Basic Home/Office Electrical/ Electronic Equipment Servicing

Level II

Learning Guide -24

Unit of Competence: Maintain and Repair Electronically Controlled Domestic Equipment

Module Title: Maintaining and Repairing Electronically Controlled Domestic Equipment

LG Code: EELHOS2 M06 LO1-24

TTLM Code: EELHOS2 TTLM 0919v1

LO 1: Prepare units, tools, Equipment and workstation

Instruction Sheet-1	Learning Guide #24

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- ❖ Preparing Workplace/equipment for maintenance
- ❖ Verifying maintenance history with the company procedures
- ❖ Acquiring Service manuals and service information
- ❖ Setting Workplace for repair
- ❖ Preparing tools, test instruments and personal protective equipment

This guide will also assist you to attain the learning outcome stated in the cover page.
Specifically, upon completion of this Learning Guide, you will be able to

- ❖ Prepare Workplace/equipment for maintenance
- ❖ Verify maintenance history with the company procedures
- ❖ Acquire Service manuals and service information
- ❖ Set Workplace for repair
- ❖ Prepare tools, test instruments and personal protective equipment

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5. respectively
4. Accomplish the “Self-check 1, Self-check 2, Self-check 3 ,Self-check 4 and Self-check 5”respectively
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ”
6. Do the “LAP test”

Information Sheet-1	**Basic Electricity and Electronics** **content -1** Preparing Workplace/equipment for maintenance

1 Preparing Workplace/equipment for maintenance

In every electronic work, it is a must to prepare first the necessary tools, materials, equipment and well organized workplace needed as well as the information. Some of The following list of tools, materials, and equipment/but not limited/ are needed in maintaining and repairing domestic electronically controlled equipment/appliances and a sample of workshop organization shown below.

Figure 1

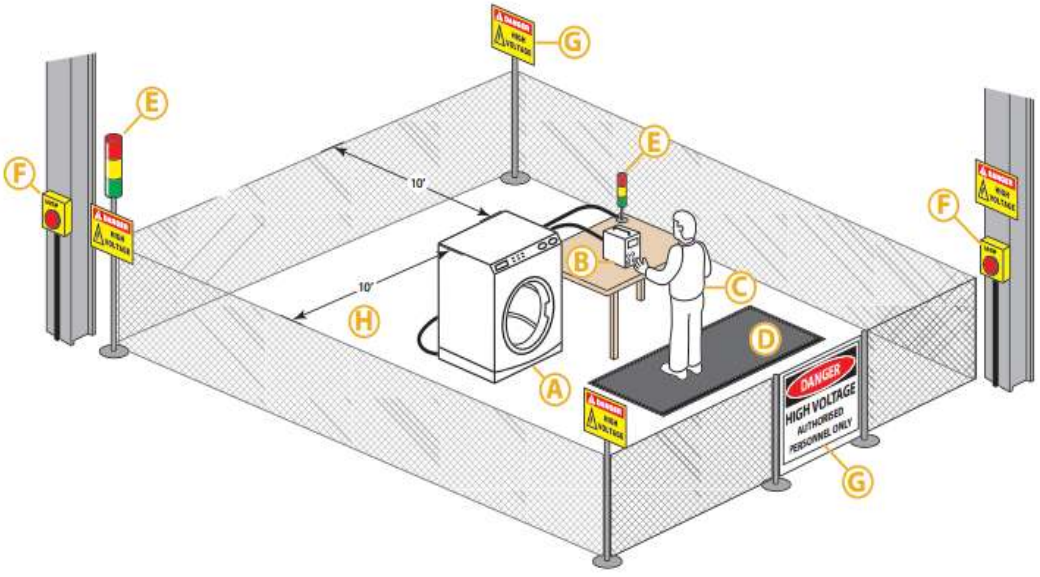

Figure 2

A	DUT – This large DUT prevents you from using a product safety enclosure. Instead, other precautions must be taken to ensure a safe testing station.
B	The Hipot Tester – tester used to test the DUT.
C	Test Operator.
D	High Voltage Insulation Mat – This isolates you from ground which provides an additional means of protection when operating high voltage equipment.
E	Signal Tower Light – gives an indication as to the status of the testing area. A green light indicates the Hipot tester is not outputting high voltage and the test area is safe. A red light indicates that the Hipot tester is active and to stay clear of the test area.
F	Emergency Stop Button – An E-stop button is located on the perimeter of the test area. In the event of an emergency, someone outside the test area can hit the E-Stop button to immediately cut off power to the entire test station.
G	Warning Signs4 – Mark the testing area with clearly posted signs that read: DANGER-HIGH VOLTAGE TEST IN PROGRESS. UNAUTHORIZED PERSONNEL KEEP AWAY.
H	Sectioned Off Test Area – Since the size of the DUT restricts the use of an enclosure, this test area is sectioned off by a mesh fence to keep unauthorized personnel away from the testing station. NEC (National Electric Code) and NFPA (National Fire Protection Agency)5 stipulate that any unqualified workers shall not come within 10 feet of an EXPOSED energized circuit.

Table 1

Self-Check -1	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, In every electronic work, it is a must to prepare first the necessary***(3 pt each)***

A, tools B, equipments C, workstations D, all

2, Identify the tools, equipment and materials in maintaining and repairing a domestic equipments and Write your answers on a separate sheet. ***(10 pt each)***

1	2	3	4	5
				
6	7	8	9	10
				

1. ---------- 2. ----------3. ----------4. ----------5. ----------

6.----------7. ----------8. ----------9. ----------10----------

Note: Satisfactory rating – 14 and above points Unsatisfactory below 14 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	**Basic Electricity and Electronics** **content -2** Verifying maintenance history with the company procedures

2. 1 Maintenance history with the company procedures

Maintenance recommendations are based on industry standards and experience in Reclamation facilities. However, equipment and situations vary greatly, and sound engineering and management judgment must be exercised when applying these recommendations. Other sources of information must be consulted (e.g., manufacturer=s recommendations, unusual operating conditions, personal experience with the equipment, etc.) in conjunction with these maintenance recommendations.

2.2 types of maintenance

Maintenance is work done to correct, reduce, or counteract wear, failure, and damage to equipment. Maintenance of electrical and electronic equipment is divided into two main categories: PREVENTIVE (routine) and CORRECTIVE maintenance.

A Preventive maintenance:- consists of mechanical, electrical, and electronic checks to determine whether equipment is operating properly. It also consists of visual inspections of cabling and equipment for damage and to determine if lubrication is needed.

B Corrective maintenance:- isolates equipment failure by means of test techniques and practices; it also replaces defective parts and realigns or readjusts equipment to bring it back to proper performance

2.3 Maintenance and test procedures

Maintenance activities fall into three general categories:

• ***Routine Maintenance*** **:-** Activities that are conducted while equipment and systems are in service. These activities are predictable and can be scheduled and budgeted. Generally, these are the activities scheduled on a time-based or meter-based schedule derived from preventive or predictive maintenance strategies. Some examples are visual inspections, cleaning, functional tests, measurement of operating quantities, lubrication, oil tests, and governor maintenance.

• ***Maintenance Testing: -*** Activities that involve using test equipment to assess condition in an offline state. These activities are predictable and can be scheduled and budgeted. They may be scheduled on a time or meter basis but may be planned to coincide with scheduled equipment outages. Since these activities are predictable, some offices consider them “routine maintenance” or “preventive maintenance.” Some examples are governor alignments and balanced and unbalanced gate testing.

• ***Diagnostic Testing: –*** Activities that involve using test equipment to assess the condition of equipment after unusual events, such as equipment failure/ repair/replacement or when equipment deterioration is suspected. These activities are not predictable and cannot be scheduled because they

are required after a forced outage. Each office must budget for these events. Some examples are governor troubleshooting, unit balancing, and vibration testing.

2.4 Maintenance procedures

- Prepare necessary tools, test instruments and personal protective equipment in line with job requirements

- Acquire service manuals and service information required for repair /maintenance as manufacturer's specifications
- Conduct complete check-up of electronically-controlled domestic appliances
- Document the identified defects based on check-up conducted

Self-Check -2	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, Activities that involve using test equipment to assess the condition of equipment after unusual events ***(3 pt each)***

A, *Routine Maintenance* B, *Diagnostic Testing* C, *Maintenance Testing* D, all

2, Isolates equipment failure by means of test techniques and practices. ***(3 pt each)***

A *Diagnostic Testing B,* Corrective maintenance C, Preventive maintenance D, *Maintenance Testing*

3, consists of mechanical, electrical, and electronic checks to determine whether equipment is operating properly. ***(3 pt each)***

A *Diagnostic Testing B,* Corrective maintenance C, Preventive maintenance D, *Maintenance Testing*

Note: Satisfactory rating – 14 and above points Unsatisfactory below 14 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	Basic Electricity and Electronics **content -3** Acquiring Service manuals and service information

3 Acquiring Service manuals and service information

3.1 Service manuals

Service manual is the full written information provided by the manufacturer regarding the equipment. This service manual usually accompanies the equipment at time of purchase. A service manual consists of some or all of the f/f

1. Safety & precautionary measures during dissembling
2. Dismantling or blow-up diagram
3. Block diagram of the equipment
4. Circuit diagram
5. PCB lay out
6. Parts-list
7. Service manual/schematic diagram/parts list
8. Operating instructions/User's/Owner's manual
9. Component data sheet/handbook

3.2 Service information

Record all information during maintaining/repairing electronically-controlled domestic appliance.

This may include but not limited to:

1. Job report sheets 2. Job order 3. Bill of materials 4. Customer index 5. Service flowchart 6. stock and inventory record 7. Requisition slips (for acquisition of parts) supplier index

Directions: Provided with the defective domestic appliance use Maintain and Repair Form to gather and document the information about the appliance at hand. Follow the procedures below:

Resources:

Domestic appliance: ----------

Receiving/Check-up Form

Procedure:

1. Conduct an initial interview to the owner of the appliance.
   - Ask what the problem is.
   - Request for the details of the problem (how does it happen/since when/ nature of the problem)
2. As serviceman, you must confirm the problem/ complain.

3. Make an initial inspection/ testing of the appliance.
   - Physical appearance
   - Operating controls
   - Power cord **etc**.
4. Take note of the information gathered and observed.
5. Accomplish Receiving and Repair Form.

Receiving and Repair Form

Customer's name: _____

Address: _____

Product/ Brand name: _____

Serial no: _____

Complain: _____

_____

Electric…… Checklist (e.g. Refrigerator, washing machine, flat iron)

Part of equipment	**condition**	
	good	**defective**
Power cord		
Power switch		
.		
.		
.		
.		

customer's Signature_____ Date Repaired: _____

technician's Signature_____ Date Checked: _____

Self-Check -3	Written Test

Directions: ***For the Following Questions you are Given Four Alternatives then Choose the Correct Answer and circle***

1,A service manual consists of some or all of the f/f **(3 points)**

A, Safety & precautionary measures during dissembling
B, Dismantling or blow-up diagram
C, Block diagram of the equipment
D, All

2, Record all information during maintaining/repairing electronically-controlled domestic appliance. This may include but not limited to: . **(3 points)** A, Job report sheets B, Job order C, Bill of materials D, Block diagram of the equipment E, all .

3, Service manual is the full written information provided by ----------. **(3 points)**

A, manufacturer B, Technician C, seller D, teacher

Note:Satisfactory rating – 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

4. Setting Workplace for repair

4.1 Introduction

Building maintenance is work undertaken to keep, restore or improve every facility i.e. every part of a building, its services including maintenance operations to a currently acceptable standard and to sustain the utility and value of the facility.

The objective of setting workplace is: -

(i) To preserve machinery, building and services, in good operating condition.

(ii) To restore it back to its original standards, and

(iii) To improve the facilities depending upon the development that is taking place in the building

engineering.

4.2 Setting up a Safe Workstation

one of the best ways to prevent injury is to ensure that the test station is set up safely and securely. Test stations can be setup with or without direct protection depending on your requirements. Direct protection means that the operator cannot physically come into contact with an energized DUT/device under test/ while a test is running

Sample Proper Arrangement and storage of tools and equipment

Figure 1

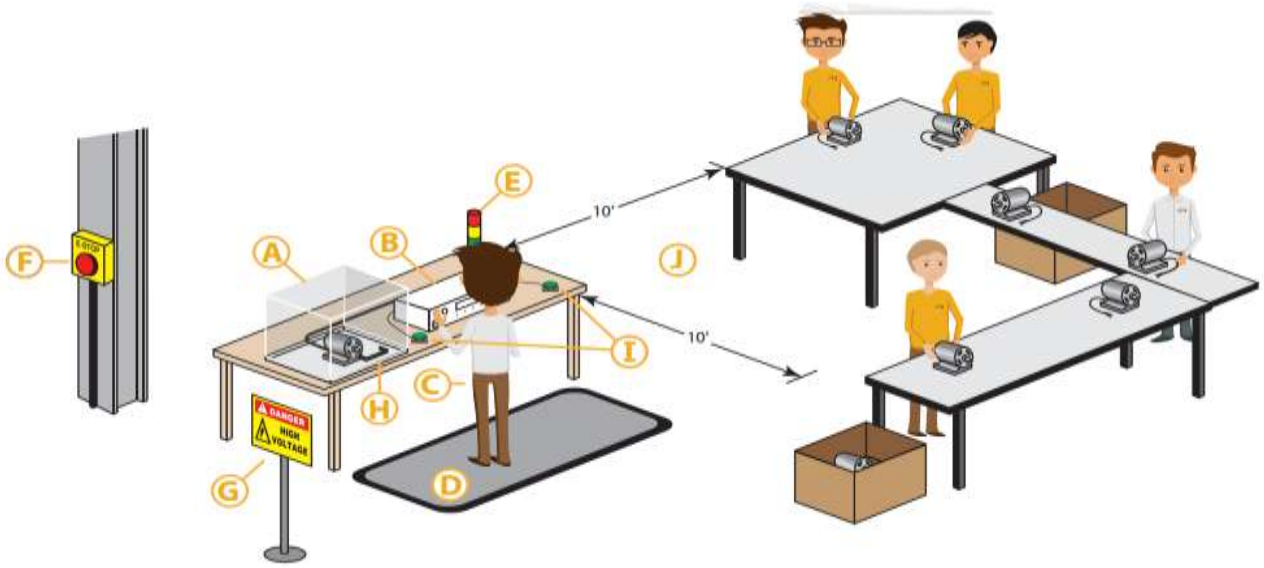

Figure 2
Station with protection against electric shock.

A

DUT Safety Enclosure

This is wired to the Hipot tester's Remote Safety Interlock. This protects you from touching the DUT while a test is in progress. If the enclosure door is opened, the tester's high voltage is immediately disabled.

E

Signal Tower Light

Gives an indication as to the status of the testing area. A green light indicates the tester is not outputting high voltage and the test area is safe. A red light indicates that the Hipot tester is active and to stay clear of the test area.

H

Non-Conductive Work Bench

Only use a work bench made of non-conductive material such as plastic or wood. This ensures no stray leakage current could flow through you during a test.

B

Electrical Safety Tester

Tester used to test the DUT.

C

Test Operator

F

Emergency Stop Button

Located on the perimeter of the test area. In the event of an emergency, someone outside the test area can hit the E-Stop button to immediately cut off power to the entire test station.

I

Dual Remote Palm Switches

Two hand operation switches force the operator to place a hand on each switch and hold them throughout the test. The palm switches should be placed at least 21.6" (550mm) apart to prevent the operator from one hand activation of both switches.

D

High Voltage Insulation Mat

This isolates you from ground which provides an additional means of protection when operating high voltage equipment.

G

Warning Signs

Mark the testing area with clearly posted signs that read: DANGER - HIGH VOLTAGE TEST AREA. AUTHORIZED PERSONNEL ONLY.

J

NEC (National Electric Code) & NFPA (National Fire Protection Agency

Stipulate that any unqualified workers shall not come within 10' of an EXPOSED energized circuit.

Self-Check 4	Written Test

Directions: ***For the Following Questions you are Given Four Alternatives then Choose the Correct Answer and circle***

1, The objective of setting workplace is **(3 points)**

A, To preserve machinery, building and services, in good operating condition.

B, To restore it back to its original standards, and

C, To improve the facilities depending upon the development that is taking place in the building engineering. D, all

2, one of the best ways to prevent injury is to ensure that the test station is set up safely and securely.

A True B, False(3 points)

3,Test stations can be setup with or without direct protection depending on your requirements.(3points)

A True B, False

Note:Satisfactory rating – 14 and above points Unsatisfactory below 14 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-5	**Basic Electricity and Electronics** **content -5** Preparing tools, test instruments and personal protective equipment

5 Preparing tools, test instruments and personal protective equipment

5.1 Preparing tools, test instruments: same of are listed bellow but not limited

		
Soldering Iron with stand	Soldering Lead	Desoldering Tool
		
Diagonal Cutting Pliers	Long Nose Pliers	Wire Stripper
		
Adjustable Plier	Philip Screwdriver	Flathead Screwdriver
		
Multitester/ Volt-Ohm-Milliammeter (VOM)	Combination Wrench	Utility Knife

Figure1

Tools Commonly Used By Refrigeration And Air-Conditioning Technicians

Wire Stripper

Figure2

Figure3

5.2 Personal Protective Equipment

Personal Protective Equipment (PPE) is defined in the Occupational Safety and Health Administration (OSHA) as a tool used to protect workers from injury or illness caused by having contact with the dangers (hazards) in the workplace, whether they are chemical, biological, radiation, physical, electrical, mechanical and other. Exposures to hazards are reduced using PPE.

5.3 The types of Personal Protective Equipment

Personal Protective Equipment can be classified according to target organs potentially affected of the risk of danger. Identification of hazard and risk assessment of a job, process and activity must be done first before deciding which type of PPE to be used.

	Organ	Source of danger	PPE
1	Eye	splashes of liquid chemicals or metals, dust, catalyst powder, projectiles, gas, steam and radiation.	safety spectacles, goggles, face shield, welding shield
2	Ear	the sound with the noise level more than 85 dB.	ear plug, ear muff, canal caps.
3	Head	crushed by falling objects, hit by hard objects, rotating objects entangled hair	helmets, bump caps.
4	Respiratory	dust, steam, gas, lack of oxygen (oxygen deficiency).	respirators, breathing apparatus

5	Body	extreme temperatures, bad weather, splashes of liquid chemicals or metals, a blast from a leaking pressure, penetration of sharp objects, dust contaminated	boiler suits, chemical suit, vest, apron, full body suits, jackets.
6	Hand and Arm	extreme temperatures, sharp objects, crushed by heavy objects, electric shock, chemicals, skin infections.	gloves, armlets, mitts.
7	Foot	slippery floors, wet floors, sharp objects, falling objects, chemical splashes and liquid metals aberration.	safety shoes, safety boot leggings.

Table 1

Figure 4

Self-Check -5	Written Test

Directions: Identify the tools, equipment and materials in maintaining and repairing a domestic equipments and Write your answers on a separate sheet. *(10 pt each)*

1, ---------- 7, ---------- 13, ---------- 19, ---------- 25, ----------
2, ---------- 8, ---------- 14, ---------- 20, ---------- 26, ----------
3, ---------- 9, ---------- 15, ---------- 21, ---------- 27, ----------
4, ----------10, ---------- 16, ---------- 22, ---------- 28, ----------
5, ---------- - 11, ---------- 17,---------- 23, ----------
6,---------- 12, ---------- 18, ---------- 24, ----------

Note:Satisfactory rating – 14 and above points Unsatisfactory below 14 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation Sheet1	Techniques for Preparing Workplace/equipment for maintenance

Techniques for Preparing Workplace/equipment for maintenance

Step 1- select work area
Step 2- select required tools, materials and equipments
Step 3- wear PPE.
Step 4- layout work area.
Step 5- arrange tools and equipments.

Operation Sheet 2	Setting Workplace for repair

Techniques for Setting Workplace for repair:

Step 1- select required materials tools and equipment.
Step 2- clean workshop.
Steps 3- design workshop.
Step 4- arrange workshop for work.

Operation Sheet 3	Preparing tools, test instruments and personal protective equipment

Techniques for Maintaining and storing tools and equipment's:

Step 1- wear PPE.
Step 2- Identifies tools and equipment's depends on their type.
Steps 3- set in order by placing the tools and equipment's in proper places.
Step 4- apply 5s

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour.

Task 1. Preparing Workplace/equipment for maintenance

Task 2 Verifying maintenance history with the company procedures

Task3 Acquiring Service manuals and service information

Task4 Setting Workplace for repair

Task 5 Preparing tools, test instruments and personal protective equipment

List of Reference Materials

1. COFFEE MAKER KM 5260 ENGLISH
2. Medical Equipment Maintenance Manual Shower pan construction,
3. K to 12 Basic Education Curriculum Technology and Livelihood Education **Learning Module**
4. ELECTRICAL INSTALLATION MAINTENANCE 130 K to 12 – Technology and Livelihood Education
5. Managing electrical risks in the workplace
6. CENTRAL PUBLIC WORKS DEPARTMENT MAINTENANCE MANUAL
7. **Grade 10GOP – Textbook Funds**
8. 7808-e-facts sheet technician
10. A Consumer's Guide to fnding the right Energy Efcient Vacuum Cleaners

Basic Home/Office Electrical/ Electronic Equipment Servicing

Level II

Learning Guide -25

Unit of Competence: Maintain and Repair Electronically Controlled Domestic Equipment

Module Title: Maintaining and Repairing Electronically Controlled Domestic Equipment

LG Code: EELHOS2 M06 LO2-25

TTLM Code: EELHOS2 TTLM 0919v1

LO 2: Diagnose faults of the unit

Instruction Sheet-1	Learning Guide #25

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

Diagnose faults of the unit

- Checking **electronically-controlled domestic appliances**
- Pre-testing procedure
- Identifying System defect/fault symptoms
- Use testing instruments in accordance with user manuals and safety procedures
- Implementing Proper troubleshooting procedures
- Testing Circuits
  - ✓ Types of tasting
- Explaining Identify defects and faults
- Checking Control settings/adjustments
- Documenting Results of diagnosis and testing
- Advising/informing Customers regarding the status and serviceability

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to

- Check electronically-controlled domestic appliances
- Pre-test procedure
- Identify System defect/fault symptoms
- Use testing instruments in accordance with user manuals and safety procedures
- Implement Proper troubleshooting procedures
- Test Circuits
  - ✓ Types of tasting
- Explain Identify defects and faults
- Check Control settings/adjustments
- Document Results of diagnosis and testing
- Advise/inform Customers regarding the status and serviceability

Learning Instructions:

7. Read the specific objectives of this Learning Guide.
8. Follow the instructions described below 3 to 6.
9. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 Sheet 5 Sheet 6 Sheet 7 Sheet 8 Sheet 9 and Sheet 10,
10. Accomplish the “Self-check 1, Self-check 2, Self-check 3 ,Self-check 4, Self-check 5 Self-check 6 Self-check 7 Self-check 8 Self-check 9 and Self-check 10”
11. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2, Operation Sheet 3 ” Operation Sheet 4 ” Operation Sheet 5 ” Operation Sheet 6 ” Operation Sheet 7 ” Operation Sheet 8 ”respectively.
12. Do the “LAP

Information Sheet-1	**Basic Electricity and Electronics content -1 Checking electronically-controlled domestic appliances**

1.1 Electronically-Controlled Domestic Appliances

Electronic control is also referred as electronic regulation that is done to an appliance, situation or load by electronic devices. Domestic appliances are commonly controlled directly or manually using electrical switches and timers. Same of these electronic controlled domestic appliances are Washing Machines and Driers, Vacuum Cleaners and Polishers, Home Food Processing equipment, Pressure and Rice Cooker, Blender, coffee maker , Toaster, waffle maker , Microwave Oven, Electronic Clock Flat irons and presses, Rechargeable Light, Electronic controlled Light ,Security equipment, Remote Control Appliances, Air conditioner, Refrigerators.

In electronic devices, transformer is commonly used not just to reduce the supply voltage (220VAC) but also to isolate the load from the power source.

Step-up Transformers

• A transformer in which the secondary voltage is greater than the primary voltage is called a step-up transformer

• The ratio of secondary voltage (Vsec) to primary voltage (Vpri) is equal to the ratio of the number of turns in the secondary winding (Nsec) to the number of turns in the primary winding (Npri) **Vsec/Vpri = Nsec/Npri**

Step Up Transformer

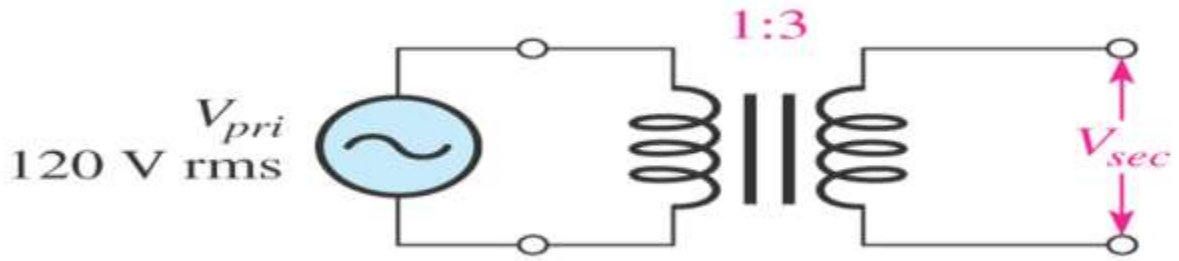

Figure 1 step up transformer

Step-Down Transformer

• A transformer in which the secondary voltage is less than the primary voltage is called a **step-down transformer**

• The amount by which the voltage is stepped down depends on the turns ratio• The turns ratio of a step-down transformer is always less than 1

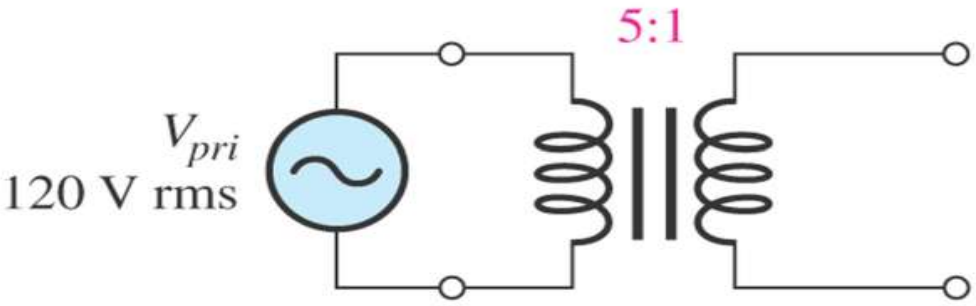

Figure 2 Step Down Transformer

The Transformer as an Isolation Device

• Transformers are useful in providing electrical isolation between the primary circuit and the secondary circuit because there is no electrical connection between the two windings

• In a transformer, energy is transferred entirely by magnetic coupling DC Isolation

• A transformer does not pass dc, therefore a transformer can be used to keep the dc voltage on the output of an amplifier stage from affecting the bias of the next amplifier

• The ac signal is coupled through the transformer between amplifier stages

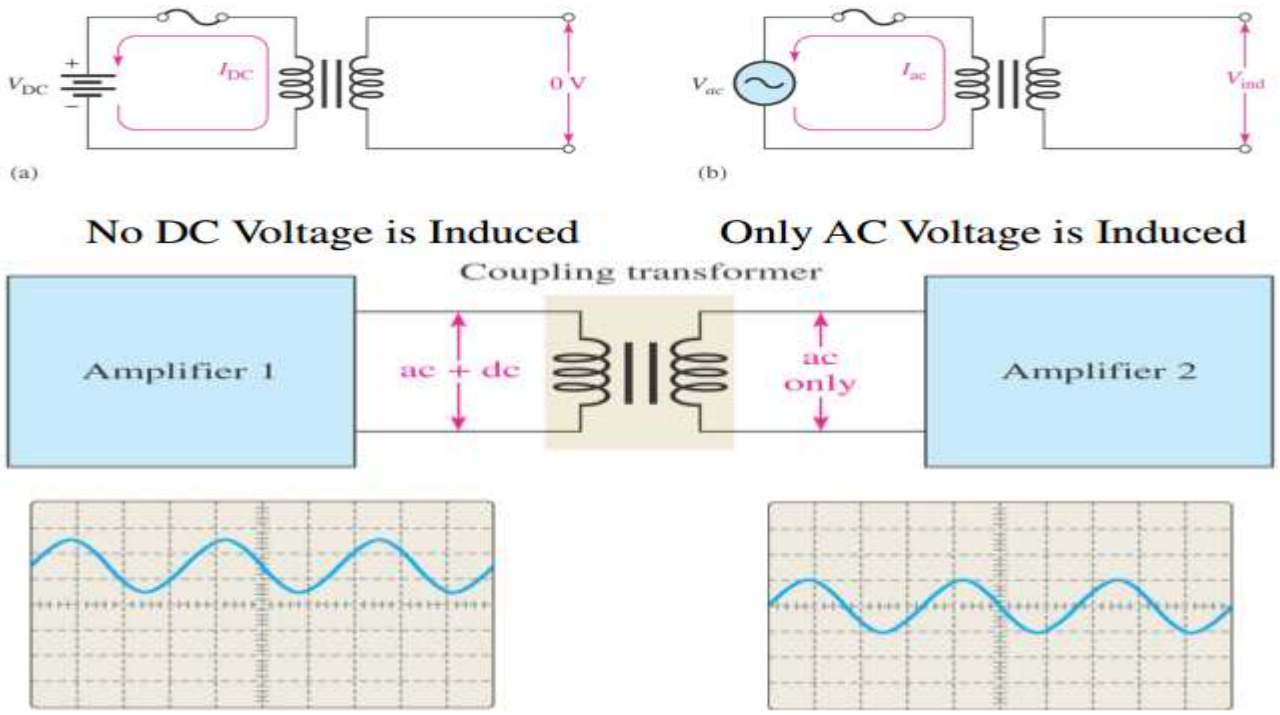

Figure 3 **isolation transformer**

Power Line Isolation

• Transformers are often used to electrically isolate electronic equipment from the ac power line

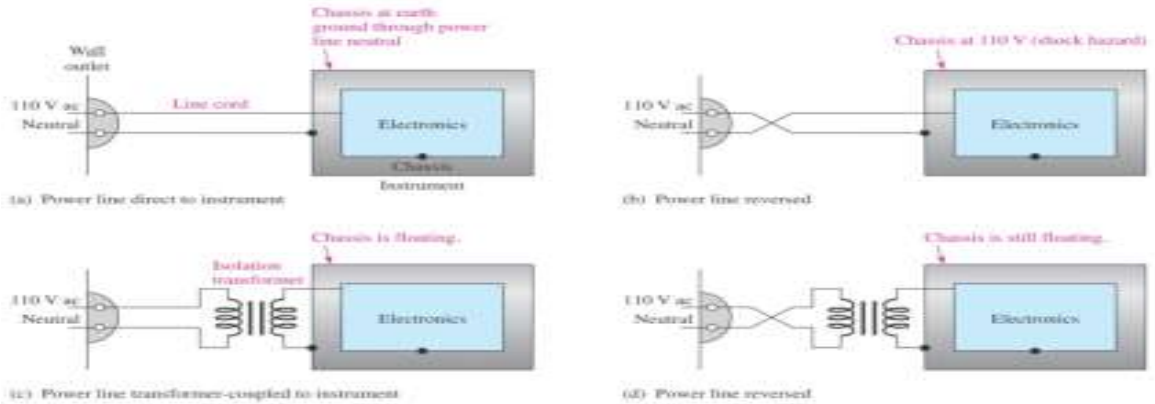

Figure 4

Testing of transformer

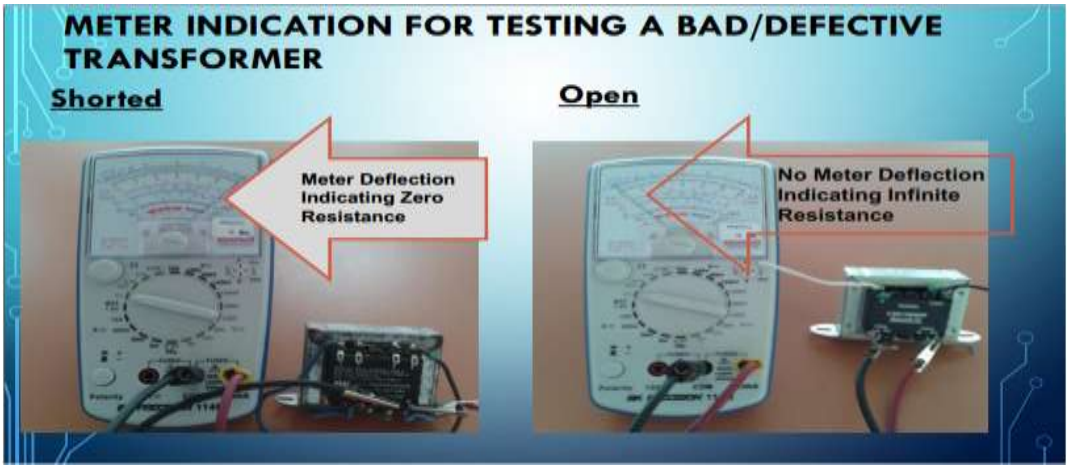

Figure 5

To apply this safety feature to domestic appliance, a device (electrically or electronically operated) is needed. Relay and triac is just an example of devices that can be used.

Relay

A relay is an electrically operated switch. Various relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal or where several circuits must be controlled by one signal.

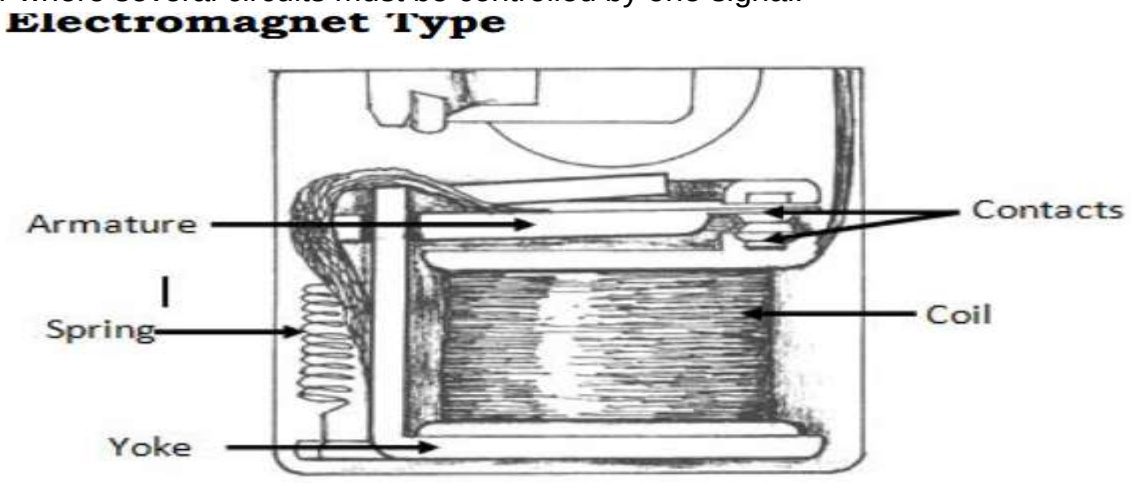

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Figure 6

Parts of Electromagnet Type Relay

1. **Yoke:** Heavy-duty frame that enclose and supports the parts of the relay.
2. **Coil:** Magnetic wire that is wound around a metal core. Creates an electromagnetic field when energize.
3. **Armature:** A relays moving part. The armature opens and closes the contacts. An attached spring returns the armature to its original position.
4. **Contacts:** The conducting part of the switch that closes or opens a circuit.

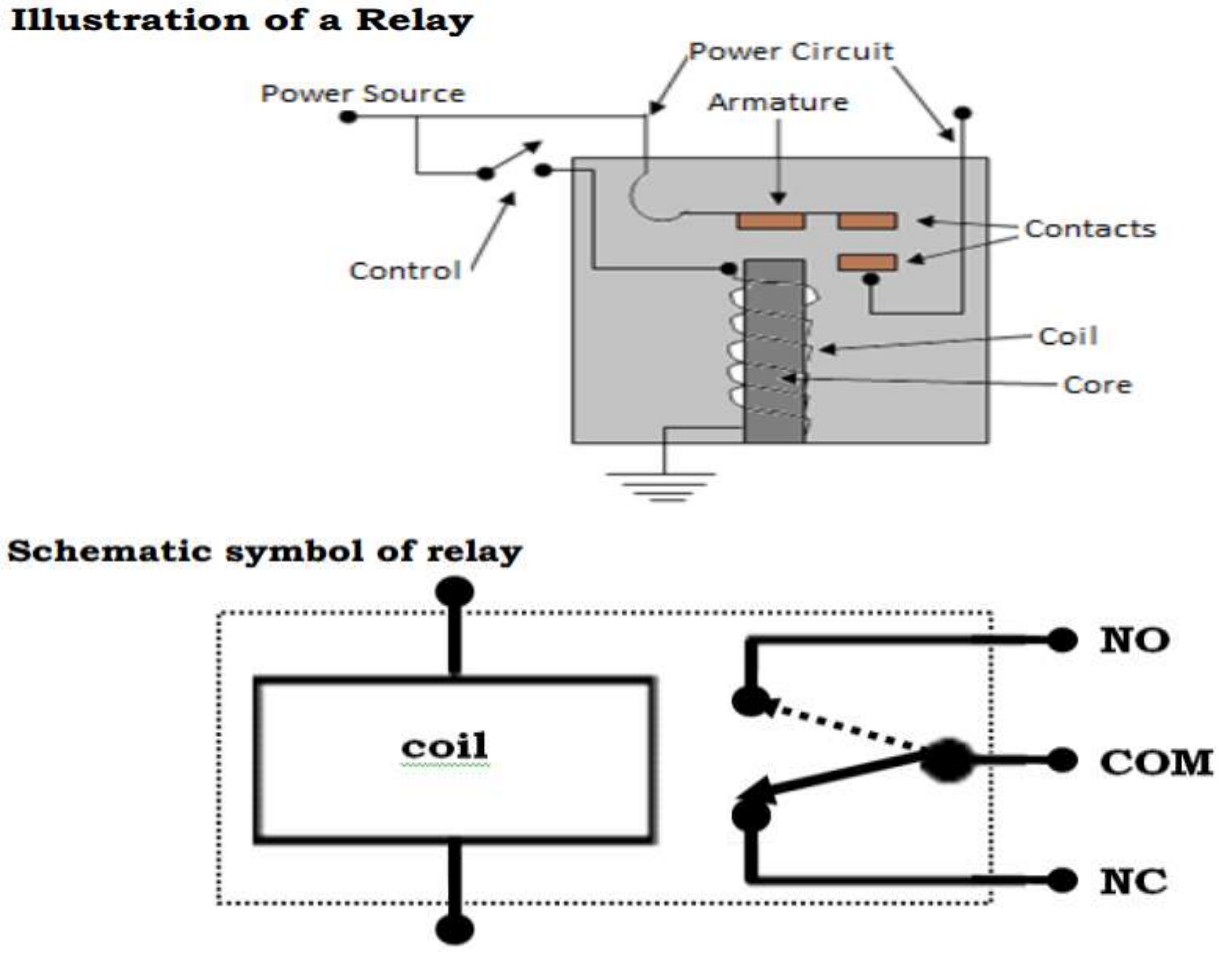


Figure 7

Coil is a wire wound around a metal core. If this coil of wire is energized, electromagnetic field is produced causing the COM terminal to connect with NO terminal. If coil is not energized, COM is at NC terminal (COM-common/ NO- normally open/ NC- normally-closed). Relays involve two circuits: the energizing circuit and the contact circuit. The coil is on the energizing side; and the relays contacts are on the contact side. When a relays coil is energized, current flow through the coil creates a magnetic field. Whether in a DC unit where the polarity is fixed, or in an AC unit where the polarity changes, the basic function remains the same: the magnetic coil attracts a ferrous plate, which is part of the armature. One end of the armature is attached to the metal frame, which is formed so that the armature can pivot, while the other end opens and closes the contacts. Contacts come in a number of different configurations, depending on the number of Breaks, poles and Throws that make up the relay. For instance, relays might be described as Single-Pole, Single-Throw (SPST), or Double-Pole, Single-Throw (DPST). These terms will give an instant indication of the design and function of different types of relays.

Solid-State Type

Semiconductors such as Silicon-Controlled Rectifier (SCR), TRIAC, or transistor output are

used instead of mechanical contacts to switch the controlled power. The output device (SCR, TRIAC, or transistor) is optically coupled to an LED light source inside the relay. The relay is turned on by energizing this LED, usually with low-voltage DC power. This optical isolation between inputs to output rivals the best that electromechanical relays can offer.

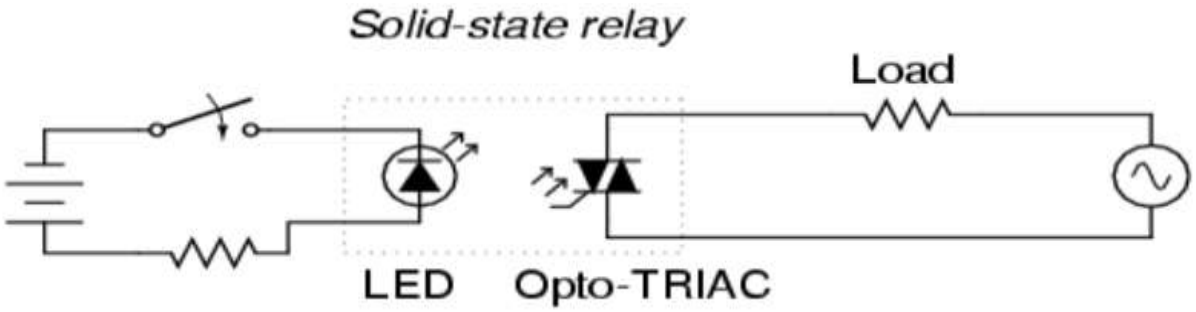


Figure 5

Being solid-state devices, there are no moving parts to wear out, and they are able to switch on and off much faster than any mechanical relay armature can move. There is no sparking between contacts and no problems with contact corrosion. triac is one type of thruster that functions as an electrically controlled switch for AC loads. This device can switch the current in either direction by applying a small current of either polarity between the gate and one of the two main terminals. It is used in AC applications such as light dimming, motor-speed control, and in micro-controller power control.

Self-Check -1	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, one is not Parts of Electromagnet Type Relay.*(3 pt each)*

A, Yoke B, Coil C, Armature D, Contacts E, none of the above

2, A device needed to apply safety feature to domestic appliance. A, Relay B, triac C, all.*(3 pt each)*

3, Transformers are often used to electrically isolate electronic equipment from the ac power line A, true B, false *(3 pt each)*

4, A transformer in which the secondary voltage is less than the primary voltage is called a A, step-down transformer B, Step dawn transformer C, non *(3 pt each)*

5, Domestic appliances are commonly controlled directly or manually using electrical switches and timers. A, true B, false *(3 pt each)*

Note:Satisfactory rating 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Basic Electricity and Electronics content -2 Pre-testing procedure

2. Pre-testing procedure

Pre testing is the process of testing before the post testing is done to identify the defect /faulty parts of the electronically controlled domestic equipment.

2.1 Why Test?

There are four main reason why you should safety test your products prior to shipment

1. Safety	Ensure that the product is not going to pose a hazard to the end user.
2. Quality	Detect workmanship defects and prevent faulty components from being installed.
3. Cost Control	Identify production problems before a product is shipped, preventing costly recalls.
4. Liability	Prevent product liability suits because the responsibility of performing electrical safety tests ultimately rests on the manufacturer

Table 1

- **The following are the general pre testing procedures.**

1. Visual inspection of the unit with power off
2. Interview of customer re history of unit
3. Be sure you understand how the domestic appliance (washing machine, micro-oven, refrigerator etc.) operates. If possible, read the operation's manual first for its function and additional features.
4. Operate the appliance according to manual to confirm defects
5. Determine what the problem really is.
6. Perform preliminary inspection to locate where the problem has originated.
7. Perform closer inspection into the suspected parts or components.
8. Use appropriate instrument in initial testing of the appliance.
9. Plan your approach to repair the problem.

Self-Check -2	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, which one of the is general pre testing procedures.*(3 pt each)*

A, Plan your approach to repair the problem. B, Determine what the problem really is. C, Interview of customer re history of unit D, all of the above

2, which one of the main reason why we should safety test your products prior to shipment.

A, quality B, Cost control C, safety. D all *(3 pt each)*

3, Pre testing is the process of testing before the post testing is done to identify the defect /faulty parts of the electronically controlled domestic equipment. A, true B, false *(3 pt each)*

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

3. Identify System Defect/Fault Symptoms

3.1 FAULT FINDING

A fault is defined as a disturbance in an electrical system of such magnitude as to cause a malfunction of that system. It must be remembered, of course, that such disturbance may be the secondary effects of mechanical damage or equipment failure. Actual electrical faults, or should one say faults that are caused by 'electricity ', are rare and are confined in the main too bad design and/or installation or deterioration and ageing.

3.2 Troubleshoot and Fault localizing

Trouble shooting means finding the problem that is occur in the equipment.Before you begin to troubleshoot any piece of equipment, you must be familiar with safety rules and procedures for working on electrical equipment. These rules and procedures govern the methods you can use to troubleshoot electrical equipment (testing procedures.) and must be followed while troubleshooting.

Next, you need to gather information regarding the equipment and the problem. Be sure you understand how the equipment is designed to operate. It is much easier to analyze faulty operation when you know how it should operate. Operation or equipment manuals and drawings are great sources of information and are helpful to have available. If there are equipment history records, you should review them to see if there are any recurring problems. During trouble shooting schematic diagram is important to see components of the equipment and to find the fault easily and to reduce the time required to find the fault in different components of the equipment.

Functional block diagram is simple than schematic diagram but for maintenance it is better to use schematic diagram. That is, functional block diagram is simply used to explain how the equipment operates or the operation of the circuit. So to locate different parts of the equipment schematic diagram is preferable.

When trouble shooting is carry out we should have service data that gives the value of each component, the block diagram and the output of each block. Therefore it is important to detect the fault easily.

Service data includes theory of operation, schematic diagram, functional block diagram, spire part lists, trouble shooting procedures and alignment procedures.

Visual inspection: - is important to localize the faulty component during trouble shooting. Fault localizing means determining the functional unit or the electronic equipment responsible for the indicated fault. In the initial inspection of any equipment, first open the

equipment to look at it. There are several things that can observe by using our sense of organs. Such as broken parts, burned resistors, open wires and poor connections, there can be smoke or smell, damaged or worn out parts. Many troubles can be located with initial inspection using our senses. The final solution involves application of our knowledge of electronic circuit operation and understanding of proper usage of the test equipment. In this step by using test instruments we can check the continuity (open circuit), short circuit, ground etc and also input output tests on the proper units is performed in order to locate the one that was actually at fault.

Testing is an experiment in which the system is exercised and its resulting response is analyzed to check its behavior. If incorrect behavior is detected, the system is diagnosed and locates the cause of the misbehavior. Diagnosis requires the knowledge of the internal structure of the system under test.

The task of detecting and diagnosing fault on appliances lies on technicians. Successful fault finding calls for an additional skill set, including the ability to:

- devise a plan;
- think logically;
- select and use a range of test equipment;
- make a detailed record of the process.

steps to Fault Finding

Step 1 - Prepare

- Are there any safety issues?
- What test equipment do you intend to use?
- Document your findings!

Step 2 - Observe

- Are there signs of damage - overheated components, melted insulation, frayed wire, bad solder joints?
- Can you smell burning or overheating?
- Take voltage measurements from a working circuit.
- Take voltage measurements from the faulty circuit to compare.
- Document your findings!

Step 3 - Identify the problem subsystem

- Which subsystems are operating correctly?
- Where does the problem seem to lie?
- Document your findings!

Step 4 - Suggest possible causes

- Check likely components:
- Switches, fuses and bulbs tend to wear out or burn out.
- Check possible components:
- Motors, relays, inductors - components with coils - may overheat.
- Check connections:
- Look for faulty connections or loose contacts which may offer high resistance.
- Look for stray connections that can short-circuit.
- Look for breaks that create open-circuit conditions.
- Document your findings!

Step 5 - Test and repair

- Be safe! Remember -
- capacitors can store electrical charge and give electric shocks;

- Inductors can store energy in a magnetic field and give electric shocks.
- Take measurements around the circuit, but mentally predict what they should be.
- In this way, home in on the problem component(s), and replace it(them), observing all safety procedures.
- Next, re-test the system to ensure that no other faults exist.
- Document your findings!

3.3. Common faults and their symptoms:

✓ **Short circuit**:

- zero volts between positive and 0V power rails everywhere;
- power supply output voltage restored when the circuit is removed from the supply;
- excessive current drawn from power supply;
- the fuse protecting the circuit may 'blow';
- zero ohms between power rails, (with circuit removed from power supply.)

✓ **open circuit:**

- zero volts between positive and 0V power rails at one end of the circuit, but not the other;
- part of the circuit may function while another part does not;
- reduced or zero current drawn from power supply.
- reverse connection:
- can occur in 'polarised' components - ones which only work when connected the 'right' way round, e.g. diodes, LEDs, transistors and some capacitors;
- can be the result of the power supply or battery being connected to the circuit the 'wrong' way round;
- produces an unusual voltage drop across the component.
- incorrect value or faulty component:
- an incorrect value can be identified by examining the component against that specified in the circuit diagram;
- a faulty component may show signs of overheating or mechanical damage;
- both produce an unusual voltage drop across the component.
- incorrect component:
- can be identified by examining the component against that specified in the circuit diagram;
- produces an unusual voltage drop across the component.

3.4 Importance of Testing

In Today's Electronics world, more time is required for testing rather than design and fabrication. When the circuit/device is developed, it is necessary to determine the functional and timing specifications of the circuit/device. When the multiple copies of a circuit are manufactured, it is essential to test each copy to verify whether the manufacturing process has introduced any flaws. In order to meet the requirements of the consumer, it is essential to test the circuit effectively, before it is released into the market.

Good Testing leads to:

- ☞ Better quality products
- ☞ Good brand value for company
- ☞ Total Customer satisfaction improves yield in manufacturing

A. Testing Principle

During testing, a set oftest stimulus are applied to the inputs of the Circuit/Device under test (CUT/DUT) and the output responses are analyzed. Circuits that produce the correct output responses for all input stimuli are considered as fault-free and the circuits that fail to produce a correct response are assumed to be faulty.

- ➢ ***Types of Testing***

Manual testing and Automated Testing:

Devices can be tested in two ways, manually and automatically. Testing Devices with human intervention is referred as Manual test. Testing devices with the help of programs or tools with minimal human intervention is referred as Automation test. Before Automation testing of any device, one must know how to test the particular device manually.

To identify system defects and fault symptoms follow the following basic steps

- Observe systematic pre-testing procedures in accordance with manufacturer's instructions
- Check and isolate circuits using specified testing procedures
- Document results of diagnosis and testing accurately and completely within the specified timeframe Explain identified defects and faults based on the result of diagnosis and testing
- Provide data/information regarding the status and serviceability of the unit as per procedure

Electronically controlled domestic equipment defect/fault identification Checklist (e.g. Refrigerator, washing machine, flat iron …….)

Part of equipment	**condition**	
	good	**defective**
Power cord		
Power switch		
.		
.		
.		
.		

- customer's Signature_____ Date Repaired: _____
  technician's Signature_____ Date Checked: _____

Self-Check -3	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, which one of the is not Good Testing. A, Better quality products *B,* Good brand value for company *C,* Total Customer satisfaction improves yield in manufacturing D, none of the above *(3 pt each)*

2, A fault is defined as a disturbance in an electrical system of such magnitude as to cause a malfunction of that system. *(3 pt each)*A, true B, false *(3 pt each)*

*3,*Visual inspections important to localize the faulty component during trouble shooting. A, true B, false *(3 pt each)*

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-4	**Basic Electricity and Electronics content -4 Use Testing instruments in accordance with user manuals and safety procedures**

4.1 Use Of Electrical Test Equipment

Test equipment is necessary for determining proper set-up, adjustment, operation, and maintenance of electrical/electronic systems and control panels.

4.2 Types

1. Voltmeters

For measuring differences of potential (voltage) between two points in an electrical circuit. The instrument is connected in parallel with the circuit being measured. Ranges vary from a few tenths volt to a few thousand volts. Instruments are capable of measuring both A.C. and D.C. voltage.

2. Ohmmeters

For measuring the electrical D.C. ohm resistance of a circuit, circuit part, or component. Calibrated from zero ohms to infinite. Measures either series or parallel resistance.

3. Ammeters

Measure magnitude of electrical current flow in an electrical circuit. When measuring D.C. currents, some types must be inserted in series with the circuit. A.C. ammeters are of two types. One requires that it be connected in series with the circuit; the other needs only to be clamped around the current carrying conductor. Ranges are from less than .0005 to over 100 Amperes, depending upon the instrument.

4. High Potential Testers (Hi-Pot)

Capable of generating calibrated voltages from zero to several thousand for purpose of testing the integrity of insulation on wiring (usually buried in the earth).

5. Ground Rod Tester

For testing the effectiveness of, and determining the value of resistance of the grounding electrode (rod) circuit in an electrical system. Usually operate by a balanced bridge circuit and has a direct readout of resistance.

6. Chart Recorders

electrically driven and operated roll chart indicator. Gives a graphic readout of parameters versus time. Units are available for recording voltages, currents, pressures, temperatures, light levels, etc. Some instruments are single channel; others can measure multiple inputs. Useful for monitoring a parameter over a period of time.

Instrument sensitivities and accuracies vary approximate proportional to the quality. Some instruments combine functions and are capable of measuring different quantities. One is the common VOM, or the volt-ohm- Ammeter. Mode and range is selected by a switch or switches.

A convenient and versatile instrument is a late model VOM of great sensitivity and range and has

a liquid crystal readout, is portable and capable of operating for long periods of time powered by

an internal replaceable battery.

7. Wire Gauge - used to measure the diameter of magnetic wire

- **Multimeter**

4.3 Multi-tester:- an electrical measuring instrument used to measure the voltage, the resistance or the current of a circuit. It is connected either through parallel or series with the circuit depending on what to measure

. **Types Of Multimeter**

1. Analog Multimeter

:

Advantage:

Low Cost

Disadvantages

Difficult to read measured value.

Need to start at **highest range** and work way down to suitable range.

2. DIGITAL

Advantages:

Easy to read measured value

More accurate readings

Disadvantages:

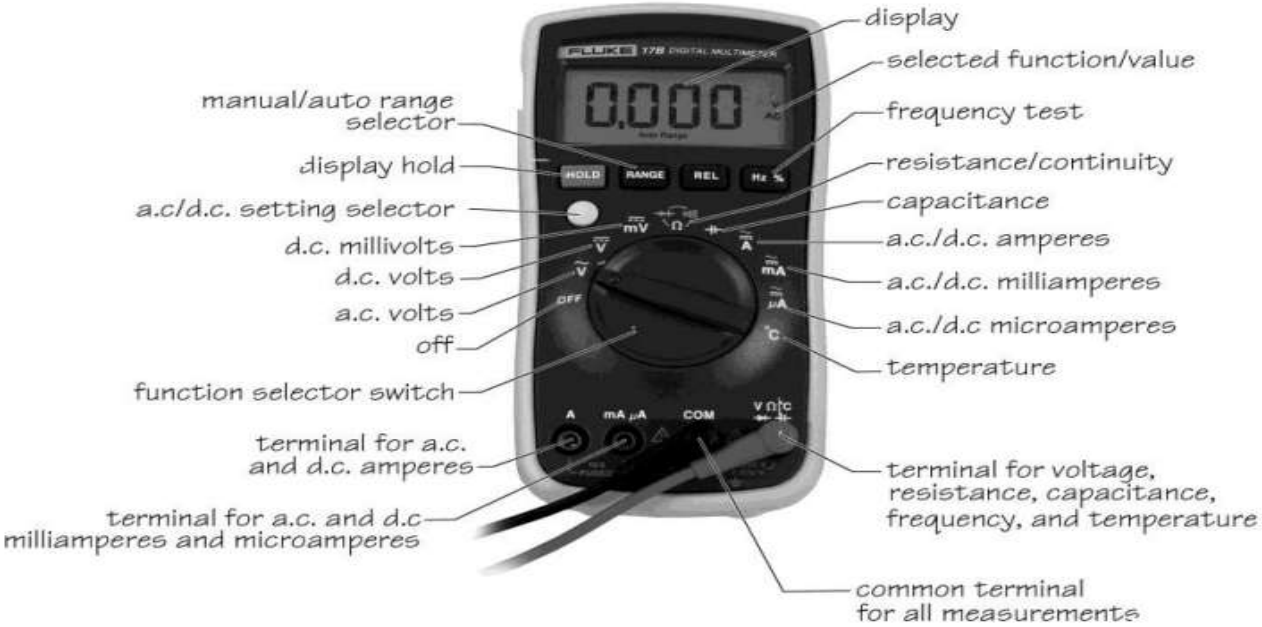
High Cost

Need to start at **highest range** and work way down to suitable rang

Digital Multimeter

There is an enormous range of digital multimeters available from a great many manufacturers: from inexpensive consumer-level models to very expensive professional models. They all measure d.c. and a.c. voltages and currents, as well as resistance, but many will also have additional features, enabling them to measure frequency, capacitance, inductance, etc., and to test electronic components such as diodes and transistors.

In this Section, we'll briefly look at the basic features that are common to most professional multimeters, using the following example:



In this example, the black test-lead is inserted into the **common** terminal, and the red lead inserted into the appropriate function terminal: **current** (amperes), **current** (milli/microamperes), or **voltage**/**resistance**. This particular instrument offers manual or automatic range selection; when

'automatic' is selected, the instrument will choose the most appropriate range for any particular measurement. The rotary switch allows the appropriate function/range to be selected, and this selection is confirmed on the LCD display panel.

Clamp onmeter is also called tong-tester. It is used to measure current flowing in a conductor It is clamped or hanged in a conductor.

Current measurment probes

A compact AC current measurement device composed of a flexible sensor and an electronic module designed to measure frequency response up to 1MHz

A compact AC current measurement device composed of a flexible sensor and an electronic module designed to measure frequency response up to 1MHz

Tachometer/speedmeasurment/

Simple to use and offers numerous measurement capabilities with or without contact

Merger - an instrument used to measure the insulation resistance of conductors or wire. It gives measurement in ohms or meg-ohms

Self-Check -4	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, For measuring differences of potential (voltage) between two points in an electrical circuit .A, home meter *B,* volt meter *C,* ammeter D, none of the above *(3 pt each)*

2, **Clamp onmeter** is also called tong-tester is used to measure current flowing in a conductor It is clamped or hanged in a conductor. *(3 pt each)*A, true B, false *(3 pt each)*

3, Test equipment is necessary for determining proper set-up, adjustment, operation, and maintenance of electrical/electronic systems and control panels.. A, true B, false *(3 pt each)*

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-5	**Basic Electricity and Electronics** **content -5 Implementing Proper troubleshooting procedures**

5 1 What is troubleshooting?

Troubleshooting is a form of problem solving, often applied to repair failed products or processes. It is a logical, systematic search for the source of a problem so that it can be solved, and so the product or process can be made operational again. Troubleshooting is needed to develop and maintain complex systems where the symptoms of a problem can have many possible causes.

- Troubleshooting is used in many fields such as engineering, system administration, electronics, automotive repair, and diagnostic medicine. Troubleshooting requires identification of the malfunction(s) or symptoms within a system. Then, experience is commonly used to generate possible causes of the symptoms. Determining which cause is most likely is often a process of elimination - eliminating potential causes of a problem. Finally, troubleshooting requires confirmation that the solution restores the product or process to its working state

5. 2 Basic steps of Troubleshooting

Step1 analysis

Step2 problem identification/replication

Step3 action plan

Step4 implementation

Step5 testing

Step 6 documentation

Step7 follow up

Figure 1


CLIMBING THE LADDER TO
BECOME A "TROUBLESHOOTER"
start
Tools Needed
Basic Electronic & Electrical Component
Basic Electrical & Electronics Circuit Analysis
Repair & Maintenance Procedure
TROUBLESHOOTER

Figure 2

Self-Check -5	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, To be trouble shooter one must be a knowledge of .A, tools needed *B,* basic electronic/electrical component *C,* basic electronic/electrical ckt analysis D, all of the above *(3 pt each)*

2, Troubleshooting is used in many fields such as engineering, system administration, electronics, automotive repair, and diagnostic medicine. *(3 pt each)*A, true B, false *(3 pt each)*

3, write basic steps of Troubleshooting.

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-6	**Basic Electricity and Electronics** **content -6** check and isolate Circuits using specify testing procedures

6 Introduction

First, you have to understand how all the circuits on the board work before you can figure out how to test them. Once you've gotten over this hurdle, you have to write test procedures specifying exactly how the board will be tested. Remember, you want *to* test all the circuits; otherwise, you can't be sure the board will work properly under all normal operation conditions.

Figure 1

Once you've written the test procedures, you have to assemble all the necessary test equipment: oscilloscopes, voltage sources, current sources, meters. and so on.

Figure 2

Manual testing

Now, connect all this equipment to the appropriate points on the pc board. Some of those points may be hard to reach. If **you** have many boards to test, vou may want to build a fixture to simplify connecting the test leads.

Finally, turn on the equipment, apply known inputs to the circuit, **check** the outputs and determine if the circuit is operating **properly.** And, oh yes, if the circuit is not operating properly, find the dckctive part and replace it.
The term **automatic zest equipment (ATE) applies to** many forms of programmable, computer-controlled *test* **instruments** and **systems.** This **equipment is** used in **many stages** of the manufacturing process, including:

- Component manufacturing
- Quality assurance
- Income inspection
- PC board testing
- System testing
- Field service

What Es an in-circuit sestet?
It's a tester that tests each component on a pc board, one at a time. And it does this while the component is "in-circuit," thar is, while it's connected to other components on the board. A divide-and-conquer approach is taken. First, the tester checksthe loaded pc board for unwanted shorts and opens. Then, it isolates and tests each separate component on the board, one at a time.
The **tester performs all the manual procedures that were** described :

- Writes test procedures
- Connects the test equipment to the board
- Turns the equipment on and sets it up
- Applies known input signals and checks outputs
- Determines if the circuit is OK
- Locates defective components when the circuit is not OK and last, but not least,
- Repeats this for all the circuitry on *the* board

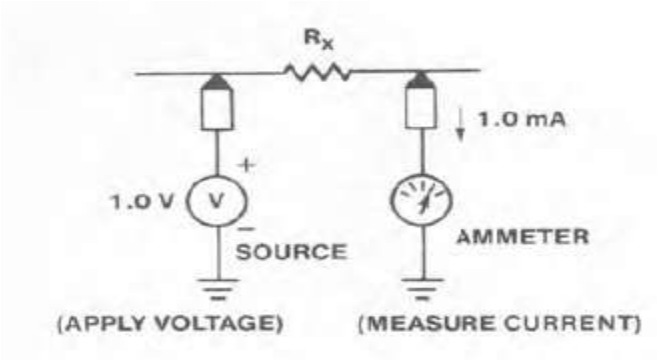
In-circuit testing's
Test the individual components on ully assembled pc board :
It must **have** access to all the circuit nodes on the board. Obviously, to test each component individually, the raster
must he able to connect test instruments to each pin of **each** component.
Also, it must be able to **isolate** each component-under-tc5t from surrounding components. Since components .Ire intc-rconnected on the board, some special isolation techniques are needed to prevent the component-under-test from being affected by other components.
Analog testing
To perform analog testing. the tester uses the following instruments:

- DC Current Source
- DC Voltage Source
- DC Voltmeter
- DC Ammeter (Current filter)
- AC Impedance measurement **module**

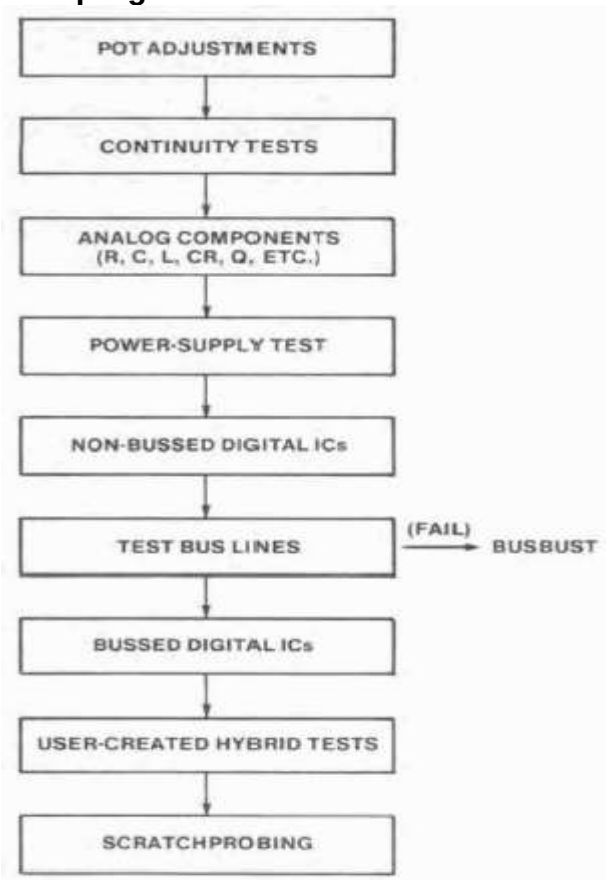
Now, the question is, how can the taster connect any one of these instruments to any one of hundreds of' circuit node. on *the* hoard.
Isolating and testing analog components Suppose you wanted to test an analog component, such as a
Resistor. that is not connected in a circuit. You could apply a known voltage across that resistor, measure the
Resulting current, and calculate resistance by using Ohm's **Law:**

$$R=V/I.$$

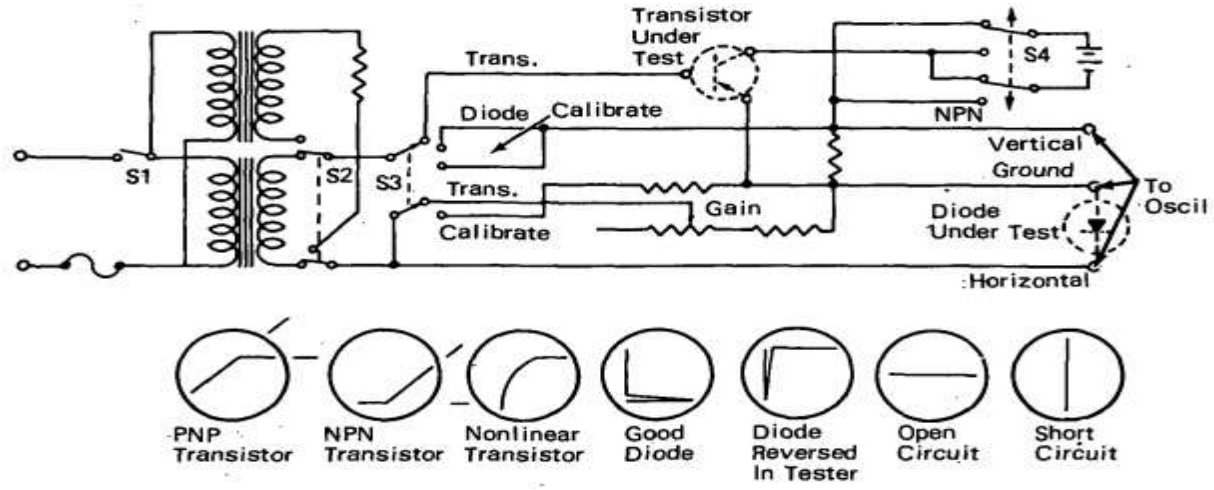
For example, if the applied voltage were 1.0 V and the measured current were 1.0 mA, the calculated resistor value would be



Test program



Example of electronic circuit testing



Classification of non-functional and functional electronically controlled domestic Equipment

Domestic equipment are very useful to us in our homes especially to our job. But Domestic equipment that are no longer functional may cause harm.

A. Make an inventory of functional and non-functional tools in your shop.

B. Classify your tools according to is function.

6.2 Method of identifying non-functional tools and equipment

1. ***Visual inspection.*** It refers to the visual observation of an expert on the appearance of the tools and equipment.
2. ***Functionality.*** Vibration or extra noise from the operation means problems on parts and accessories started to develop.
3. ***Performance.*** When there is something wrong with the performance of either hand tools or equipment they need an immediate repair or maintenance.
4. ***Power supply (for electrically operated only).*** Failure to meet the required power supply, malfunction will occurs in the part of hand tools or equipment.
5. ***Person's involved.*** It refers to the technical person who has the knowledge and skills about the technology.

Non-functional tools and equipment are those that are not able to perform its regular function because of impaired and damage part. Examples of these are the following

6.3 Types of tasting

1. Cooled Test is the test performing without power source/the device under test is fully disconnect from any electrical power/.
2. Hot Test is the test performing with power source.

Self-Check -6	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, Hot Test is the test performing with power sorce.

.A, true *B,* false *(3 pt each)*

2, which one is the method to identifying non-functional tools and equipment.

. *(3 pt each)*A, *Visual inspection* B, *Functionality* C, *Performanced, all*

3 ,write Types of tasting. *(3 pt each)*

.

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-7	**Basic Electricity and Electronics content -7 Explaining Identify defects and faults by the *responsible person***

7.1. **Roles of a Supervisor**

If you are charged with managing others' performance, including conducting performance evaluations, you are considered to be a UVa supervisor. UVa supervisors are expected to understand and be able to assume many roles. The five key supervisory roles include Educator, Sponsor, Coach, Counselor, and Director. Each is described below. Note that in your role as a supervisor, you will be using these five roles, in some combination, simultaneously, depending on the needs of the team members.

- **Educator:** You will act as an educator when employees and team members are new, when you are new to a team, when processes or conditions change, and when discussing performance expectations with your direct reports.

Additionally, you will most likely educate when you hold or attend meetings, write and distribute policies, manuals, or other documents, and provide cross-training opportunities. (Refer to the Toolkit document, "Talking with Employees, The Conversation Process" for more information on having productive conversations.)

- **Sponsor**: When acting as a sponsor, you assume your employees have the skills they need to perform their current jobs and work to provide opportunities for them to showcase their talents and strengths. Additionally, you are expected to support employee career development, even if it means that the employee will move to position outside your team. (Refer to the Toolkit document, "Developing Your Employees, Questions to Ask During Career Conversations" for more information on questions to ask and consider.)

Example: Helping employees identify and complete the Career Development Action Plan (CDAP)

- **Coach:** You will be coaching an employee when you are explaining, encouraging, planning, correcting, or just checking in with your employees. (Refer to Toolkit document, "Coaching Employees, The Take 10 Check In".)

Example: You should take ten minutes a week to check in with each of your employees. During those ten minutes, ask the following three questions and document the result of your conversation:

- How do you think the team is doing?
- How can things be improved?
  UHR – Employee Development 2
- How are you doing?

- **Counsel:** Counseling is used when an employee's problems impact performance and is intended to mitigate any further action, including formal disciplinary action. The employee should solve the problem and your role is to be positive, supportive, and encouraging in that process. (Refer to the Toolkit documents, "Counseling Your Employees, The 2-Minute Challenge" and "Counseling Your Employees, The Role of a Good Supervisor".)

Example: One of your classified staff employees is habitually 15-20 minutes late and provides no explanation for her behavior. As soon as you notice her repetitive behavior, you should counsel her, seeking her ownership of the issue, and hopefully avoid any further action.

- **Director**: Directing is used when performance problems continue and assumes you have educated, coached, and counseled. During "directing" conversations, you should make recommended alternatives and consequences clear, be calm and serious, get your

school or department HR or HRCS involved, and make sure the meeting is thoroughly documented.

Example: Unfortunately the employee mentioned in the last example continues to be late. You should have a meeting with the employee clearly outlining the problem, the desired result, and the consequences of not correcting the problem. Additionally, you should document your conversation with the employee and forward it to HR.

7.2 Receive and Explaining Identify defects and faults format

Directions: Provided with the defective domestic appliance use Maintain and Repair Form to gather and document the information about the appliance at hand. Follow the procedures below:

Resources:

Domestic appliance: Electric ----------

Receiving/Check-up Form

Procedure:

1. Conduct an initial interview to the owner of the appliance.
- Ask what the problem is.
- Request for the details of the problem (how does it happen/since when/ nature of the problem)
2. As serviceman, you must confirm the problem/ complain.
3. Make an initial inspection/ testing of the appliance.
- Physical appearance
- Operating controls
- Power cord . . .
4. Take note of the information gathered and observed.
5. Accomplish Receiving and Repair Form.
6. Inform about servsebility of the equipment owners

Self-Check -7	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, If you are charged with managing others' performance, including conducting performance evaluations, you are considered to be a UVa supervisor *(3 pt each)*

.A, true *B,* false

2, Directing is used when performance problems continue and assumes you have educated, coached, and counseled.. *(3 pt each)*.A, true *B,* false

3. Make an initial inspection/ testing of the appliance. *(3 pt each)*

A. Physical appearance

B, Operating controls

C. Power cord . D. all

.

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-8	**Basic Electricity and Electronics** **content -8 Checking Control settings/adjustments**

8.1 Household appliance tasks, controls and displays

This section provides a high level task analysis of the types of tasks performed for a range of household appliances, with examples for each, and suggests the types of controls and displays found on such appliances.

Task type	Example	Control or display types possible
1 Turn product on/off (without starting or stopping a process)	Turn on power to an appliance	•Switch (on plug point)

2 Review list of possible control options	Choose washing machine programme	•Menu list (text or icons)
3 Choose a control option (action may also start a process)	Select washing machine programme Select oven operation (oven, oven + fan, grill, both together)	•Knob (selection points) – may be latched (see definitions below) •Slider (selection points) •Push button (one per option)
4 Set a value (discrete scale)	Timer on microwave Timer on cooker	•Knob (with notches at value points) •Push button (setting buttons with display)
5 Set a value – continuous scale (action may also start a process)	Heat level on oven Heat level on iron Thermostat level on boiler	•Knob (may be latched) •Slider
6 Start/stop a process	Set kettle to boil Set toaster going Stop toast burning Ignite a gas flame	•Knob •Switch •Push button (may have light or latch) •Slider (may have latch)
7 Control a flow	Control gas flame on hob	•Knob (continuous selection) •Slider (continuous selection)
8 Perform instantaneous action	Water spray on iron Ignite gas hob	•Push button
9 Check operation in progress	Kettle started boiling Oven still cooking	•Simple LED light indicator (in addition to any auditory feedback)
10 Check progress through an operation	Check if dishwasher or washing machine cycle near completion	•LED numeric display shows progress (time left) •Knob position (In addition to any auditory feedback)
11 Be alerted that process finished	Microwave cooking finished Washing machine cycle finished	•Auditory warning •Simple LED indicator goes off •Flashing light •LED numeric display value reaches zero
12 Closing/opening an appliance door	Door of washing machine Door of tumble drier	•Catch which requires handle to be lifted and pulled to open door.
13 Testing alarm	Testing smoke, CO2 or water overflow alarm	•Button on alarm device

14 Turning off alarm	Turning off CO2 or water overflow alarm	•Button on alarm device. (Note: Normally device only turns off when hazard stops being detected i.e. smoke clears.)

table 1: Tasks, Controls and Displays

A **push button** returns to its 'out' position after being pressed.
A **latch button or latch knob** stays 'in' after pressing and is released when pressed again.
A **latch slider** has two positions 'released' and 'latched'. When it is slid to the latched position it stays in this position until the process is finished when it automatically releases. Alternatively it may be released by an interrupt button or by pushing the slider out of the latched position. This control is often used with a toaster appliance as the process of moving the slider down to the latched position also lowers the base that the toast is resting on into the toaster.
An **LED numeric display** (light emitting diode) shows numeric values (e.g. time left or program number).
A **simple LED** indicator is a single light that is either on or off. LED may be in one of a range of colours e.g. red, green, yellow, and appear bright against a black background. In future, appliances may have small black and white or colour LCD (liquid crystal display) equivalent to that on a
portable games console or mobile phone.

Control types for specific variables

table 2 below provides some high level guidance on the type of control recommended for a range of variables, drawn together from previous studies at the Loughborough Design School. For large force application, there are no controls suitable, as hand levers etc. are unlikely to be required for household
appliances. (Please note that the contractors make a distinction between a hand lever and a lever on a toaster, which would be considered a slider or latch slider.) Hand levers may nevertheless be an appropriate solution for some controls, for example, gross body actions are utilized to operate a salad
spinner. This avenue could be explored by designers to apply to other operations. To enable a better feel for the types of controls and common dimensions being used in today's household appliances, a quick survey was also undertaken of a range of appliances. This provided a 'reality check' and further contextualization of values found in the literature in order to make a more informed choice where values conflicted. A selection of these photos is given below in Figure 1. The list of control types is not meant to be comprehensive. For example, buttons or sliders (a linear control) could be latched, or may be used with an indicator light to give a visual cue of position. Controls with lights to indicate
status are not suitable for those with visual impairment, but latched buttons would indicate status in both tactile and visual terms. For a control to be free from inadvertent action is context dependant and is likely to be a relative term, unless further protective solutions are also in use, such as latch covers or
interlocks. It is unlikely that we can increase usability whilst eliminating inadvertent action completely. The list, therefore, suggests the range of variables that should be considered

and ways of accommodating them. This section does not suggest a particular type of control for an individual appliance, but only for a particular variable, such as the types of controls to consider when quick operation is required. other types of controls may indeed be used, e.g. remote controls or multimode controls (a single control that regulates all functions), all of which can be challenging for, or simply not wanted by, older and disabled people. It is suggested in Section 8 that further investigation be conducted on contact area and feedback for touch screen and membrane buttons or objects, as well as
the upcoming area of remote control of household appliances. There are likely to be other control mechanisms and future developments that require consideration, but these would be outside the scope of the current research project.

Key - (clear = poor, half-filled = acceptable, filled = good)

Variable	Push button	Toggle	Rocker	Slide switch	Thumb wheel	Finger knob	Finger lever
Large force application	○	○	○	○	○	○	○
Quick operation	●	●	●	◑	○	◑	◑
Small space requirement	●	●	●	●	●	◑	◑
Free from inadvertent action	○	○	◑	◑	○	●	○
Visual cue of position	○	●	◑	●	○	◑	●
Tactile cue of position	○	●	●	●	○	○	◑
Shape coding possibility	◑	○	○	○	○	●	●
Integral legends or symbols	●	○	●	●	○	○	○
Colour coding possible	●	●	●	●	●	●	●
Integral illumination	●	○	◑	○	○	○	○
Weather proofing	◑	○	○	○	○	●	●
Oil proofing	●	○	◑	○	○	●	●
Ease of operation with gloves	●	●	◑	○	○	◑	◑
Check reading array of like controls	○	●	◑	●	○	○	●
Simultaneous use of two like controls	●	●	●	●	◑	◑	●

table 2: Control types for specific variables

Toaster with push buttons and bar knob Latch slider with knob and push buttons

Figure 1: Selection of kitchen appliance controls used for comparison with guidelines

Self-Check -8	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, A push button returns to its ‘out’ position after being pressed. *(3 pt each)*

.A, true *B,* false

2, An LED numeric display shows numeric values (e.g. time left or program number). *(3 pt each)*.A, true *B,* false

3. A latch slider has two positions ‘released’ and ‘latched’. *(3 pt each)* A, true *B,* false

.

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-9	**Basic Electricity and Electronics** **content -9 Documenting Results of diagnosis and testing**

9.1 Documenting Results of diagnosis and testing

Documentation

The organizational Unit is to keep testing and inspection records which are to be stored on a shared system drive.

Record to be kept by:	Organisational Unit, Academic Unit
Records	Records of inspection and testing of electrical equipment, including: • register of all electrical equipment • record of formal inspection and tests • repair register and • record of all faulty equipment showing details of services or corrective actions.
To be kept for:	Records should be kept in alignment with the Records Management Policy and Guidelines

Table 1

- Complete, accurate, and current documentation is essential to an effective maintenance program. Whether performing preventive, predictive, or reliability centered maintenance, keeping track of equipment condition and maintenance—performed and planned—is critical.
- Maintenance recommendations contained in this volume should be used as the basis for establishing or refining a maintenance schedule. Recommendations can be converted into Job Plans or Work Orders in MAXIMO or another maintenance management system. Once these job plans and work orders are established, implementation of well-executed maintenance is possible.
- The maintenance recordkeeping system must be kept current so that a complete maintenance history of each piece of equipment is available at all times. This is important for planning and conducting an ongoing maintenance program and provides documentation needed for the Power O&M Reviews .
- Regular maintenance and emergency maintenance must be well documented as should special work done during overhauls and replacement. The availability of up-to-date drawings to management and maintenance staff is extremely important. Accurate drawings are very important to ongoing maintenance, testing, and new construction; but they are essential during emergencies for troubleshooting. In addition, accurate drawings are important to the continued safety of the staff working on the equipment.

Self-Check -9	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1 Regular maintenance and emergency maintenance must be well documented asshould special work done during overhauls and replacement.*(3 pt) A ,true B, false*

2, The organizational unit is to keep testing and inspection records which are to be stored on a shared system drive. (*3 pt) A ,true B, false*

3. Maintenance recommendations contained in this volume should be used as the basis for establishing or refining a maintenance schedule. (*3 pt)*

A, true B, false

Note: Satisfactory rating 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-10	**Basic Electricity and Electronics content -10 Advising/informing Customers regarding the status and serviceability**

10.1 Introduction

When most people think of a the equipment technician, they don't jump to anyone in the service department first. Service advisors come from all over: they could be former technicians or people who love to communicate with others, mixed with a passion for cars. Success in the service department can lead to promotion within the company or the equipment because there are clear measurable outcomes that are easy to track. Service advisors exist to facilitate sales within a repair facility, and their job is to push additional sales. However, the job title is service, so there is a whole other layer to the field. Service advisors are also viewed in the repair facility or dealership as the main customer support line for customers. Strong customer support is often overlooked but is sometimes the key to making sales. Their role is to provide customers with a trustworthy place to bring their equipment and to create a long-term relationship with customers. Once the bond between customer and service department has been successfully created, the advisor is able to use the tools provided to create a mutually beneficial bond for both parties. This isn't done by guessing or using lingo to convince customers. Instead, successful dealerships use extensive inspection and diagnostic-based selling to ensure accurate repairs for customers' needs and recommendations that make sense for their machines.

Create the Repair Order

After all the information has been gathered, the service advisor returns with the customer to the advisor's desk in the service department. At this point, the advisor takes all of the information gathered to generate a repair order, which is the beginning of the record stored in the computer system. The repair order is the document used to authorize the work being requested by the customer and any additional recommendations they have approved. After this has been generated, the next step is to give an accurate cost estimate to the customer and let them review the repair order.

After the initial part of the service agreement has been completed, the service advisor is then responsible for ensuring that the customer is aware of a timeline for the repair and for gathering appropriate contact information. Once the repair has been authorized the communication and relationship building continues throughout the service process between the advisor and the customer. For example, if the advisor were to tell the customer that the repair will be done right away, but the car is in the shop for the entire day, the advisor would not be providing an accurate representation of the repair. Each instance is different:

Some customers may be in for only a routine oil change and may opt to wait for the vehicle to be repaired. That is why it is crucial to provide accurate repair estimates with timelines, So that there are no questions or flags raised that could affect how the customer trusts the Dealership.

Reporting a Diagnosis

Customers bring their machines into the service department for a variety of reasons: one of

the main reasons customers return to the dealership is that they want factory-certified technicians to diagnose their machines issues. Customers expect the dealership of their equipments to be the expert, and they understand that such expertise might come with a premium cost. Dealerships have this level of legitimacy typically as an assumption, something that local shops have to build up over time with their customer base.The service advisor is the main point of contact for the repair estimate. After the technician performs the multipoint inspection and diagnoses the vehicle, it is their job to gather the quote for necessary parts and hours to complete the job . They pass this information onto the advisor to call the customer and report their findings. This quote may also include other recommendations found by the technician during their diagnostic.

- Advising is used when an employee's problems impact performance and is intended to mitigate any further action, including formal disciplinary action. The employee should solve the problem and your role is to be positive, supportive, and encouraging in that process. (Refer to the Toolkit documents, "Counseling Your Employees, The 2-Minute Challenge" and "Counseling Your Employees, The Role of a Good Supervisor".)
  Advising customers depend on :-
  - How to safe from accidents
  - How to use equipments
  - How to safe the equipments rom aults
  - When/how to clean the equipments

Self-Check -10	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1 Advising customers depend on *(3 pt)*

A. How to safe from accidents
B. How to use equipments
C. How to safe the equipments roomfuls
D. When/how to clean the equipments E. all

2, Customers bring their machines into the service department for a variety of reasons(*3 pt)*

A , true B, false

3. After all the information has been gathered, the service advisor returns with the customer to the advisor's desk in the service department

A, true B, false

Note: Satisfactory rating 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation Sheet 1	Reassemble units Techniques

Techniques for reassembling units:

Step 1- wear PPE.
Step 2- select required tools and materials
Steps 3- reassembling units.
Step 4- testing reassembling units.

Operation Sheet 2	Final testing and cleaning

Techniques for Final testing and cleaning Service Completing:

Step 1-wear ppe
Step 2- Step3- select required tools and equipment.
Step 4- perform final test.
Steps 5- apply 5s.
Step 6- turn the equipment to normal position.

Operation Sheet 3	Completing maintain/repairing Service

Techniques for maintain/repairing Service Completing:

Step 1-wear ppe
Step 2-prepar work stations/equipments
Step3- select required tools and equipment.
Step 4- maintain and repair.
Steps 5- reassemble units.
Step 6- test.
Step7-applay 5

Operation Sheet 4	Disposing Waste materials

Techniques for Disposing Waste materials:

Step 1- wear PPE.
Step 2- prepare, tools and equipment’s depends on west type.
Steps 3- sort /identify wastes.
Step 4- dispose un necessary wastes.

LAP Test	Practical Demonstration

Name: _____ Date: _____
Time started: _____ Time finished: _____
Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour.

Task 1. Check electronically-controlled domestic appliances
Task 2. Pre-test procedure
Task 3. Identify System defect/fault symptoms
Task 4. Use testing instruments in accordance with user manuals and safety procedures
Task 5. Implement Proper troubleshooting procedures
Task 6. Test circuits
Task 7. Explain Identify defects and faults
Task 8. Check Control settings/adjustments
Task 9. Document Results of diagnosis and testing
Task 10. Advise/inform customers regarding the status and serviceability

List of Reference Materials

1 COFFEE MAKER KM 5260 ENGLISH
2 Medical Equipment Maintenance Manual Shower pan construction,
3 K to 12 Basic Education Curriculum Technology and Livelihood Education Learning Module
4 ELECTRICAL INSTALLATION MAINTENANCE 130 K to 12 – Technology and Livelihood Education
5 Managing electrical risks in the workplace
6 CENTRAL PUBLIC WORKS DEPARTMENT MAINTENANCE MANUAL
7 Grade 10GOP – Textbook Funds
8 7808-e-facts sheet technician
9 A Consumer's Guide to finding the right Energy Efficient Vacuum Cleaners

Basic Home/Office Electrical/ Electronic Equipment Servicing

Level II

Learning Guide -26

Unit of Competence: Maintain and Repair Electronically Controlled Domestic Equipment

Module Title: Maintaining and Repairing Electronically Controlled Domestic Equipment

LG Code: EELHOS2 M06 LO3-26

TTLM Code: EELHOS2 TTLM 0919v1

LO 3: Maintain/repair the unit

Instruction Sheet-1	Learning Guide #26

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: –

- Occupational Health and Safety
- Electro-static discharge (ESD) protection procedure
- Replacing Defective parts/components
- Soldering/mounting Repaired or replaced parts/components
- Performing Control settings/adjustments in conformity with service-manual specifications
- Performing Repair activity within the required timeframe
- Observing Care and extreme precaution during handling the unit/product as per procedures
- Cleaning with standard procedures

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Occupational Health and Safety
- Electro-static discharge (ESD) protection procedure
- Replace Defective parts/components
- Solder/mount Repaired or replaced parts/components
- Perform Control settings/adjustments in conformity with service-manual specifications
- Perform Repair activity within the required timeframe
- Observe Care and extreme precaution during handling the unit/product as per procedures
- Clean with standard procedures

Learning Instructions:

13. Read the specific objectives of this Learning Guide.
14. Follow the instructions described below 3 to 6.
15. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5, Sheet 6 , Sheet 7 , Sheet 8 respectively.
16. Accomplish each of the “Self-check 1, Self-check 2, Self-check 3 ,Self-check 4 and Self-check 5, Self-check6, Self-check7, Self-check8”respectively.
17. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 Operation Sheet 3, Operation Sheet 4, Operation Sheet 5, Operation Sheet 6 Operation Sheet 7 and Operation Sheet 8, ”
18. Do the “LAP test”

Information Sheet-1	Basic Electricity and Electronics content -1 Occupational Health and Safety

1. **Occupational Health and Safety**

Occupational Safety and Health (OHS) is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goal of all occupational safety and health programs is to foster a safe work environment. As a secondary effect, it may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are impacted by the workplace environment. It may involve interactions among many subject areas, including occupational medicine, occupational (or industrial) hygiene, public health, safety engineering / industrial engineering, chemistry, health physics.

Risks include acute and chronic health effects, for example, irritation or cancer, and physical effects such as fires or explosions. The hazards are physical and health hazards.

A **hazard** is something that can cause harm, eg electricity, chemicals, working up a ladder, noise, a keyboard, a bully at work, stress.

Risk is the chance or probability that a person will be harmed or experience an adverse health effect once to a hazard. It may also apply to situations with property or equipment loss. sA risk is the chance, high or low, that any hazard will actually cause somebody harm.

Figure 1

For example, working alone away from your office can be a hazard. The risk of personal danger may be high. Electrical repair is a hazard. If someone accidentally turned on the power the worker's life will be in a 'high-risk' category

II. Risk assessment

A. Risk assessment is the process where you:

1. identify hazards
2. analyze or evaluate the risk associated with that hazard
3. determine appropriate ways to eliminate or control the hazard

B. Factors that influence the degree of risk include:

- how much a person is exposed to a hazardous thing or condition
- how the person is exposed (e.g., breathing in a vapor, skin contact), and how severe are the effects under the conditions of exposure

Self-Check -1	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, **(OHS)** is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. *(3 pt each)*A, true B, false

2, **Risk** is the chance or probability that a person will be harmed or experience an adverse health effect once to a hazard.*(3 pt each)*A, true B, false

3 . Write the methods risk assessment*(3 pt each)*

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

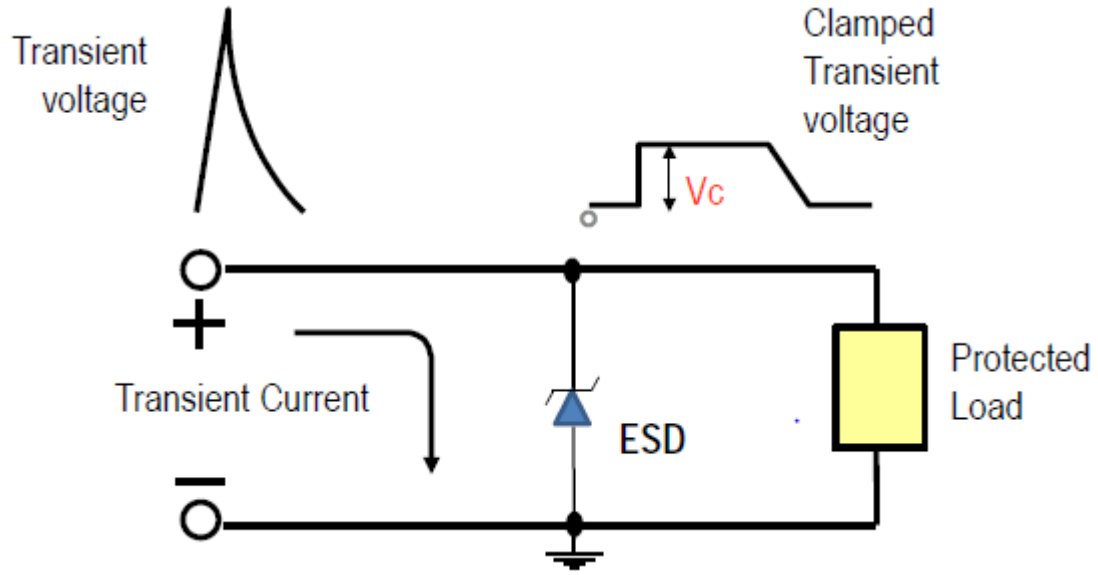
Information Sheet-2	**Basic Electricity and Electronics** **content -2** Electro-static discharge (ESD) protection procedure

2.1 Introduction to electrostatic discharge

What is ESD? Electrostatic Discharge is a high voltage event from the release of electrical energy caused by static electricity or electrostatic induction.

ESD can cause permanent damage to electronics and integrated circuits.

ESD Principle Protect the IC by suppressing incoming transient voltage to an acceptable level (Output of Vc: Clamping voltage).



2.2. Types of ESD

1) **Sparks** – A spark is triggered when the electric field strength exceeds approximately 4-30kV/cm. This may cause a very rapid increase of free electrons and ions in the air, temporarily causing the air to abruptly become an electrical conductor. eg, lightning.

2) **Corona discharge** – A corona discharge occurs between a highly curved electrode (eg, tip of pen) and an electrode of low curvature (eg flat plate)

3) **Brush discharge** – A brush discharge occurs between an electrode with a curvature between 5mm and 50mm and a voltage of about 500 kV/m. The resulting discharge paths have the shape of a brush.

ESD Simulations

There are three models for assessing the survivability/susceptibility of electronic devices to ESD:

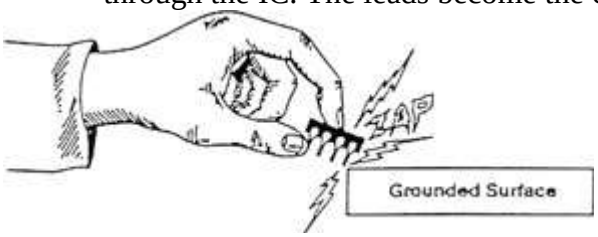
1)Human Body Model, HBM

2)Machine Model, MM

3)Charged Device Model, CDM

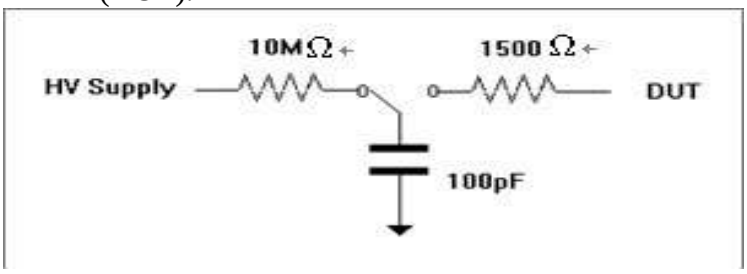
Human Body Model - HBM

- Simulates ESD from human contact.
- A person accumulates static electricity from walking or moving and discharges the static through the IC. The leads become the conductive path to a grounded surface due to contact.



- HBM (Human Body Model) test circuit simulates ESD from human contact and consists of 100pF and 1.5KΩ to simulate the equivalent capacitance and resistance of a human body.

- The capacitor is charged to a predetermined high voltage from an external source, and then suddenly discharged through the resistor into an electrical terminal of the device under test (DUT).



: Human Body Model (HBM) test circuit

Machine Model - MM

This simulates the discharge of static electricity accumulated from machines and equipment (i.e. moving mechanical arms, test probes, etc.)

The test circuit consists of charging a 200pF capacitor to a predetermined high voltage from an external source, and then suddenly discharging the DUT through an electrical terminal.

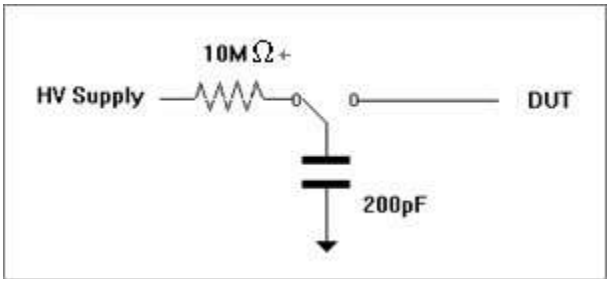


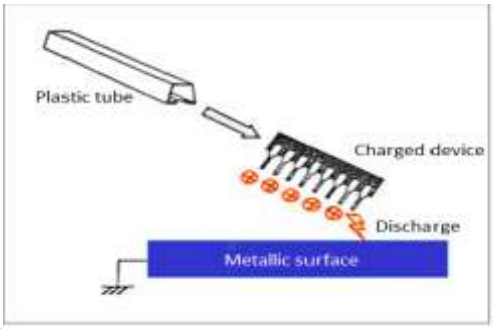
Fig: Machine Model (MM) test circuit

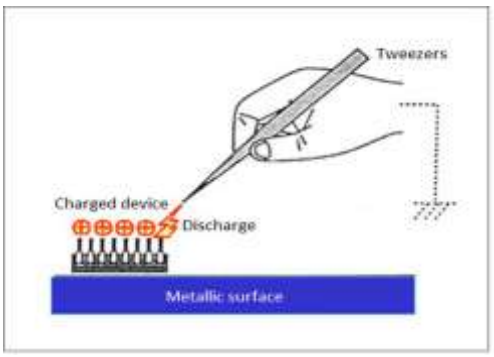
Charged Device Model – CDM

- The CDM test simulates how the device acts when the device itself has an electrostatic charge and the effects of the discharge when it comes in contact with a metallic surface. This type of discharge is the most common type of ESD in electronic devices and is the main cause of ESD damage during the manufacturing process.
- CDM discharge depends mainly on parasitic parameters of the discharge and is strongly dependent on the size and type of component package.

CDM Scenario :

When the IC slides from the packaging tube, friction causes static to form on the device. The IC discharges as the terminals contact a grounded surface (i.e. metal table), or whenthe part is picked up with metallic



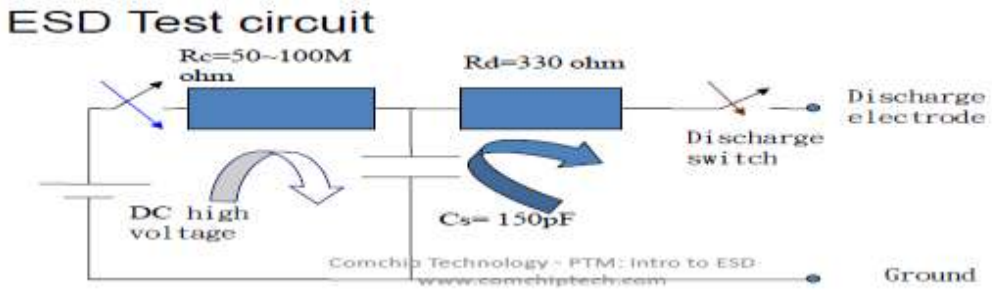


tweezers

2.3 Electrostatic discharge testing (CDM)

Simulates ESD in a charged device at 150pF and 330Ω.

The capacitor is charged to a specific high voltage from an external source, and then suddenly discharged through the resistor into an electrical terminal of the device under test (DUT).



IEC – International Electro technical Commission: standards & specifications
61000: Electromagnetic Compatibility (EMC)
Parts 1, 2, & 3: General, Environment, Limits
Part 4: Testing & Measurement Techniques
4-2: Electrostatic Discharge Immunity
4-3: Radiated, RF, Electromagnetic Field Immunity
4-4: Electrical Fast Transients/Burst Immunity
4-5: Surge Immunity

IEC61000-4-2 is the series of specifications used to test the susceptibility of electronic devices to ESD.

-Embodies the guidelines and requirements for the test cell geometries, generators, test levels, discharge rate and waveform, types and points of discharge, and functional criteria for gauging product survivability.

Purpose: to establish a benchmark for testing

-Testing methods and standards are set for Direct Discharge and Air Discharge.

Contact Discharge

Discharge via contact with a conductor. Preferred test method; more stringent.

Air Discharge

Discharge without direct contact and used only in special circumstances. For example, when the metal (conductive) part of a remote control is covered in insulation.

Contact discharge test

In the contact discharge test, direct discharges should be applied to all points accessible to the operator during normal use. For example: keyboard controls, display monitor, knobs, power cords, etc.
Before choosing a discharge point, test susceptible areas 20 times per second, then test selected area using 10 discharges.

ESD Protection Procedure

1. Anti-static kit can be purchased from a computer or electronics store. The main component is an ESD wrist strap with a wire several feet long having an alligator clip at the other end.
2. Before troubleshooting any domestic appliance, wear an ESD wrist strap and wear it as you go under the covers, handle ICs, and circuit boards.
3. Put the adjustable strap around your wrist. If you are wearing an ESD wrist strap connected to frame or ground, it drains static charges of your body, thus, it prevents damaging ESD sensitive devices.
4. Attach the clip at the end of the wire to an electrical ground connection or metal framework of the washing machine.
5. If you work on a washing machine without a conductive wrist strap, touch an electrical appliance such as a lamp or the screw in a wall outlet cover plate before touching the PCB. An electrostatic discharge of just a few hundred volts is too small to feel in most cases but can be usually deadly to ESD sensitive devices. Also avoid wearing clothes that easily produce a static charge, such as knits and wools and limit your movements as much as possible, especially on carpets while working on electronic circuits of a washing machine.

Self-Check -2	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, Testing methods and standards are set for Direct Discharge and Air Discharge.

*(3 pt each)*A, true B, false

2, **What is ESD?** Electrostatic Discharge is a high voltage event from the release of electrical energy caused by static electricity or electrostatic induction.

*(3 pt each)*A, true B, false

3 . three models for assessing the survivability/susceptibility of electronic devices to ESD*(3 pt each)*

A. Human Body Model, HBM

B. Machine Model, MM

C. Charged Device Model, CDM

D. all

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	**Basic Electricity and Electronics** **content -3** Replacing Defective parts/components

3. Replacing Defective parts/components

The learner demonstrates an under sanding of the concept in maintaining and repairing the following domestic appliances

A. Washing Machines and Driers
B. Refrigerators
C. Vacuum Cleaners and Polishers
D. Home Food Processing equipment
E. Rice Cooker
F. Blender, coffee maker
G. Toaster, waffle maker
H. Microwave Oven
I. Electronic Clock
J. Flat irons and presses
K. Rechargeable Light
L. Electronic controlled Light
M. Security equipment
N. Remote Control Appliances
O. Air conditioner

3.1 Refrigerators

DEFINITION:-Refrigeration is the process of removing heat from an enclosed space, or from a substance, to lower its temperature. A refrigerator uses the evaporation of a liquid to absorb heat. The liquid, or refrigerant, used in a refrigerator evaporates at an extremely low temperature, creating freezing temperatures inside the refrigerator.

PURPOSE OF REFRIGERATION:-The fundamental reason for having a refrigerator is to keep food cold. Cold temperatures help food stay fresh longer. The basic idea behind refrigeration is to slow down the activity of bacteria (which all food contains) so that it takes longer for the bacteria to spoil the food.

3.1.1 Operation Principle of Refrigerator

- **Principle**
  - It cools stored food by rotating the fan motor to circulate cold air generated from evaporator.
- **Characteristics**
  - Do not need to remove frost.
  - Can cool fast.
  - Use the fan motor to cool the freezer and cool chamber.
  - Used for households

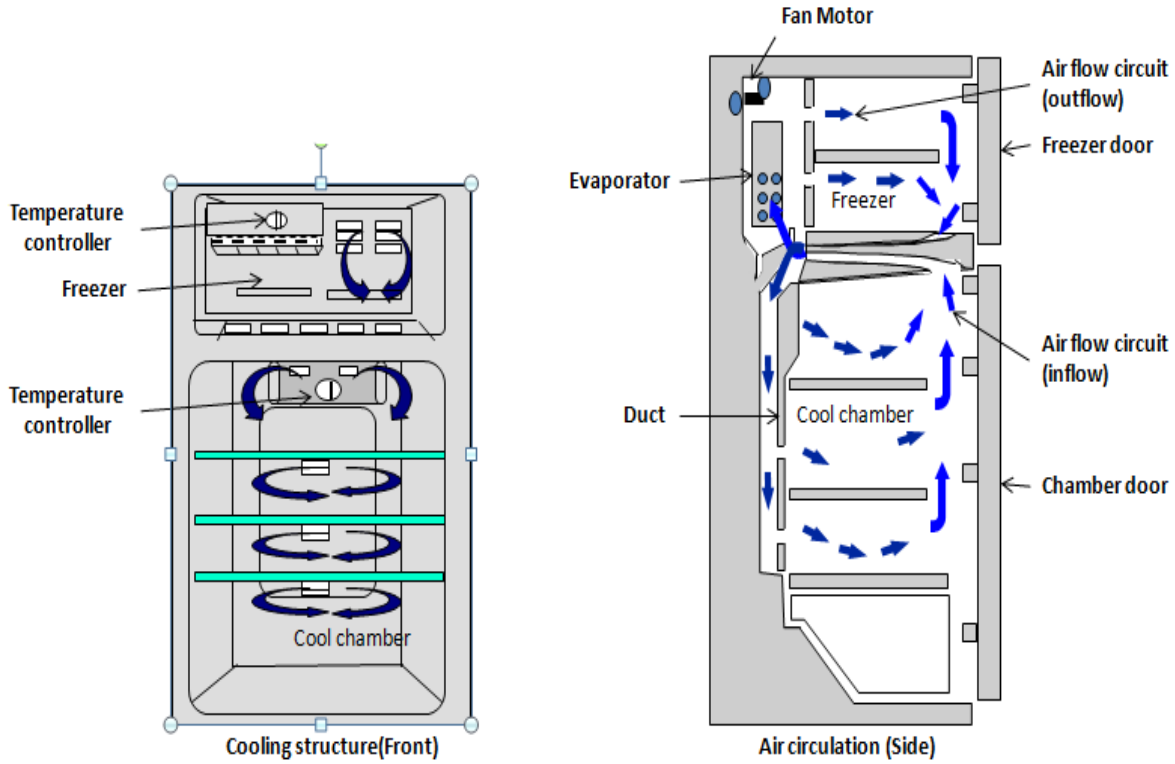


Figure 1

I Understanding refrigeration cycle

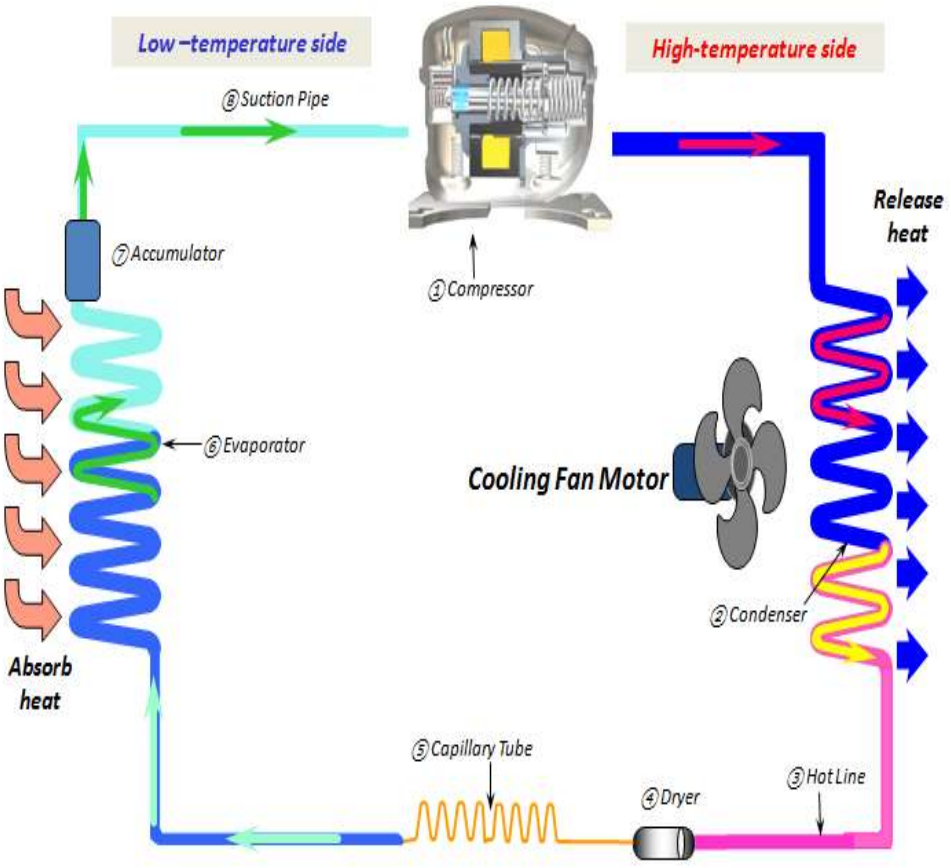


Figure 2

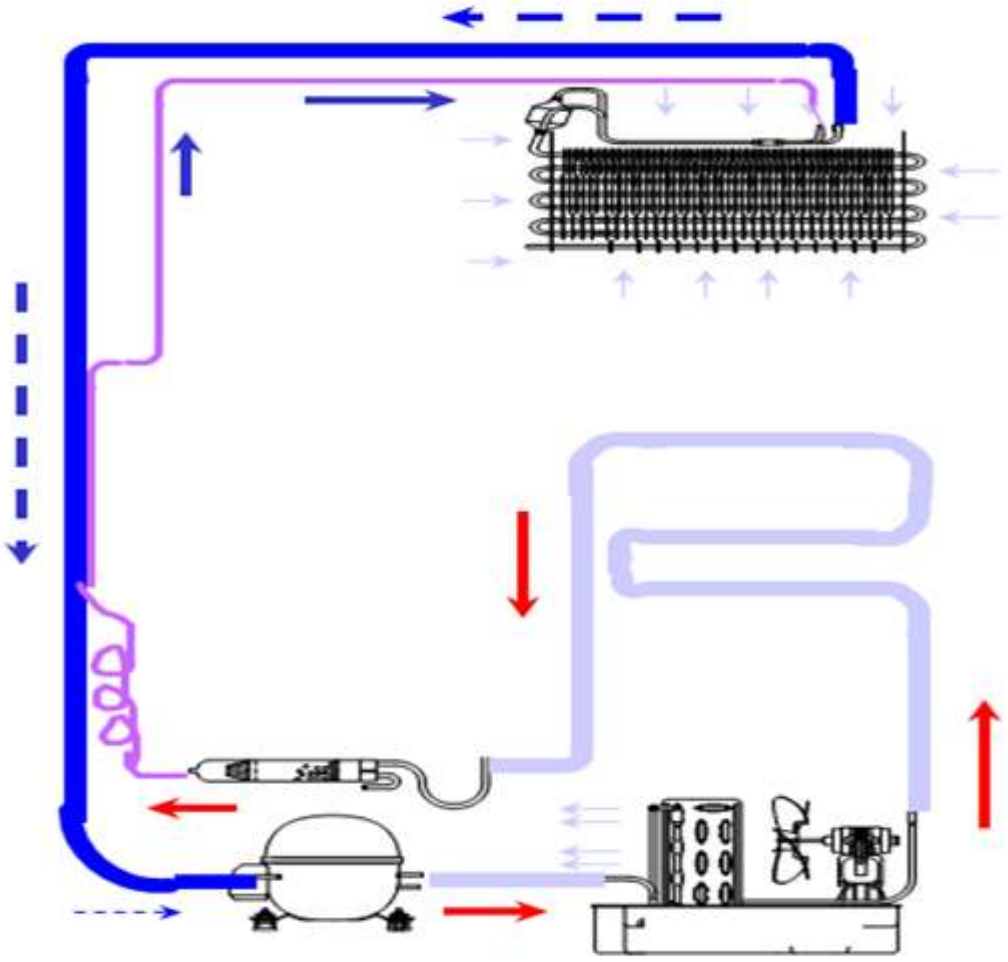


Figure3

- *Compressor absorbs low-temperature/low-pressure refrigerant gas, compress it to high-temperature/high-pressure refrigerant gas and send it to condenser*
- *In Condenser, high-temperature/high-pressure refrigerant gas exchange heat to make it into liquid type refrigerant of high-temperature/high-pressure*
- *In Hot line, fluid type refrigerant of high-temperature/high-pressure flows through inside of case foam where gasket is stuck and prevents creation of dewdrops*
- *Dryer eliminates impurities or moisture until fluid type refrigerant of high- temperature/high-pressure flows through*
- *Capillary Tube makes fluid type refrigerant of high-temperature/high-pressure into fluid type refrigerant of low-temperature/low-pressure*
- *Evaporator makes fluid type refrigerant of low-temperature/low-pressure into low temperature/low-pressure refrigerant gas by exchanging heat*
- *Accumulator makes remaining fluid type refrigerant of low-temperature/low pressure into low-temperature/low-pressure refrigerant gas*
- *Suction Pipe helps low-temperature/low-pressure refrigerant gas from Evaporator move to Compressor*

II. Cycle components/COMP

1 Role

- Inhale low-temperature/low-pressure refrigerant gas → Compress it to high-temperature/high-pressure gas → Send it to condenser

2 Operation principle

- Compress by using straight line motion of a linea motor and low speed changes

3 Malfunction

- Cooling system does not work at all
- Compressor has power on but does not work

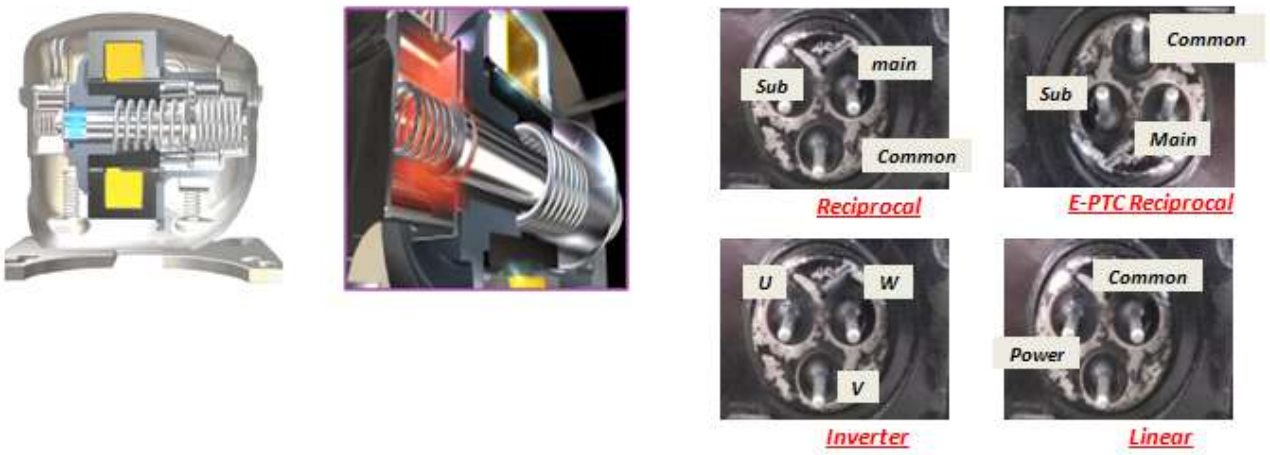


Figure 4

II. Cycle components/CONDENSOR

1 Role

- Device that turns high-temperature/high-pressure refrigerant gas to fluid texture using exchange of heat

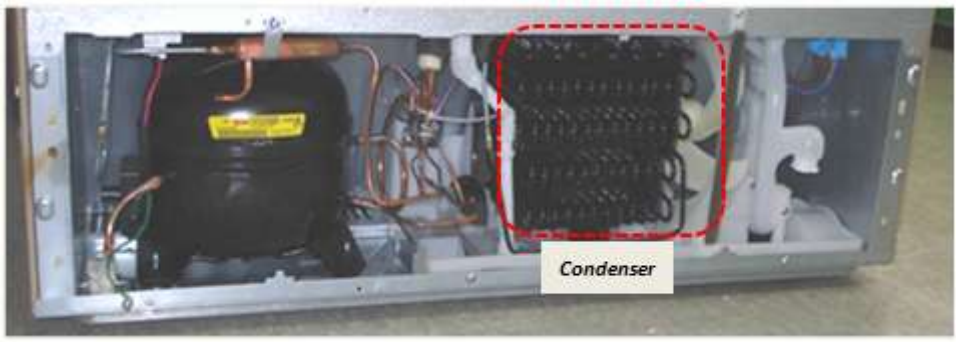


Figure 5

2 Operation principle

- High-temperature/high-pressure refrigerant gas exchange heat with the atmosphere very fast by Cooling fan

3 Malfunction

- when cooling fan is defective, temperature of refrigerator increases
- when cooling fan is defective, O.L.P component operates and intercept the power of compressor

II. Cycle components/ Capillary Tube

1 Role

- Device that reduces the flow of fluid type refrigerant with high-temperature high-pressure and turn them into low-temperature /low-pressure

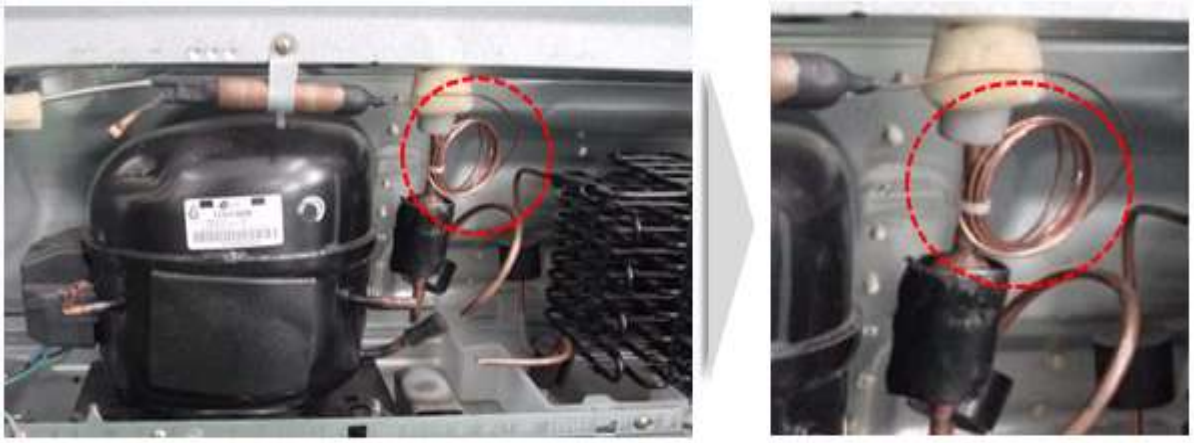


Figure 6

2 Operation principle

- It is made with very thin and long pipe
- Friction helps to make refrigerant evaporate

3 Malfunction

- Impurities or clogged water might cause a defective of gas flow

II. Cycle components/ Evaporator

1 Role

- With an exchange with air inside refrigerator, fluid type refrigerant of Low-temperature/low l pressure turns into gas type

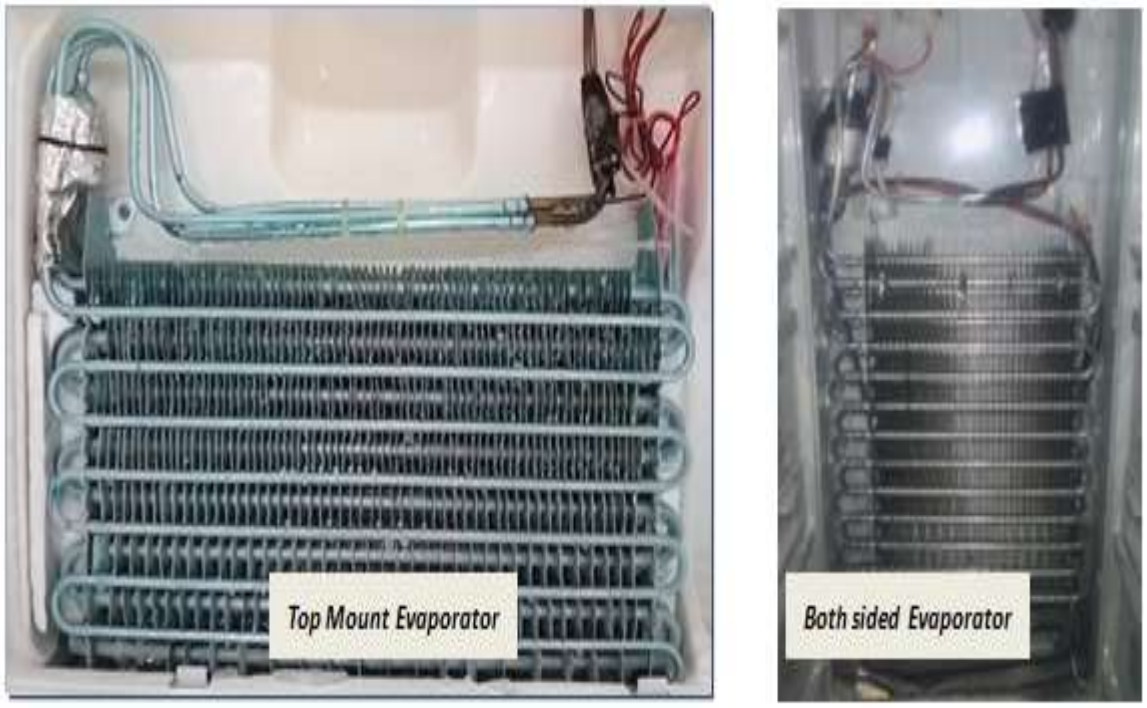


Figure7

2 Operation principle

- Fluid type refrigerant of low-temperature/low-pressure absorbs heat that are around and makes the inside temperature low

3 Malfunction

- When freezer fan motor is defective, temperature of refrigerator and freezer can increase
- When freezer fan motor is defective, food inside refrigerator can get frozen

II. Cyclic Components/ Main PCB

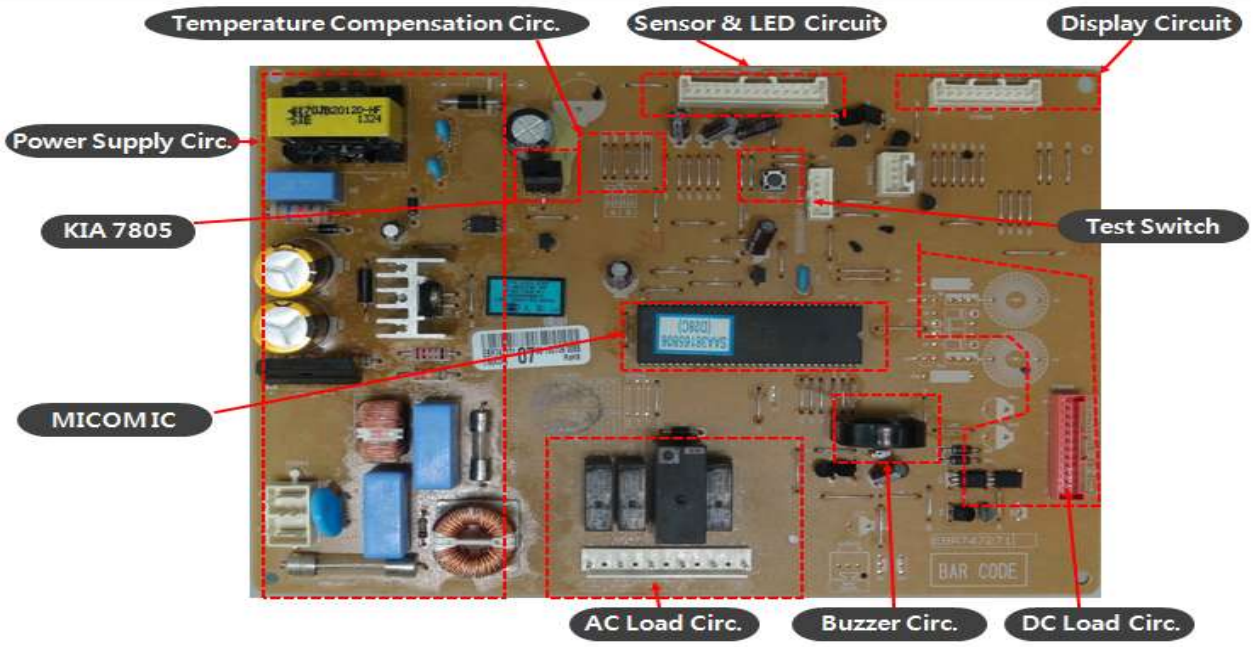


Figure 8

II. Components/ Sensor& Lightning

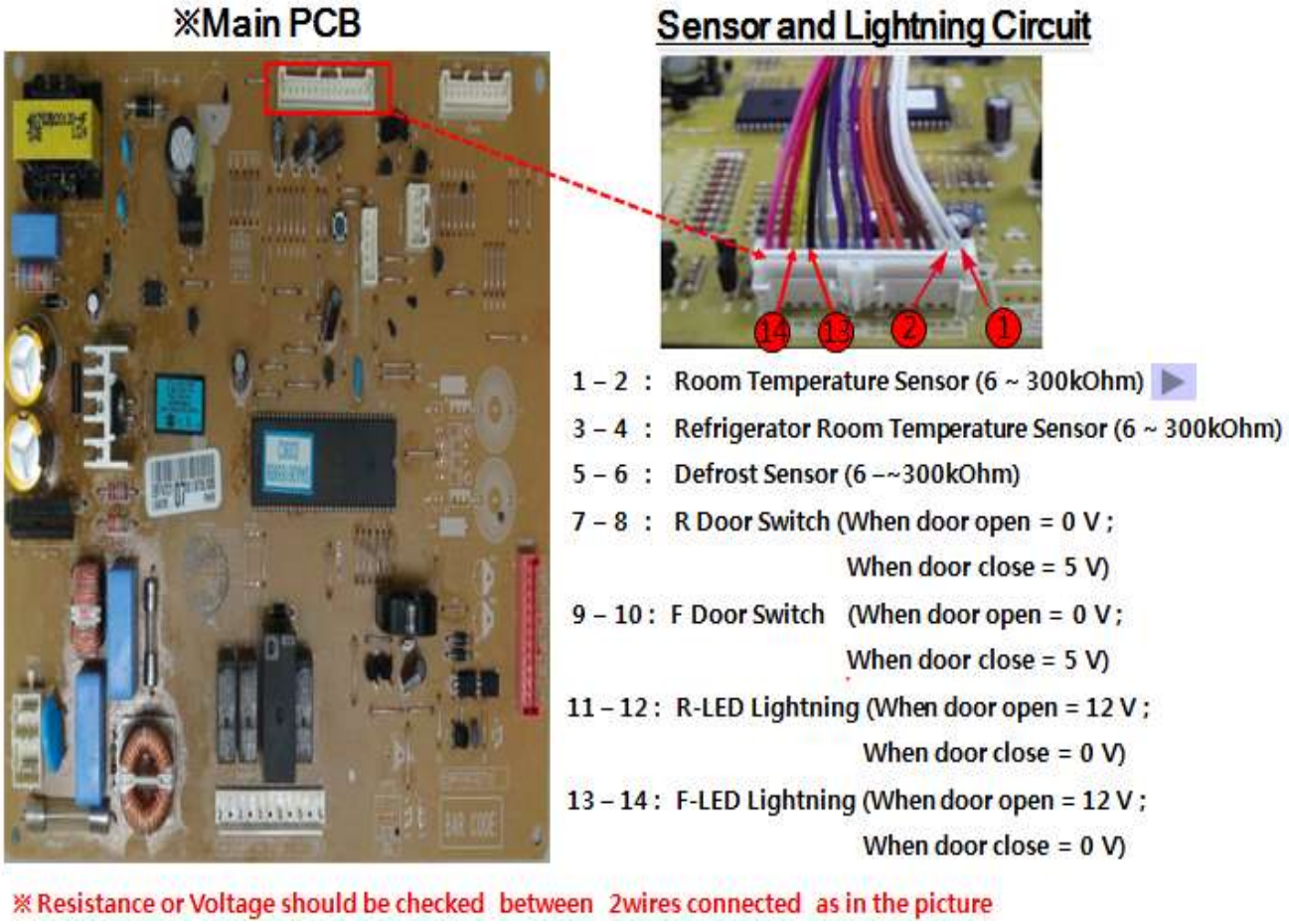


Figure 9

II. Components/ AC Connector

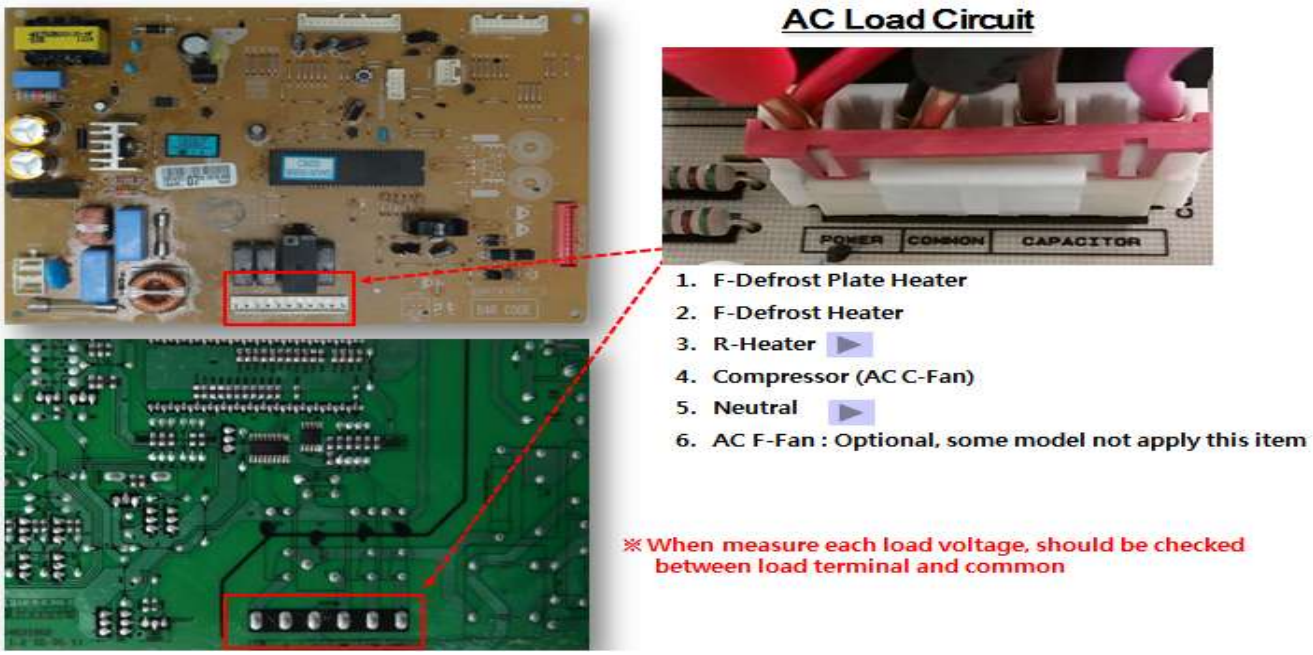


Figure 11

II. Components/ AC Connector

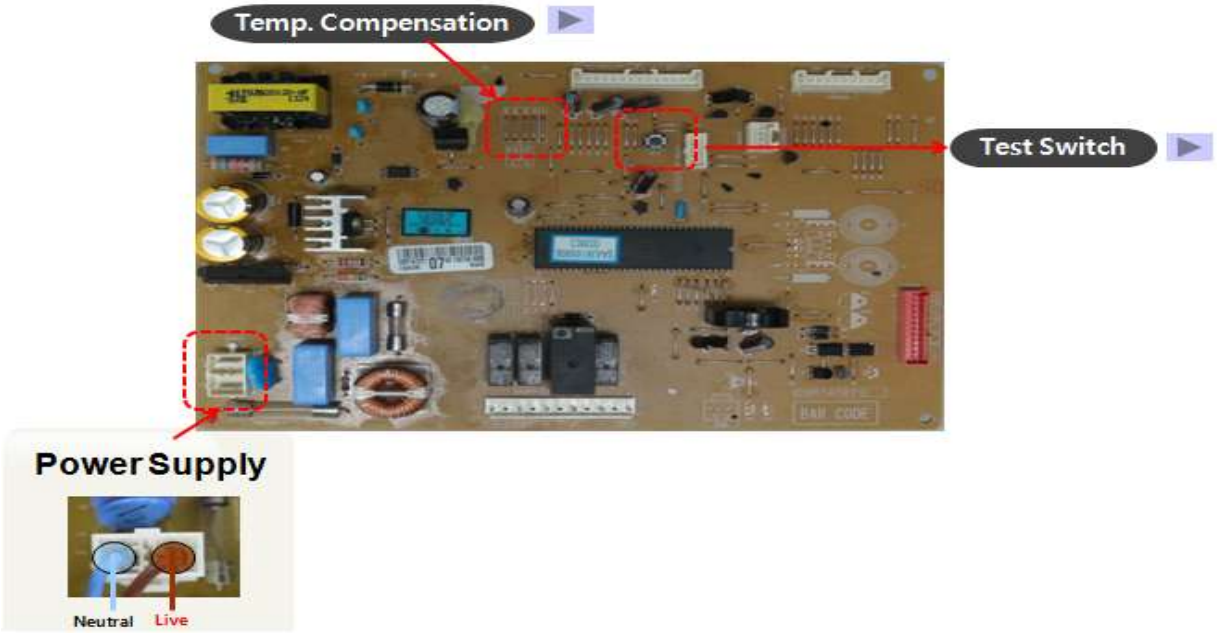


Figure 12

II. Display PCB functions

E-MICOR M DISPLAY FUNCTION

- CHILD LOCK

Press and hold CHILD LOCK button for 3 seconds to activate CHILD LOCK function. When it's locked, the CHILD LOCK LED will be ON and the other will not operate. To unlock, press and hold CHILD LOCK button again for 3 seconds

- FAST FREEZING

When pressed, the compressor and circulating fan operate at maximum cooling capacity to quickly lower the refrigerator temperature. This mode shut off automatically after 30 min

- HYGIENE FRESH

* Press one time to activate Hygiene Fresh in auto mode.
* Press two times to activate Hygiene Fresh in power mode.
* RESET will happened at maximum 2 years product lifetime. If It's happened, change the Hygiene Filter and press the button for 5 seconds.

- REFRIGERATOR TEMPERATURE

✓Hygiene Model

Each time of the refrigerator key is pressed, the temperature display is counted down. (Max : 6°C , Min : 0°C)

6 → 5 → 4 → 3 → 2 → 1 → 0

✓No-Hygiene Model

Non Hygiene Filter model : Each time of the refrigerator temp' up or down key is pressed, the temperature display is counted up or down. (Max : 6°C , Min : 0°C)

6 ↔ 5 ↔ 4 ↔ 3 ↔ 2 ↔ 1 ↔ 0

Figure 13

II. Display PCB functions

❖I-MICOM DISPLAY

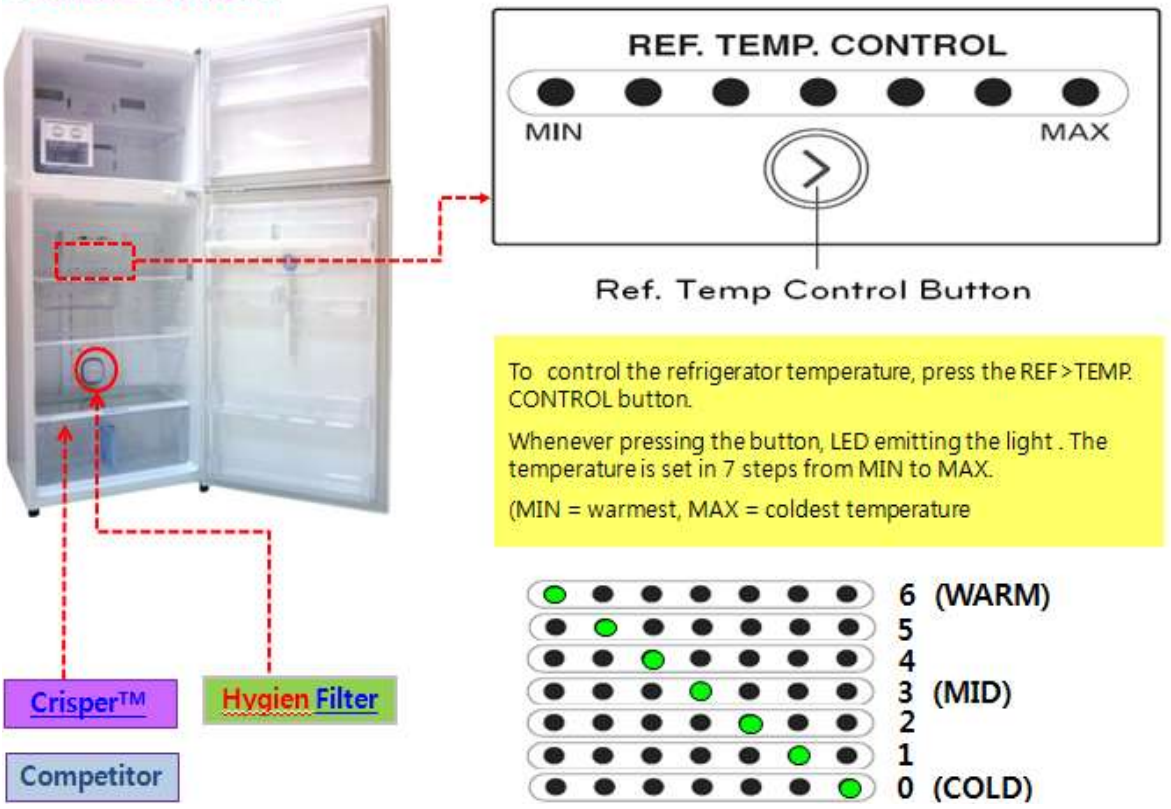
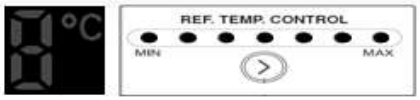


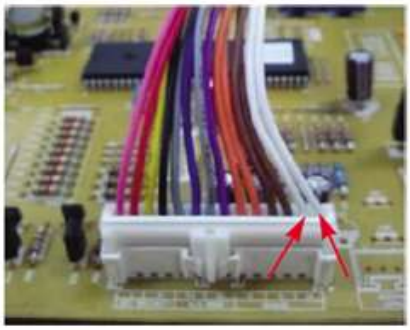
Figure 14

TROUBLESHOOTING

III Trouble shooting With Error Display

1) Room Temperature Sensor Error



No	Checking Flow	Result & SVC Action
1	Check L/Wire White to White 	Result: 0 Ω Short → Change the sensor Result: Infiniteohms Open → Check the resistance of the sensor wires back to the main PCB. if they are open between the main PCB and connector it will be necessary to replace the refrigerator Result: Other Normal → Check the Temp and resistance (Table-3)

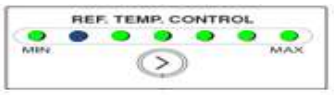
<Temperature table-1>

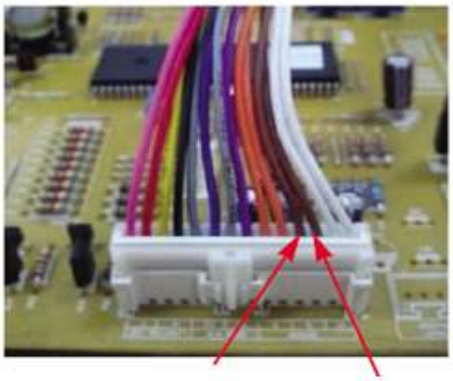
(1) To (2)	Result
23°F / -5°C	38 kΩ
32°F / 0°C	30 kΩ
41°F / 5°C	24 kΩ
50°F / 10°C	19.5 kΩ
59°F / 15°C	16 kΩ

Tip)The sensor is determined by the temperature. For example 30 KΩ Indicated 32°F / 0°C

III. Troubleshooting With Error Display

2) Refrigerator Temperature Sensor Error



No	Checking Flow	Result & SVC Action
1	Check for a loose connection	Make sure there is no loose connection
2	Check L/Wire Brown to Brown Resistance 	<Result & SVC Action table> <Temperature table-1> The sensor is determined by the temperature. For example 30 KΩ Indicated 32°F / 0°C

Result		SVC Action
0 Ω	Short	Change the sensor
Infiniteo hms	Open	Check the resistance of the sensor wires back to the main PCB. If they are open between the main PCB and connector it will be necessary to replace the refrigerator
Other	Normal	Check the Temp and resistance (Table-1)

<Temperature table-1>

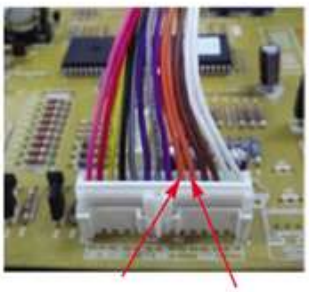
(1) To (2)	Result
23°F / -5℃	38 kΩ
32°F / 0℃	30 kΩ
41°F / 5℃	24 kΩ
50°F / 10℃	19.5 kΩ
59°F / 15℃	16 kΩ

The sensor is determined by the temperature. For example 30 KΩ Indicated 32°F / 0°C

Figure15

III. Troubleshooting With Error Display

3) Defrost Sensor Error (d)

No	Checking Flow	Result & SVC Action
1	Check for a loose connection	Make sure there is no loose connection
2	Check Orange to Orange Resistance 	<Result & SVC Action table> <Temperature table-2> The sensor is determined by the temperature. For example 23 KΩ Indicated -4°F / -20°C

Result		SVC Action
0 Ω	Short	Change the sensor
Infiniteo hms	Open	Check the resistance of the sensor wires back to the main PCB. If they are open between the main PCB and connector it will be necessary to replace the refrigerator
Other	Normal	Check the Temp and resistance (Table-2)

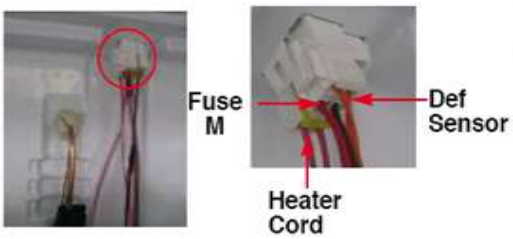
<Temperature table-2>

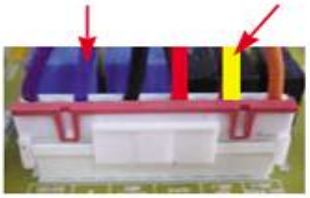
(1) To (2)	Result
-22°F / -30℃	40 kΩ
-13°F / -25℃	30 kΩ
-4°F / -20℃	23 kΩ
5°F / -15℃	17 kΩ
14°F / -10℃	13 kΩ
23°F / -5℃	10 kΩ
32°F / 0℃	8 kΩ

Figure 16

III. Troubleshooting With Error Display

4) Defrost Heater Error (H)

No	Checking Flow	Result & SVC Action
1	Check The Door Gasket	Make sure door gasket in good condition (not loose/ gap)
2	Check The Defrost Control Part 	Part / Result / SVC Action: Fuse-M: Short → Go to the 3; Open → Change Fuse M. Def Heater: 67 – 340 Ω → Go to the 3; Other → Change Def heater. Def Sensor: Short (0 Ω) → Change Sensor; Others → Check temp and resistance value; Open (Infinite) → Check resistance sensor wire to main PCB. If they are open, replace the product

No	Checking Flow	Result & SVC Action
3	Input Test 2 Mode (Push the Test Switch 2 times)	
4	Check Load Control (Yellow to Blue) 	Result: 100 ~ 240 V → Go to the 5; 0 V → Replace Main PCB

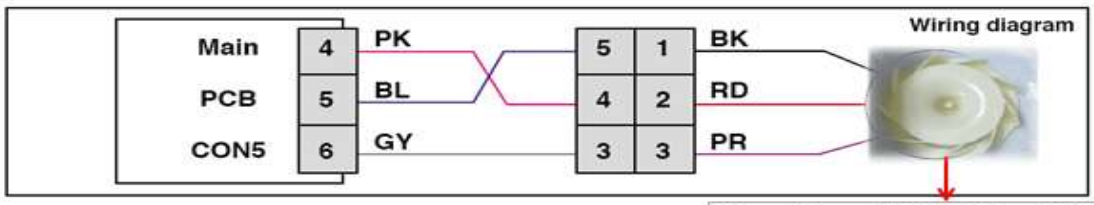
III. Troubleshooting With Error Display

No	Checking Flow	Result & SVC Action
5	Release the test mode, push the test switch 1 times (normal)	
6	Check Load Control (Yellow to Blue) 	Result: 0 V → Nomal; 100 ~ 240 V → Replace Main PCB

Figure 17

III. Troubleshooting With Error Display

5) Freezer BLDC Fan Motor Error



GVL/GVF

Normal speed 300RPM ↓ ~4,000RPM ↑

No	Checking Flow	Result & SVC Action
1	Input Test Mode 1	
2	Open the door freezer and check the air flow 	<table><tr><th>Status</th><th>SVC Action</th></tr><tr><td>airflow</td><td>Go to the 4</td></tr><tr><td>No airflow</td><td>Go to the 3</td></tr></table>

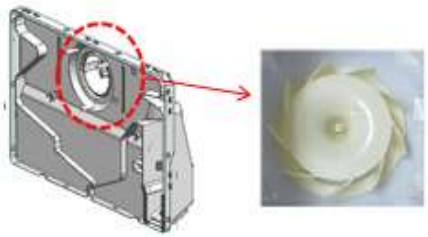
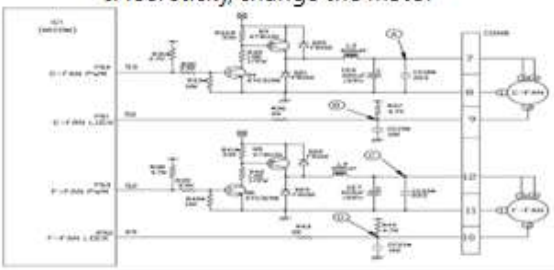
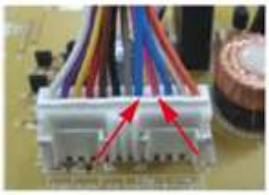
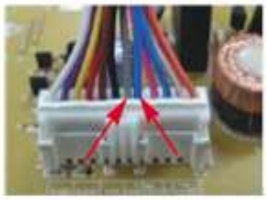
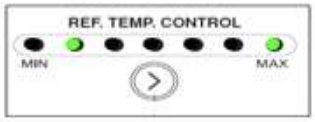
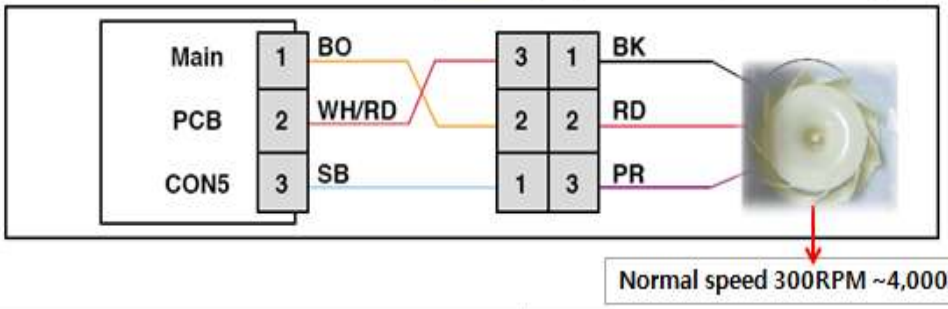
No	Checking Flow	Result & SVC Action
3	Check the fan motor, rotate it with your hand 	If feel sticky, change the motor 
4	Check fan motor voltage (PINK to BLUE) 	<table><tr><th>Status</th><th>SVC Action</th></tr><tr><td>8-15 Vdc</td><td>Normal</td></tr><tr><td>Other</td><td>Change the PCB</td></tr></table>
5	Check the fan motor feedback voltage (BLUE to GRAY) 	<table><tr><th>Status</th><th>SVC Action</th></tr><tr><td>1-4 Vdc</td><td>Normal</td></tr><tr><td>Other</td><td>Change the PCB</td></tr></table>

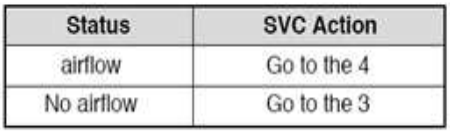
Figure 18

III. Troubleshooting With Error Display

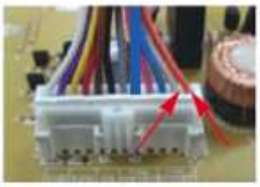
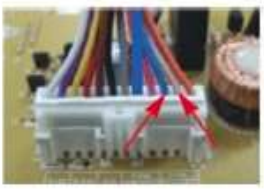
6) Cooling BLDC Fan Motor Error





No	Checking Flow	Result & SVC Action
1	Input Test Mode 1	
2	Check cooling fan 	

Status	SVC Action
airflow	Go to the 4
No airflow	Go to the 3

No	Checking Flow	Result & SVC Action
3	Check the fan motor, rotate it with your hand 	If feel sticky, change the motor
4	Check fan motor voltage (ORANGE to 	
5	Check the fan motor feedback volatage (WHITE/RED to SKY BLUE) 	

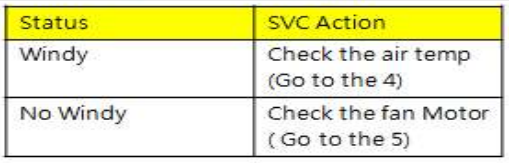
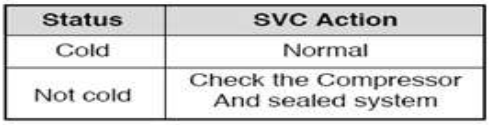
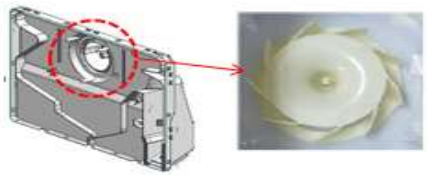
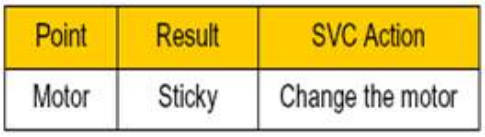
Status	SVC Action
8-15 Vdc	Normal
Other	Change the PCB

Status	SVC Action
1-4 Vdc	Normal
Other	Change the PCB

Figure 19

7) Less Cooling in Refrigerator Room

No	Checking Flow	Result & SVC Action
1	Check Brown to Brown Resistance 	 The sensor is determined by the temperature. For example 30 KΩ Indicated 32°F / 0°C
2	Reset the unit and input Test 1 Mode (Push the Test Switch 1 time)	

No	Checking Flow	Result & SVC Action
3	Open the freezer door and check the air flow 	
4	Check the air temperature. Cold or Not? Freezer sensor ↓ 0.3kΩ ~140kΩ ↑ Refrigerator sensor ↓ 1.7 kΩ ~400 kΩ ↑	
5	Check the fan motor. Rotate fan using your hand. 	

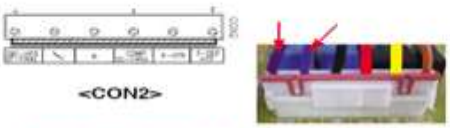
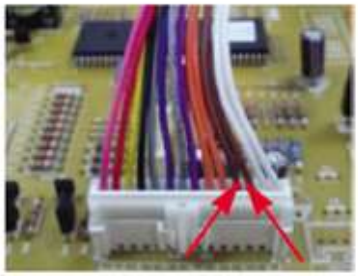
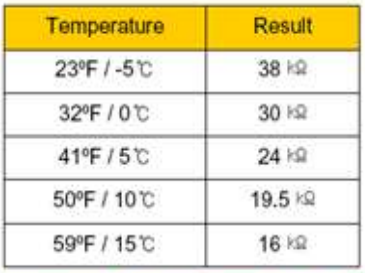
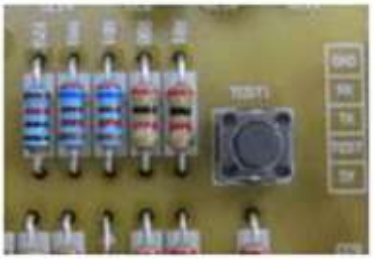
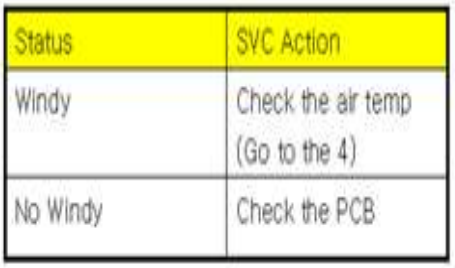
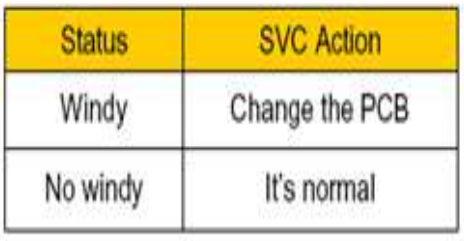
No	Checking Flow	Result & SVC Action
6	Check the fan motor voltage (Purple to Blue)  *only for model which have AC C-Fan type	

Figure 20

8) Over Cooling in Refrigerator Room

No	Checking Flow	Result & SVC Action
1	Check R-Sensor Resistance (Brown and Brown) 	 The sensor is determined by the temperature. For example 30 KΩ Indicated 32°F / 0°C
2	Reset the unit and Input Test 1 mode (Push the Test Switch 1 time)	

Temperature	Result
23°F / -5℃	38 kΩ
32°F / 0℃	30 kΩ
41°F / 5℃	24 kΩ
50°F / 10℃	19.5 kΩ
59°F / 15℃	16 kΩ

No	Checking Flow	Result & SVC Action
3	Open the freezer door and check the air flow 	
4	Input Test 2 Mode (Push the Test Switch 2 time Check the air flow 	

Status	SVC Action
Windy	Check the air temp (Go to the 4)
No Windy	Check the PCB

Status	SVC Action
Windy	Change the PCB
No windy	It's normal

Figure 21

9) Freezer Room LED doesn't work

No	Checking Flow	Result & SVC Action
1	Check the freezer door switch 	If feel sticky, change the door switch
2	Check the door switch resistance 	<table><tr><th>Status</th><th>Result</th><th>SVC Action</th></tr><tr><td rowspan="2">Normal</td><td>0 Ω</td><td>Go to the 3</td></tr><tr><td>Other</td><td>Change door S/W</td></tr><tr><td rowspan="2">Push S/W</td><td>Infinity</td><td>Go to the 3</td></tr><tr><td>Other</td><td>Change door S/W</td></tr></table>
3	Check RED to PINK 	<table><tr><th>Status</th><th>Result</th><th>SVC Action</th></tr><tr><td rowspan="2">Door Open</td><td>12 V</td><td>Normal, Go to 4</td></tr><tr><td>Other</td><td>Change the PCB</td></tr><tr><td rowspan="2">Door Closed</td><td>0 V</td><td>Normal, Go to 4</td></tr><tr><td>Other</td><td>Change the PCB</td></tr></table>

No	Checking Flow	Result & SVC Action
4	Check the Purple to Gray 	<table><tr><th>Status</th><th>Result</th><th>SVC Action</th></tr><tr><td rowspan="2">Closed</td><td>5 V</td><td>Normal</td></tr><tr><td>Other</td><td>Change the PCB</td></tr><tr><td rowspan="2">Open</td><td>0 V</td><td>Normal</td></tr><tr><td>Other</td><td>Change the PCB</td></tr></table>

12) Display Communication Error

*Only for model which have touch display type

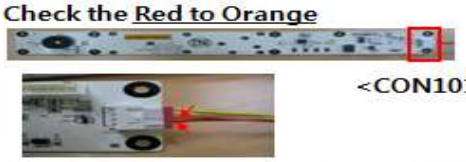
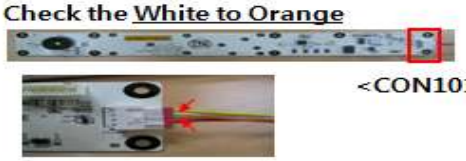
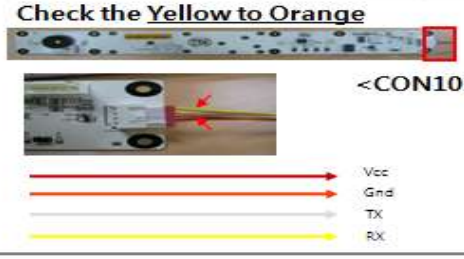
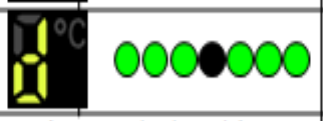
No	Checking flow	Result & SVC Action
1	Check the loose connection	
2	Check the Red to Orange  <CON101>	<table><tr><th>Result</th><th>SVC Action</th></tr><tr><td>12V</td><td>Go to the 3</td></tr><tr><td>Other</td><td>Check the Hinge (loose connection) Change the Main PCB</td></tr></table>
3	Check the White to Orange  <CON101>	<table><tr><th>Result</th><th>SVC Action</th></tr><tr><td>0 or 5 V</td><td>Change the Display PCB</td></tr><tr><td>Other</td><td>Go to 4</td></tr></table>
4	Check the Yellow to Orange  <CON101>	<table><tr><th>Result</th><th>SVC Action</th></tr><tr><td>0 or 5 V</td><td>Change the Main PCB</td></tr><tr><td>Other</td><td>Go to 5</td></tr></table> 

Figure 22

III. Error Code Function

No	Condition	Malfunction Display		Condition of Malfunction	Remarks
		E-MICOM	I - Micom		
1	Normal	NOTCH		-	Display works normally.
2	R-Sensor Error			R-room temp' sensor short or open	Check the connection of each sensor.
3	D-Sensor Error			Defrost temp'sensor short or open	
4	RT-Sensor Error	(On LED Check Mode) 		Ambient temp' sensor short or open	
5	Defrost Error			Although defrost operated for 2hour, Defrost-sensor temp' doesn't over 13°C.	M FUSE open / HEATER open / DRAIN blocked. / HEATER RELAY broken.
6	F-FAN Error (*)			Feedback signal from each BLDC fan motor was not detected more than 65 sec during F/C-fan ON condition.	Some wires to BLDC fan motor was disconnected. / Drive IC or TR broken. / Fan locked
7	C-FAN Error (*)				

(*) Only for product with DC-BLDC Fan Motor

Reference

* Primary Error : R-sensor, D-sensor, Defrost Error, F-FAN Error, C-FAN Error
* Secondary Error : RT-sensor

Figure 23

III. Error Code Function

- Primary Errors are displayed after 3 hours from the Error detected point of time. Even though the 3 hours did not pass, Error can be confirmed with LED Check Mode.
- Secondary Errors are not displayed directly. They can be confirmed with LED Check Mode.
- If error has been detected, MICOM controls as the operating mode for each error.
- If the Primary Error is detected during the Secondary Error detected, Primary Error is displayed.
  - If more than 2 errors detected simultaneously, first detected error is displayed.
  - If the Primary Error is solved after it detected, system will reset to initial state.
  - During error mode, if any display key or TEST button is pressed, that function does not operate. Just the buzzer operates as the key sound.
  - If any error is detected during TEST mode, display shows error mode.
  - On ERROR mode, the refrigerator operates as the last NOTCH.

No	Condition	Load Control			
		Comp	F-FAN	C-FAN	Defrost
1	Normal	●	●	●	●
2	R-Sensor Error	15M ON / 15M OFF	●	●	●
3	D-Sensor Error	●	●	●	No Defrost
4	RT-Sensor Error	●	●	●	●
5	Defrost Error	●	●	●	●
6	F-FAN Error	●	OFF (Recheck at every 30min)	●	●
7	C-FAN Error	●	●	OFF (Recheck at every 30min)	●

3.2 Air conditioner

Definition:- Air conditioning is the process of altering the properties of air (primarily temperature and humidity) to more favorable conditions. More generally, air conditioning can refer to any form of technological cooling, heating, ventilation, or disinfection that modifies the condition of air.

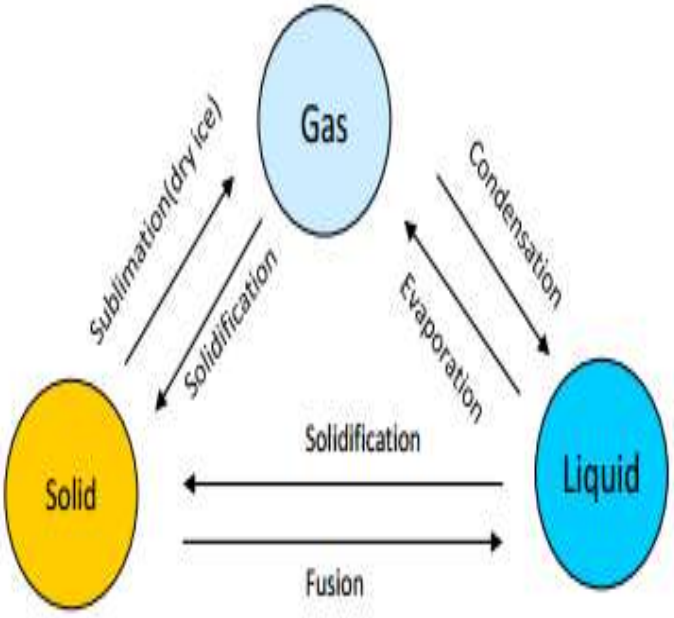
I. Basic Principles of

1-1-1. Change in status of matter and heat flow

A) Heat types

① Sensible heat → Heat used for temperature change of an object (heat sensing).
② Latent heat → Heat used for materials' status change.
ⓐ Heat of evaporation(heat of condensation) → Heat needed for liquid to become gas (from gas to liquid)
ⓑ Heat of fusion(heat of solidification) → Heat needed for solid to become liquid (from liquid to solid)
ⓒ Heat of sublimation → Heat needed for solid to become gas

B) Change in status of matter



◎ AE uses evaporating latent heat from when liquid becomes gas.

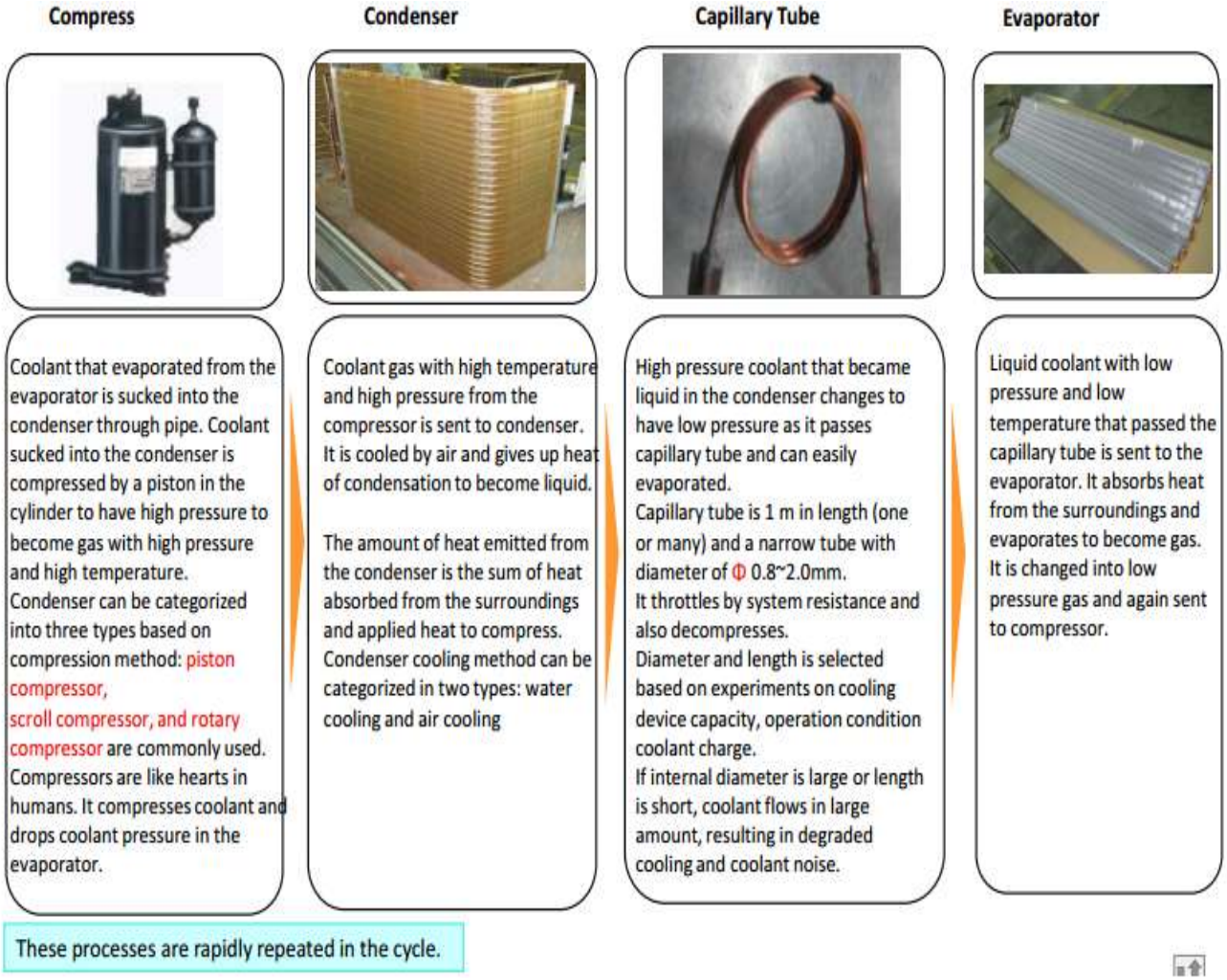
C) Liquid and gas properties

◎ When liquid evaporates to become gas
☞ Absorb heat from surroundings
Emits heat when gas becomes liquid.

◎ When pressure is decreased, liquid
☞ evaporates easily
When pressure is increased,
gas liquefies easily

Figure 1

I. Basic Principles of



Figur1

Cooling cycle principle of wall-mounted air conditioner

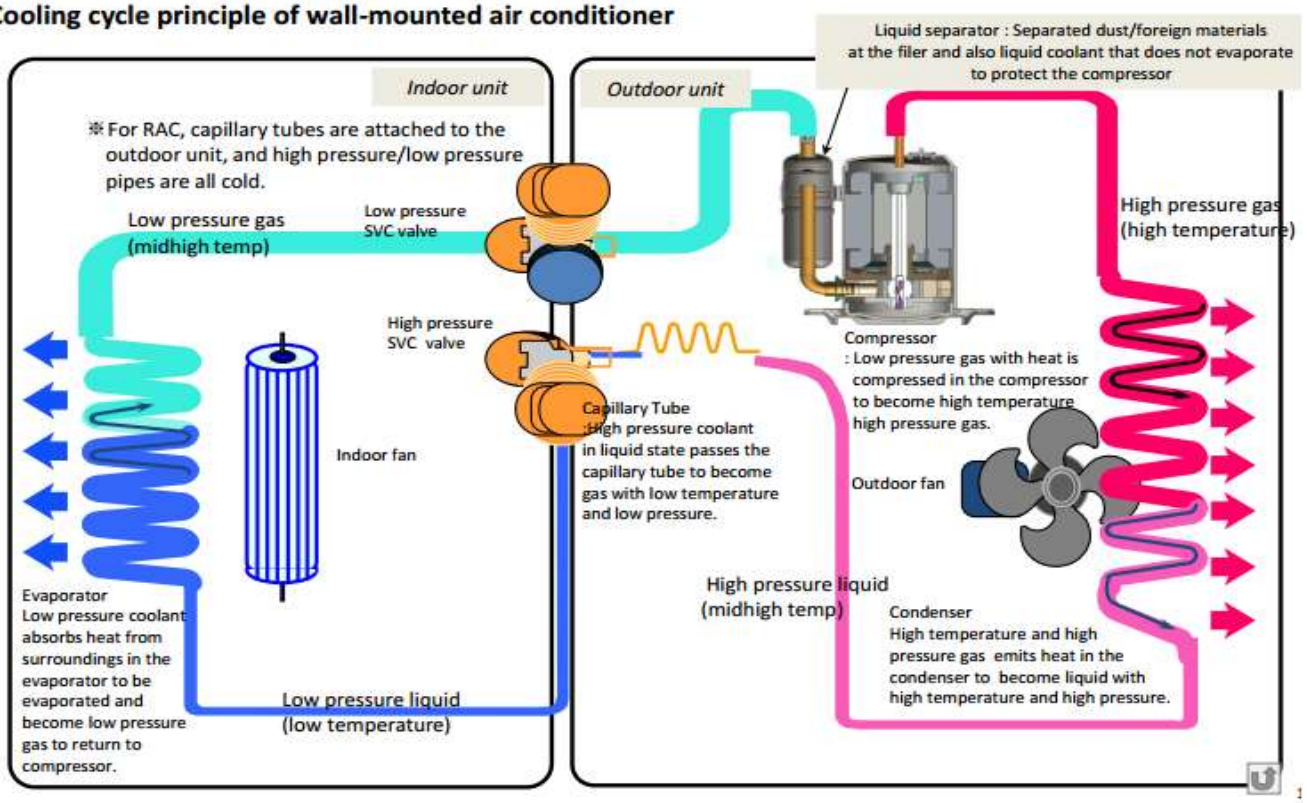


Figure2

Cooling cycle principle of standing air conditioner

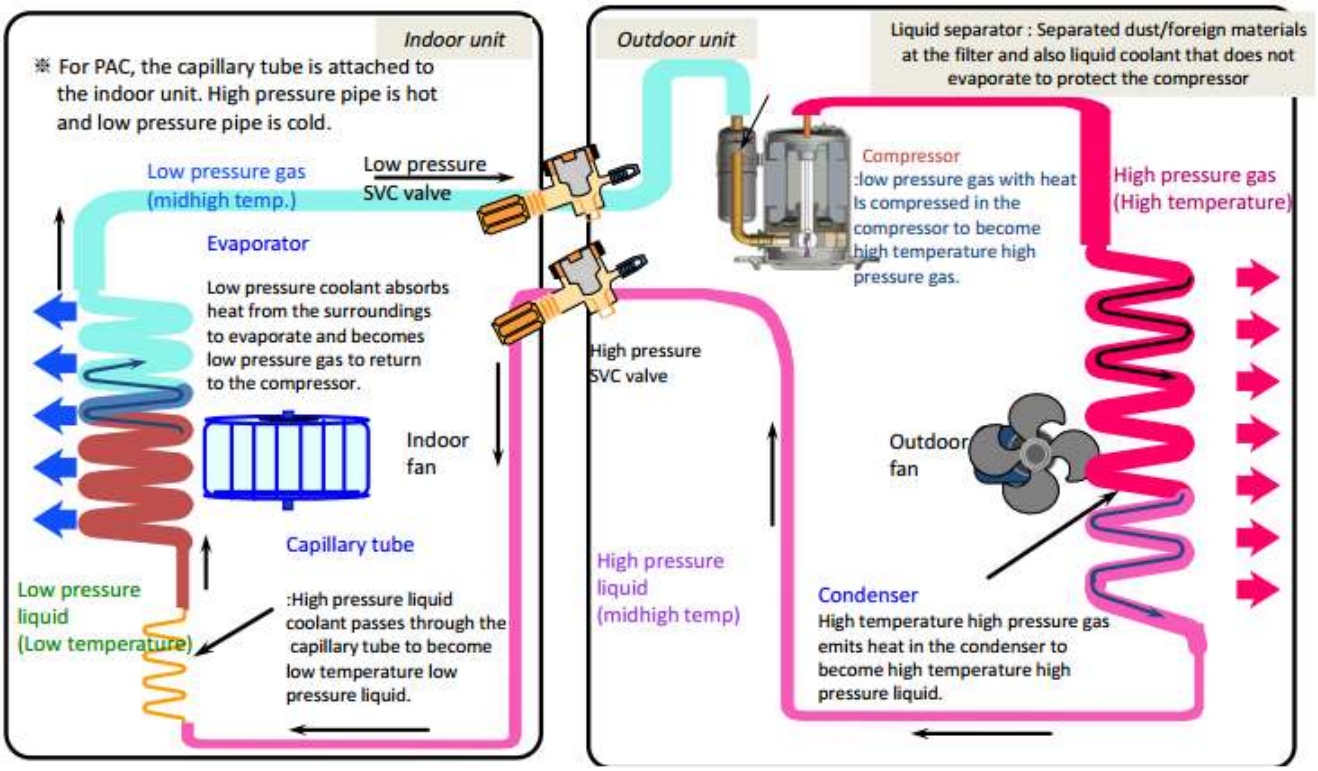


Figure3

Heating cycle principle

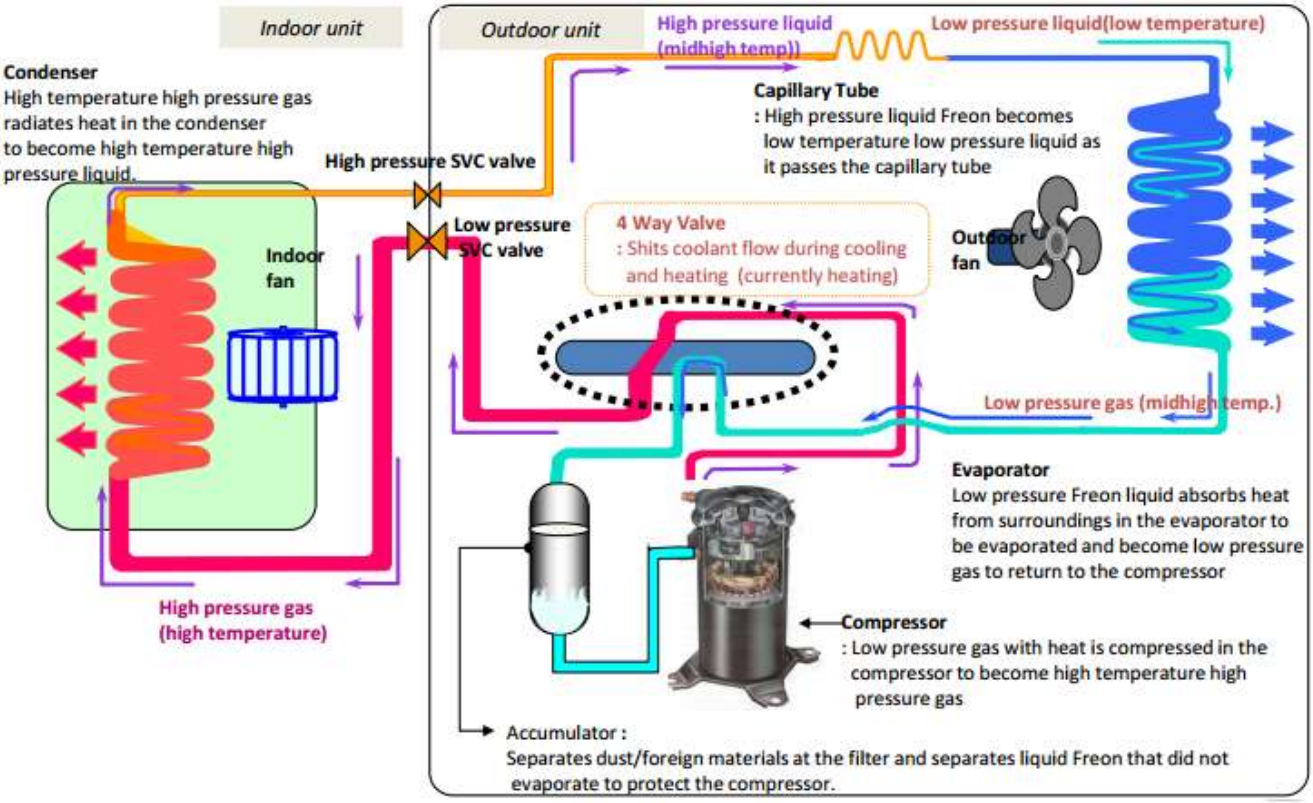


Figure 4

Basic Process of Coolant and Cycle

Manifold gage consists of high/low pressure gauge, handle and connecting hoses. It is used to charge or discharge of refrigerant, vacuum and operating pressure measurement, etc.

1.Low pressure gauge : measurement range :R22 : -30inHg ~ 250 Psig(0 ~ 18kg/㎠) / R410A : -30inHg ~ 300 Psig(0 ~21kg/㎠)

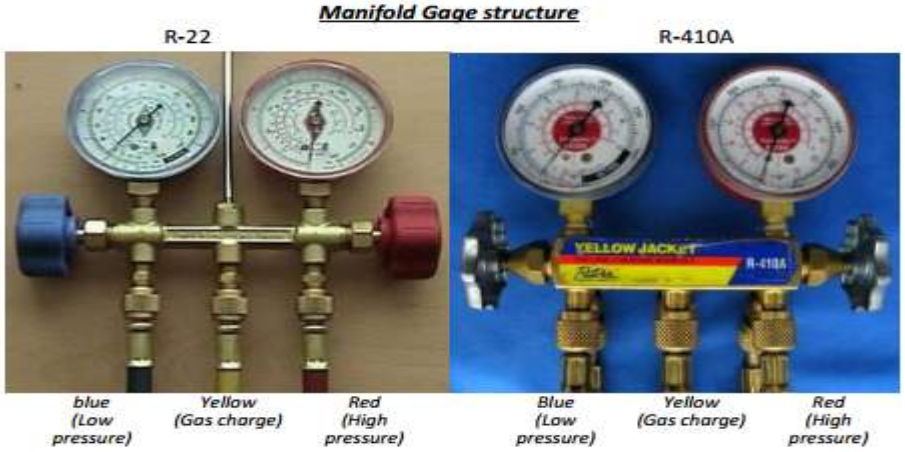
2.High pressure gauge : measurement range :R22 : 0 ~ 500 Psig(0 ~ 35kg/㎠) / R410A : 0 ~ 800 Psig(0 ~ 56kg/㎠)

3. Refrigerant Charge Blue to the low pressure service valve Red to the high pressure service valve yellow to the refrigerant box remove air in the yellow hose.

4. Measure pressure Open the valve slightly to let the air out. Close the valve and read the pressure gauge.

5.Refriegerant out Connect the low pressure hose to the low pressure service valve and let refrigerant out in state of air with yellow hose.

6. Vacuum Connect the yellow hose to the vacuum pump and high and low hoses to high pressure and low pressure service valves respectively. Open valve and activate the vacuum pump.



Manifold Gage Difference and How to Use Gage (R-410A,R-22)

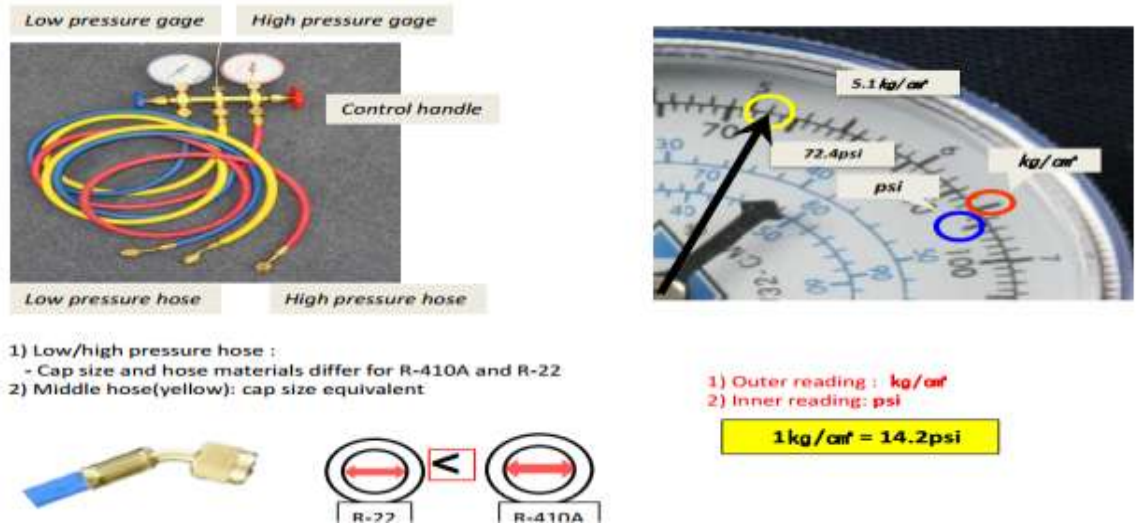


Figure 6

How to charge refrigerant

Sequence

Ⓐ Connect the gage hose to the cylinder (bombe).

▸ When using the bombe, hold it upside down (Liquid refrigerant filling).

Ⓑ Remove the air from the hose (Be careful of air refrigerant).

Ⓒ Open the gage valve (low pressure, blue) and charge liquid refrigerant.

▸ When cannot fill to the standard level, charge refrigerant in small amounts (150g).

If charged amount is insufficient, recharge again in the same way after one minute. Charging liquid refrigerant in a large amount may damage the compressor, therefore directions above should be followed.

ⒹRemove hose: -Make sure refrigerant charging is complete before removing the hose.

ⒺTest for gas leakage.

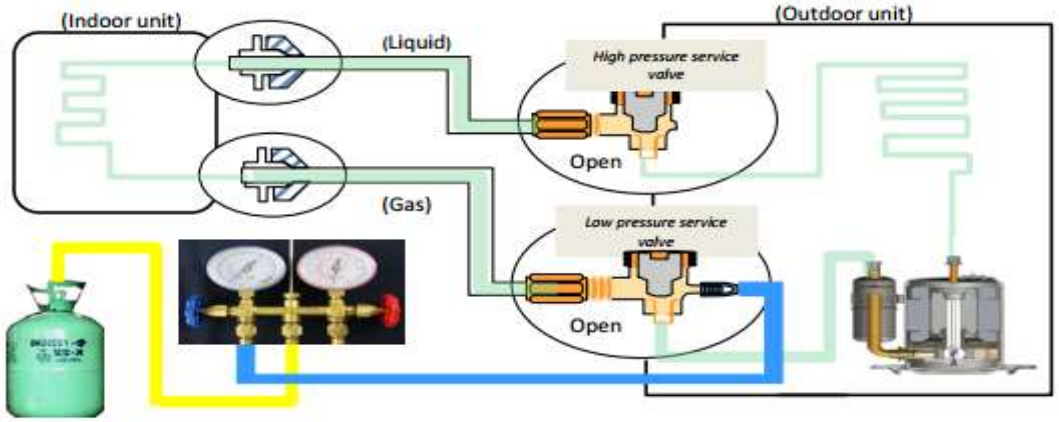


Figure7

How to Pump Down

This refers to the process of accumulating refrigerant in the cycle to the outdoor unit when relocating or reinstalling the produce

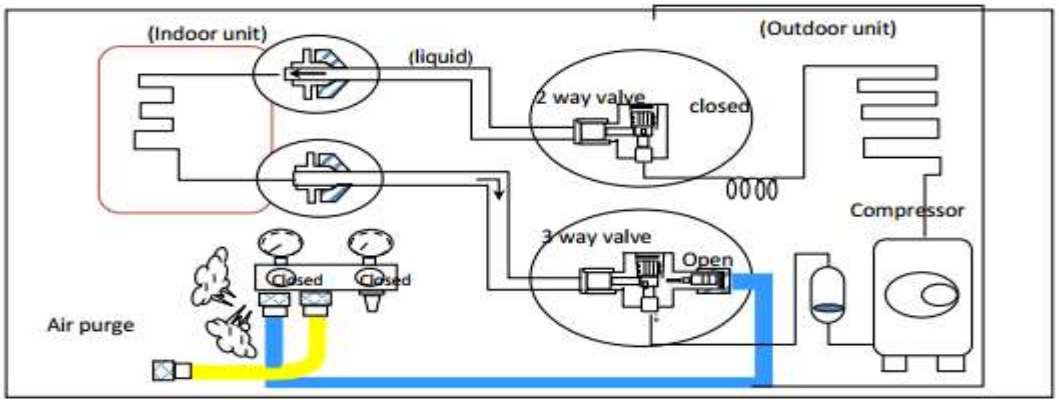


Figure 8

Sequence

ⒶTurn on the air conditioner for 10~15 minutes (To protect the compressor and recover oil easily).

ⒷConnect the gage hose to three way valve during operation (Air purging of the charging hose)

ⒸTurn the 2 way valve clockwise to close.

ⒹWhen the gage reading reaches 1kg/㎠ , stop operation (Turn off the power).

ⒺTurn three way valve (low pressure) clockwise to quickly close it.

▸Should be done in a quick manner so that low pressure gage reading should not exceed 3 ~ 5 kg/㎠

▸Check the pressure when the product stopped.

ⒻCheck for gas leak from the main unit. Seal pipes and service valves

How to Vacuum

This refers to a process of removing air in the cycle after outdoor heavy repair.

- Failure symptoms : impeded cooling power, more electricity consumption, overheated compressor, frozen capitally tube, clogging, compressor rust

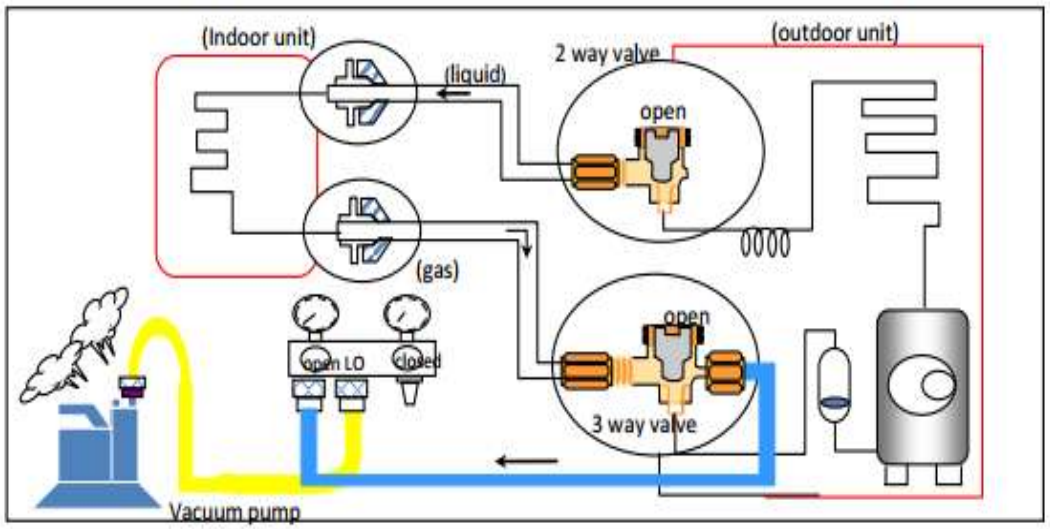


Figure 9

Sequence

- Start after the product stopped and air in pipe is discharged

Ⓐ Connect the vacuum pump in the middle of the gage hose.

Ⓑ Activate the vacuum pump, and open low pressure (blue hose).

Ⓒ Check how low pressure gage reading moved toward -76cmHg after 5 minutes.

Ⓓ Close the gage and stop the vacuum pump. Check if low pressure gage reading moves or not. (after 5 minutes)

Ⓔ Vacuum for about 1 hour.

- When charging refrigerant after making it vacuum Separate the hose from the vacuum pump. Inject refrigerant for a certain amount when stopped, and operate the product to fill the refrigerant with standard pressure.

Chemical properties of R-410A

Similar to R22, R410A is chemically stable, non-toxic, and inflammable refrigerant.

However specific gravity of R-22 (in state of steam) is heavier than that of air. Therefore if it leaks in an enclosed room, it tends to stay low, causing suffocation due to oxygen shortage.

Also, it generate toxic gas when comes in direct contact with heat, therefore it should be treated where has a good ventilation.

✖ Property comparison of R-410A and R-22

	R-410A	R-22
Composition (Mass ratio %)	R32/R125 (50/50)liquid	R22 (100)
Elements	H(hydrogen), C(carbon),F(fluorine)	H(hydrogen), C(carbon), F(fluorine), Cl(chlorine)
Evaporation point(℃)	-51.4	-40.8
Steam pressure (25℃,㎫)	1.56	0.94
Saturated vapor density (25℃, kg/m²)	64.0	44.4
Flammability	Non-flammable	Non-flammable
ODP (Ozone Depletion Potential)	0	0.055
GWP(Global Warming Potential)	1370	1700

Table1

• R of R-22 stands for refrigerant.

• Cl is the main culprit of ozone depletion.

• ODP indicates a number in terms of R-11.(The bigger the worse)
• GWP indicates a number in terms of CO2.(The bigger the worse)
• Refrigerants alternative to R-22 are R-407C and R-410A, advanced countries limited their use from 1996**Tools required for installation and repair**

Figure 10

Refrigerant shortage

Failure	Refrigerant shortage
Symptom and reason	Weak cool air

Failure details	Correct Installation
◆ When extending pipes during reinstallation due to relocation, appropriate refrigerant pressure should be reached. If pressure is lower than It should be, cooling power is impeded. ◆ Symptoms when refrigerant is short Temperature difference between sucked and discharged air is less than 8℃. Operating current is below rated, and pressure on the low pressure side is also low.	◆ How to determine whether refrigerant is short 1) Frost is formed from the exit if the capillary tube to the entrance of the evaporator. 2) Suction pipe of the compressor is not cold. (Suction pipe temperature is similar to ambient temperature.) 3) Pressure on the low pressure side is low when cooling is used (There may be difference based on outside temperature). 4) Compressor oil leaks from indoor and outdoor unit joints and welds.

Figure 11

Refrigerant Leak

Failure	Refrigerant leakage
Symptom and reason	Weak cool air

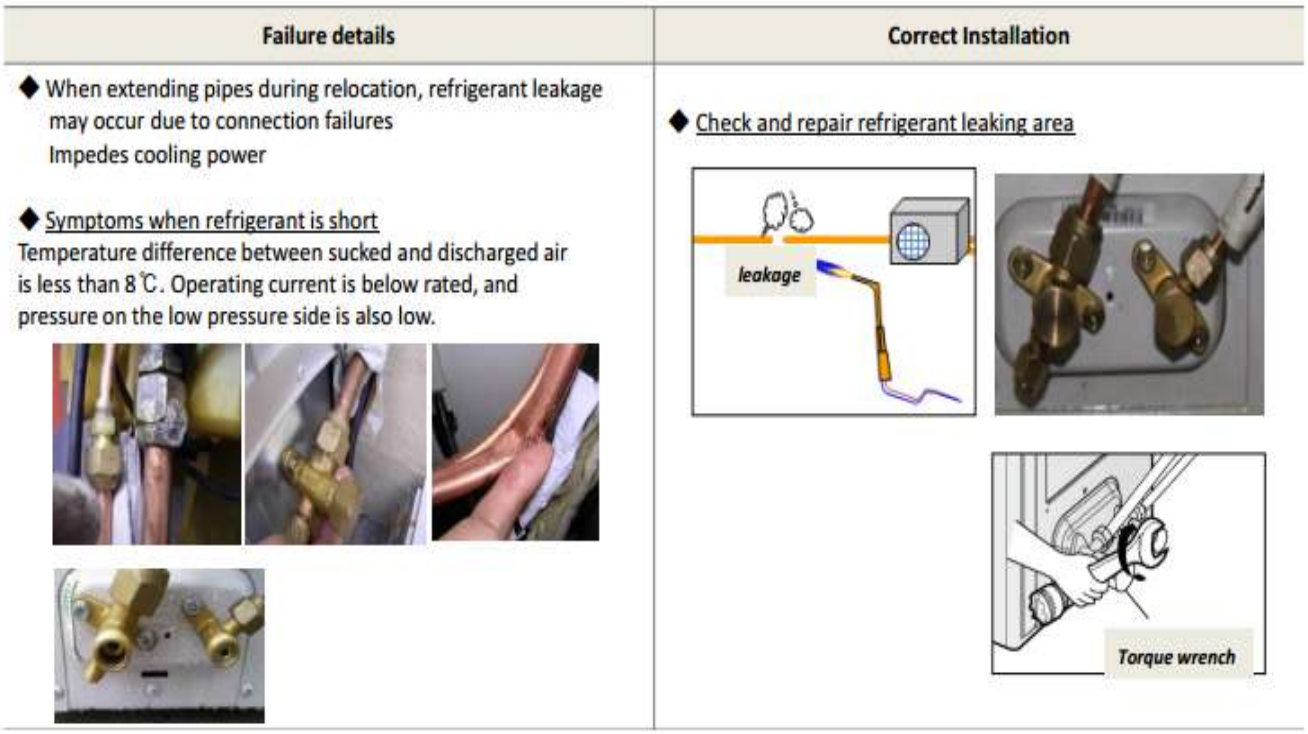
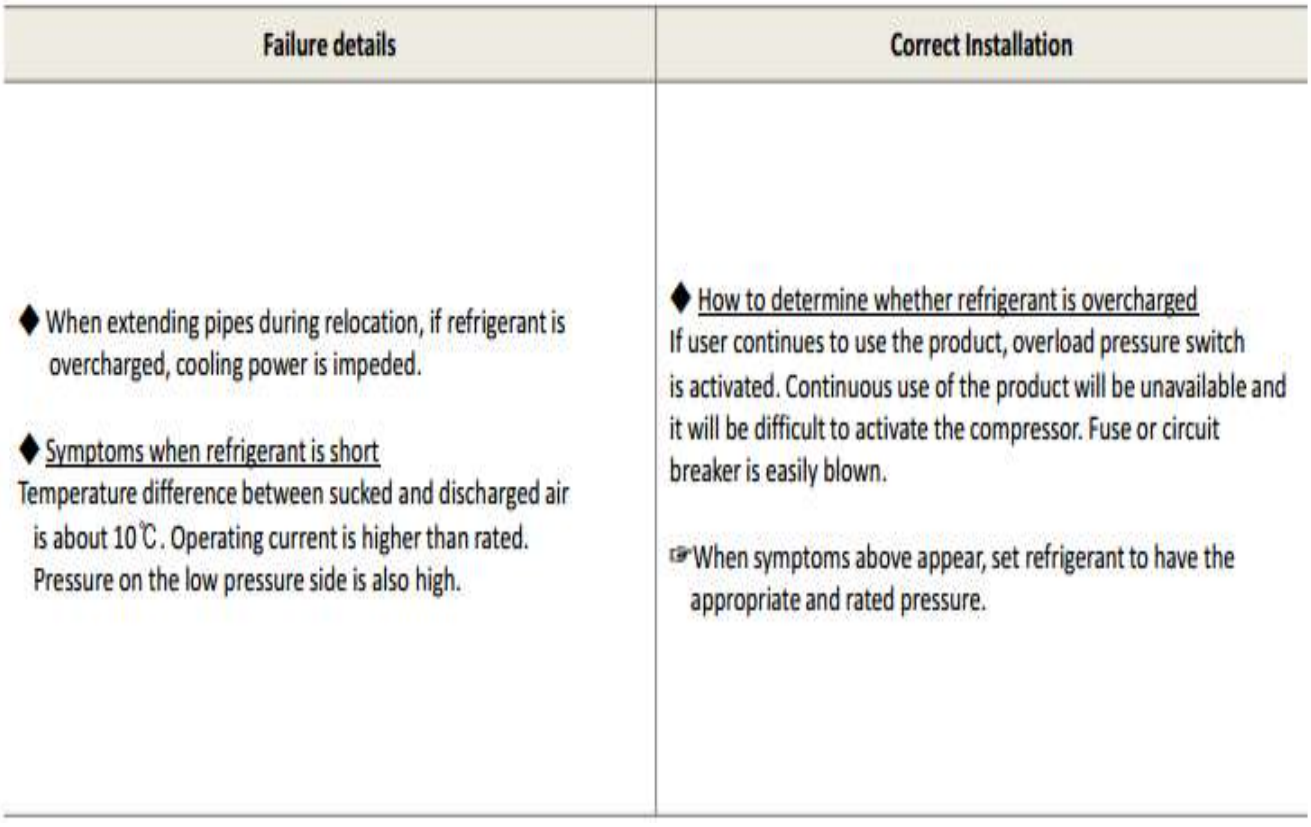


Figure12

Overcharging refrigerant

Failure	Overcharged refrigerant
Symptom and reason	Weak cool air



Refrigerant Clogged

Failure	Refrigerant clogged
Symptom and reason	Weak cool air

Failure details	Correct Installation
◆ If pipe is clogged or bent, while extending pipe during relocation, cooling power is impeded. ◆ Symptoms when refrigerant is overcharged When strainer and capillary tube are clogged, pressure drops at the exit. Refrigerant evaporates to form dews or frost. Operating current is below rated and pressure on the low pressure side will be below normal. If completely clogged, pressure on the low pressure side will eventually reach 0kgf/㎠.	◆ How to determine 1) Same symptoms as those for refrigerant shortage appear. Same symptoms occur when refrigerant is charged. 2) Refrigerant balancing time can take more than 3 minutes. ☞If user continues to use the product, temperature of the gas discharged from the compressor gets higher to make refrigeration oil depleted, affecting product lifetime.

Table 2

Gas Leak from Flare Due to Pipe Connection Defective

Failure	Gas leak from flare due to defective pipe connection
Symptom and reason	When cutting the copper pipe for flaring, it is not cut perpendicularly. When nut is put on, results in leakage due to not smooth flaring

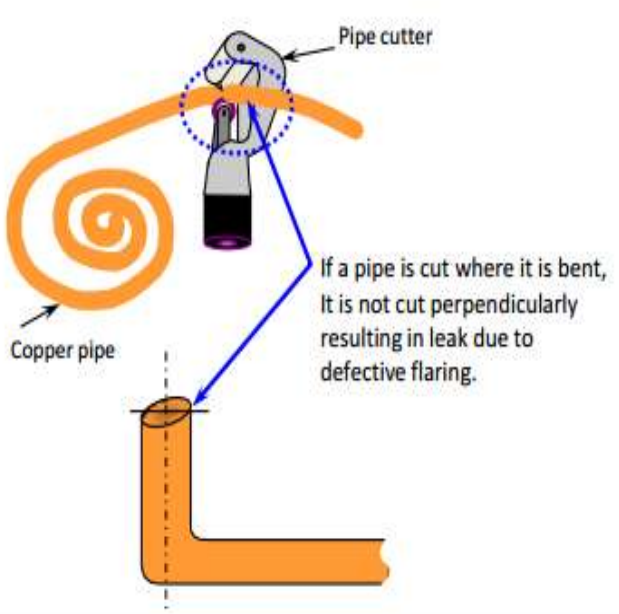
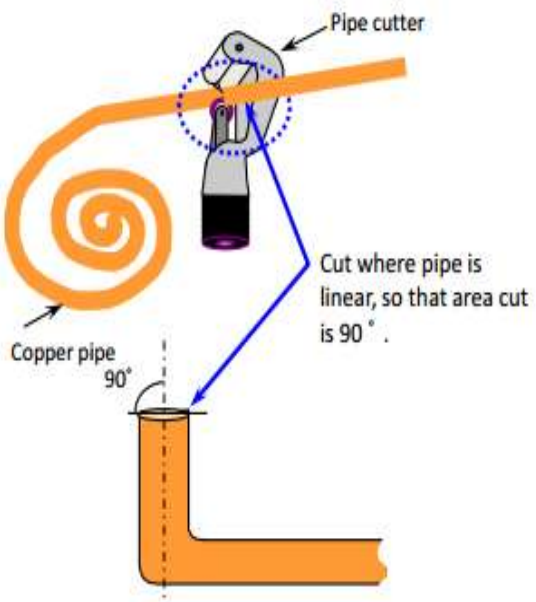
Failure details	Correct Installation
	

Figure 13

Gas Leak due to unmoved burr

Failure	Gas leakage due to not removed burr
Symptom and reason	Leak occurs at nut due to not removed burr before flaring after a pipe was cut

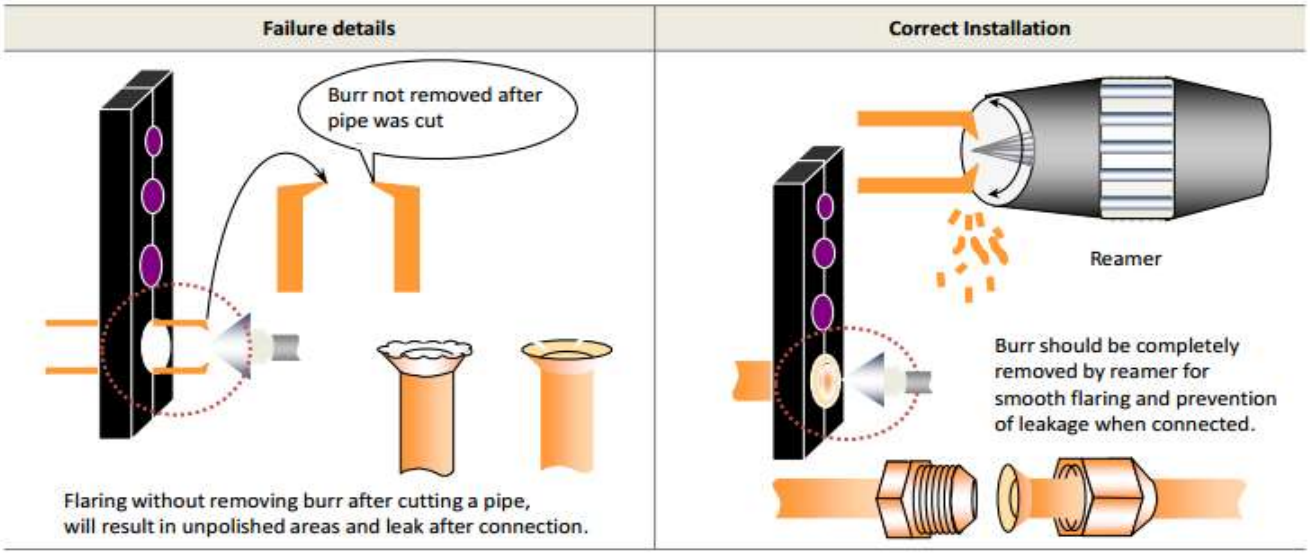


Figure14

Gas leak due to defective flaring (defective processing)

Failure	Gas leakage due to defective flaring (defective processing)
Symptom and reason	Size was not accurate when flaring was done. Leak occurs or cannot connect due to size

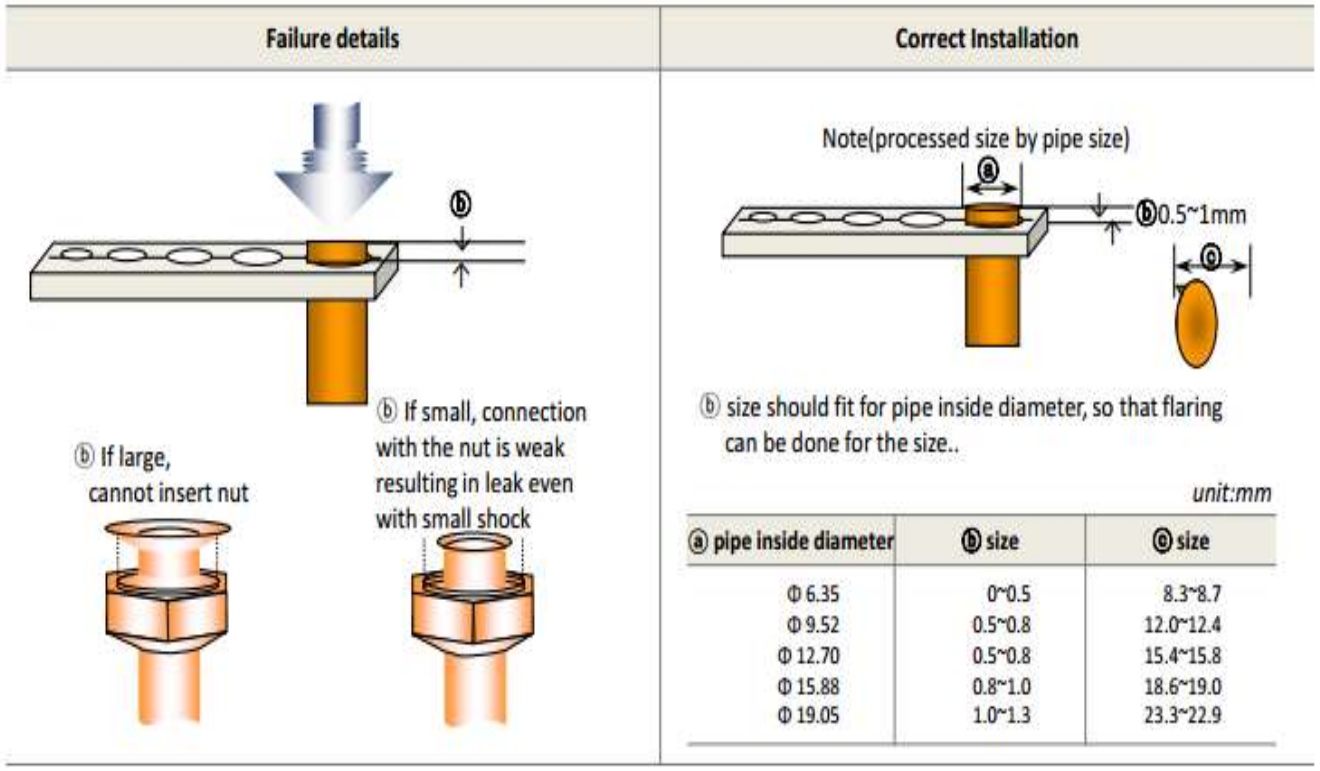


Figure15

Gas leak due to defective flare nut connection

Failure	Gas leak due to defective flare nut connection
Symptom and reason	When connecting flare nut, flaring is damaged to cause leakage due to incomplete or excessive connection

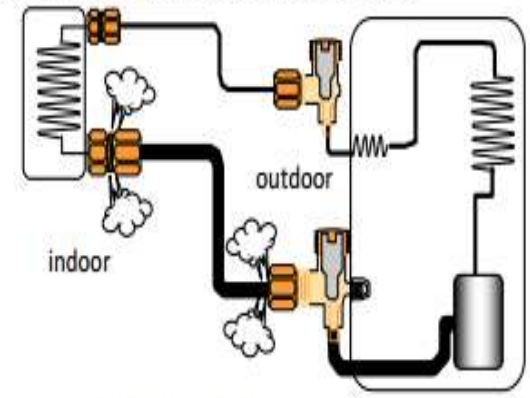
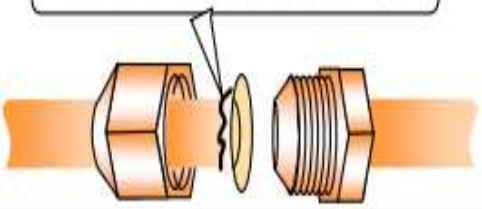
Failure details	**Correct Installation**
Leak occurs due to not completely tightened nut  When flare nut is overly tightened, flared area is cracked to cause leakage 	◆ Flare Nut connection torque (Kg.Cm). Outside diameter(mm) / torque(Kg.Cm). Φ 6.35 — 160~180 Φ 9.52 — 230~270 Φ 15.88 — 430~470 Φ 19.05 — 620~680 ◆ Use the flare nut torque wrench. ◆ Do a soap water test for 4 flare nut jointed area and welded areas for leak. ※ Soap water test during operation for high pressure Soap water test on standby for low pressure (Test when inner gas pressure is the highest)

Figure 16

Water Leak due to not horizontal indoor unit

Failure	1. Water leak age due to not horizontal indoor unit 2. Water leak s when drain hose is connected
Symptom and reason	Indoor is not horizontally installed to cause drain hose to flow out

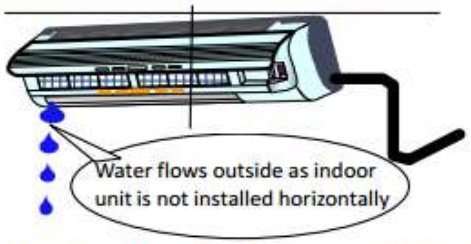
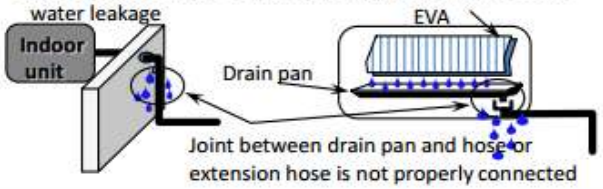
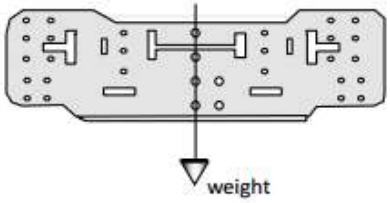
Failure details	**Correct Installation**
1. Water leaks as indoor unit is not horizontal  2.Indoor unit drain hose is not properly connected to cause water leakage  	◆ Room air conditioner should be installed horizontally as follows. (Fix the installation plate to be inclined by 2~3 degrees toward the drain pan outlet)  ◆ Check water is drained by pouring water into the drainage after installing the indoor unit ◆ Waterproof glue should be used for drain pan and hose joints not to cause water leakage.

Figure17

Water leakage due to defective drain hose installation

Failure	1. Water leakage due to not properly installed drain hose. 2. Water leak s due to drain hose installed upward
Symptom and reason	Water leakage due to defective drain hose joint and upwardly curved drain hose

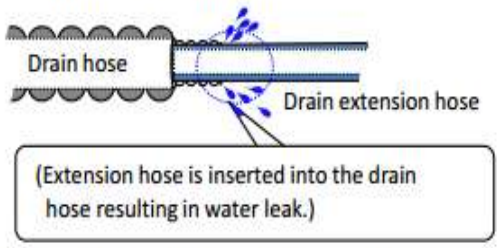
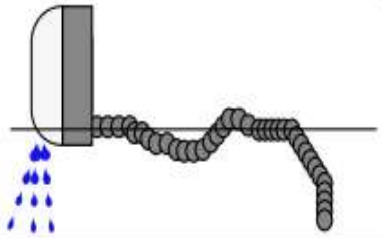
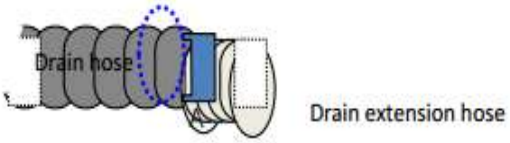
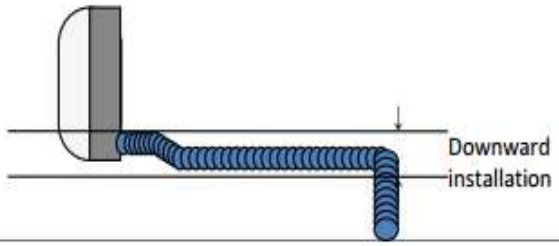
Failure details	Correct Installation
1. Water leaks due to defective connection between drain hose and extension hose  (Extension hose is inserted into the drain hose resulting in water leak.) 2. Water leaks as drain hose is curved and facing upward. 	☞ At area A, apply waterproof glue outside the drain hose and completely seal with insulation tape  ☞ Make sure the drain hose is not curved and it face downward so that water can be drained. 

Figure 18

Water Leak due to Wrong Pipe Connection through Wall

Failure	1. Water leakage due to upward connection through the wall and drain hose under water 2. Water leaks as drain hose is dipped in ditch
Symptom and reason	Pipe is connected upward through a wall making drain flow difficult causing water leakage. Drain hose end is dipped in the water to cause water leakage

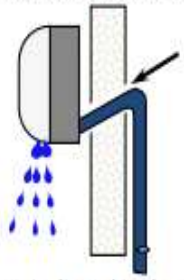
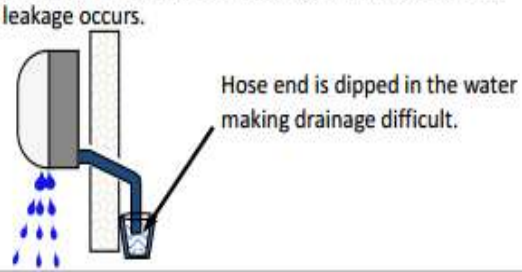
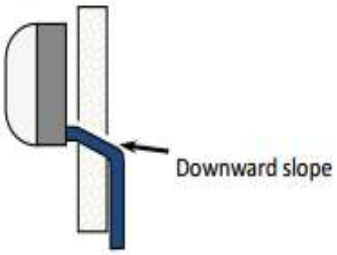
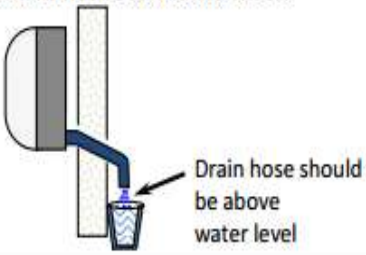
Failure details	Correct Installation
1. Pipe is installed upward through a wall causing water leakage  2. Drain hose is dipped in the water making drain flow difficult. Water leakage occurs. 	☞ should be installed downward when connected through wall  ☞ Drain hose should not be sank under water. 

Figure 19

Water Leakage due to Defective Rainwater Trap

Failure	1. Rainwater flows inside as rainwater trap is not installed. 2. Water leaks as rainwater flows inside due to defective insulation taping
Symptom and reason	Rainwater or water in pipe flows inside to cause water leakage

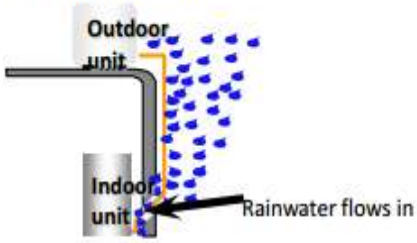
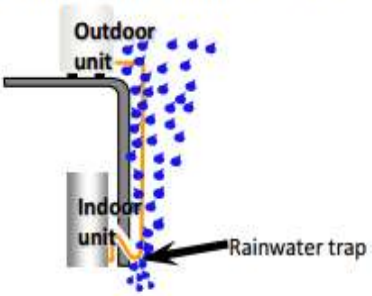
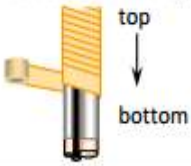
Failure details	Correct Installation
1. When outdoor unit installed above, pipe comes down vertically, so that rainwater can enter. 	☞ Install a rainwater trap so that rainwater or water does not enter 
2. When taping pipe for outdoor unit installed above, rainwater can enter due to defective taping. (taping top -> bottom) 	☞ Taping should be done from bottom to top to prevent water from entering. 

Figure 20

Refrigerant shortage after pipe extension

Failure	1. Refrigerant shortage due to not supplemented refrigerant after pipe was extended. 2. Refrigerant shortage due to gas leakage at welds
Symptom and reason	Impeded cooling power due to refrigerant shortage by leakages after pipe extension

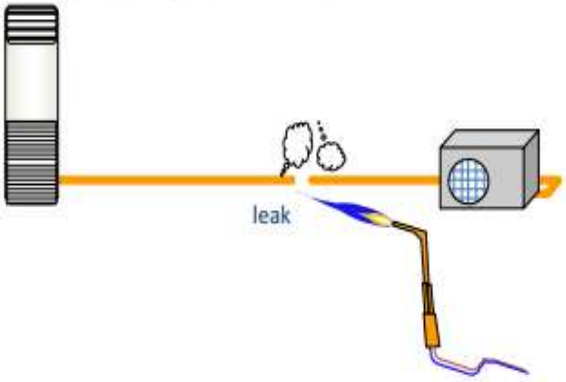
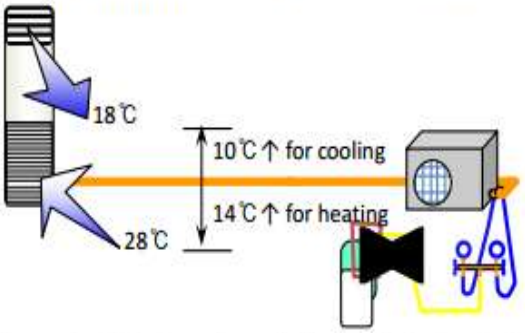
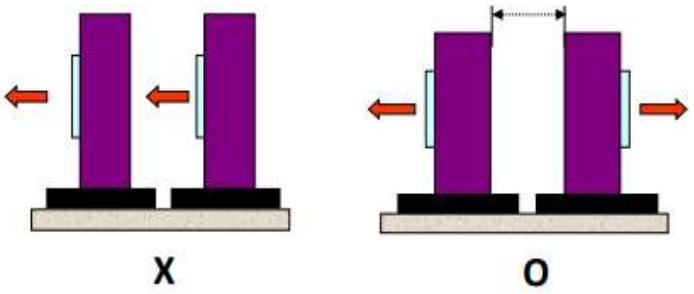
Failure details	Correct Installation
1. Impeded cooling power due to not supplemented refrigerant after pipe was extended 	☞ Refrigerant should be charged after pipe was extended. (After operating on strong cooling for about 15 minutes, when refrigerant pressure becomes parallel, check the pressure with Manifold gage, and inject appropriate amount of refrigerant. ◑ *Refer to refrigerant pressure table by temperature* 
2. Refrigerant shortage due to small leak in welds	☞ Leak test should be done for welded areas before insulating.

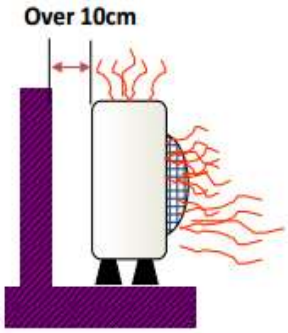
Figure21

Wrong Outdoor Unit Installations

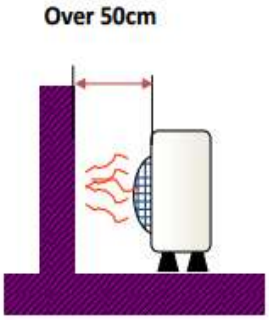
- ☞ Do not install outside veranda or on a wall
- ☞ Install the product on level surface.
- ☞ Install outdoor units in parallel



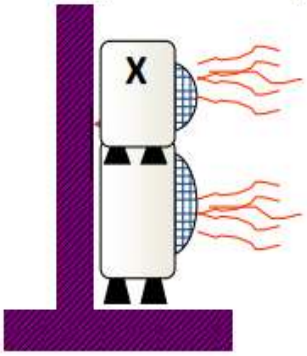
◆ Air intake vent is facing a wall O



◆ Air outlet vent is facing a wall O



◆ Installing an unit on another X



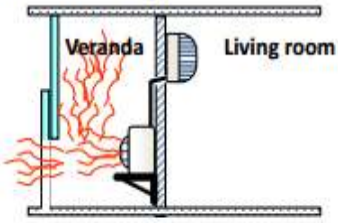
Example

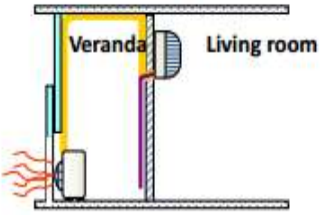
Figure 22

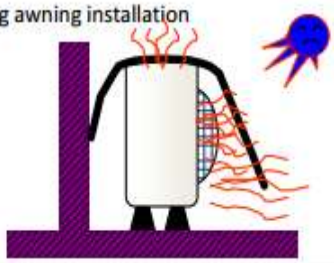
Wrong Outdoor Unit Installation

Failure	1. Wrong locations of outdoor units in apartment veranda 2. Wrong awning installations
Symptom and reason	No cooling due to wrong outdoor unit locations and risen surrounding temperature due to direct sunlight

Failure details	**Correct Installation**
1. When outdoor unit is installed at a wrong location, veranda temperature rises resulting in outdoor unit OLP activation and no cooling	☞ Outdoor vent should be installed outwards so that heat from the condenser can be let outside.
2. Wrong awning installation	☞ Correct awning installation







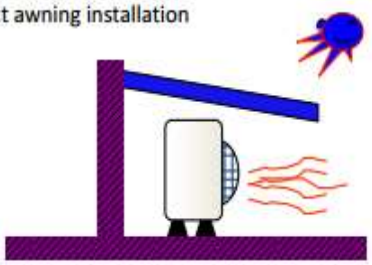


Figure 23

Defective Power Plug Connection

SVC Valve not Open

Failure	SVS valve not open when installing product
Symptom and reason	If user continues to use the product without valve open, compressor may be damaged

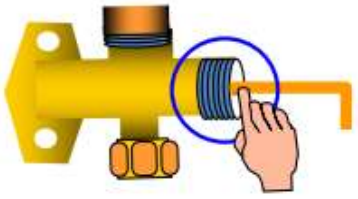
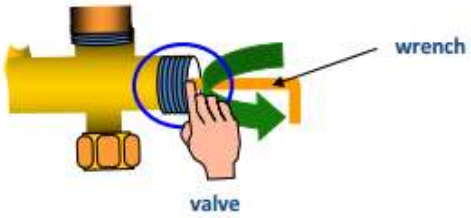
Failure details	Correct Installation
◆ If the product is installed and used without valve open, refrigerant cannot circulate resulting in damaged compressor.	◆ Use a hexagonal wrench to turn valve for high/low pressure counter clockwise to open completely and run test drive.
 Valve not open	

Figure 24

Use of Wrong Installation Pipe

Failure	Use of wrong installation pipe
Symptom and reason	Rate size of pipe for indoor/outdoor installations are not used resulting in weak cooling and damaged compressor.

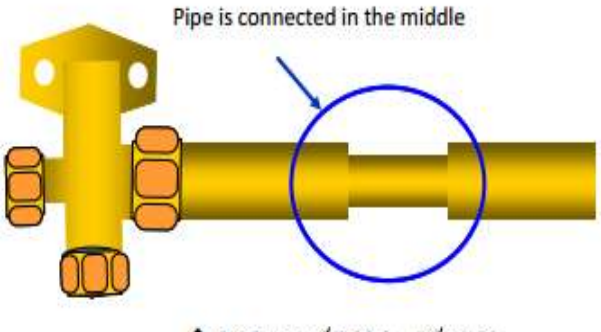
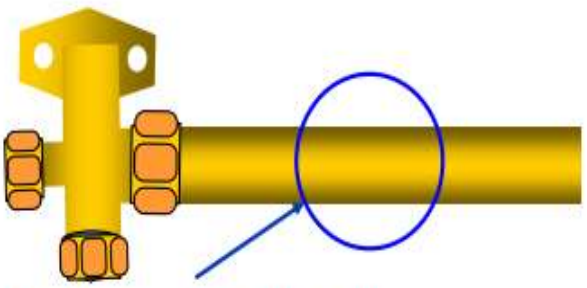
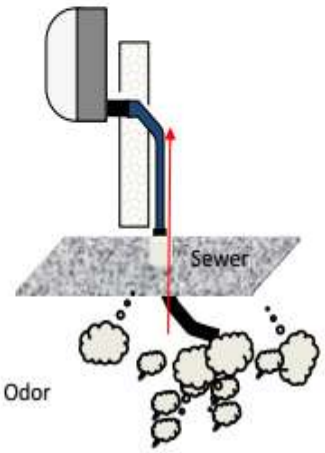
Failure details	Correct Installation
◆ When the product is installed or relocated, rated sizes of high/low pressure pipes are not used. Pipe with different specifications are used in the middle, resulting in weak cooling and damaged compressor.	◆ When installing the product, rated pipe should be used for full performance of the product. Pipe with different sizes should not be used in the middle.
 ◆ E.g:Spec: Φ5.88→ Use 9.52	 ◆ *Do not connect the pipe in the middle. Pipes with same size should be used.*

Figure 25

Odor when Using the Product

Failure	Odor occurs when using the product
Symptom and reason	End of drain hose is connected to the sewer, and odor moves inside when the product is used.

Failure details	**Correct Installation**
◆ End of the drain hose is connected to the sewer to let odor inside.	◆ Do not connect the end of drain hose to sewer or washroom. (Causes odor)



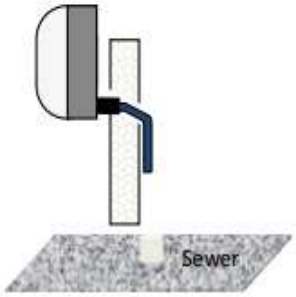


Figure 26

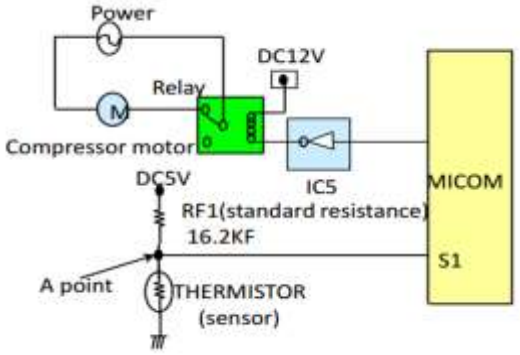
AC Parts

1. Temperature Sensor
2. Accumulator
3. O L P Over Load Protector
4. Plasma Air Purifier
5. Expansion Valve
5. Stepping Motor
6. Evaporator
7. Reversing Valve
8. Capillary Tube
9. Outdoor Fan Motor
10. Compressor
11. Pre AMP
12. Blower Motor
13. SVC Valve
14. Capacitor

A) Principle of Sensor

Refers to a semiconductor that its resistance changes depending on changes in temperature. Commonly used for electronic display. (Used for room temperature control)

- NTC TYPE: Resistance drops when temperature rises, and resistance increases and temperature decreases
- PTC TYPE: Resistance rises when temperature drops, and resistance decreases when temperature increases



Temp. (℃)	In/outside temp(kΩ)	Indoor pipe(kΩ)	Outdoor pipe(kΩ)	Outlet pipe(kΩ)
35	6	3	3	160
30	8	4	4	180
25	10	5	5	200
20	12	6	6	220
15	16	8	8	240
10	21	10	10	260
5	27	13	13	280
0	35	17	17	300

Figure26

B) Key checkpoints during repair

① Pull L/Wire – Check if it pulls out easily

② Check how deep sensor is inserted– Check if sensor is located in the middle of the holder

③ Check sensor, holder and sensor exterior – Check for dent

④ Check for any changes in open, short, and resistance

C) Sensor Type

1.Role of thermostat : senses room temperature (indoor/outdoor) or pipe temperature to control compressor and fan

2. Importance of thermostat: senses each temperature and detect defrosting and overload to control compressor and fan

3. Thermostat type:

1) Room temperature sensor: detects room temperature

2) Indoor pipe sensor : detects indoor unit pipe temperature (senses **preheat**, low temperature and overload)

3) Outdoor temperature sensor: detects outdoor temperature

4) Outdoor unit pipe sensor: detects outdoor unit pipe temperature (senses defrosting, low temperature and overload)

5) Outlet temperature sensor : detects outdoor unit D-pipe temperature
(senses overload) (senses compressor outlet temperature of inverter products)

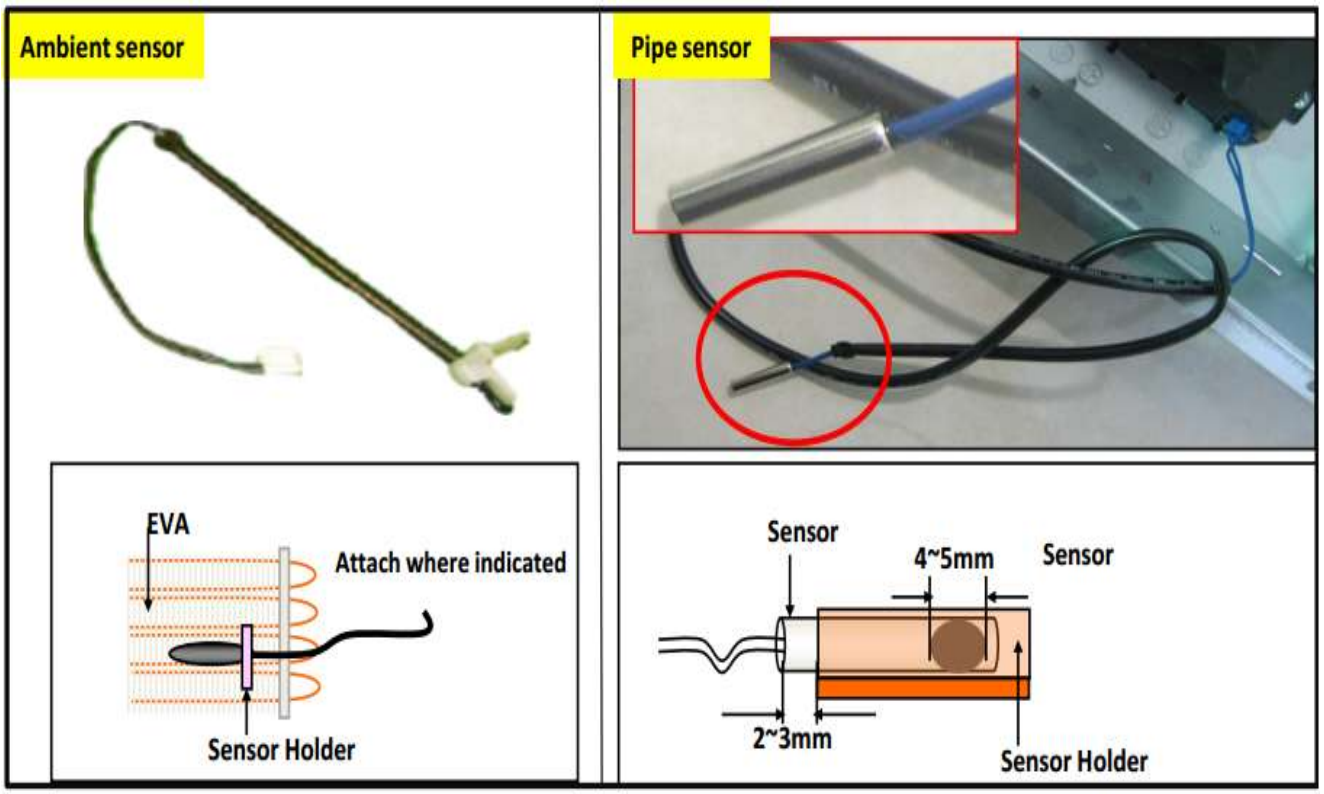


Figure 27

Evaporator

A) Role

Also called cooler as it absorbs heat in the air to evaporate refrigerant and cools surroundings

Cannot exchange heat when clogged with foreign materials and frost forms on the evaporator

B) Failure Symptoms

- Dramatically reduced cooling power
- Cannot charge refrigerant properly
- Pressure does not rise
- Can not evaporate when gas leakage occurs at welded areas

- Impeded cooling power when foreign materials are on the surface of evaporator
- Operating current decreases

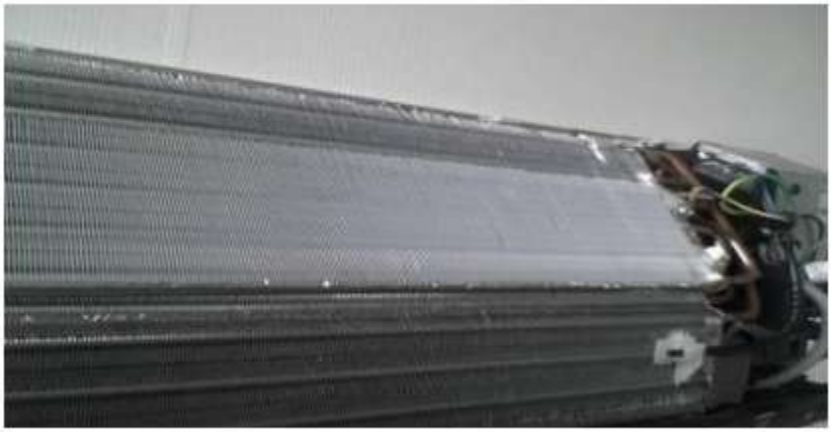


Figure28

3 Blower Motor

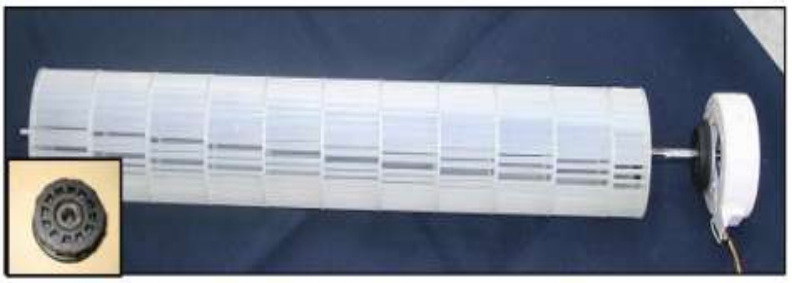
A) Role

Blows cooled air to the room as the air gives up heat at the evaporator (attached at the indoor unit)

B) Failure Symptoms

- Evaporator freezes
- Cannot discharge cool air
- Compressor stops due to activated pipe sensor
- Motor rotates at low speed only (cannot control between low, middle, and high)

Phase control motor BLDC motor



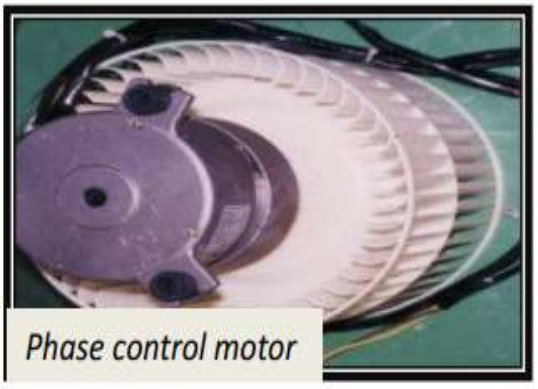


Figure 29

4 Stepping Motor

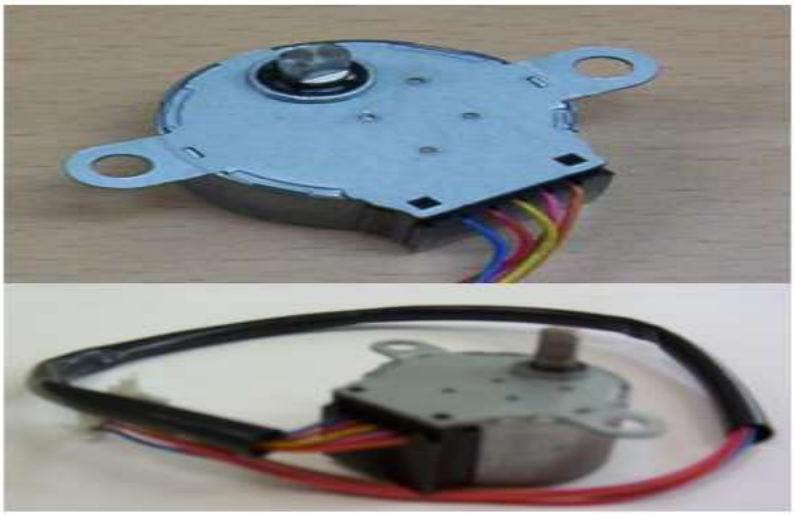


Figure 30

A) Role

Stepping motor (pulse motor or stepper motor) are advantageous for accurate angle control compared to AC servo and DC servo motor, and commonly used. Motor axis rotates at a set angle depending on number of pulse. Speed can be controlled by adjusting pulse intervals.

B) Advantages

- Easy to start, stop, rotate forward/backward and change speed, and responds promptly.
- Can achieve rotation speed proportional to pulse signal frequency and easily control speed.
- High torque motor at low speed.
- Does not have brush and highly credible with small number of parts in the motor.
- Feedback to calculate angle of rotation is unnecessary and control is simple. Price is relatively inexpensive.

C) Disadvantages

- Can easily fall out when operating at high speed
- Vibration and resonance can occur easily at certain frequency, and weak against load inertia

5 Pre AMP

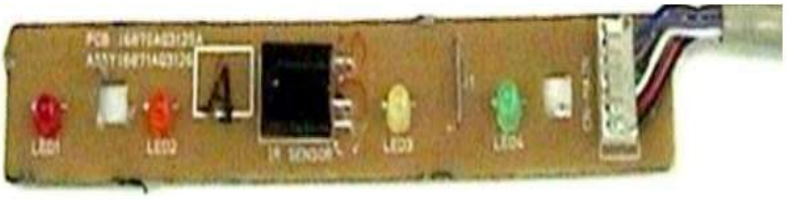


Figure31

A) Role

Attached at the indoor unit, and receives signals transmitted from the remote controller. Delivers to Micom.

For RAC and PAC, remote PRE-AMP is attached at LED PCB and DIDPLAY PCB.

B) Failure Symptoms

Does not work when remote controller is used (works on test run or forced operation)

◆ How to check: - Check if remote controller is normal

- Check PRE-AMP connector connection

- Check DC5V for PRE-AMP PIN power input

6 Plasma Air Purifier

A) Role

Using DC voltage and pulse overlapped voltage for dissociation and plasma electric collecting technology with supplied DC

voltage at the collector are used to enable collecting and odor removing with high efficiency

B) Principle

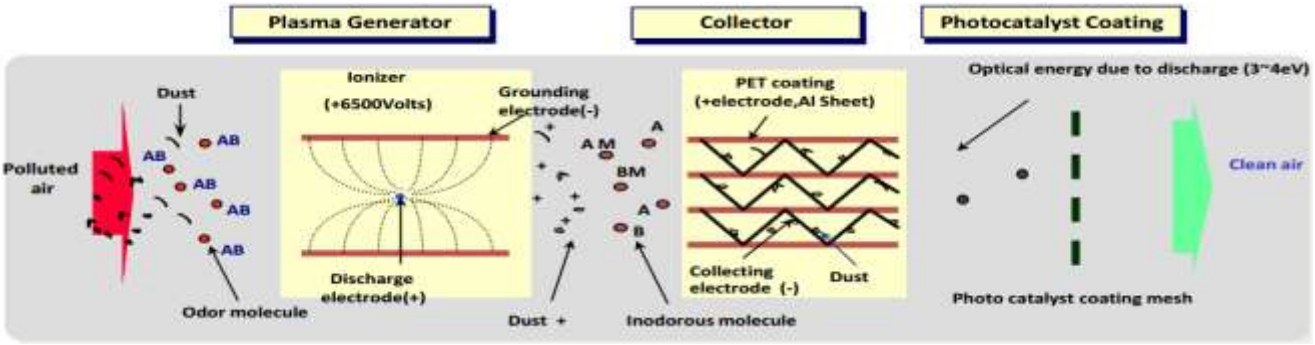


Figure 31

7 Compressor

A) Type and characteristics

Core of the air conditioner and makes refrigerant in the cycle to flow. Changes motor rotation to compression to push refrigerant.

(low temperature low pressure gas → high temperature high pressure gas) It is difficult to process parts of the Scroll compressor

that has many advantages of reciprocating and rotary type, compared to others.

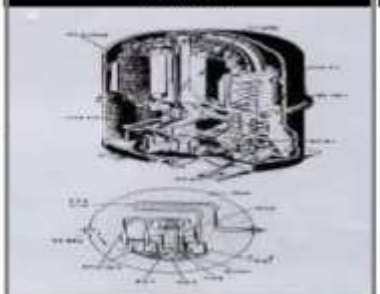
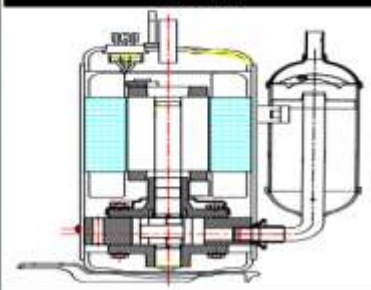
	RECIPRO.	ROTARY	SCROLL
Compressor structure			
Use	Refrigerator, vending machine Small/large cooling machines	Room air conditioner refrigerator for households	Large-size PAC, some vehicle air conditioner
Characteristics	A piston in the cylinder moves back and force to compress and discharge refrigerant.	Consists of stator and rotor in motor that rotates and pump that compresses the refrigerant gas.	Has a pair of scrolls (one is fixed and one orbits). Refrigerant is compressed by a scroll fixed on the dome and orbiting scroll that rotates by the motor.

Figure32

B) Reasons for Compressor Failure

1) Electrical failure

ⓐ Check grounding

- Remove line connected to the compressor.
- Set R X 10K and measure resistance between discharge(suction) pipe and each terminal
- If reading moves dramatically, the terminal is grounded -> replace compressor

ⓑ Check terminal connections (refer to diagram)

ⓒ If readings for each terminal does not move, disconnected

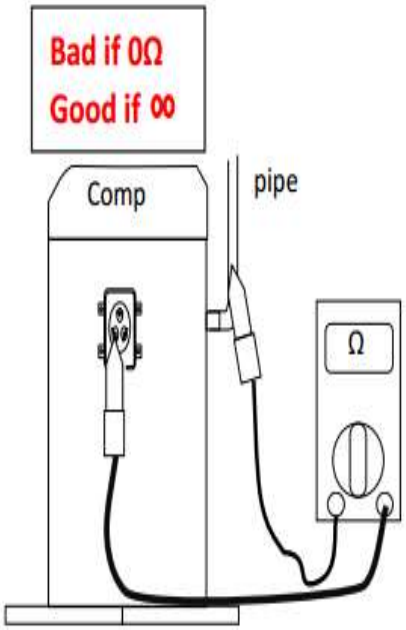
E.g.) Single-phase : R - S → 3.4Ω / C- S → 3Ω / R - C → 1.5Ω

Three phases: UV = VW = WU

ⓓ If measuring moves noticeably, short circuit -> replace compressor

ⓔ Check compressor OLP (If short circuit between terminals occur, check after cooling the compressor)

◆ Measure resistance between terminal and pipe



◆ Measure single-phase compressor resistance

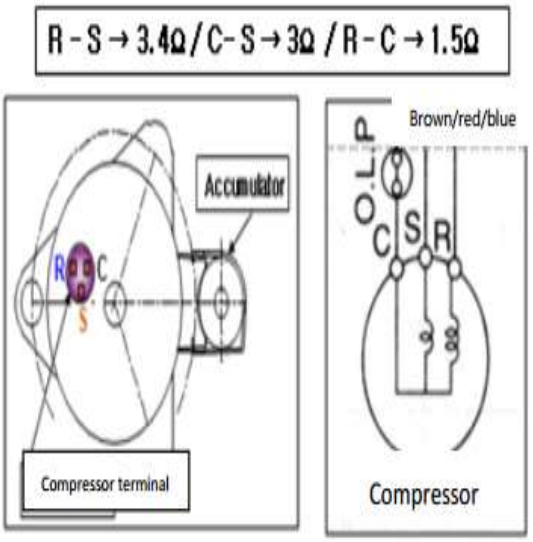


Figure33

2) Compressor lock

ⓐ Starting failure (Compressor is not activated but starting current continuously flows)

▸ Check capacitor ♤Check starting relay ♤ Check magnet ♤If cannot be started, compressor lock

◆ How to unlock

* With a higher capacity for a starting capacitor, activate (Compressor connection terminal (S-R) 60㎌ or 130㎌ parallel connection)
* Activate while discharging gas.(to complete discharge)
* Start with shock after complete discharge. If does not start, replace compressor.

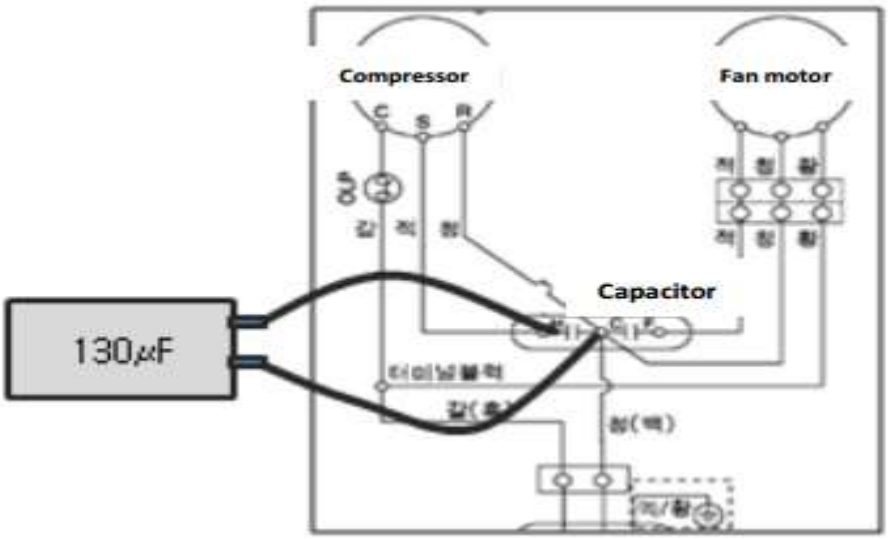


Figure 34

3) Compression failure

(Compressor is activated but cooling power is weak, high pressure is low, and low pressure is high due to damaged valve connecting load or crank shaft).

◆ How to check

ⓐ Stop condenser fan and activate, if high pressure does not rise, compression failure

ⓑ Measure compressor outlet pipe temperature – if below 50℃, compression failure

ⓒ Measure operating current – If noticeably below indicated value (about 1/2), compression failure

ⓓ Close high pressure and activate, if suction pressure does not fall, compression failure due to inner leakage and damaged valve

▸ Replace compressor assumed to have compression failure

(Operating the product with compression failure for a long time causes overheating and damaged compressor motor. Cycle has to be washed.)

8 O L P (Over Load Protector)

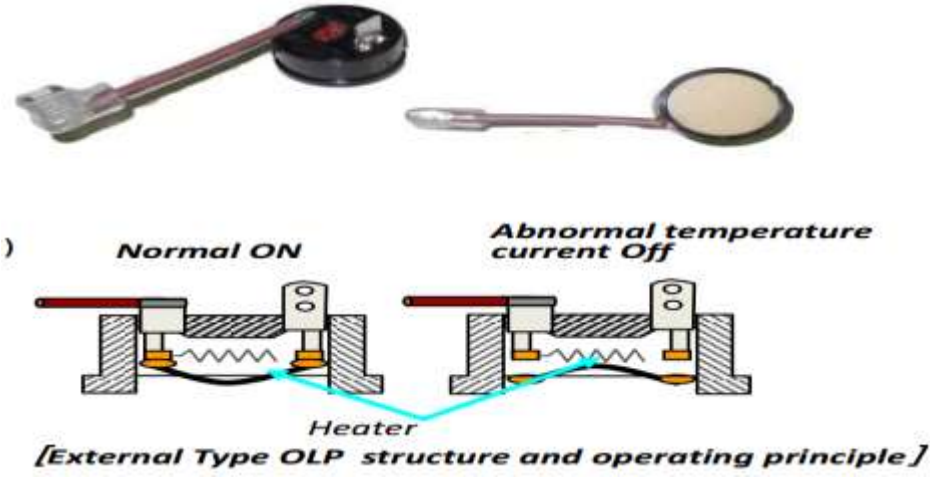


Figure 34

A) Role and structure

Attached at the top of the compressor. Is a safety device that protects the compressor by blocking compressor motor power

when compressor is overheated or over current flows.(current sensitive)

• Has bimetal and heater that generates heat when over current flows.

• Recovers automatically

• Operating temperature

☞ 115 ± 5 ℃ → Open 93 ± 5 ℃ → Reset

• If open

☞ Only compressor is off, outdoor fan and indoor unit fan operates (no cooling)

• Checkpoints when open

ⓐ Operate with low pressure ⓑ Defective operating or starting capacitor

ⓒ Clogged condenser pin (foreign materials, defective outdoor unit fan) ⓓ Cycle clogged

9, Capillary Tube

when capillary tube is clogged

Figure 35

A) Role

A part that changes high temperature high pressure liquid **gas** to low temperature low pressure liquid **gas.** Narrow and thin,1~2 m in length. Decreases pressure.

B) Symptoms when clogged

▸ Cooling power dramatically reduced

▸ Cannot charge refrigerant as it should be Pressure does not rise

▸ Operating current is less than 80% of indicated

▸ Temperature difference between suction discharge below 8℃

▸ Symptoms as same as those occurring when refrigerant is short observed

10 Accumulator

A) Role :-While gas evaporates at the evaporator, liquid refrigerant that did not evaporate can be enter the compressor to affect its lifetime. Accumulator is installed at compressor inlet to separate liquid refrigerant.

B) Failure Symptoms

▸High pressure drops and low pressure rises due to clogging of refrigerant gas

▸Operating current decreases ▸Cooling power weakens ▸Compressor overload noise occurs

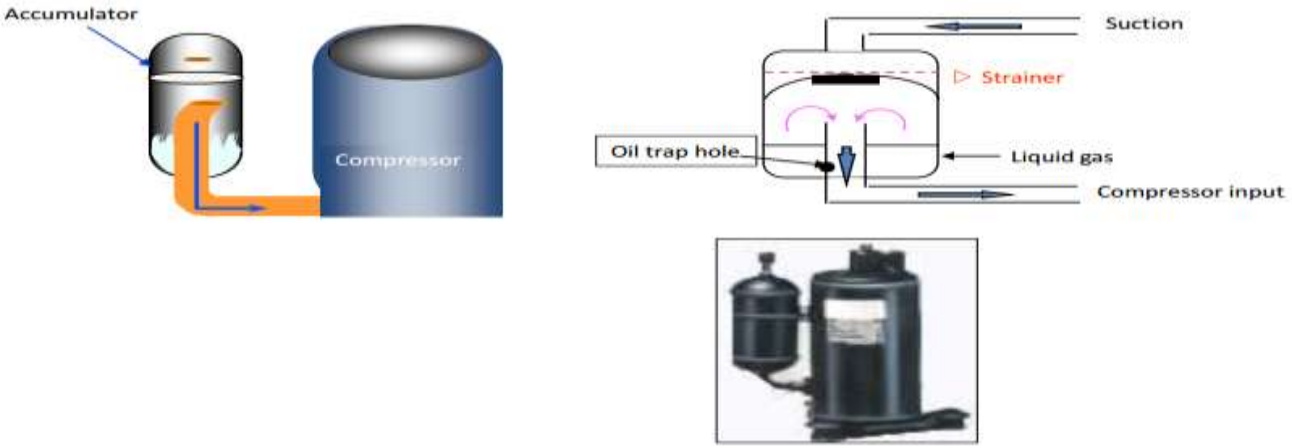


Figure 36

11 Four Way Valve / Reversing Valve

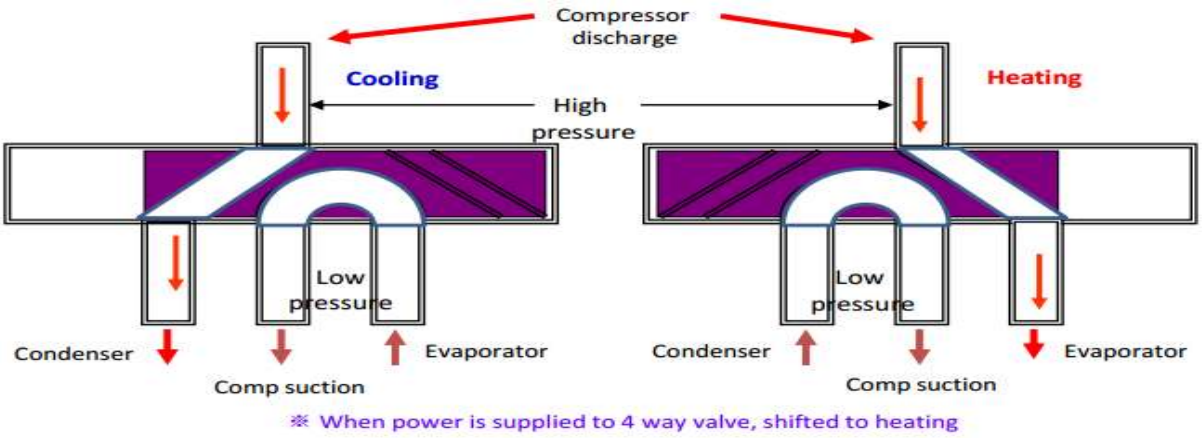


Figure 37

A) Principle

Valve that shifts role of condenser and evaporator as it shifts refrigerant flow during cooling/heating. When cooling, high temperature refrigerant flows to condenser and high temperature refrigerant flows to the evaporator for heating.

B) Operation

- When changing from cooling to heating → After sending signals by remote controller, turn off compressor. 4 way valve is shifted.
- Initial heating → 4 way valve on after receiving from the remote controller
- Changed from cooling from heating and when stopped → 4 way valve delay operation and off.
- If operation mode is pressed and other operation is activated during heating, compressor is turned off and there is a 3 minute delay before the product starts to operate.

C) How to check failures

① Symptoms

1. Due to 4 way valve coil failure, high pressure drops and low pressure rises.
2. Cool air does not come out during cooling and cannot cancel preheat during heating

Figure 38

② How to check

1. When the product is running, check for reversing coil (4 way valve) power continuity.

- After turning on heating, check for noise when power is turned off.

③ Failure symptoms

1. No cooling with equivalent symptoms as those of compression failure.

2. Check temperature at the entrance and exit 3. Check 220V voltage for reversing coil

12. Service Valve

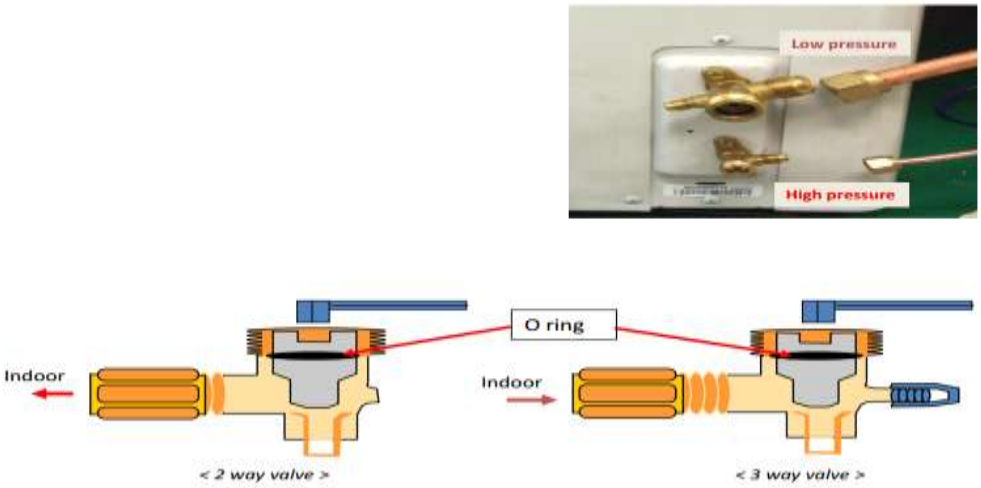


Figure 39

A) Role

Used for vacuuming and discharging refrigerant

▸2 way valve (high pressure, liquid) ▸3 way valve (low pressure, gas) Front seat

▸Valve is turned clockwise (refrigerant flow stopped) Back seat

▸Valve is turned counter clockwise (refrigerant flows)

B) Failures

Gas leakage due to O ring abrasion (deformation

13. Expansion Valve = LEV, EEV

A) Role

Device that changes liquid amount of refrigerant slightly for optimal cycle condition

Degree of openness can be changed based on user control logic (programming)(differs by model)

Degree is adjusted by the motor.

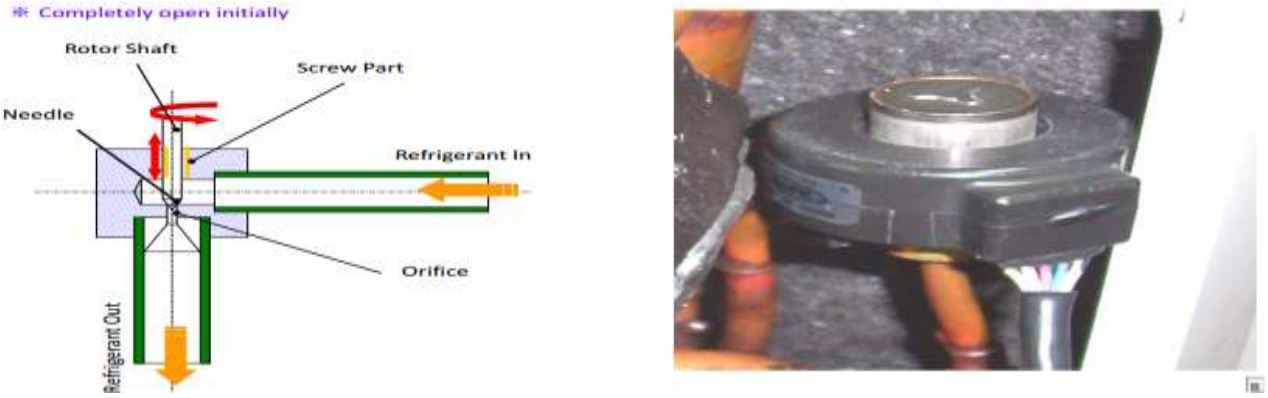


Figure 40

14. Outdoor Fan Motor

Figure 41

A) Role and Failure Repair

1) Role : Blows heat generated by the condenser to liquefy refrigerant with wind created by motor rotation out to cooling cycle Installed in the outdoor unit

2) Failure symptoms

▸ Overheating as condenser cannot discharge heat ▸ H.P S/W activated due to pressure rise

▸ Degraded cooling power ▸ OLP activated due to overheated compressor

▸ Rise in operating current

3) How to repair

▸ Turn power off. Remove motor to separate terminal.

Measure resistance of main-coil, sub-coil, control-coil of motor, normal if can measure resistance.

▸ Use working capacitor to run motor on its own to check

① Motor does not start. ② Rotating speed is very slow. ③ Bearing failure (axis does not move) ④ Arc occurs inside motor. ⑤ Smoke occurs inside motor. N⑥ Loud noise occurs.

15. Capacitor

A) Role:-Makes it easy to start the compressor and motor and maintain normal running. Categorized into those for starting and running.

B) Type

1) Starting capacitor

If compressor cannot be activated by supplying starting current, use starting capacitor to supply. (Single-phase compressor improves voltage starting characteristic with short-term rating.)

2) Running Capacitor

Motor consists of coil windings, and when electricity flows in coil,
loss is great at an efficiency rate of 40 ~ 60%.
Capacitor that works in reverse to the coil is used to improve power factor
enhancing efficiency and reducing electricity consumption,.

C) How to Check

▸Measuring resistance with an analog multitester

- Needle moves momentarily and returns → Normal - Needle moves and stops at the place → short
- Needle does not move → disconnection

- Check short circuit between the unit and terminal (good if ∞)

▸Measuring capacity with a digital multitester

- Measure capacity of C and H, C and F of capacitor ex) if 40㎌is measured for 45㎌Capacitor bad (capacity decreased) if last unit of measured value is Nf, bad (disconnection)

D) How to check

Compressor starting failure, noise occurs and OLP is activated

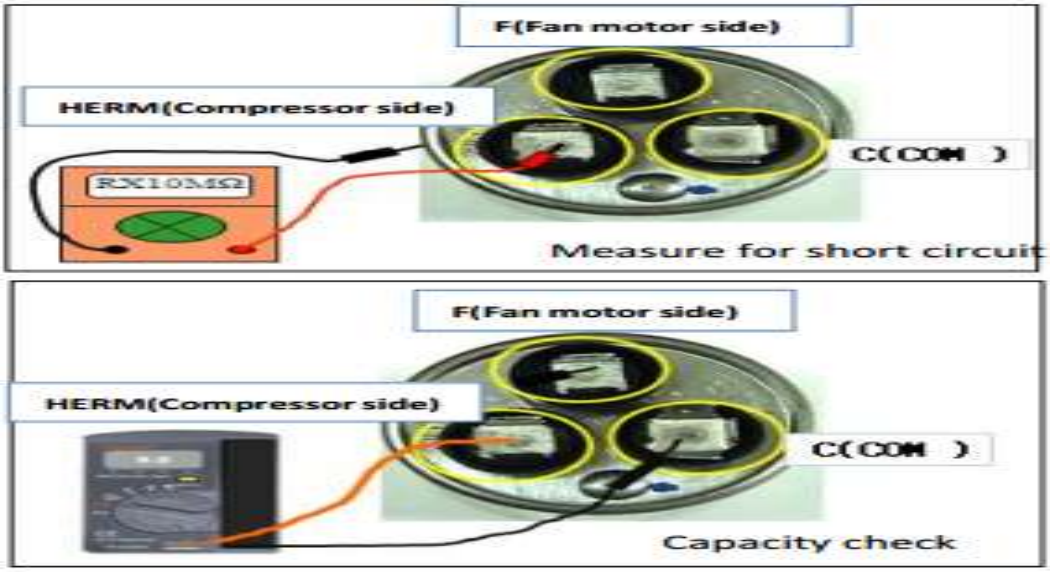


Figure42

V. Features and How to Use

1. Indoor unit parts and view

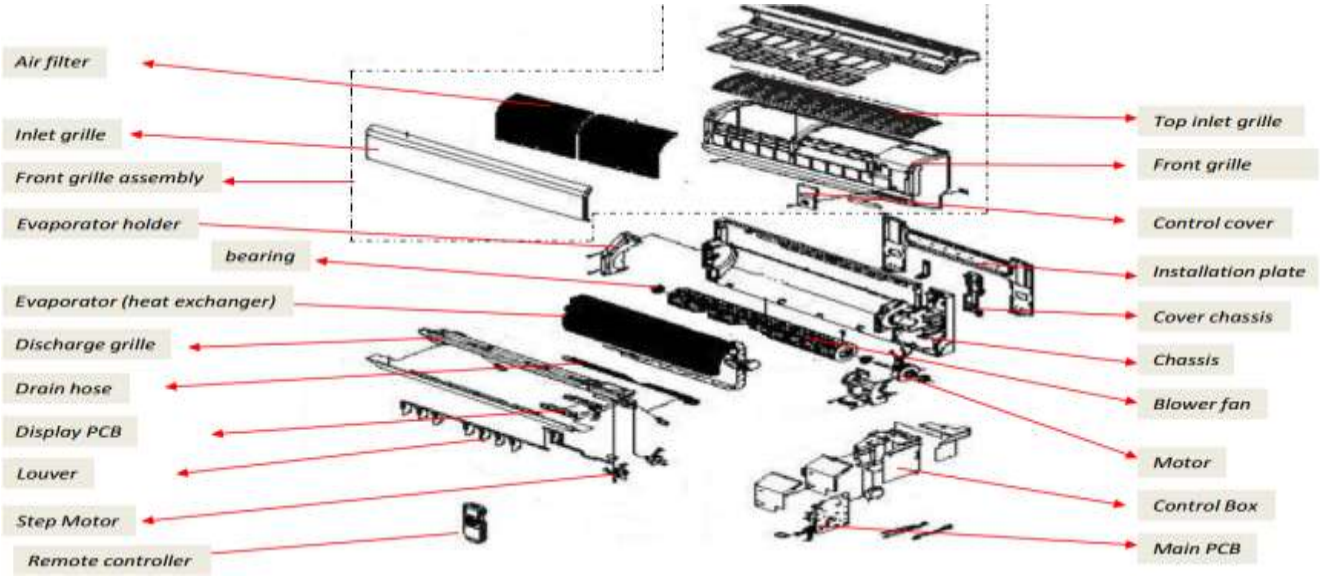


Figure43

2. Outdoor unit parts and view

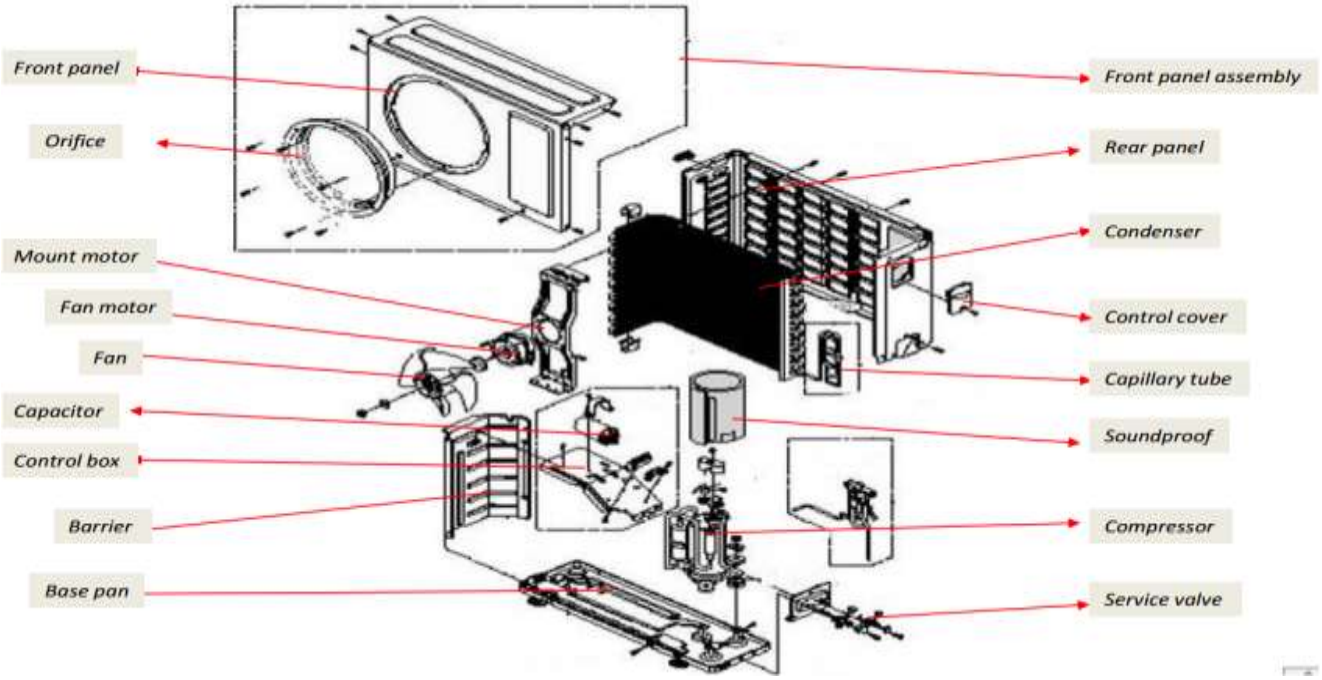


Figure 44

1. Role of Indoor Unit

Sucks air at room temperature, cools it down and discharges. Air conditioner cooling pin should be clean at all times.

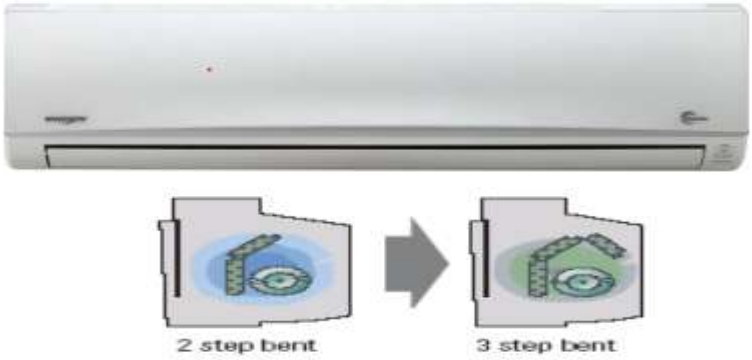


Figure 45

2. Role of Outdoor Unit

Outdoor unit condenses refrigerant that evaporated at the evaporate or to send it back to the indoor unit. It lets out hot air, dislike the indoor unit. If condenser in the outdoor unit is polluted due to dust, smoke and more, air conditioner performance may be degraded. If the product is heavily polluted, it can be overloaded resulting in higher electricity consumption, shorted lifetime and product failure

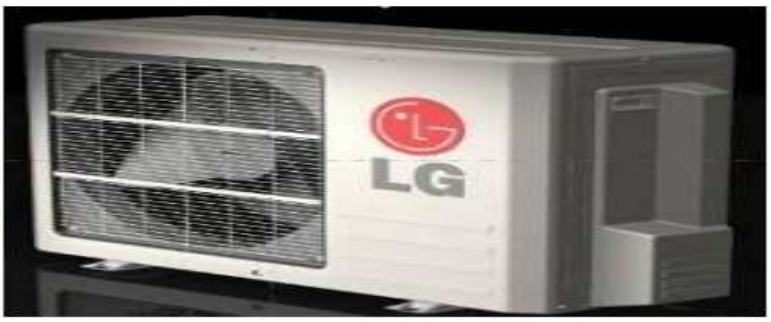


Figure 46

1. Cooling

Stops the compressor/outdoor fan when the room temperature reaches below 0.5℃ from set temperature.

Restarts the product when the room temperature is higher than the desired temperature by 0.5℃.

- When the compressor is stopped, the indoor fan will operate at low, and fan speed cannot be controlled.
- Cooling temperature range : 18℃ ~30℃

2 Delay Start/Pre-Set Stop

- To prevent the compressor overload, the product is activated after 3 minutes compressor stopped based on conditions

3. Indoor Fan Speed

- Indoor fan speed is controlled by key entered on the remote controller. (low, medium, high, and chaos)
- When the product is on auto, fan speed cannot be controlled. However, fan speed can be selected during dehumidification.

4. Sleep mode

During cooling/dehumidification, if sleep mode is turned on, set temperature will automatically change as time passes for comfortable sleep.

- Indoor fan speed follows initial settings and is changed to low or stops after a certain period of time to minimize noise.
- After time set, (1,2,3,4,5,6,7 hours), the product will stop

5. Timer (on/off) setting

- The product is activated or stops based the timer

6. Healthy Dehumidification Operation

- Press Operation mode to select Healthy Dehumidification. The product will dehumidify by detecting the room temperature and setting desired temperature and fan speed automatically.

However, desired temperature will not be shown on the remote controller and temperature cannot be controlled.

- During Healthy dehumidification operation, fan speed is automatically set to be operated with optical algorithm.

The function is appropriate to be used in monsoon season, when humidity is high.

7. Jet Cool

1) Jet Cool?

- Press the Jet Cool button during any modes to run the product with super high speed on cooling mode for 30 minutes to reach room temperature of 18℃.
- When operation, fan speed, temperature, Jet Cool is entered during operation, Jet Cool will be canceled and the product will run on cooling operation.

2) Display

Figur47

8. Auto Clean Operation

1) Auto Clean Operation?

- Air conditioner will remove moisture inside the product (for 30 minutes) and stop after cooling operation when the Auto Clean button is pressed.
- The product can be used with the function on with the remote controller. Pressing the button again will deactivate the function.

2) Display

- Display : CO (Cleaning Operation)
- Left, right, and bottom wings open slightly during operation

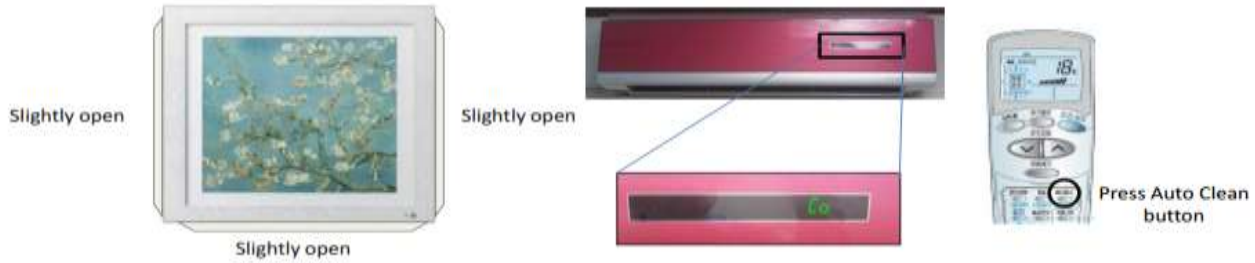


Figure 48

9. Auto Operation

1) Auto Operation?

- Based on room temperature, desired temperature is automatically set based on the Fuzzy Rule. (normal operation)
- Indoor fan speed is automatically adjusted based on changes in the room temperature, therefore fan speed cannot be controlled on the remote controller.
- Temperature control by the remote controller is done in 5 stages based on room temperature and Fuzzy Rule.

2) Display

- Display : AI

	Display during auto operation					
Fuzzy Key valve	Initial display	Hot 2	Hot 1	Normal	Cold 1	Cold 2
LED Display	AI	-2	-1	0	1	2

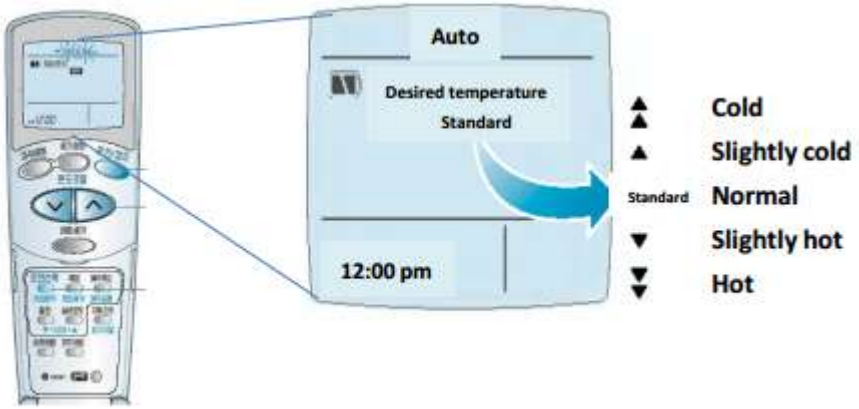


Figure49

10. Forced run and test run

A) Switch Type

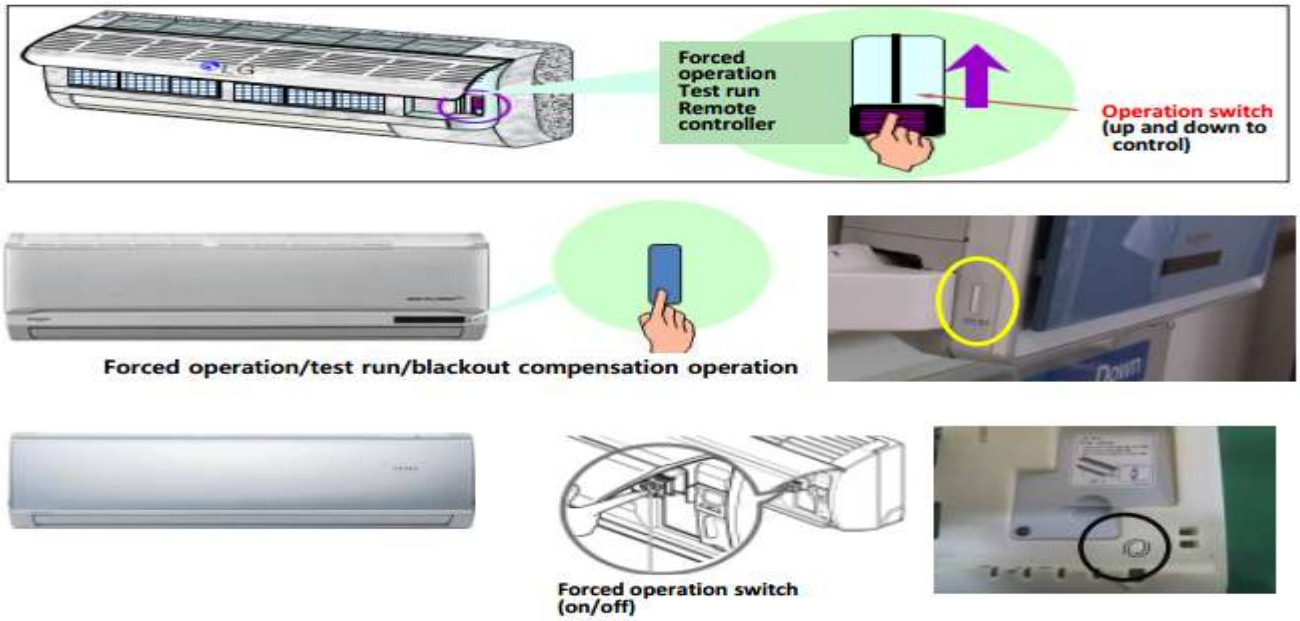


Figure 50

B) Operation condition and cancel

▸ Press tact switch to start forced operation.

▸ Press for 3 seconds for test run.

▸ Press for 7 seconds for blackout compensation operation(Press for 7 seconds to cancel

C) Forced operation? Used to operate the product with set conditions by pressing the Forced Operation switch for in case the
remote controller is lost or batteries are discharged and the remote controller can not used.

◎ set conditions ▸ Temperature :22℃ (automatically set)

▸ Wind: strong (cannot be controlled)

D) Test run? Can be used when the product needs to be tested after installation in winter (low temperature).

① Set the slide switch at Test Run when power is turned on. ② Operate at cooling/high fan speed regardless of room temperature. ③ The product automatically stops after 18 minutes.
④ The product can be stopped by the remote controller during test run, and the test run will stop if the slide switch is moved to the remote controller.

☞ During test run, “Lo” is displayed for desire temperature. When buttons that changes set temperature (mode, temperature control, fan speed, and zet cool) are pressed, display of 88 is changed and test run will be canceled.

1. Indoor Unit Wiring Diagram

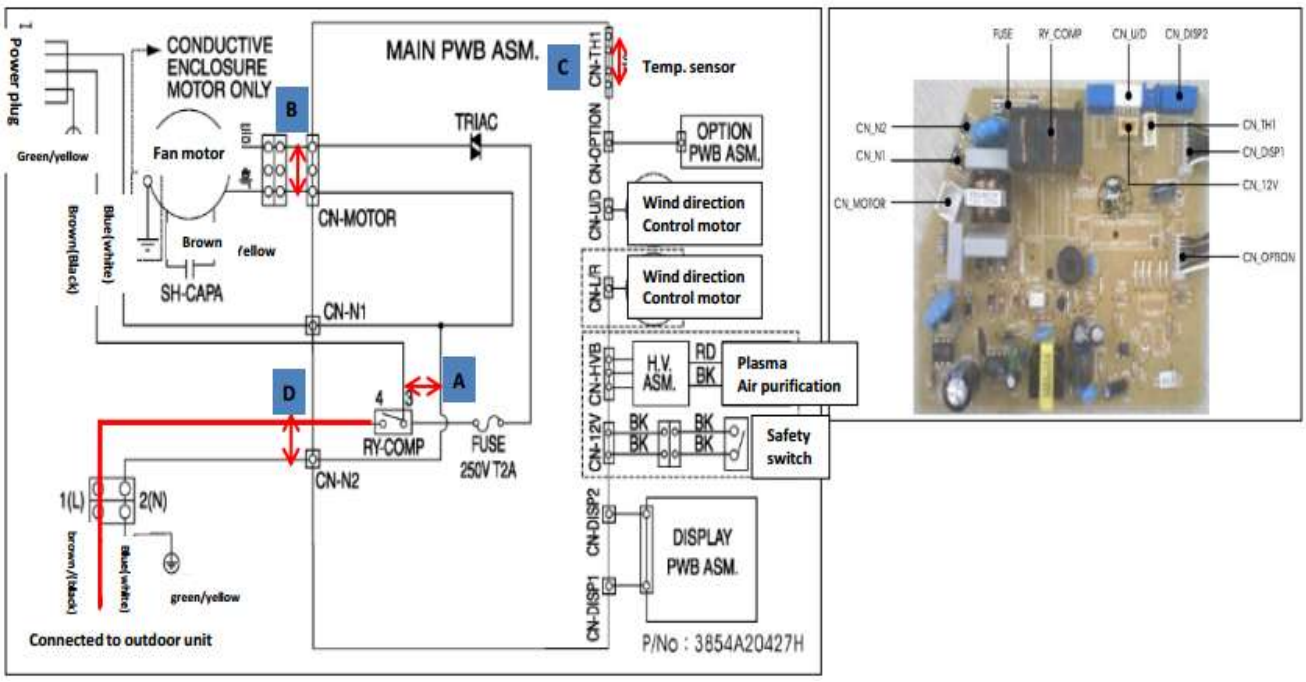


Figure 51

.Power plug: AC 220V 2.RY-COMP : On when outdoor unit in operation

3.Fan motor: Indoor unit motor (Motor for phase control) 4.SH-CAPA : Capacitor for indoor motor

5.TRAIC : Controls strong/normal/weak for motor 6.FUSE : blows when over current flows.

7.OPTION PWB ASM : PCB to identify model, malfunctions when removed

8.HV ASM :High voltage ASM 9.Temperature sensor : senses indoor temperatur

1) Power

When power is turned on, 220V supplied to both end of A(RY3,CN-N1) →through fuse and both ends of CN-N2 supply 220V for main PCB

※RY3 is for power input and RY4 is for compressor output. No power occurs for wrong connection, disconnection, or blown fuse.

2) Indoor motor

When the indoor motor operates, voltage of 150~220V (voltage changes based on cooling setting) can be measured at the end of B

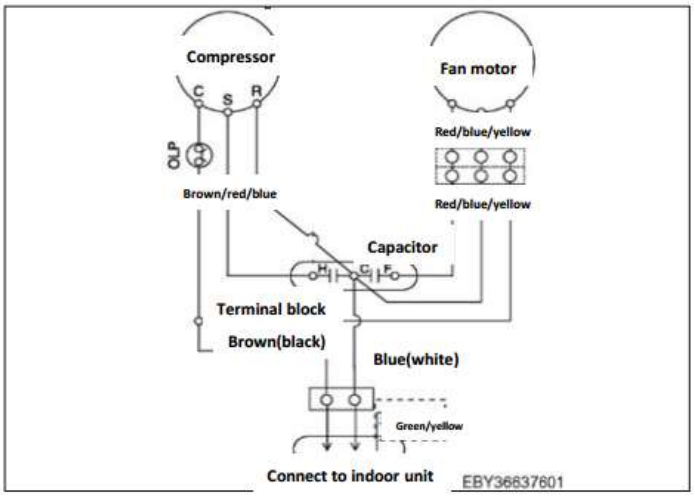
3) Ambient sensor

Resistance changes based on indoor temperature. C voltage (DC 1V~4V) through sensor is delivered to Micom to compare with set temperature and determine to turn RY on or off.

4) Outdoor unit activation

When requirements for turning on RY-COMP are met, 220V is supplied for both end of D RY4, CN-N2 to be applied to both ends of L and for outdoor unit

2.1 Indoor Unit Wiring Diagram



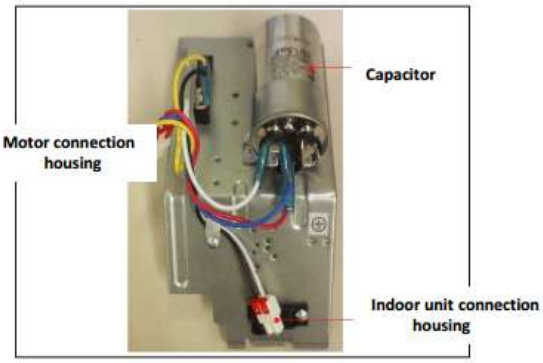


Figure 52

1. Compressor: For single-phase 2.Fan motor : Motor for outdoor unit
3.OLP : Safety device to protect the compressor 4.Capacitor : Capacitor for compressor and fan motor
5.Terminal block : Line connection terminal

3.3 Microwave Oven

OPERATION OF A TOASTER OVEN, PARTS and FUNCTIONS

Toaster is an electrical or a typical small kitchen appliance used to toast a bread. Bread that is cut into slices and cooked at a high temperature to make it brown and crisp is referred as toast. The toaster ovens at present are not just for toasting breads, instead the function was extended to other related tasks for particular purpose. The additional task are baking, roasting and broiling.

. The three cowmen selections among toasters are pop-up toaster, toaster oven, and conveyor toaster. Toaster oven will be the focus of this lesson. Toaster oven is a small electric oven with front door, wire holder and a removable pan for roasting. This domestic appliance is considered as a miniature oven that allows you to bake and broil foods. Combination of heating elements is used to provide desired temperature for the purpose. As the unit is plugged-in to the power source, set of controls are turned to the desired level allowing the current to flow throughout the circuit. The heating element is energized and therefore produces equivalent temperature suited for the purpose. Timer switch sets how long the cooking takes and turns the unit off upon cycle completes. Several functions were in corporated to toaster oven nowadays resulting to additional control. Toaster oven may vary its capabilities and features depending on the brand, model, and application. The following procedures could be used as reference.

3.3.1Toast function

This is used for toasting breads and other similar foods. All heating elements are used during this function.

1. Place the oven **rack** on the middle oven rails. 2. Turn the **TEMP** control knob to **450°F**.
3. Turn the **FUNCTION** control knob to **TOAST**. 4. Place the food to be toasted on the oven rack.
5. Turn the **TIME** control knob to the required browning level. The **POWER** indicator turns on. (See owner's manual for preferred setting) 6. At the end of the toasting cycle, a bell will ring, to indicate the cycle has finished, and the appliance switches off. The **POWER** indicator turns off.

3.3.2 Bake function

This function provides constant and even heat suitable to be used for baking (cookies, cakes, and pies), and roasting (beef, pork, chicken, or other meat). All heating elements are used during this function.

The convectionfan circulates the hot air around the inside of the appliance.
1. Place the **broil rack**in the appliance. 2. Turn the **TEMP** control knob to the required temperature.
3. Turn the **FUNCTION** control knob to **BAKE**.
4. Preheat the appliance, if required, by turning the **TIME** control knob to the required time. The **POWER** indicator turns on.
5. Place the baking dish with the item/s to be baked on the **broil rack**.
6. Turn the **TIME** control knob to **STAY ON** or to the required time. The **POWER** indicator turns on.
7. If a time was set, a bell will ring at the end of the cycle, to indicate the cycle has finished, and the appliance switches off (**POWER** indicator turns off).
8. If no time was set, turn the **TIME** control knob to **OFF** when baking is completed. The **POWER** indicator turns off.

3.3.3 Roast function

The procedures given in the Bake function are the same. It is recommended to refer to the instruction manual of your appliance.

3.3.4 Rotisserie function

Do not to use a roast larger than 5lb. on the **spit**. Only the upper heating elements are used during this function. Chicken should be bound to prevent the legs or wings from separating during roasting and to allow the **rotisserie assembly** to rotate smoothly. It is recommended to use a meat thermometer to check the roasting progress. The procedures given in the Bake function are the same. It is recommended to refer to the instruction manual of your appliance.

3.3.5 Keep warm function

After 30 minutes, food may become dry and starts to spoil.
1. Place the **broil rack** on the **oven rails** in the middle of the appliance.
2. Turn the **TEMP** control knob to **180°F**.
3. Turn the **FUNCTION** control knob to **WARM**.
4. Place the cooked food on the broil rack.
5. Turn the **TIME** control knob to **STAY ON** or as to required time. The **POWER** indicator turns on.
6. If the time was set, a bell will ring at the end of the cycle and the **POWER** indicator turns off.
7. Remove the food from the appliance, and then switch the appliance to off position by turning the **TIME** control knob to **OFF**. The **POWER** indicator turns off.

A) Parts of a Toaster Oven (Manually Operated) Parts and components may vary due to brand, model and feature/s of toaster oven available. The following numbered parts are identified and its function defined on the next page.

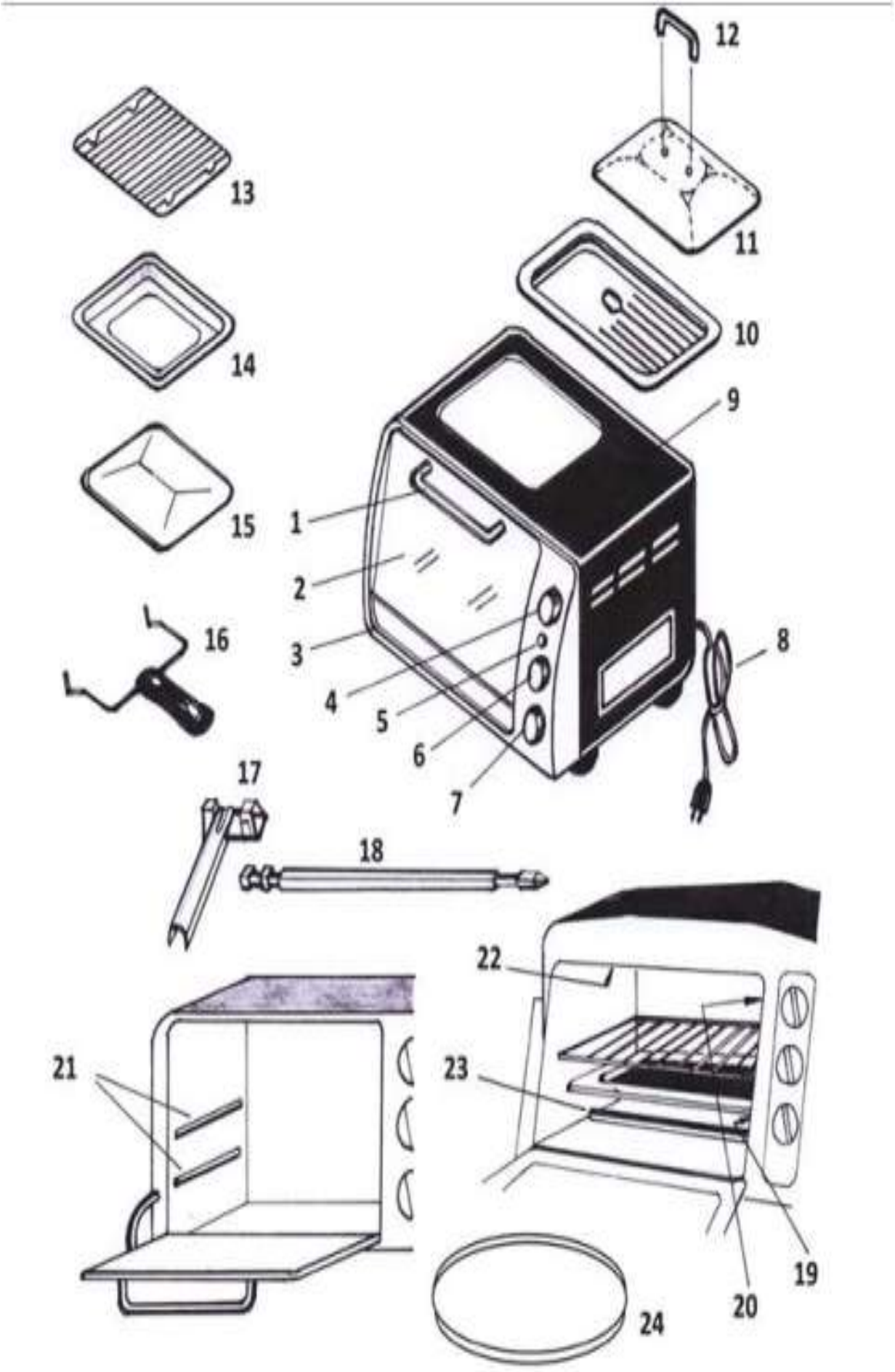


Figure 53

	PARTS	FUNCTIONS
1	Door Handle	A small round object or lever that is attached to the glass door and used for opening and closing it
2	Glass Door	Used to secure the food and temperature inside the toaster oven. A glass is used for viewing of food.
3	Lower Door Frame	Part of the housing where the door hinges are fixed.
4	Temperature Control Knob	A turning knob used to adjust the thermostat to the desired temperature.
5	Power Indicator	To indicate that the toaster oven in ON.
6	Function Control Knob	A turning knob used to set the cooking function to a desired setting.
7	Timer Knob	A turning knob used to set the cooking time up to certain minutes and will turn the oven OFF at the end.
8	Power Cord	Used to connect the appliance to the power source.
9	Housing	A compartment where all parts of the toaster oven in place.
10	Griddle	A piece of metal sheet or a pan placed on a cooker prior to cooking.
11	Griddle Cover	Used to cover the food.
12	Griddle Cover Handle	A small object or lever that is attached to the cover for holding purpose.
13	Wire/ Broil/ Cooking Rack	This is used for toasting, baking, and general cooking with casseroles and other cookware.
14	Bake/ Roasting Pan	Used for all you're baking and roasting needs, attaches to Oven/Broil Rack.
15	Crumb Tray	A removable part inside the bottom of the oven.
16	Rotisserie Removal Handle	Used to safely remove/ replace the rotisserie.
17.	Tray Handle	Used to safely remove/ replace the tray.
18.	Rotisserie Skewer	Used in roasting purpose.
19	Drive mount	The interface for the skewer.
20	Convection fan	This is activated to provide air circulation around the food for faster and more even cooking.
21	Two Rack Levels	To accommodate a variety of foods.
22	Upper heating elements (x2)	Provide required temperature from the top.
23	Lower heating elements (x2)	Provide required temperature from the bottom.
24	Pizza pan	For broiling and baking pizza.

Table 3

ELECTRONICALLY-CONTROLLED TOASTER OVEN

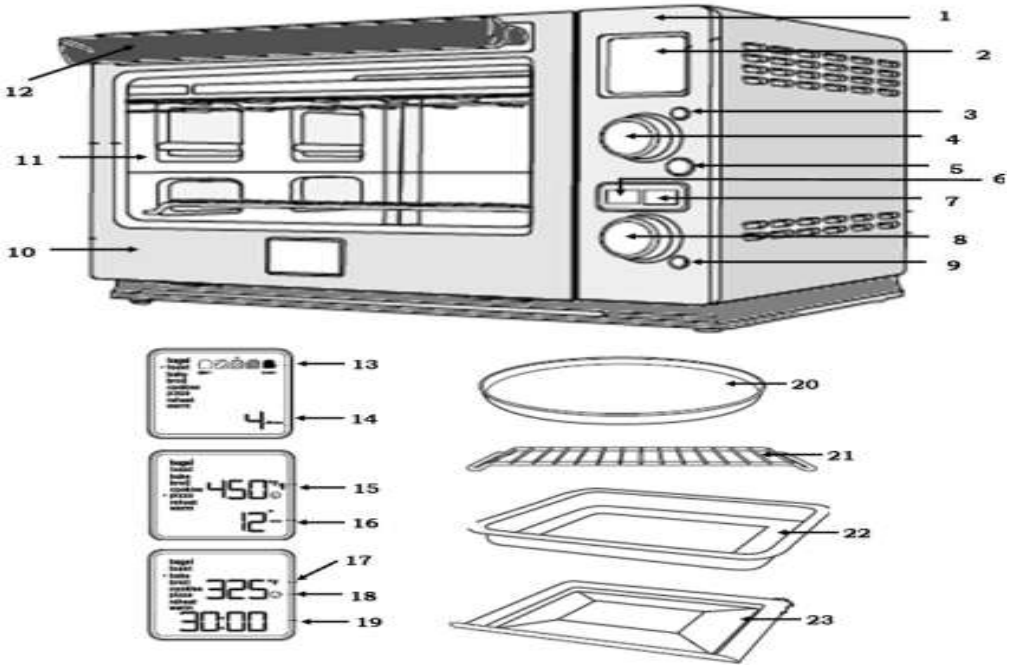


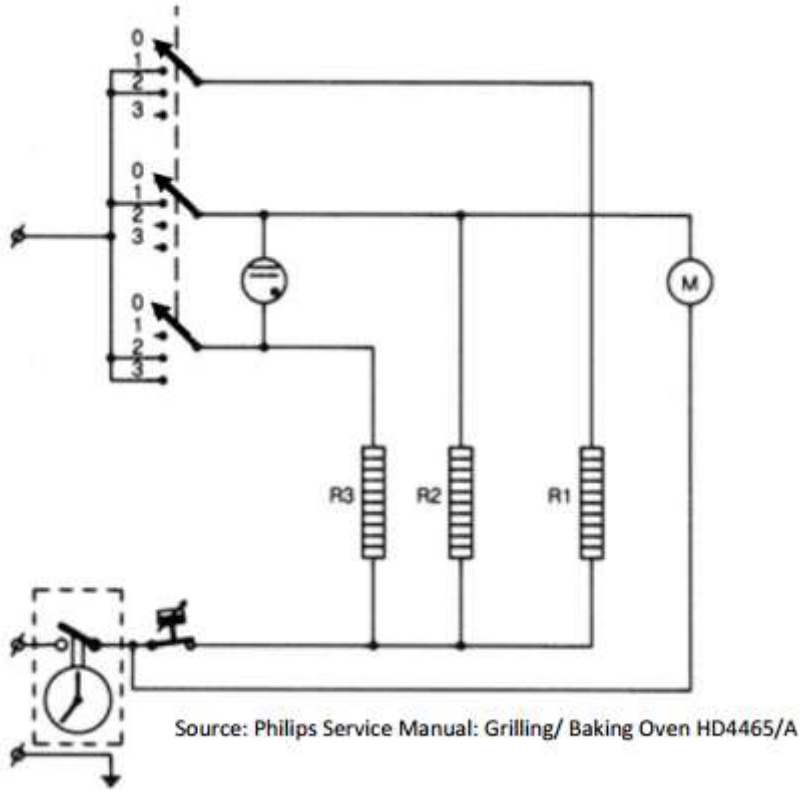
Figure 54

PARTS NAME					
1	Control Panel	9	Set	17	Temperature
2	LCD Screen	10	Door Frame	18	Convection
3	PowerPlus™ Convection	11	Flat Glass Door	19	Cook Time
4	Function/Mode Control	12	Door Handle	20	Pizza Pan
5	Start/Cancel	13	Toast/Bagel	21	Cooking Rack
6	Temp/Darkness	14	Number of Slices	22	Bake Pan
7	Time/Slices/Size	15	Preheat Icon	23	Crumb Tray
8	Temp/Timer	16	Pizza Size		

Table4

Sample diagram of a toaster oven (w/grilling and baking function)

Mechanical



Source: Philips Service Manual: Grilling/ Baking Oven HD4465/A

Figure 56

Technical Specifications	
Timer	Mechanical (max. 20 min.
Thermostat	Adjustable (30°C to 255°C)
Grill motor	2 r.p.m.
Elements top	R_1- 650 W
	R_2- 500 W
Elements bottom	R_3 = 700 W

Position	Function	Elements switched ON	Max. power consumption
1	Grilling	R_1 + R_2	1150 W
2	Baking	R_1 + R_3	1350 W
3	Toasting	R_3	700 W

Table5

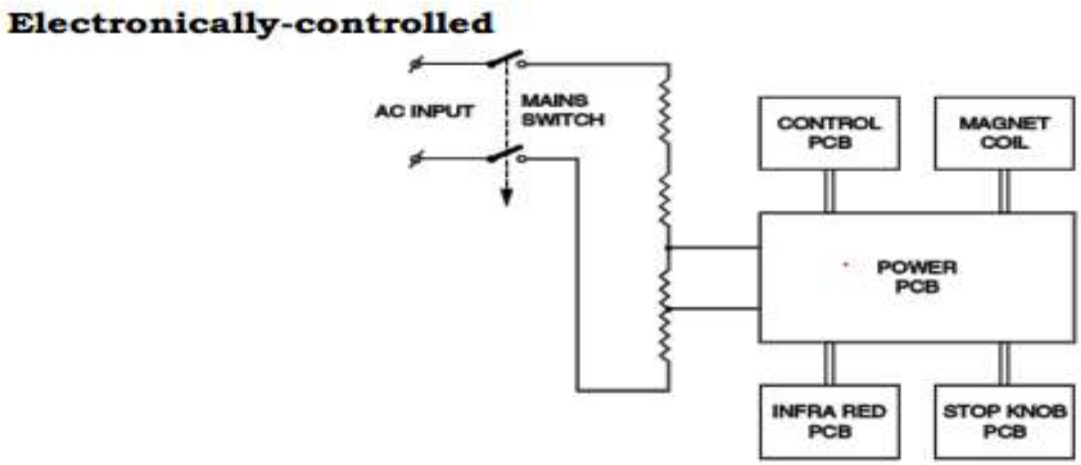


Figure 57

PRE-TESTING and TROUBLESHOOTING a TOASTER OVEN (ELECTRONICALLY-CONTROLLED)

1. Determine the specific problem by asking the symptom.

A. Ask the owner/operator of the toaster oven of what is the symptom of the unit.

B. Request some details of the symptom (how does the symptom happen and how long it has been observed).

2. Operate the device if possible. Make sure that you know how to operate a toaster oven. If not, review the operating manual as well as service manual (if available) of the unit prior to its testing and operation.

A. If you have worked on the same unit before, check out to see if it functions in the same way.

B. Determine the last time it has been modified/repaired.

C. You must recognize the symptom/ complain of the owner to the unit.

3. Perform visual inspection of the unit.

A. Prepare the tools needed and remove the cover ready for inspection.

B. Apply careful physical inspection of the parts/components. (Look for burned and broken components; Inspect for loose connections or broken wires; Check for misaligned/ deformed parts)

4. If all looks fine, test the unit for resistance checks.

A. Get the multi tester and set at lower range. Connect the test probes to each of the plug terminals, the reading must be infinite having the control/s at zero position.

B. Then, adjust slowly the timer, temperature, and function knob, decrease in resistance should be observed upon turning the knob to the right. If this happens, the unit might be in good condition. For safety, place one probe across the plug terminals and the other probe to the body. There should be very high (infinite) resistance. If resistance is observed, do not attempt to plug the unit instead solve this first. Refer to troubleshooting guide in this lesson.

5. Record your findings for future reference.

Diagnosing and Troubleshooting Procedure/ Guide:

SYMPTOM: Toaster oven is not working.		
POSSIBLE DEFECT	**PROCEDURE**	**CORRECTIVE MEASURE**
Power cord	Check the continuity of the power cord using ohmmeter.	Replace power cord if necessary.
Power source	Check the power at the outlet.	Insert the power plug into a different outlet. Reset the circuit breaker if necessary.
Fuse	Check the continuity of the fuse using ohmmeter.	Replace fuse if necessary

SYMPTOM: Toaster oven is energized but not reach set temperature.		
POSSIBLE DEFECT	**PROCEDURE**	**CORRECTIVE MEASURE**
Door not closed	Check the door.	Ensure the door is closed properly.
	Compare the thermostat setting and temperature.	Replace the thermostat if necessary.

SYMPTOM: Food not fully cooked.		
POSSIBLE DEFECT	**PROCEDURE**	**CORRECTIVE MEASURE**
Setting too low	Check the function setting as to requirements.	Set the function setting as to requirements.
	Check the temperature setting as to requirements.	Set the temperature setting as to requirements.
	Check the timer setting as to requirements.	Set the timer setting as to requirements.

SYMPTOM: The skewer is not rotating.		
POSSIBLE DEFECT	**PROCEDURE**	**CORRECTIVE MEASURE**
Oversize food	Check the food on the skew for its size and part/s touching the housing.	Switch off the appliance and remove the skew to reduce size of food. Return the skew and continue the process.

SYMPTOM: The LCD display is not backlit.		
POSSIBLE DEFECT	**PROCEDURE**	**CORRECTIVE MEASURE**
Standby mode Backlight LED	Press any button to activate the screen and backlight.	Nothing to correct.
	Check the temperature setting as to requirements.	If the screen display is ok, check the LED and replace if needed.

Table 7

Maintenance of Toaster oven

1. Turn off the toaster oven and remove the cord from the source of voltage.
2. Apply lubricant to mechanical parts of the toaster oven that requires lubrication through a drop of oil or grease to assure smooth operation without grinding or squeaks.
3. Clean and check cooling louvers for any obstructions to avoid cutting off the air flow.
4. Clean or wipe dust and foreign particles at the PC Board and metal parts of the motor.
5. Replace worn or frayed AC cord and electrical wires.

Cleaning Instructions

After every use, it is important to clean all parts of the oven. This will prolong the life of yourappliance.

1. Always switch off, unplug and allow getting cool before cleaning. Never use harsh abrasives or corrosive products. These could damage the oven surface.
2. Use damp cloth to wipe the exterior of the toaster oven. Dry immediately. Do not immerse in water.
3. Wipe the interior walls with a damp cloth and a mild liquid soap solution on a sponge. Dry immediately.
4. Slide out the crumb tray and discard to remove. Wipe clean and return.

Procedure in Repairing a Toaster Oven

1. Once the specific electrical/mechanical problem is located:
- consider the techniques for the proper removal of the defective component or parts;
- anticipate what to do if the replacement part does not correct the problem;
- and check the installation of the replacement or original part for any improper mounting in the mechanical assembly or circuit board.

2. Examine carefully the mounting of the replacement of original parts of the system.
- Check the placement of the wires or leads of the replacement component.
- Consider significant factors used in the original installation such as insulating toaster oven, silicon grease and locating mark for pin connections.
- Observe proper placement of the component leads for electrical parts.

3. Perform the techniques for the proper soldering of electrical parts.
- Be careful not to damage adjacent components.
- Be careful not to lift the copper conductive path from circuit board base material.
- Avoid any solder bridges between board paths.
- Do not destroy the component being removed in case it is still functional and be careful not to damage the component being installed.

4. Verify all connections and harness.
- Be sure that all components pre-positioned in a manner that will avoid the possibility of having adjacent components short circuited.
- Be sure to check or inspect all insulators and barriers between sections after working on any model/brand of toaster oven.
- Check for frayed or broken insulation on all wiring including the AC line cord.
- Be sure to replace fuses, resistors and capacitors with special designation such as flame proof to components equal to the original value for both safety and liability purposes.

5. Once the repair is completed, perform an AC leakage test on all exposed metal parts of a toaster oven to eliminate the possibility of electric shock.
- Perform complete retesting of the toaster oven to ensure the correctness of the actual repair.
- Connect the toaster oven into the 60Hz power to allow the time period required to let the new parts settle in and operate as they are designed to work with each other.
- Recheck or inspect if the repair was done correctly and the unit functions properly to ensure successful completion of the repair.

6. Clean the toaster oven before it would be returned to the customer.
- Be sure that the front and rear guards of the toaster oven are properly cleaned. Be sure that proper

REASSEMBLING and TESTING REPAIRED TOASTER OVEN

Reassembling Procedure:

1. After replacing the defective component of the appliance, prepare the parts for reassembling. Make sure that there are no missing part/ component and as well as the screw/s.
2. Fix all the disassembled parts in the housing/ compartment, considering the fittings/ lock/s.

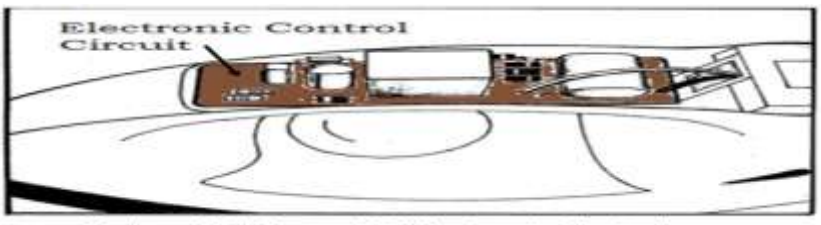
3. Wires and loose parts should be in proper place to avoid damaged due to misaligned compartment.
4. All sides of the housing should fit accordingly. Moving parts must move as it can be moved by hand and free from obstructions.
5. Tighten the screw/s accordingly.
6. Clean the unit before doing the post-testing procedure. Post-testing Procedure:
1. Test the resistance at the AC plug to determine the continuity of the power line to the heating element. A resistance reading must be observed as you turn the timer switch to ON position. This indicates that the circuit connection is good.
2. In the case of electronically-controlled toaster oven, there is no resistance reading as you test the AC plug. The reason is that there is a lowvoltage power supply circuit that controls the functions of the appliance.
3. Energize the unit to check its functionality. Plug the AC cord to the power source (the timer switch is at OFF position and power ON button for electronically-controlled must be OFF too). Turn the timer switch accordingly and observe if the unit functions as it should be. In the case of electronically-controlled, press button one at a time observing the behavior. This time, the unit should operate normally. If not, review the documentation and the problem for the second time.

3.4 AN ELECTRIC FLAT IRON

OPERATION OF AN ELECTRIC FLAT IRON, PARTS AND FUNCTIONS

The domestic Electric Flat Iron was the first of the household heating devices to receive universal recognition. From the power source at home, electricity flows through a flat cord passes through a thermal fuse and a temperature control going to the heating element. Heating element is insulated by a mica insulator from the body and it heats up the sole plate for the purpose of removing wrinkles from fabric. With the heat and the weight of the ironing plate, the fibers are stretched and the fabric maintains its new shape when cool. Some materials such as cotton require the use of water to loosen the intermolecular bonds. Many materials developed in the twentieth century are advertised as needing little or no ironing. Modern irons for home use can have the following feature:
1. a method of setting the iron down 2.a thermostat to ensure maintenance of constant temperature
3. a temperature control dial (usually marked with types of cloth) 4. an electrical cord with heat resistant Teflon insulation 5. a steam features
6. a cord control/ anti-burn control/ energy-saving control/ cordless iron

figure1
Example of Common Electric Flat Iron



Modern Flat Iron with Electronic Control
Figure 2

Basic Parts of Flat Iron

1. **AC line cord** is used to connect the unit to power source.

Figure 2

2. **Selector Switch** is a type of switch used to select the amount of heat required in ironing different types of fabrics. It can be a rotary or slide type.

Figure 3

3. **Thermal Fuse** is a safety protective device used to cut-off the circuit when the temperature rises at above normal as designed for the unit. It also protects the unit from damage when overheating and short circuit occurs.

Figure 4

4. **Heating Element** is a form of nichrome wire that assembles properly inside the high temperature metallic tube in flat iron to provide heat.

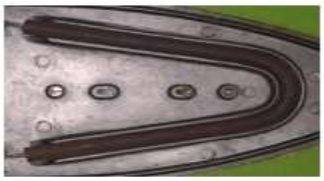


Figure 5

5. **Soleplate** is a base metal that serves as fabric pressing part made of metal where the heating element is placed

Figure 6

6. **Handle** is the part of a flat iron by which it is carried or controlled

Figure 7

7. **Body/Case** is used to protect the internal parts of the flat iron and serve as shield for the heat and protection of the hand of the user.

figure 8

8. **Neon/Pilot Lamp** is used to indicate that electricity is flowing along theheating element.

figure 9

9. **Thermostat Assembly** is used to regulate the temperature.

Figure10

10. **Electronic Control** is the added feature of modern electric flat iron which can act as timer or automatic power cut-off switch for additional protection.

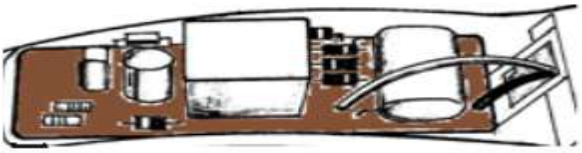


figure11

Note: To avoid a circuit from overload, do not operate another high wattage appliance on the same circuit. If an extension cord is absolutely necessary a 16A cord should be used with a 220V iron. Cords rated for less amperage may overheat. Care should be taken to arrange the cord so that it cannot be pulled or rippledover.

Sample Schematic Diagram

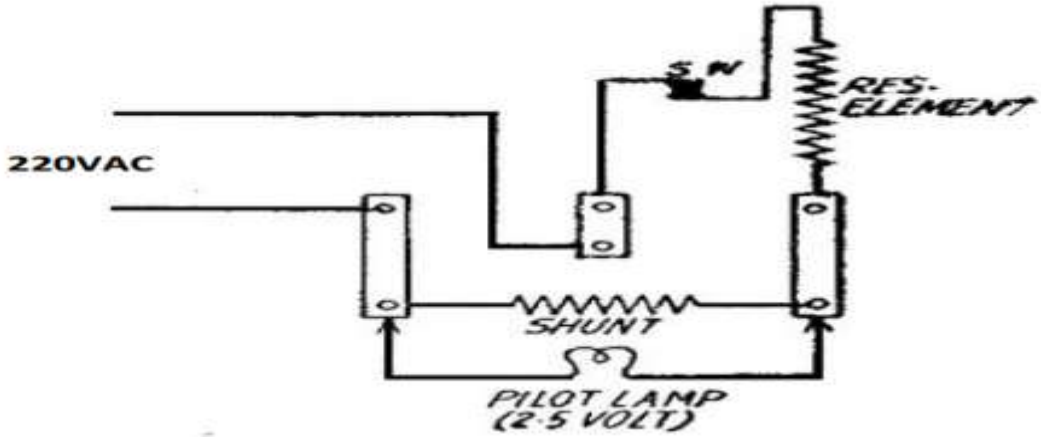


Figure12

Parts of Thermostat Assembly

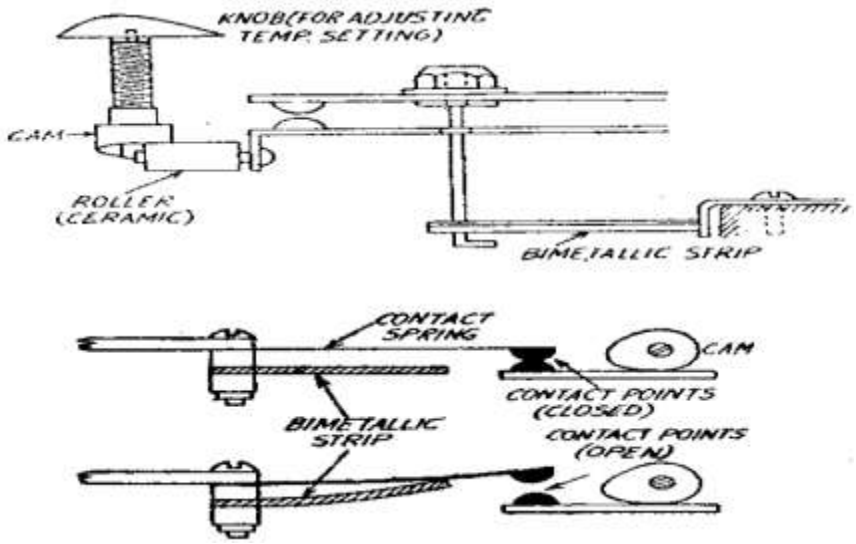


Figure13

HEATING AS ONE OF THE EFFECTS OF ELECTICITY

electricity is also converted into another usable power like heat. When an electric current flow through a wire some loss occurs and this loss is almost inevitable, more the resistance of wire, more the loss. This loss is due to the electrical resistance of wire is mainly responsible for the heating effect of electric current. The more electrical resistance of the wire, the more generated heat. The fixed atoms of the wire resist the flow electrons and as a result, there are collisions and as the kinetic energy converts into heat energy we see that the wire is getting hot. Electric heating has several advantages: it can be precisely controlled to allow a uniformity of temperature within very narrow limits; it is cleaner than other methods of heating because it does not involve any combustion; it is considered safe because it is protected from overloading by automatic breakers; it is quick to use and to adjust; and it is relatively quiet. For these reasons, electric heat is widely chosen for industrial, commercial, and residential use. Resistance heaters produce heat by passing an electric current through a resistance: a coil, wire, or other obstacle which impedes current and causes it to give off heat. Heaters of this kind have an inherent efficiency of 100% in converting electric energy into heat. Devices such as electric ranges, ovens, hot-water heaters, sterilizers, stills, baths, furnaces, and space heaters are part of the long list of resistance heating equipment.

Procedure in Pre-Testing and Troubleshooting an Electric Flat Iron

1. Determine the specific problem by asking the symptom.

a. Ask the owner/operator of the electric fan of what is the symptom of the unit.

b. Request for the details of the symptom (how does the symptom happen) and how long it has been observed).

2. Operate the device. Make sure that you know how to operate an electric flat iron. If not, review the operating manual as well as the service manual (if available) of the unit prior to its testing and operation

a. If you have worked on the same unit before, test out to see if it operates in the same way.

b. Determine the last time it has been modified/repaired.

c. You must recognize the symptom/ complain of the owner to the unit.

3. Perform visual inspection of the unit.

a. Prepare the tools needed and remove the cover ready for inspection.

b. Apply careful physical inspection of the parts/components. (Look for burned and broken components; Inspect for loose connections or broken wires)

4. If all looks fine, test the unit for resistance checks.

a. Get the multitester and set it at range Rx1. Connect the test probes to each of the plug terminals, the reading must be infinite having the temperature control at zero position.
b. Then, adjust slowly the temperature control, decrease in resistance should be observed. If this happen, the unit might be in good condition. For safety, place one probe across to the plug terminals and the other probe to the body. There should be very high (infinite) resistance. If there's something different, refer to troubleshooting guide on this lesson.
5. Record your findings for future reference.

How to use an electric flat iron

1. Adjust the temperature selector to a minimum position before plugging cord into electrical outlet.
2. Pre-heat the unit at least 2 minutes before using.
3. To improve dry ironing results, sprinkle the garments with water evenly at least one hour before ironing.
4. Unplug iron by gripping plug and pulling it from the outlet. Never pull the cord.

Diagnosing and Troubleshooting Procedure/ Guide:

SYMPTOM: Flat iron not energized.		
POSSIBLE DEFECTIVE PART	**PROCEDURE**	**CORRECTIVE MEASURE**
Power Cord	Measure the continuity of the power cord using ohmmeter.	Replace power cord.
Thermal Fuse	Measure the continuity of the fuse using ohmmeter.	Replace fuse.
Selector Switch	Check for the alignment of the switch to the thermostat.	Align the selector switch.
Thermostat	Measure the continuity of the power cord using ohmmeter.	Replace thermostat.
Heating Element	Measure the continuity of the heating element.	Replace heating element.

SYMPTOM: Intermittent Power or Heat		
POSSIBLE DEFECTIVE PART	**PROCEDURE**	**CORRECTIVE MEASURE**
Thermostat	Check the contact points for accumulated carbon or dirt.	Clean the contact points with fine sand paper. Adjust the temperature knob if necessary.

Table 1

TROUBLESHOOTING, MAINTENANCE AND CLEANING TIPS

Troubleshooting

6. Conduct a *quick* diagnosis of the trouble symptom and repair the defective set in the *shortest possible time*. Do not troubleshoot an electric flat iron unless you have determined the fault.
7. Secure a circuit diagram.
8. If the iron doesn't heat, make sure power is on to the outlet, check the electrical cord, and check the thermostat.
9. Always suspect a faulty contact on mechanical switch circuit rather than defective electronic/electrical parts.
5. If the iron produces too much or too little heat, test the electrical cord for loose wiring and connection. Also test and, if needed, adjust calibration of the thermostat.
6. Use Personal Protective Equipment. Maintenance and Cleaning
1. Turn-off and unplug the electric flat iron and make sure it's cool before cleaning.

2. Check the owner's manual for your iron to learn the specified manufacturer's suggestions for cleaning.
3. You may use a sponge and commercial soleplate cleaner or baking soda and water to remove dirt buildup on the soleplate. Rinse well with water and dry. Don't submerge an electric flat iron in water or cleaning liquid. If needed, use very fine emery cloth or sand paper to remove scratches and burns on the soleplate. Don't use harsh abrasives.

REASSEMBLING AND TESTING AN ELECTRIC FLAT IRON

Reassembling Procedure:
1. After replacing the defective part of the appliance, prepare the parts for reassembling. Make sure that there are no missing parts or component and as well as the screws.
2. Review the operating and service manual if available.
3. Fix all the disassembled parts in the housing/compartment, considering the fittings, lock etc.
4. Wires should be in their proper places and loose parts should be tightened to avoid damaged due to misalignment.
5. All sides of the housing should fit. See to it that Selector Switch is moving appropriately and the rest of the movable parts.
6. Clean the unit before doing the testing procedure.Testing Procedure:
1. Set the ohmmeter to Rx1.Test the AC plug to determine the continuity of the power line to the heating element. Reading must be around 14 ohms.
2. Energize the unit to check its functionality. Move the Selector Switch slowly. Within a minute or two, the unit should operate normally. If not, review the documentation and troubleshoot again.

3. 4 ELECTRIC RICE COOKER

3.4.1 Operation Of An Electric Rice Cooker

A rice cooker is a kitchen appliance dedicated to cooking rice. Rice is cooked by heating in boiling water and steam, or a combination (boiling until water evaporates, and then continuing in steam generated by continued heating). It absorbs a great deal of water in the process, expanding its volume and using up the cooking water. For the modern home rice cookers, the smallest single-person model cooks 1 rice cup (180 *ml*) whereas the largest cooks 10 rice cups (1.8 *liter*).The typical lower price models use electric heaters to heat the inner cooking bowl controlled by thermostat assembly or built-in electronic control, whereas the high-end models feature various ideas of improved and better cooking methods. Electric rice cookers automate the process by mechanically or electronically controlling heat and timing. Although the rice cooker does not necessarily speed up the cooking process, with an electric rice cooker the cook's involvement in cooking rice is reduced to simply measuring the rice, preparing the rice properly and using the correct amount of water. Once the rice cooker is set to cook, the rice will be cooked with no further attention.

3.5 Principle of operation (basic rice cooker models)

The **bowl** in the rice cooker is usually removable, to which rice and water are in place. A **heater** and **thermostat** is beneath the bowl. A spring pushes the thermostat against the bottom of the bowl for good thermal contact. During cooking, the rice/water mixture is heated at full power. The water reaches a temperature of 100 °C (212 °F); it cannot get hotter than its boiling point.

figure 1

By the end of cooking there will be no free water left; most will have been absorbed by the rice, and some boiled off. As heating continues, the temperature can now rise above boiling point; this makes the thermostat

trip. Some cookers switch to low-power or "warming" mode, keeping the rice at a safe temperature of approximately 65 °C (150 °F); other models simply switch off.

Basic Parts of Electric Rice Cooker

It is best to acquire Service Manual and Diagrams specific for different models, design might vary from one manufacturer and/or model to another.

Exploded Views

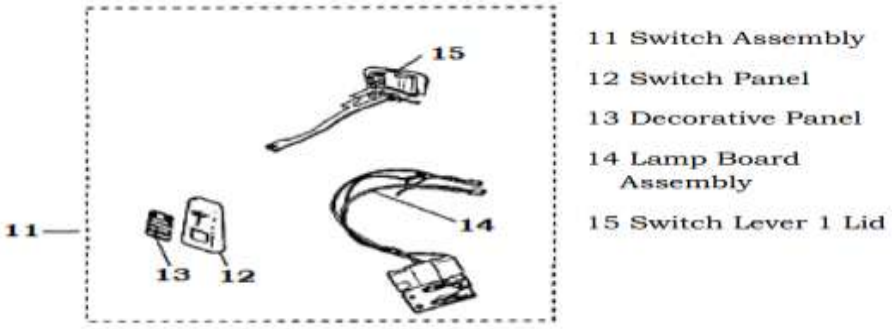


Figure 2

In simple models, a mechanical thermostat is used to turn off the cooker when the rice is ready. Since 1980s, higher-end electric rice cookers have used electronic components such microprocessors to control the cooking process, often incorporating a memory and electronic timer that can be used to set the desired "ready time". Some models can be used as steamers to cook food

Sample Schematic Diagram of a Rice Cooker

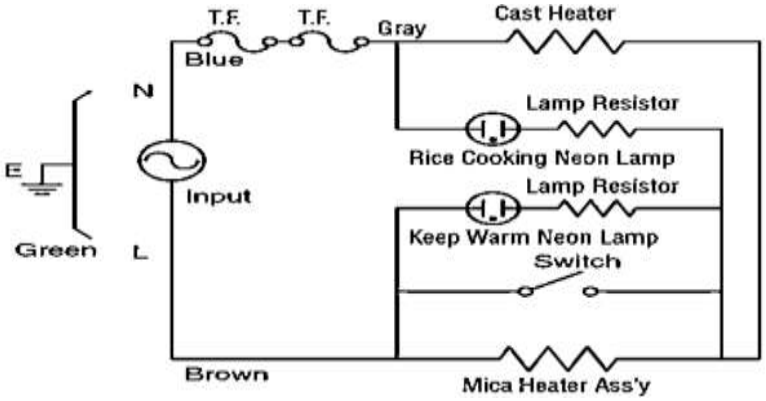


Figure 3

Function of Center Thermostat and Thermal fuse

The center thermostat turns off the cooking cycle, and starts the warming cycle when it senses that the bottom of the rice cooker pan reach 134°C ± 6°C. The illustration below shows the construction of center thermostat upon cooking and warming.

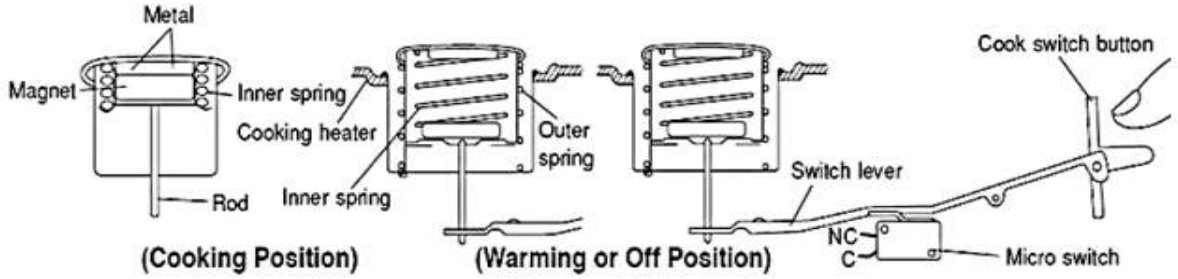


Figure 4

Wiring Diagram of an Electric Rice Cooker

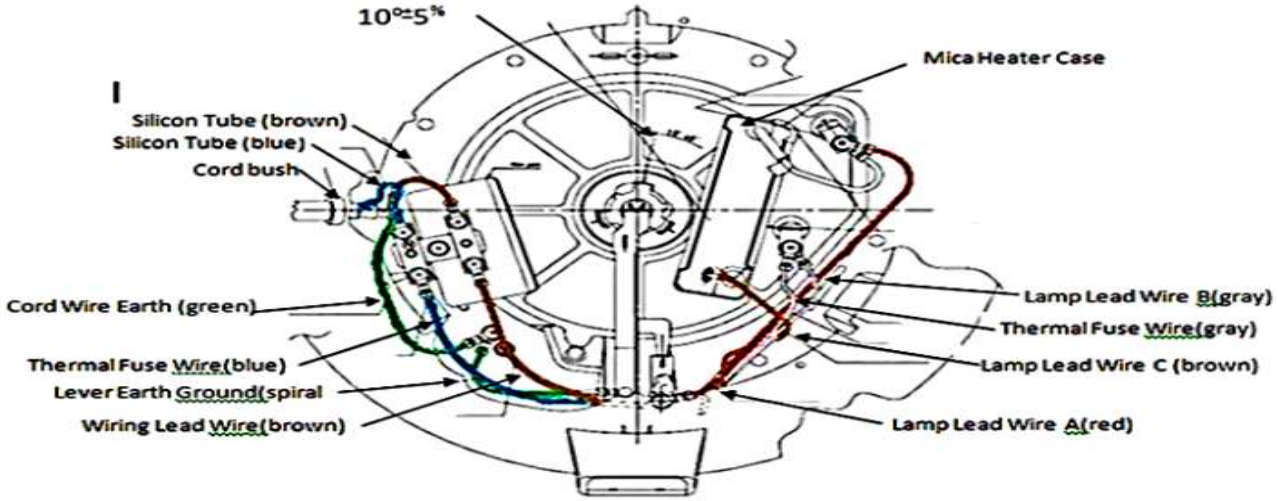


Figure 4

The ability of a metal to be attracted by the magnet decreases as it is heated. Finally, the inner spring pressure becomes stronger than the magnetic pull and the metal and magnet will pop apart. The rod activates the switch lever which causes the auxiliary lever to press the micro-switch button into the warming cycle.

Switch-On Preventive System

This prevents the rice cooker from being turned on without the pan placed into position.

1. Normally when the pan is inserted properly into the rice cooker, the pan will depress the center thermostat. The center thermostat outer spring will be compressed causing the switch button to depressed, and then the following will happen:

a. The auxiliary lever will activate the micro-switch button. This puts the micro-switch in the cook position.

b. The switch lever will push the rod which will allow the magnet tomeet with the metal.

c. When the rice is cooked and the proper temperature has been reached (134°C ± 6°C), the metal and magnet will pop apart.

d. The rod will push the switch lever and cause micro-switch to turn in warming position.

2. When the pan is not in place within the rice cooker, the center thermostat is not depressed.

a. In this condition, the outer spring is not compressed within the center thermostat preventing the metal from reaching its normal operating position.

b. When the switch button is depressed, the switch lever and auxiliary lever work as above but the magnet cannot come in contact with the metal to hold the switch lever in the cook position.

c. When the pressure is taken off the switch button, the switch lever releases immediately to the open or warm positions.

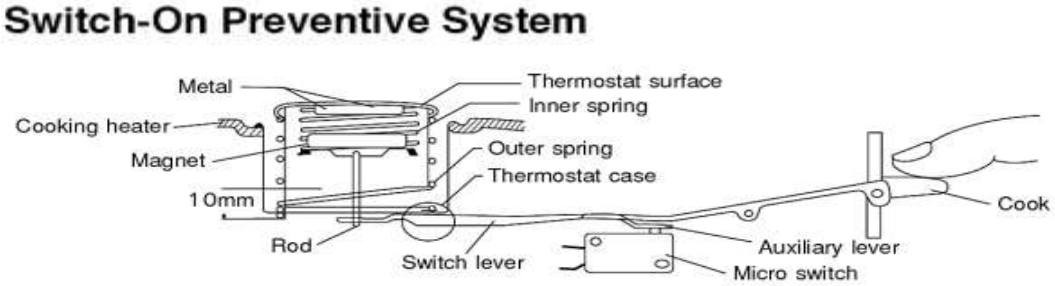


Figure 5

Thermal Fuse

The thermal fuse is used to open the circuit to the cooking heater when the temperature has gone unusually high. An incomplete contact between the heater and pan or if the switch buttons is forced to stay on keeping the heater energized abnormally may cause the thermal fuse to open.

ELECTRONIC CONTROL SYSTEMS USED IN RICE COOKER

There are two types of control system: the open loop system and the closed loop system.

Open Loop System

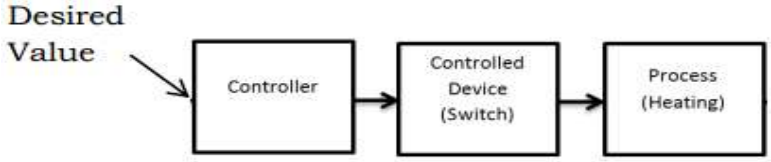


Figure 6

Closed Loop System

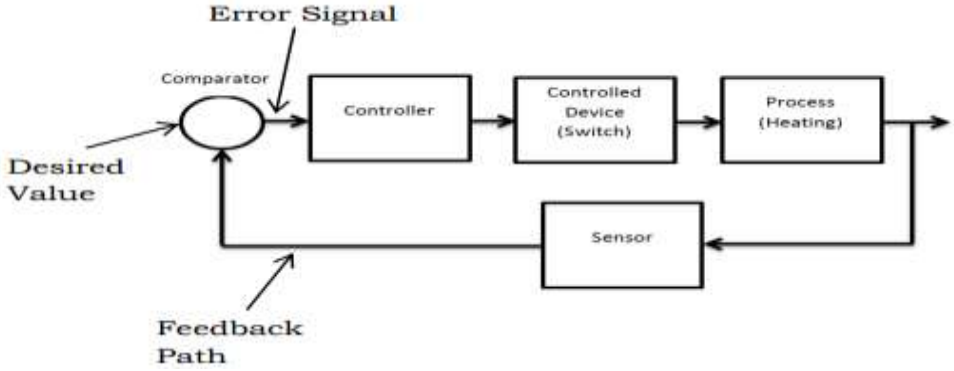


Figure7

Closed Loop System Diagram

PROCEDURE IN PRE-TESTING AND TROUBLESHOOTING ELECTRIC RICE COOKER

1. Determine the specific problem by asking the symptom.

a. Ask the owner/operator of the electric rice cooker of what is the symptom of the unit.

b. Request for the detail of the symptom (how does the symptom happen) and how long it has been observed.

2. Operate the device. Make sure that you know how to operate an electric rice cooker. If not, review the operating manual as well as service manual (if available) of the unit prior to its testing and operation

a. If you have worked on the same unit before, test out to see if it operates in the same way.

b. Determine the last time it has been modified/repaired.

c. You must recognize the symptom/ complain of the owner to the unit.

3. Perform visual inspection of the unit.

a. Prepare the tools needed and remove the cover ready for inspection.

b. Apply careful physical inspection of the parts/components. (Look for burned and broken components; Inspect for loose connections or broken wires)

4. If all looks fine, test the unit for resistance checks.

a. Get the multi tester and set it at range Rx1Connect the test probes to each of the plug terminal, the reading must be very high since you are measuring the resistance of the keep warm heater having the temperature control at zero position.

b. Then, turn-on the cook switch, make sure that you have properly inserted or placed the pan into the rice cooker with enough weight to depress the center thermostat, decrease in
resistance should be observed since the cook heater will be activated. If this happen, the unit might be in good condition. For safety, place one probe across to the plug terminals and the other probe to the body. There should be very high (infinite) resistance. Proceed to checking for consistency of heat. If there's something different, refer to troubleshooting guide o this lesson.

5. Record your findings for future reference.

3.6Washing Machines and Driers

OPERATION OF A WASHING MACHINE

Washing Machine is a domestic appliance that washes clothes with the aid of water and detergent. It is also called laundry machine, clothes washer, or washer that includes immersing dipping, rubbing, or scrubbing of clothes in water. This machine is power driven with an AC motor connected to the power source (220v/60 Hz) so that the electrical energy can be converted into mechanical energy in order to facilitate an act of washing rinsing and spinning. The simplest washing machine just agitates clothes in water with detergent, wherein some includes wash and spin timers for automatic operations.

Automatic machines or those electronically controlled may fill, empty, wash, spin and heat in a cycle. The usual domestic washing machine can be considered automatic because of the mechanical timer used. Electronically-controlled are those machines that utilize electronic circuit for switching and program of the operation depending on the features.

Parts of Washing Machine and their Functions

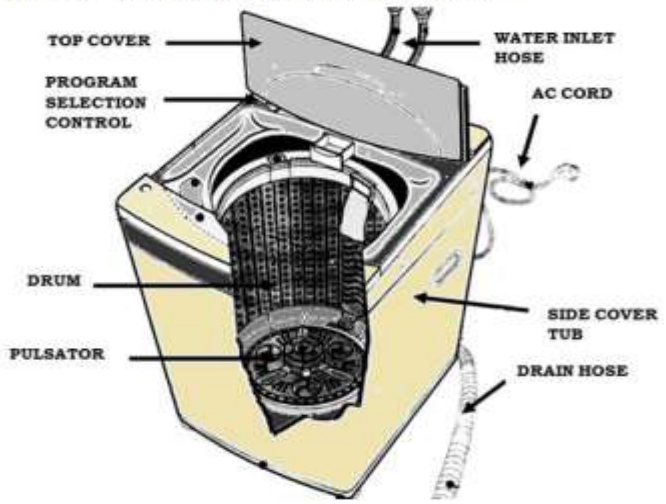


Figure 8

Internal Parts	External Parts
Drum	Program Selection Control
Pulsator	AC Cord
	Water Inlet
	Side Cover Tub
	Drain Hose
	Top cover

Table 1

3.5.2 Functions of each part

Top Cover is used to cover the tub.

Pulsator is a rotating part inside the tub and responsible in making the water spin.

Drain Hose is an outlet serves as a passage way out for water after spinning has been done.

Side Cover Tub is the main casing/housing for the parts of the unit.

Drum serves as a washing tub.

Water Supply Hose is an inlet of water.

Tub is a drum-like component in which water, clothes and soap are put together prior to washing/spinning.

Block Diagram of Electronically-Controlled Washing Machine

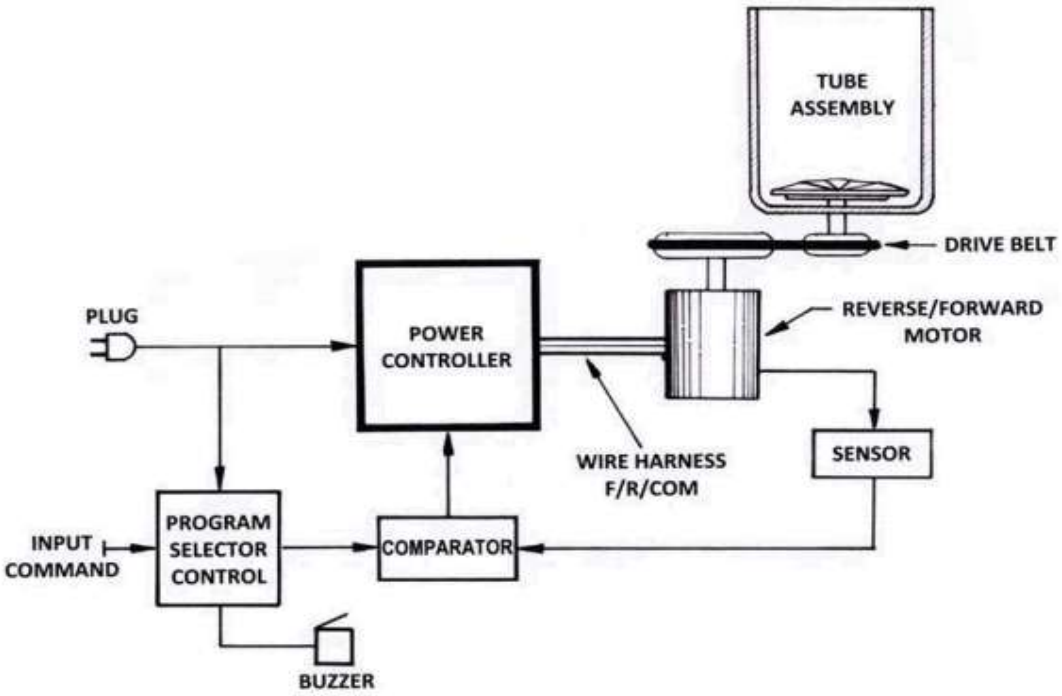


Figure 9

Power Controller- is a circuit that controls the amount of power supplied to the motor.

Sensor- is an input receiver that detects input signal coming from forward and reverse motor. It detects any abnormality of the operation for automatic shut off.

Program Selection Control- is a set of push button switch that set the operation required of the washing machine. This circuit has a timing sequence to be selected as low, medium, or high depending on how long and type of fabric to be washed.

Comparator- is a processing circuit that accepts the input signal coming from sensor and program selection control. This enables/disables a sequence of command for the power controller

Forward/Reverse Motor- is an electric machine which changes applied electrical energy or power into mechanical output energy or power.

Input Command - is a setting period of the user.

AC Plug- is a connector intended for connecting the unit to the main power source of 220V.

Drive Belt - is used to transmit mechanical energy from a driving pulley to a drive pulley.

Buzzer- is an audio/ sound signal device to confirm or indicate that task programmed or set is done or a problem occurred. This may be mechanical, electromechanical, or piezoelectric.

Another example of Washing Machine (parts labeled)

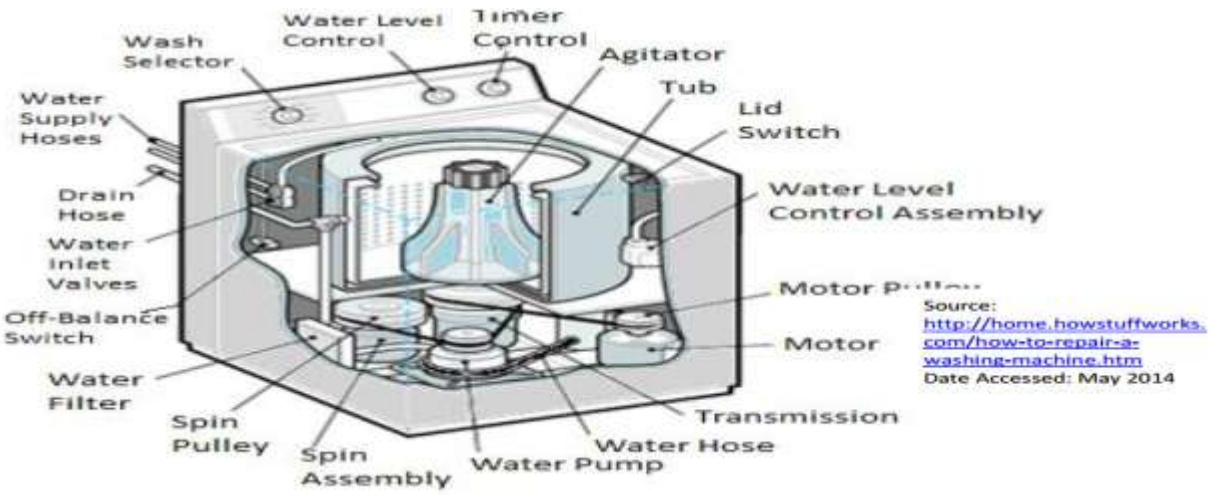


Figure 10

Functions of each part

Timer Control-is a special clock mechanism or motor operated device used to perform switching operations at predetermined time intervals.

Water Level Control- is a dial used to manage the quantity of water needed.

Wash Selector- is used to choose the task to be done

Water Supply Hoses- is an access for water supply

Drain Hose- is an outlet for the water to be dispense

Water Inlet Valve- is used to allow or stop water to flow

Off-Balance Switch- is used to shut the washer off to protect the washer if load is unbalance

Water Filter- is used to take out dirt from water by means of a fine physical barrier

Spin Pulley- is used to transmit power from the electric motor to spin assembly

Spin Assembly- is used to control the power at the transmission

Water Pump- is used to push the water out of the unit.

Water Hose- is a passage way out of the water.

Transmission- is also known as gear box assembly; transmit and boost mechanical power from the motor to the agitator.

Motor- is an electromechanical device that converts electrical energy into mechanical energy or motion.

Motor Pulley- is used to transmit power from the electric motor to the transmission through drive belt.

Water Level Control Assembly- it contains valve that is used to control the quantity of water needed.

Lid Switch- is the safety feature of the unit that operates with the lid.

Tub- is a large round container where act of washing happen.

Agitator- is a mechanism inside the tub that makes the water and clothes to spin.

3.5.3 Procedure and Techniques in Pre-Testing an Electronically Controlled Washing Machine

1. Be sure you understand how the washing machine operates. If possible, read the operation's manual first for its function and additional features.
2. Determine what the problem really is.
3. Perform preliminary inspection to locate where the problem has originated.
4. Perform closer inspection into the suspected parts or components.
5. Use appropriate instrument in initial testing of the appliance. (With the aid of ohmmeter, connect the test prods to the AC plug, turn on the timer switch and observe the pointer of the ohmmeter. If resistance is observed, the power line as well as the motor is in good

condition. If the pointer did not move it means an open circuit.)

6. Plan your approach to repair the problem.

Diagnosing and Troubleshooting Procedure/ Guide:

SYMPTOM: Washer is not energized.		
POSSIBLE DEFECT	**PROCEDURE**	**CORRECTIVE MEASURE**
Power cord	Check the continuity of the power cord using ohmmeter.	Replace power cord if necessary
Fuse	Check the continuity of the fuse using ohmmeter.	Replace fuse if necessary
Timer	Check for the continuity of the timer using ohmmeter.	Replace timer if necessary

SYMPTOM: Washer is energized but not spinning.		
POSSIBLE DEFECT	**PROCEDURE**	**CORRECTIVE MEASURE**
Starting capacitor	Check the condition of the capacitor using ohmmeter.	Replace starting capacitor if necessary
Disconnected capacitor	Check the continuity of the capacitor wiring using ohmmeter.	Replace/reconnect capacitor wiring if necessary
Broken belt	Check the size/ specification of the belt for replacement.	Replace belt

SYMPTOM: Pulsator doesn't rotate normally.		
POSSIBLE DEFECT	**PROCEDURE**	**CORRECTIVE MEASURE**
Loose belt	Check the fitness of the belt from the motor to the pulley. Check the motor fixing screw/nut.	Adjust the motor alignment to tighten the belt, if necessary replace belt. Adjust the motor accordingly with the belt.
Gear box assembly	Unplug the unit from the power source. Turn the pulsator clockwise (cw) and counter-clockwise (ccw) and see if the pulley responds accordingly. If not, the assembly is defective.	Replace the gearbox.
Timer	Turn on the washing machine and observe the interval of motor rotation(cw/ccw).If the interval is not normal, timer is defective.	Replace the timer.

SYMPTOM: Abnormal Noise and Vibration		
POSSIBLE DEFECT	**PROCEDURE**	**CORRECTIVE MEASURE**
Friction between pulsator and wash tub	Unplug the unit from the power source. Turn the pulsator clockwise (cw) and counter-clockwise (ccw) and check the tightness of the screw. Check the pulsator for misalignment or deformed spline.	Tighten screw. Replace pulsator
Presence of foreign matter	Check for unnecessary materials in between pulsator and wash tub.	Remove foreign material/s with care.
Over tightened belt	Check the belt for its tightness. If too tight, loosen the two nut of the wash motor prior to adjustment.	Adjust the wash motor accordingly.

Table 2

Component Replacement Procedure:

1. Determine the description of the values and ratings of the individual defective parts using the manufacturer's service manual.
2. Identify the sources of the replacement components/parts.

- Original replacement components from the original factory sources
- Universal replacement components from independent factory sources

(Note: Always consider the physical size of the replacement part).

3. Consider the following factors in selecting parts.

- **Quality**. The ability to provide exact value or specification to replacement part
- **Tolerance**. The ability to provide exact value or acceptable parameters to replacement parts.
- **Availability**. The local access to parts and whether the parts are available.
- **Price.** Refers to the affordability of the replacement parts at a reasonable price.

4. Disconnect or remove properly the electrical/mechanical parts of an electric fan.
5. Install correctly the replacement parts/components in the existing electric fan.
6. For burnt components where values are impossible to recognize, secure a schematic diagram or service manual if possible. In other case, you can look for the same brand and model as reference.
7. Double check the testing procedure in suspected defective components (on and off the circuit).
8. Check the nearby components for possible consequence of being damaged too.
9. Consider the original orientation/connection of the components in replacing defective one.
10. Observe safety at all times

Maintenance of Washing Machine Steps

1. Turn off the washing machine and remove the cord from the source of voltage.
2. Apply lubricant to mechanical parts of the washing machine that requires lubrication through a drop of oil or grease to assure smooth operation without grinding or squeaks.
3. Replace the bushings or end bells for squeaks with the use of appropriate tools if squeaks cannot be corrected by applying lubricants.
4. Apply or spray anti-rust lubricants to all mechanical parts of the washing machine to drive out moisture, protect corrosion, loosen rusted metal parts and even frees sticky mechanism.
5. Clean and check cooling louvers for any obstructions to avoid cutting off the air flow.
6. Clean or wipe dust and foreign particles at the PC Board and metal parts of the motor.
7. Replace worn or frayed AC cord and electrical wires.

Procedure in Repairing a Washing Machine

1. Once the specific electrical/mechanical problem is located:

- consider the techniques for the proper removal of the defective component or parts;
- anticipate what to do if the replacement part does not correct the problem;
- and check the installation of the replacement or original part for any improper mounting in the mechanical assembly or circuit board.

2. Examine carefully the mounting of the replacement of original parts of the system.

- Check the placement of the wires or leads of the replacement component.
- Consider significant factors used in the original installation such as insulating washer, silicon grease and locating mark for pin connections.
- Observe proper placement of the component leads for electrical parts.

3. Perform the techniques for the proper soldering of electrical parts.

- Be careful not to damage adjacent components.
- Be careful not to lift the copper conductive path from circuit board base material.
- Avoid any solder bridges between board paths.

• Do not destroy the component being removed in case it is still functional and be careful not to damage the component being installed.

4. Verify all connections and harness.

• Be sure that all components pre-positioned in a manner that will avoid the possibility of having adjacent components short circuited.

• Be sure to check or inspect all insulators and barriers between sections after working on any model/brand of washing machine.

• Check for frayed or broken insulation on all wiring including the AC line cord.

• Be sure to replace fuses, resistors and capacitors with special designation such as flame proof to components equal to the original value for both safety and liability purposes.

5. Once the repair is completed, perform an AC leakage test on all exposed metal parts of a washing machine to eliminate the possibility of electric shock.

• Perform complete retesting of the washing machine to ensure the correctness of the actual repair.

• Connect the washing machine into the 60Hz power to allow the time period required to let the new parts settle in and operate as they are designed to work with each other.

• Recheck or inspect if the repair was done correctly and the unit functions properly to ensure successful completion of the repair.

6. Clean the washing machine before it would be returned to the customer.

• Be sure that the drum, pulsator, side cover tub and top cover of the washing machine are properly cleaned.

• Be sure that proper cleaning is given to the control panel or switch box to ensure safety

3.7 Vacuum Cleaner

Function of Vacuum Cleaner

- ❖ A vacuum cleaner is common household appliance used for cleaning purposes.
- ❖ A vacuum cleaner cleans by creating suction. A pump creates a pressure difference inside the unit causing atmospheric air to be forced up through a tubing system.
- ❖ Most vacuum cleaners utilize a rotating brush at its entrance to help “sweep” dust and dirt into the suction path. Vacuumed particles are finally deposited in some collecting container that can be removed.

Main Components:

- There are five main components to a standard vacuum cleaner. They are
  1. Intake port which may include attachments such as a brush
  2. Exhaust port
  3. Electric motor
  4. Fan
  5. Porous bag or container

Vacuum Cleaner Features:

- Weight – lighter vacuum cleaners can be more portable
- Wheels – most vacuum cleaners move along on wheels be fixed and/or variable
- Dust container/dust bag full indicator – tells you when to empty the dust container or dust bag
- Cord length – the longer the cord, the further you can vacuum clean from the power socket. This also means you don’t have to change power sockets
- Automatic cord rewind/storage – saves time, effort and space

vacuum cleaner: The electric current makes the motor work.

- The motor is attached to the fan, which has angled blades. As the fan blades turn, they force air forward, toward the exhaust port. When air particles are driven forward, the density of particles increases in front of the fan and decreases behind the fan. This pressure drop behind the fan is just like the pressure drop in a straw when you drink.

The pressure level behind the fan drops below the pressure level outside the vacuum cleaner. This creates suction, a partial vacuum, inside the vacuum cleaner. The air pushes itself into the vacuum cleaner through the intake port because the air pressure inside the vacuum cleaner is lower than the pressure outside

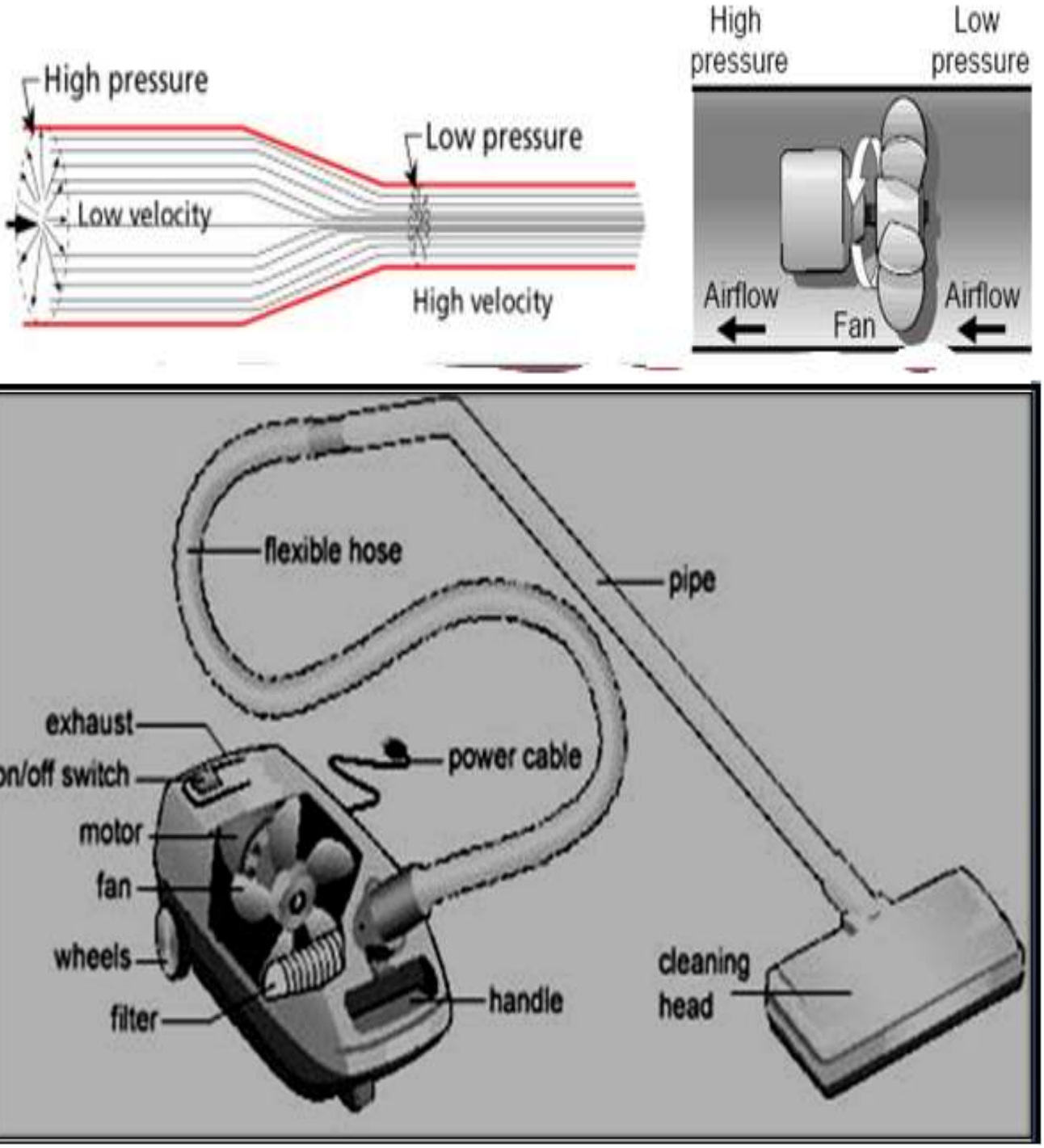


Figure 1

Vacuum Cleaner Filtration :

Vacuum filters are essential for trapping harmful particles and cleaning the air.

Two types of vacuum filter are available;

1. Standard
2. HEPA/S-class

Standard filters offer basic filtration, but *HEPA and S-class filters* can trap up to 100% of allergens and over 99.7% of particles down including dust mites, which makes them ideal for allergy sufferers.

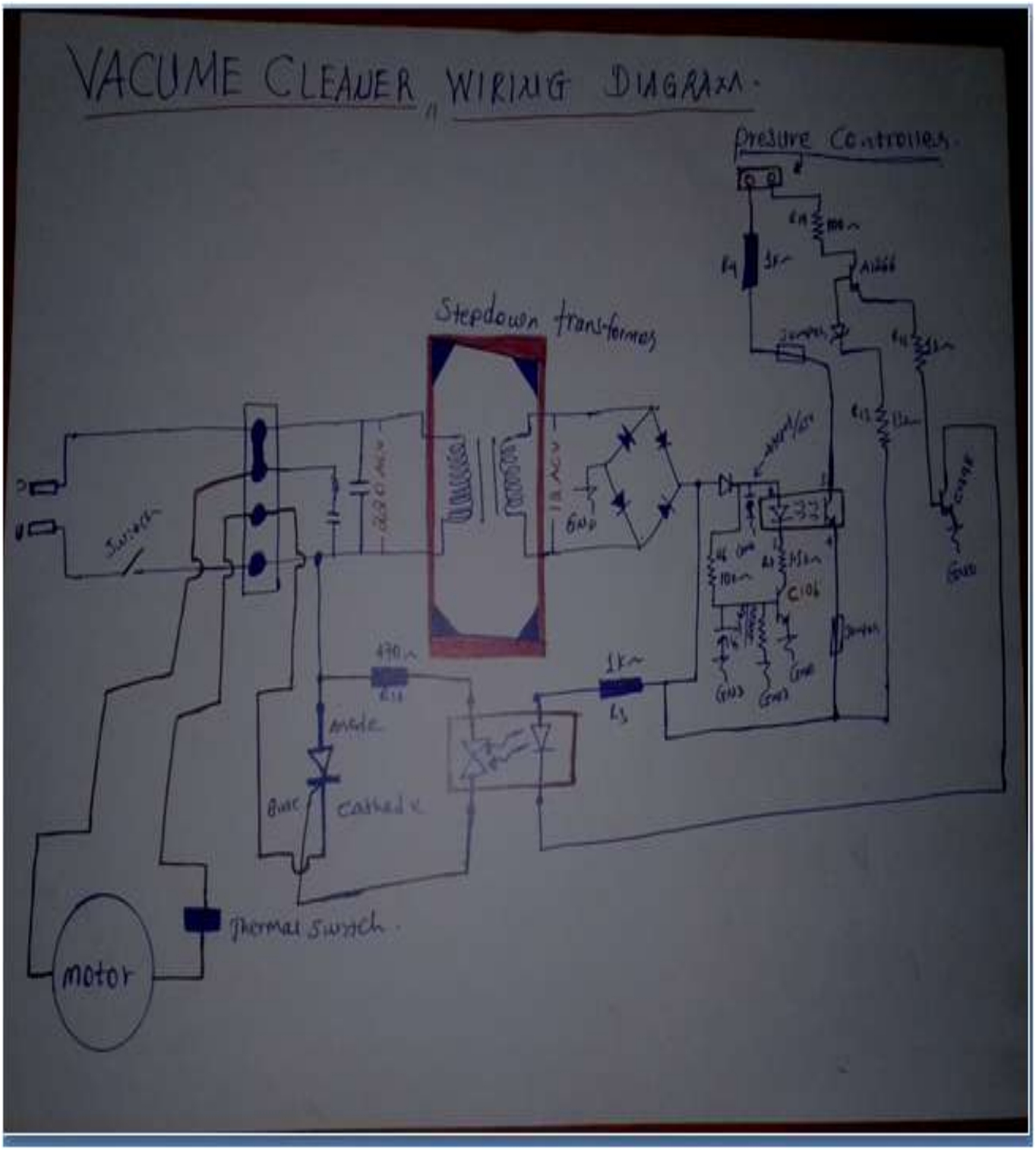


Figure 2

Type of vacuum cleaner

Figure 3

3.8 Waffel Makeer

Figure 1

IMPORTANT SAFEGUARDS

To reduce the risk of personal injury or property damage, when using electrical appliances, basic safety precautions should always be followed, including the following:

1. Read all instructions before using the waffle maker.
2. Do not touch hot surfaces. Use handles or knobs.
3. To protect against the risk of electrical shock, never put the cord, plug, or unit in water or other liquids.
4. Close supervision is necessary when any appliance is used by or near children.
5. Unplug from outlet when not in use and before cleaning. Allow to cool before putting on or taking off parts, and before cleaning the appliance.
6. Do not operate any appliance with a damaged cord or plug or in the event the appliance malfunctions or has been damaged in any manner. Return the appliance to the Presto Factory Service Department for examination, repair, or electrical or mechanical adjustment.
7. The use of accessory attachments not recommended or sold by the appliance manufacturer may cause injuries.
8. Do not let cord hang over edge of table or counter or touch hot surfaces.
9. Do not use outdoors.
10. Do not place on or near a hot gas or electric burner or in a heated oven.
11. It is recommended that this appliance not be moved when it contains hot oil or other hot liquid.
12. Do not use appliance for other than intended use.

Timer Operating Instructions

NOTE: The timer works independently from the unit; it does not turn the unit on or off.

1. Activate the timer by holding the button (Fig. A) down until 00 is visible in the displa screen.
2. Press the button once for each individual minute or hold the button down to increase the display time rapidly until you have reached the desired time. The timer can be set for 1 to 30 minutes. The timer will automatically begin counting down approximately 2 seconds after it is set.

NOTE: Shortly after you depress the button, the time remaining will flash on the screen. It will continue to flash until the time has elapsed. To reset the timer to 0, press and hold the timer button for about 2 seconds.

3. When there is just 1 minute left on the timer, you will hear 2 beeps to alert you time is almost up. In addition, the seconds remaining will now be displayed. When the set time has expired, the timer will beep 5 times. After about 1 minute, the display screen will go blank.

NOTE: If the timer does not beep, this can be corrected by simply removing the battery, wiping it clean, and then reinserting it. See

How To Use

1. Place the unit on the countertop so the timer display is facing towards you and the cover is closed (Fig. B). Plug the cord into an outlet and preheat the waffle maker in the closed position. The signal light will glow (Fig. A).

When the unit has reached the correct temperature, the light will go out indicating the unit is ready for use. Preheat time is short, approximately 3 to 5 minutes. During cooking, the light will go on and off indicating temperature is being maintained.

NOTE: When using the waffle maker for the first time, a slight odor or smoking may occur as manufacturing residue burns off. This is normal during initial use.

2. While unit is preheating, prepare waffle batter.
3. Before the first use after the unit has preheated, use a brush or paper towel and apply a light coating of vegetable oil to the grids. No-stick cooking spray is not recommended. The oil seasons the grids and thereafter you typically will not need to apply oil. If you find it difficult to remove a waffle, apply a light coating of vegetable oil during your next use.
4. Pour approximately ¾ to 1 cup waffle batter into the center of the bottom waffle grid (Fig. C, page 3). The amount of waffle batter needed may vary with the recipe or brand of batter mix used. If using

the recipes in this booklet (pages 4 and 5), refer to them for the recommended amount of batter.
5. Set the timer by pressing the button (Fig. A) to the desired time. See the recipes on pages 4 and 5 for recommended cooking times. Most waffle recipes will take about 4 minutes.

3. 9 COFFEE MAKER

There are different types of coffee maker machine .One is gravity filter coffee maker

GRAVITY FILTER COFFEE MAKER

Figure1

• This appliance can be used by children aged from 8 years and above and persons with reduced physical, sensory or mental capabilities or lack of experience and knowledge if they have been given supervision or instruction concerning use of the appliance in a safe way and understand the hazards involved. Children shall not play with the appliance. Cleaning and user maintenance shall not be done by children unless they are older than 8 and supervised.
• Make sure your electricity supply matches the voltage shown on the appliance.
• Ensure all packaging materials and any promotional labels or stickers are removed from the appliance before the first use.
• Always inspect the appliance before use for noticeable signs of damage. Do not use if damaged or has been dropped.
• Do not use this appliance if the lead is damaged

• Always use the appliance on a dry, level, heat resistant surface.
• Unplug from the mains when not in use and before cleaning. Allow to cool before cleaning the appliance. To disconnect, turn the socket to “off “and remove the plug from the mains socket.
• Do not use any accessories or attachments with this appliance other than those recommended by Lakeland.
• To protect against fre, electric shock or personal injury, do not immerse cord, plug or unit in water or other liquids. Do not use near the sink.
• Do not leave the lead hanging over the edge of a kitchen table or worktop. Avoid contact between the lead and hot surfaces.
• For indoor use only.
• For domestic use only.
• This appliance should be used for preparation of drinks as described within the instructions for use that accompany it.
• Always ensure that your hands are dry before removing the plug from the mains socket. Never pull the plug out of the mains socket by its lead.
• To avoid injury or possible fre, do not cover the appliance when in use.
• Do not connect this appliance to an external timer or remote control system.
• An extension cable may be used with care. The electrical rating of the cable should be least as great as the appliance. Do not allow the cable to hang over the edge of the worktop or touch any hot surfaces.
• This appliance complies with the basic requirements of Directives 04/108/EC (Electromagnetic Compatibility) and 06/95/EC (Safety of Domestic Electrical Appliances).
• **WARNING:** A cut off plug inserted into a 13amp socket is a serious safety (shock) hazard. Ensure the cut off plug is disposed of safely.
• **CAUTION:** The plastic bags used to wrap this appliance or the packaging may be dangerous. To avoid risk of suffocation, keep these bags out of reach of babies and children. These bags are not toys.
• Do not place the appliance on or near a gas or electric oven, or any hot surfaces.
• Do not move the appliance while it is switched on.
• Only use the carafe with this appliance, it must never be used on a hob or in a microwave. Do not put the hot carafe down onto a wet or cold surface. Do not use the carafe if it is damaged. Ensure the carafe is securely on the base before switching on the appliance.
• Ensure the carafe lid is securely in place when using the Gravity Filter Coffee Maker and when pouring coffee. Do not use force when putting the lid on the carafe.
• The water tank must be flled with water to at least the ‘**¼ litre/2 cup MIN**’ mark, before it is switched on. Do not fll beyond the ‘**1¼ litre/10 cup MAX**’ mark, or the appliance may spit boiling water.

INSTRUCTIONS FOR USE

• Fill the carafe with clean cold water, to the amount you require using the cup measurements on the side.
• Always fll beyond the ‘**¼ litre/2 cup MIN**’ mark, but do not exceed the ‘**1¼ litre/10 cup MAX**’ mark on the carafe and the water tank, or the appliance may spit boiling water.

• Lift the water tank lid and pour in the water from the carafe.

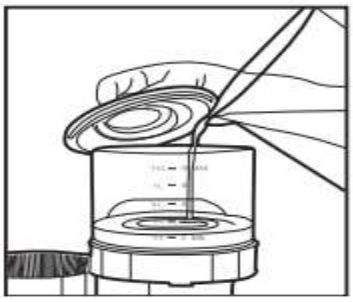


figure 2

• Put the water tank lid back onto the water tank with the ‘front’ mark facing you and the vents towards
the back of the machine. Ensure the water tank lid is fully closed.

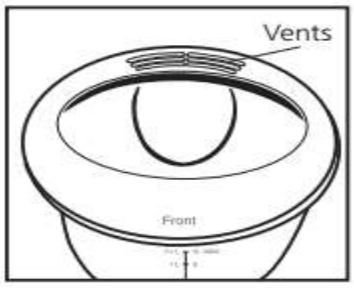


figure3

• Slide the brewer handle to the left in the direction of the arrow to open the brewer, and remove the filter
basket and permanent filter.

• Add your coffee to the permanent filter, or alternatively use a paper filter. For each cup of coffee (125ml), add 7.5 grams of ground coffee into the filter, or one level measuring spoon. Do not fall beyond the **‘MAX’** mark
inside the permanent filter.

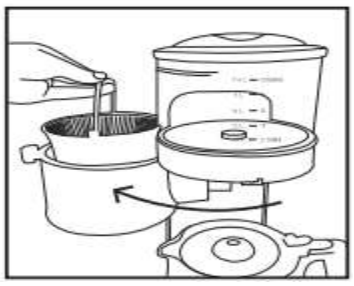


figure4

• Place the filter into the filter basket.

• Place the filter basket back inside the filter holder, it will only ft one way, with the handle folded forwards so it
lies flat.

• Close the brewer by sliding it to the right until the handle clicks into place at the front of the coffee maker.

• Plug in the coffee maker and switch it on at the socket.

Figure 5

• Slot the empty carafe onto the hot plate.
• The pourer is on a spring, which will move upwards when the jug is put onto the hot plate. The hole in the
carafe lid will line up with the pourer when the carafe is in position on the hot plate, so the coffee can flter straight into the carafe. Ensure the carafe is securely on the base.

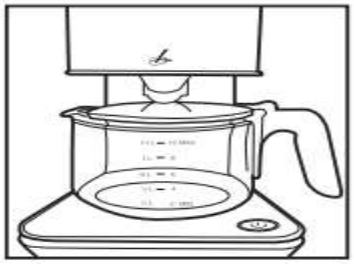


Figure 6

• Press the **on/off** button, it will illuminate and the water in the tank will start to heat up.
• Once boiled, the water will automatically start to filter through the brewer into the carafe.
• **Do not remove the carafe from the hot plate during brewing.**
• The hot plate will keep your coffee warm for around 40 minutes after brewing has started, then automatically switch off.
• Press the **ON/OFF** button to turn the coffee maker off to stop the coffee brewing mid cycle; when the carafe has been emptied; or when you no longer want to keep the coffee warm. Always remove the used coffee filter from the appliance immediately
after brewing.
• During brewing, condensation will form underneath the water tank lid. When brewing has fnished, take off the lid to help the condensation evaporate and stop it running back into the water tank. Take care, steam/water could be hot when you take of the lid.

TROUBLESHOOTING

The following are some common problems that can occur when using the Lakeland Gravity Filter Coffee Maker. Please review the problems, their possible cause and any corrective action that should be taken.

Problem	Possible cause	Solution
The coffee tastes too weak.	Not enough ground coffee is being used.	Add more coffee to the permanent or paper filter.
Coffee is overflowing from the paper filter or filter basket.	There is too much water in the water tank.	Use the carafe to measure the amount of water you are putting into the water tank. Do not exceed the '1¼L /10 cup MAX' mark.
The filter basket is overflowing or the coffee is brewing too slowly.	There is too much coffee in the filter.	Use less ground coffee in the filter. The coffee may be ground too finely. The coffee maker may need cleaning. The paper filter may not be in the correct position.
The coffee is not brewing or the coffee maker will not turn on.	The carafe is not on the hot plate. The water tank is empty. The coffee maker is not plugged in.	Check the carafe is on the hot plate, and the pourer is lined up with the hole in the carafe lid. Check the water tank is filled and the coffee maker is plugged in.
The coffee maker is taking a long time to brew.	The coffee maker may need cleaning.	See 'Care and cleaning', the coffee maker may need descaling.

Table 1

CARE AND CLEANING

• Switch off and unplug the coffee maker from the socket before cleaning and when not in use. Always allow the coffee maker to cool down completely before cleaning.
• Before the first use and after every use, clean each part thoroughly.
• Check all parts before reassembly.
• Never immerse the coffee maker in water or any other liquid.
• To clean the outer parts of the coffee maker, wipe with a clean damp cloth and dry before storing. Do not immerse in water.
• Wash the carafe, filter basket, permanent filter, water tank lid and measuring spoon in hot soapy water, rinse and dry thoroughly. These parts are also dishwasher safe.
• Always remove the used coffee filter from the appliance straight away after brewing.
• Store the coffee maker with the power cable loosely coiled. Never wrap it tightly around the base unit. Use the cord storage to tidy excess cord.
• Do not use steel wool, or abrasive cleaners or materials.
• If the coffee maker is not going to be used for a period of time, empty the water tank completely, by turning it upside down.

DESCALING THE COFFEE MAKER

• Bitter tasting coffee, a 'sizzling' noise during brewing, or a prolonged brewing time compared to normal indicate that the coffee maker may need decaling.
• We recommend decaling the Coffee Maker once a month or when the appliance has made 25 brews. It may need decaling more frequently in hard water areas.
• Fill the water tank with clean cold water to the '**¾ litre/6 cup**' mark, then add white wine vinegar to halfway between the '**1 litre/8 cup**' and '**1¼" litre/10 cup**' marks.
• Ensure there is no coffee in the brewer.
• Place the carafe onto the hot plate.
• Press the **on/off** button to start brewing, allow the mixture to boil and start to flter through the coffee maker. When two thirds of the mixture has faltered through, press the **on/off** button again and leave the coffee maker off for 15 minutes.
• Press the **on/off** button again, to allow the rest of the solution to filter through.
• Run two or three more carafes of clean cold water (without vinegar) through the coffee maker, as above, allowing it to cool between cycles

ELECTRICAL CONNECTIONS

THIS APPLIANCE MUST BE EARTHED.

This appliance is fitted with a fused three-pin plug to BS1363 which is suitable for use in all homes fitted with sockets to current specifications. If the fitted plug is not suitable for your socket outlets, it should be cut off and carefully disposed of. To avoid an electric
shock, do not insert the discarded plug into a socket.

Fitting a new plug

If for any reason you need to ft a new plug, the flexiable mains lead must be connected as shown here. The wires in the mains lead fitted to this appliance are colored in accordance with the following code:

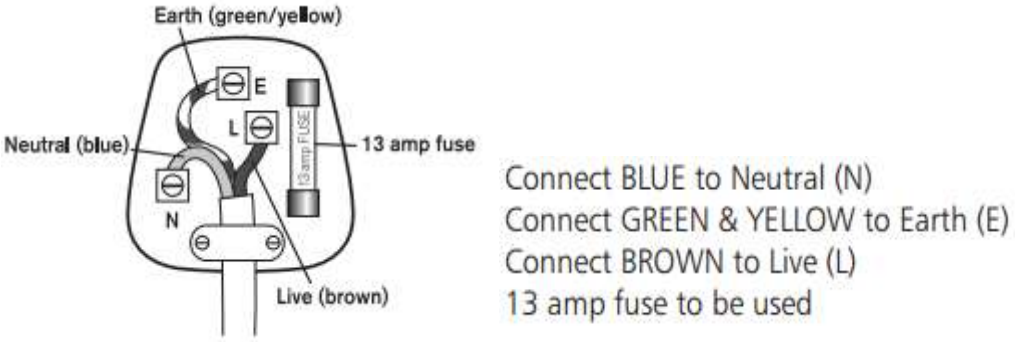


Figure 6

If the colours of the wires in the mains lead of this appliance do not correspond with the coloured markings identifying the terminals in your plug, proceed as follows. The wire which is coloured green and yellow MUST be connected to the terminal which is marked
with the letter E (Earth) or colored green. The wire which is coloured blue MUST be connected to the terminal which is marked with the letter N (Neutral) or coloured black.
The wire which is coloured brown MUST be connected to the terminal which is marked with the letter L (Live) or coloured red.
Before reftting the plug cover, check that there are no cut or stray strands of wire inside the plug. Use a 13 amp BS1362 fuse. Only BSI or ASTA approved fuses should be used. If you are at all unsure which plug or fuse to use, always refer to a qualifed electrician.

Electrical stove

The double burner solar stove has mainly 5 components.

1. Heater coil
2. Heat controller
3. Battery
4. Charge controller
5. Solar panel

3.1 Heater Coil

For two stoves we bought two heater nicrome coils from the market. This coil is actually used for AC stove but here we used them for DC as our stove runs on DC power from solar. The coil rating was 1000W but for our system the power needed to be decreased to 500W. While decreasing the wattage we needed to find the correct voltage & current for the coil to run efficiently. There was a limitation for not to increase the voltage very high
as because it will increase the cost of the battery. So the solution was to have higher current. For that the résistance of the coil needed to be decreased. As a result we madesome modification of the coil.

Redesigning the Coil

The resistance of the existing coil was 51 ohms. To decrease the resistance we cut 3 parts from the coil. Each had 13.5 ohms. Then we connected them in parallel as we know the
resistance decreases by parallel connection. The final resistance of the coil was
(13.5||13.5||13.5||) Ω =4.5Ω.

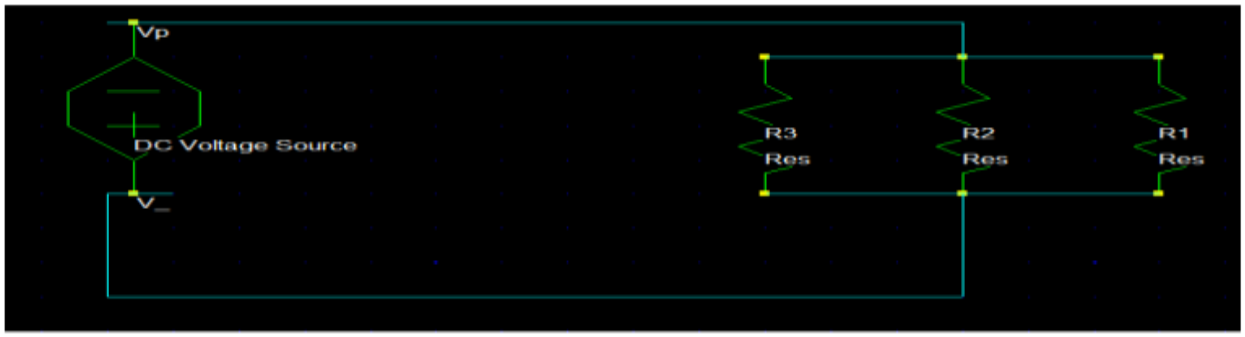


Figure 7

Current through each of 3 pieces of the coil was 3.5A.So the total current through the stove was (3x3.5) A=10.5A So, power P = (10.5^2×4.5), W = 496.125W, V= (496.125/10.5)V = 47.25V. So it was decided that the voltage for the stove will be 48v.[4] For placing the modified coil in the mud casing we made two extra holes in the two corners of the casing. Fig 3.2 below will clarify the coil modification.

Figure 1

Heat Controller

This is one of the most interesting addition in our system. We added a circuit to the system, by which the heat of the stove can be controlled by the user. We used one heat controller for each of the stove. There is a knob for each of the controller by which the user can increase or decrease the heat according to their preference.

All the details of the heat controller are given in the chapter 4. The analysis of its mechanism will be discussed there.

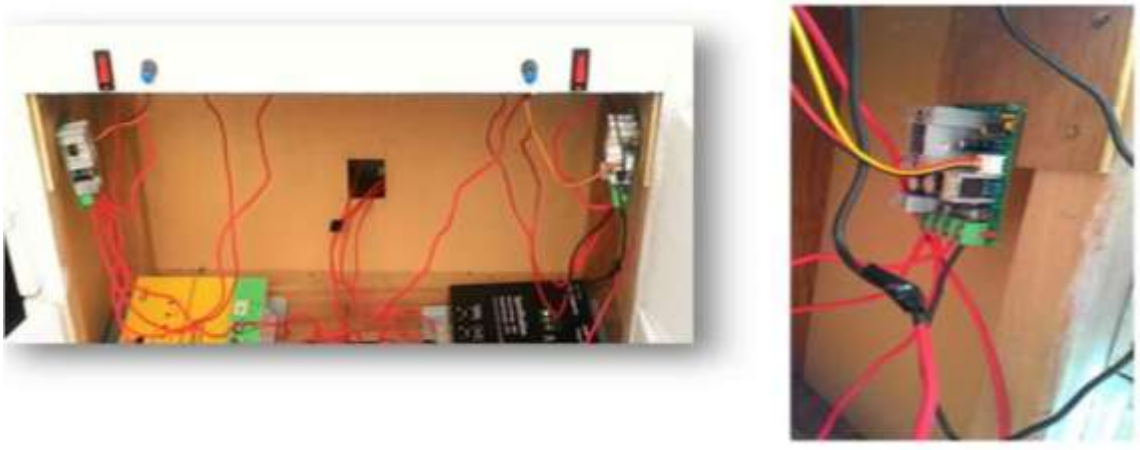


Figure 2 shows the heat controller circuit installed in the stove

Battery

For each stove, 48v was required. So, two sets of 48v battery were used (one for each stove).In each set of 48v, four 12V sealed lead acid batteries of 20Ah were connected in series. The battery set is connected with the charge controller& it shares the load power with the solar panel. When the stove is on, one portion of the 10.5 load current comes from the battery& the rest of the current comes from the solar panel. When the load is off, the PV panel charges the battery.

Figure 3

Charge Controller

Charge controllers were used for charging the battery and share the load power. Two charge controller were used for two stoves in our system. Each charge controller has 4 ports, PV+, PV-, Battery+, Battery -.the solar panel connection goes to the PV+ & PVports. Battery positive and negative terminal goes to the battery + and battery – ports. The two end of the stove goes to the battery + and battery – ports. When the stove is off, the solar panel charges the battery, through the charge controller. When the stove is on, the load current comes from the battery & the PV panel. The ratio of the current sharing depends on the sunlight. When the sun is scorching bright the PV current will provide more percentage of load current. In a gloomy day the battery can provide more percentage of the load current. shows the two charge controllers that we have used in the double burner Stove.

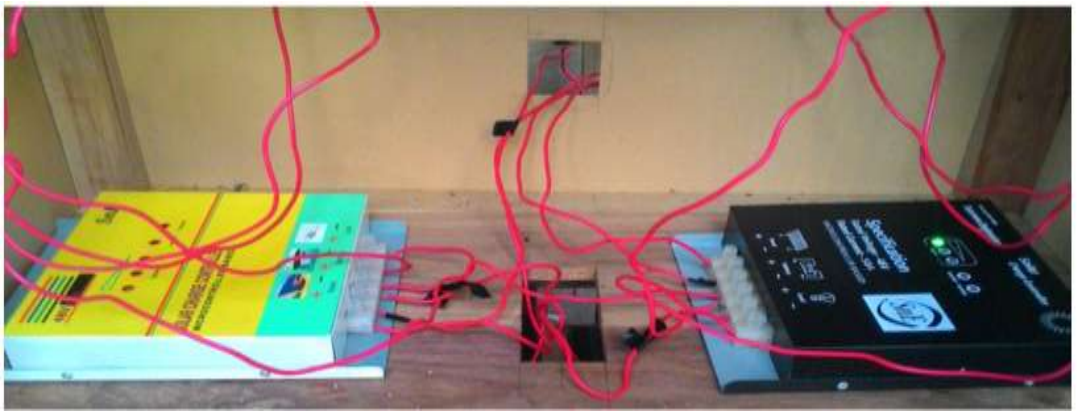


Figure 4

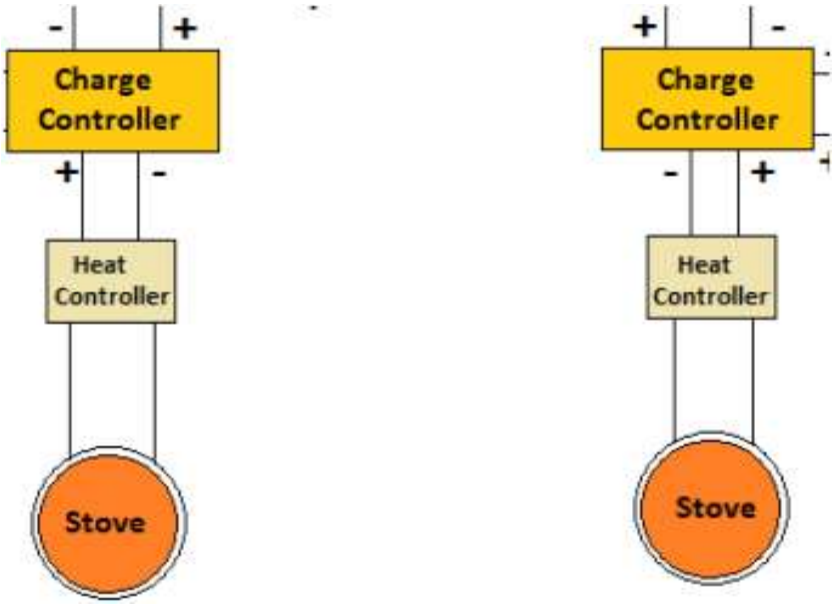


Figure 5 System connection diagram

Note: - Your Trainer Should Tell About The Following Equipments

- Rechargeable Light
- Electronic controlled Light
- Security equipment
- Remote Control Appliances
- Electronic Clock
- Electric mitad

Self-Check -3	Written Test

Directions:*For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle*

1, During use of a coffee maker A cut off plug inserted into a 13amp socket is a serious safety (shock) hazard. Ensure the cut off plug is disposed of safely.
(3 pt each) A, true B, false

2, One of the ff is not The double burner solar stove main component? *(3 pt each)*
A. Heater coil B. Heat controller C. Battery D. Charge controller . E. non of the above

3. The base metal part of electric flat iron that presses the fabric.
A. AC Cord C. Neon/Pilot Lamp
B. Body/Case D. Sole Plate

4. Connects the unit to power source.
A. AC Cord C. Neon/Pilot Lamp
B. Body/Case D. Sole Plate

9. It is a handtool used in holding, gripping and cutting of wires.
A. Blade cutter B. Pliers
C. Screwdriver D. Soldering iron

10. It is a measuring instrument used to check continuity and resistance of a circuit.
A. Ammeter B. Ohmmeter
C. Voltmeter D. Wattmeter

3. A part of the rice cooker that turns off the cooking cycle and starts the warming cycle.
A. Center Thermostat B. Thermal Fuse
C. Switch D. Neon Lamp
c

4. A system that compares the output with the expected result.
A. Closed Loop System B. Open Loop System
C. Switch-On Preventive System D. Keep Warm System

4. This is turned ON to provide air circulation around the food for faster and more even cooking.
A. Control switch B. Convection fan
C. Function control knob D. Power switch

5. It is used for us to view the food inside the toaster oven.
A. Display B. Function control knob
C. Glass door D. Indicator

6. It is used to set the duration of cooking task of toaster oven.
A. Function control knob B. Glass door
C. Temperature control knob D. Timer knob

7. This part illuminates when the timer knob of the toaster oven is turned ON.
A. Control switch B. Power indicator

C. Function control knob D. Power switch

8. It refers to an electrically-operated switch that is common to switching circuits.

A. Monitor B. LCD screen C. Timer D. Relay

9. It refers to an electronic circuit that is useful in automatic shut-off function of electrical appliance.

A. Monitor B. LCD screen C. Timer D. Relay

Note:Satisfactory rating 3 and above points Unsatisfactory below 3 points

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Information Sheet-4	**Basic Electricity and Electronics** **content -4** Soldering/mounting Repaired or replaced parts/components

2. Soldering/mounting Repaired or replaced parts/components

4.1. Soldering Technique

soldering is the process of connecting two or more wires using another conductor called lead.
After splicing and or termination conductors must be soldered. Soldering adds security to the splice and discourages conductor oxidation. To do an effective soldering job, the parts to be soldered must be clean. Use sand paper or lightly scrap the conductor with a knife.
To ensure a good solder job, use noncorrosive soldering flux. Soldering flux performs three functions.

1) It is an additional cleaning agent.
2) It aids in tinning or coating the conductor when solder is applied.
3) It ensures adhesion of solder to the splice.

❖ Acid type flux must never be used in electrical soldering job.

Advantage of good soldering
1. increase mechanical strength
2. decrease air gap between wire which decreases the resistance of a wire and increase the conductance of the wire
3. decrease oxidation of the wire

How to Solder?
First a few safety precautions:

- Never touch the element or tip of the soldering iron.
  They are very hot (about 400°C) and will give you a nasty burn.
- **Take great care to avoid touching the mains flex with the tip of the iron.**
  The iron should have a heatproof flex for extra protection. An ordinary plastic flex will melt immediately if touched by a hot iron and there is a serious risk of burns and electric shock.
- **Always return the soldering iron to its stand when not in use.**
  Never put it down on your workbench, even for a moment!
- **Work in a well-ventilated area.**
  The smoke formed as you melt solder is mostly from the flux and quite irritating. Avoid breathing it by keeping you head to the side of, not above, your work.
- **Wash your hands after using solder.**
  Solder contains lead which is a poisonous metal.

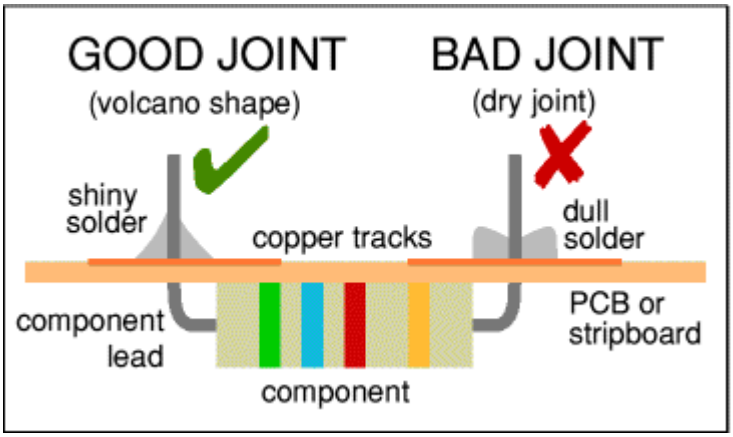


Figure 1

Preparing the soldering iron:

- Place the soldering iron in its stand and plug in.
  The iron will take a few minutes to reach its operating temperature of about400°C.
- Wait a few minutes for the soldering iron to warm up.
  You can check if it is ready by trying to melt a little solder on the tip.
- Melt a little solder on the tip of the iron. This is called '***tinning***' and it will help the heat to flow from the iron's tip to the joint. It only needs to be done when you plug in the iron, and occasionally while soldering if you need to wipe the tip clean on the sponge.

Desoldering

Desoldering is just the opposite of soldering which means simply removing compo nents from circuit board.

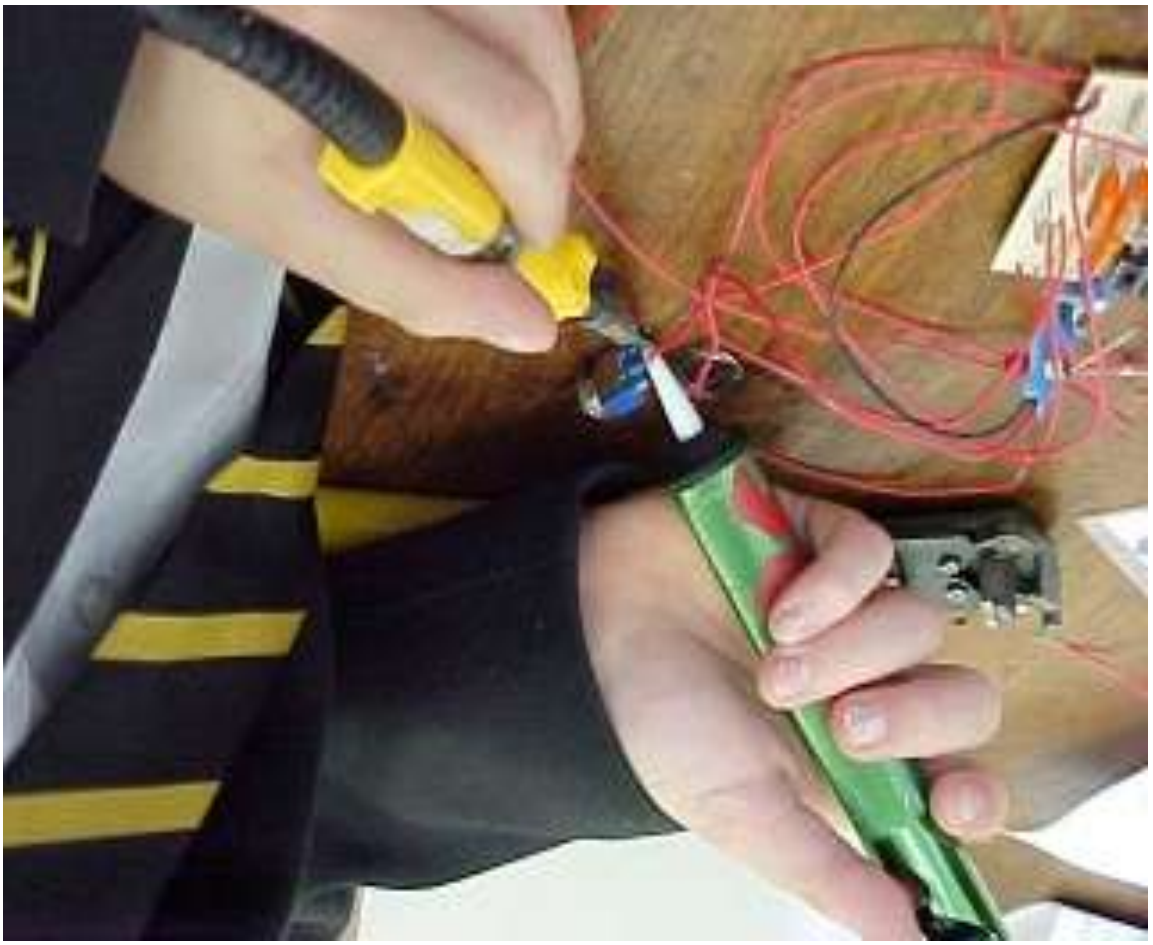


Figure 2

Self-Check -4	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, Disoldering is just the opposite of soldering which means simply removing components from circuit board. *(3 pt each)*A, true B, false

2, soldering is the process of connecting two or more wires using another conductor called lead. *(3 pt each)*A, true B, false

3 . Soldering flux performs three functions.

A. It is an additional cleaning agent.
B. It aids in tinning or coating the conductor when solder is applied.
C. It ensures adhesion of solder to the splice.

E. all

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-5	**Basic Electricity and Electronics** **content -5** Performing Control settings/adjustments in conformity with service-manual specifications

5.1 Household appliance tasks, controls and displays

This section provides a high level task analysis of the types of tasks performed for a range of household appliances, with examples for each, and suggests the types of controls and displays found on such appliances.

Task type	**Example**	**Control or display types possible**
1 Turn product on/off (without starting or stopping a process)	Turn on power to an appliance	•Switch (on plug point)
2 Review list of possible control options	Choose washing machine programme	•Menu list (text or icons)
3 Choose a control option (action may also start a process)	Select washing machine programme Select oven operation (oven, oven + fan, grill, both together)	•Knob (selection points) – may be latched (see definitions below) •Slider (selection points) •Push button (one per option)
4 Set a value (discrete scale)	Timer on microwave Timer on cooker	•Knob (with notches at value points) •Push button (setting buttons with display)
5 Set a value – continuous scale (action may also start a process)	Heat level on oven Heat level on iron Thermostat level on boiler	•Knob (may be latched) •Slider
6 Start/stop a process	Set kettle to boil Set toaster going Stop toast burning Ignite a gas flame	•Knob •Switch •Push button (may have light or latch) •Slider (may have latch)
7 Control a flow	Control gas flame on hob	•Knob (continuous selection) •Slider (continuous selection)
8 Perform instantaneous action	Water spray on iron Ignite gas hob	•Push button
9 Check operation in progress	Kettle started boiling Oven still cooking	•Simple LED light indicator (in addition to any auditory feedback)
10 Check progress	Check if dishwasher or	•LED numeric display

through an operation	washing machine cycle near completion	shows progress (time left) •Knob position (In addition to any auditory feedback)
11 Be alerted that process finished	Microwave cooking finished Washing machine cycle finished	•Auditory warning •Simple LED indicator goes off •Flashing light •LED numeric display value reaches zero
12 Closing/opening an appliance door	Door of washing machine Door of tumble drier	•Catch which requires handle to be lifted and pulled to open door.
13 Testing alarm	Testing smoke, CO2 or water overflow alarm	•Button on alarm device
14 Turning off alarm	Turning off CO2 or water overflow alarm	•Button on alarm device. (Note: Normally device only turns off when hazard stops being detected i.e. smoke clears.)

table 1: Tasks, Controls and Displays

A **push button** returns to its 'out' position after being pressed.

A **latch button or latch knob** stays 'in' after pressing and is released when pressed again.

A **latch slider** has two positions 'released' and 'latched'. When it is slid to the latched position it stays in this position until the process is finished when it automatically releases. Alternatively it may be released by an interrupt buttonor by pushing the slider out of the latched position. This control is often used with a toaster appliance as the process of moving the slider down to the latched position also lowers the base that the toast is resting on into the toaster.

An **LED numeric display** (light emitting diode) shows numeric values (e.g. time left or program number).

A **simple LED** indicator is a single light that is either on or off. LED may be in one of a range of colours e.g. red, green, yellow, and appear bright against a black background. In future, appliances may have small black and white or colour LCD (liquid crystal display) equivalent to that on a portable games console or mobile phone.

Control types for specific variables

table 2 below provides some high level guidance on the type of control recommended for a range of variables, drawn together from previous studies at the Lough borough Design School. For large force application, there are no controls suitable, as hand levers etc. are unlikely to be required for household appliances. (Please note that the contractors make a distinction between a hand lever and a lever on a toaster, which would be considered a slider or latch slider.) Hand levers may nevertheless be an appropriate solution for some controls, for example, gross body actions are utilised to operate a salad spinner. This avenue could be explored by designers to apply to other operations. To enable a better feel for the types of controls and common dimensions being used in today's household appliances, a quick survey was also undertaken of a range of appliances. This provided a 'reality check' and further contextualization of values found in the literature in order to make a more informed choice where values conflicted. A selection of these photos is given below in Figure 1. The list of control types is

not meant to be comprehensive. For example, buttons or sliders (a linear control) could be latched, or may be used with an indicator light to give a visual cue of position. Controls with lights to indicate status are not suitable for those with visual impairment, but latched buttons would indicate status in both tactile and visual terms. For a control to be free from inadvertent action is context dependant and is likely to be a relative term, unless further protective solutions are also in use, such as latch covers or interlocks. It is unlikely that we can increase usability whilst eliminating inadvertent action completely. The list, therefore, suggests the range of variables that should be considered and ways of accommodating them. This section does not suggest a particular type of control for an individual appliance, but only for a particular variable, such as the types of controls to consider when quick operation is required. Other types of controls may indeed be used, e.g. remote controls or multimode controls (a single control that regulates all functions), all of which can be challenging for, or simply not wanted by, older and disabled people. It is suggested in Section 8 that further investigation be conducted on contact area and feedback for touch screen and membrane buttons or objects, as well as the upcoming area of remote control of household appliances. There are likely to be other control mechanisms and future developments that require consideration, but these would be outside the scope of the current research project.

Key - (clear = poor, half-filled = acceptable, filled = good)

Variable	Push button	Toggle	Rocker	Slide switch	Thumb wheel	Finger knob	Finger lever
Large force application	○	○	○	○	○	○	○
Quick operation	●	●	●	◑	○	◑	◑
Small space requirement	●	●	●	●	●	◑	◑
Free from inadvertent action	○	○	◑	◑	○	●	○
Visual cue of position	○	●	◑	●	○	◑	●
Tactile cue of position	○	●	●	●	○	○	◑
Shape coding possibility	◑	○	○	○	○	●	●
Integral legends or symbols	●	○	●	●	○	○	○
Colour coding possible	●	●	●	●	●	●	●
Integral illumination	●	○	◑	○	○	○	○
Weather proofing	◑	○	○	○	○	●	●
Oil proofing	●	○	◑	○	○	●	●
Ease of operation with gloves	●	●	◑	○	○	◑	◑
Check reading array of like controls	○	●	◑	●	○	○	●
Simultaneous use of two like controls	●	●	●	●	◑	◑	●

table 2: Control types for specific variables

Figure 1

Toaster with push buttons and bar knob Latch slider with knob and push buttons

Figure 1: Selection of kitchen appliance controls used for comparison with guidelines

Self-Check -5	Written Test

Directions:*For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle*

1, A **simple LED** indicator is a single light that is either on or off.

*(3 pt each)*A, true B, false

2, A latch button or latch knobstays 'in' after pressing and is released when pressed again.

*(3 pt each)*A, true B, false

Note:Satisfactory rating 3 and above points Unsatisfactory below 3 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-6	**Basic Electricity and Electronics** **content -6** Performing Repair activity within the required timeframe

5. Performing Repair activity within the required timeframe

5.1 Repair Procedure:

1. Determine the description of the values and ratings of the individual defective parts using the manufacturer's service manual.
2. Identify the sources of the replacement components/parts.
- Original replacement components from the original factory sources
- Universal replacement components from independent factory sources (Note: Always consider the physical size of the replacement part).
3. Consider the following factors in selecting parts.
- **Quality**. The ability to provide exact value or specification to replacement part
- **Tolerance**. The ability to provide exact value or acceptable parameters to replacement parts.
- **Availability**. The local access to parts and whether the parts are available.
- **Price.** Refers to the affordability of the replacement parts at a reasonable price.
4. Disconnect or remove properly the electrical/mechanical parts of an electric fan.
5. Install correctly the replacement parts/components in the existing electric fan.
6. For burnt components where values are impossible to recognize, secure a schematic diagram or service manual if possible. In other case, you can look for the same brand and model as reference.
7. Double check the testing procedure in suspected defective components (on and off the circuit).
8. Check the nearby components for possible consequence of being damaged too.
9. Consider the original orientation/connection of the components in replacing defective one.
10. Observe safety at all times.

Steps in Troubleshooting:

1. Conduct a *quick* diagnosis of the trouble symptom and repair the defective set in the *shortest possible time*.
2. When troubleshooting integrated circuits (ICs) in the electrical/electronic circuit section, do not remove the IC from the PCB.
3. When troubleshooting in the electrical/ electronic circuit section, prior to pre-testing, consider voltage measurement on components first before removing it for testing.
4. If the trouble symptom is caused by aging components, the defective component is usually one of them.
5. Be familiar with the usual defects of components.
6. Don't replace an opened fuse or burned resistor unless you have corrected the trouble.
7. Always suspect a faulty contact on mechanical switch circuit rather than defective electronic components.
8. When measuring resistance in the circuit, make sure that the circuit if OFF and power is not being supplied in the circuit, and that stored charges in capacitors are properly discharged.
9. While using a VOM for in-circuit resistance measurement, always exchange the setting of positive and negative probes.
10. Use soldering irons with the proper power rating to prevent the components and the circuit board

from being overheated and damaged.

11. Use proper tools and soldering aids when troubleshooting PCB.
12. Dry solder joints are hard to detect.
13. USE Personal Protective Equipment.

Self-Check -6	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, service manual determine the description of the values and ratings of the individual defective parts using the manufacturer's *(3 pt each)*A, true B, false

2, Consider the following factors in selecting parts.*(3 pt each)*

A. Quality.

B. Tolerance.

C. Availability.

D. Price.? *E. none*

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-7	**Basic Electricity and Electronics** **content -7** Observing Care and extreme precaution during handling the unit/product as per procedures

7. Observing Care and extreme precaution during handling the unit/product as per procedures

7.1 Maintaining and Storing Tools & Equipment

An important aspect of any business is the maintenance and storage of tools and equipment. The investment in tools and equipment is a significant part of the overhead expenses in any operation. Proper selection and maintenance of equipment are important factors in managing business. Selecting the proper tool for the job and using the tool properly will increase efficiency and reduce maintenance problems. Purchase tools, which are well-made and suited to the intended use. Commercial usage may entail more heavy duty demands on equipment.

Hand tools:

1. Clean dirt and debris from tools after each use.
2. Oil metal parts to prevent rust.
3. Lightly sand rough wooden handles and apply linseed oil.
4. Repair loose handles.
5. Sharpen blades of cutting tools.
6. Store tools in a clean dry storage area.
7. Protect surfaces of cutting tools in storage.

Power tools:

1. Read and follow the maintenance schedule in the owner's manual for each piece of power equipment.
2. Change the oil.
3. Clean the air filter.
4. Lubricate moving parts.
5. Sharpen dull blades or replace worn blades according to the owner's manual.
6. Replace spark plugs.
7. Drain oil and gasoline before long-term storage.
8. Check electric cords and connections on electric-powered tools.
9. Store tools in a clean dry storage area.

Equipment:

1. Store equipment in a clean dry storage area.
2. Rinse and clean spray equipment after each use.
3. Clean spreaders and check wheel-driven gears.
4. Clean carts and wheelbarrows after use.

Sample Proper Arrangement and storage of tools and equipment

Figure1

Self-Check -7	Written Test

Directions:*For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle*

1, An important aspect of any business is the maintenance and storage of tools and equipment. *(3 pt each)*A, true B, false

2, One of the ff is not true about equipment handling? *(3 pt each)*

A. Store equipment in a clean dry storage area.

B. Rinse and clean spray equipment after each use.

C. Clean spreaders and check wheel-driven gears.

D. Clean carts and wheelbarrows after use.

E.None of the above

Note:Satisfactory rating 3 and above points Unsatisfactory below 3 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

2 Cleaning with standard procedures

2.1 Introduction Cleaning

Cleaning is an essential process within electronics manufacture and has been used for many years to remove potentially harmful contaminants during PCB manufacture. Such contaminants include flux, solder and adhesive residues, and other more general contaminants such as dust and debris present from other manufacturing processes.

Cleaning PCBs has been a vast topic for many years, particularly so since the ban of CFCs and HCFCs. These products offered solvency power, low surface tension properties to dissolve, remove and dry within minutes any parts of any de-sign. The electronic industry has grown so rapidly since the 80s, that today, nearly 50% of any individual's belongings are composed of electronics: e.g.: Mobile phones, remote controls, TVs, radios, cars, IPods, computers, HiFi, hard discs, memory sticks, cameras, videos, refrigerators, dish and laundry washers, cars, planes , satellites, implants, etc…

Since the 90s, the electronic evolution has been exponential, and the miniaturization has advanced proportionally. The introduction of such new small parts not only raised some design problems, but also some practical aspects such as handling and some reliability problems. In meantime, the suppliers of solder fluxes and pastes had to adjust new formula-tions for the new markets, the new demands and the new regulations.

Accordingly, the electronic suppliers adapted their production to the customers' demands with cleanable and no clean fluxes, also called consumable devices. The non consumable devices such as medical implants, military tools, satellites, safety parts for cars, trains, medical equipments and many other products, should be reliable and thus cleaned. To achieve a good cleaning result, it is worth understanding the various parameters present and the physical laws which are ruling this chemical operation.

Cleaning has a cost and it should be adapted to the needs while maintaining stability in time, efficiency, quality and performance.

1) Miniaturization

Today, miniaturization is a hundred times greater than during the 80's.This reduction in size means reduction of solder pads and also amount of flux residues. But it also means a reduction of space between legs and board/components. Today, size of components are down to 0,1mm.In addition, the components became of high capacity with resistors, diodes, quartz, selfs, BGA and others. The reliability of these components should be always increased. This miniaturization should not become a reason of instability and unreliability. The cleanliness should be performed and pass the norms.

2) Contaminants

The contaminants on a circuit board are mainly composed of: organics such as natural and/or synthetic rosins, ions, acids, solder balls, fingerprints, and particulates of PCBs. The lead-free alloys need higher soldering temperatures than the standard Sn/Pb which are carrying significant evolutions on the fluxes to be used. These fluxes are most of the time more active and must resist to higher reflow profiles. They present more risks than the one formerly used , and the temptation is high to choose production parameters allowing shining soldering pads. The ionic cleaning of the PCBs is then more critic-cal before tropicalisation, but will also help to control the assembling process and help to establish final assembly life-time. The ionic contamination is a good quality indicator for the long term reliability .Please see next Figure

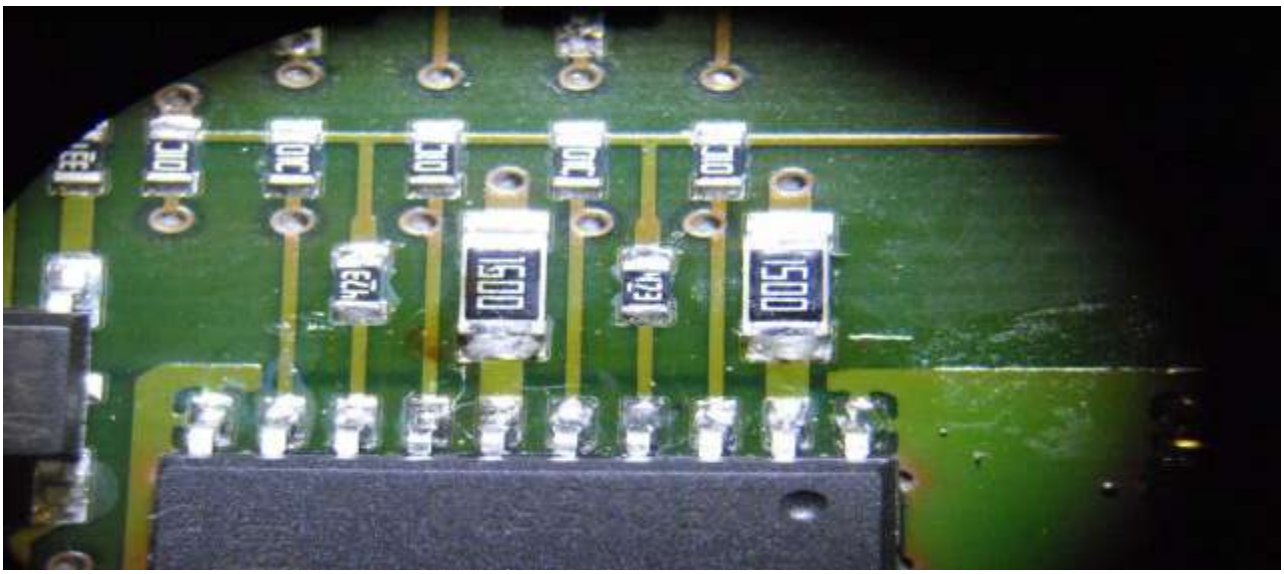


Figure 1

3) Specifications set up

Every end-user has his own typical specifications which are depending on his own or his customers. For this study, the specifications have been taken as described in Table 1. Six hundred PC Bs for trials were produced in large quantities to triple the cleaning results (Figure 3). Each trial contains 30 components. All residues must disappear, including the con-taminants under the components. No fingerprint, particle or dust should remain, including residues of cleaning products. The components, the rosins, the under fill and the substrate should not be damaged by the cleaning operation. The part should be dried at the end of the washing step. The ink markings should be resistant to the cleaning.

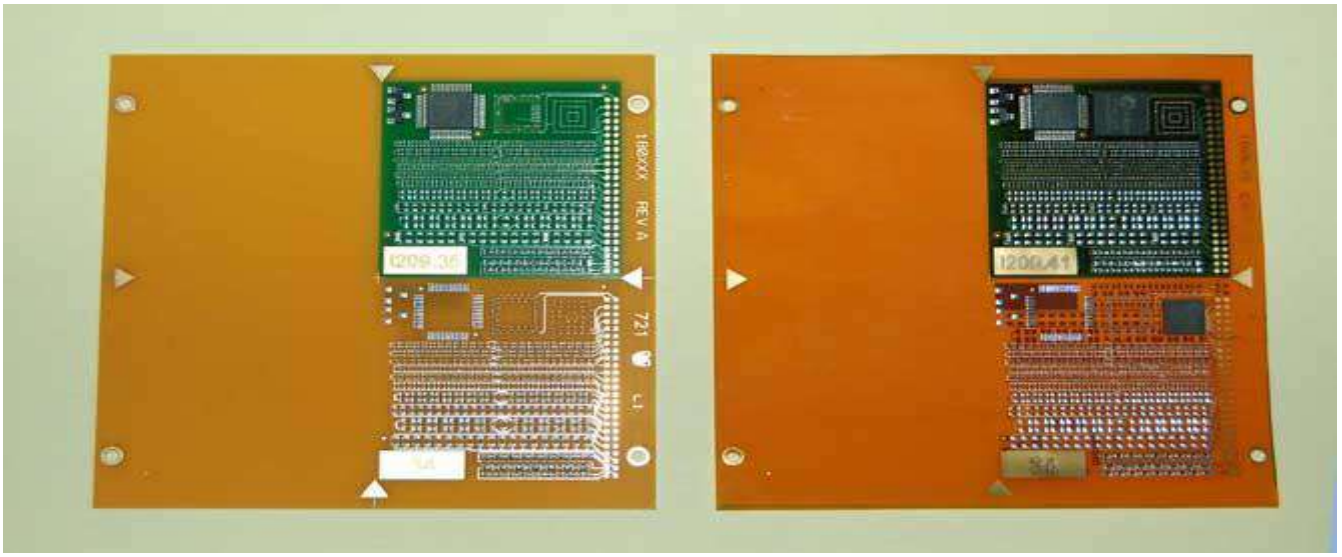


Figure .2

4) Cleaning products available

The most important part of the job is to remember which chemical families are available in the market. The cleaning products available can be classified in five different families: The detergents, the light petroleum distillates, Formulated hydrocarbons, Brominated solvents, glycols and fluorinated solvents.

a) The detergents

Detergents A are good most of the time, but very specific to the type of fluxes to be removed. Its concentration is very important in water and can vary between 3 to 50 %wt in some cases. The temperature can vary from 20-60°C, and the agi-tation used, sprays, spray under immersion or ultrasonic's should be considered. It is the aqueous cleaning process The drawbacks of these detergents are: the removal of all residues under components because of the poor/high surface tension included between 40-50mN/m, the aggression of these formulations and its compatibility with materials, the rinsing with tap or DI water (high surface tension70-80mN/m), the drying operation, the water-proof compatibility and the disposal of soiled mixture. (Figure 5). The total cost of these should also be considered.

b) The petroleum distillates

The petroleum distillates B, such as alcohols and ketones are mainly used for the cold cleaning operation, even though used they can be found used at warm temperatures. There should be no need to mention that these products are very flammable at room temperatures and used under warm conditions are very risky. Costs are acceptable, but disposal and annual cost can be significant.

c) Formulated hydrocarbons

Formulated hydrocarbons Chave been developed mainly after the CFCs and HCFCs story and when perfectly formulated, easily outperform any other cleaner. They are able to remove flux residues, solid residues and salts under any type of components because of their very low surface tension (approx. 20mN/m). They must be rinsed with a rinsing product which can be water or solvent(fluorinated base F). The water rinse system is the semi-aqueous process and the solvent based system is a co-solvent process. With the aqueous process, the same detergents' drawbacks are found, whereas, with the co-solvent process, the PCBs are very nicely rinsed and dried with the vapour phase. The rinsing solvent can be recycled by distillation and the formulated hydrocarbon is disposed easily. The lifetime of the formulated hydrocarbons is very extensive and the total costs are the lowest of all type of cleaning systems. The surface tension of both C and F are outstanding to reach specifications. It is one of the most user-and environmental-friendly process.

Main Cleaning Processes

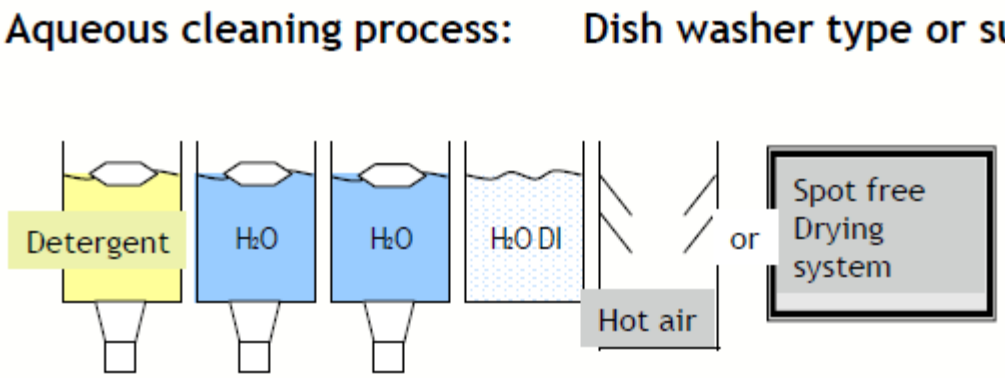


Figure 3

Miniaturization has a direct impact on clean ability

- No clean fluxes and Lead-free trends impact cleanliness
- The Surface tension parameter should be understood with respect to design
- A Cleaning process and a mechanical agitation should be chosen
- The ultrasonic's effects on Quartz were evaluated, and no damage has been observed so far.
- The separated co-solvent used with HFE zoetrope shows the best cleaning result vs many others.

• Jets under immersion with Co-solvent/HFEs provide excellent results
• High optical quality and ionic contamination were achieved

2.2 purposes of cleaning

The purpose of cleaning, specifically within the rapidly expanding electronics industry, is to essentially improve product lifetime by ensuring good surface resistance and by preventing current leakage leading to PCB failure. This developing market sees modern and future electronics becoming smaller and smaller and the requirement for high performance and reliability is stronger than ever. In order to achieve good insulation resistance and ensure adequate adhesion of conformal coatings and encapsulation resins, the cleanliness of the electronic assemblies is essential.

There are many stages where cleaning is required; prior to stenciling and soldering in order to remove contaminants from the many previous production stages, after stenciling to remove excess solder paste/adhesive and after soldering to remove corrosive flux residues and any solder balls.

In industry today, many manufacturers are turning to ‘no clean’ processes, implying that cleaning is not required after soldering. In the ‘no clean’ process the solids content of the flux is lower than traditional types, however they still contain rosin and activator. Such residues, along with any other unwanted elements collected due to the missing cleaning stage, could cause issues with adhesion and possibly affect the performance of the protecting media applied, ie. Encapsulation Resins or Conformal Coating. It can therefore be stated that even with advances in new technologies, such as ‘no clean’ fluxes, cleaning is still an essential multi-stage process within the electronics industry.

Finally, there are also cleaning stages required for the removal of coatings and adhesives when re-work is necessary, for the cleaning of individual components and for maintenance of the production line.

GENERAL RECOMMENDATIONS FOR CLEANING

- Electronic devices in both clinical and non-clinical areas become contaminated with microorganisms, which are transmitted via contaminated hands. Follow the guidance in Table 1 for cleaning and disinfecting electronic devices.
- Unless there is a protective, washable cover for the electronic mobile device it should not come into contact with the patient environment.
- Replace computer components when:
- Grossly contaminated e.g. saturated with blood or body fluids or
- Cleaning doesn’t remove visible soil, e.g., keyboards.

Equipment	Minimum frequency	Product
Mobile electronic devices taken into the patient's room, but not directly into the patient environment, for activities, such as charting in an electronic health record, order entry, or data collection, e.g., computer or workstation on wheels, tablets, wireless laptops	Before use on the next patient; and when visibly soiled	Follow manufacturer's instructions for use for specific recommendations. • Use a disposable soft, non-abrasive, lint-free damp cloth or wipe, pre-moistened with a ready to use (RTU) AHS provided cleaner/**disinfectant**. • Squeeze out excess liquid before use. • Never spray products directly onto electronic devices Examples of disinfectants that may be indicated in the manufacturer's instructions for use: • Alcohol swabs and wipes (often used for phones, mouse, pagers) • Combination products such as alcohol/quaternary ammonium e.g. CaviWipes® • Hydrogen peroxide products such as accelerated hydrogen peroxide (AHP) products e.g. Virox RTU®, Accel®, Oxivir®, Percept Wipe® Example a of product not usually recommended: • Sodium hypochlorite (bleach) such as Clorox® Do not use compressed air to clean electronic devices, e.g., keyboards
Mobile electronic devices taken into the patient's room and used directly in the patient environment, e.g., pager, smart phone, cell phone, or personal digital assistant	Before contact with a patient or patient's environment; after contact with a patient or patient's environment; and when visibly soiled	
Telehealth equipment in all clinical areas	Before use on the next patient; when equipment leaves the patient environment; and when visibly soiled	
Fixed electronic devices including key boards used in the patient environment, e.g., wall-mounted computers	Daily; when visibly soiled; and at discharge	
Electronic devices including keyboards used near the patient environment, e.g., computers in the hallway and outside the patient's room	Daily, and when visibly soiled	
All other fixed electronic devices located in clinical areas, e.g., nursing station.	Daily, and when visibly soiled	

Equipment	Minimum frequency	Product
Electronic devices in public areas for patient use.	Daily, and when visibly soiled	
Desk phones	Daily	• Use alcohol swabs or wipes. • Other cleaning wipes such as CaviWipes®, Lysol®, and Green Works® may leave a residue which can compromise the keys and affect the internal electronics.

Table 1

Self-Check -8	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, Cleaning is an essential process within electronics manufacture and has been used for many years to remove potentially harmful contaminants during PCB manufacture. *(3 pt each)* A, true B, false

2, The purpose of cleaning, specifically within the rapidly expanding electronics industry, is to essentially improve product lifetime by ensuring good surface resistance and by preventing current leakage leading to PCB failure. *(3 pt each)* A, true B, false

3, General Recommendations For Cleaning *(3 pt each)*.

A, Replace computer components when:

B, Grossly contaminated e.g. saturated with blood or body fluids or

C, Cleaning doesn't remove visible soil, e.g., keyboards.

D. all

Note: Satisfactory rating 4 and above points Unsatisfactory below 4 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation Sheet 1	Occupational Health and Safety

Techniques for Occupational Health and Safety:

Step 1- selects PPE.
Step 2- wear ppe.
Steps 3- apply safety procedures.

Operation Sheet 2	**Replacing Defective parts/components**

Techniques for **Replacing Defective parts/components**:

Step 1-wear ppe
Step 2-prepar work stations/equipments
Step3- select required tools and equipment.
Step 4- **Replacing Defective parts/components**..
Step 5- test.
Step 6-applay 5s

Operation Sheet 3	**Soldering/mounting Repaired or replaced parts/components**

Techniques for **Soldering/mounting Repaired or replaced parts/components**:

Step 1- wear PPE.
Step 2- prepare tools, materials and equipment's.
Steps 3-solder/mount repaired or replaced parts/components.
Step 4- apply 5s.

Operation Sheet 4	**Performing Control settings/adjustments in conformity with service-manual specifications**

Techniques for **Performing Control settings/adjustments in conformity with service-manual specifications**:

Step 1- wear PPE.
Step 2- prepare, tools and equipment's depends on west type.
Steps 3- identify control settings.
Step 4- apply control settings.

Operation Sheet 5	**Performing Repair activity within the required timeframe**

Techniques for **Performing Repair activity within the required timeframe**:

Step 1- wear PPE.
Step 2- prepare, tools and equipment's depends on west type.

Steps 3- identify faults.
Step 4- perform repairing activities .
Step5- apply 5s

Operation Sheet 6	**Observing Care and extreme precaution during handling the unit/product as per procedures**

Techniques for **Observing Care and extreme precaution during handling the unit/product as per procedures**:

Step 1- wear PPE.
Step 2- prepare, tools and equipment's depends on west type.
Steps 3- handle equipments.

Operation Sheet 7	**Cleaning with standard procedures**

Techniques for **Cleaning with standard procedures**:

Step 1- wear PPE.
Step 2- prepare, tools and equipment's depends on west type.
Steps 3- sort /identify wastes.
Step 4- do clean activities.

LAP Test	Performing Control settings/adjustments in conformity with service-manual specifications

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour.

Task 1. Occupational Health and Safety's

Task 2. Electro-static discharge (ESD) protection procedure

Task 3. Replacing Defective parts/components

Task 4.Soldering/mounting Repaired or replaced parts/components

Task 5. Performing Control settings/adjustments in conformity with service-manual specifications

Task 6. Performing Repair activity within the required timeframe

Task 7. Observing Care and extreme precaution during handling the unit/product as per procedures

Task 8. Cleaning with standard procedures

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Basic Home/Office Electrical/ Electronic Equipment Servicing

Level II

Learning Guide -27

Unit of Competence: Maintain and Repair Electronically Controlled Domestic Equipment

Module Title: Maintaining and Repairing Electronically Controlled Domestic Equipment

LG Code: EELHOS2 M06 LO4-LG-27

TTLM Code: EELHOS2 TTLM 1019v1

LO4: Test repaired unit

Instruction Sheet-1	Learning Guide #26

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Reassembling units
- Final testing and cleaning
- completing Service Based on manual
- Disposing Waste materials

This guide will also assist you to attain the learning outcome stated in the cover page.
Specifically, upon completion of this Learning Guide, you will be able to –

- Reassemble units
- Final test and cleaning
- complete Service Based on manual
- Dispose Waste materials

Learning Instructions:

19. Read the specific objectives of this Learning Guide.
20. Follow the instructions described below 3 to 6.
21. Read each information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet Sheet 4 Sheet 5 Sheet 6 Sheet 7 Sheet 8 Sheet 9 and Sheet10.
22. Accomplish the “Self-check 1, Self-check 2, Self-check 3 Self-check 4 Self-check 5 Self-check 6 Self-check 7 Self-check 8 Self-check 9 and Self-check10 .
23. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 ,Operation Sheet 3 Operation Sheet 4 Operation Sheet 5 Operation Sheet 6 Operation Sheet 7 Operation Sheet 8 Operation Sheet9 and Operation Sheet10 ”.
24. Do the “LAP test”

Information Sheet-1	Basic Electricity and Electronics content -1 Test repaired unit

4.1 Reassemble units:- is the process of assembling each parts of the appliance.

4.2 Reassembling Procedure:

1. After replacing the defective part of the appliance, prepare the parts for reassembling.
2. Review the operating and service manual if available.
3. Fix all the disassembled parts in the housing/compartment, considering the fittings, lock etc.
4. Wires should be in their proper places and loose parts should be
5. All sides of the housing should fit accordingly.
6. Moving parts must move as it can be moved by hand and free from obstructions.
7. Tightened to avoid damaged due to misalignment.
8. Clean the unit before doing the testing procedure.
9. perform final test.

Self-Check -1	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, A reassemble unit is the process of assembling each parts of the appliance.*(3 pt each)*

A, true B, false

2, write reassembling Procedure of a domestic equipments *(9 pt each)*

Note: Satisfactory rating 6 and above points Unsatisfactory below 6 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Basic Electricity and Electronics content -2 Final testing and cleaning

2. Final test and cleaning

2.1 Post-testing Procedure:

1. Test the resistance at the AC plug to determine the continuity of the power line to the AC unit . A resistance reading must be observed as you turn the switch to ON position. This indicates that the circuit connection is good.
2. In the case of electronically-controlled domestic equipment, there is no resistance reading as you test the AC plug. The reason is that there is a low-voltage power supply circuit that controls the functions of the appliance.
3. Energize the unit to check its functionality. Plug the AC cord to the power source (the switch is at OFF position and power ON button for electronically-controlled must be OFF too). Turn the switch accordingly and observe if the unit functions as it should be. In the case of electronically-controlled, press button one at a time observing the behavior. This time, the unit should operate normally. If not, review the documentation and the problem for the second time.

2.2 Testing Procedure:

1. Test the resistance at the AC plug to determine the continuity of the power line to the AC unit. A resistance reading must be observed as you expect in normal.
2. Energize the unit to check its functionality. Press button one at a time observing the behavior. This time, the unit should operate normally. If not, review the documentation and the problem for the second time.

Following are definitions of three categories of test that shall apply:

1 Operational Test

- That procedure required to ascertain only that a system or unit is operable. These tests should require no special equipment or facilities other than that installed on the aircraft and should be comparable to the tests performed by the flight crews.
- It is not intended that the operational test of the unit shall meet the specifications and tolerances ordinarily established for overhaul, or major maintenance periods.

2 Functional Tests

- That procedure required to ascertain that a system or unit is functioning in all aspects in accordance with minimum acceptable system or unit design specifications. These tests may require supplemental ground support equipment and should be more specific and detailed than an operational test. It should contain all necessary information to perform proficiency tests to maintain system or unit reliability at an acceptable level, without reference to additional documents.

3. System Test

- That procedure containing all adjustment specifications and tolerances required to maintain system and/or unit performance at maximum efficiency and design specifications. It shall be self-contained and may duplicate other tests. It is normally used at major maintenance periods.

Self-Check -2	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, A post testing unit is the process of testing after assembling of each parts of the appliance.*(4 pt each)*A, true B, false

2, write the post testing procedures of a domestic equipments *(6 pt each)*

Note: Satisfactory rating 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	**Basic Electricity and Electronics** **Content:** Service completion procedures and documentations are complied with based on manual

3. Completing Service Based on manual

Record all information during maintaining/repairing electronically-controlled domestic appliance**.** This recorded Service information may include but not limited to:

- job report sheets
- job order
- bill of materials
- customer index
- service flowchart
- stock and inventory record
- requisition slips (for acquisition of parts)supplier index
- Apply **5S** - Sort, Systematize, Sweep, Sanitize, and Self-Discipline for service compilation.

The Organisational Unit is to keep testing and inspection records which are to be stored on a shared system drive.

Record to be kept by:	Organisational Unit, Academic Unit
Records	Records of inspection and testing of electrical equipment, including: • register of all electrical equipment • record of formal inspection and tests • repair register and • record of all faulty equipment showing details of services or corrective actions.
To be kept for:	Records should be kept in alignment with the Records Management Policy and Guidelines

- Complete, accurate, and current documentation is essential to an effective maintenance program. Whether performing preventive, predictive, or reliability centered maintenance, keeping track of equipment condition and maintenance—performed and planned—is critical.
- Maintenance recommendations contained in this volume should be used as the basis for establishing or refining a maintenance schedule. Recommendations can be converted into Job Plans or Work Orders in MAXIMO or another maintenance management system. Once these job plans and work orders are established, implementation of well-executed maintenance is possible.

- The maintenance recordkeeping system must be kept current so that a complete maintenance history of each piece of equipment is available at all times. This is important for planning and conducting an ongoing maintenance program and provides documentation needed for the Power O&M Reviews (section .
- Regular maintenance and emergency maintenance must be well documented as should special work done during overhauls and replacement. The availability of up-to-date drawings to management and maintenance staff is extremely important. Accurate drawings are very important to ongoing maintenance, testing, and new construction; but they are essential during emergencies for troubleshooting. In addition, accurate drawings are important to the continued safety of the staff working on the equipment.

Self-Check -3	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, Record all information during maintaining/repairing electronically-controlled domestic appliance*(4 pt each)*A, true B, false

2, write the recorded Service information may include *(10 pt each)*

Note: Satisfactory rating 7 and above points Unsatisfactory below 7 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-4	Basic Electricity and Electronics content -4 Disposing Waste materials

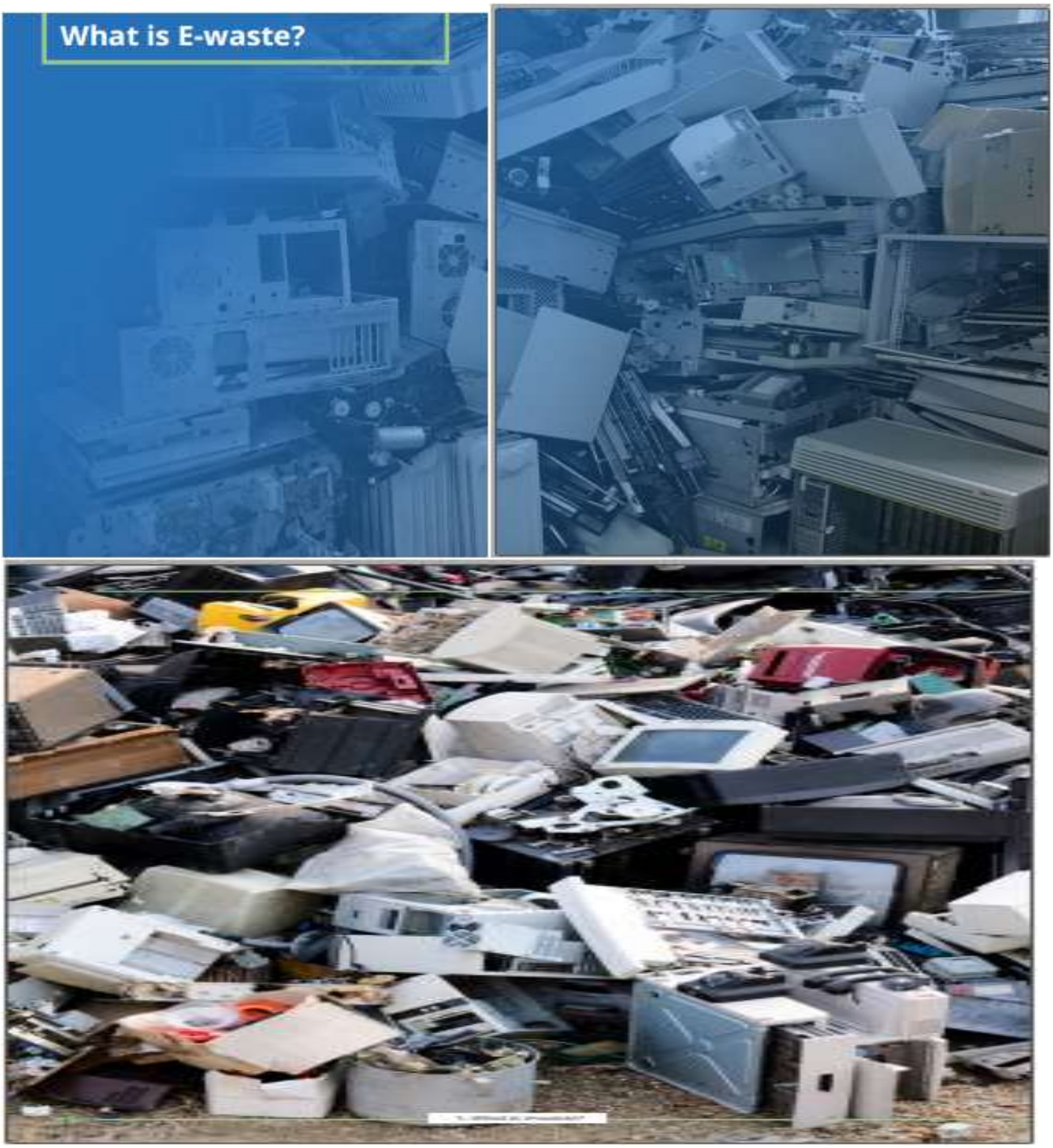

Figure 1

4.1 Disposing Waste materials

Electronic waste, or e-waste, refers to all items ofelectrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of re-use It includes a wide range of products – almost any household or business item with circuitry or electrical components with power or battery supply. the definition of e-waste is very broad. It covers six waste categories:

1. Temperature exchange equipment, more commonly referred to as cooling and freezing

equipment. Typical equipment includes refrigerators, freezers, air conditioners, heat pumps.
2. Screens, monitors. Typical equipment includes televisions, monitors, laptops, notebooks, and tablets.
3. Lamps. Typical equipment includes fluorescent lamps, high intensity discharge lamps, and LED lamps.
4. Large equipment. Typical equipment includes washing machines, clothes dryers, dish-washing machines, electric stoves, large printing machines, copying equipment, and photovoltaic panels.
5. Small equipment. Typical equipment includes vacuum cleaners, microwaves, ventilation equipment, toasters, electric kettles, electric shavers, scales, calculators, radio sets, video cameras, electrical and electronic toys, small electrical and electronic tools, small medical devices, small monitoring and control instruments.
6. Small IT and telecommunication equipment. Typical equipment includes mobile phones, Global Positioning Systems (GPS), pocket calculators, routers, personal computers, printers, telephones.
Each product of the six e-waste categories has a deferent lifetime profile, which means that each category has deferent waste quantities, economic values, as well as potential environmental and health impacts, if recycled inappropriately.
Consequently, the collection and logistical processes and recycling technology differ for each category, in the same way as the consumers' attitudes when disposing of the electrical and electronic equipment also vary.
EEE products have been categorized into various groupings by pieces of national legislation taking into account their original purpose, size, composition and/or weight.
1. Large household appliances, such as large cooling equipment like refrigerators, freezers, or equipment for cookers, microwave ovens, etc.
2. Small household appliances, such as cleaning equipment like vacuum cleaners and irons.
3. Information technology (IT) and telecommunication equipment, personal computers, laptops, printers, photocopiers, telephones, cell phones, modems, routers, tablets, data processing management equipment, etc.
4. Consumer electronics, such as radios, televisions, video cameras, musical instruments, etc.
5. Lighting equipment, fluorescent lamps, compact fluorescent, excluding incandescent lamps for homes.
6. Electrical and electronic tools (except fixed industrial tools of great significance) like crushing equipment for coatings.
7. Toys or sporting and leisure equipment, video consoles, trains, electric cars, etc.
8. Medical devices (with the exception of all implanted and infected products), such as cardiology equipment, radiotherapy, dialysis, etc.
9. Monitoring and control instruments, such as smoke detectors, thermostats, control panels, etc.
10. Vending machines for drinks, automated teller machines (ATMs), etc.
The characteristics of each of these categories will determine the best treatment process and disposal for their respective equipment after EoL. The logistics of collection, management and recycling of this equipment should be carried out according to its characteristics.
E-waste can come from household, professional, industrial, institutional or other uses. Its generation depends on several factors, including the useful life of the equipment (e.g.,

computers, televisions, etc.), the need for renewal of the equipment by users (e.g., mobile phones) and major technological changes (e.g., the global system for mobile communications (GSM) to the universal mobile telecommunications system (UMTS) mobile telephony). For example, according to Step Initiative and the Massachusetts Institute of Technology (MIT), the average lifespan of a mobile phone is estimated at three to five years. (GSMA, 2014) This use should be taken into account as it highly contributes to the rapid growth of e-waste globally.

Sustainable management of e-waste

The majority of the e-waste and its components are recycled or reused by formal or informal programmers, depending on the recycling capacities of the country where the e-waste is generated. If e-waste is properly managed, business opportunities can be created to meet the need for reconditioning of equipment and recovery of raw materials. Governments, non-governmental organizations (NGOs) and the ICT sector consider e-waste management a tool and opportunity for sustainable development. (ITU, 2014) E-waste is a complex mixture of hazardous and non-hazardous materials that requires specialized processes of collection, transportation, segregation, treatment and disposal. It is important to be familiar with the life cycle of EEE to understand its potential environmental impacts. Figure 1 describes the life cycle of EEE and the processes it undergoes once it becomes e-waste.

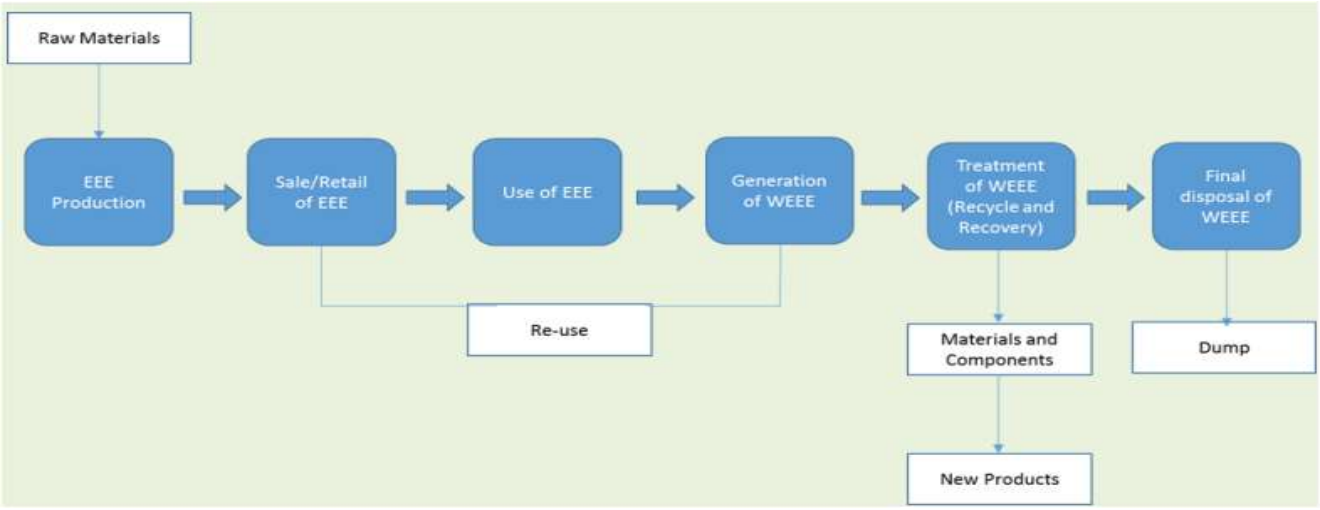

Figure 2

There are some basic principles and definitions of environmental sustainability for the management of e-waste.

Reuse: Extension of the end of life of equipment or component parts to be used for the same purpose for which they were originally conceptualized; this may or may not include a change in ownership of the equipment.

This process aims to promote optimal use of available resources, but social or environmental risks associated with poor management should be taken into account.

Dismantling and segregation: This involves careful manual separation of the parts and components of a piece of equipment in disuse. It is suggested that this activity be carried out by authorized recycling companies that specialize in reconditioning.

Recycling and recovery: This process involves the recovery of devices, components and material. The dismantling can be manual or semi-manual. The recovery of materials is part of

the WEEE recycling process, especially for metal recovery, which requires specialized facilities and investment.

Refurbishment: This is any process that allows re-utilization of EEE that was previously WEEE. It includes changes in hardware and software.

Final disposition: In the process of final disposal of waste or materials, non-recoverable materials can be disposed of in controlled landfills (dumps) or by incinerating

The principles of reduce, reuse and recycle (3Rs) should also be taken into account for the proper management of e-waste in order to minimize the generation of waste throughout its life cycle by employing innovative and efficient processes and technologies. Reuse is an alternative that should include the implementation of a proper collection and refurbishment process. Reusing products has its limitations; it can only temporarily extend the life of the equipment.

Self-Check -4	Written Test

Directions: ***For the Following Questions You are Given Four Alternatives then Choose the Correct Answer and circle***

1, one is not the basic principles and definitions of environmental sustainability.*(4 pt each)*

A, Reuse B, Recycling and recovery C, Final disposition D, none of the above

2, write the six e- waste categories.*(6 pt each)*

Note: Satisfactory rating 5 and above points Unsatisfactory below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation Sheet 1	Reassemble units Techniques

Techniques for reassembling units:

Step 1- wear PPE.
Step 2- select required tools and materials
Steps 3- reassembling units.
Step 4- testing reassembling units.

Operation Sheet 2	Final testing and cleaning

Techniques for Final testing and cleaning ServiceCompleting:

Step 1-wear ppe
Step 2- Step3- select required tools and equipment.
Step 4- perform final test.
Steps 5- apply 5s.
Step 6- turn the equipment to normal position.

Operation Sheet 3	Completing maintain/repairing Service

Techniques Completing for maintain/repairing Service:

Step 1-wear ppe
Step 2-prepar work stations/equipments
Step3- select required tools and equipment.
Step 4- maintain and repair.
Steps 5- reassemble units.
Step 6- test.
Step7-applay 5

Operation Sheet 4	Disposing Waste materials

Techniques for Disposing Waste materials:

Step 1- wear PPE.
Step 2- prepare, tools and equipment’s depends on west type.
Steps 3- sort /identify wastes.
Step 4- dispose un necessary wastes.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour.

Task 1. Test repaired unit

Task 2. Reassemble units Techniques.

Task 4. Final testing and cleaning.

Task4. Completing maintain/repairing Service.

Task5.Disposing Waste materials.

List of Reference Materials

1.COFFEE MAKER KM 5260 ENGLISH
2. Medical Equipment Maintenance Manual Shower pan construction,
3 . K to 12 Basic Education Curriculum Technology and Livelihood Education Learning Module
4 . ELECTRICAL INSTALLATION MAINTENANCE 130 K to 12 – Technology and Livelihood Education
5 . Managing electrical risks in the workplace
6. CENTRAL PUBLIC WORKS DEPARTMENT MAINTENANCE MANUAL
7. Grade 10GOP – Textbook Funds
8. 7808-e-facts sheet technician
9.- A Consumer's Guide to fnding the right Energy Efcient Vacuum Cleaners

No	Name of trainer	Qualification	Region	E-mail
1	ENIYEY YIRSAW	MSC	AMHARA	ene.fre12@gmail.com
2	Fasil Dawit	BSC	Dire Dawa	
3	GETNET ALELIGN	MSC	BENISHANGUL	
4	MOGES CHERE	MSC	ADISS ABABA	Mog.cher2@gmail.com
5	TAMIRU HAILU	MSC	Dire Dawa	

Self-Check answer

Lo1 Self-Check1

1 D

2, 1,solder,2 logons paler,3 ESD wrist strip 4, flat scrwdraver 5, multi tester 6,philipins screwdriver 8, mask 9,combination ranch 10, cable tip

Lo1 Self-Check2

1 .B

2. B

3. C

Lo1 Self-Check3

1 . D

2 . E

3 . A

Lo1 Self-Check4

1 . D

2 . A

3 . A

Lo1 Self-Check5

Lo2 Self-Check1

1. E

2.A

3. A

Lo2 Self-Check1

1 D

2 D

3 A

Lo2 Self-Check2

1 D

2 A

3 A

Lo2 Self-Check3

1 B

2 A

3 A

Lo2 Self-Check4

1 B

2 A

3 A

Lo2 Self-Check5

1 D

2 A

3 analysis
problem identification/replication
action plan
implementation
testing
documentation
follow up

Lo2 Self-Check6

1 A

2 D

Lo2 Self-Check7

1A

2A

3 D

Lo2 Self-Check8

1 A

2 A

3 A

Lo2 Self-Check9

1 A

2 A

3 A

Lo2 Self-Check10

1 E

2 A

3 A