so that purified water free from germs dead bodies.
- RO water purifier improves the taste and odour of water by removing the contaminants that causing bad taste and odour.
- RO water purifier is safe, cost effective and easy to maintain.

Disadvantages of RO water purifier

- RO water purifier requires electricity to run. Even it needs running water with optimum water pressure.
- RO water purifier produces lots of waste water. Whatever dissolved solids, germs are flushed through the drain along with wastewater. To purify 10 liters of water RO water purifier produces approximately 5 liter waste water which have to be drained out.

2. UV Water Purifier

UV water purifiers use ultraviolet rays to kill all germs, bacteria and microbes dissolved in water. A small mercury lamp is placed inside the purifier, which produces high frequency short wave UV radiations. When water passes through this element, it is exposed to the UV light which kills all the living organisms.

Separate filters then remove the dead germs.

UV purifiers are used in residences, breweries, water stores, restaurants and municipalities. The following image shows the working of UV water purifiers -

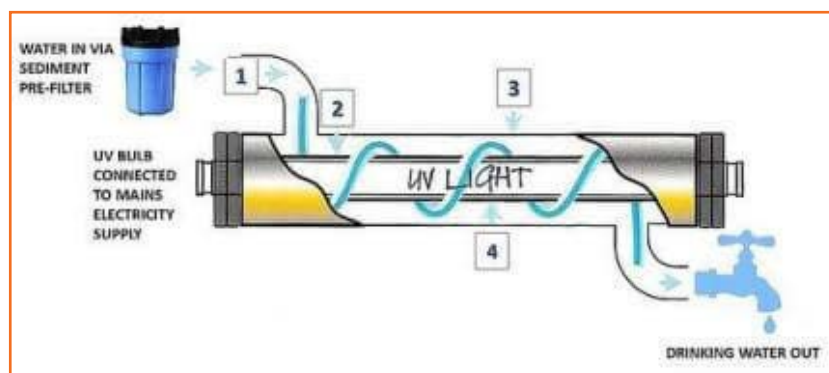


Fig 4.1.2 UV water purification

UV water purifier is ideal for low TDS (Total Dissolved Solids) water like lakes, river water. UV water purifiers incapable to treat hard water, which has high TDS level. Just as a UF water purifier, UV water purifier does not remove chemicals like chlorine, arsenic, fluoride present in water.

Advantages of UV water purifier

- **Low maintenance cost.** Change the UV lamp once in a year or when it stops working.

- **High purification rate.** UV water purifier capable to deliver 2 to 4 liters of purified water within a minute. Whereas other RO, UF, Activated Carbon water purifier takes several minutes to purify one liter water.
- **Low energy consumption.** UV water purifier uses electricity as much as an electric bulb use.
- **Very less manual cleaning.** If you have a UV water purifier with storage tank, it requires to clean twice in a week, whereas without storage tank water purifier need almost no manual cleaning.
- **Does not alter the water taste.** UV water purifier does not use any chemicals, or any semi permissible membrane. Therefore, water taste does not alter.
- **UV keep essential minerals.** Does not remove, change the human essential mineral present in water.

Disadvantages of UV water purifier

- **Germs bodies remains in purified water.** UV water purifier kills water borne disease causing bacteria, viruses and other pathogens, but their dead bodies still remain in purified drinking water. In case of fewer germs not exposed to UV light and remains live or redevelop and reproduce their population and makes water impure.
- **UV does not improve water taste or colour.** Using UV water purifier, before and after purification taste and color does not alter. If treating water has a bad smell, odor than have to use the Activated Carbon water purifier with a combination of UV water purifier.
- **Does not effective on turbid, mud water.** Undissolved Solids like sand, mud and other organic solid matter becomes an obstacle to pass UV light through the water.
- **UV water purifier not purifies hard water.** UV water purifier designed for purifying low TDS (Total Dissolved Solids) lake, river water.
- **UV water purifier not removes toxic chemicals.** UV light exposure does not effect on chemicals like chlorine, fluoride.

3. UF (UltraFiltration) Water Purifier

UF water purifiers use membranes similar to an RO membrane but with larger pores. They remove all germs and bacteria from water but do not remove dissolved salts or solids. They are suitable in homes where the water supplied is not very hard and has less dissolved salts. The process of purification in a UF purifier is shown in the following image -

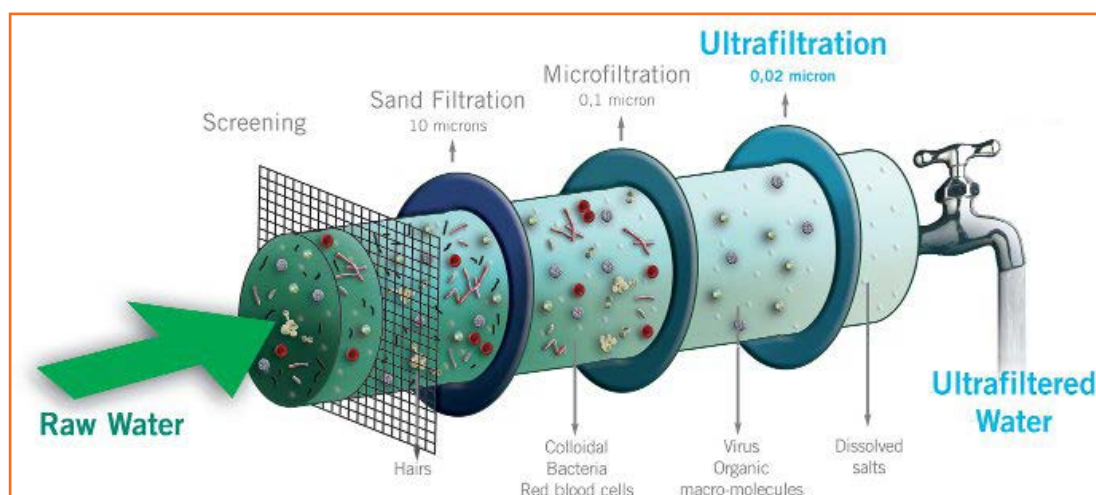


Fig 4.1.3 UF water purification

UF water purifier is ideal for the places where presence of chemical contamination is low, because UF does not remove chemicals present in water, it is only capable to block, remove germs like bacteria and viruses.

The important thing is to remember that UF does not work with hard water. As UF does not remove dissolved salts present in hard water, as a result before and after purification, water is still hard.

Advantages of UF water purifier

- Works without electricity. Just poured raw water in the upper storage tank and purified water collected in the lower storage tank. No need to bother about water pressure.
- Work in low water pressure conditions.
- Does not use chemicals. UF uses hollow membranes to block bacteria and viruses.
- Filter muddy water also. UF is capable to remove mold and germs from water, whereas other water purifiers like UV are incapable to purify muddy water.
- No germs' dead bodies in purified water. Whatever germs like viruses, bacteria are blocked in UF membrane. Purified water is free from their dead bodies, whereas other water purifiers like UV, even after purification germs' dead bodies are floating in purified water which can further contaminate water.
- Long life span. As UF membrane blocks germs and during manual cleaning these trapped germs are flushed out. UF membrane can be cleaned thousands of times. Pesticides, chemicals are not able to damage UF hollow membranes. In good conditions, UF membrane can be used up to 3 to 5 years.

Disadvantages of UF water purifier

- Unable to remove dissolved impurities such as arsenic, lead, nitrates and fluorides
- Ineffective as compared to an RO water purifier as it cannot block dissolved salts and solids
- Good only for water with low TDS

4. Activated Carbon Water Purifier

Activated carbon is carbon with a positive charge added to it. When water flows over it, the negative ions of contaminants get attracted to the surface of the activated carbon filter. Activated carbon water purifiers can remove volatile organic compounds, pesticides, herbicides, chlorine and other chemicals found in tap water. This makes the water safe to drink.

Advantages of Activated Carbon

- Removes diseases causing pesticides and toxic chemicals like Chlorine.
- Removes heavy metal particles
- Makes water smells and tastes good.
- Activated carbon helps to improve RO membrane life by blocking chlorine and other particles which are damaging the RO membrane.

Disadvantages of Activated Carbon

- Activated Carbon does not remove dissolved salts which causing hardness of water.
- Does not remove bacteria and viruses. The worst thing is improper maintenance causing higher growth of bacteria on the Activated Carbon surface. In case, activated carbon water purifier not in use for a long time, microorganisms like bacteria and viruses starts growing on the activated carbon surface.



Fig 4.1.4 Carbon filter

5. Gravity Based Water Purifiers

Gravity based water purifiers are based on the principle of gravity. The water flows from a higher compartment over the filters to a lower compartment. They do not require electricity and use either chemical based, UF based or ceramic cartridge based filters to purify water.

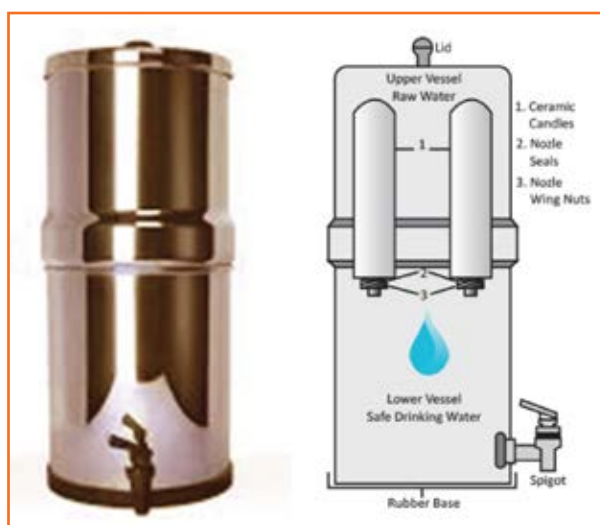


Fig 4.1.6 A gravity based purifier

Advantages of gravity based purifier

- Removes impurities and germs from muddy water
- Environmental friendly
- Does not require electricity to purify water
- Suitable for soft water
- Portable and easy to install

Disadvantages of gravity based purifier

- Unable to remove dissolved impurities such as arsenic, lead, nitrates and fluorides
- Ineffective as compared to an RO water purifier as it cannot block dissolved salts and solids
- Good only for water with low TDS

4.1.2 Components of Water Purifier

There are various components involved in a Reverse Osmosis system. The functions of the components that play an integral part in the RO system are as follows -

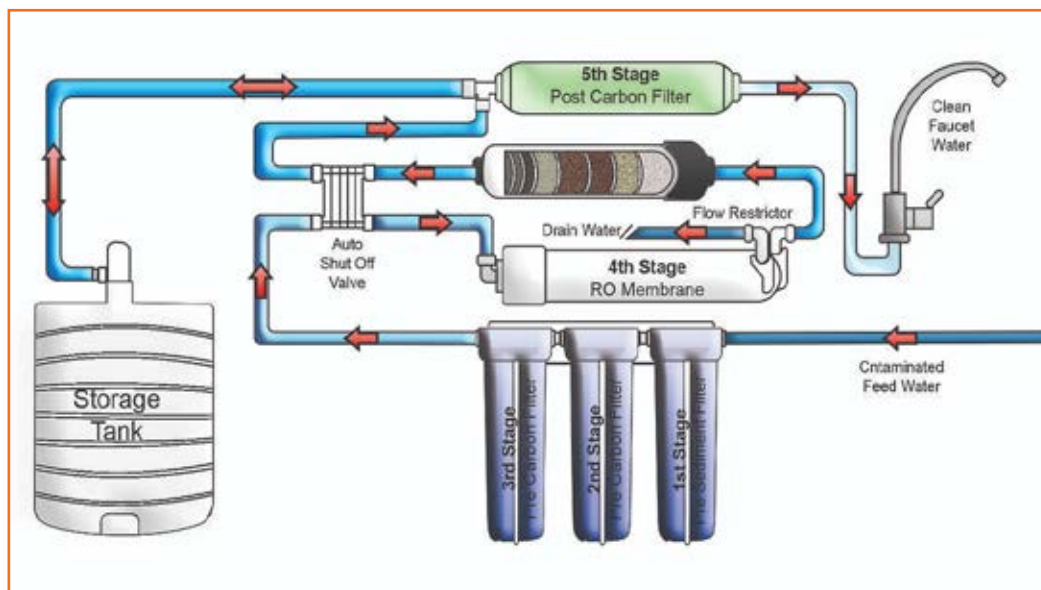


Fig 4.1.7 Basic components of a RO water purifier

1. **Water Supply Connector:** A water supply connector also known as a feed water supply adapter connects to the house cold water supply as the source of water to the reverse osmosis filter. It may include a variety of fittings, valves, and saddle valves that are available to best match the plumbing configuration.
2. **Pressure Regulator (optional):** A pressure regulating valve is used to protect the pre-filter housings from high pressure and water hammer.
3. **Sediment Pre-filter:** The sediment cartridge removes sand, grit, precipitated mineral particles,

insoluble iron oxide and other debris that can clog the reverse osmosis membrane surface or plug the drain flow restrictor, causing reduced water production.

4. **Carbon Filter for Chlorine Removal:** Drinking water is disinfected by city utilities to prevent growth of harmful bacteria, viruses and other microorganisms that can cause serious illnesses and/or death. The carbon filter removes chlorine and protects the membrane downstream of it.
5. **Auto Shut-off Valve (ASO Control Valve):** Conserves water by eliminating the drain flow when the tank is full. Main purpose of the ASO valve is to control the water supply to the reverse osmosis membrane. When the pressurized storage tank fills 2/3 of the feed pressure, ASO valve cuts off the water supply to the membrane and waits until the tank is drained down to 1/3 of the feed pressure before turning water back on.
6. **Reverse Osmosis Membrane:** RO Membrane is an important component of the system. The membrane helps in removing contaminants from water. Water enters into the storage tank after this purification stage.
7. **Check Valve:** Check valve prevents pressurized filtered water in the storage tank from flowing back and rupturing the RO membrane when the ASO valve turns off the feed water pressure to the membrane.
8. **Storage Tank:** The pressure tank in a RO system stores filtered water from the membrane permeate and provides water under pressure when the drinking water faucet is turned on.
9. **Post-Filters:** Before water stored in the storage tank runs out of the Reverse Osmosis faucet, it enters through the final post-filters. It is actually a carbon filter. Carbon filters help remove bad odors from the water that you drink and also improve the taste of water.
10. **Drain Line:** The drain line is used to drain out the waste water which consists of dirt and other contaminants.
11. **Drinking Water Faucet:** It is a controllable tap to direct water flow and is typically installed on the kitchen sink.
12. **Ultra Violet Disinfection System:** Ultra Violet disinfection usually involves a UV lamp. UV lamp provides pure and safe drinking water. The UV light used in this process is a high-powered UV which is also known as UV-C or germicidal UV. UV-C rays penetrate into the body of pathogens to deactivate them. These rays have the ability to kill 99.9% of the microorganisms.
13. **Ultra-Filtration System:** Ultra-Filtration process uses hydrostatic pressure to force water against a semi-permeable membrane. This semi-permeable membrane helps in removing bacteria and different types of microorganisms and bad odor in the water.
14. **Optional RO Components:** Optional Reverse Osmosis components include pressure booster pumps, pH balancing post filters, TDS water quality monitors etc.



Fig 4.1.8 RO membrane

4.1.3 Functioning of RO Water Purifier

The following diagram shows the flow of water in an RO purifier -

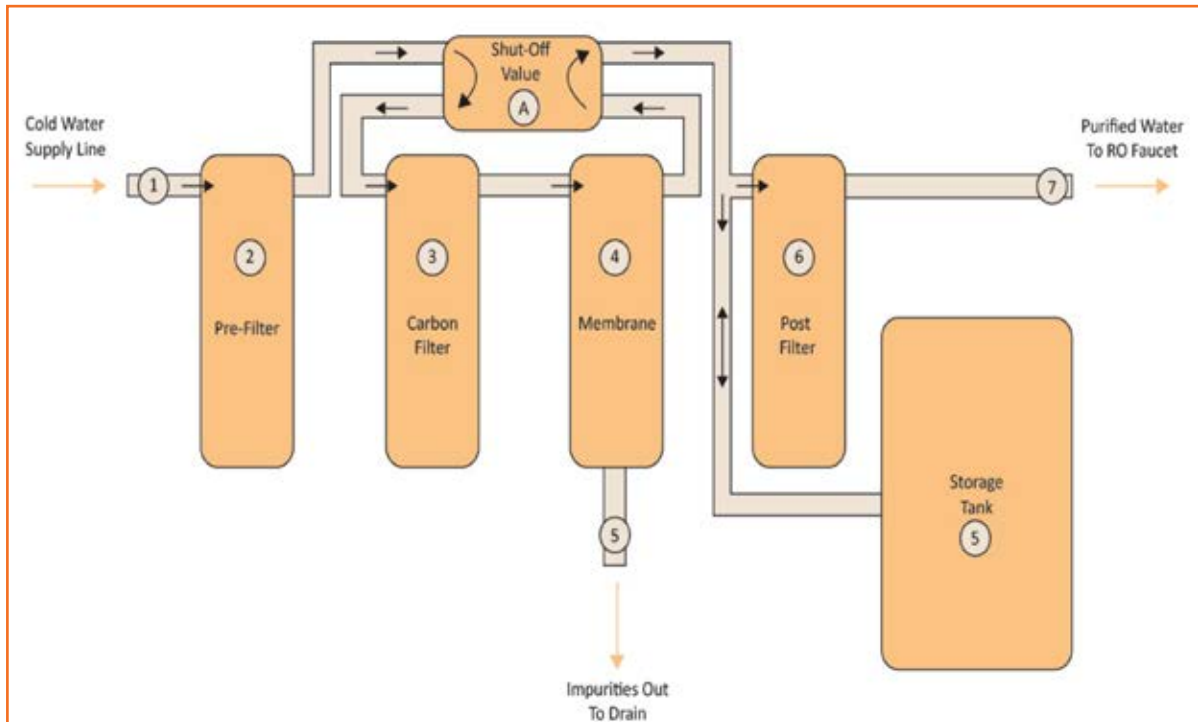
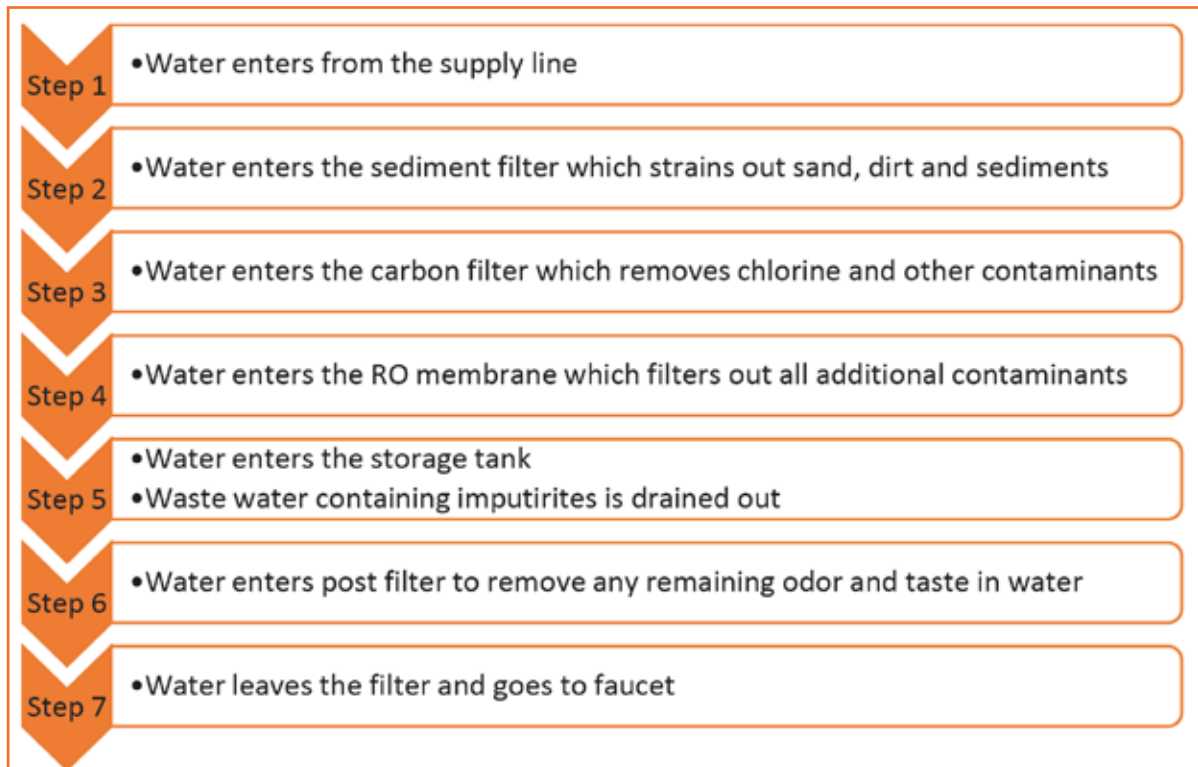


Fig 4.1.9 Water flow in an RO water purifier

The following figure explains the steps involved in the functioning of an RO water purifier -



Multi stage filtration process:

The RO water purifier has different stages of filtering the raw water.



Fig 4.1.10 Multi stage filtration process

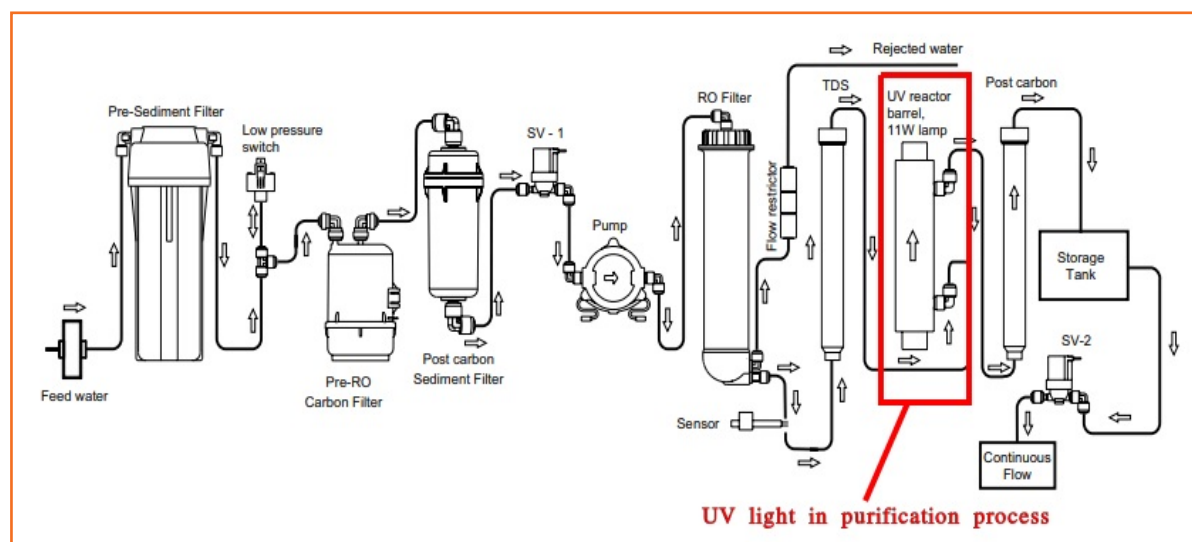


Fig 4.1.11 Multi stage filtration process

1. **Pre-filter / Sediment Filter:** RO purification process starts with pre-filter, which is the first step in purifying water. The filter helps in removing larger sediment and even reduce chlorine from the water. The filter has a bed that catches all the unwanted dirt particles as soon as the water flows through the system. The water moves into the filter and leaves the sediment behind, as a result, the water coming out would be free from particulate. It cannot remove pathogen elements, heavy metals, and even micro-organisms.
2. **Carbon Filter:** Followed by pre-filter, the next stage is the carbon filter, which is commonly used to absorb natural organic compounds, taste and odor compounds. The filter also removes synthetic organic chemicals in drinking water and make it fit for consumption.
3. **Ultrafiltration:** The next process of filtration that the RO purifier has is UF. It is a type of hollow

fibre membrane through which water is forced to pass leaving the impurities behind and delivering pure and clean water.

4. **Reverse Osmosis (RO):** It is the Reverse Osmosis (RO) system that offers a multi-stage filtration of water by combining sediment, active carbon, and UV/UF in the complete purification of raw water. An RO water purifier not only removes the solid impurities but even improves the taste of water, thus offering water that is safe for consumption. RO filters are recommended for places where the TDS level of water is high and the water has a high content of dissolved minerals.
5. **TDS Controller:** During the reverse osmosis purification process, an essential mineral also gets removed and to retain the same TDS controller is added in the water purifiers. The work of this controller is that it can retain the lost minerals in water and make it suitable for consumption.
6. **UV filtration:** RO water purifier also comes with a UV lamp that helps in disinfecting bacteria from the water by killing all the harmful pathogens present in the water. The high-power UV ray destroys the illness-causing microorganisms by attacking their genetic core, thereby eliminating their ability to reproduce. The ultimate work of a UV lamp is to destroy 99.99% of harmful microorganisms from the water, thereby making it safe for consumption.
7. **Post carbon filter:** The final stage of RO purification process is the addition of post carbon filter. Water passes through stage gets more filtered and if any odour is still present in the feed water it gets removed. Passing through this stage would ensure that you are receiving 100% pure and safe water that is free from any kind of contamination/impurities.

UNIT 4.2: Installation and Operation of Water Purifier

Unit Objectives



At the end of this unit, participants will be able to:

1. Demonstrate procedure of installing a water purifier
2. Demonstrate how to setup and use the features of water purifier

4.2.1 Site Requirements for Installation

The first step of an installation process is to conduct a site survey and ensure that it meets all the requirements. The selected site should comply with all the safety codes and should not interfere with normal movement of people.

The following are the site requirements of installing a water purifier:

- Select a well-ventilated place which is near to the tap water
- Avoid installing the water purifier in outdoor place, damp area and keep away from direct sunlight, dust and direct water splashing. This could cause product malfunctioning.
- Place on a firm, level place

After checking the site requirements, the next step is to check the power supply at the location site.

The following are the power requirements for installation:

- Ensure that voltage and electrical wiring is appropriate
- Use a separate socket for water purifier and ensure that wall socket is properly earthed
- Place the water purifier close to the electrical outlet
- Check water pressure of 35 -860 kPa / 5.6 to 124.7 Psi

4.2.2 Installation Process

Before starting the installation, following tools are necessary, depending on each particular installation-



Fig 4.2.1 Tools required during installation

The installation process consists of unpacking the unit, disposing the packing material and installing the water purifier at the designated place.

Unpacking water purifier

To protect the water purifier from any kind of damage, it is properly packed and delivered. Once it is transported from the delivery truck, it needs to be carefully unpacked.

Steps for unpacking a water purifier:

1. Unbox the box by keeping it on a smooth and fair surface. Remove the packing strip and cut the tapings on the upper face with the help of a knife or sharp object.
2. Tilt the box and remove the tapings applied on the base with the same sharp object.
3. Take out all the accessories from the box.

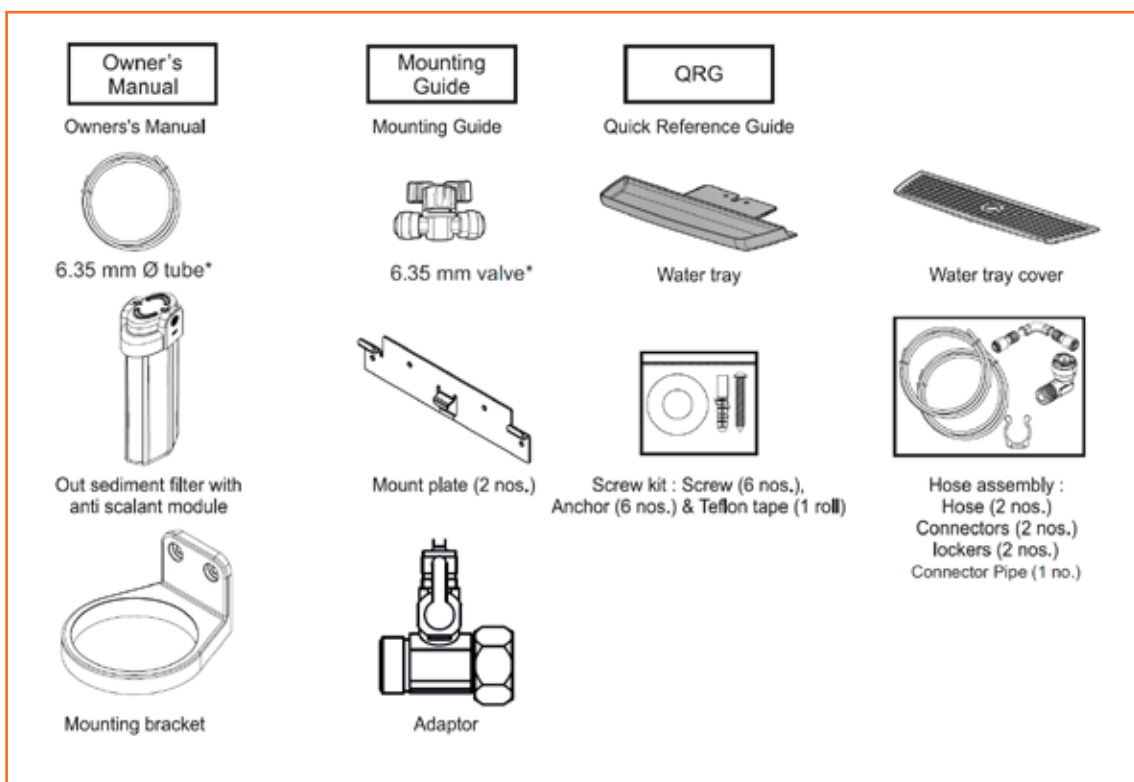


Fig 4.2.2 Accessories in a water purifier

Note: Accessories in box may differ for different models and brands

4. Now, hold the thermocol sheet (polystyrene base), remove the box. Gently, keep the water purifier horizontally, remove the thermocol sheets from both ends. Once you have removed out the thermocol sheet carefully and gently, remove the poly packing. Handle your product with care. Now you are ready for the core installation process.

Installing water purifier

Plumbing operations -

1. Choose the area where the water purifier needs to be fitted.

Observe and analyze the space including its advantages and disadvantages. Choose the space keeping in view that RO can be repaired and serviced easily. Don't place in the area near direct sunlight or moisture. Never place it just above the water taps as drilling can damage pipelines.

2. Check for the TDS level of the tap water and pressure of water flow on the tap using Pressure Gauge.

- ☐ Take a glass of tap water and check for TDS level of water which should be below 2000 Parts Per Million (PPM) using TDS Meter. If Total Dissolved Solids (TDS) Level is above 2000 PPM it can damage RO membrane and the tap water is not recommended for drinking purpose.
- ☐ Check the pressure of water tap using pressure gauge and it should be in between 0.3 Kg/sqcm to 2 Kg/sqcm. To get this value, the tank height should be over 1 meter above from purifier. Reduce the pressure if the value is above 2 Kg/sqcm and if pressure is less than 0.3Kf/sqcm, recommend booster pump installation with the unit.



Fig 4.2.3 Installation of water purifier

- ☐ Check for signs of contaminated water or dust particles or yellow stains in the sinks, in any of these cases, use Pre-filters and do check for rust and leakages in kitchen pipelines.

3. Remove the water tap and insert the diverter.

Install the water purifier in the facility of normal water supply only. Close the water supply line from main water tank. Remove the water tap attached to the water supply (normal water) using pipe wrench. Apply Teflon tape on the end of water diverter so that there is no leakage. Place the external thread exactly at the vacant spot where you removed your valve. Tighten it by using the pipe wrench.



Fig 4.2.4 Diverter

4. Fix the water tap and diverter.

Now, apply the Teflon tape on the back end of water tap and fix it using pipe wrench on the other side of the diverter valve. Remove the nut from up ends and place a thin white pipe over the top of the diverter valve.

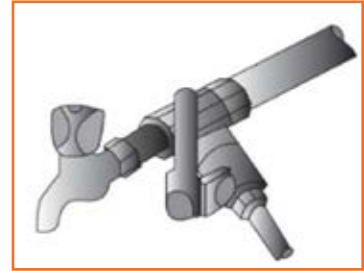


Fig 4.2.5 Diverter connected on tap

Mounting operations:

1. Drill holes to hang the purifier.

Make sure that you are placing the purifier on the right position so that it may not be too near or too far from the reach of consumers. Use leveller to mark brackets for drilling.

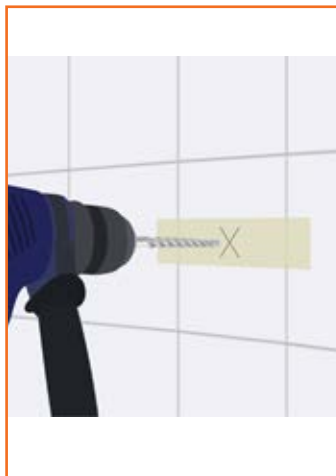
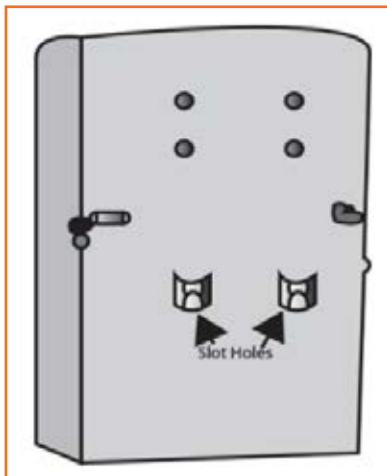


Fig 4.2.6 Drilling holes and inserting plastic inserts in wall

2. Insert the plastic inserts and mounting bracket.

Using drill, make holes in the wall carefully. Make holes a deep bit to ensure that plastic inserts can be easily placed in it. Place the plastic inserts using hammer inside the holes and using self-tapping screws, fix the mounting bracket properly.

Water connection operations:

1. **Remove the back cover of the purifier and open the dead blocks.**

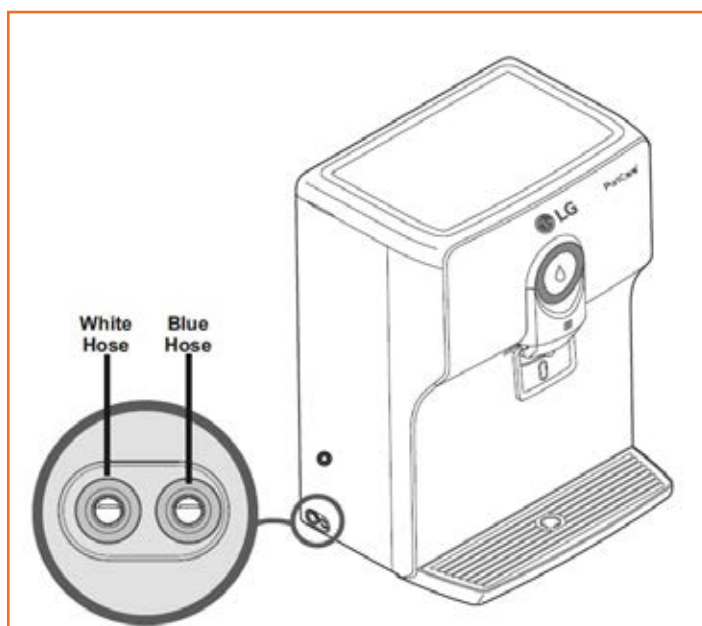


Fig 4.2.7 Hose connections in water purifier

Remove the back cover of the purifier by unscrewing the four nuts on the cabinet. Carefully, remove all the dead plugs of the purifier from the back. Remove the tie crossed over the membranes and filters using knife or sharp object without harming the core hardware.

2. **Attach the jointer between the purifier membranes to the drain pipe using jointers.**

Attach a mutual and joint outlet between overflow and reject outlet using pipes and jointers. Cut the pipes and attach them to the nobs of overflow and reject outlet bases and connect them using jointer placed it between. It is very important so that in future if water purifier malfunctions, at that time, the water may drain from the drainpipe without harming the internal spheres and creating complexity.



Fig 4.2.8 Connecting hoses

3. Plug in the Blue pipe from the Water purifier to the waste water outlet and install it in the sink.
4. Plug in the White pipe in the inlet port on Purifier and water supply tap.
5. Now mount the purifier on mounting bracket and fix it properly.
6. Connect the power cord in the power socket



Fig 4.2.9 Correct ways of installation

Starting water purifier

1. Now open the water supply valve and as well as the electricity socket (by closing the circuit or switching the plugged circuit ON).
2. After installation, fill the storage tank and drain out the unclean or yellowish water from the sediment filter when the tank is full. Make sure that the process gets completed. It will take about 5 to 15 minutes depending upon the quality and atmospheric conditions of the tap water and ultimately, the area.

It is very important because if you don't do it, at that time, the impure yellowish/blackish water may go and detoxicate/damage the carbon and purifier filters of the purifier or it may also, effect or reduce the activity or durability of water purifier.

3. **Final check of all the connections.**

Make sure everything is attached properly and there is no leakage inside the purifier structure. Check for all the connections, jointers, points and nobs so as to ensure the maximum and proper productivity. Attach the pipes in original state as they should be. Also, make sure to connect all the parts properly and carefully. Remember to plug in the setup by switching ON the electricity and the first full tank is not suitable for drinking purpose.

4.2.3 Operation of Water Purifier

After the installation process, technician has to explain the operation, security features and use of control panel of purifier.

Using control panel

Icons on control panel

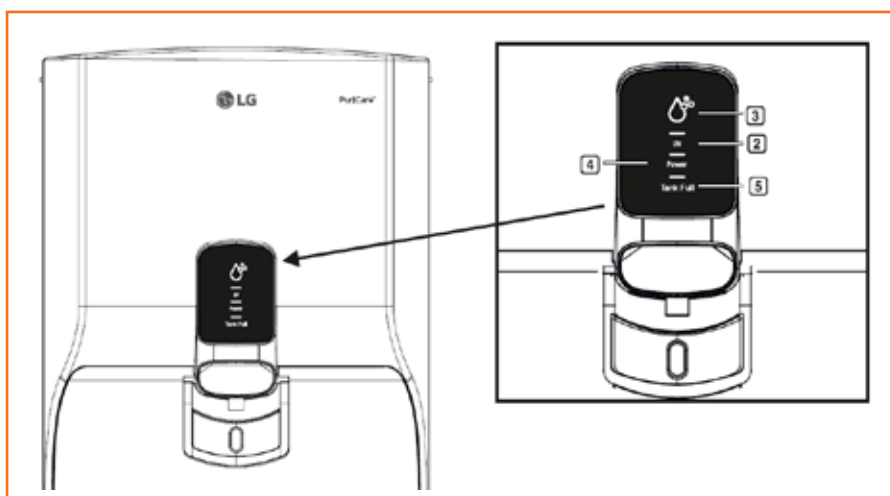


Fig 4.2.10 Control panel

1 Water level indicator

The water level of the storage tank is displayed in 3 levels.

- The icon is divided into 3 levels according to the water level, and as more indication Light turn on, the water level becomes higher. However, the water level cannot be adjusted discretionally.

**2 UV Sterilizing indicator***

Purified water is sterilized by the UV LED. Blue color indicates that UV sterilization is ON & White color indicates that UV sterilization is OFF.

3 Filter Change Indicator **

When the color of indicator changes from blue to amber, this indicates that it is time for preventive maintenance service.

4 Power Indicator*

The Power LED glows to indicate ON condition of Water Purifier.

5 Tank Full Indicator*

When the water storage tank gets filled up completely then Tank full indicator will turn ON.

Operation of water purifier

Open the faucet, purified water will come out.

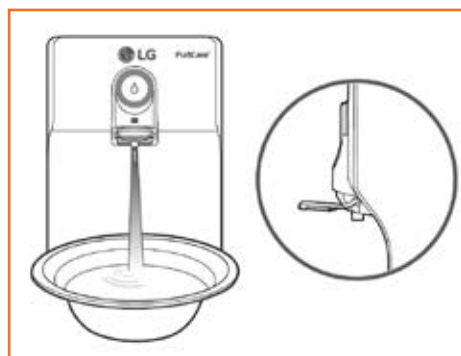


Fig 4.2.11 Using water purifier

Scan the QR code or click on the link to watch related videos



<https://www.youtube.com/watch?v=GXZ5i5s5FOI>

Installation of water purifier

UNIT 4.3: Troubleshooting and Repairing of Water Purifier

Unit Objectives

At the end of this unit, participants will be able to:

1. Demonstrate servicing of water purifier.
2. Demonstrate procedure of troubleshooting and repairing of faults in water purifier.

4.3.1 Servicing of Water Purifier

Cleaning of water tank

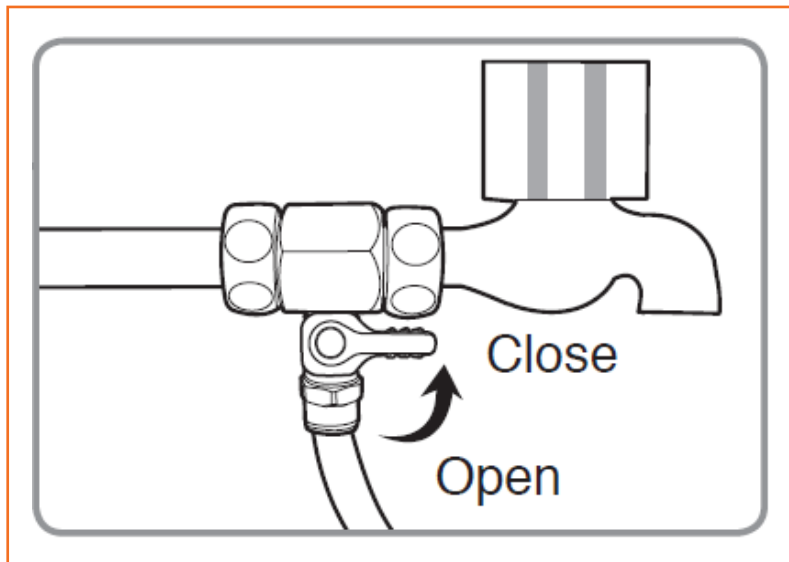


Fig 4.3.1 Closing inlet water valve

1. Close the tap water valve.
2. Drain the water inside the stage tank entirely using the drain hose and water outlet.



Fig 4.3.2 Draining water from water purifier

3. Unplug the power cord
4. Open the top cover by lifting it upward and unlock the cover of the storage tank.

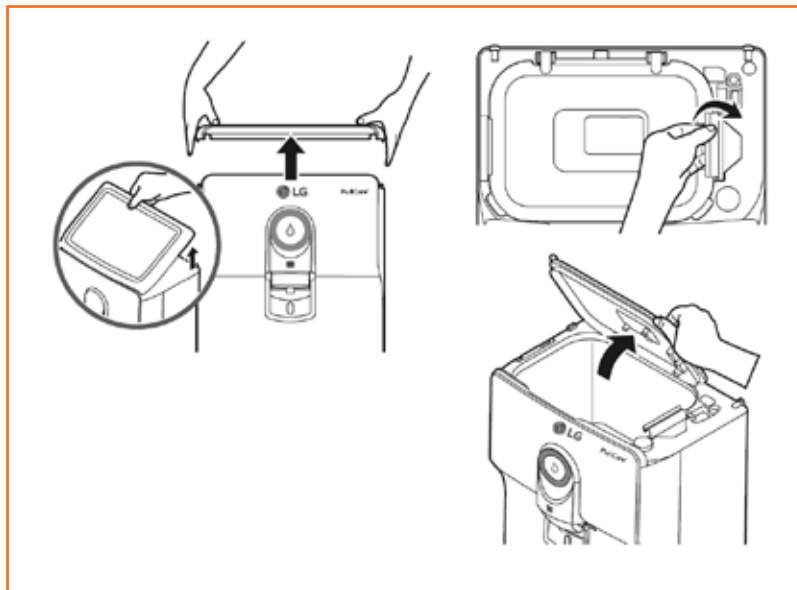


Fig 4.3.3 Opening top cover

5. Wipe the surface of the tank with soft cloth. Do not use any chemical or detergent. If chemical or detergent is not washed completely, this may be harm to human body.

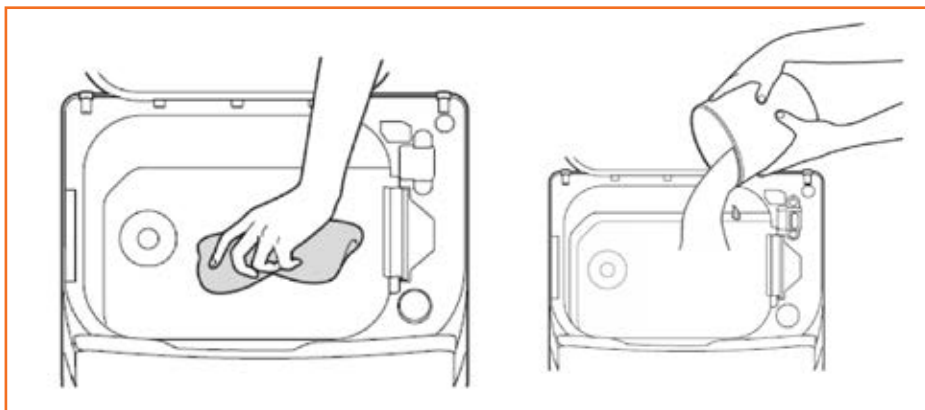


Fig 4.3.4 Cleaning water tank

6. Rinse the storage tank clearly with the prepared purified water and then drain the water completely.
7. Insert and lock the storage tank cover

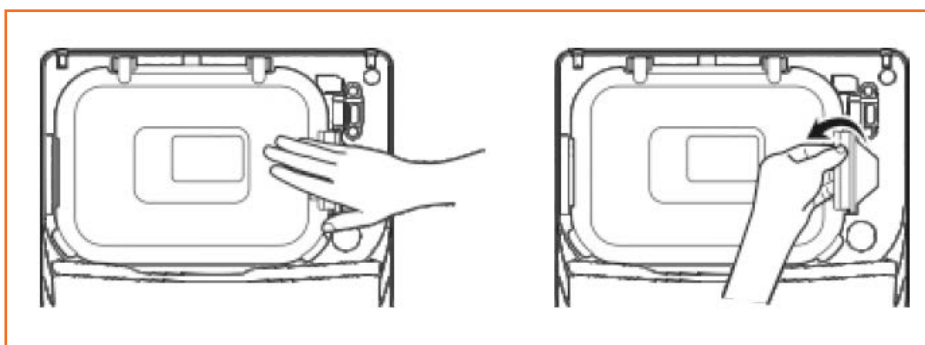


Fig 4.3.5 Fixing tank cover

- Put the top cover back, connect the power cord, and open the supply valve of original water.

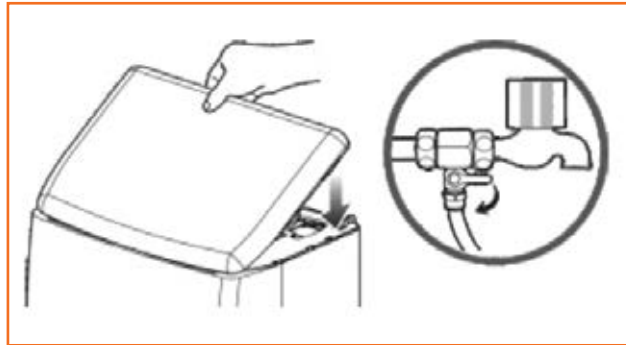


Fig 4.3.6 Fixing top cover

Changing filter

- Close the tap water valve.
- Drain the water inside the stage tank entirely using the drain hose and water outlet.

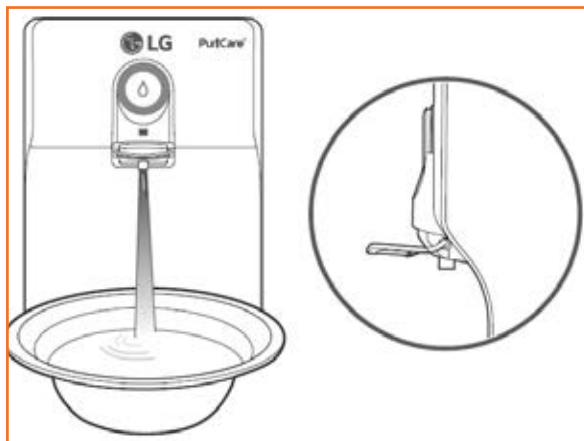


Fig 4.3.8 Draining water from water purifier

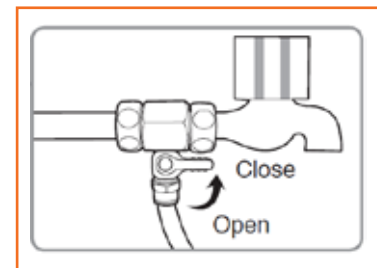


Fig 4.3.7 Closing inlet water valve

- Unplug the power cord
- Open the top or back cover of purifier and remove the filter cover.

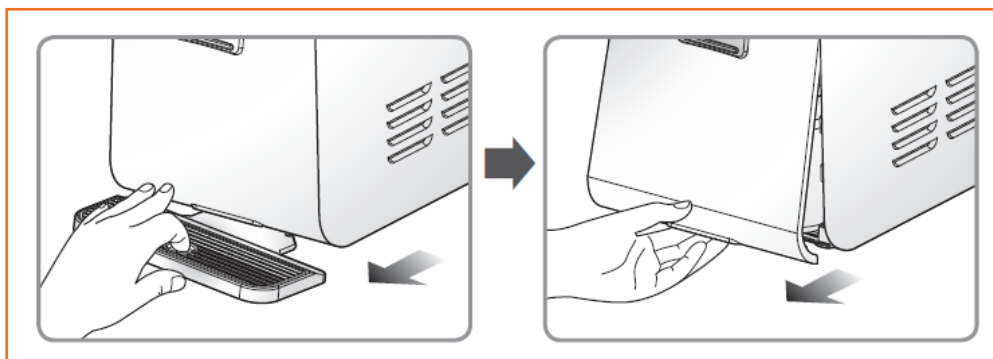


Fig 4.3.9 Opening top or back cover

5. Wash the filter that needs to be replaced, and then change the filter.

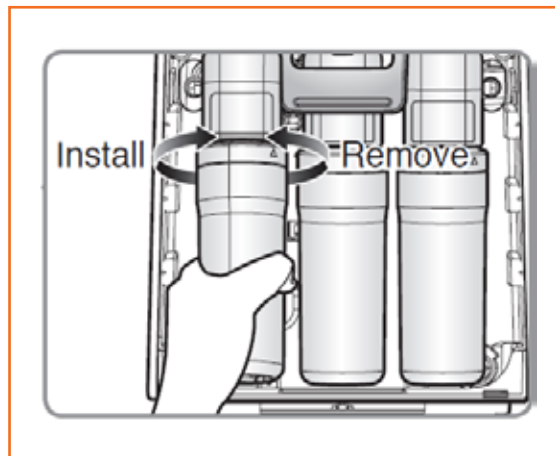


Fig 4.3.10 Replacing filters

6. Fit the top part of the filter cover to the groove and push it upward for closing.

4.3.2 Troubleshooting and Repairing of Faults

There are many different ways that a water purifier would go wrong. Each issue has multiple possible causes. Let's take a look at the possible causes and solutions for the water purifier problems.

Problem	Cause	Solution
Not Enough /No water from Tap	Blocked or closed feed water input	Open or unblock valve
	Blocked sediment/carbon filter	Replace filters
	Closed tank valve	Open valve
	Blocked drain flow restrictor	Replace drain flow restrictor
	Membrane housing valve stuck	Replace check valve
	Malfunctioning automatic shut-off valve	Replace automatic shutoff valve
	Membrane polluted	Replace membrane
Low pressure from water outlet tap/faucet	Incorrect air pressure in storage tank	• Empty storage tank • Find the air valve stem and add air till all water is removed • Pressurize the tank to 8 PSI

Problem	Cause	Solution
		- Reinstall the tank - Turn on the feed supply
	Blocked post carbon filter	Replace post carbon filter
	Partially closed tank valve	Open valve
	Faulty faucet	Replace faucet
High TDS in output water	Blocked pre-filter	Replace pre-filter
	Incorrectly sealed membrane	Install the membrane correctly
	Exhausted membrane	Replace membrane
	Output and drain water lines reversed	Swap the connections
	Malfunctioning automatic shut-off valve	Replace automatic shut-off valve
	Dirty post-carbon filter	Clean/replace post-carbon filter
Bad taste or odour	Blocked post carbon filter	Replace post carbon filter
	Exhausted membrane	Replace membrane
	Dirty storage tank	Clean storage tank
	Water in storage tank left for a long time	Drain and clean storage tank
Leaking membrane housing	Leak in threaded end cap	- Lubricate O-ring and tighten cap - Replace O-ring if leak continues
	Leak in cap or body of housing	- Check housing/cap for cracks - Replace if cracked or damaged
Leaking filter housing	Improper O-ring seating	- Seat O-ring in groove - If dirty, clean and lubricate O-ring

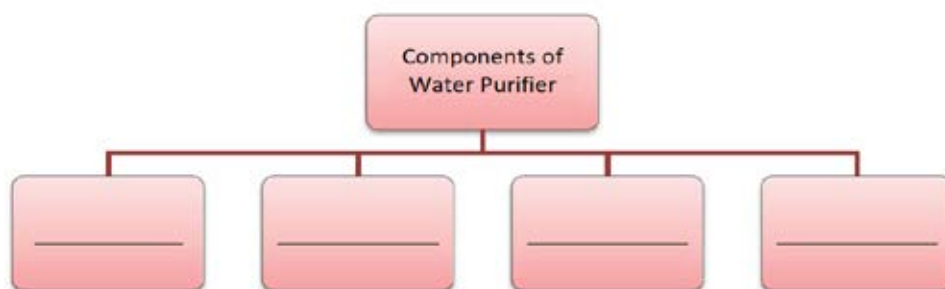
Problem	Cause	Solution
		Replace if cracked or damaged
	Housing cap loose	Hand tighten cap properly
	Damaged housing	Replace if cracked or damaged
Leaking fitting	Damaged or cracked fitting	Replace fitting
	Improper tubing or thread installation	Check and correct tubing and thread installation
System continuously running	Automatic shut-off valve not working	Replace Automatic shut-off valve
	Low incoming water pressure	Increase water pressure to 40 psi
	Low air pressure in storage tank	Increase air pressure to 5 - 7 psi when empty
	Damaged storage tank	Replace storage tank
	Worn out flow restrictor	Replace flow restrictor
	Incorrectly installed membrane	Check membrane installation
Milky water	New System or filters	Air in lines - will go way with use
	Water supply	High oxygen content - will go way with use
	Bad membrane	- Check TDS of water - Replace membrane
Noisy drain/ faucet	Air gap faucet	Check air gap is properly installed
	Drain tube	Check drain line for loops, bends, dips or kinks

Table 4.3.1 Common problems and their solutions in water purifier

Exercise



1. Write the basic components of a water purifier in the space provided in the following figure.

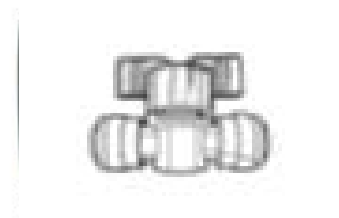


2. Identify the components of a water purifier and write their names in the space given below their images.









5. Install and Repair Refrigerator and Washing Machine



Unit 5.1 – Basics of Refrigeration and Refrigerators

Unit 5.2 – Installation and Repairing of Refrigerator

Unit 5.3 – About Washing Machines

Unit 5.4 – Installation and Repairing of Washing Machine



Key Learning Outcomes



At the end of this module, participants will be able to:

1. Define refrigeration
2. Explain refrigeration cycle
3. List parts of a refrigerator
4. Describe different types of refrigerators
5. Demonstrate installation procedure of a single door and double door refrigerator
6. Demonstrate how to setup and use the features of refrigerator
7. Demonstrate troubleshooting and repairing of a refrigerator
8. Demonstrate installation procedure of semi-automatic washing machine
9. Demonstrate how to use semi-automatic washing machine
10. Demonstrate troubleshooting and repairing of semi-automatic washing machine

UNIT 5.1: Basics of Refrigeration and Refrigerators

Unit Objectives

At the end of this unit, participants will be able to:

1. Define refrigeration
2. Explain refrigeration cycle
3. List parts of a refrigerator
4. Describe different types of refrigerators

5.1.1 Refrigeration

Refrigeration is the process of removing unwanted heat from an object or an area and transferring it to another object or area. This enables an item to be stored below room temperature by keeping it in a system that is designed to cool or freeze.



Fig 5.1.1 Refrigerator

A system/ machine that provides refrigeration under controlled conditions is called refrigerator. A refrigerator uses a chemical substance called refrigerant to transfer heat from one area to another.

Uses of Refrigeration

Refrigeration has had a huge impact on lifestyle, agriculture, manufacturing and processing industry. It has made it possible to preserve food for long periods of time, to store and distribute agriculture produce over long distances, to facilitate many chemical processes, to manufacture different medicines and to provide comfort air conditioning.



Fig 5.1.2 Uses of refrigeration

Apart from comfort, refrigeration has provided suitable conditions in the industries to carry out processes required in the manufacture of various products. Some applications of industrial air conditioning are in -

- IT industry
- Printing industry
- Textile industry
- Semi-conductor industry
- Mines and power plants

5.1.2 Refrigeration Cycle

The basic principle behind the refrigeration process is that when a liquid expands into gas, it extracts heat from its surrounding area. A refrigerant is a chemical liquid which evaporates at a very low temperature enabling it to extract heat at a faster rate. This refrigerant is propelled through a closed system to ensure that it is not dispersed in the surroundings and can be used again and again.

The following figure shows the refrigeration cycle:

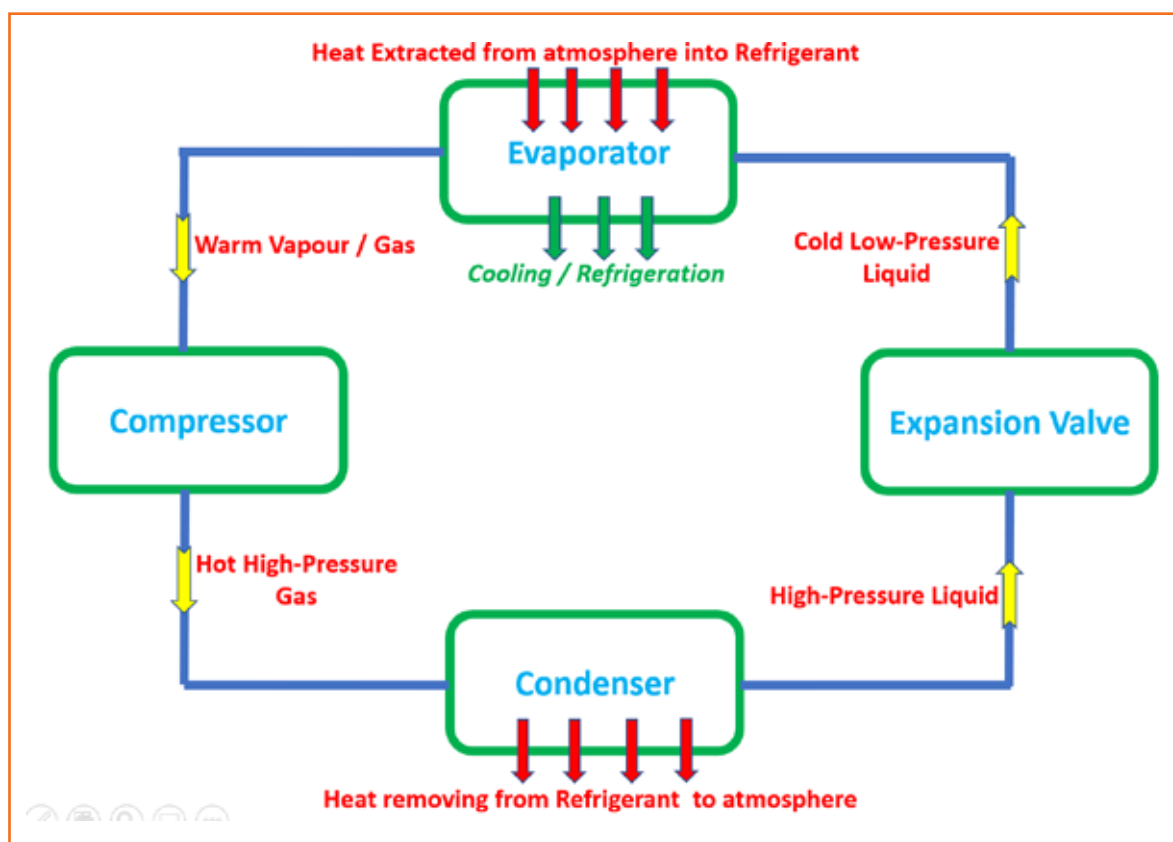


Fig 5.1.3 Refrigeration cycle

A refrigeration cycle consists of two sides or pressure areas, the evaporating or low pressure side and the condensing or high pressure side. A metering device such as an expansion valve or a capillary tube separates the two areas on one side. On the other side, a compressor is placed between the two areas. The metering device controls the flow of refrigerant and the compressor compresses the refrigerant into high pressure gas. The low-pressure refrigerant passes through the evaporator causing it to evaporate. This low-pressure vapour then enters the compressor where it is compressed into a high temperature, high pressure vapour. It then goes into the condenser where it gives up its heat to the cooler air passing through the condenser. The refrigerant condenses back into high pressure liquid which travels to the metering device. It is made to pass through a small opening resulting in a drop of temperature and pressure. This low-pressure refrigerant then enters the evaporator again, thereby completing the refrigeration cycle.

5.1.3 Components of a Refrigerator

A refrigerator consists of four main components as shown in the following figure -

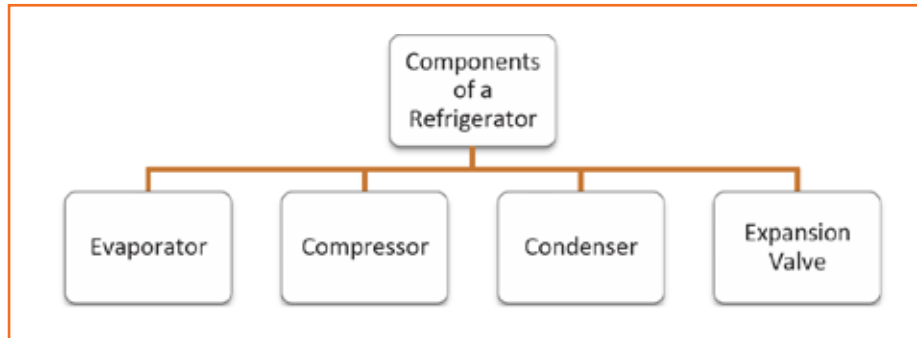


Fig 5.1.4 Components of a refrigerator

Evaporator

The evaporator turns the cold, low pressure refrigerant into vapour. It is in the freezer section of the refrigerator and has a fan blowing across coils of copper or aluminium tubing. The cooler refrigerant absorbs the warmer heat from the surroundings and its temperature rises. This cools down the surrounding and a warm, low pressure refrigerant is sucked into the compressor.

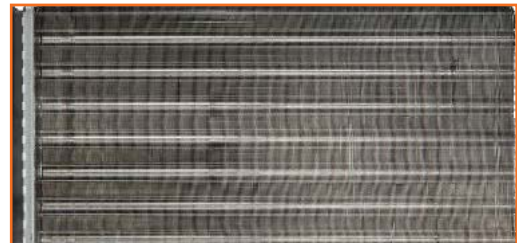


Fig 5.1.5 An evaporator

Compressor

The compressor is the most important part of the refrigeration system. It pulls in the low pressure refrigerant from the evaporator through a suction line and compresses it into a high pressure vapour.

The compressor is a mechanical device that consists of a power source, that is the motor and a compressing mechanism sealed inside a metal housing. There are five main types of compressors that are used in any refrigeration system. -



Fig 5.1.6 A compressor

Reciprocating compressor	A positive displacement compressor that delivers gas at high pressure by using pistons
Scroll compressor	A positive displacement rotary compressor with a fixed and rotating scroll. Gas is compressed by confining in between the two scrolls
Screw compressors	A positive displacement rotary compressor made up of two intermeshing screws/ rotors. Gas is compressed by confining in between the two rotors
Rotary compressors	A positive displacement compressor that uses a rotary impeller to drive the air through a curved chamber to compress it.
Centrifugal compressors	A compressor that uses centrifugal force generated by rotating impeller blades to compress gas

Fig 5.1.7 Types of compressors

Condenser

The condenser is a device that removes heat from the refrigerant and changes it to a liquid form. It consists of coils of aluminium exposed to the atmosphere and a fan that blows across the coils. It is located at the back of a refrigerator. When the hot, high pressure refrigerant flows through the copper tubes, fan cools the vapour refrigerant and changes it into liquid. This liquid refrigerant enters the expansion valve.



Fig 5.1.8 A condenser

Thermal Expansion Valve

The thermal expansion valve is a type of metering device. It consists of a spring-loaded valve connected to a diaphragm. A thin, capillary tube connects the valve with a thermal bulb. The expansion valve restricts the flow of the regular temperature; high pressure refrigerant. The refrigerant expands as it passes through leading to a drop in its temperature and pressure as it leaves the valve and enters the evaporator thereby completing the refrigeration cycle.

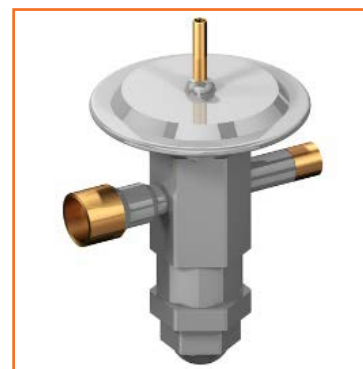


Fig 5.1.9 Thermal expansion valve

5.1.4 Types of Refrigerators

A refrigerator is one of the most essential appliances in the kitchen. There are many types of refrigerators that are available in the market today and it is very important to select the right type of refrigerator.

Refrigerators can be divided into two broad categories:

- Direct Cool
- Frost Free

The following figure shows the different types of refrigerators:

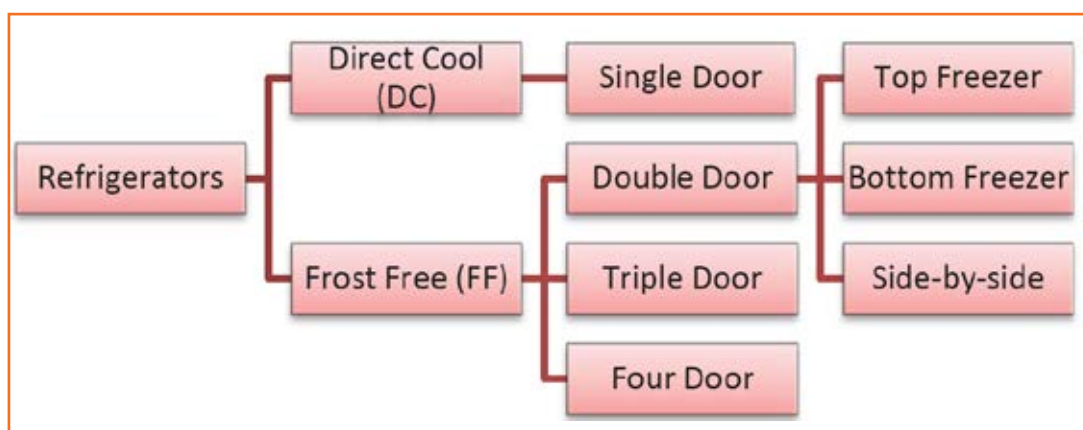


Fig 5.1.10 Types of refrigerators

Direct Cool (DC)

The Direct Cool refrigerator works on the principle of vapour condensation and natural convection. They are single door refrigerators which need to be defrosted manually or semiautomatically.

**Frost Free**

The Frost-Free refrigerators do not require manual defrosting. They contain a small element that melts the built-up ice without interfering in the cooling cycle of the refrigerator.

**Top Freezer**

The Top freezer has the freezer compartment on the top and the refrigerator at the bottom. It has a spacious design with wide shelves which allow easy access to items at the back. It is the most economical and energy efficient model.



Bottom Freezer

The bottom freezer has the refrigerator on the top and the freezer compartment at the bottom. It makes it easy to reach the food items in the refrigerator without needing to bend. The freezer section is either a door or a pull-out drawer. It is slightly expensive than the top freezer model.

**Side-by-Side**

The unit is divided vertically with the refrigerator and the freezer compartments parallel to each other. The doors of both compartments open from the middle. It provides easy access to both fresh and frozen foods. It is more expensive than the basic models.

**Triple Door / French Door**

The French door features side-by-side refrigerator compartments and a bottom freezer. It is one of the most expensive models and is available in many designs. They are wider than the double-door models.



Four Door

The four door model is a variant of the French door one where the freezer compartment is also split in two.



Direct Cool Vs Frost Free refrigerators

The following figure lists the various differences between Direct Cool and Frost-Free refrigerators -

Direct Cool	Frost Free
Single door model only	Multiple door models
Cooling achieved by natural convection	Cooling achieved by forced convection
Single thermostat controls cooling	Multiple thermostats control cooling
Non-uniform cooling	Uniform cooling
Slow cooling	Fast cooling
Manual defrost	Automatic defrost
Capacity upto 300 litres only	Capacity upto 800 litres

Fig 5.1.11 Direct cool Vs frost free refrigerators

5.1.5 Direct Cool (DC) Refrigerator

DC refrigerators are single door refrigerators having separate compartments within one unit. The top compartment is the freezer which stores frozen food. The middle compartment is the storage where food items are kept. The bottom compartment consists of vegetable drawers to store fresh vegetables and fruits.



Fig 5.1.12 Compartments in a DC refrigerator

All the compartments are maintained at different temperatures according to their function and the food they store. The following table shows the functions and temperatures of the different compartments in DC refrigerator -

Compartment	Food stored		Temperature
Freezer		Frozen meat, fish, ice cream	-16 ⁰ C to -18 ⁰ C
Chiller		Milk, butter, cheese	1 ⁰ C to 3 ⁰ C
Refrigerator		Cooked food, cut fruits	3 ⁰ C to 6 ⁰ C
Vegetable drawer		Fruits and vegetables	6 ⁰ C to 8 ⁰ C
Door shelf		Water bottles, juices, eggs	8 ⁰ C to 10 ⁰ C

Fig 5.1.13 Functions and temperatures of compartments in a DC refrigerator

Working of DC Refrigerator

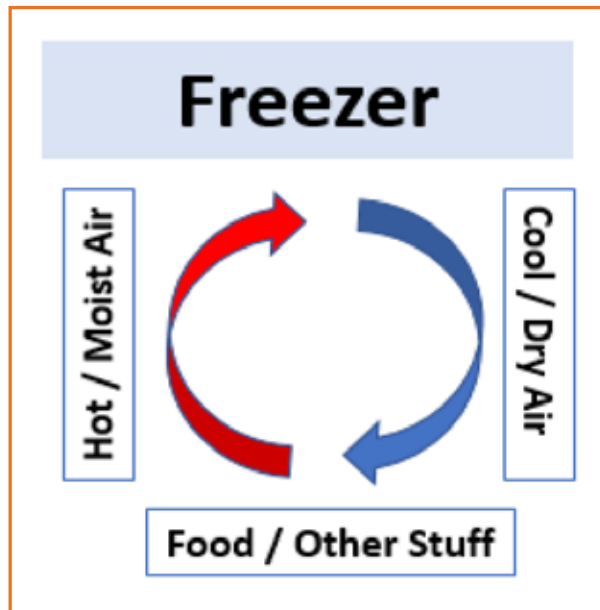


Fig 5.1.14 Working of a DC refrigerator

DC refrigerators are based on the principle of cooling through vapour condensation and natural convection. The air within the inner compartments of the DC refrigerator is hot and moist. This air rises up and comes in contact with the evaporator. The evaporator absorbs the heat and moisture from the hot air. As a result, the air in the freezer compartment becomes cold and dry. Being heavier, this cold air moves down and cools the remaining compartments. The cold air again pushes the hot air up. In this way, the cycle keeps on repeating till the set temperature is attained. The compressor then switches off. When the temperature rises again, the thermostat restarts.

Components of DC Refrigerator

Component	Description
Drier	Absorbs moisture content in the sealed system and prevents the moisture from entering the capillary.
Accumulator	- Located in the suction line between the evaporator and compressor - Stores excess liquid refrigerant or oil that has not evaporated - Designed to avoid damage to the compressor
Overload protector (OLP)	- Mounted in series with the common terminal of compressor - Designed to protect the compressor from overload
Thermostat	- Regulates the temperature inside the refrigerator - Controls the running and stopping time of the compressor

PTC Relay	Disconnects the power supply to the compressor when it reaches 80% of its speed
Door Switch	Controls the operation of cabinet bulb
Cabinet bulb	Glowes when the refrigerator door opens
Drain pipe	Connects the chill tray with the drain pan
Drain pan	Collects the drain water
Door gasket	- Located at the edges of the door - Prevents flow of air from inside the refrigerator to outside and vice versa

Defrosting DC Refrigerator

The evaporator absorbs the moisture from the air in the freezer compartment. When this moisture condenses, it results in the formation of frost on the evaporator. If the refrigerator door is opened frequently or if the humidity in air is more, it will lead to more frost. As ice is a bad conductor of heat, excess frost adversely impacts the heat transfer in the refrigerator.

Therefore, to ensure efficient cooling, a DC refrigerator needs to be defrosted regularly.



Fig 5.1.15 Frost formation in the freezer of DC refrigerator

Defrost Method

Press the defrost switch manually. The power supply to the compressor gets switched off automatically. The air inside the compartments starts to heat up making the frost on the evaporator melt. The defrosted water gets accumulated in a chill tray and is carried by a drain pipe to a drain pan. As soon as the temperature of evaporator reaches a pre-set value (zero-degree C), the thermostat restores the power to the compressor and the cooling cycle starts.

Before defrosting the refrigerator, remember to:

- Turn off the freezer
- Remove frozen items from the freezer

Wiring diagram of DC refrigerator

A wiring diagram represents the electrical circuit of an appliance. It depicts the power and signal connections between the devices and the components in an electrical circuit. This information is useful while installing or servicing a device.

The following figure shows the wiring diagram of a DC refrigerator with electronic controls (PCB):

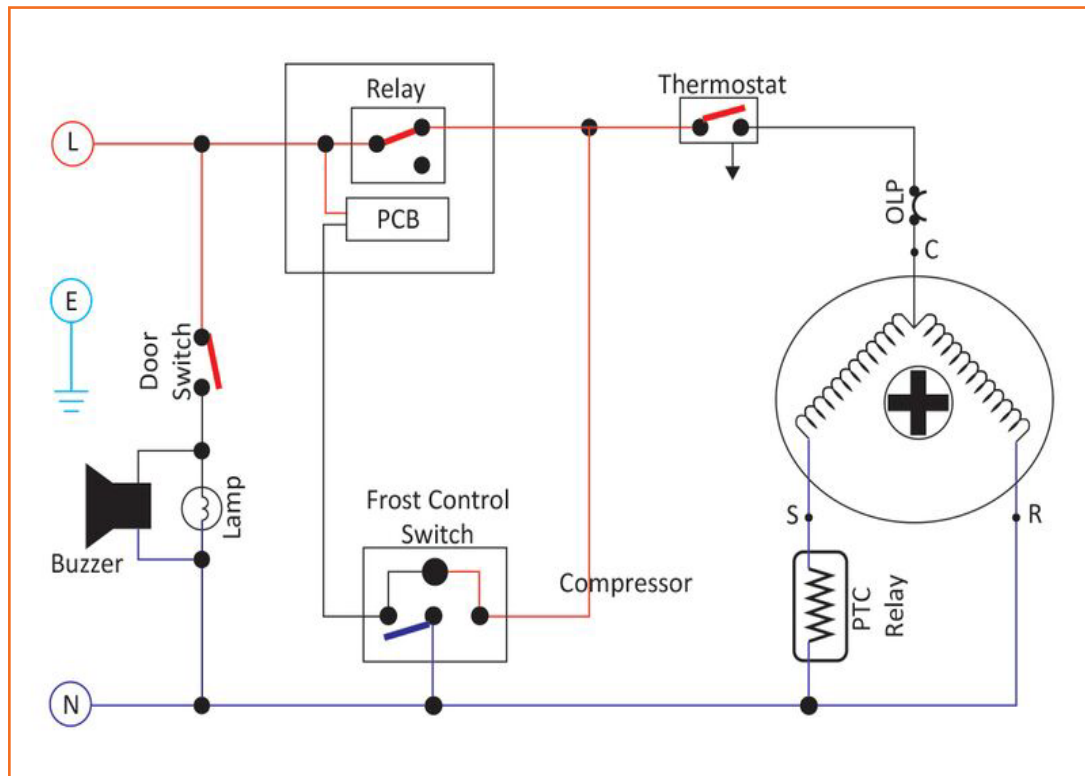


Fig 5.1.16 Wiring diagram of DC refrigerator with electronic controls

The following figure shows the wiring diagram of a DC refrigerator with timer for auto defrost:

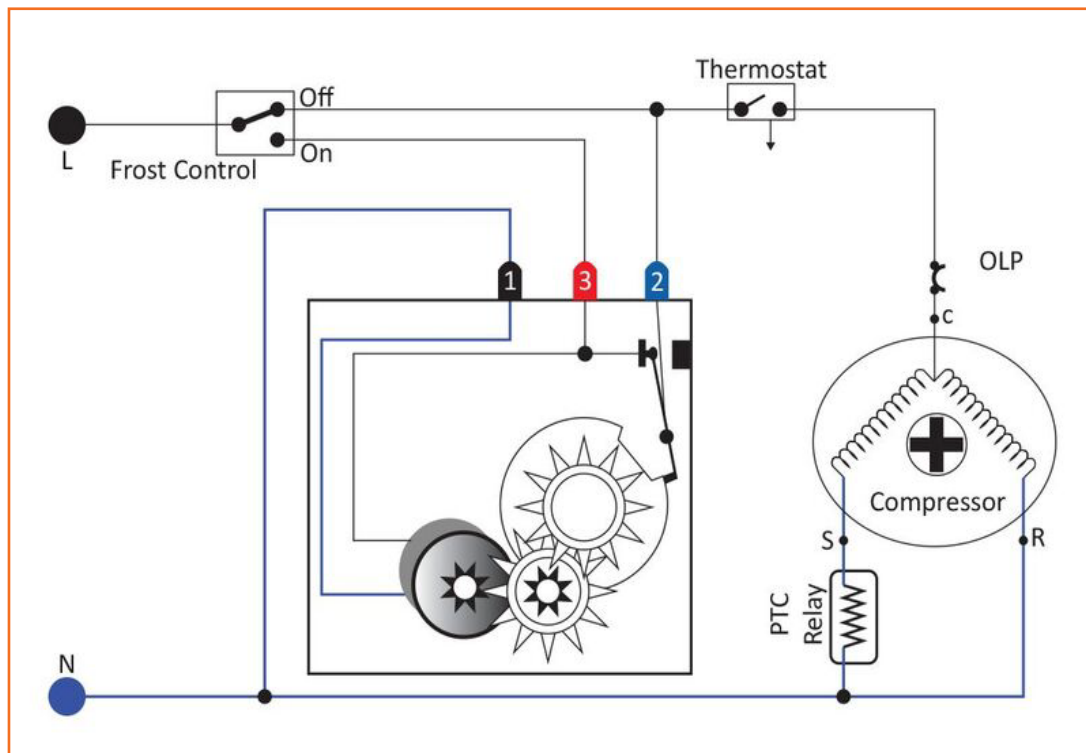


Fig 5.1.17 Wiring diagram of DC refrigerator with timer for auto defrost

5.1.6 Frost Free (FF) Refrigerator

FF refrigerators are multi-door units that are based on the principle of auto-defrost technique. In FF refrigerators, the freezer and the refrigerator compartments open separately. This ensures that when one compartment is opened, there is no cooling loss in another. They are spacious and wider than the DC refrigerators.



Fig 5.1.18 FF refrigerator

The following table shows the different compartments in FF refrigerator

Compartment	Food stored		Temperature
Freezer		Frozen meat, fish, ice cream	-16 ⁰ C to -18 ⁰ C
Chiller		Milk, butter, cheese	1 ⁰ C to 3 ⁰ C

Refrigerator top compartment		Dairy products, cooked meat/fish	2° C to 3° C
Refrigerator middle compartment		Cooked or raw vegetable or food	3° C to 6° C
Vegetable drawer		Fruits and vegetables	6° C to 8° C
Door shelf		Water bottles, juices, eggs	8° C to 10° C

Working of FF Refrigerator

FF refrigerators work on the principle of forced convection wherein a fan is used to force the heat transfer. The freezer and the refrigerator compartment are connected to each other to allow air to pass from the freezer to the refrigerator compartment. A damper regulates this flow of air. A blower fan generates forced air circulation to cool the compartments. The fan sucks in the hot air and pushes it through the evaporator fins. The evaporator fins are at subzero temperature and absorb heat and moisture from the hot air. The resulting cold, dry air is pushed to the freezer and the refrigerator compartments. This cycle continues till the preset temperature for both the compartments is achieved. An electrical thermostat regulates the temperature in the freezer/refrigerator compartments by switching the compressor on and off.

Components of FF Refrigerator

Some of the components of the FF refrigerator are similar to the DC refrigerator -

Component	Description
Evaporator fan motor	Drives the evaporator fan to facilitate the movement of air
Condenser fan	Sucks hot air from the condenser and throws it outside

Component	Description
Bi-metal thermostat	Contains a bi-metal coil that contracts when cold and expands when heated Fixed in the evaporator Cuts off the defrost heater after defrosting is over
Thermal fuse	Protects the freezer compartment from damage Fixed in the evaporator
Defrost timer	Automatically starts the defrost timer
Damper thermostat	Non-electrical device Regulates the temperature inside the refrigerator
Defrost heater	Melts the frost formed in the freezer
Door switch	Controls the operation of refrigerator lamp

Defrosting FF Refrigerator

The defrost system of FF refrigerator consists of the defrost timer, heater and thermostat. The defrost timer is the most important component of the defrost system. It is a motorized device with the defrost heater circuit on one end and the cooling system on the other. It opens and closes these contacts at pre-set intervals such that when one of the contacts is switched on, the other is switched off.

The following image shows a typical defrost cycle:

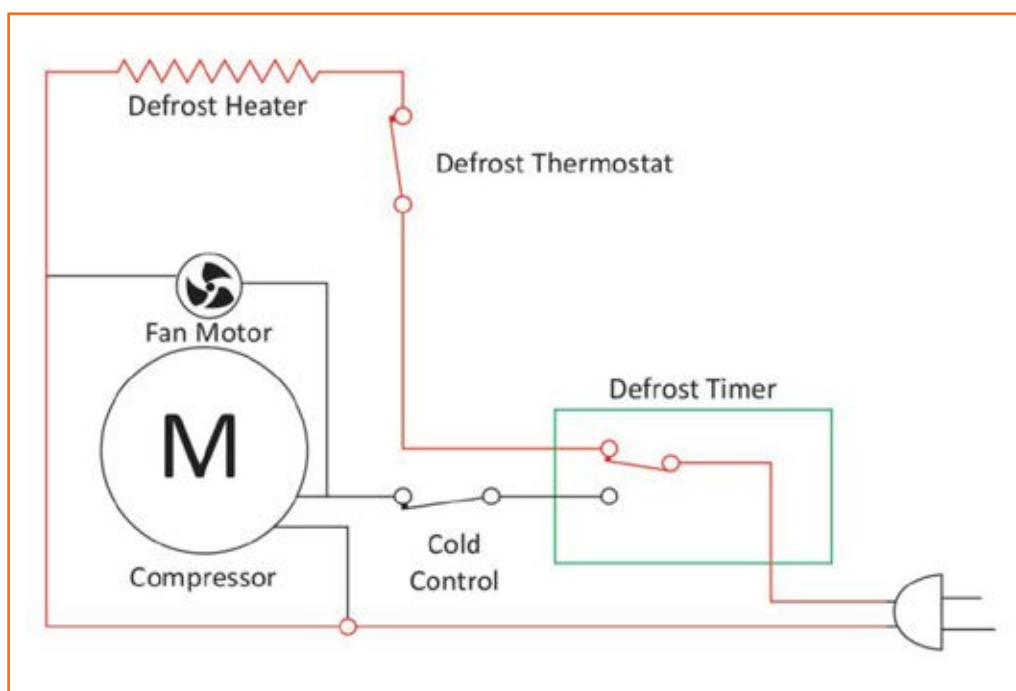


Fig 5.1.19 Defrost cycle of a FF refrigerator

The defrost timer automatically starts the defrost cycle after an interval of eight hours of compressor ON time. The defrost heater, located beneath the evaporator, starts melting the frost around the evaporator coils. The melted water flows out of a duct into a drain pan located on top of the compressor. The heat from the compressor evaporates the accumulated water. As soon as the frost is melted, the temperature of the evaporator coil increases due to the heat. The bi-metal sensor mounted on the evaporator coil senses the increase in temperature and turns off the heater.

Wiring Diagram of FF Refrigerator

A wiring diagram uses symbols to give information about the arrangement and the relative position of the components of an electrical circuit. It helps in understanding and troubleshooting problems by ensuring that all the components are present, and all the connections have been made.

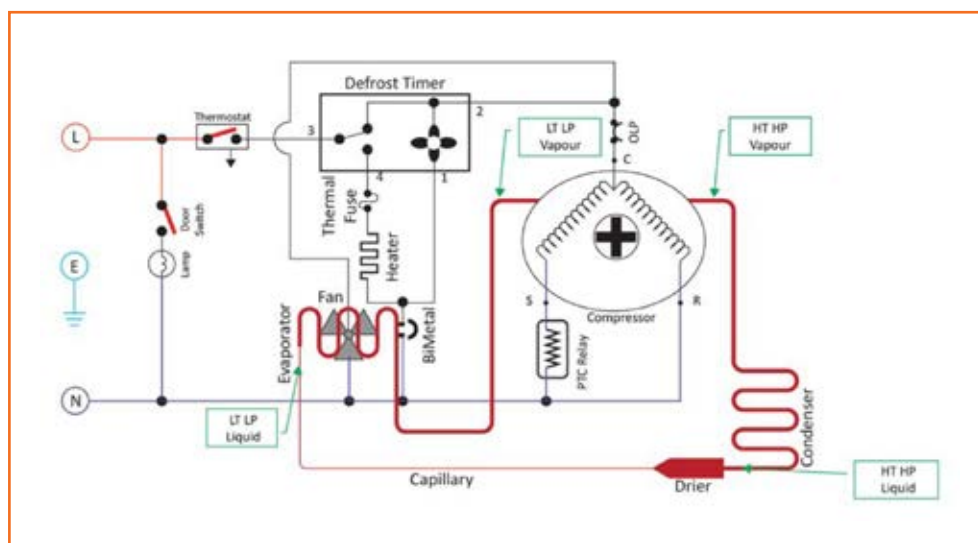


Fig 5.1.20 Wiring diagram of a FF refrigerator with manual controls

The following figure shows the wiring diagram of a FF refrigerator with electronic controls (PCB):

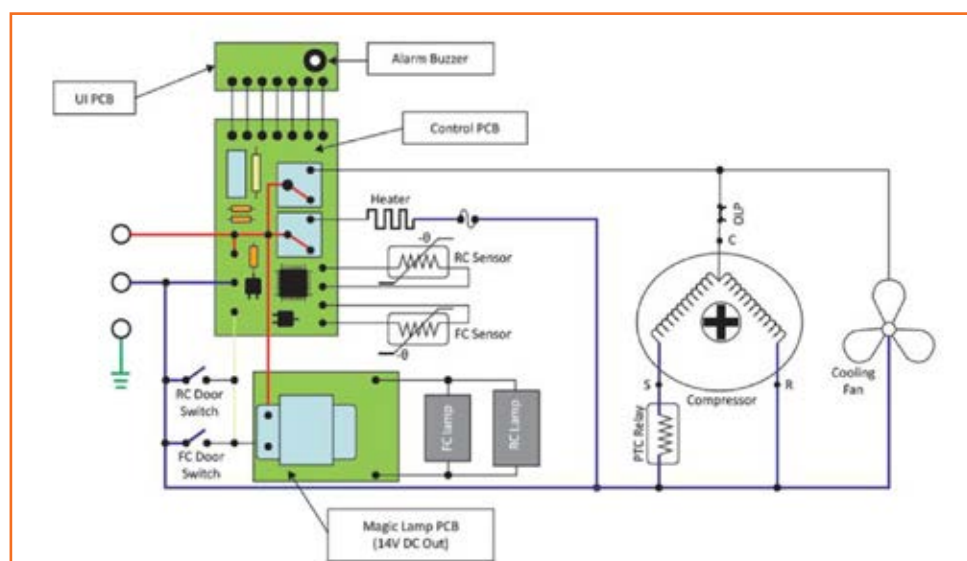


Fig 5.1.21 Wiring diagram of a FF Refrigerator with electronic controls

UNIT 5.2: Installation and Repairing of Refrigerator

Unit Objectives

At the end of this unit, participants will be able to:

1. Demonstrate installation procedure of a single door and double door refrigerator
2. Demonstrate how to setup and use the features of refrigerator
3. Demonstrate troubleshooting and repairing of a refrigerator

5.2.1 Site Requirements for Installation

The first step of an installation process is to conduct a site survey and ensure that it meets all the requirements. The successful operation of a refrigerator is dependent on proper installation. The selected site should comply with all the safety codes and should not interfere with normal movement of people.

Site requirements for installing a single door and double door refrigerator:

- Select a well-ventilated place
- Choose a location without direct exposure to sunlight. A refrigerator functions efficiently at the room temperature.
- Ensure path of delivery has enough clearance
- Avoid extreme heat and cold

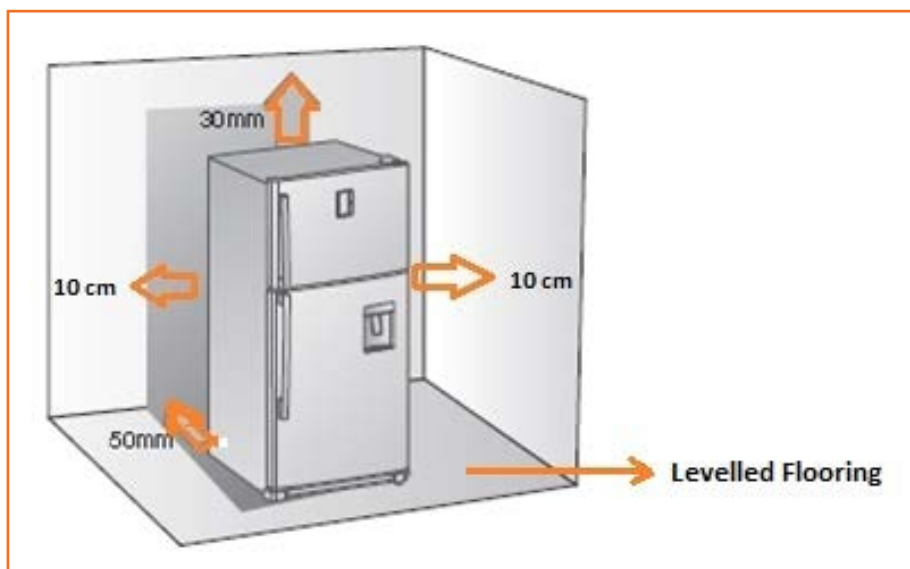


Fig 5.2.1 Area requirements for a refrigerator

- Avoid installing near any heating appliance
- Place the refrigerator near a location with level flooring. The location should be with enough space for the refrigerator doors to open easily

After checking the site requirements, the next step is to check the power supply at the location site. Power requirements for installation are -

- Ensure that voltage and electrical wiring is appropriate
- Use a separate socket for refrigerator
- Ensure wall socket is properly earthed
- Place the refrigerator close to the electrical outlet
- Do not use an extension cord

5.2.2 Installation Process

The installation process consists of transporting the unit from the delivery truck to the location, unpacking the unit, disposing the packing material and installing the refrigerator at the designated place.

Transporting Refrigerator

The refrigerator is an expensive electrical device. It should be handled with care during transportation. The following figure shows the precautions that should be taken when transporting a refrigerator:



Fig 5.2.2 Handling refrigerator properly

Unpacking Refrigerator

- Cut the binding strip of carton
- Remove the adhesive tapes and open the top flaps
- Remove the top buffers
- Remove the carton
- Remove the base plate assembly
- Remove and unpack the accessories
- Remove any tape or glue residue with mild soap solution
- Avoid using sharp instruments or abrasive cleaners

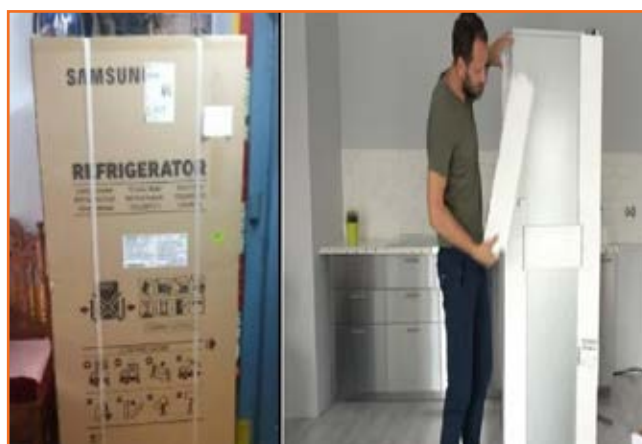


Fig 5.2.3 Unpacking refrigerator carton

Installing the Refrigerator

Now inspect the refrigerator for any damage to the cabinet or the sealed system. Lift the refrigerator gently and place it in its proper position. Once it is in place, check the air gap on each side to make sure it is as wide as the manufacturers recommend. If not, pull it out, move it in the required direction and slide it in again.

Level the refrigerator properly with the help of the adjustable legs to ensure that it stands firm on the ground. Keep the front end slightly higher than the rear end to help in door closing. Fit all the accessories in their proper place. Now install the shelves and trays, close the doors and let the refrigerator start working.

Note: Have to wait if the refrigerator has been laid on its side at some point during shipping. When laid on its side, the oil in the compressor goes up into the refrigerant lines. If you start the compressor with insufficient oil, it can be damaged. So, the manufacturers recommend 2 hours.

Connecting Electric Supply

Before plugging-in the refrigerator, check the power supply with the help of a voltmeter. If the voltage is below 170V or above 250V, advise the customer to install voltage stabilizer. This will safeguard the sealed system from any possible damage due to voltage fluctuation.

The following figure shows the steps to connect the electric supply -

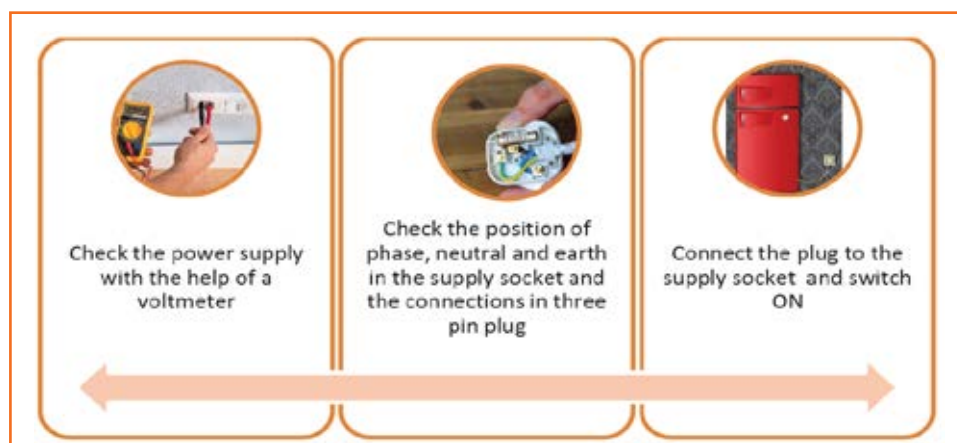


Fig 5.2.4 Connecting refrigerator with power supply

The thermostat should be switched on to normal position as shown in the following image -



Fig 5.2.4 Setting temperature of refrigerator

It takes two to three hours for the temperature in the refrigerator to stabilize. Observe the compressor and fan for some time.

Complete the Documentation

After completing the installation at the site, the technician should complete the documentation to record the details related to installation. Along with completing the documentation, the field technician should tell the customer about some do's and don'ts for using the refrigerator such as, keep the area near the product clean and dry. The field technician should also tell the customer about important pages to be referred to from the owner's manual.

5.2.2 Troubleshooting and Repairing of Refrigerator

The following table represents the common problems in the working of a refrigerator along with their potential causes and solutions -

Fault/Symptoms	Potential Causes	Recommended Solutions
Excess frost in freezer	Defective bi-metal or thermal fuse or defrost heater	1. Check the continuity of each component 2. Replace defective component
Refrigerator temperature not maintained	Improper installation	1. Check installation 2. Check ventilation
Condensation in refrigerator compartment	Air leakage	1. Check for leakage 2. Do proper insulation

Improper cooling	Gas leakage	1. Check for gas leakage 2. Repair the leakage 3. Refill refrigerant
Frequent compressor tripping	Defective condenser fan motor	1. Check condenser fan motor 2. Replace defective motor
Fan runs even when door is open	Defective door switch	1. Check door switch 2. Replace if defective
Internal bulb does not switch ON	Defective bulb	1. Replace light bulb
No cooling in refrigerator	Defective sealed system	1. Repair sealed system
Refrigerator unit not working	Fuse blown	1. Check fuse 2. Replace if defective
	Defective thermostat	1. Short thermostat connection 2. Check if refrigerator working 3. If yes, repair/replace thermostat
Refrigerator unit not humming	Low voltage	1. Check voltage 2. If not within range, connect stabilizer
	Defective relay	1. Short relay connection 2. Check if refrigerator working 3. If yes, repair/replace relay
Refrigerator running continuously	Defective thermostat	1. Short thermostat connection 2. Check if refrigerator working 3. If yes, repair/replace thermostat
Refrigerator very noisy	Improper installation	1. Check installation 2. Check foundation 3. If loose, tighten base screws
Refrigerator compartment very hot	Improper thermostat adjustment	1. Check thermostat 2. Replace if defective
	Defective door seals	1. Check door gasket 2. Replace if defective

	Defective fan motor	1. Check continuity between fan and switch 2. Check fan and switch 3. Replace the defective part
	No air circulation	1. Check air circulation 2. Check for any restriction in air path
Compressor not working	Low voltage	1. Check voltage 2. If not within range, install stabilizer
	Defective compressor	1. Check compressor 2. Replace if defective
	Defective overload protector	1. Check continuity of overload protector 2. Replace if defective
	Defective start relay	1. Check resistance of relay 2. Replace if abnormal
Compressor motor heats up	Excessive load	1. Reduce load
Current leakage	Improper grounding	1. Check grounding of all components 2. Replace if ungrounded

Table 5.3.1 Area of problems and solutions in refrigerator

Scan the QR code or click on the link to watch related videos



<https://www.youtube.com/watch?v=v59XmamNDGU>
Basic problems in refrigerator

UNIT 5.3: About Washing Machines

Unit Objectives

At the end of this unit, participants will be able to:

1. Identify the different types of washing machines
2. Describe the features and functionalities of different parts of a washing machine
3. Identify the various washing cycles

5.3.1 Washing Machine

Washing machine is the machine used to wash the various types of clothes without applying any physical efforts. With washing machine, you don't have to rub the clothes with hand or squeeze them to remove the water from them. The washing machine is also called as clothes washer or simply the washer. The washing machine enables you to wash your clothes automatically without having to supervise its operation. All you have to do is put the clothes in the machine and select the wash mode. The washing machine automatically takes in the amount of water and detergent required and it also automatically sets the timer for washing, rinsing and drying as per the selected mode and the amount of clothes.



Fig 5.3.1 Washing machine

Working of washing machine

The washing process of a washing machine comes under the working of washing machine. Different parts of a washing machine play different roles in the washing process of clothes. The washing process of washing machine comprises of the points as described below.

Filling Process

- In this, water is filled inside the drum washer depending upon the quantity of clothes to be washed.
- Hot or cold water flow is controlled by the solenoid valve.

Agitating Process

- In this process, clothes are rotated up and down by the agitator which is fixed inside the drum washer.
- Agitator moves clothes back and forth, up and down inside the washer

Draining Process

- In this, water is drained out from the washing machine during spin cycle with the help of drain pump.



Fig 5.3.2 Working of washing machine

- With the help of drain hose, water is forced out to reach the bend of drain hose and then out of the drain.

Rinsing Process

- After the clothes are agitated, they are rinsed in clean water to remove detergent.
- Rinse cycle depends on the load of the washing machine.

Spinning Process

- After the above processes, spin cycle comes into action.
- In this, after clothes are rinsed in clean water, spin motor removes extra water from the clothes and dries them.

5.3.2 Types of Washing Machine

Washing machines are classified depending upon their features and functionalities.

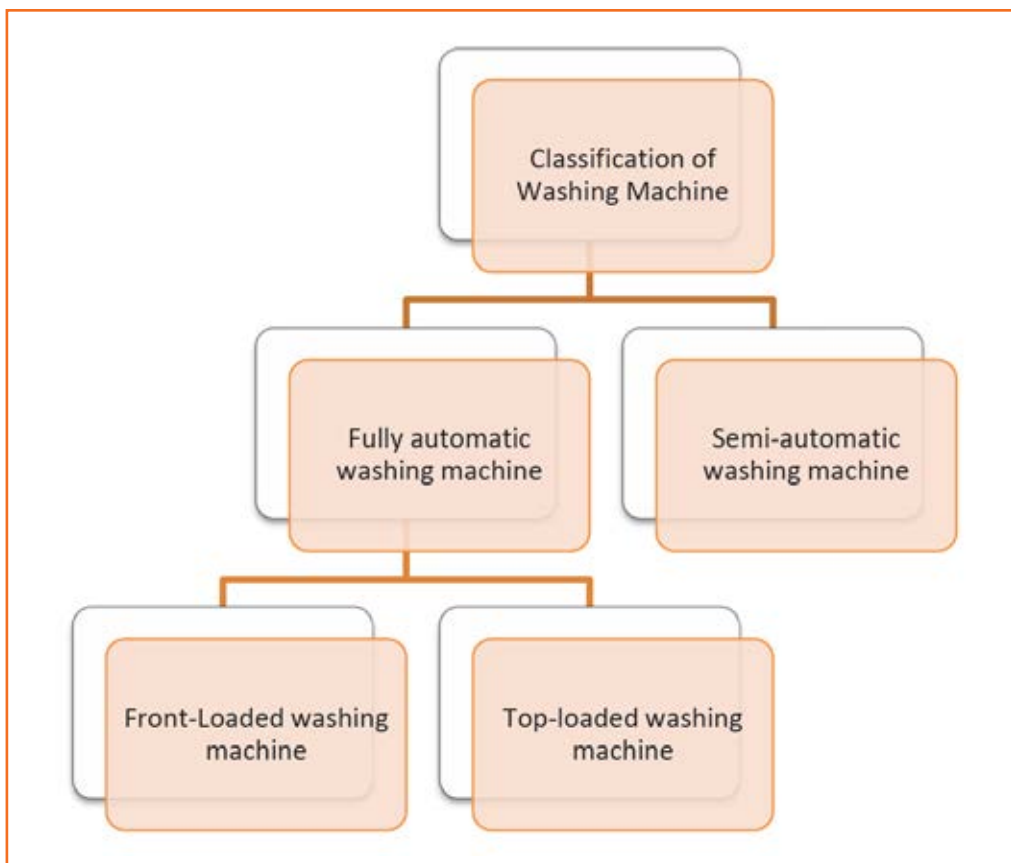


Fig 5.3.3 Classification of washing machines

The explanation for these machines is as follows:

- **Fully automatic Machine:** This type of machine works automatically in different cycles. From filling process till spinning process, it doesn't require any manual handling. It sets the temperature

of water and also drains off water. In this each cycle begins automatically after the previous cycle ends. It is further divide into:

- ☐ Top-Loading washing machine
- ☐ Front-Loading washing machine

The following table describes the differences between front load and top load washing machine based on their features and functionalities -

Top-Loading	Front-Loading
Top loading washing machine is a midrange and economical machine.	Front Loading washing machine is a premium machine.
Top loading machines are easier to move, and the lid opens from the topside.	Front loading washing machines are heavier than the top loading ones and their lid is operated from the front side.
In this type of a washing machine, clothes can be added in between the washing process.	Once the washing process has started, a front-loading machine cannot be stopped.
Top Loading machines give moderate performance.	Front loading machines give better performance.
In top loading machines, the maintenance cost is low	As this machine has some serviceable parts, its maintenance cost is high

- **Semi-automatic washing machine:** This machine works manually, and it is better than fully automatic machine as it saves water and detergent. It consists of two tubs:

- ☐ Wash Tub
- ☐ Spin Tub

In wash tub, it agitates the clothes and in this, we can fill the water according to the requirement and conditions. Drain process is also done manually by rotating the drain switch.

In spin tub, extra water from the clothes is removed by setting the time period for which it will rotate.



Fig 5.3.4 Semi-automatic washing machine

5.3.3 Basic Components of Washing Machines

A washing machine contains several parts which work together to complete the washing of the laundry.

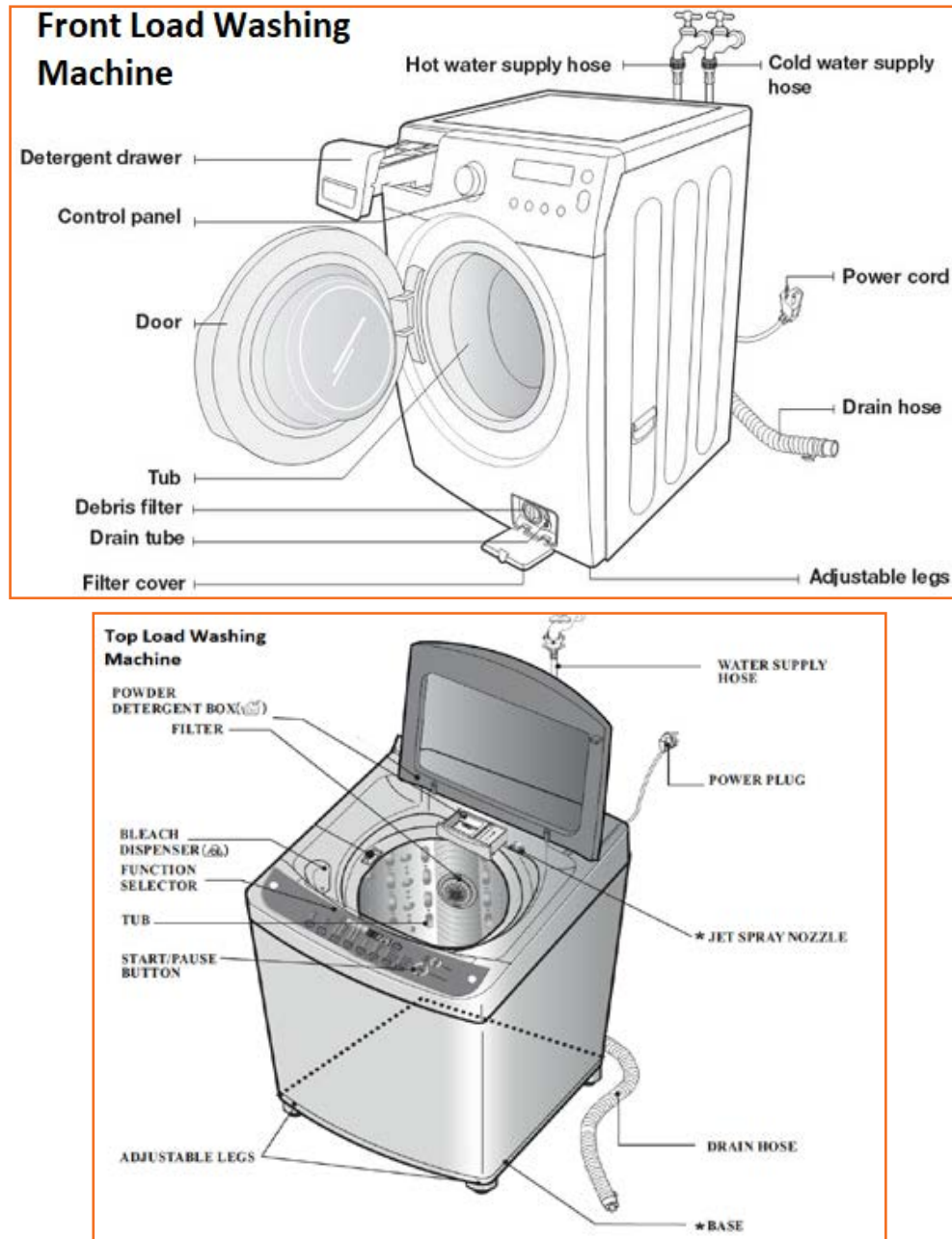


Fig 5.3.5 Components of Front load and Top load washing machine

Basic parts of a washing machine are:

1. **Drain pipe/hose:** The drain hose exits the washing machine toward the bottom and travels up to the nearby sink or standpipe. It drains the dirty water from the washing machine and is usually made of corrugated plastic.



2. **Water inlet control valves:** The water inlet valve is in the back of the washer, toward the top. It has one port for hot water and one for cold. Some front load models only have one port for cold water and an internal heater to warm the water up to temperature. The inlet valve opens and closes when it receives electrical signals from the washer, letting water enter the tub at the right times during a cycle.



3. **Tub/Drum:** Most washing machines have an inner and outer tub. The inner tub is called a wash basket in top load washers and a drum in front load washers. The outer tub remains stationary and holds the wash basket or drum, catching the wash water so it can be drained out. The wash basket or drum is the part of the washer that holds the clothes and rotates to wash them. They can be plastic, porcelain or stainless steel.

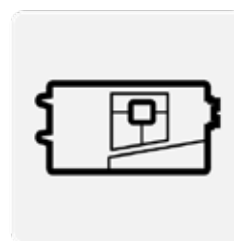


4. **Washing machine motor:** The washing machine motor powers the movement that causes your agitator, discs or drum to rotate as machine runs through a cycle. The washer motor usually sits at the bottom of the washer in top load models and the back in front load models. The most common type of motors used in washers are direct drive or belt drive.

- ☐ The direct drive motor is attached directly to the wash basket,
- ☐ while the belt drive motor sits independently and uses a belt to turn the wash basket.



5. **Printed circuit board:** The printed circuit board (PCB) is the brains of the washing machine. It commands the control panel and wash cycles, as well as firing off the different electronic parts that are needed for your washer to do its job. The PCB is also responsible for water levels, how much detergent is dispensed and other functions washing machine may have.



6. **Timer:** Timers on washing machines can either be set manually or automatically, and will set the wash time for your laundry cycles. Not all washers come with a timer, so your washer may not have this feature.



7. **Control panel:** All settings and wash cycles will be controlled on this panel, which is either on top or front of the washing machine.

8. **Heating element:** When using cycles that will run either warm or hot water, this element heats up the water to the desired temperature. Note: Heating elements are model dependent.

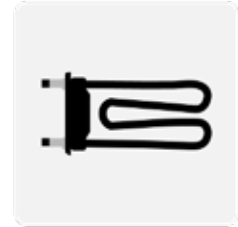


Table 5.3.1 Components of washing machine

UNIT 5.4: Installation and Repairing of Semi-automatic Washing Machine

Unit Objectives



At the end of this unit, participants will be able to:

1. Demonstrate installation procedure of semi-automatic washing machine
2. Demonstrate how to use semi-automatic washing machine
3. Demonstrate troubleshooting and repairing of semi-automatic washing machine

5.4.1 Installation of Semi-Automatic Washing Machine

To be utilized productively, a washing machine needs to be installed properly along with its supporting accessories which are important in its proper functioning. A washing machine comes with various functionalities which makes day to day work easy. A field technician should read the product manual and set up the appliance according to it and keeping in mind customer's requirement.

Check Customer Requirements

A field technician is responsible for the installation or repair/maintenance of the semi-automatic washing machine. When work is allocated, it is important to understand and analyse the requirement before going ahead with the plan of action or visiting the customer's site.

Unpacking the Washing Machine

There are certain steps involved in complete unpacking and taking out a washing machine. The following steps involved in a placing washing machine set up -

1. Open the packaging of the new product
2. Cut bands around the cardboard covering of the washing machine
3. Remove the cardboard covering from the washing machine, using scissors or a knife
4. Take out the product carefully
5. Check the accessories inside the package

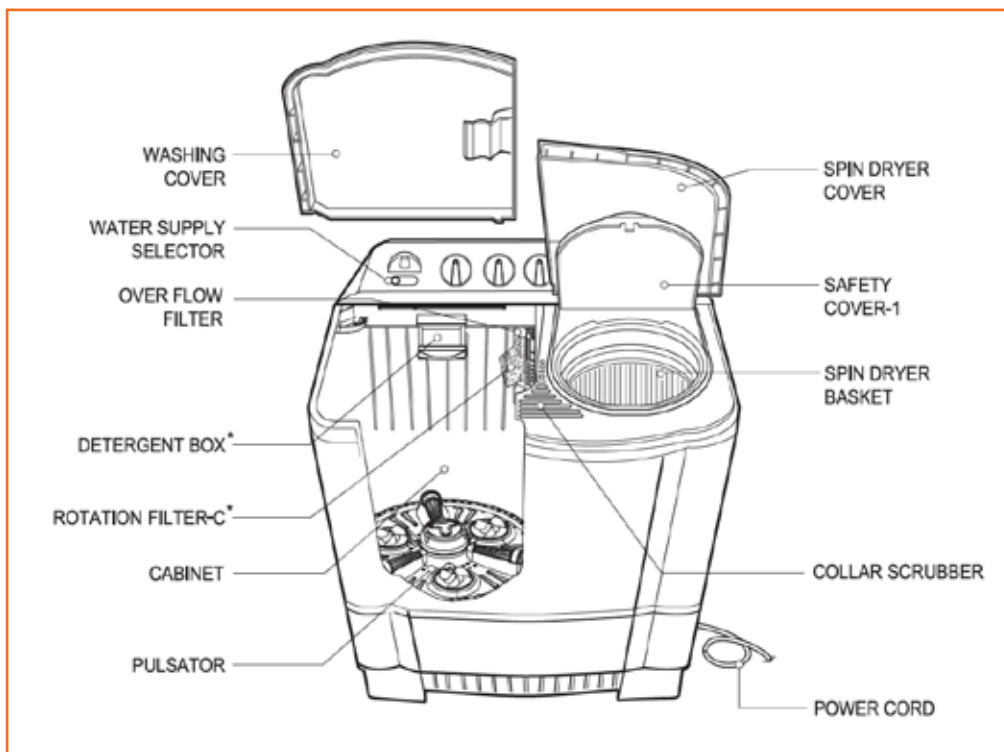


Fig 5.4.1 Parts of a semi-automatic washing machine

6. Take out the accessories from the box

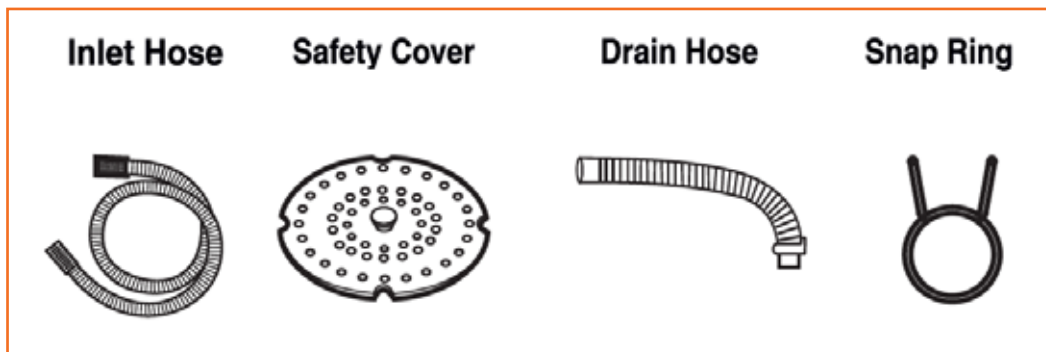


Fig 5.4.2 Accessories of a semi-automatic washing machine

Installation of machine

1. Before placing the machine, seek input from the customer
2. Read installation manual to set the washing machine at a suitable distance from the water tank
3. Place the machine on a flat and firm floor. Ensure that the machine is placed against an exterior wall

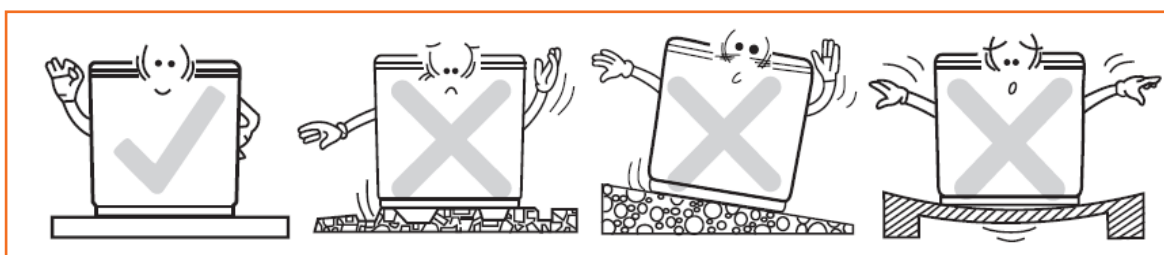


Fig 5.4.3 Levelling of washing machine

4. If surface is not flat enough use stands with adjustable legs or use proper packing.
5. Place the machine on a stand as instructed by the company in the installation manual and ensure that it is in an obstruction-free area.

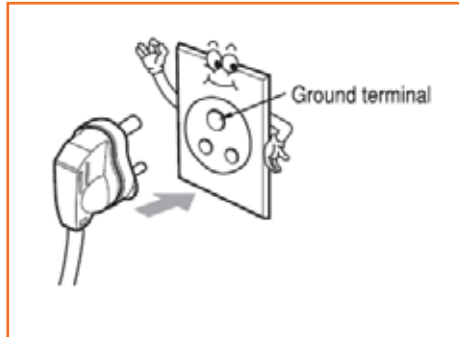


Fig 5.4.4 Connecting with power

6. Insert the power plug in the electrical socket with proper earthing.

Drain hose installation

1. Fix the snap ring to the drain hose.
2. Align the drain hose with drain outlet.
3. Push the hose towards the body of the machine and release the snap ring.

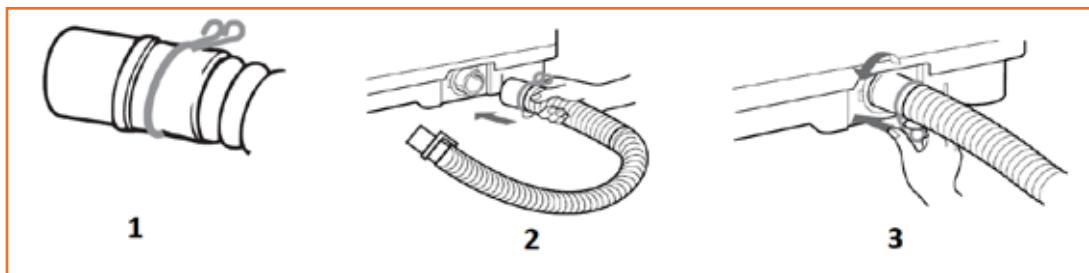


Fig 5.4.5 Attaching drain hose

Inlet hose installation:



Fig 5.4.6 Inlet hose

1. Connect one end of the inlet hose to the tap.
2. Connect other end of the hose to the inlet point of the machine.
3. The minimum requirement for the height of the taps in washing machines is 1150 mm.

Check the Functioning

After installing all the required accessories of the washing machine, it is mandatory to check the working of the appliance, to identify problems (if any) and to ensure its smooth functioning.

A technician can achieve productivity and quality in work by educating the customer about the proper place where the machine is to be installed as per the guidelines mentioned in the installation manual given by the company. Also, the technician should tell the customer about the use of the voltage regulators and to switch off the machine during voltage fluctuations.

Use of control panel

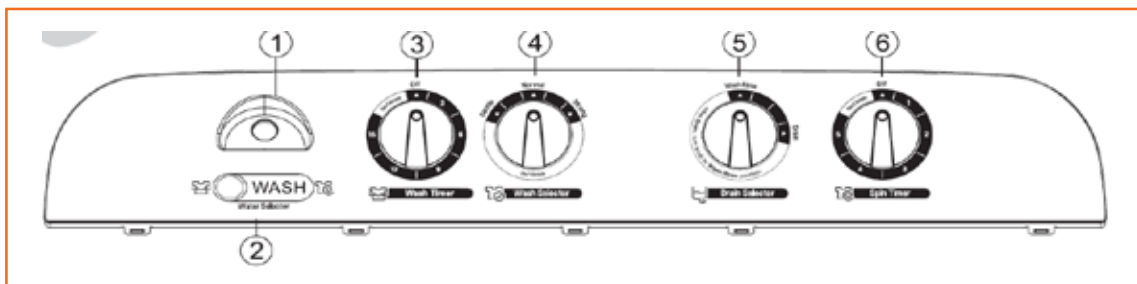


Fig 5.4.7 Control panel

1. **WATER INLET** - This is used to fill water in the washing machine.
2. **WATER SELECTOR** - Select Wash option to supply water for washing and rinsing and SPIN for spin shower rinse
3. **WASH TIMER** - Select the desired time for soaking, washing or rinsing.
4. **WASH SELECTOR** - Set the Selector to “GENTLE, NORMAL, STRONG” according to kinds and quantity of laundry.
5. **DRAIN SELECTOR** - This is used to select between Wash/Rinse or drain function.
6. **SPIN TIMER** - This is used to set desired time for spinning.

Providing Guidance to the Customer

Demonstrating a product is a way of promoting or showing the operation of equipment to the users. The goal of demonstrating the workability of equipment is to make them aware of the operation of that equipment and answer their queries related to its operation.

Take Feedback from Customer

Just like it is essential to address issues within the facility, it is also important to get feedback of the customer. The customer is always special, and the customer’s feedback is the most important thing for an organization.



Fig 5.4.8 Taking feedback from customer

5.4.2 Troubleshooting and Repairing of Semi-Automatic Washing Machine

A technician should know how to identify faults and symptoms related to that. The following steps required to understand symptoms and identify the fault -

1. Interact with the customer to identify the fault and then inspect the washing machine accordingly
2. Based on the interaction with the customer, identify the cycle in which the problem has occurred, whether it is fill, wash/rinse or drain/spin cycle
3. Switch off the machine before inspecting and repairing the fault
4. Inspect various parts such as drain hose, Wash Timer, Spin Timer, Drain Selector, Inlet hose etc.
5. Carry out some fault inspection tests such as volt ampere test, continuity test and power supply interaction test.
6. Disassemble the unit and check the lid switch, control/service panel etc. for diagnosing the fault.
7. Identify the electrical faults in the unit by inspecting each component in sequence following the electrical path of the unit
8. Inspect all the parts of the unit such as motors, pulley, belt system and the motor starting switch
9. If the problem remains unidentified at site, send it to the workshop for diagnosis

The following table shows area of problem and its solutions:

Areas of Problem	Solution
Water source problem	Ensure that there are no crimps in the water hose and also the water supply should be turned on
Accumulation of soap inside the unit	Clean the accumulated soap and run the unit for a complete wash cycle
Problem in components of the unit	Replace the faulty components

Table 5.4.1 Area of problems and solutions in washing machine

If the faulty module or part cannot be replaced, make sure to replace it during the second visit with a functional one.

Troubleshooting of faults

Troubleshooting refers to repair of faulty products or processes. It begins with searching for the source of a problem and ends with finding the solution for that problem to ensure that the product or process functions properly. Good troubleshooting consists of the following four steps:

- Identification of the symptoms
- Elimination of the causes of a problem
- Verification of the solution
- Restoration of the product or process

In other words, the first thing to do is to identify the symptoms that are causing a failure in the system. The next step is to diagnose the cause of that malfunction, till a solution is reached. This is followed by returning the product to its original state.

The following table lists some common problems and their solutions:

Problems	Checking points
Motor does not start	- Is there a power failure? - Is the power plug loose? - Is the pulsator twisted by foreign materials?
Spin part does not work	Is the spin dryer cover closed completely?
Water does not enter in washer	- Is the water tap opened up? - Is the water tap frozen?
Abnormal sound during washing	Are there hair pins, coins or metal items inside the tub?
Abnormal sound and violent vibration during the spin cycle	- Is the machine slanting? - Is there laundry adhering to the outer side of the spin cycle compartment? - Is the spin cycle compartment overloaded?
No draining	- Is the drain hose frozen? - Is the drain hose blocked by foreign material? - Is there laundry adhering to the outer side of the spin tub?

Table 5.4.2 Common problems and solutions in washing machine

Scan the QR code or click on the link to watch related videos



<https://www.youtube.com/watch?v=lvzh07QmDGA>
Repairing of washing machine



6. Install and Repair OLED TV/Monitor

Unit 6.1 – Installation and Repairing of OLED TV

Unit 6.2 – Installation and Repairing of Monitor



Key Learning Outcomes



At the end of this module, participants will be able to:

1. Demonstrate procedure of installing an OLED TV
2. Demonstrate how to setup and use the features of OLED TV
3. Demonstrate procedure of troubleshooting and repairing of faults in OLED TV
4. Demonstrate procedure of installing a monitor
5. Demonstrate how to setup and use the features of monitor
6. Demonstrate troubleshooting and repairing of the monitor

UNIT 6.1: Installation and Repairing of OLED TV

Unit Objectives



At the end of this unit, participants will be able to:

1. Demonstrate procedure of installing an OLED TV
2. Demonstrate how to setup and use the features of OLED TV
3. Demonstrate troubleshooting and repairing of the OLED TV

6.1.1 Site Requirements for Installation

Select the site which comply with all the safety codes and should not interfere with normal movement of people.

The following are the site requirements of installing an OLED TV:

- Select a well-ventilated place
- Place the OLED TV away from direct sunlight
- Place the OLED TV away from an area with high humidity such as a bathroom and area exposed to rain or wind
- Avoid installing near any heating appliance
- Place on a firm, level place

After checking the site requirements, the next step is to check the power supply at the location site.

The following are the power requirements for installation:

- Ensure that voltage and electrical wiring is appropriate
- Use a separate socket for OLED TV
- Ensure wall socket is properly earthed
- Place the OLED TV close to the electrical outlet
- Try to avoid use of an extension cord

6.1.2 Installation of OLED TV

The installation process consists of unpacking the unit, disposing the packing material and installing the OLED TV at the designated place.

Unpacking TV

1. Cut the binding strip of carton

2. Remove the adhesive tapes and open the top flaps
3. Remove the carton

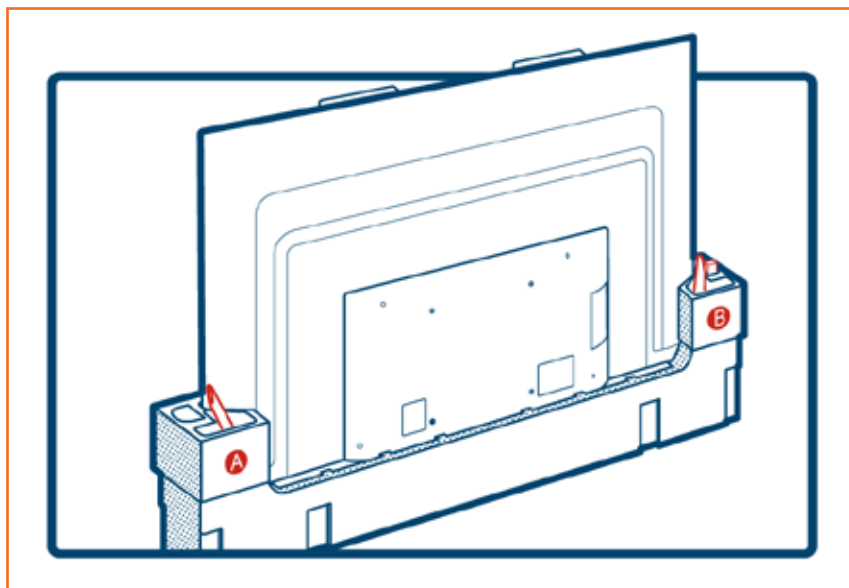


Fig 6.1.1 Unpacking TV from box

4. Remove the stands and accessories bag from packing. Take the manual, remote control, power cord, stand and screws out of the accessories bag.

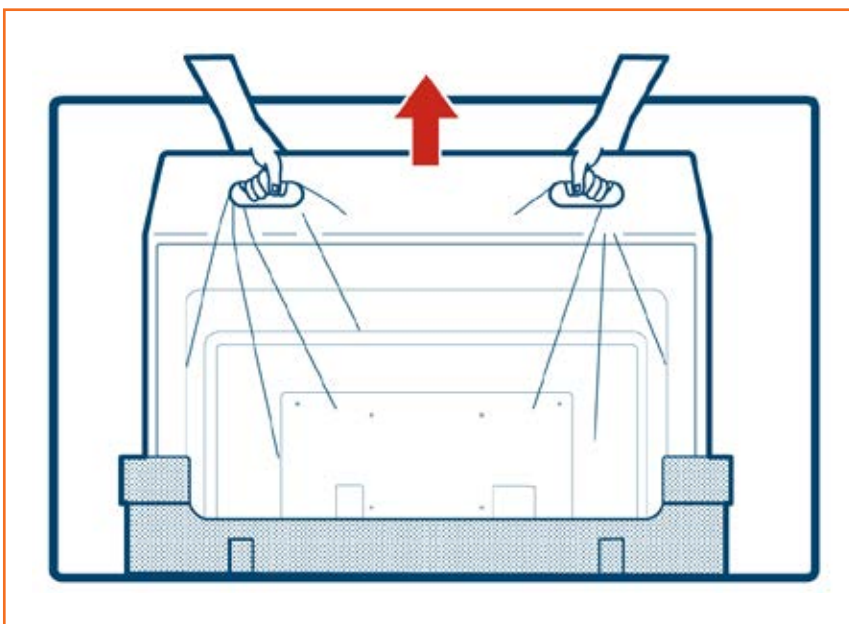


Fig 6.1.2 Unpacking accessories from box

5. Remove the TV set from the protector and place it on a flat surface with screen facing down.

Note:

- Accessory Items may vary depending upon model.

Check and understand the symbols on the package to know about the cautions and warnings related to the installation. The symbols along with their meanings are shown in the following images-



Fig 6.1.3 Safety warnings on box

Lifting and moving the OLED TV

When moving or lifting the OLED TV, follow the following to prevent the TV from being scratched or damaged and for safe transportation regardless of its type and size.

- It is recommended to move the TV in the box or packing material that the TV originally came in.
- Before moving or lifting the TV, disconnect the power cord and all cables.
- When holding the TV, the screen should face away from you to avoid damage.
- Hold the side and bottom of the TV frame firmly. Make sure not to hold the transparent part, speaker, or speaker grill area.



Fig 6.1.4 Wrong way of handling

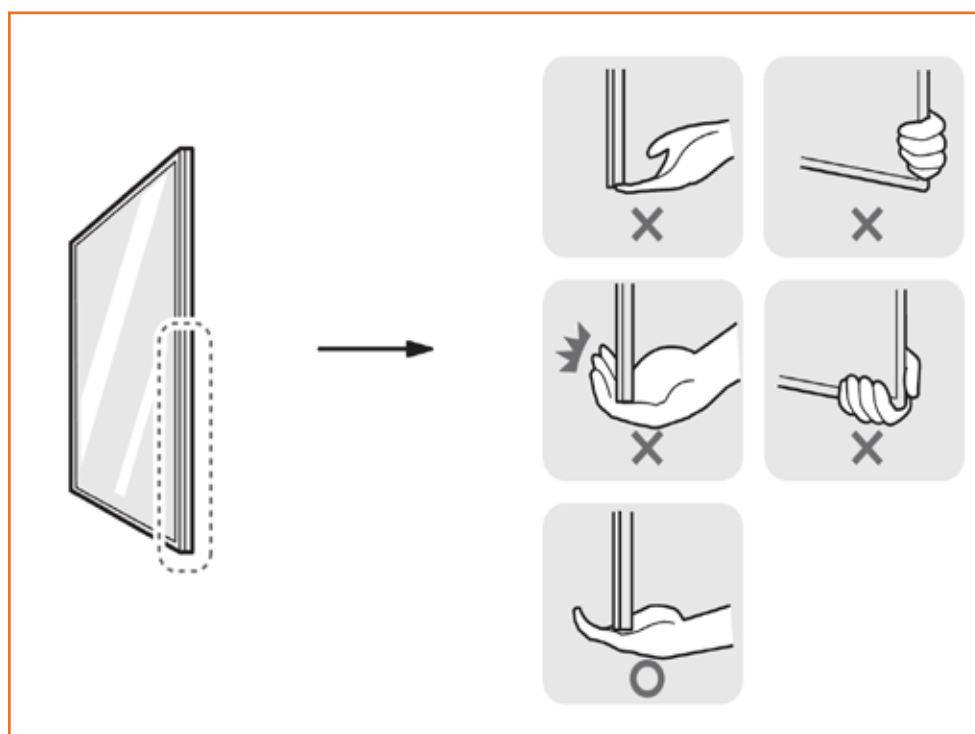


Fig 6.1.5 Correct way of handling

- When transporting a large TV, there should be at least 2 people.
- When transporting the TV, do not expose the TV to jolts or excessive vibration.
- When transporting the TV, keep the TV upright, never turn the TV on its side or tilt towards the left or right.
- Do not apply excessive pressure to cause flexing / bending of frame chassis as it may damage screen.
- When handling the TV, be careful not to damage the protruding buttons.

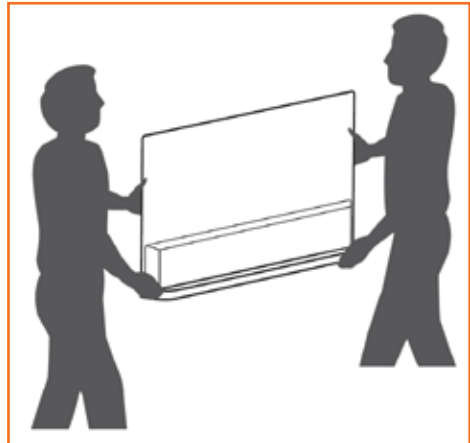


Fig 6.1.6 Correct way of handling

Caution

- Avoid touching the screen at all times, as this may result in damage to the screen.
- When attaching the stand to the TV set, place the screen facing down on a cushioned table or flat surface to protect the screen from scratches.

Setting up the TV

Place the TV on a pedestal stand and mount the TV on a table or wall as per the customer requirement.

6.1.2.1 Mounting on Table

If TV has to place on a table, use the following instructions:

1. Insert Stand Base to TV and fasten them using screws.

Note: Stand base type may be differ for different models and brands

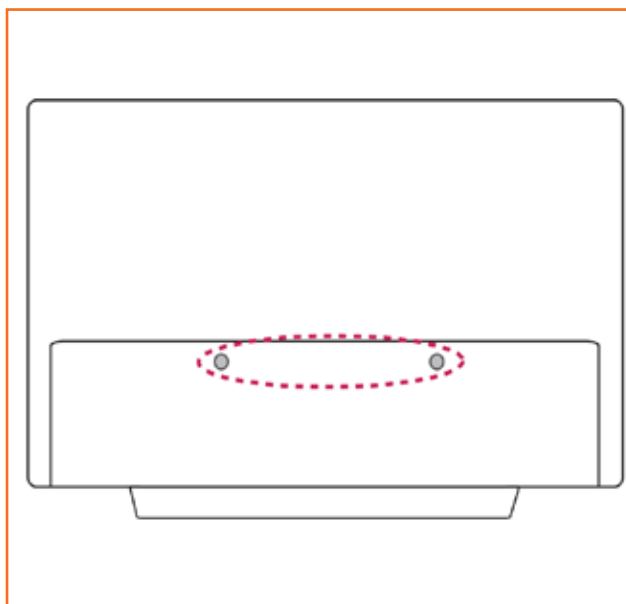


Fig 6.1.7 Attaching base stand



Fig 6.1.8 Attaching base stand



Fig 6.1.9 Attaching base stand

2. Lift and tilt the TV into its upright position on a table.

❑ Leave a 10 cm (minimum) space from the wall for proper ventilation.

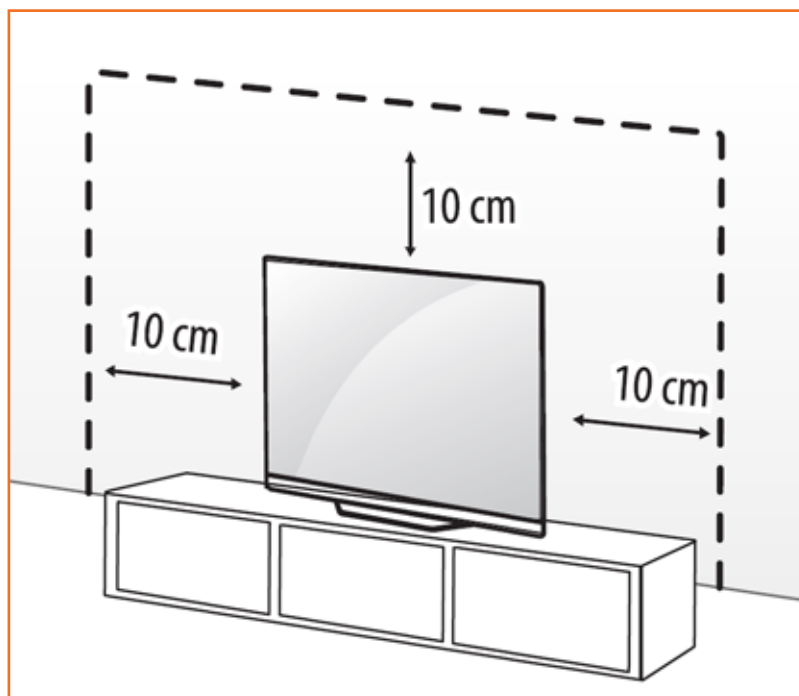


Fig 6.1.10 Placing TV on table

3. Fix the TV to a table to prevent from tilting forward, damage, and potential injury. Mount the TV on a table, and then insert and tighten the supplied screw on the rear of the stand.

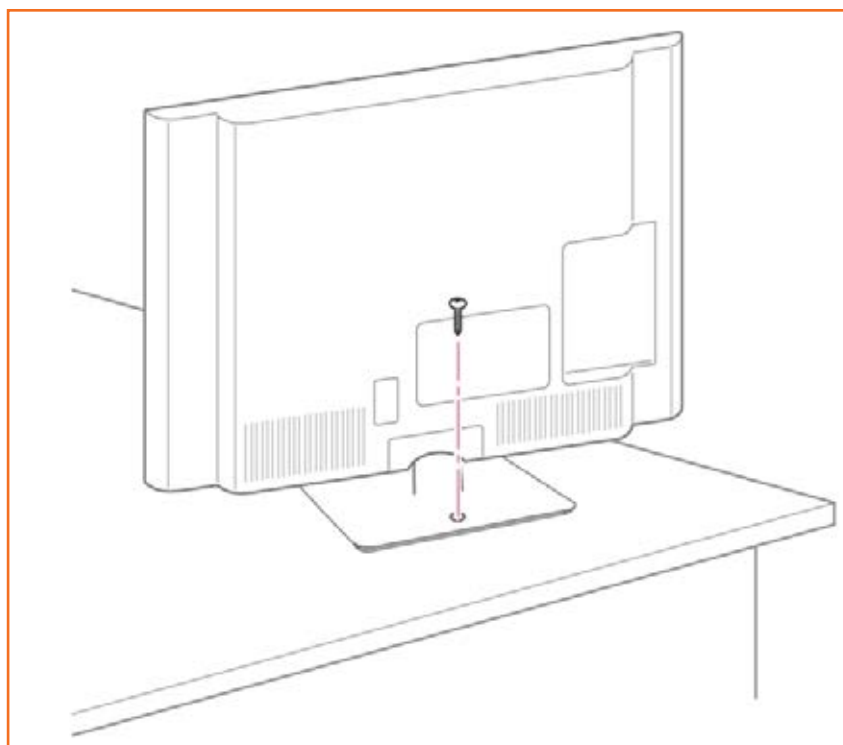


Fig 6.1.11 Fixing TV on table

4. Connect the power cord to a wall outlet.
5. Push the power button located at bottom of TV (or press power button on remote) to turn it On.
6. Follow screen instructions of quick start guide to setup TV.

Securing TV to the Wall

1. Insert and tighten the eye-bolts, or TV brackets and bolts on the back of the TV.
 - ☐ If there are bolts inserted at the eye-bolts position, remove the bolts first.
2. Mount the wall brackets with the bolts to the wall. Match the location of the wall bracket and the eye-bolts on the rear of the TV.
3. Connect the eye-bolts and wall brackets tightly with a sturdy rope. Make sure to keep the rope horizontal with the flat surface.
 - ☐ Use a platform or cabinet that is strong and large enough to support the TV securely.

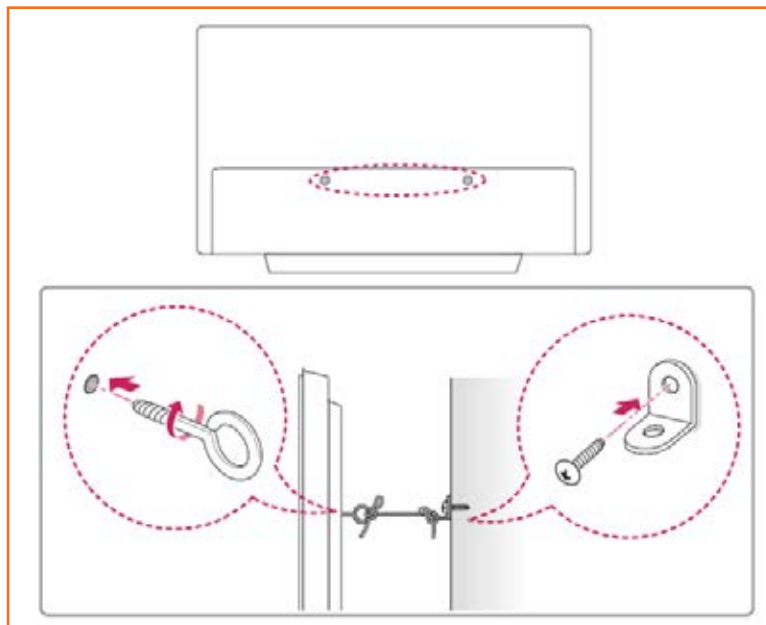


Fig 6.1.12 Fixing TV cabinet

6.1.2.2 Mounting on Wall

Before you get started on your TV mount installation, you need following tools and equipment:

- **Power drill:** You can try to mount the TV with a screwdriver, but you might be at it a while. We highly recommend using a power drill to speed things up for this project.
- **Various drill bits:**
 - ☐ **Carbide-tipped masonry bit:** Use this to make pilot holes in the drywall, which you'll drill your mounting screws into.

☐ **Phillips head drill bit:** This is what you'll use to drive the mounting screws.

- **Level:** Use a level to make sure your newly mounted TV is, well, level. This can help you avoid both a crooked TV and unnecessary holes in your wall.
- **TV mount:** To mount TV on wall, you'll need a TV mount rated for the model of TV. Check TV manual for the VESA mount measurements and get a TV mount to match.
- **Painters tape (optional):** When you find wall studs, mark them with a little piece of painters tape. This is much easier to see than a pencil mark, and you won't have to write on wall.

If TV has to mount on wall, use the following instructions:

1. **Decide where to position the TV:** Viewing angles are often important for achieving the best picture quality, so consider the location carefully.

☐ First, decide the height at which you want to mount the TV.

☐ Note where the center of the TV lies. This is the point where the wall bracket should be installed.



Fig 6.1.13 Marking and drilling holes on wall

2. **Mark and drill holes:** These are the small holes that will allow mounting screws to enter the wall.

☐ Hold the wall bracket on the wall, make sure it is horizontal. Use a spirit bubble level to get a perfectly horizontal alignment. With a pencil make marks on the wall where the fasteners will be inserted.

☐ Attach a masonry bit to drill, and drill holes where you marked using the mount.

☐ Keeping the width of the wall in mind, make the necessary holes.

3. **Attach the mounting bracket to the wall:** Hold mount to the wall and drill the mounting screws into the holes you made.

4. **Attach the mounting plate to the TV:**

☐ Locate the mounting plate attachment holes on the back of the TV. These are sometimes covered with plastic or have screws already in them. If



Fig 6.1.14 TV Wall mount

so, remove them.

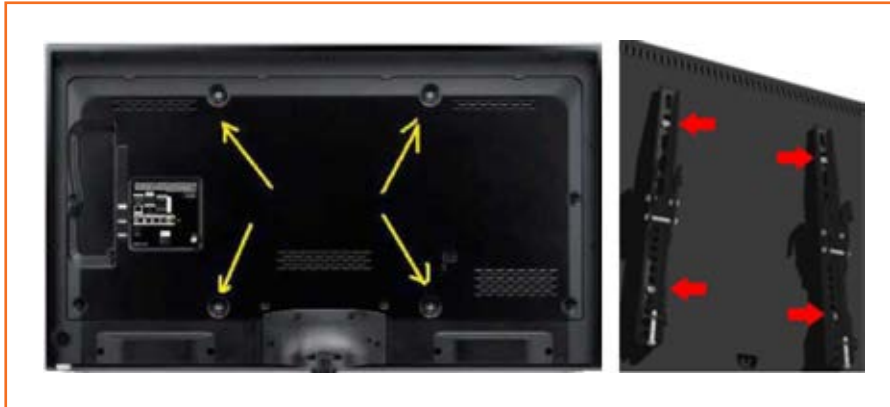


Fig 6.1.15 Attaching brackets

- ❑ Place the mounting plate/arms on the back of the television and align them to the mounting holes. Screw the mount plate/arm in place.

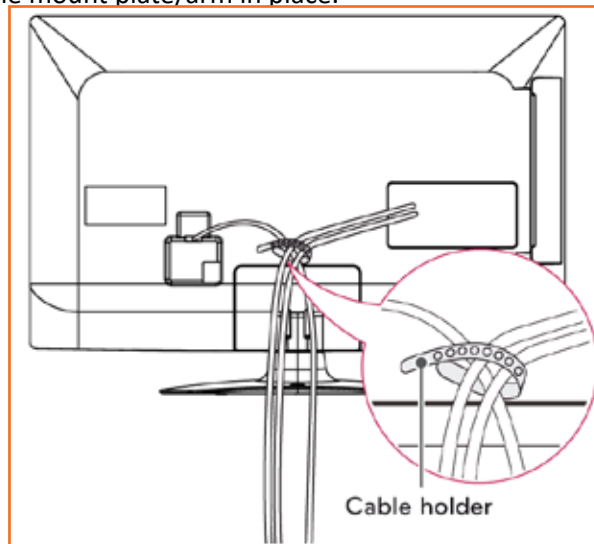


Fig 6.1.16 Binding wires

5. **Connecting the cables:** Before mounting the television, attach the necessary cables to the TV. Otherwise, if you have a fixed wall mount, it will get difficult to attach cables after mounting due to lack of space behind the TV.
6. **Mount TV to the wall:** Lift the TV carefully and line the mounting arm or plate on the TV up with the bracket on the wall and connect them following the manufacturer's instructions. Confirm a secure mount by giving the TV a slight shake.



Fig 6.1.17 Fixing TV on wall

Tidying cables

- Gather and bind the cables with the cable management clip or cable holder.
- Fix the cable management clip or cable holder firmly to the TV.

6.1.3 Setting up the OLED TV

Making connections

Connect various external devices to the TV and switch input modes to select an external device.

Connecting to an antenna or cable

Connect the TV to a wall antenna socket with an RF cable (75Ω).

- Use a signal splitter to use more than 2 TVs.
- If the image quality is poor, install a signal amplifier properly to improve the image quality.
- If the image quality is poor with an antenna connected, try to realign the antenna in the correct direction.
- An antenna cable and converter are not supplied.
- For a location that is not supported with Ultra HD broadcasting, this TV cannot receive Ultra HD broadcasts directly.

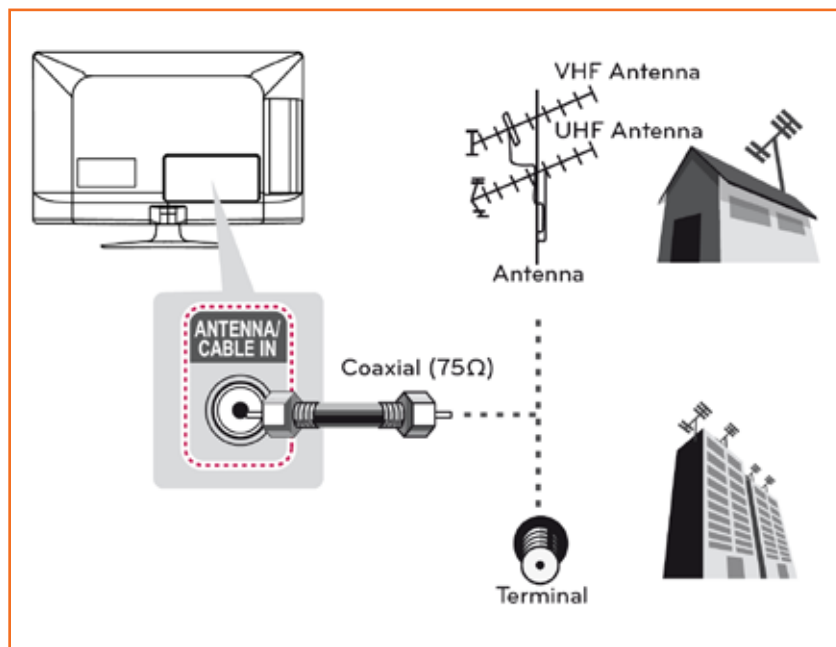


Fig 6.1.18 Connecting antenna

Connecting Set-top box, HD receiver, DVD, Sound system

Using HDMI port: HDMI is the best way to connect a device. It transmits the digital video and audio signals from an external device to the TV. Connect the external device and the TV with the HDMI cable as shown

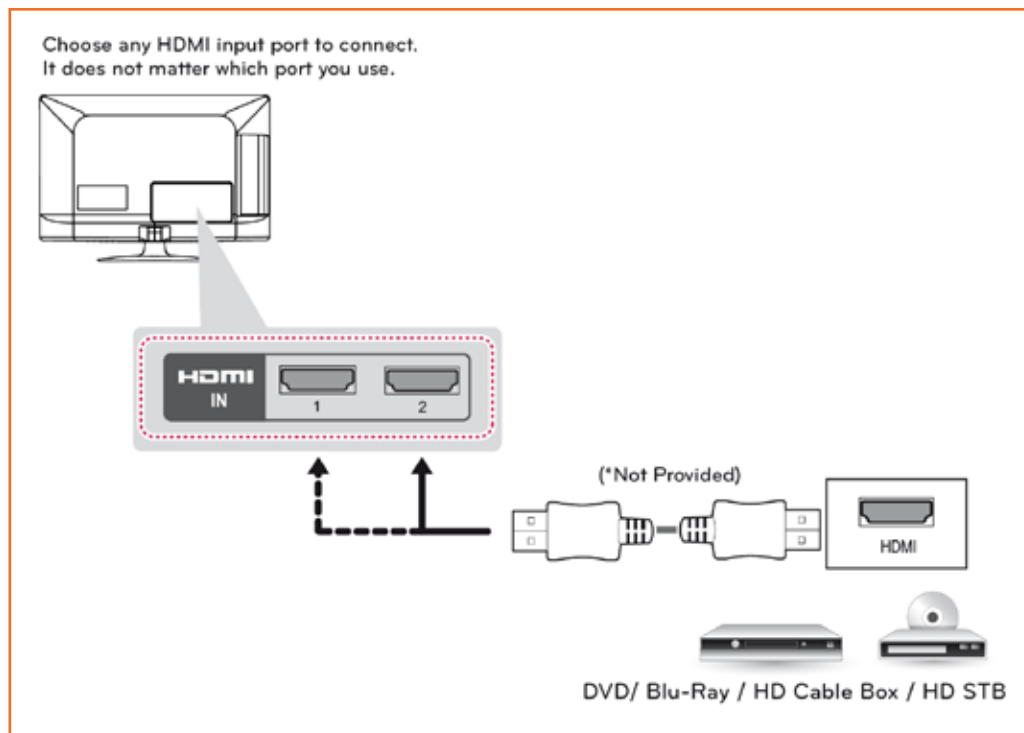


Fig 6.1.19 HDMI connections

When connecting the HDMI cable, the product and external devices should be turned off and unplugged.

It can support HDMI versions 1.4, 2.0, 2.1 & 2.2 (Depending on model)

It supports HDMI Audio format (Depending on model):

True HD (48 kHz),

Dolby Digital / Dolby Digital Plus (32 kHz, 44.1 kHz, 48 kHz), PCM (32 kHz, 44.1 kHz, 48 kHz, 96 kHz, 192 kHz)

- **Component Connection:** Transmits the analog video and audio signals from an external device to the TV. Connect the external device and the TV with the component cable as shown:

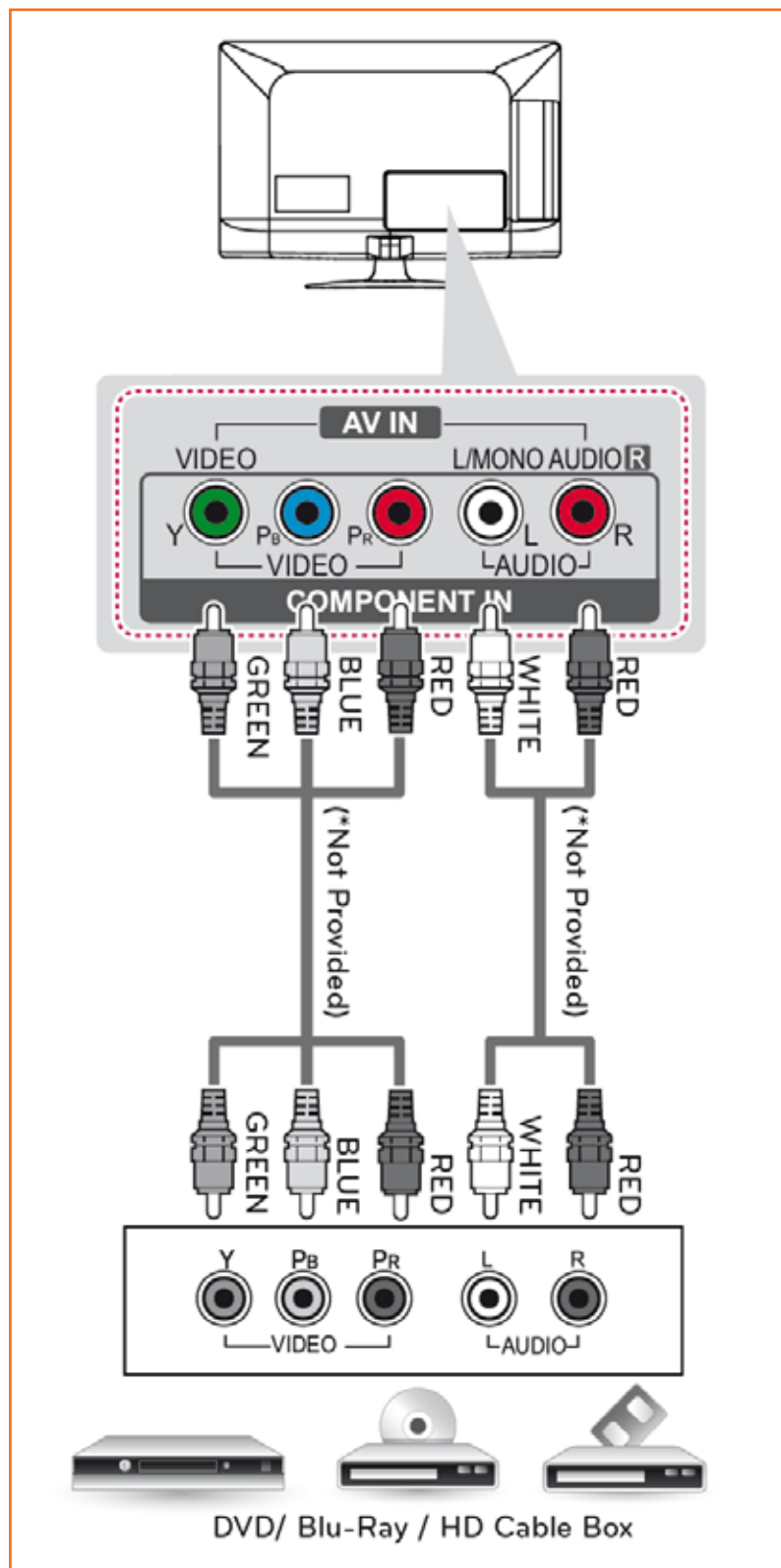


Fig 6.1.20 Component connections

- **Composite Connection:** Transmits the analog video and audio signals from an external device to the TV. Connect the external device and the TV with the composite cable as shown:

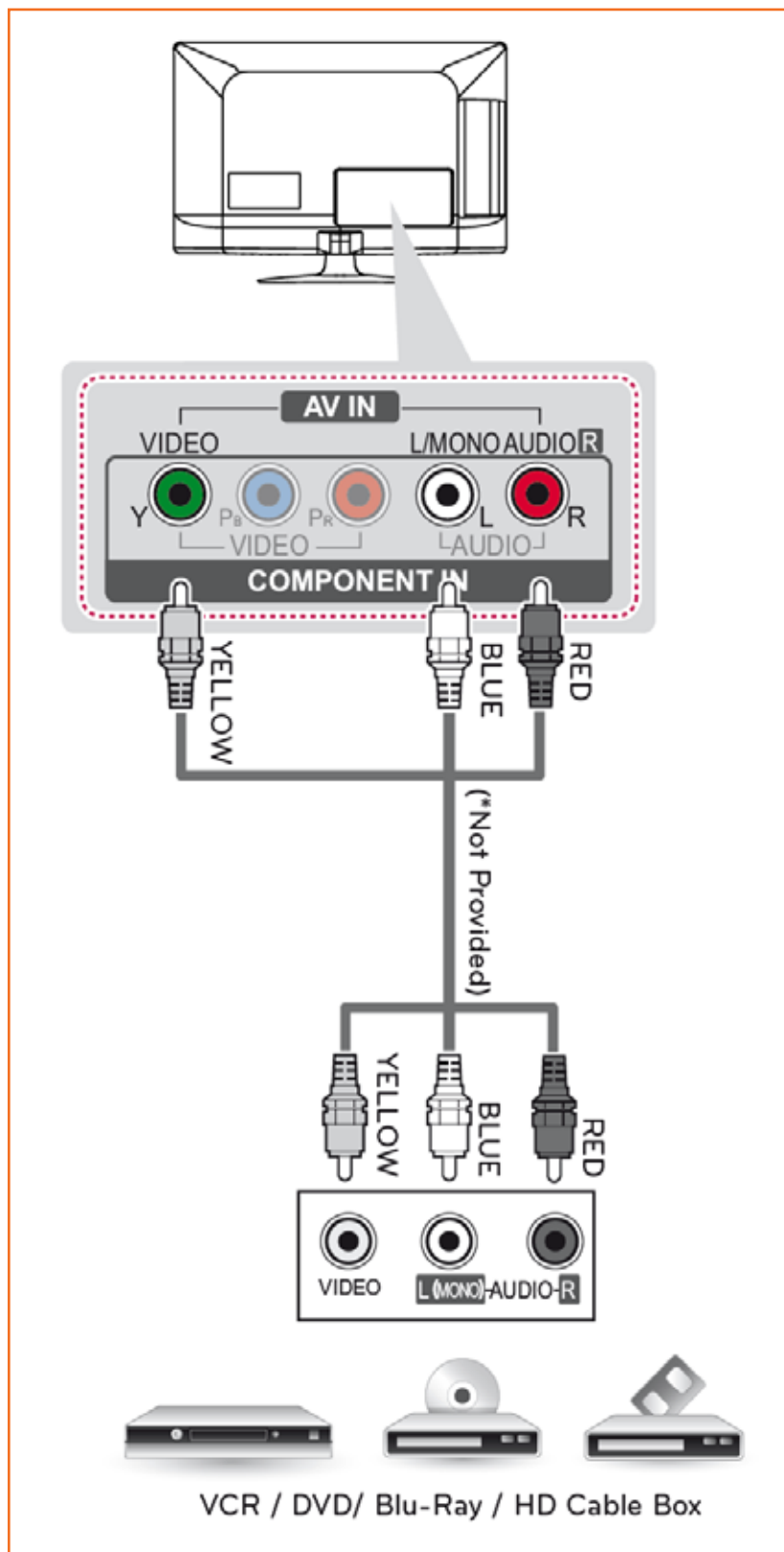


Fig 6.1.21 Composite connections

Connecting to a USB

Connect a USB storage device such as a USB flash memory, external hard drive, or a USB memory card reader to the TV. It can support USB versions like 2.0 3.0, 3.1 & 3.2 (depending on model).

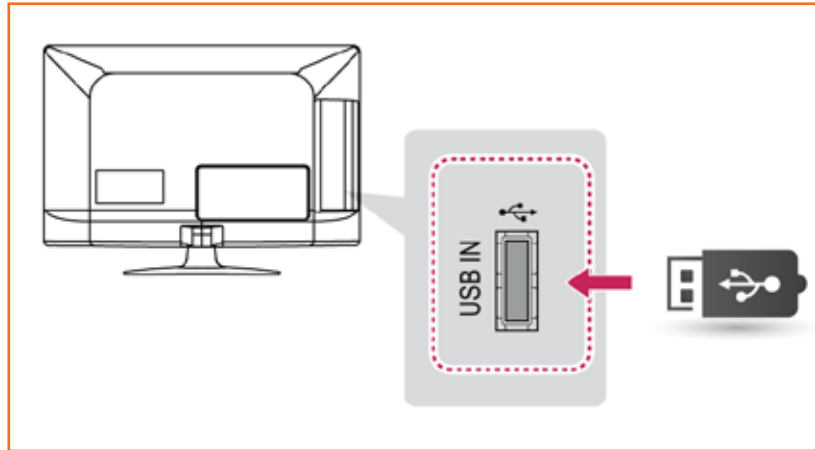


Fig 16.1.22 USB connections

6.1.4 Starting and Operating the TV

Steps for starting and operating the TV

1. Connect the AC/DC adapter plug to the power input jack on the TV.
2. Connect the power cord to the AC/DC adapter first, then plug the power cord into the wall power outlet.

When you turn the TV on for the first time, the Initial setting screen appears. Select a language and customize the basic settings.

1. Connect the power cord to a power outlet. The Power indicator turns red and the TV switches to Standby mode.
2. In Standby mode, press the power button on the remote control to turn the TV on. The Initial setting screen appears if you turn the TV on for the first time.
3. When the TV is turned on, press the  button one time. You can adjust the Menu items using the button.



Fig 6.1.23 Power button

 Turns the power off.	 Changes the input source.
 Adjusts the volume level.	 Scrolls through the saved programmes.

Fig 6.1.24 Icons on TV oanel

4. When the basic settings are complete, press OK.

5. To turn the TV off, press the power button on the remote control.

Using the remote control

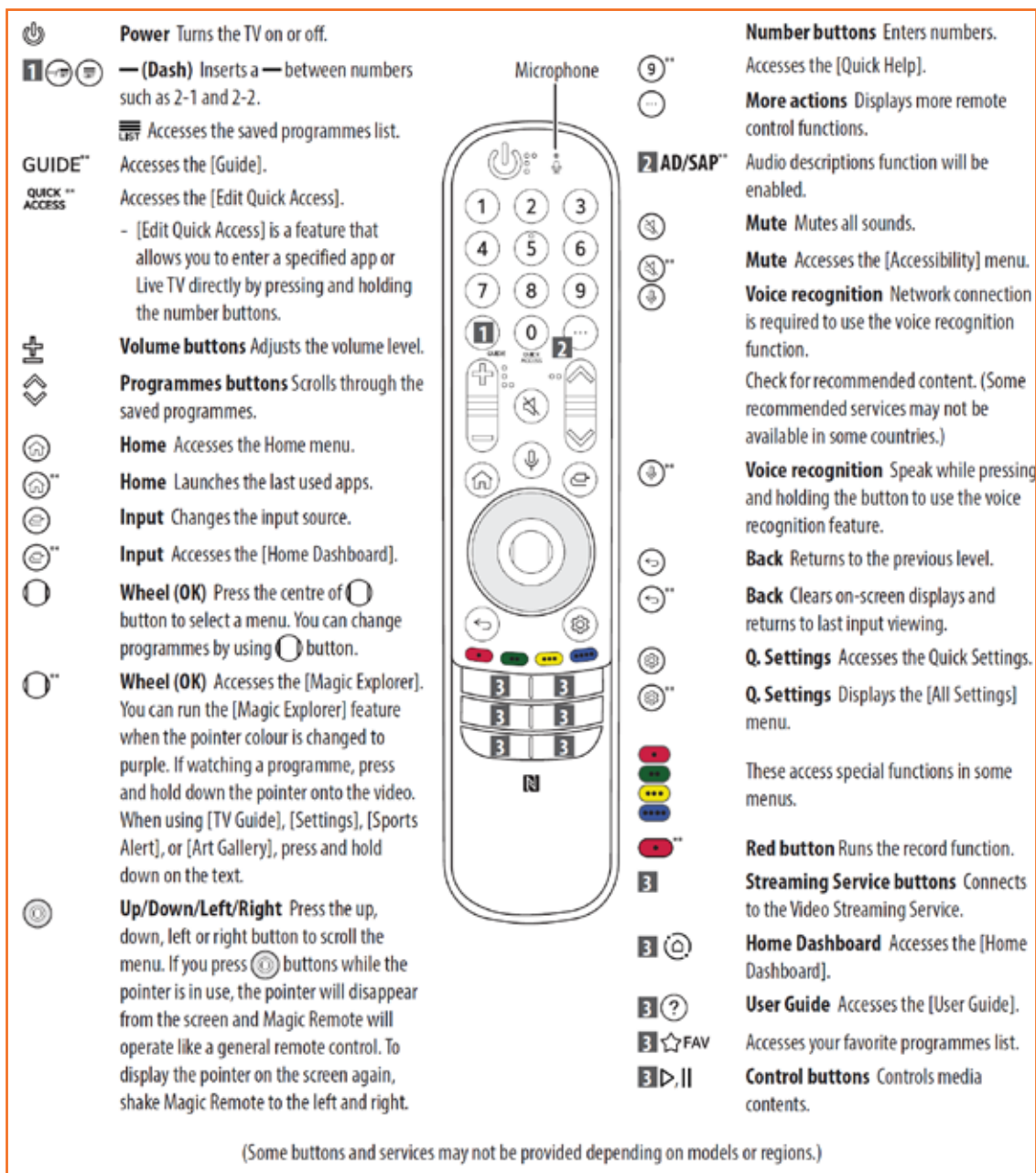


Fig 6.1.25 Remote control

Register the Remote Control

To use the remote, first pair it with your TV.

1. Put batteries into the remote and turn the TV on.
2. Point the remote at your TV and press the Wheel (OK) on the remote control.

* If the TV fails to register the remote, try again after turning the TV o and back on.

How to de register the Remote Control

Press the (Back) and (Home) buttons at the same time, for five seconds, to unpair the remote with your TV.

* Press and hold the (Home) and (Q. Settings) buttons for more than 5 seconds to disconnect and re-register the remote at the same time.

Connecting Smart Devices using NFC Tagging

NFC is technology that uses Near Field Communication, allowing you to conveniently send and receive information without separate settings.

TV initial set-up can be done through QR code scanning by smart phone. So customer no need to configure anything through the TV remote. Customer can configure the device through smart App by a smart phone.

By bringing a smart device near the NFC-enabled remote control, you can install the smart app and connect the device to the TV.

1. Turn on NFC in the smart device's settings. To use NFC with Android devices, set the NFC option to enable 'read/write tags' in the smart device's settings. The NFC settings may vary depending on the device.
2. Bring the smart device near the (NFC) on the remote control. The required distance for NFC tagging is about 1 cm.
3. Follow the instructions to install the smart app on customer's smart device.
4. Re-tagging the smart device to the remote control allows customer to conveniently access various features on the connected TV through the smart app.

Note

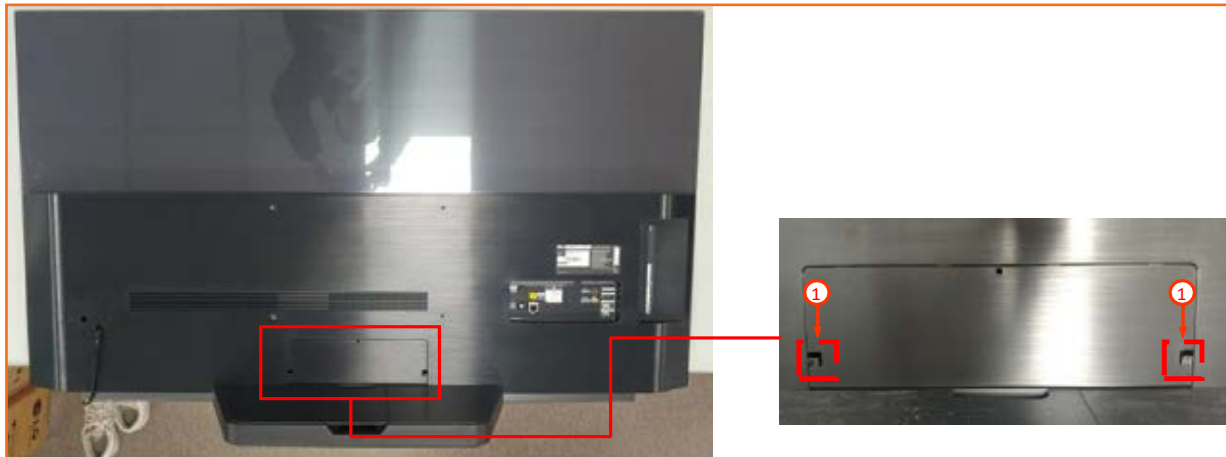
- This feature is available for NFC-enabled smart devices only.
- This feature is only available if the remote control has an NFC logo.

6.1.5 Assembly and Dis-assembly of OLED TV

Dis-assembly of OLED TV

1. Remove screw, disassemble power cord from back cover.

Push the latch, separate the stand cover to the top.



2. Remove screw, disassemble stand from back cover.

Push the latch, separate the stand cover to the top.

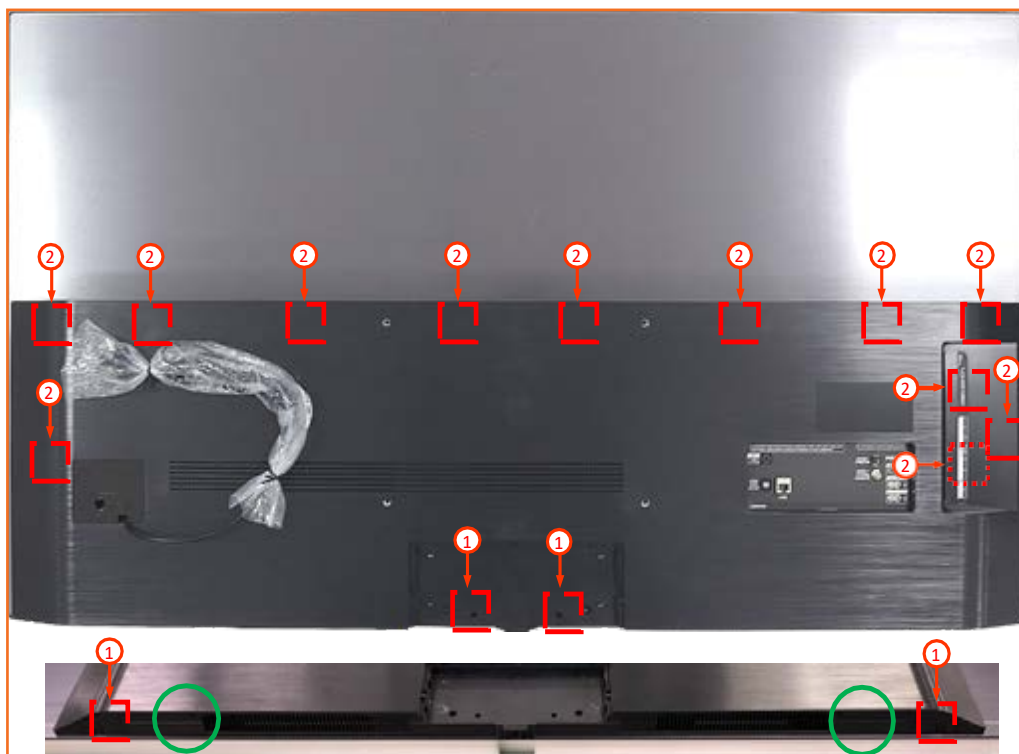


3. Remove screw, disassemble power cord from back cover

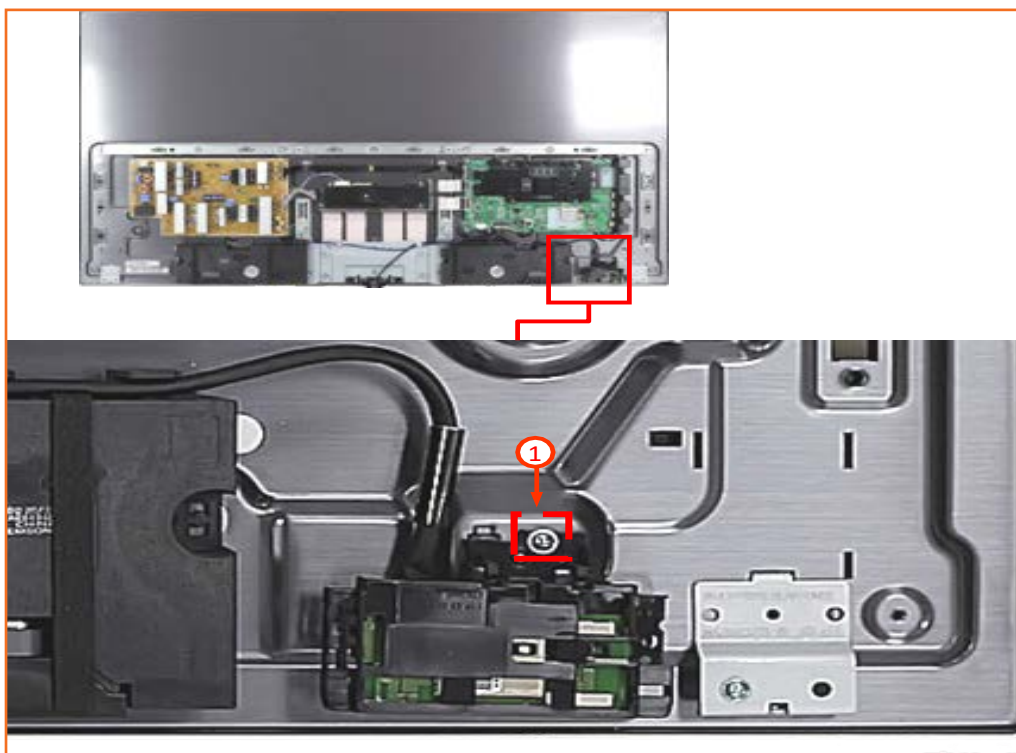


4. Remove screw, disassemble back cover from module.

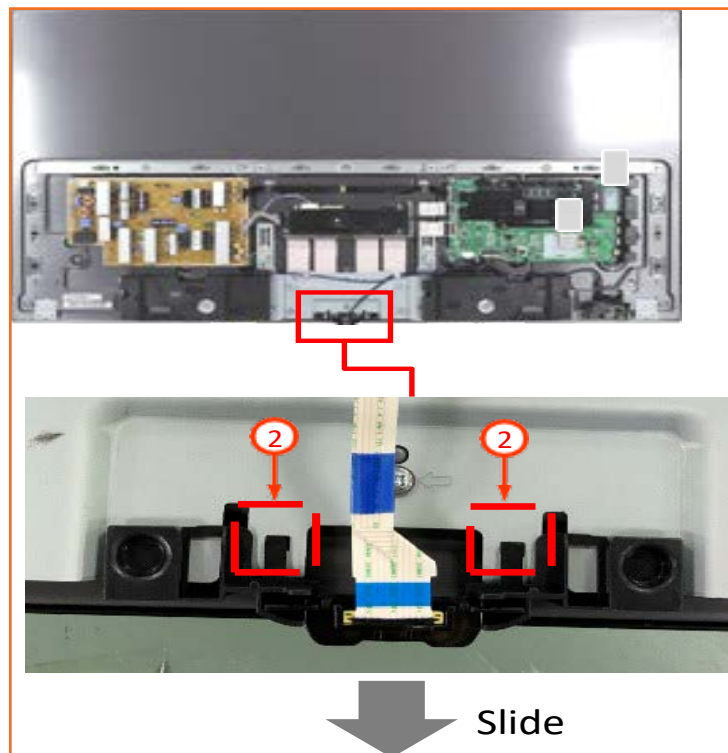
* Put hand on the marked area(), separate the back cover to the top.



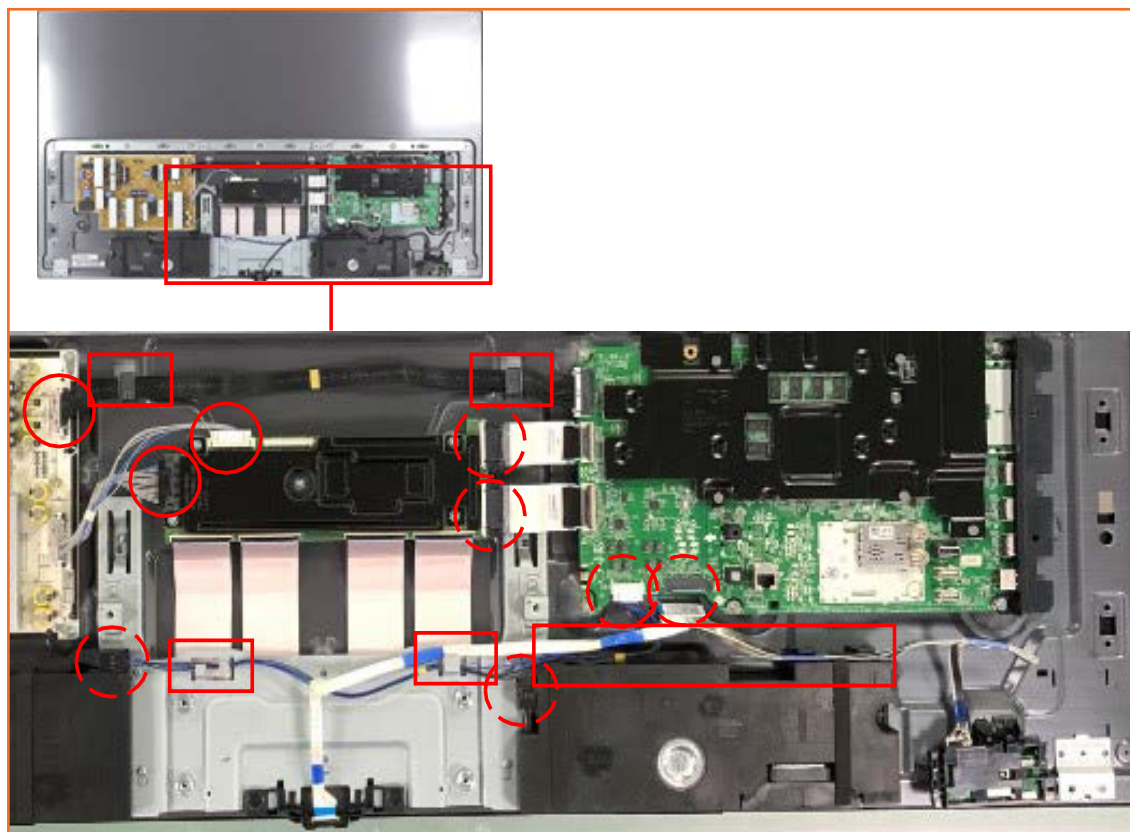
5. Remove screw 1ea, disassemble Wifi/Jog assy.



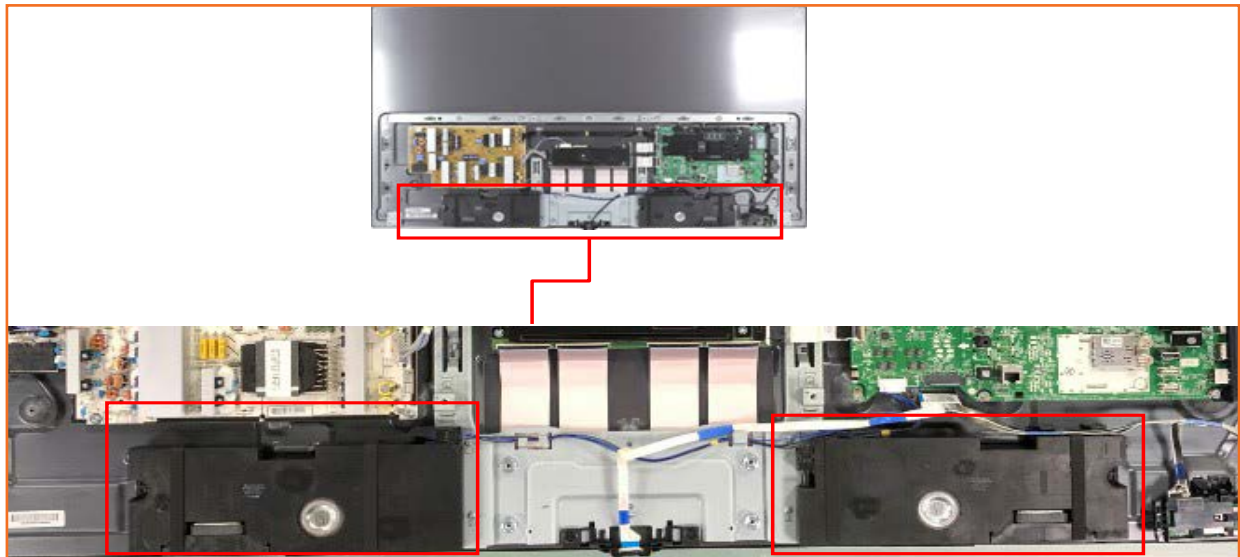
6. Remove the latch, disassemble IR assy.



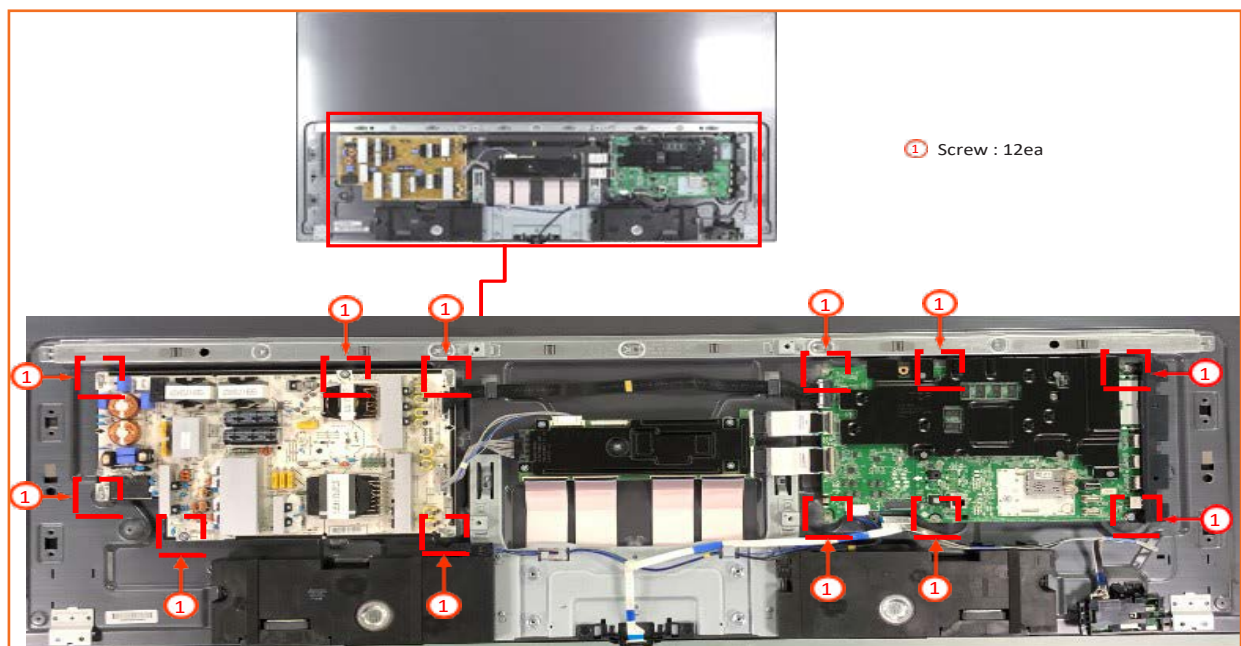
7. Remove all sort of cable.



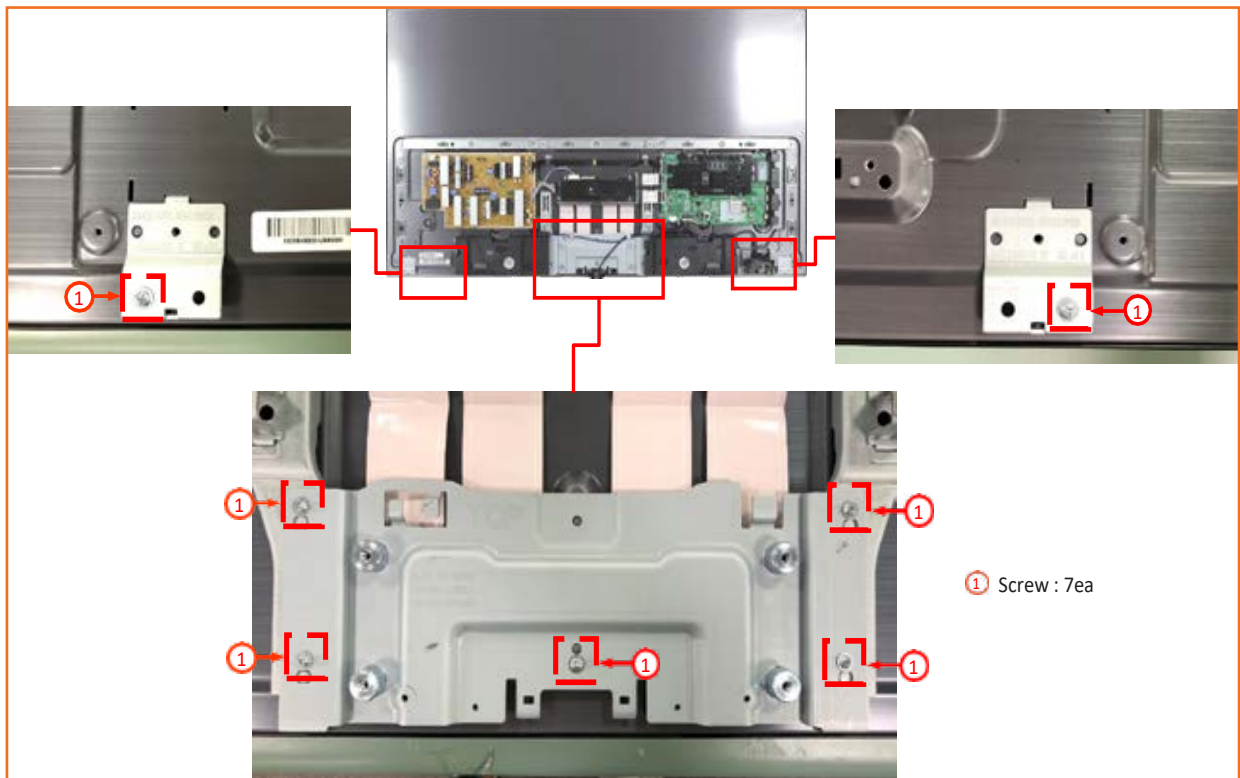
8. Disassemble speaker.



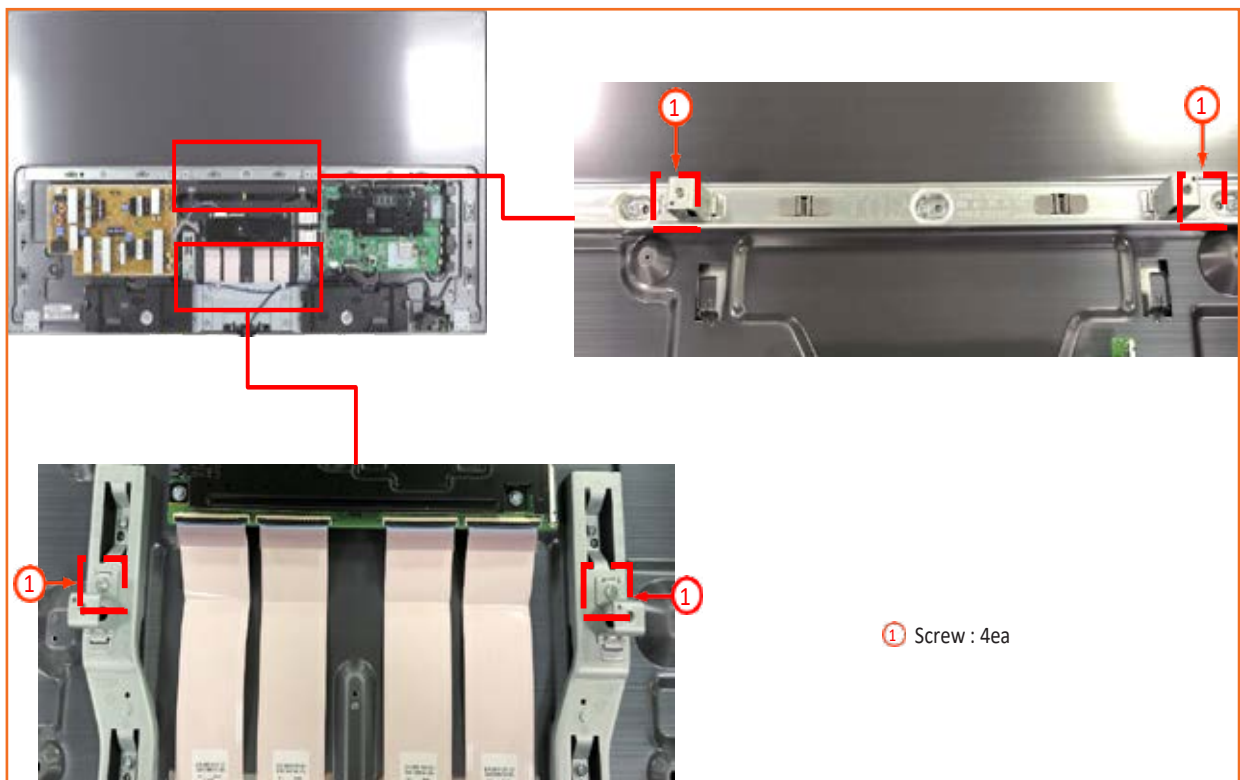
9. Remove screw, disassemble Main PCB and PSU.



10. Remove screw, disassemble stand guide and stand fixer.



11. Remove screw, disassemble VESA Bracket



For assembly of OLED TV, you can follow the steps in reverse direction.

6.1.6 Troubleshooting and Repairing of Problems in OLED TV

A Multiskill Technician should have the knowledge and skill to repair all kinds of TVs. He should be able to diagnose and troubleshoot the problem. He should carry out repairs according to the requirements of that particular model.

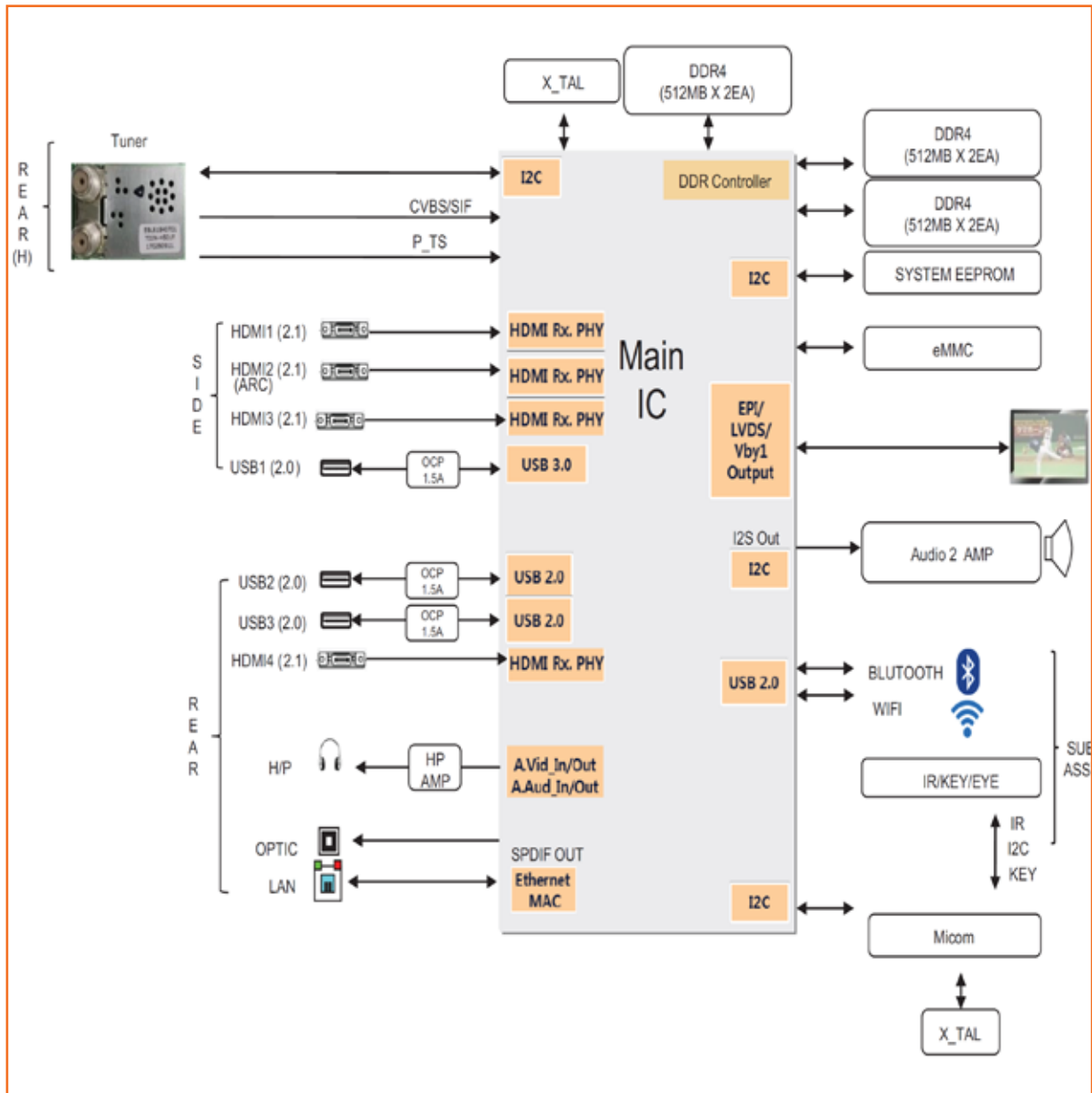


Fig 6.1.26 Sample block diagram of OLED TV

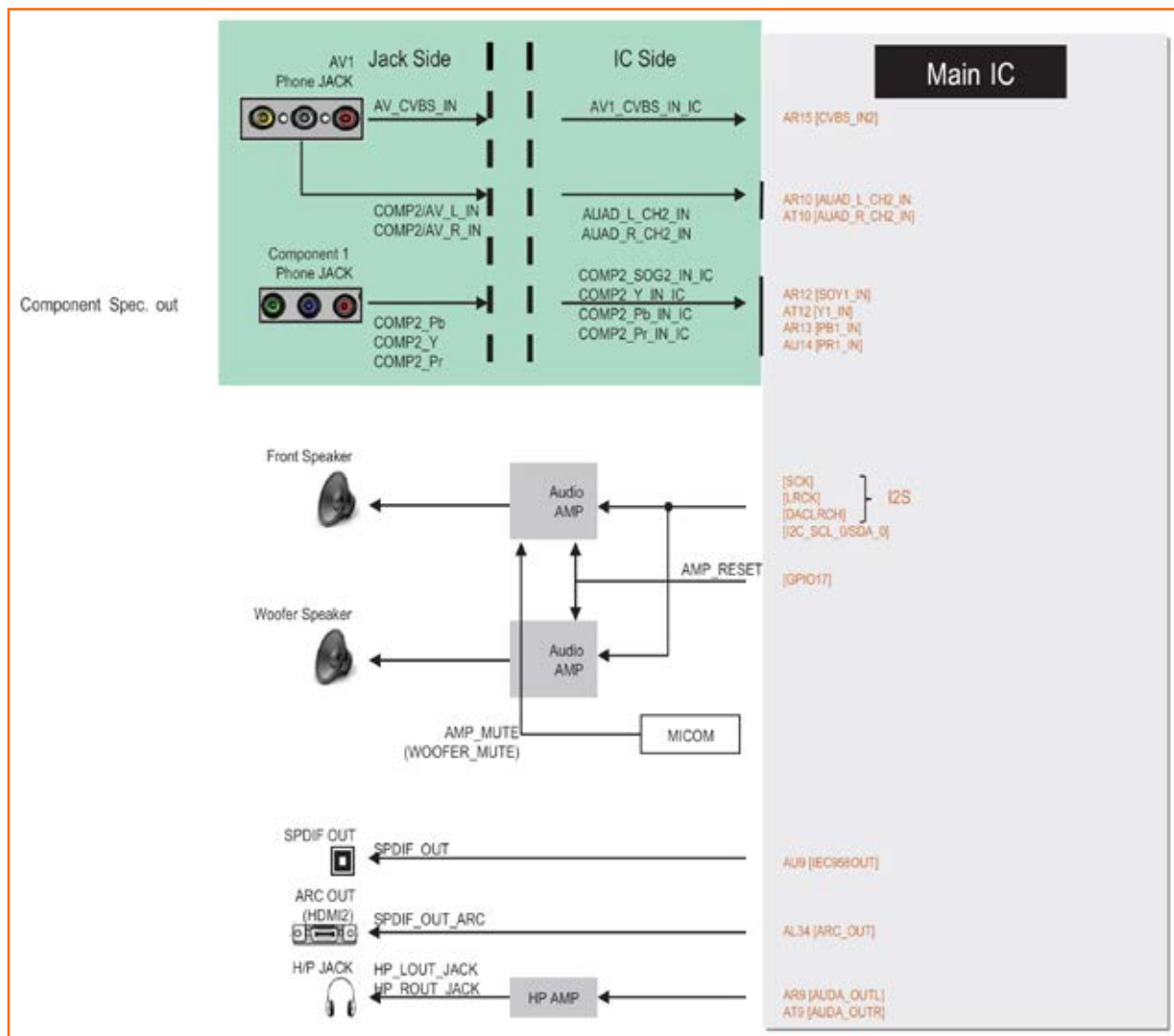


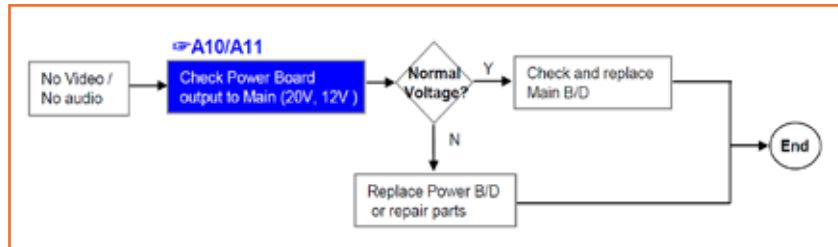
Fig 6.1.27 Sample block diagram of Video & Audio IN/OUT of OLED TV

The following table represents the common problems in the working of an OLED TV along with their solutions -

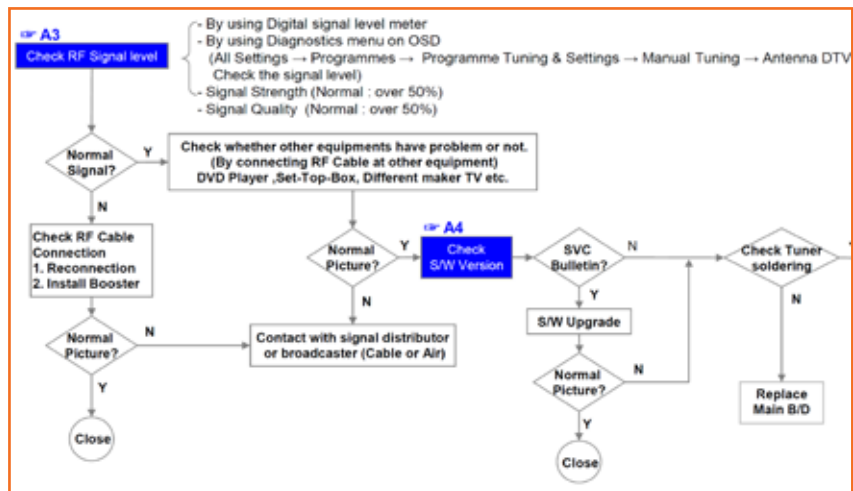
Problem and solution	
Video error	No video/Normal audio <pre> graph TD Start([No video/Normal audio]) --> CheckVx1{Check Vx1 lock voltage} CheckVx1 -- Y --> CheckPowerMain{Check Power Board output to Main 20V, 12V} CheckVx1 -- N --> MoveToNoVideo[Move to No Video/No audio] CheckPowerMain -- Y --> CheckPowerModule{Check Power Board output to Module 55"85": 23V, 12V 77": 26V, 12V} CheckPowerMain -- N --> ReplacePowerBID[Replace Power B/D or repair parts] CheckPowerModule -- Y --> ReplaceModule[Replace Module] CheckPowerModule -- N --> ReplacePowerBID ReplaceModule --> End([End]) ReplacePowerBID --> End </pre>

Problem and solution

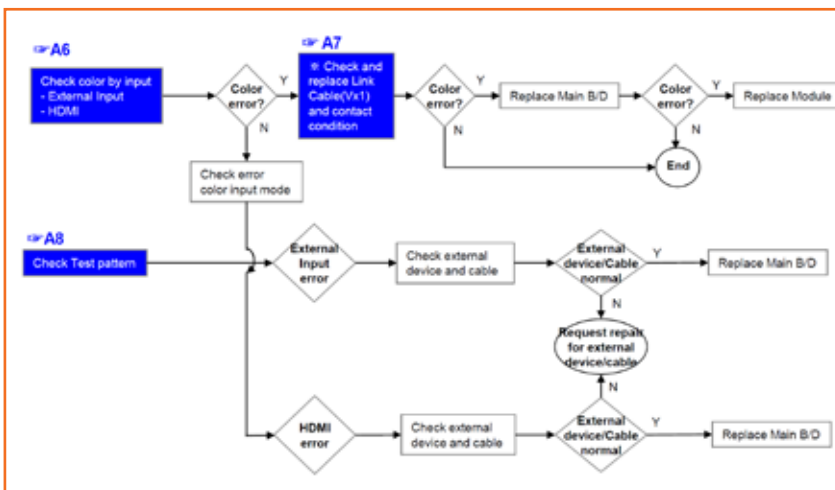
No video/No audio



Picture broken/Freezing

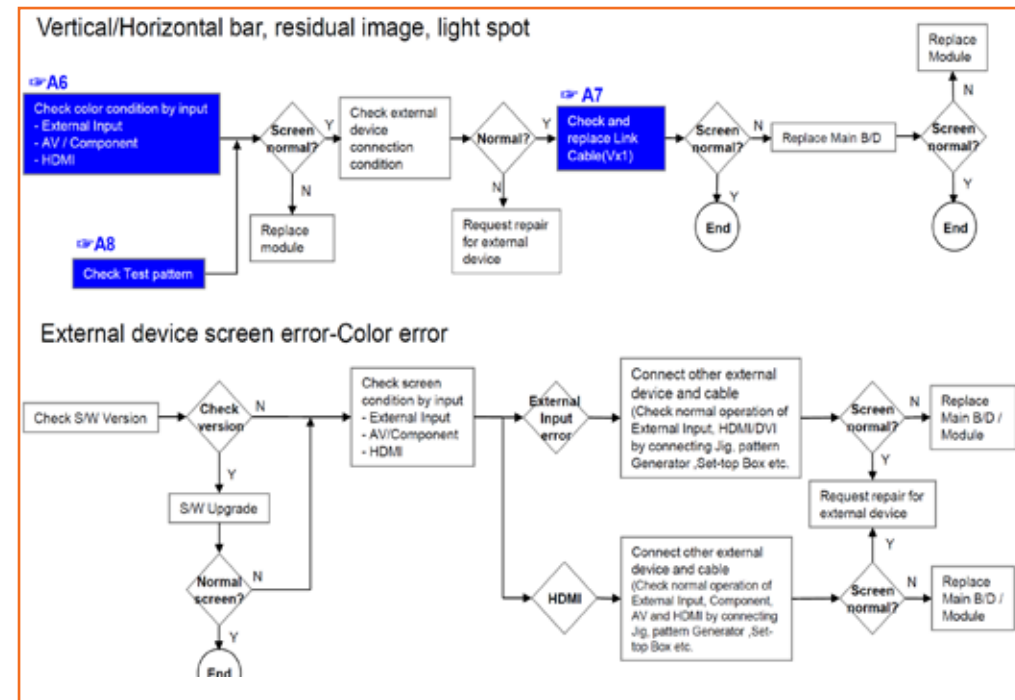


Color error



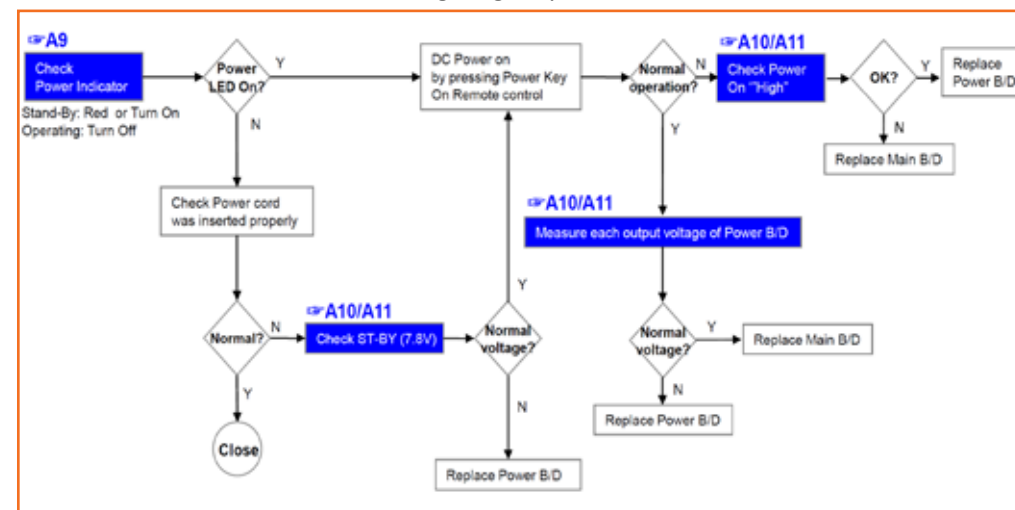
Problem and solution

Vertical/Horizontal bar, residual image, light spot, external device color error



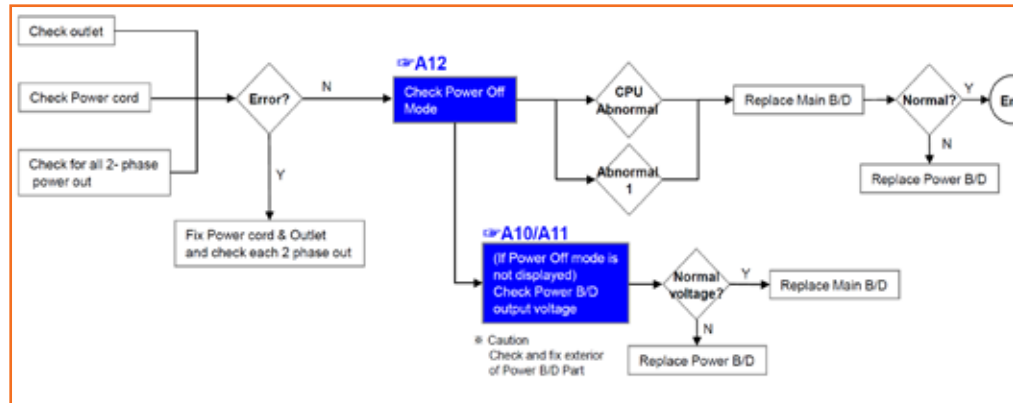
Vertical/Horizontal bar, residual image, light spot, external device color error

Power error

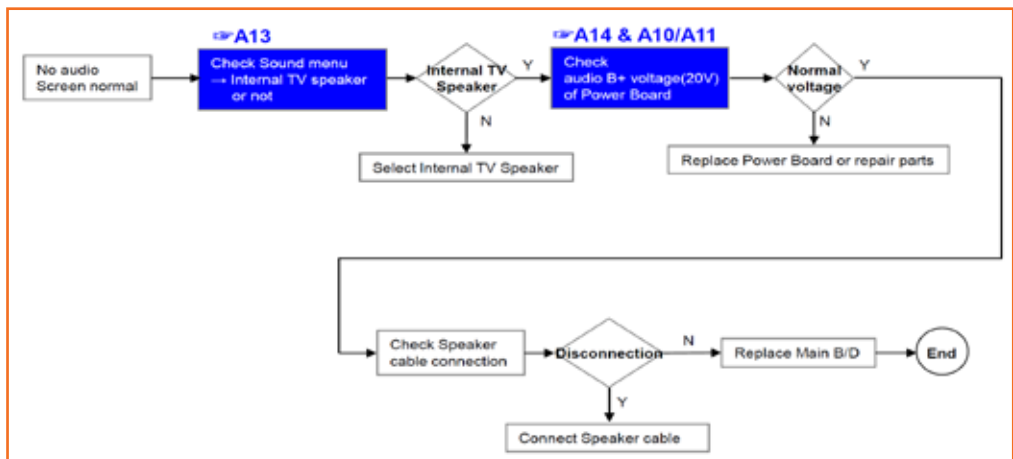


Problem and solution

Off when on, off while viewing, power auto on/off

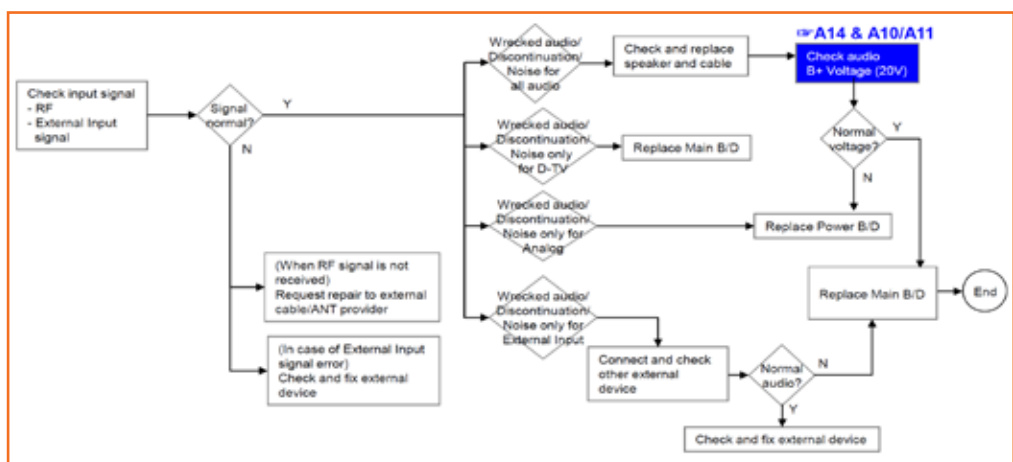


No audio/Normal video



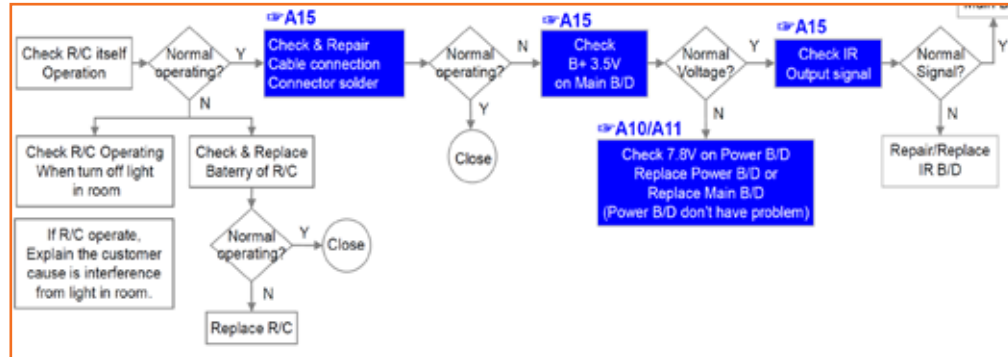
Audio error

Wrecked audio/discontinuation/noise

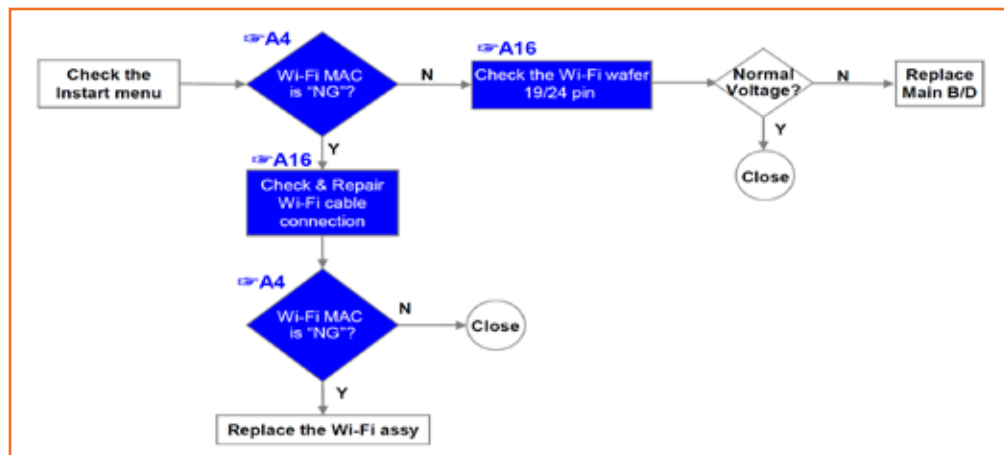


Problem and solution

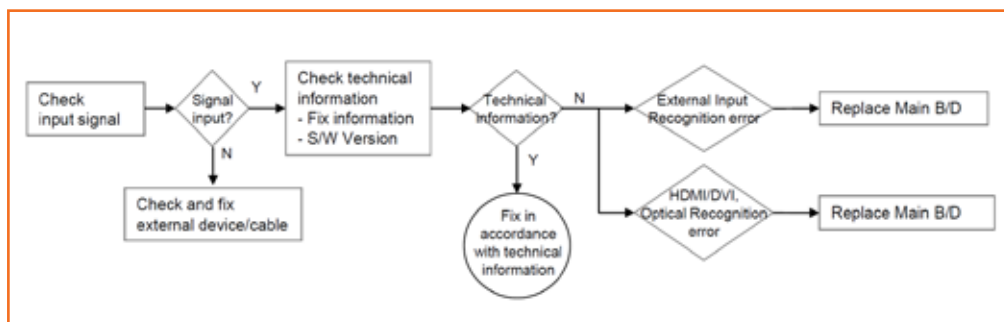
Remote control & Local switch checking



Wi-Fi operating checking



External device recognition error

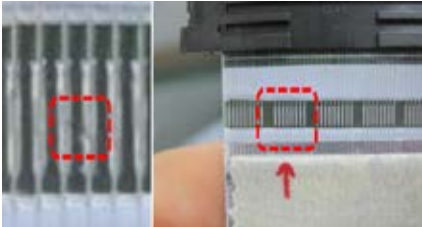
Function
error

Problem and solution	
Noise	Circuit noise, mechanical noise <pre> graph TD A[Identify noise type] --> B{Circuit noise} A --> C{Mechanical noise} B --> D[Check location of noise] D --> E[Replace Power B/D] C --> F[Check location of noise] F --> G["❖ Mechanical noise is a natural phenomenon, and apply the 1st level description. When the customer does not agree, apply the process by stage. ❖ Describe the basis of the description in "Part related to noise" in the Owner's Manual."] G -- OR --> H["❖ When the noise is severe, replace the module (For models with fix information, upgrade the S/W or provide the description)"] G -- OR --> I["❖ If there is a "Tak Tak" noise from the cabinet, refer to the KMS fix information and then proceed as shown in the solution manual (For models without any fix information, provide the description)"] </pre>
Exterior error	Exterior defect <pre> graph TD A[Zoom part with exterior damage] --> B{Module damage} A --> C{Cabinet damage} A --> D{Remote control damage} A --> E{Stand dent} B --> F[Replace module] C --> G[Replace cabinet] D --> H[Replace remote control] E --> I[Replace stand] </pre>

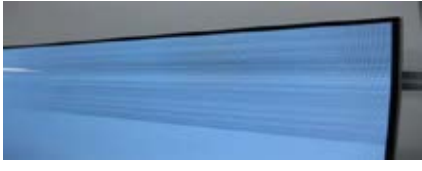
Table 6.1.1 Common problems and their solutions in OLED TV

Examples of Symptoms

Item	Symptom Name	Cause	Symptom Image
Image error			
Cable	Color smear	Poor broken pin of FFC cable	
Cable	R Color Excessive	Color is Excessive due to FFC Cable Contact	

Item	Symptom Name	Cause	Symptom Image
Cable	Screen darkness	screen is dark due to poor contact due to disconnection of the FFC cable pin	
Cable	Color spread	Vx1 cable connection problem	
Cable	Screen stop	Due to foreign substance within LVDS cable PIN	
Main			
Main	Screen noise	Bit noise from horizontal screen	
Main	Screen noise	Broken screen due to Main IC problem	
Main	Dark picture	Dark left-side screen	
Main	Broken picture	Top/bottom screen part Picture problem due to tuner Inner side quality problem	

Item	Symptom Name	Cause	Symptom Image
Main	Broken screen	Broken screen in a horizontal manner	
Main	Screen spread	Screen corner appears blurry	
Main	Color Spread	Color spread on the screen	
Main	Blurry Screen	Blurry picture on the screen	
Module			
Module	Vertical bar	Un-repairable Cases In this case please exchange the module	
Module	image broken	Source Driver issue	
Module	White dot	White dot cause by panel issue	

Item	Symptom Name	Cause	Symptom Image
Module	Line Dim	Vertical Line cause by source drive IC	
Module	Burnt	Module burnt	
Module	Horizon line	Module has damaged	
Module	Line Defect	Module has damaged	
Module	Vertical Noise Brightness difference	Un-repairable Cases In this case please exchange the module	
Module	Green light	Compensation error when Power On/off	
Module	Color difference	Color difference between screen cause by compensation error	

Item	Symptom Name	Cause	Symptom Image
Module	No image	Module has damaged (Can't fix it)	
Module	Press damage	Un-repairable Cases In this case please exchange the module	
Power Board (PSU)			
Power Board	No Light	Exchange Power Board (PSU)	
Power Board	No picture/Sound Ok	Exchange Power Board (PSU)	

Table 6.1.2 Checking parts by symptom

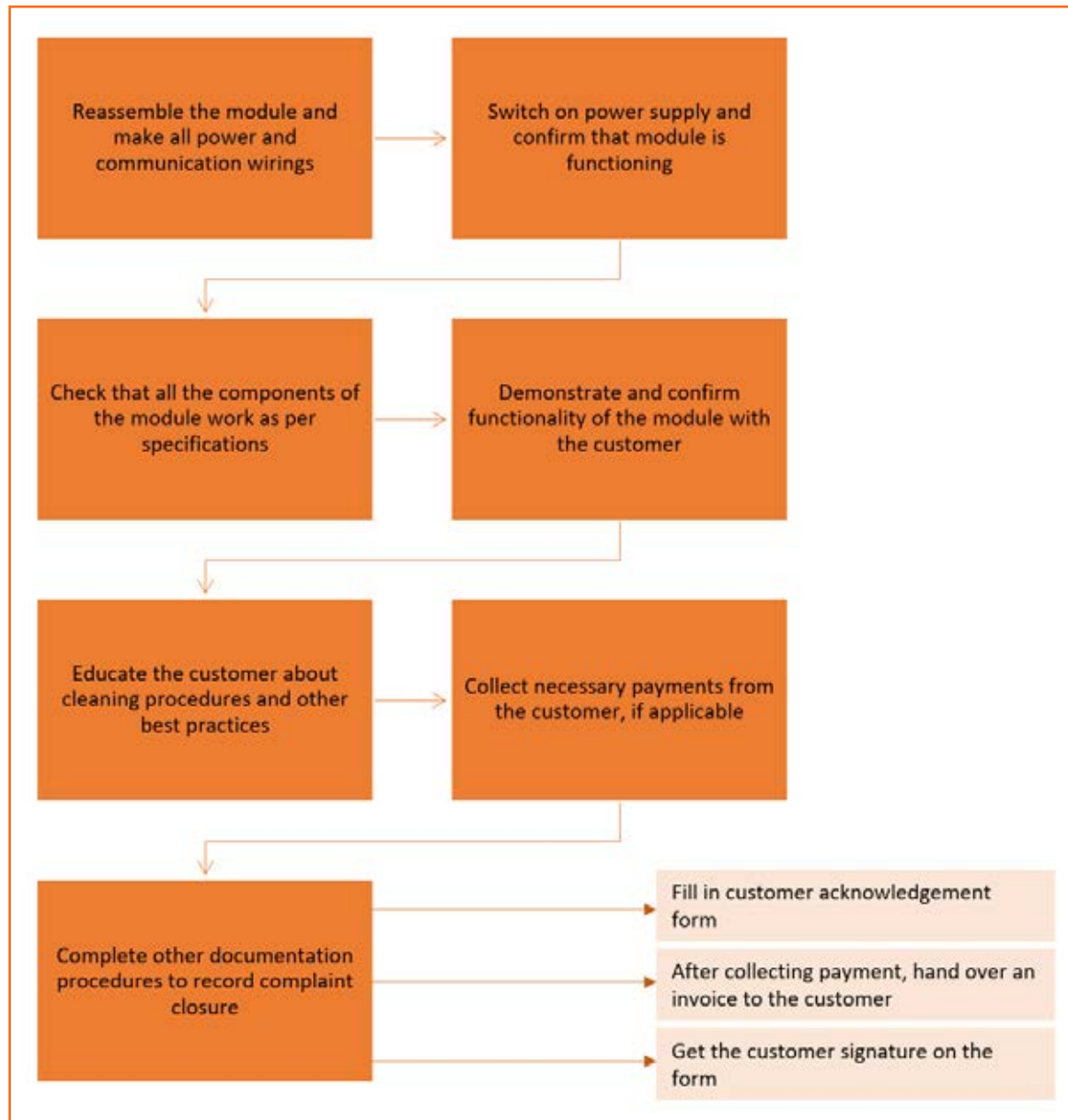
Replacing Faulty Module/Spare parts

In case the technician is unable to repair the components or fix the fault, or if the components cannot be replaced at customer's site, then the faulty module/spare parts is sent to the service centre. The field technician then collects the functional part from the service centre and replaces the defective component at the customer's site.

Confirming Functionality of the Repaired Module/Spare parts

After the faulty part has been repaired or replaced, check the new part with testing equipment such as multimeter and ammeter. This is done to ensure that the part is working fine with the other parts of the TV.

The following figure shows the steps for confirming functionality of the repaired part:

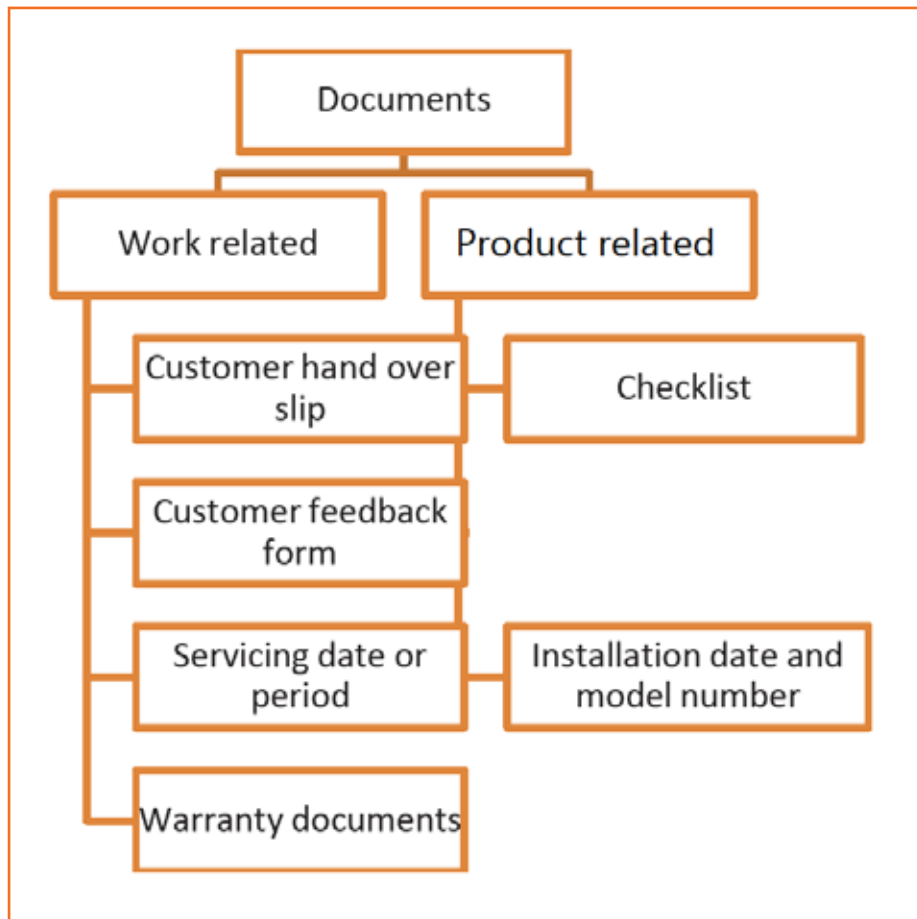


6.1.7 Post-Installation and Repairing Activities

Complete the Documentation

After completing the installation at the site, the technician should complete the documentation to record the details related to installation and repairing. Along with completing the documentation, the field technician should tell the customer about some do's and don'ts for using the TV. The technician should also tell the customer about important pages to be referred to from the owner's manual.

The following figure shows the installation and repairing documents:



UNIT 6.2: Installation and Repairing of Monitor

Unit Objectives



At the end of this module, the participant will be able to:

1. Demonstrate procedure of installing a monitor
2. Demonstrate how to setup and use the features of monitor
3. Demonstrate troubleshooting and repairing of the monitor

6.2.1 Site Requirements for Installation

Select the site which comply with all the safety codes and should not interfere with normal movement of people.

The following are the site requirements of installing a monitor:

- Select a well-ventilated place
- Place the monitor away from direct sunlight
- Place the monitor away from an area with high humidity such as a bathroom and area exposed to rain or wind
- Avoid installing near any heating appliance
- Place on a firm, level place

After checking the site requirements, the next step is to check the power supply at the location site.

The following are the power requirements for installation:

- Ensure that voltage and electrical wiring is appropriate
- Use a separate socket for monitor
- Ensure wall socket is properly earthed
- Place the monitor close to the electrical outlet

6.2.2 Installation of Monitor

The installation process consists of unpacking the unit, disposing the packing material and installing the monitor at the designated place.

Unpacking monitor

1. Cut the binding strip of carton
2. Remove the adhesive tapes and open the top flaps

3. Remove the carton
4. Remove the stands and accessories from packing.
5. Remove the monitor from the protector and place it on a flat surface with screen facing down.

Lifting and moving the monitor

When moving or lifting the monitor, follow the following to prevent it from being scratched or damaged and for safe transportation regardless of its type and size.

- Place the monitor in the original box or packing material before attempting to move it.
- Before moving or lifting the monitor, disconnect the power cord and all other cables.
- Hold the bottom and side of the monitor frame firmly. Do not hold the panel itself.
- When holding the monitor, the screen should face away from you to prevent it from being scratched.
- When transporting the monitor, do not expose the monitor to shock or excessive vibration.
- When moving the monitor, keep it upright and never turn the monitor on its side or tilt it sideways.

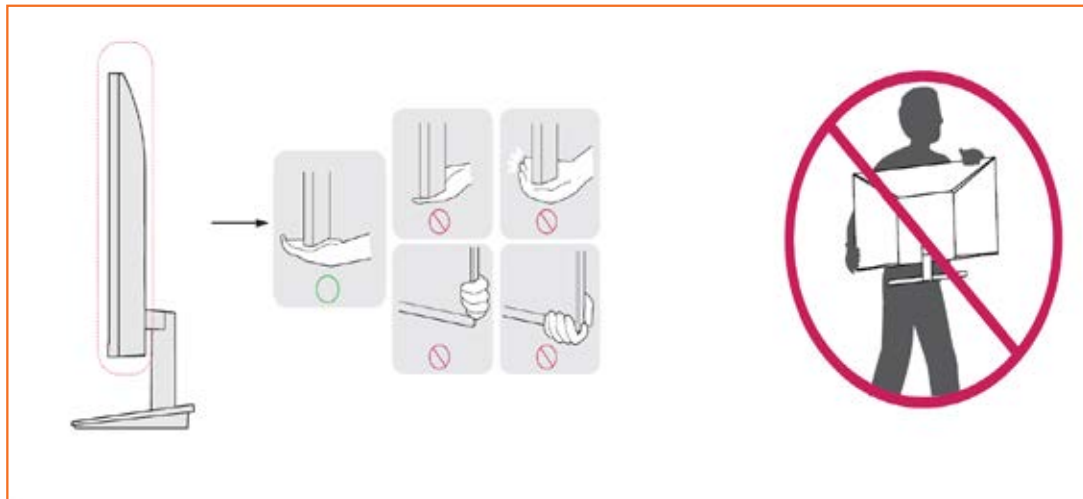


Fig 6.2.1 Correct handling of monitor

Caution

- Avoid touching the screen at all times, as this may result in damage to the screen.
- If you use the monitor panel without the stand base, its joystick button may cause the monitor to become unstable and fall, resulting in damage to the monitor or human injury. In addition, this may cause the joystick button to malfunction.

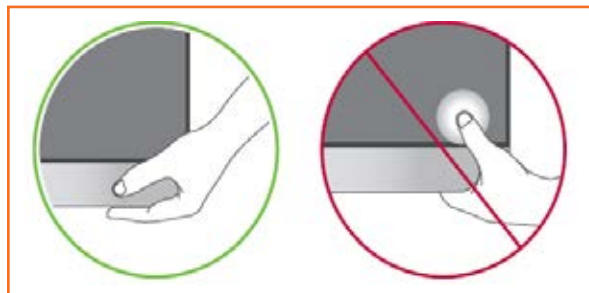


Fig 6.2.2 Starting monitor

Installing monitor on table

1. Lift the monitor and place it on the table in an upright position. Place the monitor at least 100 mm away from the wall to ensure sufficient ventilation.

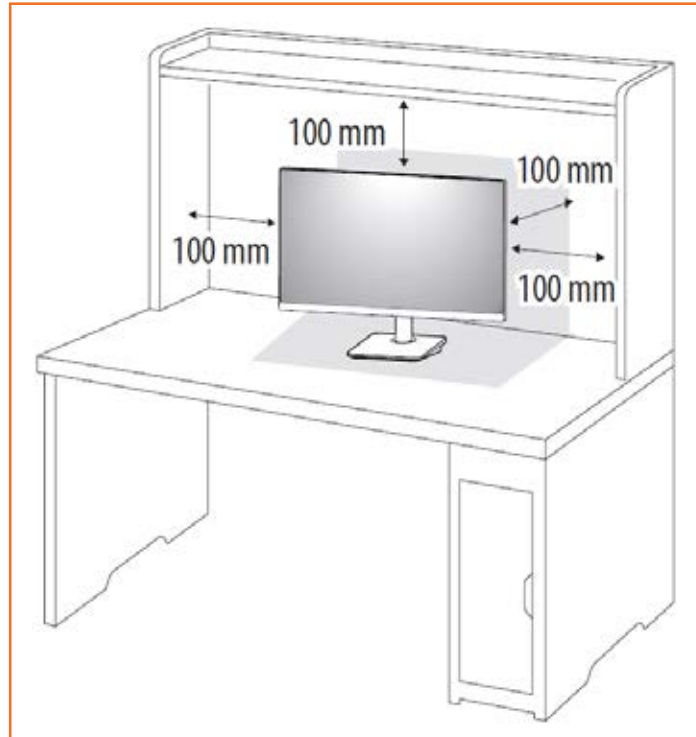


Fig 6.2.3 Placing monitor in table

2. Place the monitor mounted on the stand base in an upright position.
3. Adjust the angle of the screen.

The angle of the screen can be adjusted forward or backward from -5° to 15° for a comfortable viewing experience.

Installing monitor on wall

1. Install the monitor at least 100 mm away from the wall and leave about 100 mm of space at each side of the monitor to ensure sufficient ventilation.

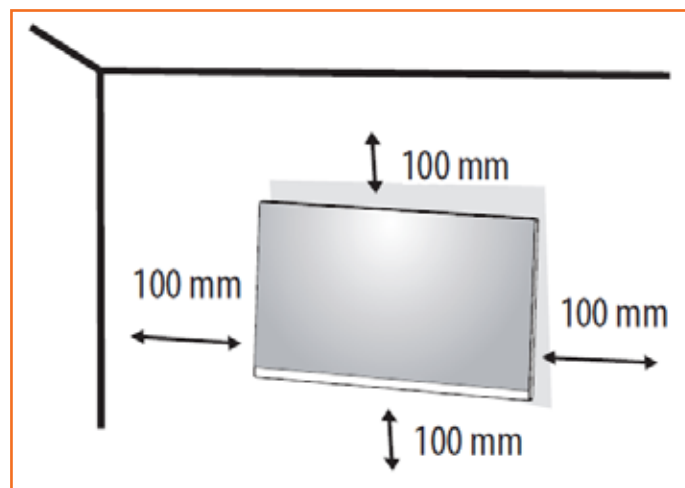


Fig 6.2.4 Area requirements for fixing on wall

2. To install the monitor to a wall, attach a wall mounting bracket (optional) to the back of the monitor.

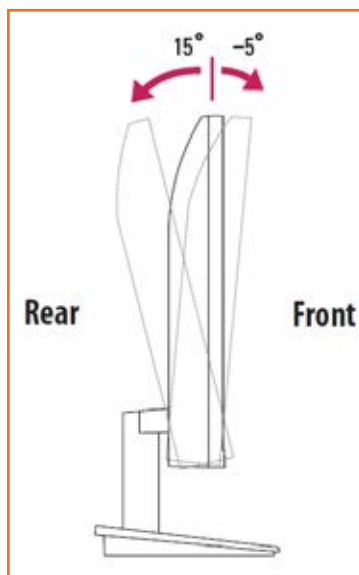


Fig 6.2.5 Adjusting monitor angle

3. Make sure that the wall mounting bracket is securely fixed to the monitor and to the wall.

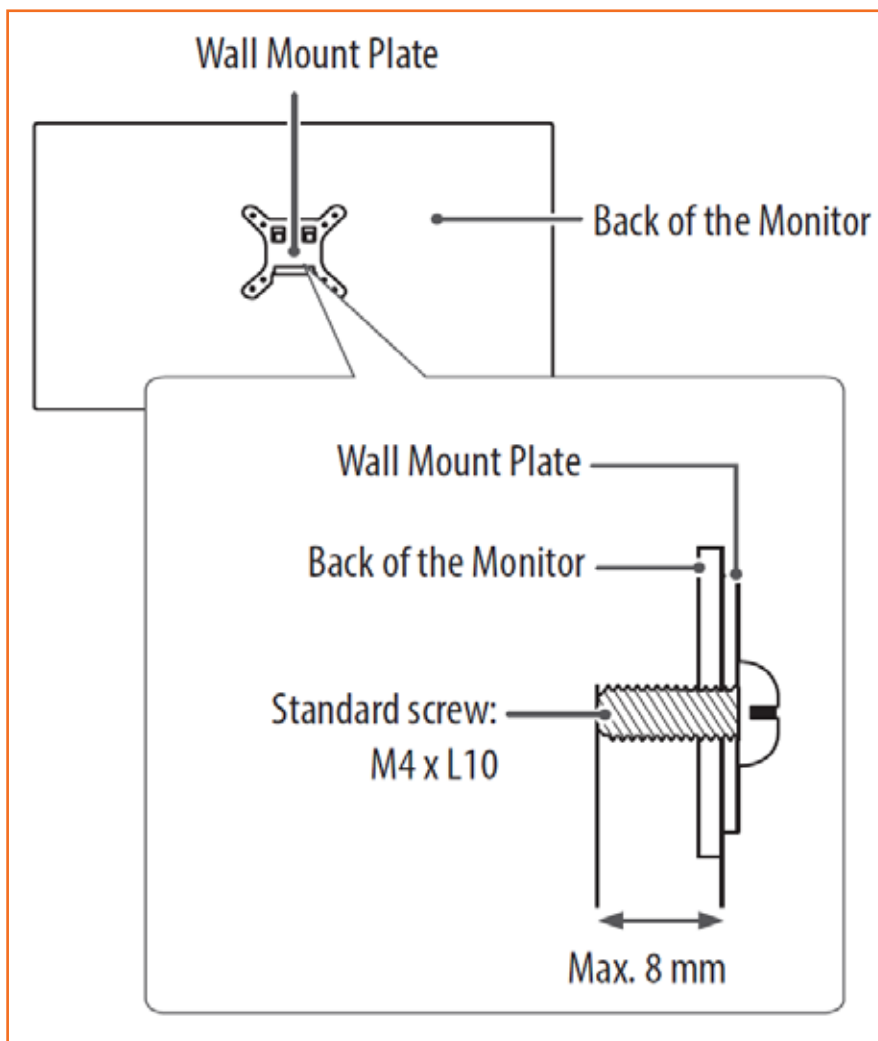


Fig 6.2.6 Fixing monitor on wall

6.2.3 Setup of Monitor

You can connect a PC and AV device by connecting the m through the HDMI/VGA port available on monitor.

USER SETTINGS

Activating the Main Menu

1. Press the joystick button on the bottom of the monitor.
2. Move the joystick up/down and left/right to set the options.
3. Press the joystick button once more to exit the main menu.



Button	Menu Status		Description
	Main menu disabled		Enables the main menu.
	Main menu enabled		Exits the main menu. (Holding down the button more than 3 seconds to turn off the monitor. You can turn off the monitor this way at any time, including when the OSD is on.)
	◀	Main menu enabled	Enters the Input features.
	▶	Main menu enabled	Enters the Settings feature.
	▲	Main menu disabled	Displays the information on the current input.
		Main menu enabled	Turns off the monitor.
	▼	Main menu disabled	Displays the information on the current input.
		Main menu enabled	Enters the Picture Mode feature. (for HDMI only)

Table 6.2.1 Using main menu features of monitor

Main Menu Features

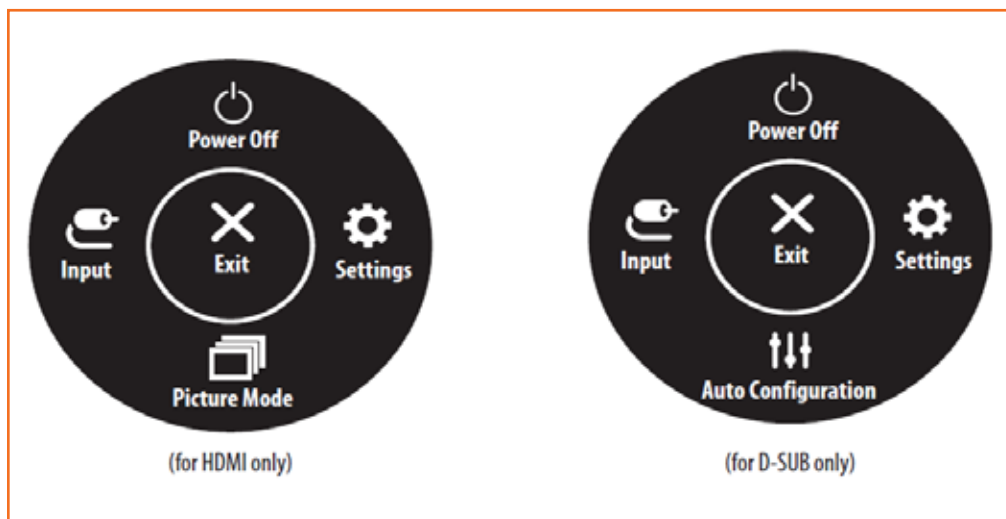


Fig 6.2.7 Main menu features

Main Menu	Description
Input	Sets input mode.
Power Off	Turns off the monitor.
Settings	Configures the screen settings.
Picture Mode	Sets the picture mode.
Exit	Exits the main menu.
Auto Configuration	Operate the Auto configuration for optimal display in D-SUB.

Menu Settings

1. To view the OSD menu, press the joystick button at the bottom of the monitor and then enter the Settings.
2. Move the joystick up/down and left/right to set the options.
3. To return to the upper menu or set other menu items, move the joystick to ◀ or pressing (⏻) it.
4. ◀ If you want to exit the OSD menu, move the joystick to until you exit.



Fig 6.2.8 Adjusting settings of monitor

5. Adjusts the color contrast and brightness of the screen.
6. Adjust the picture settings as per customer requirement.

6.2.4 Troubleshooting and Repairing of Problems in Monitor

Assembly procedure of monitor



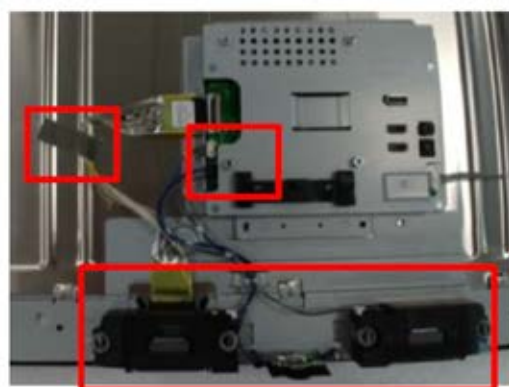
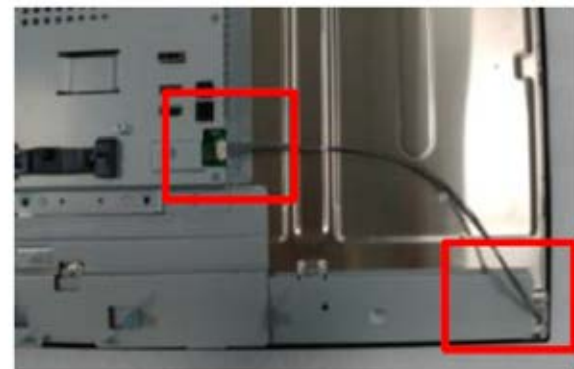
1. Assemble with CA+ Module
2. Assemble by latches



1. Put on the rear shield assy on the module guided by cabinet rib



1. Assemble LVDS cable by hand.
2. Assemble LED driver cable by hand.



1. Assemble the Jog assy and speaker assy and attach tape



1. Assemble the B/C and cabinet by latch



1. Assemble screw 4EA back cover with rear shield



1. Assemble Stand base and Body by Thumb screw.



1. Assemble Stand assy at back cover
(One click button)

Dis-assembly procedure of monitor



1. Remove the stand using one click button



1. Remove the Screw



1. Disassemble from top -> left/right -> top corner .



1. The open status top/side of both , one hand was supported module, and open the Back cover.



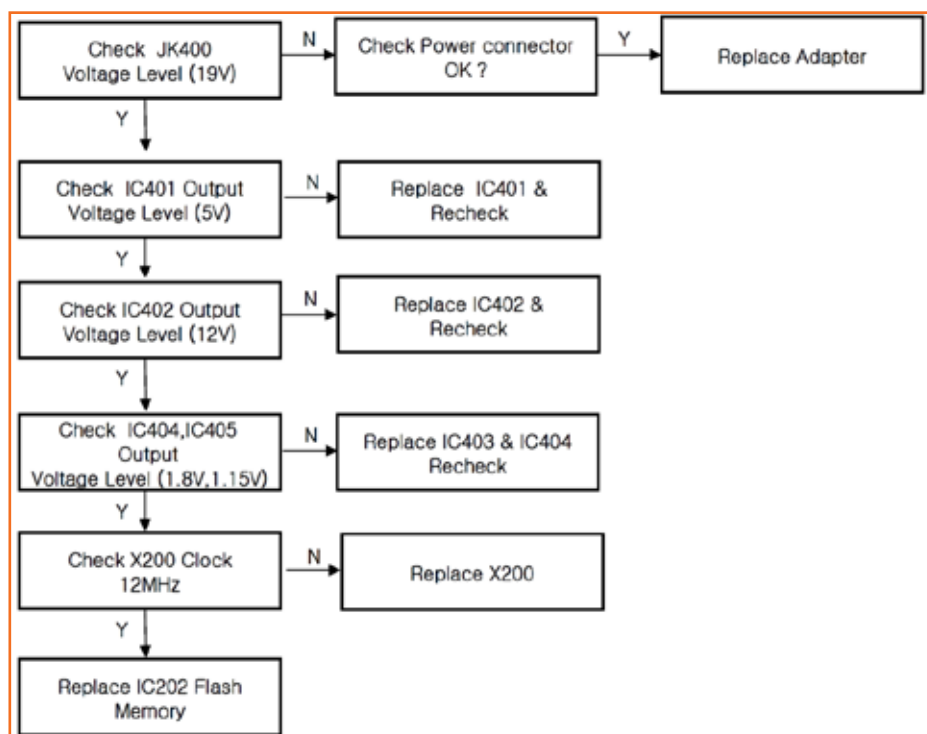
1. Disassemble the Rear shield assy and all cable.

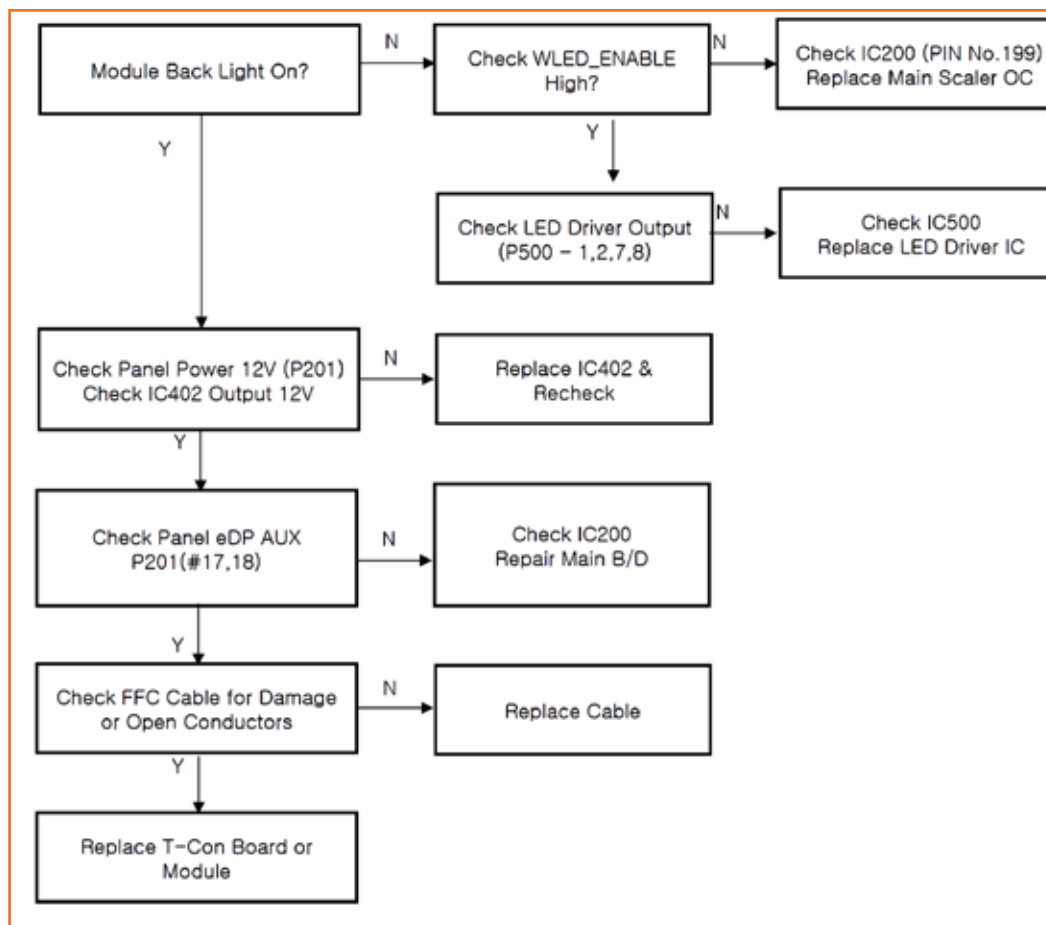
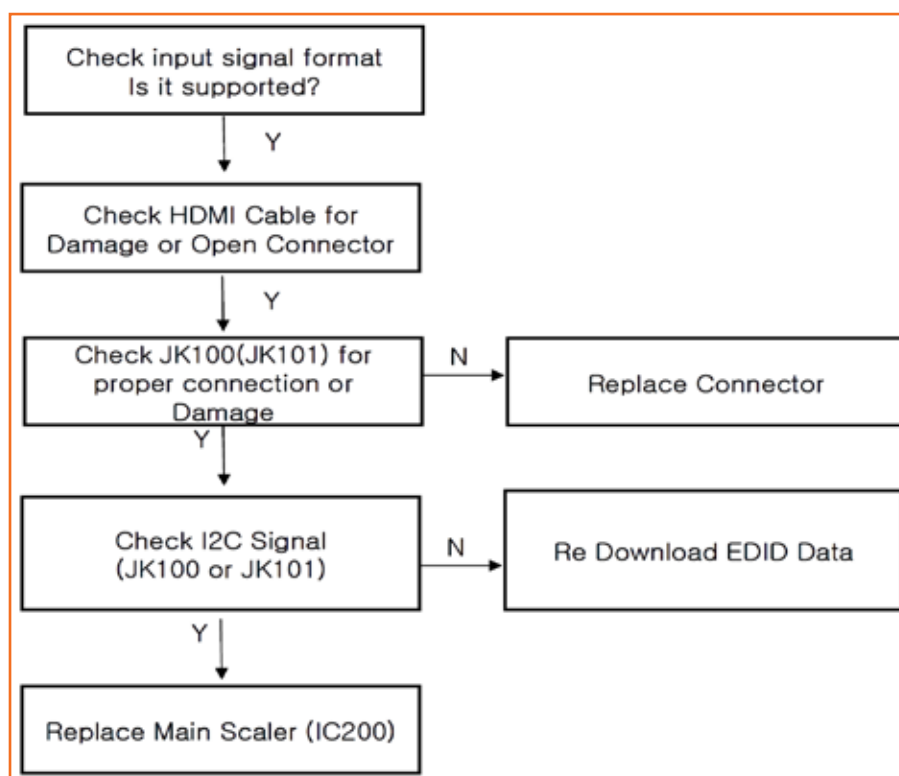


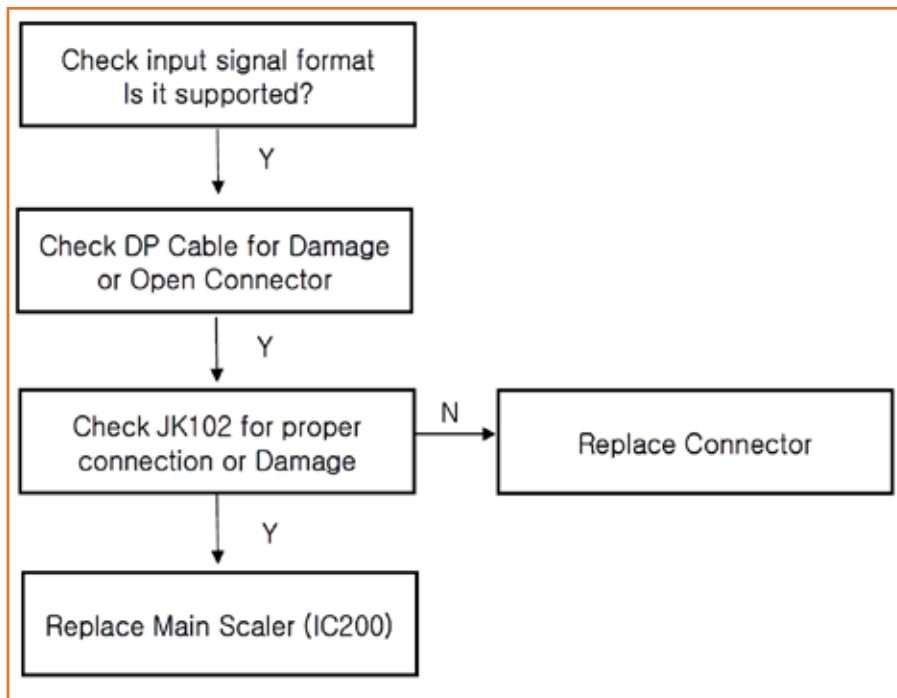
1. Remove the cabinet from module

The following flow charts represents the common problems in the working of monitor along with their solutions -

Problem 1 - No Power



Problem 2 - No screen on**Problem 3 - No video - HDMI**

Problem 3 - No video - DP

ANNEXURE - QR Codes

S.No.	Chapter No.	Unit No.	Topic Name	Page No.	QR code(s)	URL
1	Chapter 2: Install and Repair TV	Unit 2.2 – Installation and Operation of TV	Installation of TV	42		https://www.youtube.com/watch?v=ns0h-mQkiXU
2	Chapter 3: Install and Repair Micro- wave	Unit 3.2 – Installation and Operation of Microwave Oven	Installation and Op- eration of Microwave Oven	67		https://www.youtube.com/watch?v=z9pHOc5kmbw
3	Chapter 4: Install and Repair Water Purifier	Unit 4.2 – In- stallation and Operation of Water Purifier	Installation of Water Purifier	97		https://www.youtube.com/watch?v=GXZ5i5s-5FOI
4	Chapter 5: Install and Repair Re- frigerator and Washing Machine	Unit 5.2 – In- stallation and Repairing of Refrigerator	Basic prob- lems in refrigerator	128		https://www.youtube.com/watch?v=v59X-mamNDGU
5		Unit 5.4 – Installation and Repairing of Semi-Auto- matic Wash- ing Machine	Repairing of washing machine	140		https://www.youtube.com/watch?v=lvzh-07QmDGA



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