ELECTRONIC MECHANIC

NSQF LEVEL - 5

2nd Year (Volume II of II)

TRADE PRACTICAL

SECTOR: Electronics & Hardware

Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
GOVERNMENT OF INDIA

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032

Sector : Electronics and Hardware

Duration : 2 - Year

Trade : Electronic Mechanic 2nd Year (Volume II of II) - Trade Practical - NSQF level 5

First Edition : November 2018 Copies : 1,000
First Reprint : February 2019 Copies : 2,000

Rs. 170/-

Published by:

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE
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FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2020 to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of Mentor Councils comprising various stakeholders viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Electronic Mechanic, 2nd Year (Volume II of II) Trade Practical NSQF Level - 5 in Electronics & Hardware Sector under Semester Pattern.** The NSQF Level - 5 Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 5 trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 5 the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

RAJESH AGGARWAL
Director General/ Addl.Secretary
Ministry of Skill Development & Entrepreneurship,
Government of India.

New Delhi - 110 001

PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Directorate General of Training, Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of Federal Republic of Germany. The prime objective of this Institute is to develop and provide instructional materials for various trades as per the prescribed syllabi under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private sectors, Officers of DGT and DGT field institutes, proof readers, individual media developers and coordinators, but for whose active support NIMI would not have been able to bring out this materials.

R. P. DHINGRA
EXECUTIVE DIRECTOR

Chennai - 600 032

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisation to bring out this IMP **(Trade Practical)** for the trade of **Electronic Mechanic** under the **Electronics & Hardware** Sector for ITIs.

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NIMI records its appreciation of the Data Entry, CAD, DTP Operators for their excellent and devoted services in the process of development of this Instructional Material.

NIMI also acknowledges with thanks, the invaluable efforts rendered by all other staff who have contributed for the development of this Instructional Material.

NIMI is grateful to all others who have directly or indirectly helped in developing this IMP.

INTRODUCTION

TRADE PRACTICAL

The trade practical manual is intented to be used in workshop . It consists of a series of practical exercises to be completed by the trainees during the Fourth Semester course of the Electronic Mechanic trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with NSQF LEVEL - 5

The manual is divided into Eight modules. The distribution of time for the practical in the Eight modules are given below.

Module 1	Fiber Optic Communication	25 Hrs
Module 2	Digital Panel Meter	50 Hrs
Module 3	SMPS & Inverter	75 Hrs
Module 4	UPS	75 Hrs
Module 5	Solar Power (Renewable Energy)	75 Hrs
Module 6	Cell Phones	50 Hrs
Module 7	LED Lights	50 Hrs
Module 8	LCD & LED TV	125 Hrs
Project work/Industrial visits		50 Hrs
	Total	575 Hrs

The skill training in the shop floor is planned through a series of practical exercises centred around some practical project. However, there are few instances where the individual exercise does not from a part of project.

While developing the practical manual a sincere effort was made to prepare each exercise which will be easy to understand and carry out even by below average trainee. However the development team accept that there is a scope for further improvement. NIMI, looks forward to the suggestions from the experienced training faculty for improving the manual.

TRADE THEORY

The manual of trade theory consists of theoretical information for the Fourth Semester course of the Electronic Mechanic Trade. The contents are sequenced according to the practical exercise contained in the manual on Trade practical. Attempt has been made to relate the theortical aspects with the skill covered in each exercise to the extent possible. This co-relation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

The Trade theory has to be taught and learnt along with the corresponding exercise contained in the manual on trade practical. The indicating about the corresponding practical exercise are given in every sheet of this manual.

It will be preferable to teach/learn the trade theory connected to each exercises atleast one class before performing the related skills in the shop floor. The trade theory is to be treated as an integrated part of each exercise.

The material is not the purpose of self learning and should be considered as supplementary to class room instruction.

CONTENTS

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

- **Prepare fiber optic setup and execute transmission and reception.**
- **Plan and Interface the LCD, LED, DPM panels to various circuits and evaluate performance.**
- **Detect the faults and troubleshoot SMPS, UPS and inverter.**
- **Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter.**
- **Dismantle, identify the various parts and interface of a cell phone to a PC. Estimate and troubleshoot.**
- **Identify various parts of LED lights & stacks and troubleshoot.**
- **Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV & its remote control.**

SYLLABUS FOR ELECTRONIC MECHANIC TRADE

2nd Year (Volume II of II) **Duration: 6 Months**

Week No.	Learning Outcome Reference	Professional Skills (Trade Practical) with Indicative hrs.	Professional Knowledge (Trade Practical)
79	• Prepare fibre optic setup and execute transmission and reception.	**Fiber optic communication** 243. Identify the resources and their need on the given fiber optic trainer kit (3 hrs) 244. Make optical fiber setup to transmit and receive analog and digital data (4 hrs) 245. Set up the OFC trainer kit to study AM, FM, PWM modulation and demodulation. (6 hrs) 246. Perform FM modulation and demodulation using OFC trainer kit using audio signal and voice link (4 hrs) 247. Perform PWM modulation and demodulation using OFC trainer kit using audio signal and voice link (4 hrs) 248. Perform PPM modulation and demodulation using OFC trainer kit using audio signal and voice link (4 hrs)	Introduction to optical fiber, optical connection and various types optical amplifier,its advantages, properties of optic fiber, testing, losses, types of fiber optic cables and specifications. Encoding of light. Fiber optic joints, splicing, testing and the related equipment/ measuring tools. Precautions and safety aspects while handling optical cables.
80-81	• Plan and Interface the LCD, LED DPM panels to various circuits and evaluate performance.	**Digital panel Meter** 249. Identify LED Display module and its decoder/driver ICs (6 hrs) 250. Display a word on a two line LED (8 hrs) 251. Measure/current flowing through a resistor and display it on LED Module (10 hrs) 252. Measure/current flowing through a sensor and display it on a LED module(DPM) (10 hrs) 253. Identify LCD Display module and its decoder/driver ICs (8 hrs) 254. Measure/current flowing through a resistor and display it. (8 hrs)	Different types of seven segment displays, decoders and driver ICs. Concept of multiplexing and its advantages. Block diagrams of 7106 and 7107 and their configuration for different measurements. Use of DPM with seven segment display. Principles of working of LCD. Different sizes of LCDs. Decoder/ driver ICs used with LCDs and their pin diagrams. Use of DPM with LCD to display different voltage & current signals.
82-84	• Detect the faults and troubleshoot SMPS, UPS and inverter.	**SMPS and Inverter** 255. Identify the components/ devices and draw their corresponding symbols (4 hrs) 256. Dismantle the given stabilizer and find major sections/ ICs components. (6 hrs)	Concept and block diagram of manual, automatic and servo voltage stabilizer, o/p voltage adjustment. Voltage cut-off systems, relays used in stabilizer. Block Diagram of different types of Switch mode power supplies and their

		257. List the defect and symptom in the faulty SMPS. (5 hrs) 258. Measure / Monitor major test points of computer SMPS. (8 hrs) 259. Troubleshoot the fault in the given SMPS unit. Rectify the defect and verify the output with load. Record your procedure followed for trouble shooting the defects (10 hrs) 260. Use SMPS used in TVs and PCs for Practice. (6 hrs) 261. Install and test the SMPS in PC (6 hrs) 262. Install and test a inverter. (6 hrs) 263. Troubleshoot the fault in the given inverter unit. Rectify the defects and verify the output with load. (6 hrs) 264. Construct and test IC Based DC-DC converter for different voltages (6 hrs) 265. Construct and test a switching step down regulator using LM2576 (6 hrs) 266. Construct and test a switching step up regulator using MC 34063 (6 hrs)	working principles. Various types of chopper circuits. Inverter; principle of operation, block diagram, power rating, change over period. Installation of inverters, protection circuits used in inverters. Battery level, overload, over charging etc. Various faults and its rectification in inverter. Block diagram of DC-DC converters and their working principals.
85-87	• Detect the faults and troubleshoot SMPS, UPS and inverter.	**UPS** 267. Connect battery stack to the UPS. (4 hrs) 268. Identify front panel control & indicators of UPS. (4 hrs) 269. Connect Battery & load to UPS & test on battery mode. (6 hrs) 270. Open top cover of a UPS; identify its isolator transformers, the UPS transformer and various circuit boards in UPS. (10 hrs) 271. Identify the various test point and verify the voltages on these (7 hrs.) 272. Identify various circuit boards in UPS and monitor voltages at various test points (7 hrs) 273. Perform load test to measure backup time. (7 hrs)	Concept of Uninterrupted power supply. Difference between Inverters and UPS. Basic block diagram of UPS & operating principle. Types of UPS : Off line UPS, On line UPS, Line interactive UPS & their comparison UPS specifications. Load power factor & types of indications & protections UPS circuit description and working - controlling circuits, Micro controller circuits, power circuits, charging circuits, alarm circuits, Indicator circuits. Installation of single phase & three phase UPS.
88-90	• Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter.	274. Perform all above experiment for three phase UPS (30 hrs) Solar Power (Renewable Energy System) 275. Install a solar panel to a roof. (25 hrs) 276. Wire a solar controller to a battery storage station. (5 hrs)	Need for renewable energy sources, Solar energy as a renewable resource. Materials used for solar cells. Principles of conversion of solar light into electricity. Basics of photovoltaic's cell. Module, panel and Arrays. Factors that influence the

		277. Install solar power 500 panel to directly 12 V DC appliances (15 hrs) 278. Connect storage batteries to a power inverter (5 hrs) 279. Connect and test solar panel to the Inverter and run the load. (5 hrs) 280. Install a solar power to charge a rechargeable 12 V DC battery and find out the charging time (15 hrs) 281. Install a Solar Inverter. (5 hrs)	output of a PV module. SPV systems and the key benefits. Difference between SPV and conventional power. Solar charge controller or regulator and its role. Safety precautions while working with solar systems.
91-92	• Dismantle, identify the various parts and interface of a cell phone to a PC. Estimate and troubleshoot.	**Cell phones** 282. Dismantle, identify the parts and assemble different types of smart phones (6 hrs) 283. Dismantle the cell phone/smart phone remove the key pad and clean it, test for the continuity of the matrix/tracks (10 hrs) 284. Interface the cell phone/smart phone to the PC and transfer the data card (6 hrs) 285. Flash the various brands of cell phone/smart phone (at least 3) (5 hrs) 286. Format the cell phone/smart phone for virus (approach the mobile repair shop/service centre) (5 hrs) 287. Unlock the handsets through codes and software (3 hrs) 288. Perform the interfacing of cell phone/smart phone to the PC and dismantle the cell phone and identify the power section and test its healthiness (6 hrs) 289. Find out the fault of basic cell phone system. Rectify the fault in ringer section and check the performance (6 hrs) 290. Replace various faulty parts like mic, speaker, data/ charging/ audio jack etc. (5 hrs)	Introduction to mobile communication. Concept cell site, hand off, frequency reuse, block diagram and working of cell phones, cell phone features. GSM and CDMA technology. Use IEMI number to trace lost/misplaced mobile phone.
93-94	• Identify the various parts of a LED lights & stacks and troubleshoot.	**LED Lights** 291. Dismantle the LED light, identify the connections of LEDs stacks, protection circuits, regulator (12 hrs) 292. Identify the rectifier, controller part of LED lights (8 hrs) 293. Make series string connection of six LED's and connect four Series strings in parallel. (8 hrs)	Types of LED panels used in various lighting applications. Stacking of LEDs. Driving of LED stacks.

		294. Connect to such parallel sets in Series to create a matrix of LED's. (14 hrs.) 295. Apply suitable voltage and check Voltage across series strings. (8 hrs)	
95-99	• Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV & its remote	**LCD and LED TV** 296. Identify and operate different Controls on LCD, LED TV (10 hrs) 297. Identify components and different sectors of LCD and LED TV. (20 hrs) 298. Dismantle; Identify the parts of the remote control (10 hrs) 299. Dismantle the given LCD/LED TV to find faults with input stages through connectors. (20 hrs) 300. Detect the defect in a LED/LCD TV receiver given to you. Rectify the fault. (25 hrs) 301. Troubleshoot the faults in the given LED/LCD TV receiver. Locate and rectify the faults. (25 hrs) 302. Test LED/LCD TV after troubleshooting the defects (10 hrs) 303. Identify various connectors and connect the cable operators external decoder (set top box) to the TV. (5 hrs.)	Difference between a conventional CTV with LCD & LED TVs. Principle of LCD and LED TV and function of its different section. Basic principle and working of 3D TV. IPS panels and their features. Different types of interfaces like HDMI, USB, RGB etc. TV Remote Control –Types, parts and functions, IR Code transmitter and IR Code Receiver. Working principle, operation of remote control. Different adjustments, general faults in Remote Control.
100-101	**Project work / Industrial visit** **Broad areas:** 1 Remote control for home appliances 2 Solar power inverter 3 Musical light chaser 4 7 segment LED display decoder drive circuit		
102-103	Revision		
104	Examination		

Identify the resources and their need on the given fiber optic trainer kit

Objectives: At the end of the exercise you shall be able to
- **identify different cables used in OFC**
- **identify different connectors used in OFC**
- **identify various sections in the OFC trainer kit.**

Requirements

Tools/ Equipments/ Instruments

- Optical fiber trainer kit with Instruction manual - 1 Set

Materials/ Components

- Assorted OFC cables - as required
- Assorted OFC connectors - as required
- OFC data manual - as required

Note : The instructor has to label the OFC cables used for this task and also for the OFC connectors.

PROCEDURE

TASK 1 : **Identify different cables used in OFC**

1 Pick any one of the labelled optical fiber cable from the given assorted cables.

2 Identify the name/type of cables used by referring to the data manual.

3 Record the name and its application in the TABLE 1.

4 Repeat above steps for all other labelled cables.

TABLE 1

Sl. No.	Name/Type of the cable	Application

— — — — — — —

TASK 2 : **Identify different connectors used in OFC**

1 Pick any one of the connector from the given assorted OFC connectors.

2 Identify the name / type of connectors by referring the data manual used in OFC.

3 Record the name and its application in the TABLE 2.

4 Repeat above steps for all other connectors.

TABLE 2

Sl. No.	Name/Type of the cable	Application

— — — — — — —

TASK 3 : **Identify various sections of the OFC trainer kit**

1 Identify each section of the OFC trainer kit by observing the kit and refer to the Instruction manual. (Fig 1)

2 Record these names and its descriptions in the TABLE 3.

Various types of OFC trainer kits available in the market. The sections may be different depending upon the manufacturers.

Fig 1

3 Get the recorded observations checked by the Instructor.

TABLE 3

Sl. No.	Name of the section	Description

— — — — — — —

Make optical fiber set up to transmit and receive analog and digital data

Objectives: At the end of the exercise you shall be able to
- **prepare the set-up of optical fiber trainer kit to transmit and receive analog and digital data**
- **observe the input and output waveforms at different sections.**

Requirements

Tools/Equipments/Instruments

- Optical fiber trainer kit with Instruction manual - 1 set.
- CRO 20 MHz (Dual trace) with probe kit - 1 No.
- Trainees tool kit - 1 set.
- Digital multimeter with probes - 1 No.

Materials/ Components

- OFC cables - as required
- Patch cords - as required
- OFC data manual - as required

PROCEDURE

TASK 1 : **Setting up of optical fiber trainer kit to transmit and analog receive signal**

1 Check and confirm the given trainer kit is in working condition. (Fig 1)

2 Use patch cord and connect the function generator 1kHz/1V_{p-p} sine wave output to input of photo emitter circuit input as shown in Fig 1 (Emitter circuit converts electrical input into light/ optical output Fig.2).

3 Use the optical fiber cable and connect between photo emitter circuit output and input of photo detector circuit. (Photo detector circuit converts the light input into electrical output Fig.2)

4 Connect the output of photo detector circuit to AC amplifier input using patch cord.

5 Connect the function generator output to CH1 and amplifier output to CH2 of CRO.

6 Turn the mode selector switch SW1 in the photo emitter circuit to analog mode.

7 Switch ON the trainer kit and prepare CRO for measurement.

8 Observe and trace the analog signal at CH1 and transmitted output signal at CH2 of CRO.

9. Modify the connection of CH1 of CRO to photo detector output, and observe the ouput signal of photo detector circuit.

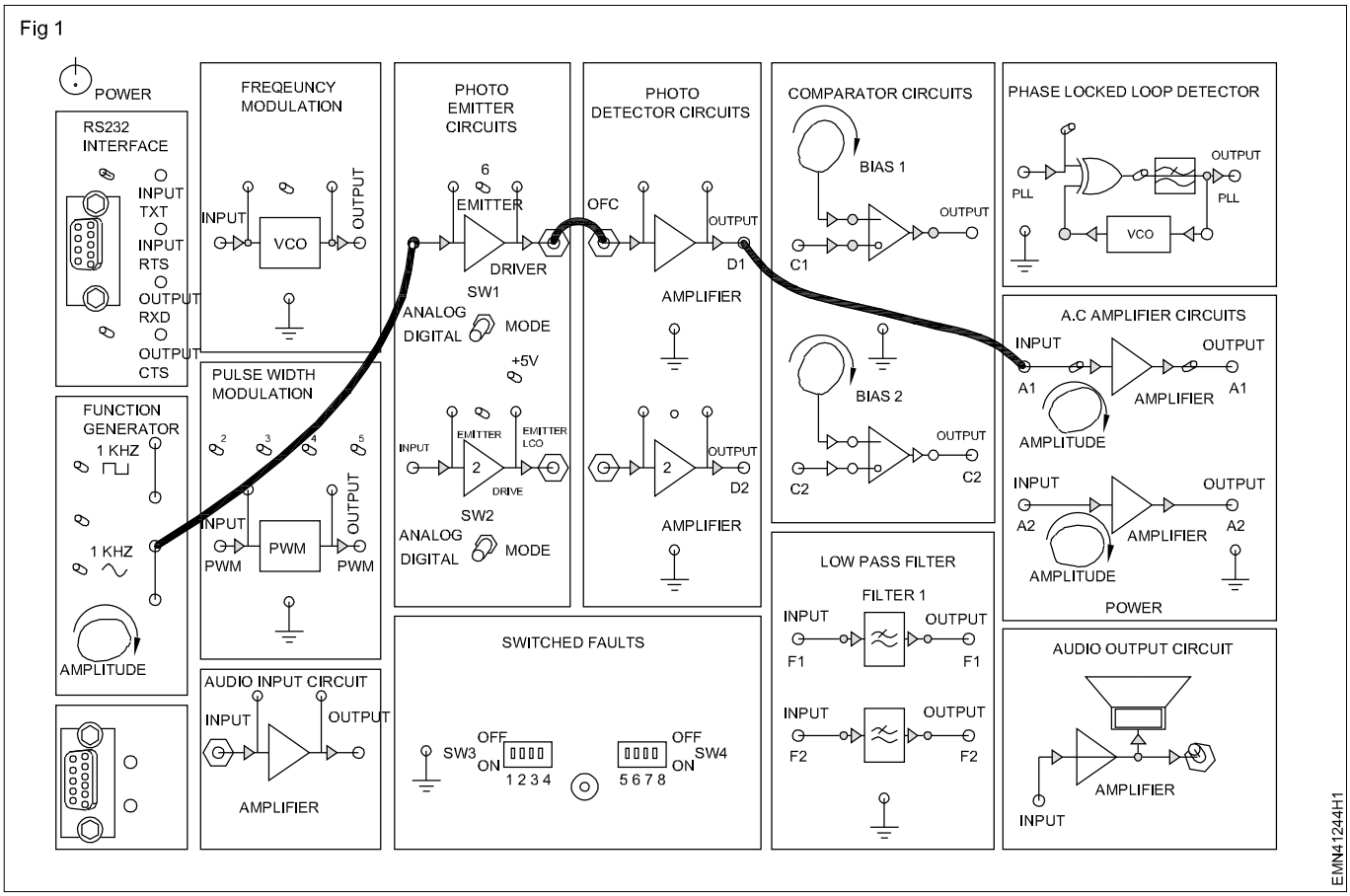
10 Record the observed waveforms in the TABLE 1 and compare with the amplifier output signal.

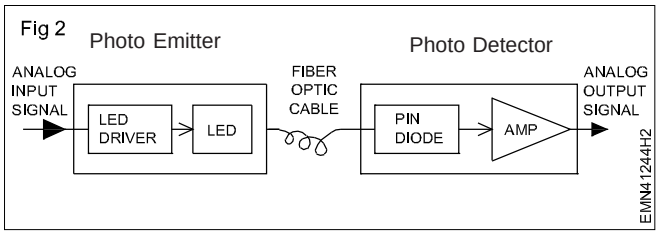
If the input and output waveforms are same, optical link has been established between the transmitter and the receiver.

Table 1

Photo emitter input Signal waveform	**Photo detector ouput signal waveform**	**AC amplifier output - V_{p-p}**

Fig 1





11 Get the work checked by the instructor.

— — — — — — —

TASK 2 : **Setting up of optical fiber trainer kit to transmit and receive and digital signal**

1 Check and confirm the given trainer kit is in working condition. (Fig 3) & (Fig 4)

2 Use patch cord and connect the function generator 1kHz/1V_{p-p} square wave output to the input of photo emitter input as shown in Fig 1.

3 Use the optical fiber cable (OFC) and connect ouput of photo emitter circuit to the input of photo detector circuits as shown in Fig1.

4 Use patch cord and connect the detector circuit's output to the input of comparator circuits; connect the comparator circuits output to AC amplifier input using patch cord

5 Connect the function generator output to CH1 and amplifier output to CH2 of CRO.

6 Get the circuit connections checked by the instructor.

7 Turn the mode selector switch SW1 in the photo emitter circuit to digital mode.

8 Switch ON the trainer kit and prepare the CRO for measurement.

9 Observe and trace the digital square wave Input at CH1 and output signal at CH2 on CRO.

10 Modify the connection of CH1 of CRO to photo detector output and observe the signal waveform.

11 Now connect CH1 of CRO to comparator output and observe the (received digital) output signal of comparator.

12 Record the observed waveforms in TABLE 2 and compare with the amplifier output signal.

If the input and output waveforms are same, optical link has been established between the transmitter and the receiver.

TABLE 2

Photo Emitter input signal waveform	Photo detector Output signal waveform	AC amplifier Output waveform

Fig 3

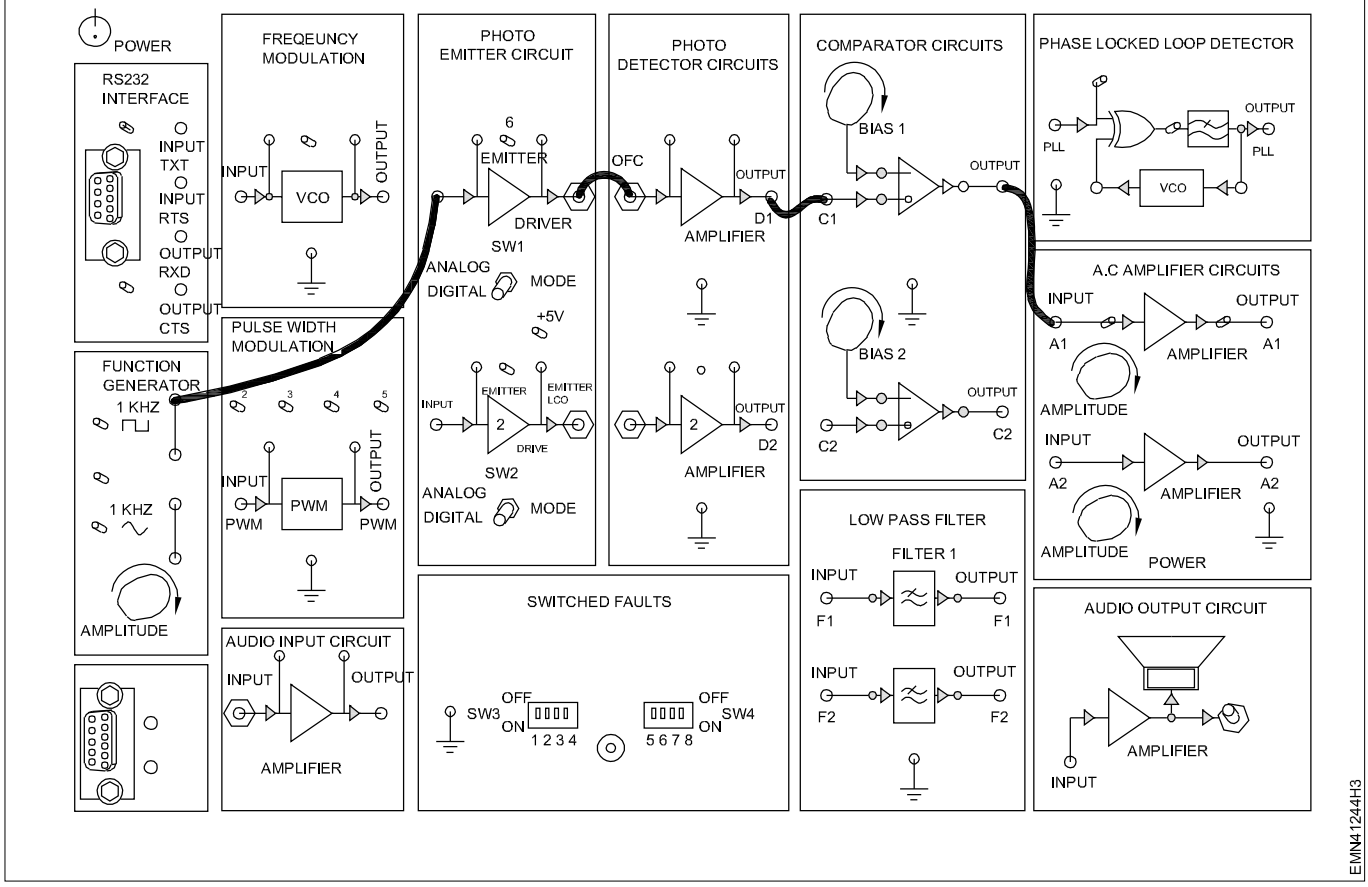
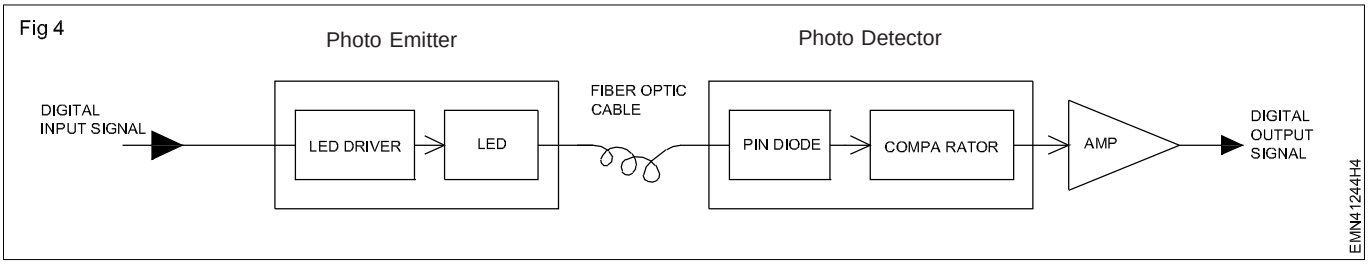


Fig 4



13 Get the work checked by the Instructor.

Set up the OFC trainer kit to study AM, FM, PWM modulation and demodulation

Objectives: At the end of the exercise you shall be able to
- **demonstrate amplitude modulation and demodulation using OFC trainer kit**
- **demonstrate frequency modulation and demodulation using OFC trainer kit**
- **demonstrate pulse width modulation and demodulation using OFC trainer kit.**

Requirements

Tools/Equipments/Instruments

- Optical fiber trainer kit with instruction manual - 1 set.
- CRO 0-50MHz (Dual trace) with probe kit - 1 No.
- Trainees tool kit - 1 set.
- Digital multimeter with probes - 1 No.
- Microphone(Dynamic) - 1 No.
- Loud speaker/ Head phone - 1 No.
- AM/FM signal generator - 1 No.

Materials/ Components

- OFC cable - 1 No.
- Patch cords - as required.
- OFC data manual - as required.

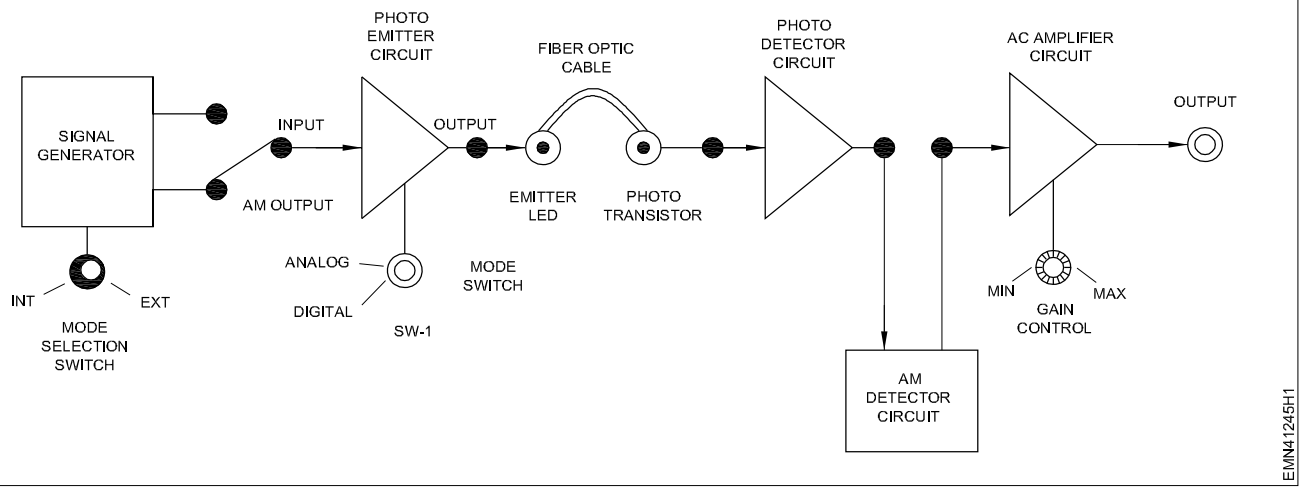
PROCEDURE

TASK 1 : **Setting up of amplitude modulation and demodulation using OFC trainer kit**

1 Check and confirm the OFC trainer kit is in working condition.

2 Make the connections as shown in figure 1.

Fig 1



(a) Use patch cord, connect the signal generator AM wave output to the photo emitter input.

(b) Use and connect the fiber optic cable between photo emitter output and photo detector input.

(c) Connect the photo detector output to AM detector circuit. Connect the AM detector output to AC amplifier input.

3 Turn the mode selector switch SW1 of photo emitter to the analog mode.

4 Get the connections made for AM modulation set up checked by the instructor.

5 Switch ON the power supply of the trainer kit and prepare Oscilloscope for measurements.

6 Set the AM mode selection of the signal generator to internal mode.

7 Observe the input and output signal waveform on oscilloscope record them in Table - 1.

Table-1

Sl. No.	Name of the section	Input/output Waveform	Remarks

8 Get the work checked by the instructor.

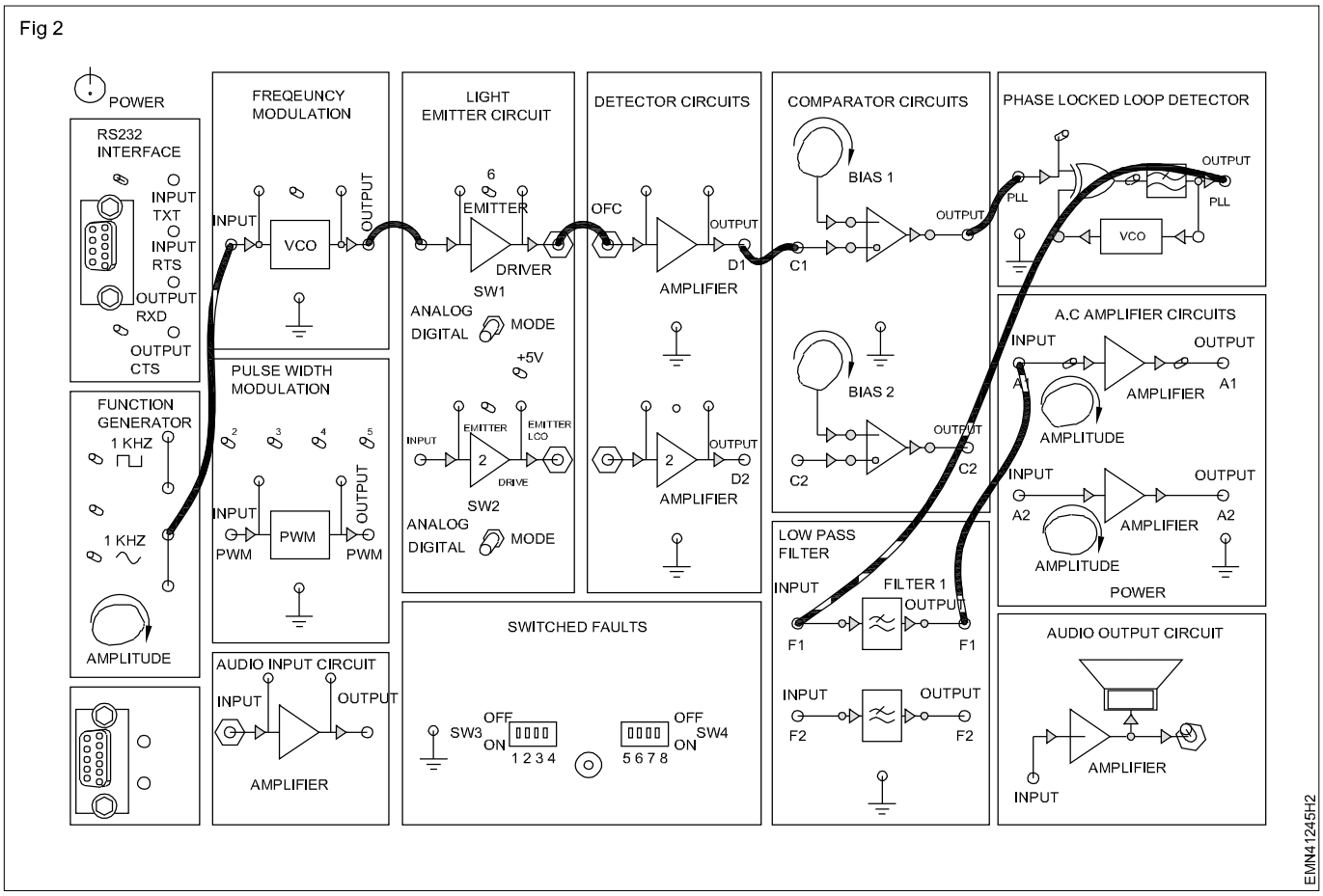
— — — — — —

TASK 2 : **Setting up of frequency modulation and demodulation using OFC trainer kit**

1 Check and confirm the OFC trainer kit is in working condition. (Fig 2)

2 Note down the sections of the OFC trainer kit in the Table-1.

Fig 2



3 Use patch cord, connect the output of function generator to the input of FM modulator section.

4 Use OFC cable, connect the output of light emitter circuit to FM detector input terminal.

Note: The instructor may follow the step as per the trainer kit available in the section.

5 Use patch cords, connect the detector output to the input of comparator.

6 Connect the comparator output to PLL detector input. and connect PLL detector output to low pass filter input.

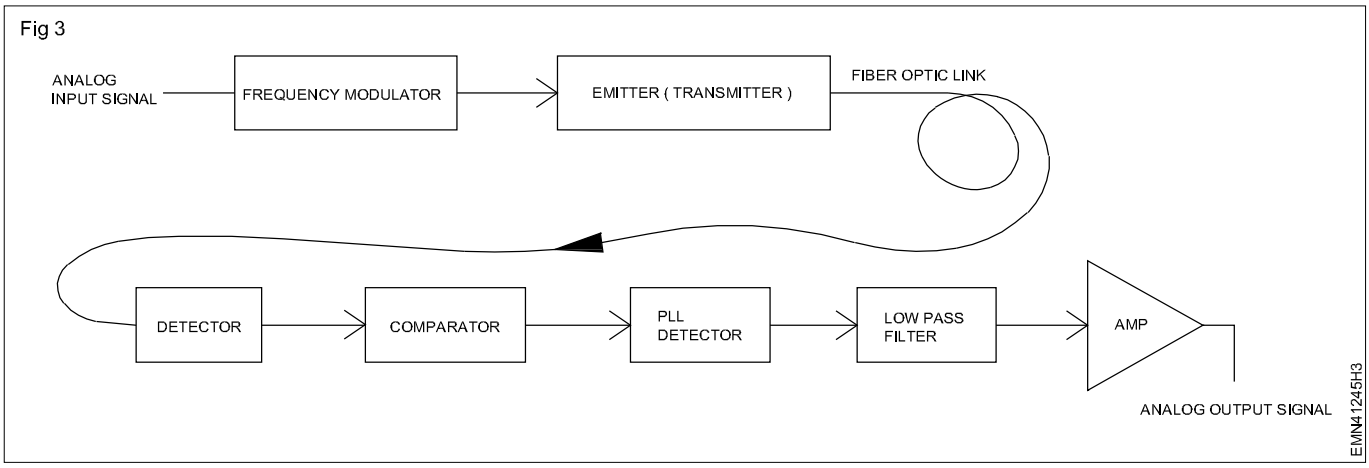
7 Connect low pass filter output to AC amplfier input as shown Fig 2 and Fig 3.

8 Prepare the CRO for measurement and connect the function generator output to channel - 1 and amplifier outpur to the channel -2 of CRO.

9 Switch ON power and set the function generator for 1 kHz/1 V_{p-p} Sine wave signal output.

10 Set the mode selector switch SW1 in the emitter circuit to analog mode and observe the input and output signals on CRO; record the observation in Table-2.

Fig 3



11 Repeat the step 11 & 12 with mode switch set at digital position.

12 Get the work checked by the Instructor.

Table-2

Mode switch position	i/p signal V_{p-p}	Wave form	Output signal V_{p-p}	Wave form
Analog				
Digital				

— — — — — — —

TASK 3 : **Setting up of pulse width modulation and demodulation using OFC trainer kit**

1 Check and confirm the OFC trainer kit is in working condition. (Fig 4)

2 Set the function generator to 1 kHz/1V_{p-p} sine wave signal output.

3 Use patch cords and connect

- the function generator to the input of pulse width modulator;
- pulse width modulator output to the light emitter circuits input.
- Use the OFC cable between emitter circuits output and detector circuits input.
- Use patch cord and connect detector circuit output to comparator circuit input; comparator circuits output to low pass filter input and low pass filter output to AC amplifier input as shown in Fig 4.

4 Connect the function generator output & amplifier output to the CH-1 and CH-2 of CRO.

5 Turn the mode selector switch in the emitter circuits to digital mode.

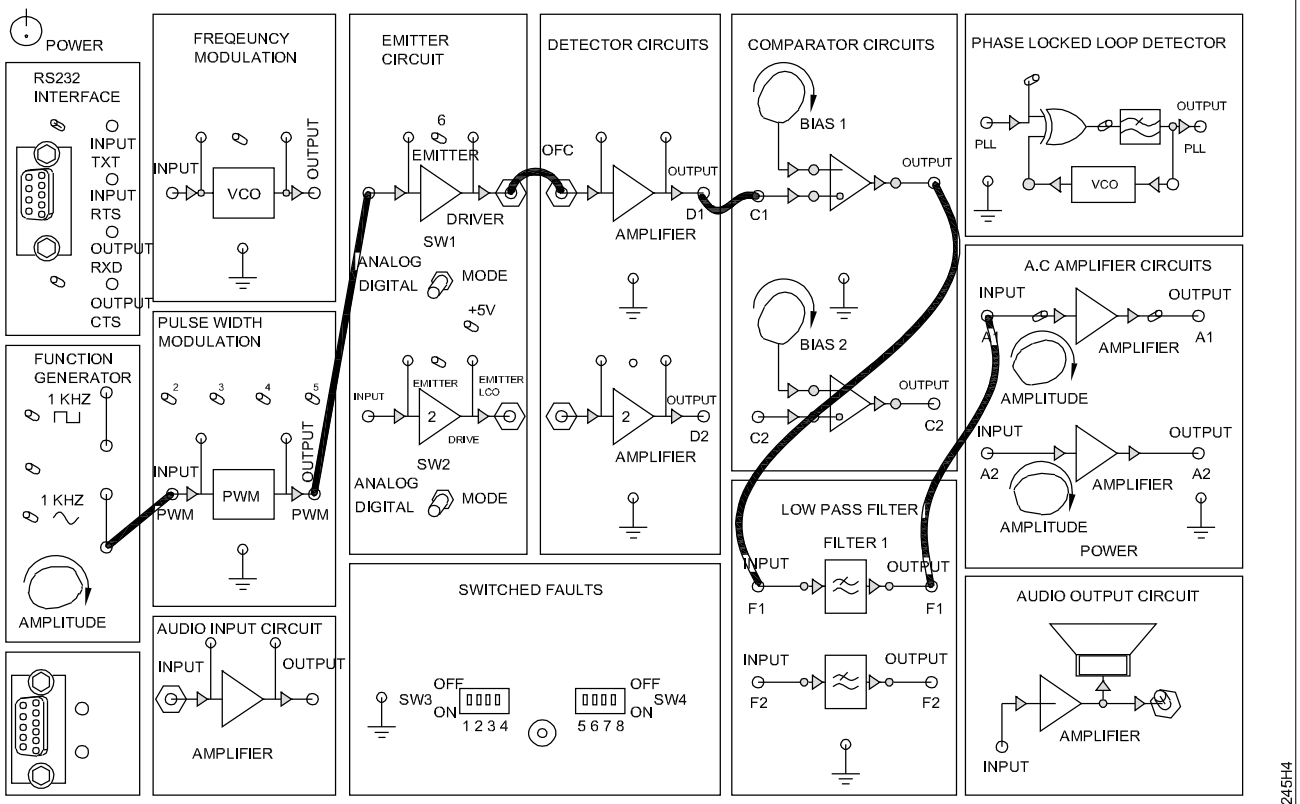
6 Switch ON the trainer kit and CRO.

7 Observe and trace the input and output signal on CRO; record the observations in Table - 3

Table - 3

Mode switch position	Emitter circuit Input signal V_{p-p}	Waveform	A/C amplifier output signal V_{p-p}	Waveform	Remark
Digital mode					

Fig 4



8 Get the work checked by the Instructor.

— — — — — —

Perform FM modulation and demodulation using OFC trainer kit using audio signal and voice link

Objectives: At the end of the exercise you shall be able to
- **demonstrate frequency modulation and demodulation using OFC trainer kit by audio signal**
- **demonstrate frequency modulation and demodulation using OFC trainer kit by voice link signal.**

Requirements

Tools/Equipments/Instruments

- Optical fiber trainer kit with instruction manual - 1 set.
- CRO 20 MHz (Dual trace) with probe kit - 1 No.
- Trainees tool kit - 1 set.
- Digital multimeter with probes - 1 No.
- Microphone(Dynamic) - 1 No.
- Loud speaker/ Head phone - 1 No.
- Audio signal source - 1 No.

Materials/ Components

- OFC cables - 1 No.
- Patch cards - as reqd.
- OFC data manual
  3.5 mm stereo EP to EP cable - 1 No.
  6 mm to 3.5 mm phono adapter - 1 No.

PROCEDURE:

TASK 1 : **Frequency modulation and demodulation of audio signal using OFC trainer kit**

1 Check and confirm the OFC trainer kit is in working condition. (Fig 1) & (Fig 2)

2 Use patch cords and connect the audio amplifier output to the input of frequency modulator; frequency modulator output to the emitter input.

Note: The instructor has to provide audio signal from any available signal sources like/CD player/mobile phone - connect audio signal source to the input amplifier.

3 Use OFC cable connect it between photo emitter output and photo detector's input; connect photo detector output to comparator input using patch cord.

4 Use patch cord and connect the comparator output to PLL detector input; PLL detector output to low pass filter input and low pass filter output to AC amplifier input. (Fig 2)

5 Connect the audio signal output to the input of audio input amplifier.

6 Put the mode switch SW1 in the emitter circuit to digital mode.

5 Prepare the CRO for measurements and switch ON the trainer kit.

6 Observe the input output signals on CRO and record them in Table 1.

7 Get the work checked by the instructor.

Table - 1

Mode switch position	Frequency modulator input signal V_{p-p}	Waveform	AC amplifier output signal V_{p-p}	Waveform

Fig 1

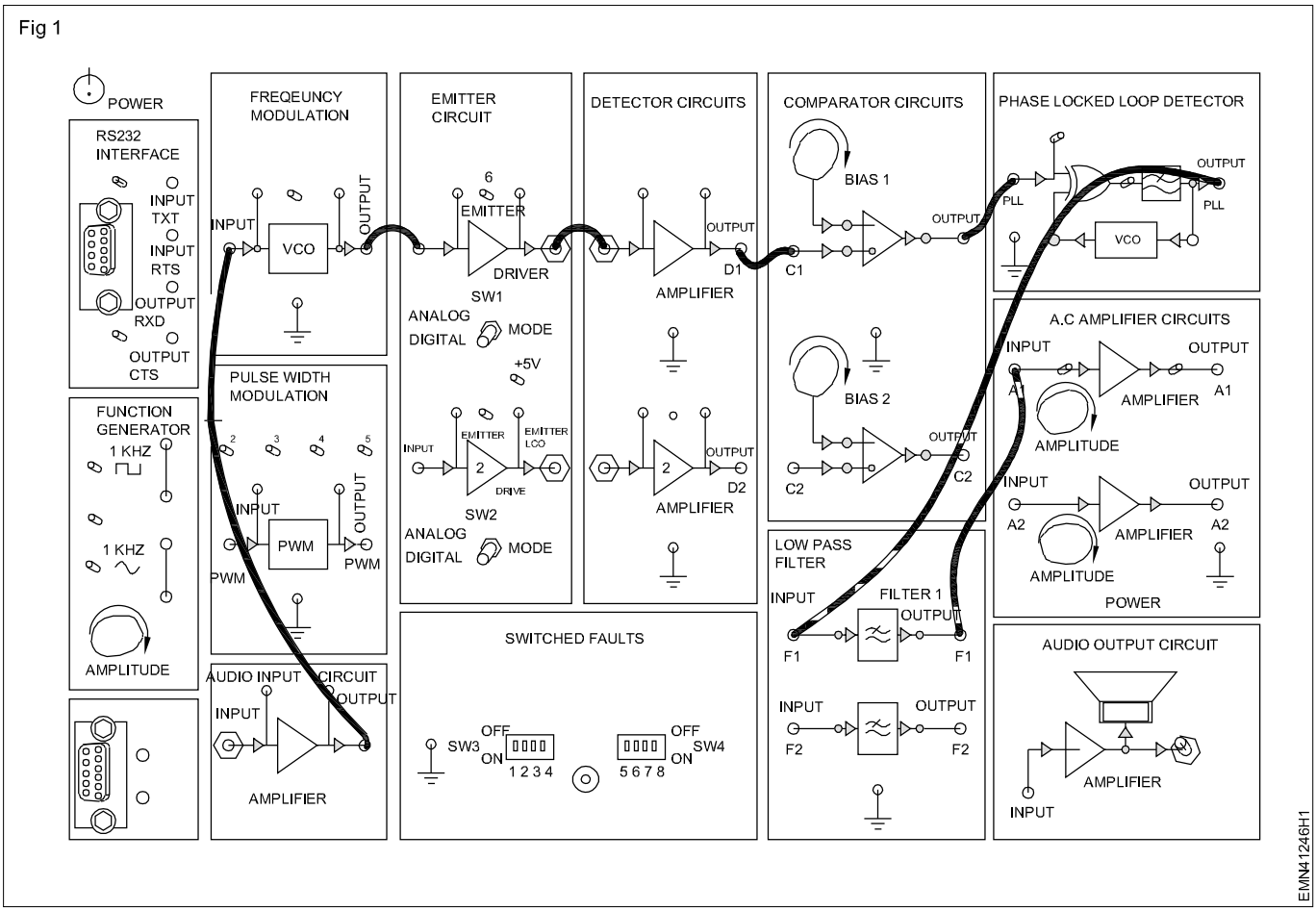
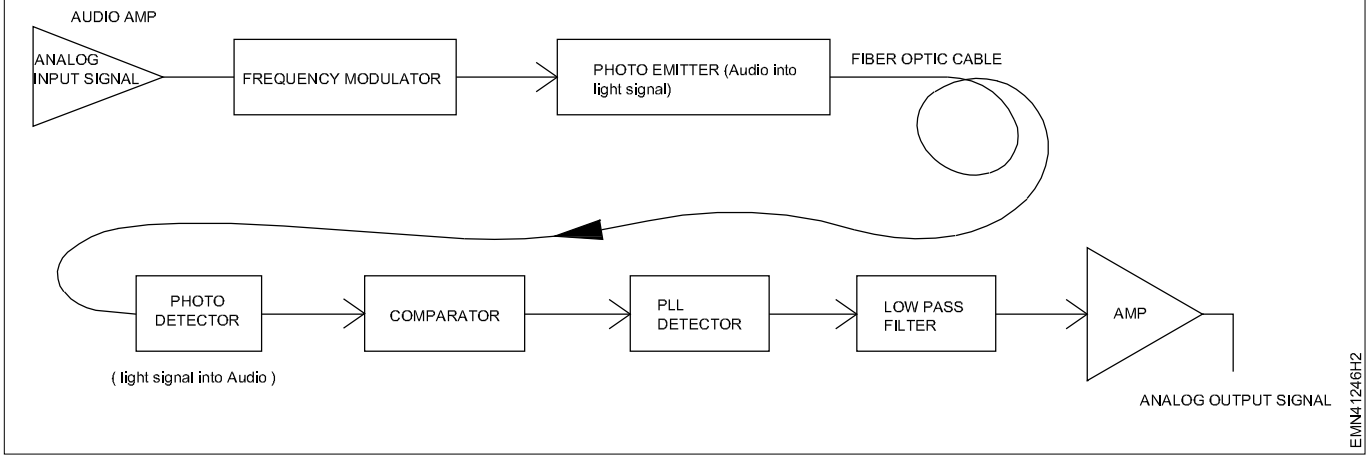


Fig 2



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TASK 2 : **Frequency modulation and demodulation of voice link signal using OFC trainer kit**

1 Keep the settings/ connections as per steps 1 to 4 of TASK 1.

2 Disconnect the audio signal and CRO from the circuit.

3 Using the phone adapter connect the external microphone into the input of audio input circuit.

4 Use patch cord and connect the output of audio input circuit to input of frequency modulator; use OFC cable, connect between emitter circuit and input of detector circuit, upto AC amplifier as shown in Fig 1 and 2.

5 Connect the Ac amplifier output to the input of the audio output circuit (Louds speaker).

If built-in speaker is not available connect speaker or headphone externally to audio output block.

6 Get the connections checked by the instructor.

7 Swith ON the trainer kit, speak in the microphone and listen to the speech sound through the loudspeaker/ headphone.

8 Get the work checked by the Instructor.

— — — — — — — — —

Perfrom PWM modulation and demodulation using OFC trainer kit using audio signal and voice link

Objectives : At the end of this exercise you shall be able to
- **demonstrate pulse width modulation and demodulation using OFC trainer kit by using analog signal**
- **demonstrate pulse width modulation and demodulation using OFC trainer kit by using voice link signal.**

Requirements

Tools/Equipments/Instruments

- Optical fiber trainer kit with instruction manual - 1 set.
- CRO 20 MHz (Dual trace) with probe kit - 1 No.
- Trainees tool kit - 1 set.
- Digital multimeter with probes - 1 No.
- Microphone(Dynamic) - 1 No.
- Loud Speaker/ Head phone - 1 No.
- Audio signal source - 1 No.

Materials/Components

- OFC cables - 1 No.
- Patch cards - as reqd.
- OFC data manual - 1 No.
- 3.5mm stereo EP to EP cable - 1 No.
- 6mm to 3.5mm phono adapter - 1 No.

Fig 1

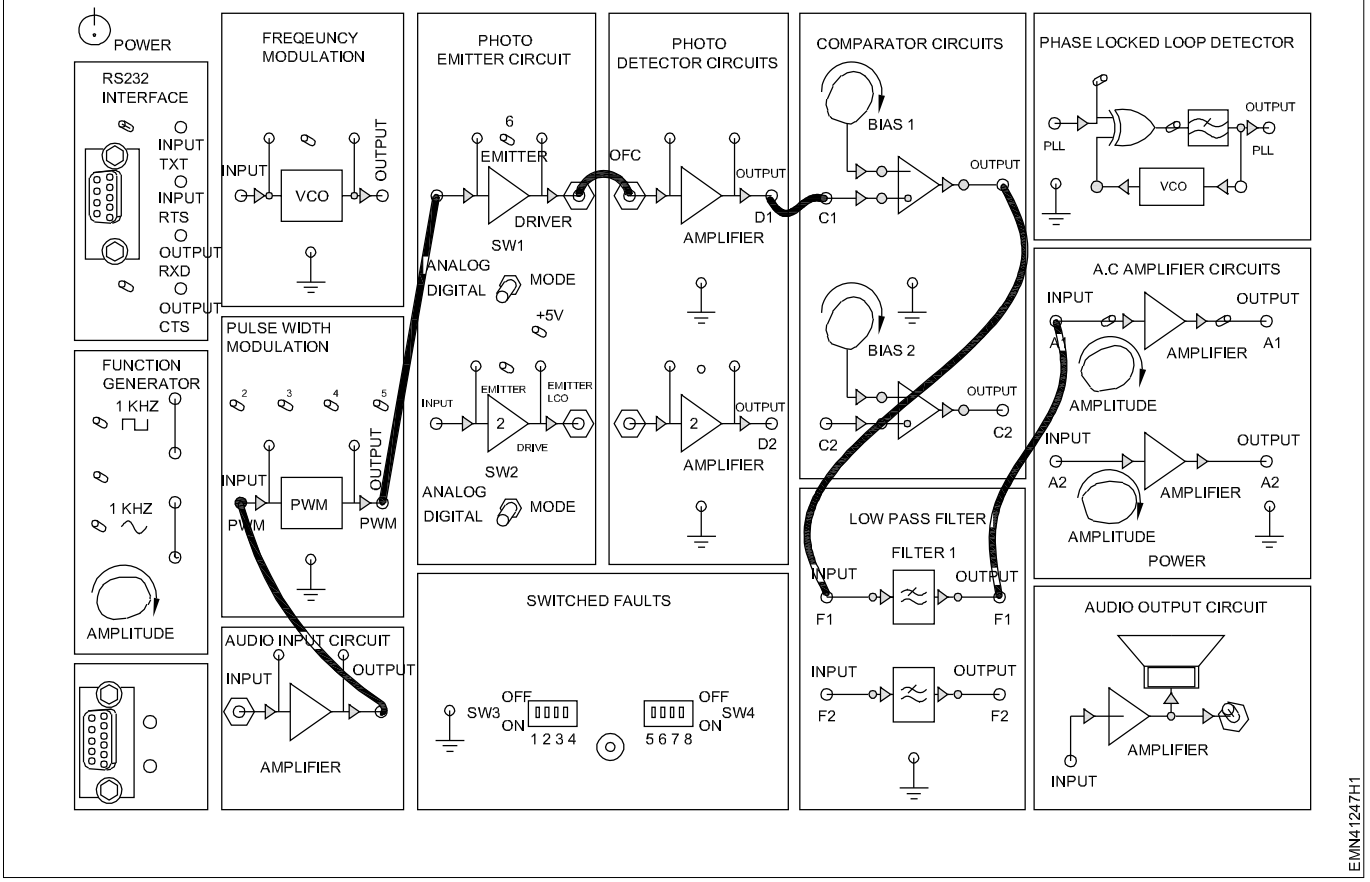
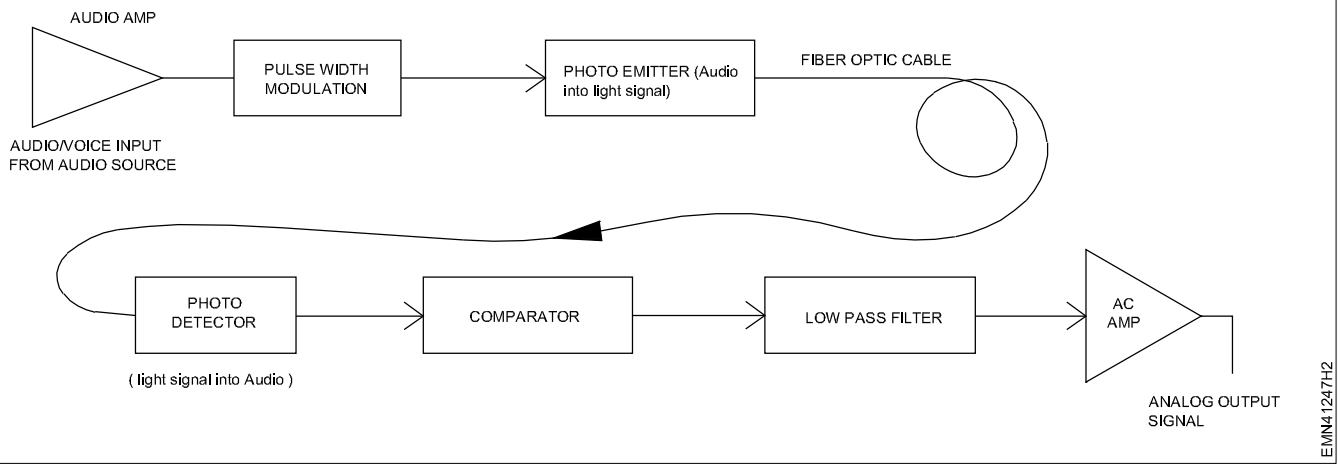


Fig 2



PROCEDURE:

TASK 1 :**Pulse Width Modulation of audio signal and demodulation using OFC trainer kit**

1 Check and confirm the OFC trainer kit is in working condition. (Fig 1)

2 Use patch cords and connect the audio signal source to the input amplifier; connect the audio input amplifier output to the input of pulse width modulator.

3 Connect the pulse width modulator output to the photo emitter circuits input using patch cord.

4 Use OFC cable between photo emitter circuits output and photo detector circuits input; connect the photo detector output to comparator circuits input, using patch cord.

Note: The instructor has to provide audio signal from any available signal source like CD/DVD player/Mobile phone.

5 Use patch cords and connect comparator circuit and output to low pass filter input; low pass filter ouput to AC amplifier input as shown in Fig 2.

6 Connect the input amplifier & ouput of AC amplifier to the CH 1 and CH 2 of CRO.

7 Turn the mode switch SW1 in the photo emitter circuits to digital mode.

8 Switch ON the trainer kit, prepare the CRO for measurements.

9 Observe the input and output signal on CRO and record them in Table - 1.

Table - 1

Mode switch Position	PWM input Signal	Waveform	AC amplifier	Wavefrom

10 Get the work checked by the Instructor.

— — — — — — —

TASK 2 :**Pulse width frequency Modulation of voice link signal and demodulation using OFC trainer kit.**

1 Keep the settings connections done in TASK 1.

2 Disconnect the audio signal source and CRO from the circuit.

3 Use the phono adapter and connect the external microphone into the input of audio input circuit.

4 Use patch cords, connect the output of audio input circuit to the input of pulse width modulator and photo emitter cirucuit.

5 Use OFC cable, connect between the photo emitter output to photo detector input.

6 Use patch cord connect the comparator, low pass filter and AC amplifier as shown in Fig 1 and 2.

7 Switch ON the trainer kit and speak in the microphone and listen the speech sound through the speaker / headphone.

If built-in speaker is not available connect speaker or headphone externally to the audio output block.

6 Get the work checked by the instructor.

— — — — — — —

Perform PPM modulation and demodulation using fiber optic communication trainer kit using audio signal and voice link

Objectives: At the end of the exercise you shall be able to

- **Identify the different cables used in OFC demonstrate pulse position modulation and demodulation using audio signal**
- **Identify the different connectors used in OFC demonstrate pulse position modulation and demodulation using voice link signal.**
- **Identify the various sections in the OFC trainer kit.**

Requirements

Tools/Equipments/Instruments

- Optical fiber trainer kit with instruction manual - 1 set.
- CRO 20 MHz (Dual trace) with probe kit - 1 No.
- Trainees tool kit - 1 set.
- Digital multimeter with probes - 1 No.
- Microphone(Dynamic) - 1 No.
- Loud Speaker/ Head phone - 1 No.
- Audio signal source - 1 No.

Materials/ Components

- OFC cables - 1 No.
- Patch cards - as reqd
- OFC data manual
- 3.5mm stereo EP to EP cable - 1 No.
- 6mm to 3.5mm phono adapter - 1 No.

PROCEDURE:

Note: The instructor has to provide audio signal from any available signal source like CD/DVD player mobile phone.

TASK 1 : **Pulse Position Modulation and demodulation of audio signal using OFC trainer kit.**

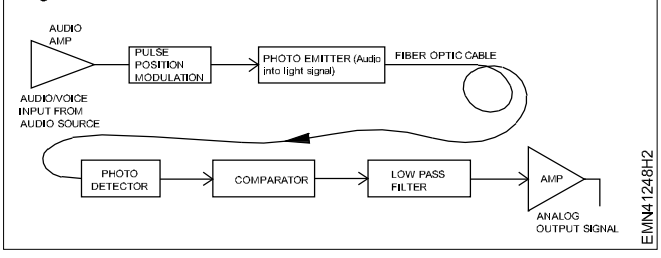
1 Check and confirm the given OFC trainer kit is in working condition.

2 Use patch cords refer to Fig 1 and connect the audio signal source to the input amplifier; the function generator output to the input of Pulse Position Modulator and Pulse position modulator output to the photo emitter input as shown in Fig 1.

3 Use OFC cable, connect the photo emitter output to the input of photo detector; use patch cord and connect Photo detector output to comparator input.

4 Use patch cords, connect comparator output to PLL detector input; PLL detector output to low pass filter input and Low pass filter output to AC amplifier input as shown in Fig 1 & 2.

Fig 2



Note: The instructor has to provide audio signal from any available signal source like CD/DVD player mobile phone etc.

3 Connect the function generator output to Ch1 and amplifier output to Ch 2 of CRO inputs.

4 Set the mode selector switch to digital mode.

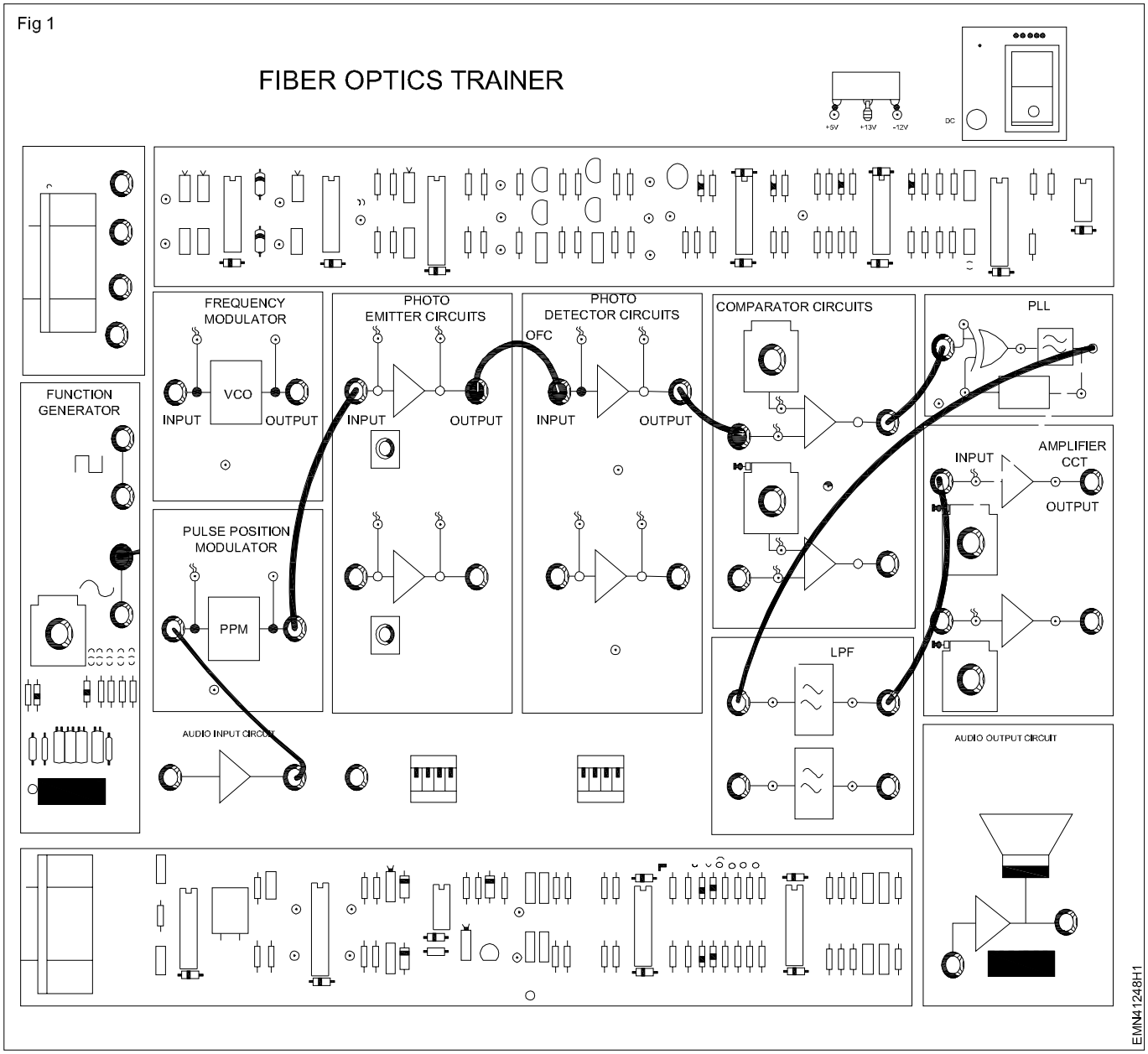
5 Prepare the CRO for measurements and switch ON the trainer kit.

6 Observe the input output signal on CRO and rocord in Table 1.

Table - 1

Waveform at PPM input	Waveform at PPM Output	Waveform at Photo Detector output	Amplifier output

Fig 1



7 Get the work checked by the Instructor.

— — — — — —

TASK 2 : **Pulse Position Modulation and demodulation of voice link signal using OFC trainer kit.**

If built-in speaker is not available connect speaker or headphone externally to the audio output block using patch cords.

1 Keep the settings as same in TASK 1.

2 Disconnect the Audio signal source remove the Ch 1 & Ch 2 connections to the CRO.

3 Use the phono adapter and connect the microphone to the input of audio input circuit. Use patch cords, connect the output of AC amplifier circuit to input of audio output circuit. (loudspeaker)

4 Get the circuit connections checked by the instructor.

5 Switch ON the trainer kit.

6 Speak in the microphone and listen to the speech sound through the speaker / Headphone.

7 Get the work checked by the Instructor.

— — — — — —

Identify LED display module and its decoder/driver ICs

Objectives: At the end of the exercise you shall be able to
- **identify the type of LED display used in the Digital Panel Meter**
- **identify various decoder/driver IC in digital panel meter.**

Requirements

Tools/Equipments/Instruments

- Digital panel meter with different driver ICs - as reqd.
- Trainees tool kit - 1 Set.
- Digital Multimeter with probes - 1 No.

Materials/ Components

- Operating / Instruction manual

Safety precaution

1 Keep the work area dry and clean.

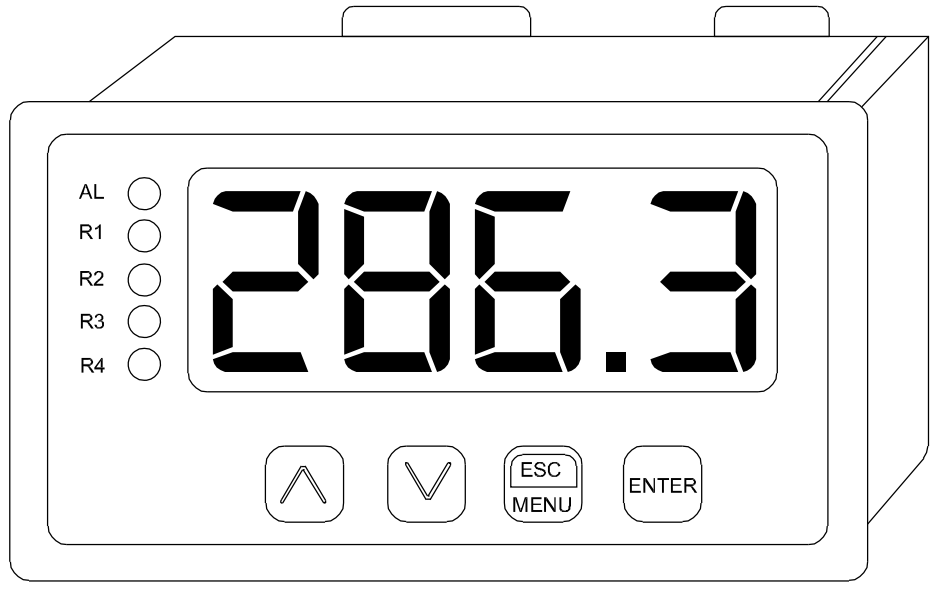
2 Use proper tools for opening the Digital Panel Meter.

PROCEDURE:

TASK 1 : **Identification of the type of LED display**

1. Pick any one of the labelled digital panel meter from the instructor
2. Note down the name plate details of the digital panel meter as shown in Fig 1.
3. Check the display type (LCD, LED, Dot matrix, etc.) and note down in Table-1.
4. Repeat the above steps for all other digital panel meter.

Fig 1



LED TYPE DPM

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TASK 2 : **Identification of the Decoder/Driver IC in Digital Panel Meter**

1. Pick any one of the labelled digital panel meter from the instructor
2. Remove the back panel in the DPM.
3. Remove the circuit board in DPM cabinet.
4. Identify the Decoder/Driver IC and record in Table by referring the block diagaram fig 2.
5. Repeat the above steps for all the panel meters.

Fig 2

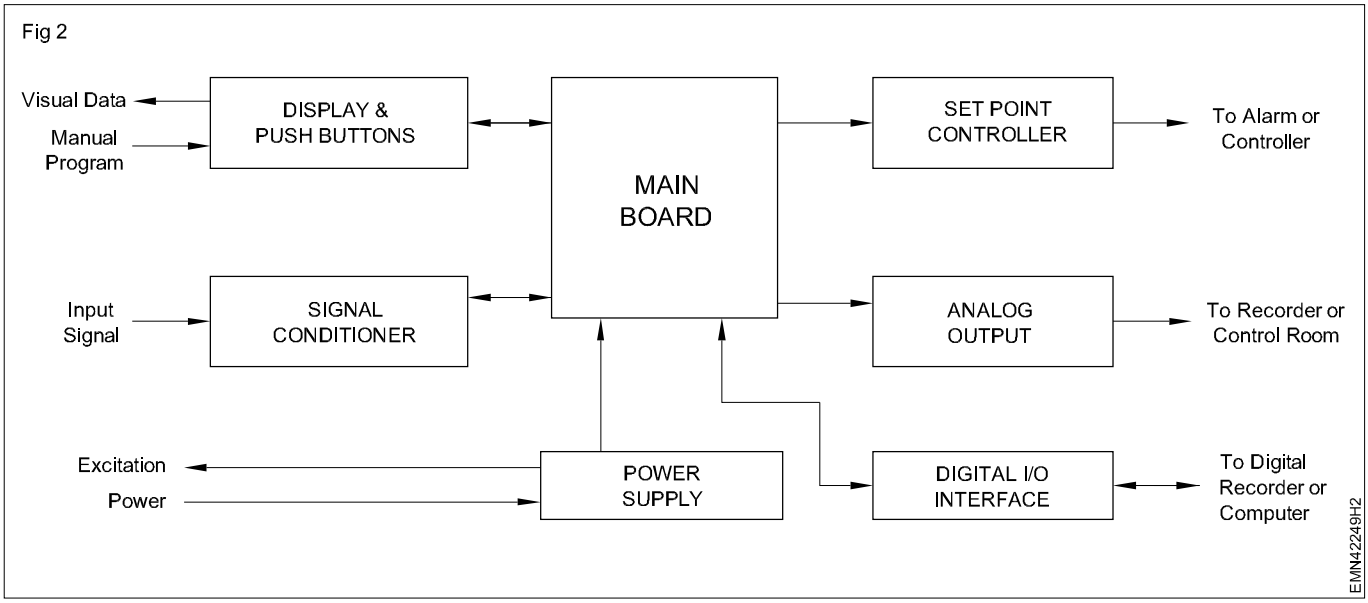


Table -1

Label No.	Name plate details of DPM	Display type	Display colour	Decoder/Driver IC

— — — — — —

Display a word on a two line LED

Objectives: At the end of the exercise you shall be able to
- **construct a two line LED circuit**
- **Test the two line LED circuit.**

Requirements

Tools/Equipments/Instruments

- Trainees tool kit - 1 Set.
- Digital multimeter with probes - 1 Set.
- Regulator DC Power supply 0-30V/ 2A - 1 No.
- Soldering iron 25W/230V - 1 No.

Materials/ Components

- Breadboard/PCB-GP - 1 No.
- Decade counter IC CD4017 - 1 No.
- Timer IC 555 - 1 No.
- Positive regulator IC 7805 - 1 No.
- Diode, IN5402 - 2 Nos.
- Diode, IN4148 - 2 Nos.
- Transistor, SL100 - 2 Nos.
- Transistor, TIP 122 with heat sink - 1 No.
- Capacitor, 10ΩF, 16V - 1 No.
- Capacitor, 0.1ΩF - 1 No.
- Capacitor, 0.01ΩF - 1 No.
- Pre-set, 100KΩ (Horizontal type) - 1 No.
- Resistor, 10KΩ, 0.5W - 1 No.
- Resistor, 470Ω, 0.5W - 3 Nos.
- Resistor, 220Ω, 0.5W - 5 Nos.
- LED, 5mm, Red - 43 Nos.
- Connecting wires - as reqd.
- Hookup wire - as reqd.
- Rosin cored solder - as reqd.

PROCEDURE

TASK 1 : **Construction of a two line LED circuit to display a word**

1 Collect all the components required and test them for good working condition.

Use heat sink for the power transistor T3

2 Plan the layout and assemble the circuit as shown in Fig 1 on the breadboard/ general purpose PCB.

The arrangement of LED1 through LED5 is used to display 'I' as shown in Fig.1. The anodes of LED1 through LED5 are connected to point-A and the cathodes of these LEDs are connected to point-B. Similarly, connect the other letters as shown in Fig.1.

3. Get the assembled circuit checked by the Instructor.

— — — — — —

TASK 2: **Testing the two line LED circuit**

1 Apply 230V, 50Hz, single phase AC supply to the primary of the transformer.

2 Switch ON the 9V DC power supply and check the circuit operation.

3 Observe the output LED display cycle.

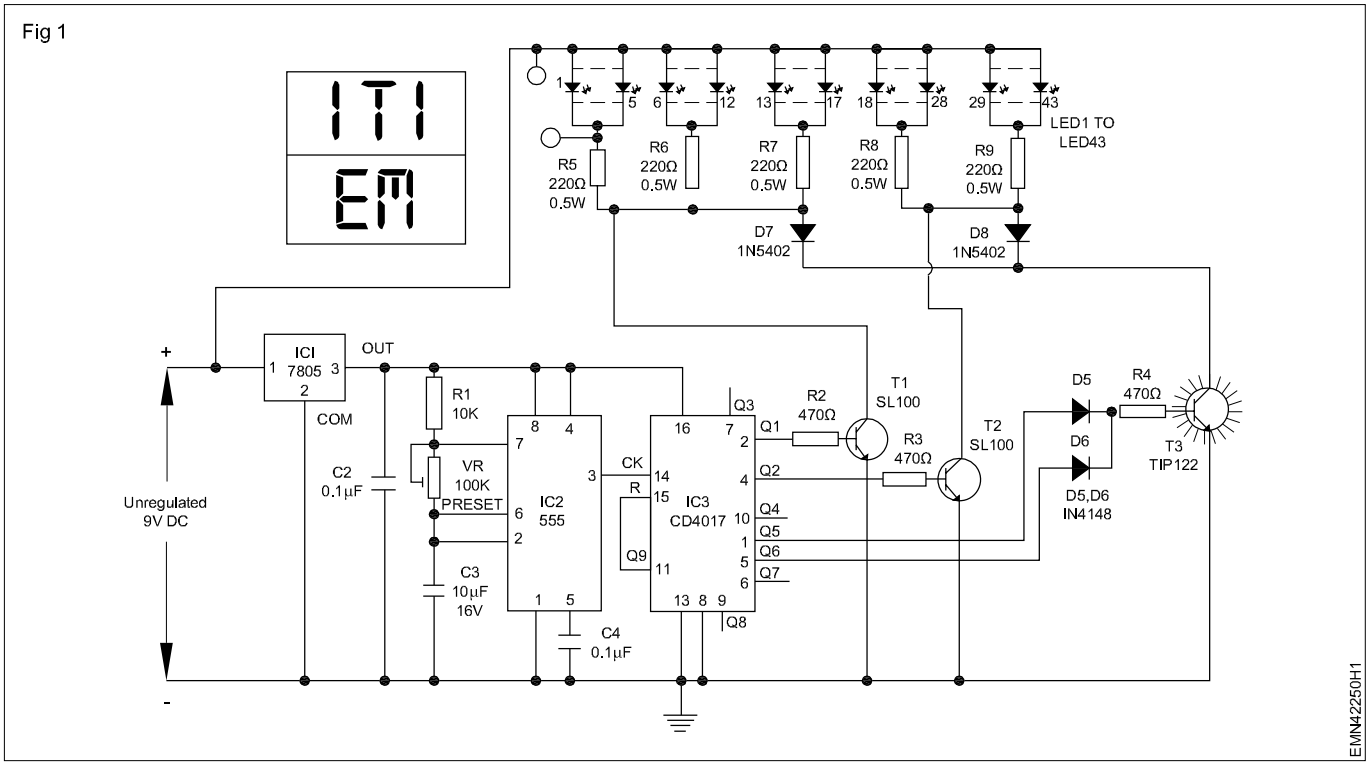
The display board displays 'ITI,' and 'EM' one after another for one second each. After that, the message "ITI EM" is displayed for 4 seconds (because Q5 and Q6 are connected to resistor R4 via diodes D5 and D6).

At the next clock input output Q9 goes high, and IC3 is reset and the display is turned off for one second. Thereafter the cycle repeats.

4 Adjust the pre-set VR of astable multivibrator to change the clock frequency of decade counter to vary the display time.

5 Observe the display output for the time/sequence of LED letters.

Fig 1



6 Get the work checked by the instructor.

— — — — — — —

Measure current flowing through a resistor and display it on LED module

Objectives: At the end of the exercise you shall be able to

- **measure the voltage in simple circuit using LED module of DPM**
- **measure the current in simple circuit using LED module of DPM.**

Requirements

Tools /Equipments/Instruments

- DPM with LED display 0-250 mA - 1 No.
- DPM with LED display 0-50V - 1 No.
- Regulated DC power supply 0-30V/2A - 1 No.
- Digital multimeter with probes - 1 No.
- Trainees tool kit - 1 Set.

Materials/ Components

- Breadboard - 1 No.
- Resistor 500 Ω/2W - 1 N
- Hook up wires - as reqd.

Safety precaution

1 Avoid loose connections

PROCEDURE

1 Collect the components required and check them for good working condition.

2 Make the simple test set-up of the circuit as shown in Fig 1.

3 Switch ON the DC power supply, increase to 5VDC.

4 Measure the voltage of variable power supply output and current through the load.

5 Record the observations in Table-1.

6 Increase the supply voltage in steps of 5V upto 25VDC and repeat steps 4 and 5.

Fig 1

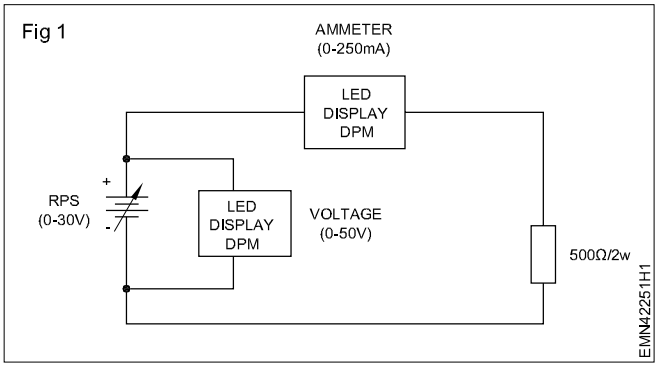


Table-1

Sl No.	Value of load resistor	Voltage across load Resistor	Current through the circuit
1			
2			
3			
4			
5			

7 Get the work checked by the Instructor.

— — — — — — —

Measure current flowing through sensor and display it on LED Module

Objectives: At the end of the exercise you shall be able to
- **measure the current flowing through the digital panel meter.**

Requirements

Tools / Equipments/ Instruments

- Trainees tool kit - 2 Nos
- Multimeter with probes - 1 No.
- Regulator power supply 0-30V/2A - 1 No.
- Rectangular battery 9V - 1 No.

Materials/ Components

- Shunt resistor 0.1 Ω - 1 No.
- Shunt resitor 0.01 Ω - 1 No.

Safety precaution

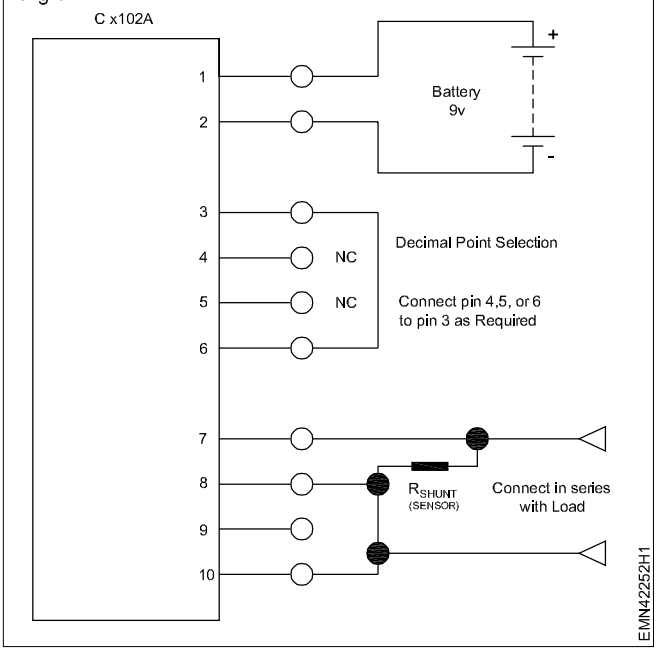
1 Keep the work area dry and clean.

2 Usse proper tools for opening the digital panel meter.

PROCEDURE

1 Connect the shunt resistor to digital panel/meter as shown in the Fig.1

Fig 1



2 The shunt resistor is placed in series with the applied current which causes a voltage deop to occur across the shunt.

3 The shunt value depends on the maximum current flow that will be encountered. For relatively small current values (below 1 Amp) a 0.1 ohm shunt resistor is adequate. This value will minimise any loading in the circuit but will procedure a reasonable reading on the DPM. If higher current levels will be encountered, 0.01 ohm or lower value should be used.

4 Connect the battery to circuit as shown in the diagram.

5 Connect the Pin No.3 to Pin No.6 of DPM for proper decimal point display.

6 Note that the current value displayed on the meter can be fine-tuned by adjusting the trimmer potentiometer on the back of the DPM.

7 Short Pin No.8 and pin No.10 together and connected to the negative end of the shunt resistor.

8 Connect R_{shunt} across Pin No.7 and Pin No.8 and will be connected in series with the load .

9 Note down the actual and indicated current readings and record in Table-1.

Calculation

- All digital panel meters, the full scale deflection are 200 mV full- scale.
- For the measurement of 1 Amps current through DPM, correct power rating of the shunt resistor can be determined by using the Ohm's Law power formula.

  P (Power) = V (Voltage) x I (Current)

  $P = V_{max} \times I_{max} = (0.200) \times (1.0) = 0.1$ Watt
- So we should use a 1/2 watt 1% resistor to be safe.

Table - 1

Value of R_{Shunt}	Actual Current Reading	Indicated Reading on DPM	Voltage & cross R_{shunt}

— — — — — — —

Identify LCD display module and its decoder/driver ICs

Objectives: At the end of the exercise you shall be able to

- **identify the type of LCD display used in digital panel meter**
- **identify the various decoder/driver IC in digital panel meter.**

Requirements

Tools / Equipments/ Instruments

- Trainees tool kit - 1 Set
- Digital multimeter with probes - 1 No.

Materials/ Components

- LCD digital panel meter with different driver ICs - 2 Nos

Safety Precaution

1 **Keep use a soft cloth and spread it on a dry and clean area on the workbench Handle the glass panel of the LCD is easily danm on the workbench.**

2 **Use proper tools for opening the digital panel meter.**

3 **If pressure is applied to LCD, orientation may be distrucbed. The LCD can be broken by shock.**

4 **DC voltage or higher voltage than specified will reduce the life time of the LCD.**

PROCEDURE

TASK 1: **Identification of the types of LED display**

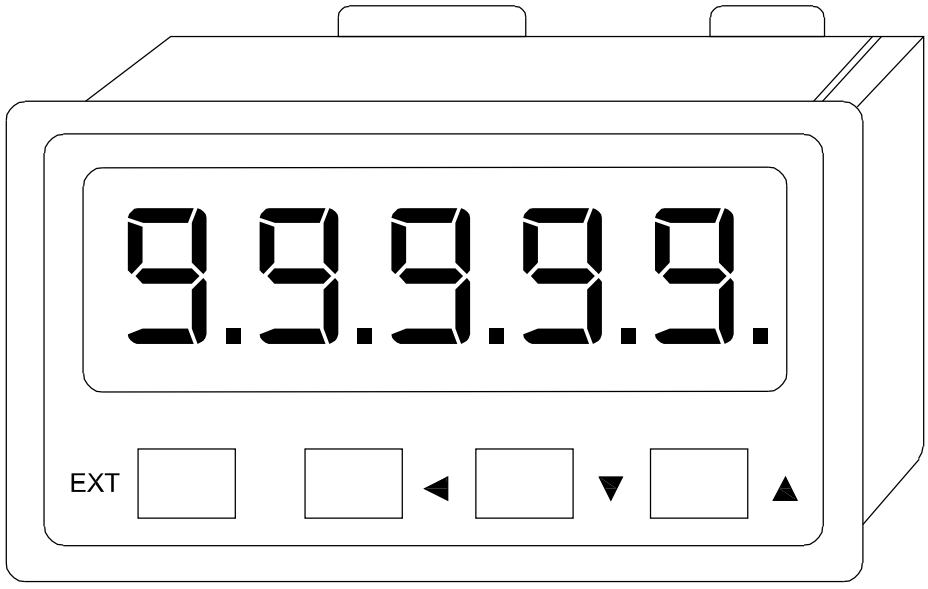
1 Pick any one of the labelled digital panel meter from the instructor as shown in Fig.1

2 Note down the name plate details of the digital panel meter in Table -1

3 Check the display type (LCD, LED, Dot Matrix, etc.) and note down in Table -1

4 Repeat the above steps for all other digital panel meters.

Fig 1



LED TYPE DPM

EMN42253H1

Table - 1

Label No.	Name plate details of DPM	Display Type	Display colour	Decorder/Driver IC
1 2 3				

TASK 2: **Identification of the Decorder/Driver IC in digital panel meter**

1 Pick any one of the labelled digital panel meter.

2 Remove the back panel in the DPM.

3 Remove the circuit board in DPM cabinet.

4 Identify the Decoder/Driver IC and record in Table -2

5 Repeat the above steps for all other panel meters.

Fig 2

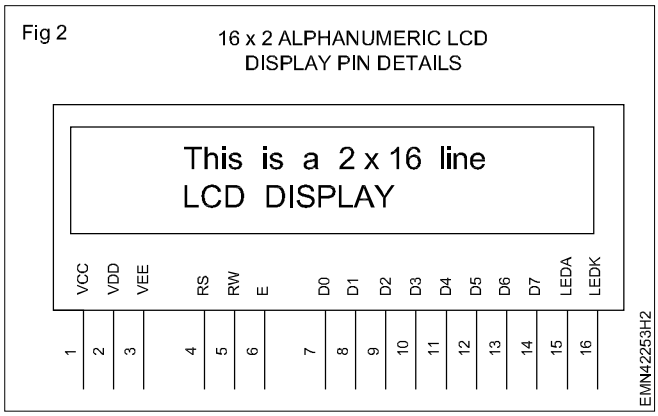


Table - 2

Pin No.	Short form	Description
1	V_{SS}	Ground
2	V_{DD}	+5V Supply
3	V_{EE}	Set LCD Contrast
4	RS	LCD Controlling Pins
5	RW	Data Pins
6	E	
7	D_0	
8	D_1	
9	D_2	
10	D_3	
11	D_4	
12	D_5	
13	D_6	
14	D_7	
15	LEDA	Back light LED anode +5V
16	LEDK	Back light LED cathode ground

Terminal details of LCD DPM

Measure current flowing through a resistor and display it

Objectives: At the end of the exercise you shall be able to

- **measure the voltage in single circuit using LCD module**
- **measure the current in simple circuit using LCD module.**

Requirements	
Tools / Equipments/ Instruments • DPM with display - 2 Nos • Regulated DC power supply 0-30V/2A - 1 No. • Digital multimeter with probes - 1 No. • Trainees tool kit - 1 Set.	**Materials/ Components** • Breadboard - 1 No. • Resistor 500Ω/2W - 1 No. • Hookup wires - as reqd.

Safety precaution

1 Avoid loose connections

PROCEDURE

1 Collect the components and check the items for its good working condition.

2 Make the simple test set-up on the Lug board/Bread bard as shown in Fig.1

3 Switch ON the variable power supply.

4 Measure the voltage varying the voltage step by step and current

5 Record it on the table-1.

6 Repeat steps 5 & 6 with five different position of reheostat.

7 Switch OFF the Regulated DC Power supply and get the work checked by the instructor.

Fig 1

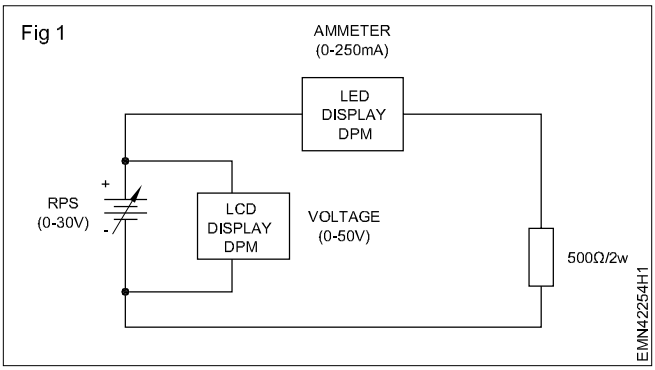


Table-1

Sl. No.	Value of Load Resistor	Voltage across Load Resistor	Current through the circuit Resistor
1			
2			
3			
4			
5			

Identify the components/devices of SMPS and draw their corresponding symbols

Objectives: At the end of the exercise you shall be able to
- **dismantle the SMPS unit from CPU cabinet and identify major section/ components of SMPS unit**
- **draw the symbols of observed components of SMPS unit.**

Requirements	
Tools / Equipments/ Instuments • ESD wrist band - 1 No. • Trainees tool kit - 1 Set. • Digital multimeter with probes - 1 No. • Aids: Block diagram of SMPS - 1 No. • Chart showing all types of connectors used in SMPS of PC - 1 No.	**Materials/ Components** • SMPS unit used in personal computer - 1 No.

Safety precaution

1 **Ensure the power cord is removed from the CPU.**
2 **Before opening CPU cabinet, touch the cabinet outer cover by wearing wrist band to discharge ESP.**

PROCEDURE

TASK 1: **Dismantling the SMPS unit from CPU cabinet and identification of sections**

1 Open the computer cabinet cover, by removing the door screws as shown in Fig 1.

Fig 1

2 Identify the location of wires with colour codes comming out of SMPS unit as shown in Fig 2.

3 Notedown the connections of SMPS going to various sections of mother board and other devices inside the CPU, put tags with label for each connector.

4 Draw the layout of mother board and mark the sections/ location of connectors with label number in it.

Fig 2

5 Record the name of the connector, type and number of pins in Table-1.

6 Remove/Unplug the connectors from HDD, DVD, FAN and mother board carefully.

7 Unscrew the fixing screws and remove the SMPS unit from the CPU cabinet and open it as shown in Fig 3.

8 Draw the layout of the assembly and mark the major sections/components/devices

Keep the fixing screws seperately for assembling the SMPS after completion of this exercise.

Fig 3

Table - 1

Sl.No.	Name of the connector	No. of wires	Type of connector	Connected to which section/device	Remark

9 Get the work checked by the instructor.

— — — — — — —

TASK 2: **Identification of type of connectors in SMPS unit**

Note : The instructor has to label the major components /devices in each section of the SMPS before issuing to trainees for this task

1 Refer to the chart, identify the connector/sections and major components/devices in each section.

2 Record the name of the component/device in Table - 2.

3 Repeat the steps for all the labelled components/ devices.

4 Draw the symbol of each component in the respective places in Table-2.

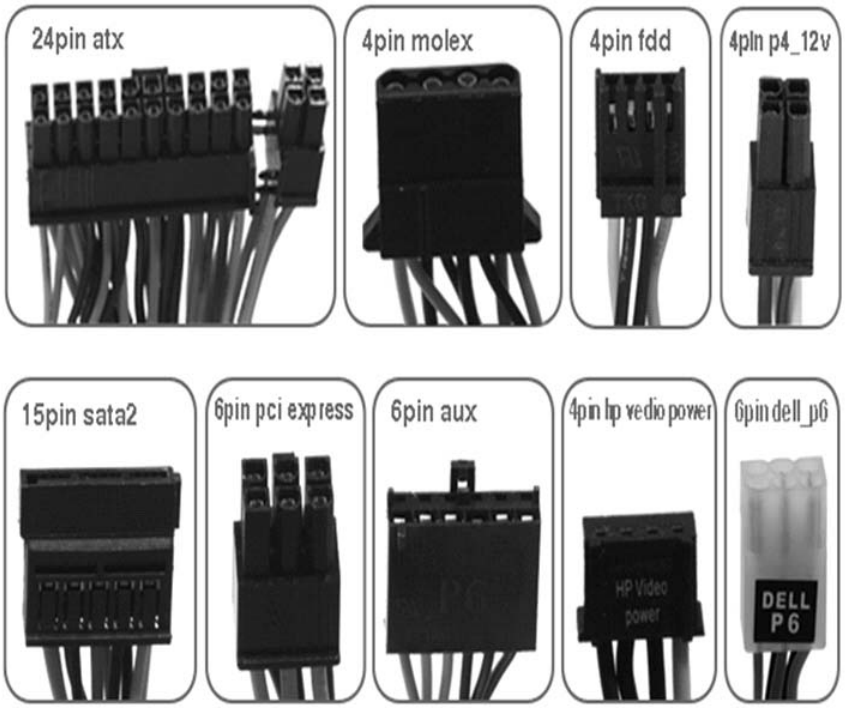
Table- 2

Sl. No.	Label No.	Name of the section	Name of the component	Circuit symbol	Remark

Chart - 1

Chart showing types of connectors used in SMPS unit of personal computer system

Fig 4



Power Connectors

5 Get the work checked by the instructor.

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Dismantle the given voltage stabilizer and find the major sections/ICs/ Components

Objectives: At the end of the exercise you shall be able to
- **dismantle the given voltage stabilizer**
- **identify sections of voltage stabilizer**
- **locate the major components of various sections.**

Requirements	
Tools/ Equipments/ Instruments • Trainees tool kit - 1 Set. • DMM with probes - 1 Set. • Voltage stabilizer (automatic type with instruction manual) 500VA to 1KVA - 1 No.	**Materials/ Components** • Nil

Note: The instructor may guide the trainees to handle the bulky/weight of the voltage stabilizer. Alert them to avoid any accidental wound by the sharp edge/corner of the metal chassis/frame etc. Remove the power cord from the A/C mains supply.

PROCEDURE

1 Note down the name plate details of the voltage stabilizer and record them in Table-1

2 Identify the fitting screws/fasteners used on the sides of the chasis /frame of the voltage stabilizer.

3 Remove the cover fitting screws/nut bolt etc. and keep them safely in a box seperately

4 Observe various sections of the stabilizer unit & identify the sections. Trace the layout of components and identify and important components.

5 Use pencil roughly sketch the layout of the assembly and the voltage stabilizer on your observation record.

6 Note down the connections of major/important components/parts on each section.

7 Record the observations on the Table-4.

Table-4

Sl.No.	Major/important component/parts	Name of section	Remarks
	1. Auto transformer 2. relay switching contacts 3. Driver transistors 4. integrated circuits voltage adj 5. Presets diodes/zener status indicators 6. Fuse, 7. output terminal socket		

8 Get the work checked by the Instructor.

List the defect and symptom in the faulty SMPS

Objectives: At the end of the exercise you shall be able to
- **list the physical defects identified in the faulty SMPS (in cold condition) without switching ON**
- **identify sections of voltage stabilizer**
- **locate the major components of various sections.**

Requirements

Tools / Equipments/ Instruments

- Trainees tool kit - 1 Set.
- Multimeter with probes - 1 No.
- Adjustable type table lamp - 1 No.
- Magnifying Lens - 1 No.
- A faulty SMPS kit - 1 No.
- Oscilloscope, 20 MHZ - 1 No.

Materials/ Components

- Spare components - as reqd.
- Rosincored solder - as reqd.

Safety precautions

1 **Disconnect the SMPS unit from the mains before remvoing from the PC.**

2 **Do not touch the PCB with bear hand without discharging the DC storage electroytic capacitor.**

3 **Discharge the storage capacitor by using an incandescent-bulb connected with wires across the capacitor**

4 **Do not use screw drivers to short the capacitor terminals for discharging static charge.**

5 **Measure the voltage and make sure it is zero before proceeding for test.**

PROCEDURE

TASK 1: **List the defect in the faulty SMPS in cold condition**

1 Record the specifications on the cover of SMPS.

2 Verify whether mains supply voltage is disconnected from the SMPS.

3 Initially perfrom cold check by keeping SMPS in OFF condition (components on PCB of the defective)

Observe the SMPS and list out the physical defects noticed as shown below:

- Charred/smoke smell on PCB
- Any component like resistor, diode, black (or) charred/ damage.
- Capacitor top bulged (or) not.
- PCB board darkened due to short
- Wire broken
- PCB track cut
- Connector broken
- Dry soldering
- Switching transistor blown
- Fuse blown.

4 Perform warm check of SMPS and measure output voltages

- Observe whether the SMPS fan is working or not.
- Observe the voltages at the connectors and various test points and record the observations in Table 1 & Table 2.

— — — — — —

TASK 2: **Find the probable symptoms of the given faulty SMPS**

1 Observe the symptoms noticed on the defective SMPS in ON condition and determine which section or junction could be faulty.

2 Ref to the list of symptoms and remedy given in Table-1 and prepare a list symptoms noticed in your faulty SMPS units.

Probable faults and remedy

Sl. No.	Faults	Cause	Remedy
1	SMPS dead, fuse blown	Shorted switching transistor or semiconductors, power cord defective, or switch , open fusible resistor, other bad parts. Actual cause of failure may be power surge/brownout/lightning strikes, random failure, or primary side electrolytic capacitor (s) with greatly reduced capacity or entirely open	Test the switching transistor or semiconductor switch. If it fails replace it. If the semiconductor switch is good, check and replace the primary diodes. Replace the fusible resistor.
2	Supply dead, fuse not blown	Bad startup circuit - open startup resistors or open fusible resistors due to shorted semicondutors, bed controller components.	Test the switching transistor or semiconductor switch. If it fails replace it. Replace the fusible resistor
3	Supply mostly dead or takes a long time to come alive	Bad electrolytic capacitors. Visually inspect for capacitors with bulging tops or that have leaked.	If any one bad capacitors are found replace all electrolytic capacitors.
4	More ripple at the line frequency (50/60 Hz) or twice the line frequency (100/120 Hz)	Dried up main filter capacitor(s) on rectified AC input	Check the filter capacitor and replace it
5	No output supply and 300V persists in the filter capacitor after switching OFF the supply	Switching transistor or semiconductor switch short and fusible resistor or starting resistor open.	Test the switching transistor or semiconductor switch. If it fails replace it.
6	SMPS output is low	If SMPS givess low voltage output then the fault is mostly in the error amplifier, and oscillator stage. Ouput loading may also affect the output voltage some time	Measure voltages and compare them with normal voltage given the circuit diagram. Probable parts may be faulty zener diode in the error amp, faulty control circuit parts, transistor, IC, opto-coupler faulty.
7	SMPS output is high	If SMPS output is high first shut down set. Fault in the error amplifier, IC, oscillator section of SMPS.	Check fauult either in switch off condition or by giving input supply through a variac or low voltage transformer.

Sl. No.	Faults	Cause	Remedy
			Disonnect TV/computer other sections by diconnecting base or output transistor. Never keep on in this fault it may danage other parts also. Check for - error amp circuit, zener diode, opto-couoler, filters on error amplifier line, transistor, IC, oscillator. Replace the faulty components.
8	Combusted coil	A winding coil is present on the board which sometimes gets burnt due to excessive flow of current.	This problem can be identified esaily by the smell or you can identify through the burnt marks located on the external section of the winding coil. It may be possible that internal loop is damaged.

Note: In all cases, bad solder connections are a possibility as well since there are usually large components in these supplies and soldering to their pins may not always be perfect. An excessive load can also result in most of these symptoms or may be the original cause of the failure.

3 Get the work checked by the instructor.

— — — — — — —

Measure/ Monitor at major test points of computer SMPS unit

Objectives: At the end of the exercise you shall be able to
- **prepare the computer SMPS unit for voltage measurements**
- **measure/monitor voltages at various test points of the SMPS unit.**

Requirements

Tools / Equipments/ Instruments

- Computer SMPS working - 1 No.
- Trainees tool kit - 1 Set.
- Digital multimeter with probes - 1 No.

Materials/ Components

- AIDS: Chart showing various voltages of connects in smps unit of PC
- Computer power cord - 1 No.
- Hook-up wire - as reqd.

Safety precautions

Make sure you conduct this test on a table with yourself standing a rubber that any insulated material to avoid static electricity destroying the computer components

PROCEDURE

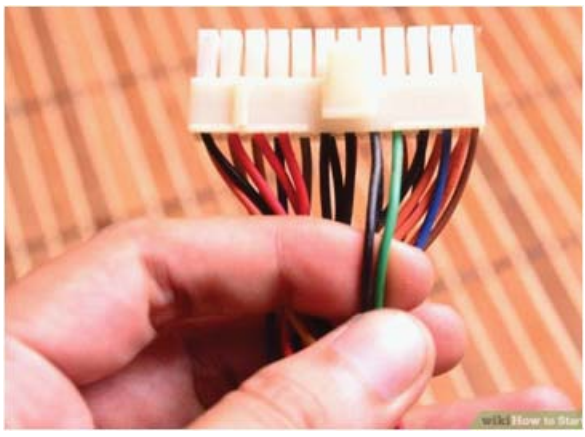
TASK 1: **Preparation of computer SMPS unit for voltage measurements**

1 Remove the SMPS from the computer cabinet by follow the procedure given in the Exercise: 4.3.256

2 Identify the green colour wire (power good signal test point) from the bunch of wires on the 24 pin molex connector as shown in Fig 1.

3 Use a piece of hookup wire, bend it as 'U' shape, connect it across the green and black wire terminals as shown in Fig 2.

Fig 1

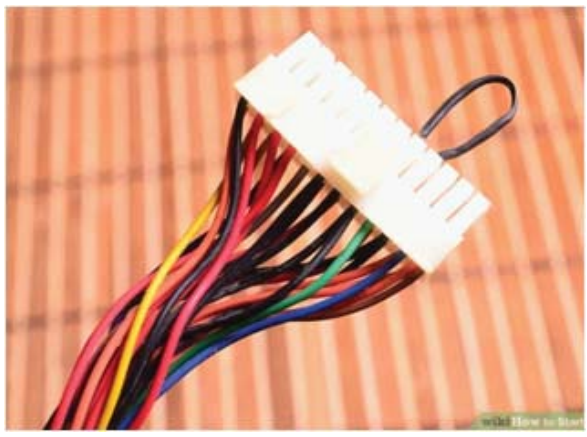


4 Connect the power cord to the SMPS unit and switch ON power.

5 Observe the fan is running to confirm the working of SMPS unit.

6 Remove the hook up wire and re-insert if the fan is not rotating.

Fig 2



7 Get the work checked by the instructor.

TASK 2: **Measurement/monitoring voltages at various test points.**

1 Start measurement of AC voltage across the three terminal mains cord and record the readings in Table-1.

Table-1

Sl. No.	Parameter to measure	Voltage (AC)	Remarks
1	Phase to Neutral	----------	
2	Phase to Earth	----------	
3	Neutral to Earth	----------	

2 Switch OFF supply and plug the mains cord into SMPS unit, and select the P-4 power cable connector used for CPU cooler fan.

3 Switch ON SMPS supply and measure the DC voltage across the P-4 cable connector and record the readings in Table-2.

Table -2

Sl. No.	Description	Wire colour	Measured voltage
1	Ground	Black	
2	Ground	Black	
3	+12 VDC	Yellow	
4	+12 VDC	Yellow	

4 Refer to the chart showing voltages at various test points on power cable connector and record the observations in Table-3.

Table-3

Sl. No.	Wire colour	Description	Measured voltage	Remarks
1				
2				
3				
.				
.				
.				
.				
24				

5 Refer to the chart details and measure test point voltage at the 4 pin molex peripheral connector and record observation in Table-4.

— — — — — — —

Table-4

Sl. No.	Wire colour	Description	Measured voltage	Remarks
1	Yellow			
2	Black			
3	Black			
4	Red			

6 Get the work checked by the instructor.

Note: The instructor has to guide the trainees to measure voltage at additional connectors for SATA, Aux power connector etc. with preparation of suitable tables to record measurements according to the SMPS model available in the section.

Chart showing voltages at various connectors of SMPS units of personal computer system Fig 3

PIN DESCRIPTION OF THE 24-PIN POWER CABLE CONNECTOR

Pin	Name		Colour	Description/voltage level	Measured voltage
1	3.3V		Orange	+3.3 VDC	
2	3.3V		Orange	+3.3 VDC	
3	COM		Black	Ground	
4	5V		Red	+5 VDC	
5	COM		Black	Ground	
6	5V		Red	+5 VDC	
7	COM		Black	Ground	
8	PWR_OK		Grey	Power Ok is a status signal generated by the power supply ON, disconnect from GND to switch OFF.	
9	5VSB		Purple	+5 VDC Standby voltage (max 10mA)	
10	12V		Yellow	+12 VDC	
11	12V		Yellow	+12 VDC	
12	3.3V		Orange	+3.3 VDC	
13	3.3V		Orange	+3.3 VDC	
14	-12V		Blue	-12 VDC	
15	COM		Black	Ground	
16	PS_ON		Green	Power supply on (active low), short this pin to GND to switch power supply ON, disconnect from GND to switch OFF.	

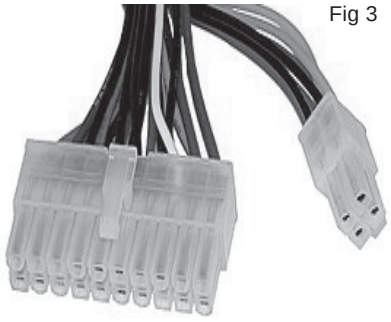


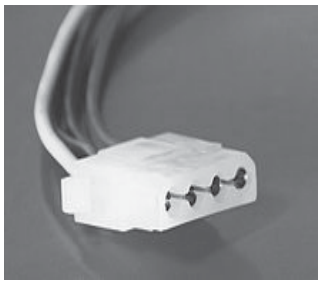
Fig 3

17	COM		Black	Ground	
18	COM		Black	Ground	
19	COM		Black	Ground	
20	-5 V		White	Ground	
21	+5V		Red	+5 VDC	
22	+5V		Red	+5 VDC	
23	+5V		Red	+5 VDC	
24	COM		Black	Ground	

PIN description of the P-4 power cable connector

Pin	Name		Colour	Description/Voltage Level	Measured Voltage	
1	GND		Black	Ground		Fig 4 
2	GND		Black	Ground		
3	12V DC		Yellow	+12 VDC		
4	12V DC		Yellow	+12 VDC		

PIN description of the 4-PIN molex peripheral connector

Pin	Name		Colour	Description/Voltage Level	Measured Voltage	
1	12V DC		Yellow	+12 VDC		Fig 5 
2	GND		Black	Ground		
3	GND		Black	Ground		
4	+5V		Red	+5 VDC		

Ac input voltage measurement (at the mains socket)

Table - 5

Sl. No	Parameters to measure	Voltage (AC)	Remarks
1	Phase to neutral voltage		
2	Phase to earth		
3	Neutral to earth		

Pin Number	Pin Name	Description
1	+5V	
2	GND	
3	+5V	
4	GND	
5	PG	+5V When power good
6	+5V STB	Stand-by power
7	+12V	
8	-12V	
9	GND	
10	GND	
11	PWR_ON	Connect to ground to power on
12	GND	
13	GND	
14	GND	
15	-5V	
16	+5V	
17	+5V	
18	+5V	
19	TFSC	Thermal Fan speed control.
20	+5V	

Another type of 20 Pin power connector used in new PCs.

Cable colors may differ between power supplies.

TFSC mainboard puts 0.7-1.4V there to control voltage supplied to power supply's fan

(Fan voltage increases when TFSC increases).

Fig 6

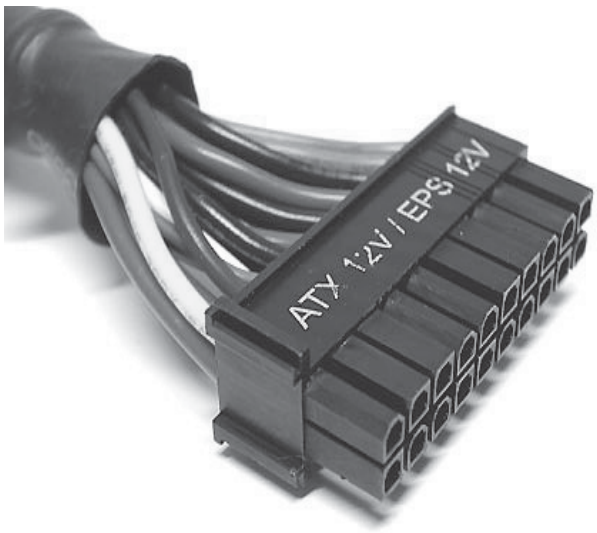


Fig 7

Troubleshoot the fault in the given SMPS unit, rectify the defect and verify the output with load (Record your procedure followed for troubleshooting the defects)

Objectives : At the end of this exercise you shall be able to
- **discharge the filter capacitor of SMPS unit**
- **identify the physical faulty component and replace it and test the output with load.**

Requirements

Tools/Equipments/Instruments

- ESD work bench - 1 No.
- Safety gloves - 1 No.
- Trainees tool kit - 1 set.
- Digital multimeter with probes - 1 set.
- LCR Meter - 1 No.

Materials/ Components

- 100 watt/230V bulb with holder - 1 No.
- Wire wound resistor (1.8kΩ or 2.2kΩ/10W) - 1 No.

Safety precaution

1 **Keep the place dry and clean**

2 **Make sure you conduct this test test on a table with yourself standing on a rubber mat or any insulated material to avoid static electricity destroying the computer peripherals.**

3 **Please note that some connections of the SMPS connectors contain a clip attached to it. Make sure to remove the clips before removing the connection.**

PROCEDURE

TASK 1 : **Discharging the filter capacitor**

A. Discharge using bulb method

Make sure the power cord is removed from the SMPS to avoid Electrical shock.

1 Dismantle the SMPS by referring to the procedure given in the previous exercises.

2 Connect 100 watt bulb wire across the leads of the capacitor as shown in Fig 1 & 2. Filter capacitors will be discharged.

Fig 1

2 Connect 100 watt bulb wire across the leads of the capacitor as shown in Fig 1 & 2. Filter capacitors will be discharged.

Fig 2

B. Discharge using reistor Method

1 Take a High wattage Low ohms wire wound resistor with proper insulated lead.

2 Use the resistor lead to short the capacitor to discharge as shown in Fig 3.

3 Use either a 1.8 K or a 2.2 K ohm 5 to 10 watt resistor to discharge the high voltage capacitor.

4 Get the work checked by the instructor.

Fig 3

— — — — — — —

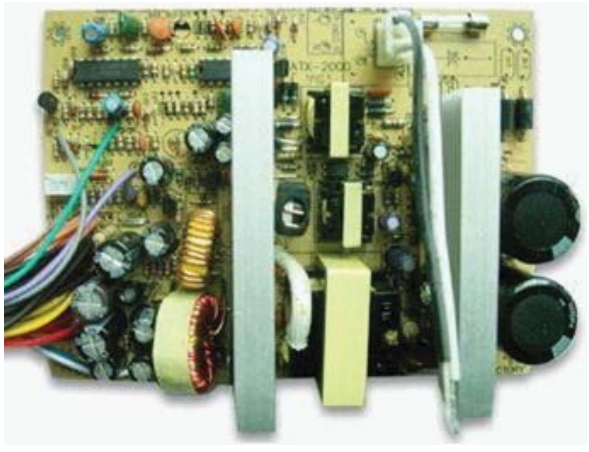
TASK 2 : **Identification of the physical fault (fuse blown) in SMPS**

1 Take the dismantled SMPS as shown in Fig 4.

Fig 4

2 The board from the SMPS cabinet is similar to as shown in Fig 5.

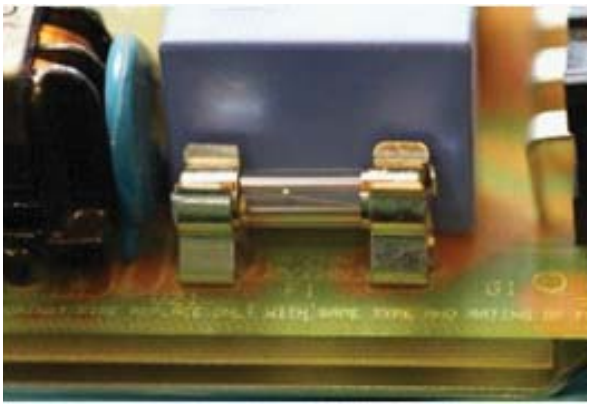
Fig 5



3 Disconnect the SMPS and make sure all electrolytic capacitors are discharged.

4 Remove the fuse from its holder as shown in Fig 6.

Fig 6



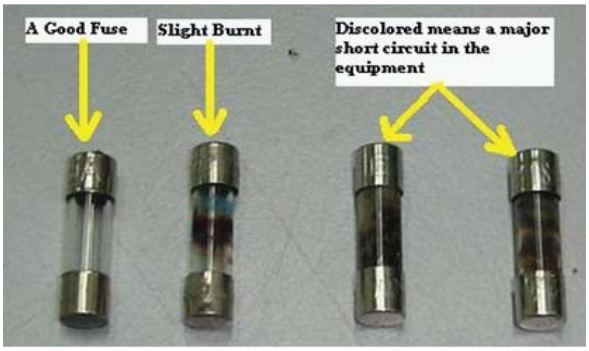
5 Look the fuse wire if there is a visible gap in the wire as shown in Fig 7.

Fig 7

6 Look the fuse carefully any dark or metallic smear inside the glass as shown in Fig 8.

7 If any above faults found in the fuse then the fuse is blown and needs to be replaced.

Fig 8



8 If there is no physical fault observed in fuse then use multimeter to check it.

9 Set a multimeter (Fig 9) to the continuity setting.

10 Place one of the multimeter leads on one end of the fuse. Place the other lead on the other end of the fuse as shown in the Fig 9.

11 If the meter shows continuity, as shown in Fig 9(a) then the fuse is good.

12 If the multimeter reading is OL(Over Limit) as shown in Fig 9(b), then the fuse is blown. If the fuse is blown, replace the fuse with one that is exactly having the same current rating.

13 Record the observations in TABLE 1.

14 Get the work checked by the instructor.

Fig 9

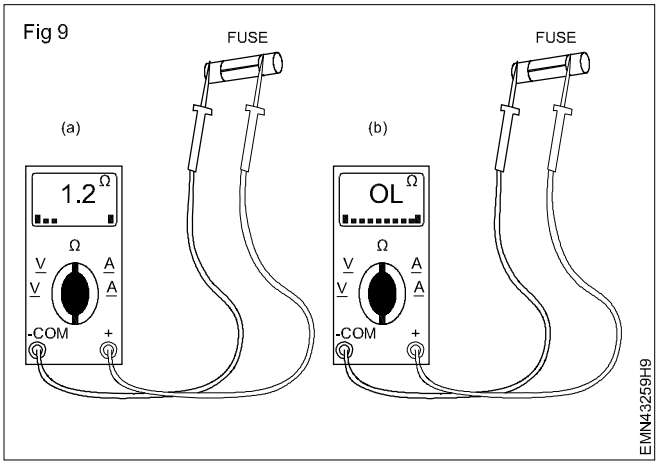


TABLE 1

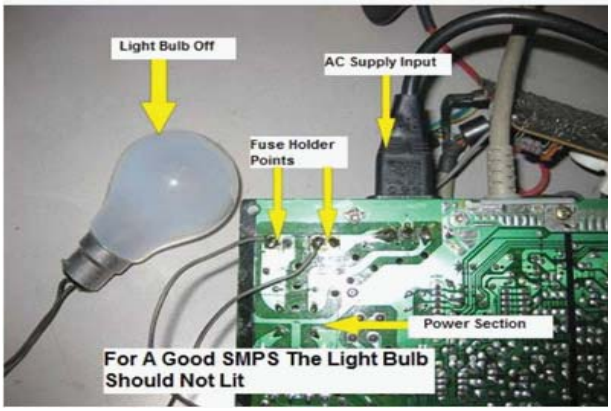
Observed	Condition

— — — — — — —

TASK 3 : **Identification of the short circuit fault using bulb**

1 Connect the 100W bulb across the fuse holder as shown in Fig 10.

Fig 10

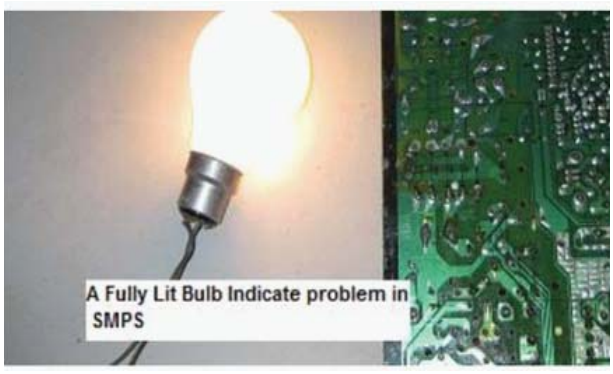


2 Power ON the SMPS unit.

3 The bulb will be initially glowing bright then for a good SMPS bulb glowing turns off, SMPS is in good / working condition.

4 The light bulb will glow bright even after you have waited for couple of minutes as shown in Fig 11, then it indicates there is problem in the SMPS.

Fig 11



a) Immediately switch off the AC main.

b) Discharge the big filter capacitor as given in TASK 1.

5 Record the observation in the TABLE 2.

6 Get the work checked by the instructor.

TABLE 2

Observed bulb status	SMPS status

B Identification the fault in short circuited components using Resistance method

3 Set the DMM to resistance unit.

4 Keep the red probe to the cold ground and black probe to each of the secondary diode as shown in Fig 12.

Fig 12

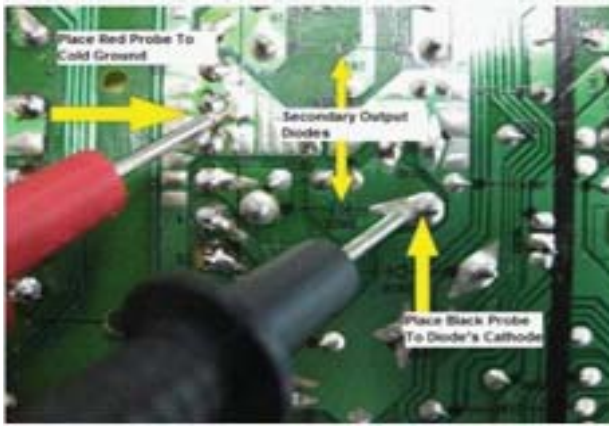
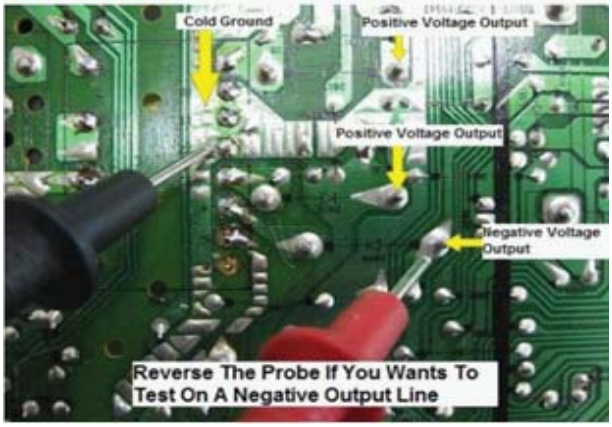


Fig 13



i) If any one of the component shows same resistance reading (low readout) on both polarity, then suspect that there is a problem in that component.

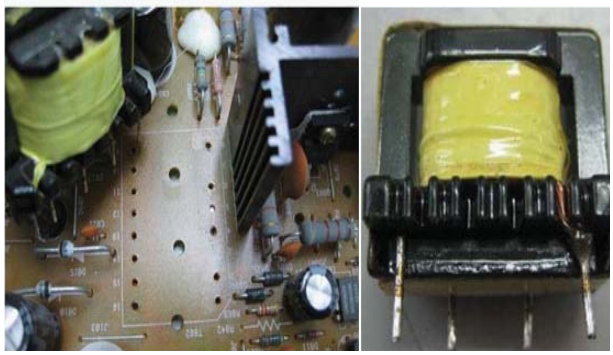
ii) If the multimeter shows different values on both polarities then the component is good.

5 Get the work checked by the instructor.

C Isolation method

1 Identify the B+ line of the Back/Boost sections and break/disconnect the B+ line from the circuit as shown in Fig.14

Fig 14



2 Connect the 100 W bulb between the B+ line to cold ground.

3 Power ON and verify the bulb glowing condition.

4 There are five possibilities that can be expected from the light bulb.

a) The light bulb lit with a constant brightness and all of the output voltage measured normal at the secondary side this indicates the SMPS is working fine and the cause of the power problem in the load side. It maybe fly back transformer, yoke coils etc.

b) No light from the light bulb and no voltage measured at the output of the power supply, this indicates the problem is in the SMPS.

c) The light bulb glows intermittently this could indicate components failure in the power supply like bad filter capacitor ,current sense resistor higher ohm, etc. (value would have been increased)

d) The light bulb become extra bright and all the output voltages have increased .this indicates the problem is in the regulation circuit like an open resistor in feedback circuit , bad opto isolator IC faulty TLC431 IC, etc.

e) The light bulb keeps cycling (continuously ON and OFF). This could indicate problem in the SMPS area and it can also mean the OPTO IC is sending an Error signal to the primary circuit of power supply through opto isolator IC causing the power supply to cycle.

5 Record the observation in the TABLE 3.

TABLE 3

Sl. No.	Probable defect	Tick

Fig 15

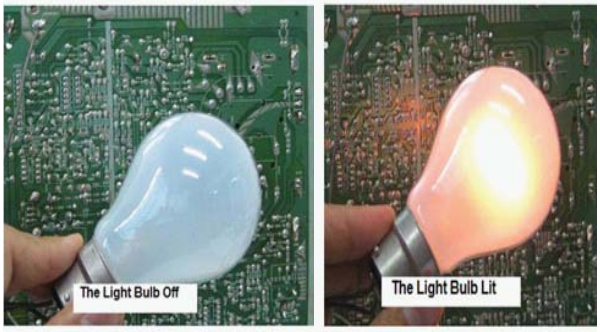


Fig 16

6 Get the work checked by the instructor.

— — — — — — —

TASK 4 : **Identification of the short circuited components**

Capacitor checking

1 Disconnect the power card.

2 Discharge the main(large) capacitor.

Fig 17

3 Test the healthyness of diodes and capacitors at secondary section using multimeter.

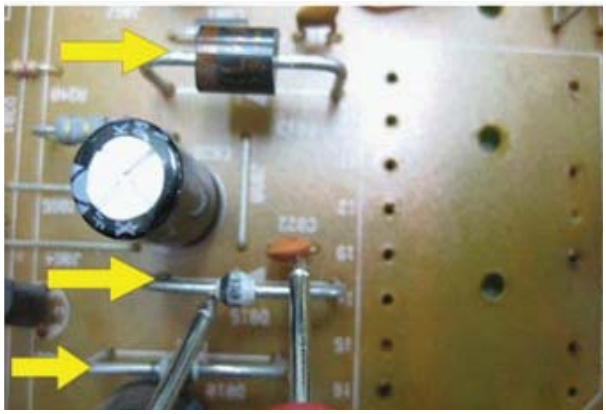
4 Open the lead of capacitor and measure capacitance using LCR meter.

5 Apply the supply to board and check the output voltage with out capacitor.

6 If the output voltage is less (or) no output measured, then fault may be in capacitor.

7 Switch OFF the supply and replace the capacitor.

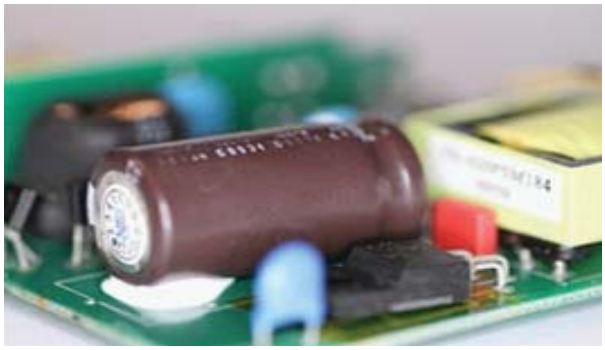
Fig 18



8 Switch ON the supply and check the output voltage.

9 Record the observation in TABLE 4.

Fig 19



Note: To confirm fault with switching transistor check the charge voltage across big filter capacitor in the input section. (after switching OFF the SMPS).

a) If the capacitor shows voltage considerably then the fault could be in the switching transistor.

b) If the capacitor shows No voltage then the fault could be in some other components/ section.

10 Get the work checked by the instructor.

TABLE 4

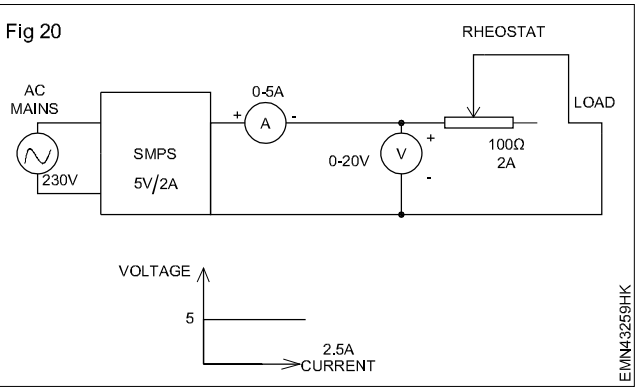
Measured output voltage	
Without capacitor	**With capacitor**

— — — — — — —

TASK 5 : **Connection of SMPS the circuit for performing load test**

1 Connect the circuit as shown in Fig 20 across 5V terminals.

Fig 20



2 Keep the rheostat in max resistance position.

3 Power ON the circuit.

4 Increase the current in steps of 200mA, note down the corresponding voltage and tabulate the reading in the TABLE 5.

5 Observe that even when the current is varied by the load, the output of SMPS remains constant at the rated voltage.

TABLE 5

Sl.No.	Load current(mA)	Voltage(V)

6 Get the work checked by the instructor.

— — — — — — —

Use SMPS used in TVs and PCs for practice

Objectives : At the end of this exercise you shall be able to
- **trace and test the different types of SMPS.**

Requirements	
Tools / Equipments/ Instruments • Trainees tool kit - 1 Set. • Digital Multimeter with probe - 1 No.	**Materials/ Components** • Different type of SMPS (TV SMPS, PC SMPS, Laptop SMPS, Mobile change (SMPS) etc) - as reqd. • Sketch per - as reqd.

PROCEDURE

1 Pick any one of the SMPS from assorted SMPS units and label it, as shown in Fig 1.

2 Unscrew the case/cover of the SMPS unit.

3 Note down the specification of SMPS and record

4 Identify the sections of SMPS units and its correspondings major components/devices.

5 Trace the circuit and identify the type of SMPS unit by referring the components/devices available in the unit.

6 Mark the test points on the PCB using sketch pen.

7 Power ON the SMPS unit.

8 Measure and record the voltage at various test points/ connectors as shown in table - 1.

9 Repeat the above steps for all other SMPS units.

Table-1

Sl.No	**Description**	**Voltage**
1	Ac input voltage	
2	AC input voltage after fuse	
3	Rectified output voltage of input section.	
4	Switching transistor (V_{CE})/ MOSFET votlages(VDs)	
5	Rectified DC output of output section	

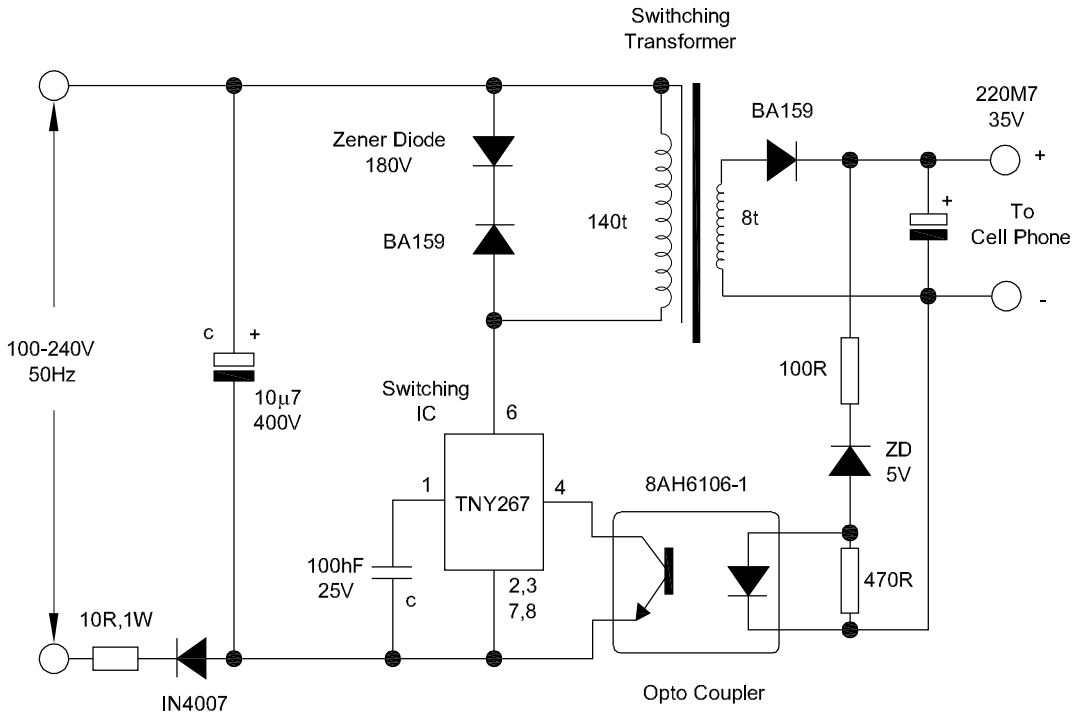
Note: For measurement of primary voltages use primary ground (Hot side-input section) and use secondary ground (cold side - output section) for secondary voltage.

Fig 1

Fig 2

Cell phone charger

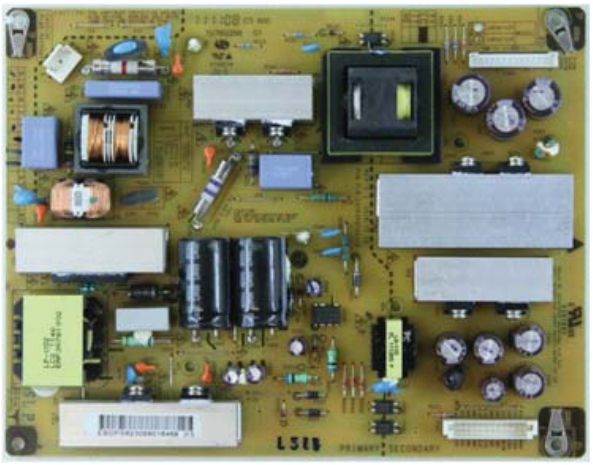
Fig 3



SMPS CELL PHONE CHARGER CIRCUIT

SMPS cell phone charger circuit

Fig 4

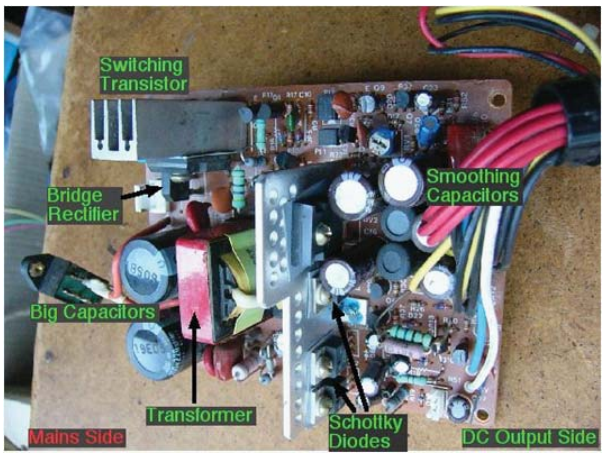


LCD TV SMPS

Fig 5

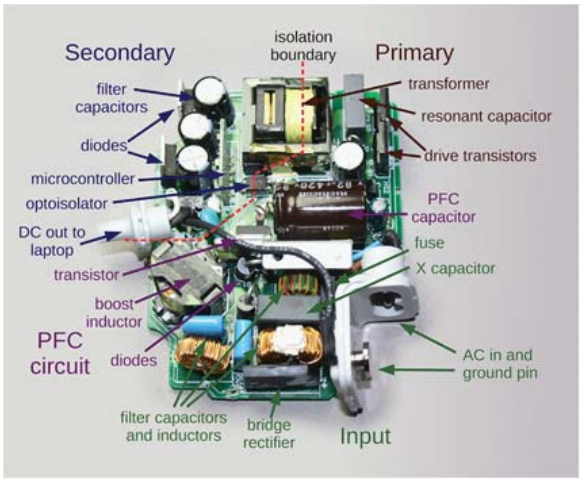
DVD Player SMPS

Fig 6



Computer SMPS

Fig 7



Laptop SMPS

10 Get the work checked by the Instructor.

Install and test the SMPS in PC

Objectives : At the end of this exercise you shall be able to
- **install and test the SMPS unit in the given PC**
- **power ON the PC and check its working condition.**

Requirements	
Tools / Equipments/ Instruments • Trainees tool kit - 1 Set • Digital Multimeter - 1 No.	**Materials/ Components** • Tested SMPS - 1 No. • PC with all peripherals - 1 Set.

PROCEDURE

TASK 1 : **Install the tested SMPS unit in the PC**

1 Place the SMPS in the PC cabinet as shown in Fig.1 and screw it

2 By referring the layout diagram shown in exercise 4.3.258 and with the help of tags & labels, place the connectors in appropriate locations.

3 Press firmly by holding the SMPS connectors to get proper contact with mother board and peripherals by referring Fig.2

4 Close the computer cabinet cover, by fixing door screws.

5. Get the work checked by the instructor.

— — — — — —

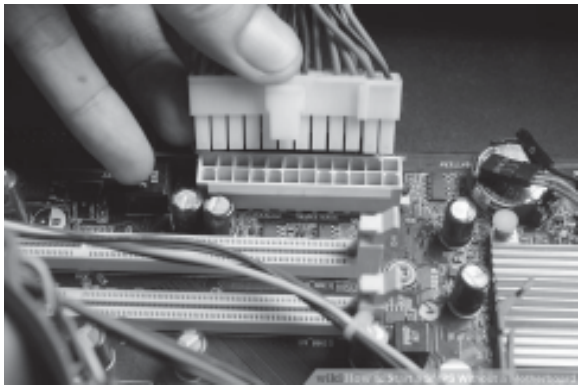
TASK 2 : **Checking the working condition of PC with Power ON.**

1 Connect the SMPS power cord to the mains and switch ON the supply

2 Switch ON the PC, wait few minutes for booting and check the display on the monitor.

Fig 1

Fig 2



3 Get the work checked by the instructor.

— — — — — —

Install and test an inverter

Objectives : At the end of this exercise you shall be able to
- **connect the external battery to inverter unit**
- **test the inverter by connecting to mains power.**

Requirements

Tools / Equipments/ Instruments

- Trainees tool kit - 1 Set
- Digital Multimeter with probes - 1 No.
- Line tester - 1 No.
- Hand gloves - 1 Set.
- Double ended spanner - as reqd.
- Inverter - 1 No.
- Battery, 12V, 150AH - 1 No.

Materials/ Components

- 240V/16A, SPST switch - 2 Nos.
- 240V/16A, 3Pin scoket - 2 Nos.
- Connecting wires -as reqd.
- 100W/240V Test lamp - 1 No.

Safety precaution

- **Do not make contact with both the battery terminals simultaneously with metal parts like screw driver, spanners and bare hand**

- **Sparking may occur during connection of battery cables to battery terminals.**
- **Use only the battery cables provided with the inverter unit to connect the external battery.**

PROCEDURE

TASK 1 : **Connection of the external battery to the inverter unit**

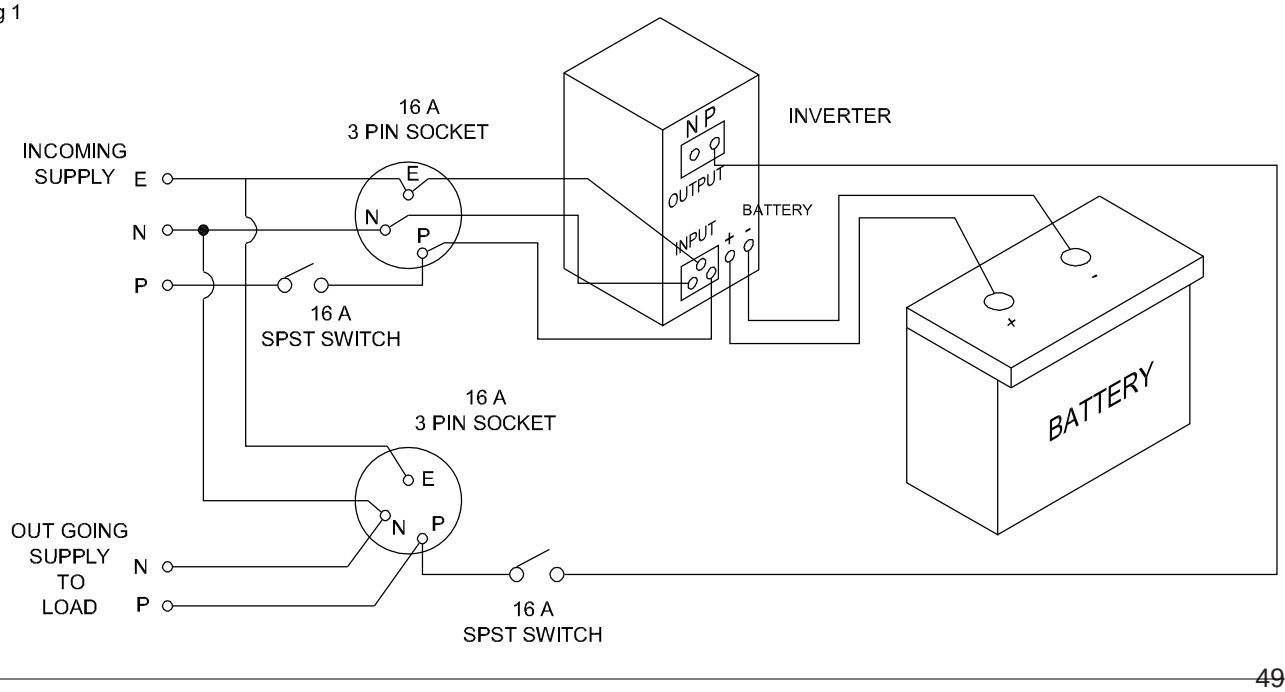
1 Read the user manual of the given inverter unit and check the capacity of battery given for inverter.

2 Identify the colour code used for the battery cables and polarity marked on the terminals of the battery.

3 Select the ref colour cable and terminals of the battery to the +Ve terminals of the UPS using bolt & nuts as shown in Fig 1.

4 Take the black colour cable from the UPS, connect it to the battery using bolt & nut as shown in Fig.

Fig 1



5 Use double ended spanners, tighten the bolt & nuts with correct force.

6 Get the connections checked by the Instructor.

— — — — — — — —

TASK 2: **Testing the inverter by connecting to mains power and load**

1 Measure the voltage across the battery terminals, record the readings in Table-1.

Note: Take care while handling 230V AC mains voltage.

Ensure that the inverter start/Run switch is in OFF condition before doing output connection.

2 Connect the AC mains supply to the inverter unit through 16A, switch & socket by referring Fig.1

3 Connect the power cord of the inverter to the AC mains supply, switch ON and measure the DC voltage across battery terminals; record the readings in Table-1.

4 Connect the test lamp across the output terminals, switch ON the UPS and observe the lamp is glowing.

5 Measure the AC voltage across the output of UPS, the DC voltage across the battery and record the readings in Table.

6 Switch OFF AC mains and measure output voltage battery voltage and record the readings in Table - 1

Table-1

AC input supply			AC output supply			Battery voltage			
P-N	P-E	N-E	P-N	P-E	N-E	UPS OFF AC OFF	UPS OFF AC ON	Load ON AC ON	Load ON AC OFF

7 Get the work checked by the Instructor and Switch OFF the UPS.

— — — — — — —

Troubleshoot the fault in the given inverter unit, rectify the defects and verify the output with load

Objectives : At the end of this exercise you shall be able to
- **identify the faulty components/section in the inverter**
- **rectify the defects in the inverter unit**
- **verify the output with load.**

Requirements	
Tools / Equipments/ Instruments • Trainees tool kit - 1 Set • Digital multimeter with probes - 1 No. • Line tester - 1 No. • Magnifying glass - 1 No. • Oscilloscope, 100MHz - 1 No.	**Materials/ Components** • Defective inverter with battery - 1 No. • Test lamp with 230V, 100W bulb - 1 No. • Sketch pen - 1 No.

PROCEDURE

TASK 1 : **Identification of the faulty components/section in the inverter**

1 Open the inverter cover and carry out the visual inspection of the board and connectors with the help of magnifying glass.

2 Identify if any damaged components or connectors are seen.

3 Remove the damaged component and check the condition

4 Trace the circuit by referring the circuit diagram (Fig.1) and identify the sections

5 Mark the different test points by using sketch pen.

6 Apply supply to the inverter unit and measure voltage at marked test points.

7 Observe the waveforms using CRO at switching device input/ouput

8 Record the measured readings in the table-1

Table - 1

Section	Test point	Description	Voltage
Battery	TP1	Battery voltage	
Inverter	TP2 TP3	Inverter feedback voltage from inverter output transformer Rectified feedback DC voltage	
PWM section	TP3 TP5	Sensed DC Voltage to PWM section Trigger pulse from PWM IC to upper switching device (AC)	
Switching section	TP7 TP8	Output AC waveform of upper switching device (AC) Output AC waveform of lower switching device (AC)	
Inverter output	TP9	Inverter output voltage (also observe output waveform)	

9. Get the work checked by the Instructor

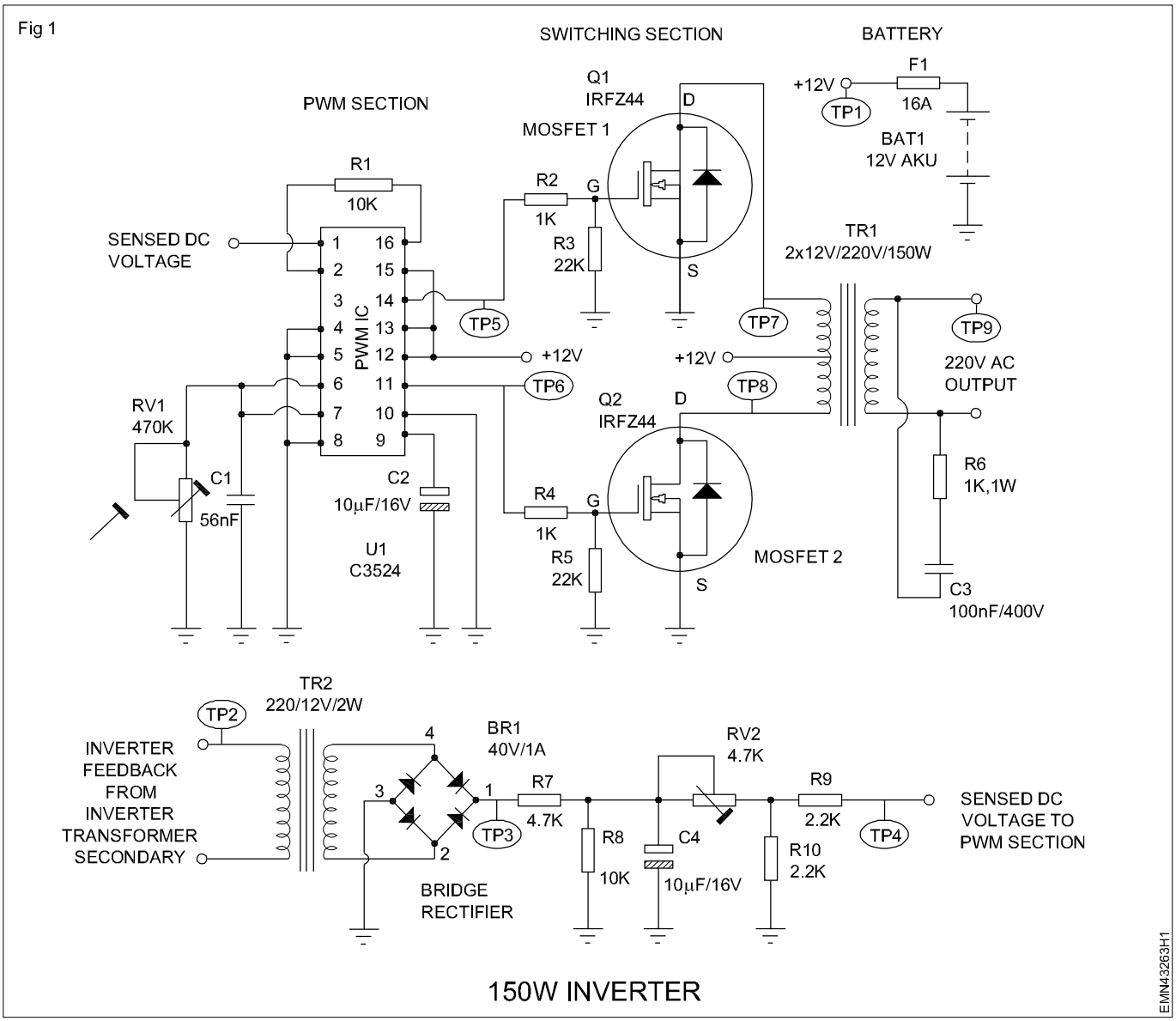
TASK 2: **Rectification of the defects in the inverter unit**

1 Based on the observed readings obtained from the marked test points and waveforms, identify the faulty section/component in the inverter.

2 Remove the suspected component from PCB and test it.

3 Replace the defective components.

Fig 1



4 Get the work checked by the Instructor.

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TASK 3: **Verification of the output terminal with lamp load**

1 Connect a 240V, 100W lamp load at the output terminal

2 Switch ON the inverter, observe the lamp light

3 Measure the output AC voltage and confirm that it remains constant.

4 Get the work checked by the instructor

Construct and test IC based DC to DC converter for different voltages

Objectives : At the end of this exercise you shall be able to
- **construct and test IC based 5V to 12V step up converter**
- **construct and test IC based 9V to 5V step-down converter.**

Requirements	
Tools / Equipments/ Instruments • Trainees tool kit - 1 Set. • Regulated DC Power supply 0-30V/2A - 1 No. • Digital multimeter with probes - 1 No.	**Materials/ Components** • Bread board/General purpose PCB - 1 No. • IC LT 1073-12 - 1 No. • IC LT 1073-5 - 1 No. • Schottky diode 1N5818 - 1 No. • Resistor, 50Ω - 1 No. • Resistor 220Ω - 1 No. • Inductor, 150µH - 1 No. • Capacitor, 100µF/25V - 2 Nos. • Hook-up wires - as reqd.

PROCEDURE

TASK 1 : **Construction and testing IC based 5V to 12V step up converter**

1 Collect the components and check them for its good working condition

2 Connect the components and construct a 5V to 12V step up convertor by referring the circuit diagram (Fig.1)

3 Set the power supply voltage to + 5V DC and apply to the circuit.

Once the supply is switched ON check if any components or the IC LT1073 is getting heated - up; if yes, switch OFF DC supply and check the circuit.

4 Measure and record the input and output voltage in table-1

5 Measure the pin voltages of IC and voltage across inductors, and diode in the circuit unit record in Table - 1

Voltage across inductor	**Voltage across diode**

Table - 1

Input DC Voltage	**Output DC voltage**	**IC pin voltages**					
		I_{LIM} (PIN-1)	**V_{IN}** (PIN-2)	**SW_1** (PIN-3)	**SW_2** (PIN-4)	**GND** (PIN-5)	**FB/SENCE** (PIN-8)

Fig 1

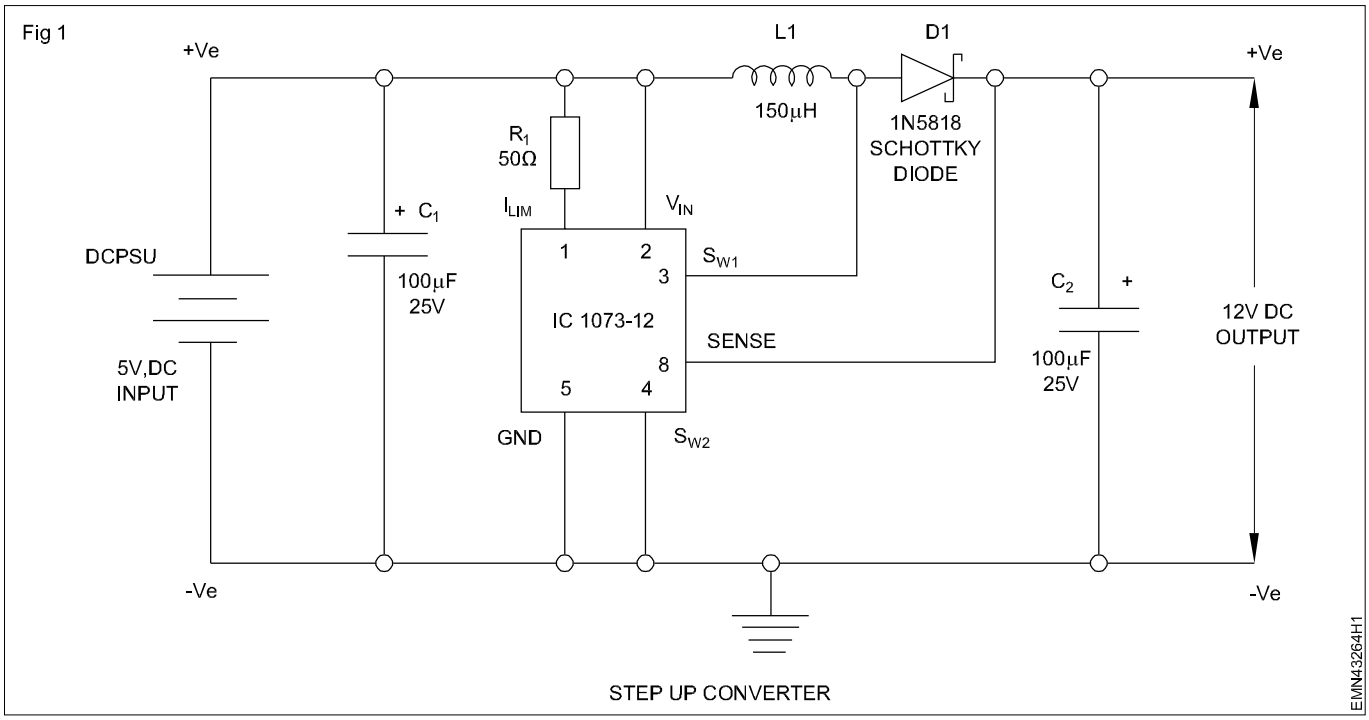
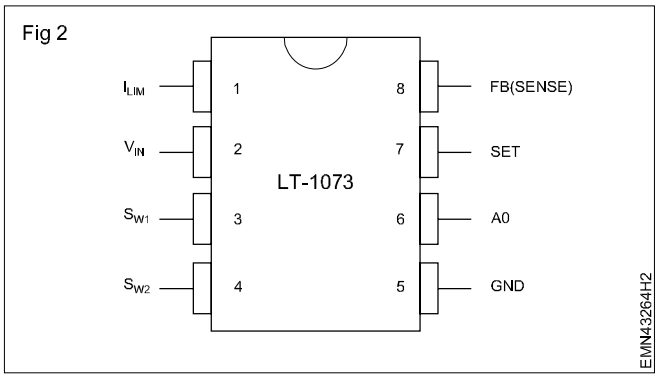


Fig 2



6 Get the work checked by the instructor.

— — — — — —

TASK 2 : **Construction and testing IC based 9V to 5V step- down converter**

1 Replace the Step-up converter IC with LT-1073-5

2 Modify the step-up converter circuit into step-down converter by referring the circuit diagram (Fig.3)

3 Set the power supply voltge to +9V DC and apply to the circuit.

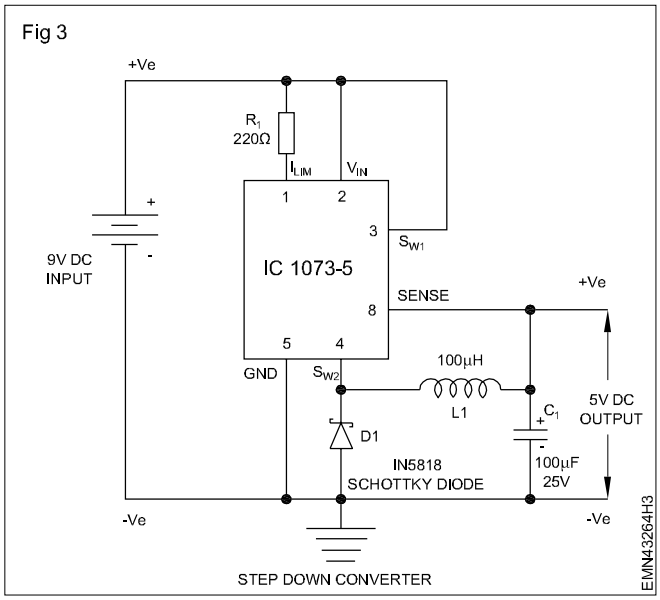
4 Measure and record the input and output voltage of step-down converter in table-2.

5 Measure the pin voltages of IC and voltage across inductor, and diode in the ciruit and record in table-2.

Table - 2

Input DC voltage	Output DC voltage	IC PIN voltage						Voltage across inductor	Voltage across diode
		I_{LIIM} (PIN-1)	V_{IN} (PIN-2)	SW_1 (PIN-3)	SW_2 (PIN-4)	GND (PIN-5)	SENSE (PIn-8)		

Fig 3



6 Get the work checked by the instructor.

Construct and test a switching step down regulator using LM 2576

Objectives : At the end of this exercise you shall be able to
- **construct and test the regulated power supply using IC LM 2576.**

Requirements

Tools/Equipments/Instruments

- Regulated DC Power supply (0-30V/2A) - 1 No.
- Digital multimeter with probes - 1 No.
- Trainees tool kit - 1 set.
- Soldering iron 25W/230V - 1 No.
- Semiconductor/IC LM 2576 data sheet - as reqd.

Materials/ Components

- IC LM2576 (5V) - 1 No.
- Inductor 100µH 2 Amps - 1 No.
- Diode 1N5822 - 1 No.
- Capacitor 1000µF/16V, 100µF/63V - 1 No. each
- Breadboard/PCB-GP - 1 No.
- Hook up wire - as required
- Rosin cored solder - as required

PROCEDURE:

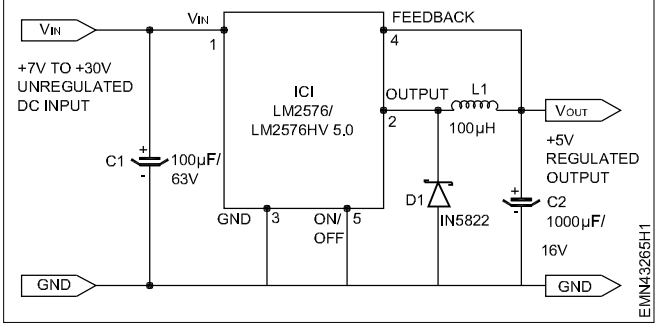
1 Collect all the components, required and check them.

2 Refer to the data sheet of the IC 2576, identify pins and test the condition.

3 Prepare the layout on the GPCB and assemble the circuit as per the diagram shown in Fig 1&2.

4 Get the assembled circuit checked by the Instructor.

Fig 1



5 Switch ON the DC supply to the input DC voltmeter across the output.

6 Increase the input voltage from 7V upto 30V in steps of 5 Volts.

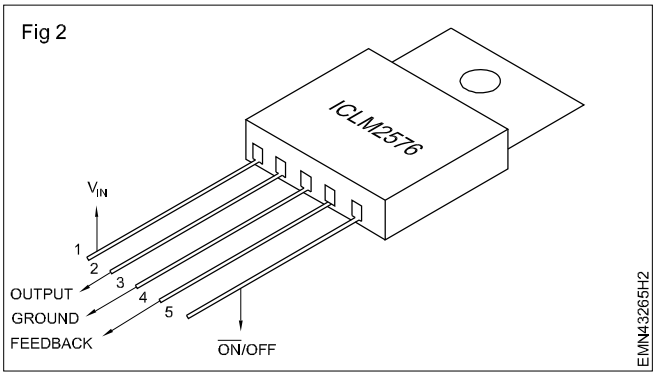
7 Note down the corresponding output voltage and record the readings in TABLE 1.

Ensure that the output voltage remains constant.

TABLE 1

Sl. No.	Input voltage	Output voltage
1	5V	
2	10V	
3	15V	
4	20V	
5	25V	
6	30V	

Fig 2



6 Get the work checked by the instructor.

Construct and test a switching step up regulator using MC34063

Objective : At the end of this exercise you shall be able to
- **construct and test the step up regulated power supply using IC MC34063.**

Requirements	
Tools/Equipments/ Instruments • Regulated DC Power supply unit 0-30V/2A - 1 No. • Trainees toolkit - 1 set. • Digital multimeter with probes - 1 No. • Data sheet of the IC MC34063 - as reqd. • Soldering iron 25W/230V - 1 No.	**Materials/ Components** • IC MC34063 - 1 No. • Resistor CR25 (0.22Ω, 180Ω,1.5k,12kΩ) - 1 No each. • Inductor 100µH - 1 No each. • Diode MBR 340 - 1 No. • Capacitor (100µF/25V,0.001µF,2200µF/25V) - 2 Nos. • Trimmer pot 1KΩ - 1 No. • Bread board/PCB-GP - 1 No. • Hook up wire - as required • Rosin core solder - as required

PROCEDURE

TASK 1 : **Construction and testing of regulated power supply**

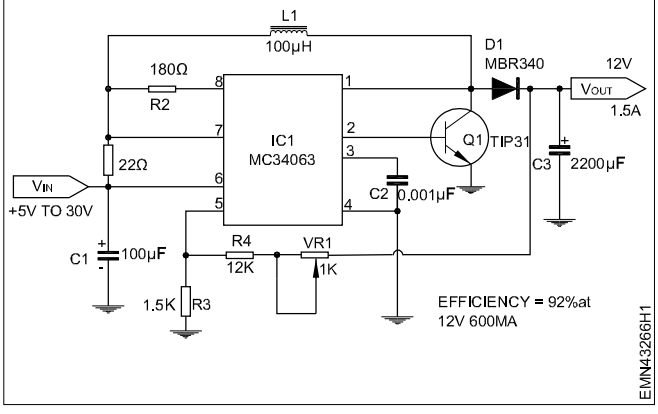
1 Collect all components required and check them for good condition.

2 Refer to the data sheet of the IC MC34063, identify pin number, test them.

3. Prepare the layout on the GPCB and assemble the circuit as per the diagram shown in Fig 1 &2.

4 Get the assembled circuit checked by the Instructor.

Fig 1



5 Switch ON the DC power supply to the input and connect DC voltmeter across the output.

6 Increase the input voltage from 5V upto 30V in steps of 5 volts.

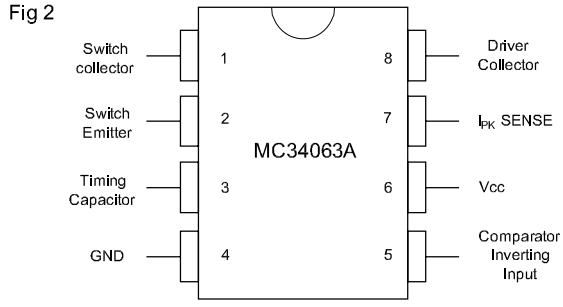
7 Note down the corresponding output voltage and record the readings in TABLE 1.

Ensure that the output voltage remains constant.

TABLE 1

Sl. No.	Input voltage	Output voltage
1	5V	
2	10V	
3	15V	
4	20V	
5	25V	
6	30V	

Fig 2



PINOUT OF IC mc34063A

8 Get the work checked by the instructor.

Connect battery stack to the UPS

Objectives: At the end of the exercise you shall be able to
- **interconnect the batteries to prepare a battery stack for the UPS**
- **connect abd test the battery stack of UPS**

Requirements	
Tools /Equipments/ Instruments • Trainees tool kit - 1 set. • Safety gloves - 1 No. • Digital multimeter with probes - 1 No. • Single phase UPS, 6KVA - 1 No. • Double ended spanners - as reqd.	**Materials/ Components** • 100W/ 230V/test lamp - 1 No. • Battery 12V, 40AH - 13 Nos. • Operating manual - 1 No. • Battery connecting wires - as reqd. • Bolt & Nuts for battery - as reqd. • cable connection - as reqd. • Rack for battery - as reqd.

PROCEDURE

TASK 1 : **Interconnection of batteries to prepare a battery stack for the UPS**

1 Read the operating manual of the UPS and find the required battery back up voltage & current rating.

2 Calculate to the required level of voltage/current, arrange the batteries on the battery rack.

Electrical hazard: Do not make contact with both of the battery terminals simultaneously with metal parts like screw driver or spanners.

3 Prepare and place the battery connecting cables

4 Check the battery voltage individually and confirm its good working condition.

- **For series connection of batteries -ve terminal of one battery should be connected with +ve terminal other battery by referring Fig.1**
- **For parallel connection of series stack of batteries connect +ve and -ve terminals of one series battery stack to the +ve and -ve terminal of the another series battery stack by referring Fig.2.**
- **Sparking may occur during connection of battery cables to battery terminals.**
- **Use only the battery cables provided with the unit to connect the external battery. Do not exted the length of these cables.**

3 Connect the cable terminals of battery to the +ve and -ve terminal of the UPS carefully.

- **Do not interchange the polarity**
- **Do not connect the battery stack to the UPS directly. First charge the UPS filter capacitor through a incandescent lamp (Fig.3) and then connect the battery stack.**

Fig 1

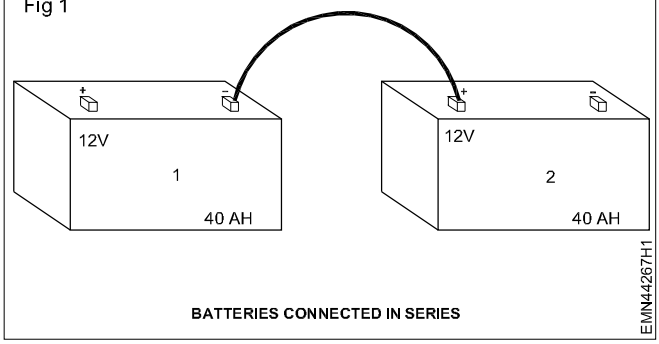
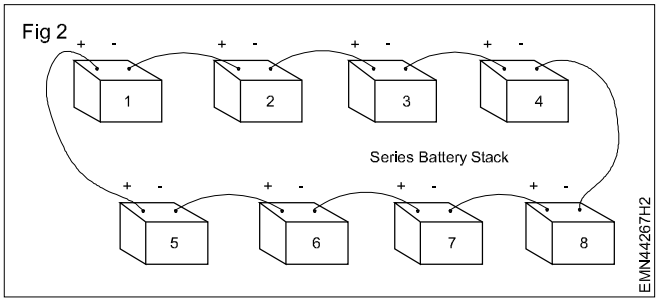


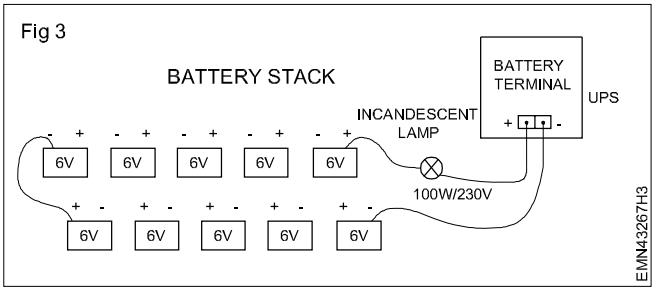
Fig 2



6 Check the battery voltage Fig.3 at the battery connector of the UPS.

7 Close the rear side cover and get the work checked by the instructor

Fig 3



8 Get the work checked by the Instructor.

Identify front panel controls & indicators of UPS

Objectives : At the end of this exercise you shall be able to
- **identify front panel indicators of UPS**
- **identify different sockets and connectors on the rear panel on the rear panel of UPS.**

Requirements	
Tools / Equipments/ Instruments • Trainees tool kit - 1 Set. • Single phase UPS, 6KVA with manual - 1 No.	**Materials/ Components** • Cotton waste - as reqd.

Safety precaution

1 Keep the place dry and clean

PROCEDURE

TASK 1 : **Identification of different controls and indicators on front panel of UPS**

1 Note down and record the specifications of the UPS.

2 Draw the sketch of front panel of the UPS with all indicators and switches

3 Identify each indicator and control on the front panel by referring to Fig.1/ Operating manual.

4 Record the observations in Table-1

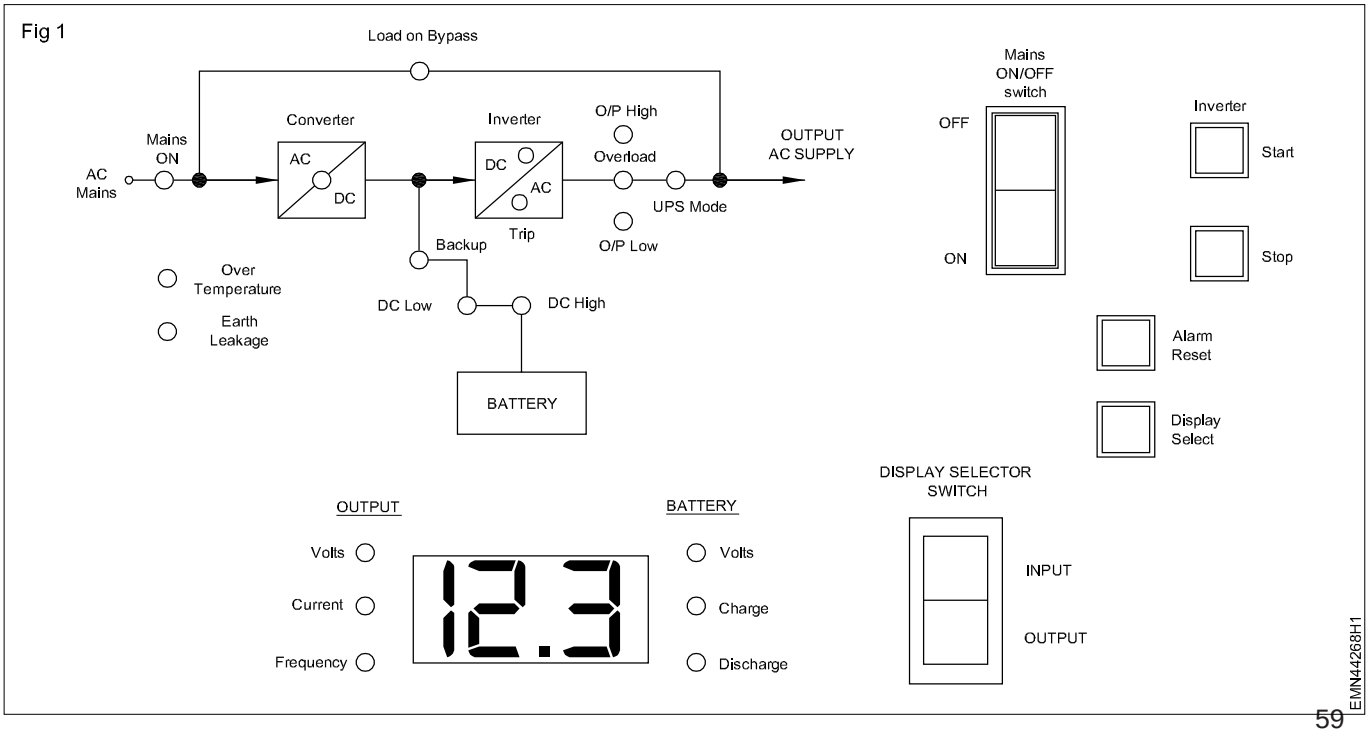
5 Repeat the above steps for all indicators and controls on the front panel and record them.

6 Referring to the manual, record a brief function of the switches and the indicators.

Table - 1

Sl.No.	Name of the indicator/control	Purpose
1		
2		
3		
4		
5		

Fig 1



TASK 2: **Identification of different sockets and connectors on the rear panel of UPS**

1 Turn the rear panel of the UPS and identify the name of unit, record its socket and connector available in rear panel with the help of operation/Instruction manual.

2 Find out each socket in the UPS, note down in the Table-2.

3 Repeat the above steps for all sockets and connectors and note down in Table-2.

Fig 2

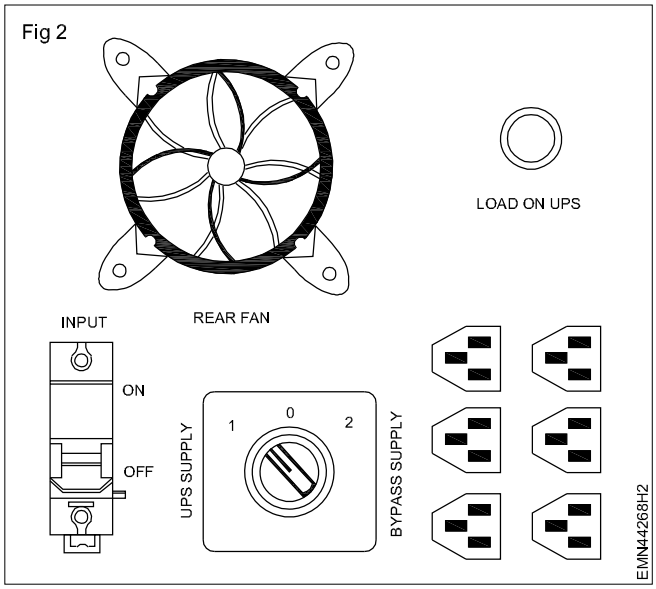


Table - 2

Sl.No.	Name of the Sockets/Connectors	Purpose

4 Get the work checked by the Instructor.

Connect battery & load to UPS & test on battery mode

Objectives : At the end of this exercise you shall be able to
- **measure the total voltage of the battery stack using voltmeter**
- **connect the UPS and load test the battery.**

Requirements	
Tools / Equipments/ Instruments • Trainees tool kit - 1 set • Safety gloves - 1 set • Voltmeter 0-600V - 2 Nos. • Digital multimeter with probes - 1 No.	• UPS of 5 KVA with battery stack - 1 Set. • Double ended spanner 10mm - 2 No. **Material/ Components** • 100W/230V Test lamp with holder - as reqd.

PROCEDURE

TASK 1 : **Measurement of the total voltage of the battery stack using voltmeter**

Safety

Electrical hazard: Do not make contact with both of the battery terminals simultaneously with metal parts like screw drivers or spanners.

Sparking may occur during connection of battery cables to may burn the skin seriously.

1 Disconnect the battery stack from main supply and remove the cable from main switch to the battery.

2 Prepare labels serially from 1 to N and paste them on each of the batteries

3 Get the work checked by the Instructor.

4 Connect the DC voltmeter acorss battery stack as shown in the Fig.1, and notedown the observation in the Table-1.

5 Note down the first label of the battery stack, connect the DC voltmeter to the battery as shown in the Fig.2

6 Measure the voltage of the battery and note down the observed voltage on table-1.

7 Repeat step 4 to 6 for measuring the voltage on all the batteries

Note: In case any variation in measured voltage of the batteries, record in the remarks column

9 Add all the voltages from label - 1 to N compare with the stack voltage.

Voltage across battery stack.....V **Table 1**

Sl.No.	**Label No**	**Measured voltage**	**Remarks**
1	Battery 1		
2	Battery 2		
3	Battery 3		
4	Battery 4		
5	Battery 5		
N	Battery N		
	Total voltage of stack		

Fig 1

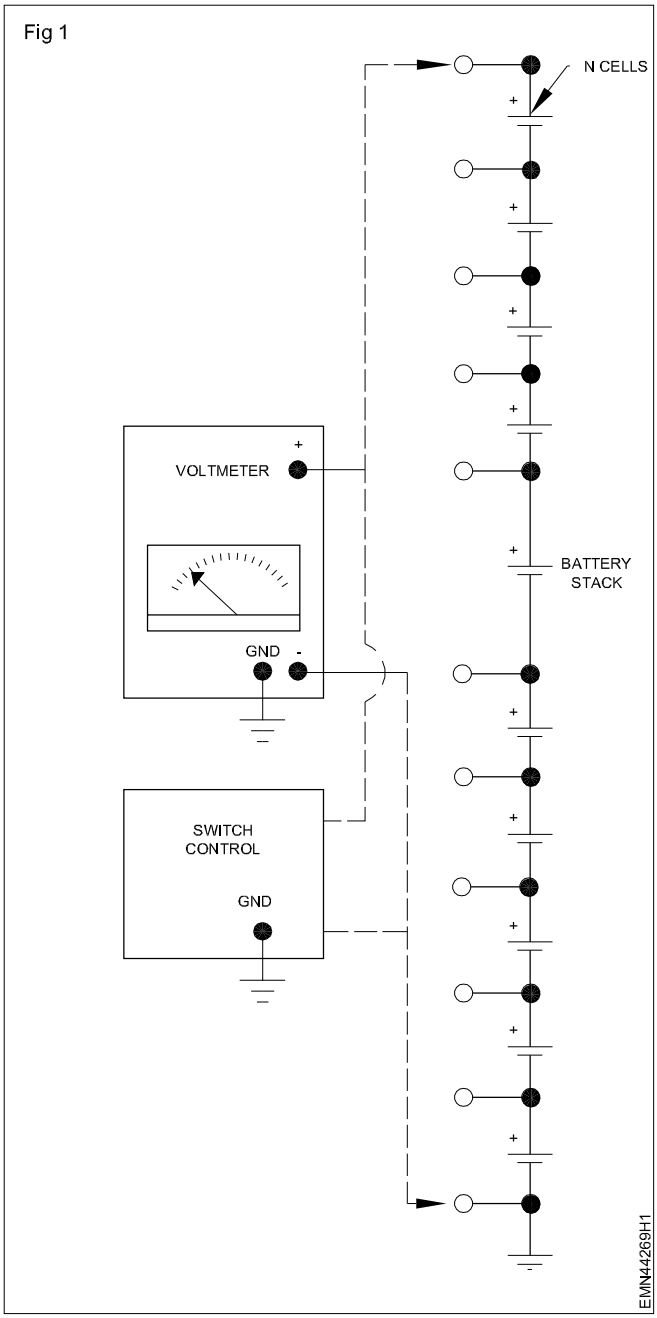
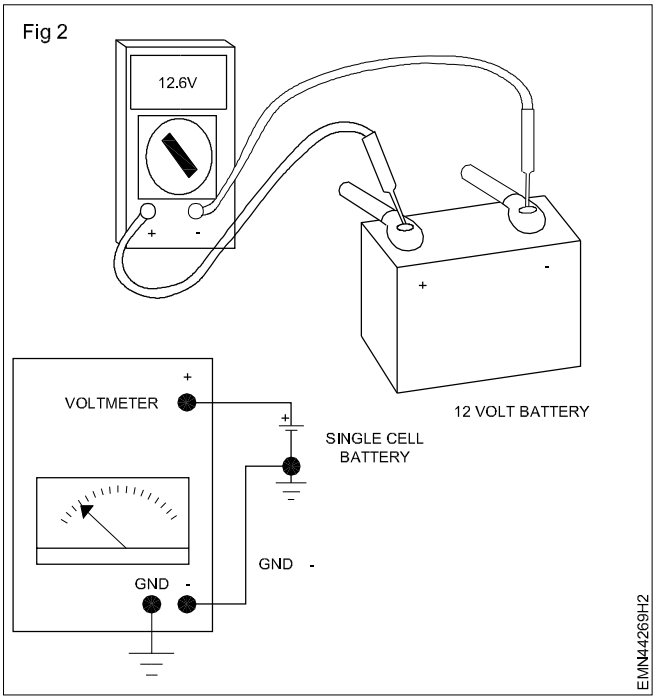


Fig 2



10 Get the work checked by the Instructor.

TASK 2: **Connection of UPS and load testing of the battery**

Safety precaution

1. **Before connecting the battery to the UPS, verify the electrode terminals symbol/ colour codes on the battery**
2. **Ensure that the UPS is kept in switched OFF condition**
3. **Connect the leads with correct polarity and tighten them.**

1 Check the battery voltage (for 12V battery minimum voltage from 9.5V to 12V)

2 Take out the terminals of the battery cable from the UPS.

3 Observe the colour code of the cable and tightly connect the battery with correct polarity.

4 Connect the DC voltmeter across the battery, measure the voltage and record the observation in Table-2 as no load voltage.

5 Connect two lamps in parallel as full load to the UPS output as shown in Fig 3 (Keep the lamps safely as the heat may damage the surface - avoid it).

6 Keeping the voltage probes across the battery, switch ON the UPS, observe the readings on the meter.

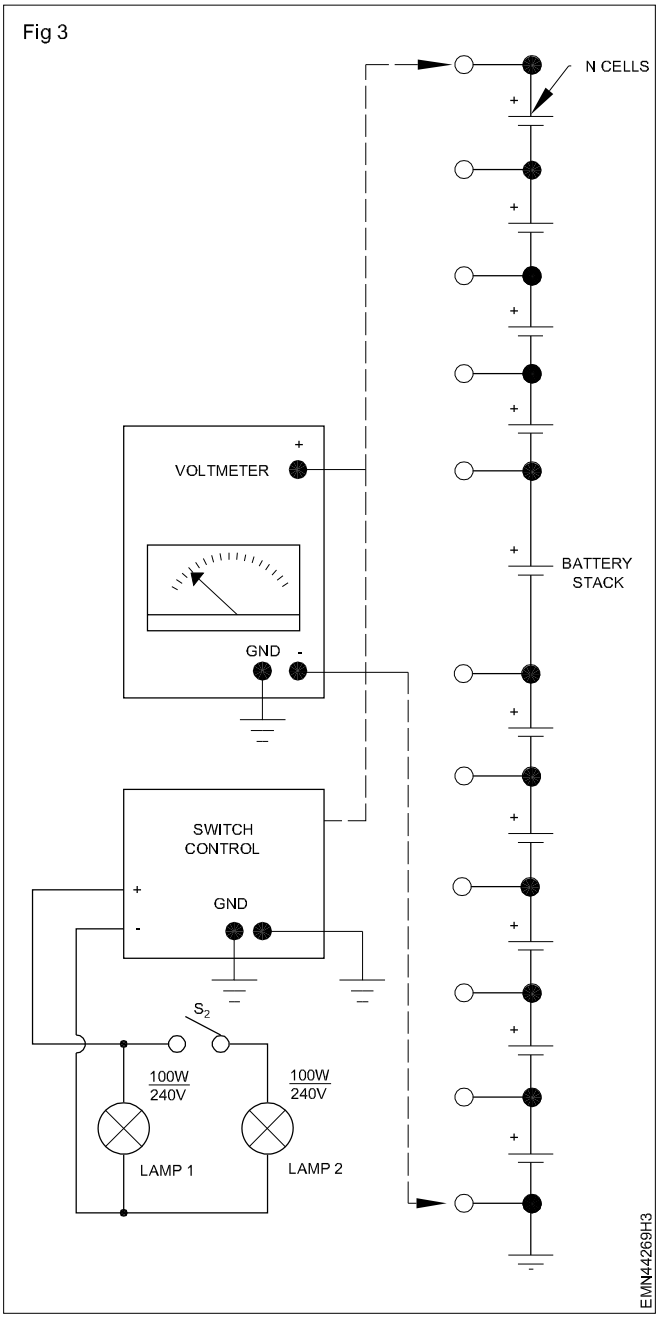
7 Record the observations in table-2 as voltage with full load

8 Remove on lamp and repeat the step as light load.

Table - 2

Sl.No	Status of UPS	Battery voltage		Full load(200W)
		No load	Light load (100W)	
1	UPS OFF			
2	UPS ON			

Fig 3



9 Get the work checked by the Instructor

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Open top cover of a UPS; identify its isolation transformers, the UPS transformer and various circuit boards in UPS.

Objectives : At the end of this exercise you shall be able to
- **identify the major section in computer UPS**
- **identify the components used in computer UPS.**

Requirements

Tools/Equipments/ Instruments

- Computer UPS(650 VA) - 1 set
- Trainees tool kit - 1 set.

Material/ Components

Nil

Note: The instructor has to label the major components/parts and sections of the UPS

PROCEDURE

TASK 1 : **Identification of major sections in computer UPS**

1 Disconnect the power cable from the mains supply. Remove the screws that are present in the side panel and open the UPS unit as demonstrated by the instructor as shown in Fig 1.

Fig 1

2 Unscrew the battery clamp pull out/ remove the battery terminal connectors and take out the battery.

Before opening CPU case touch cabinet outer cover to discharge ESD power.

3 Note down the wirings and carefully lift the circuit board. Remove from its position.

4 Find out the major section in UPS as shown in Fig 2. Note down your observations in TABLE 1.

Fig 2

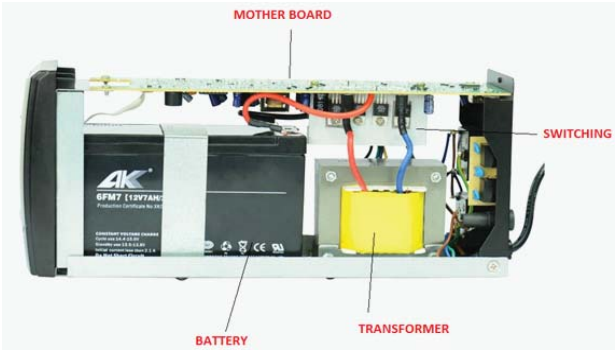


TABLE 1

Sl.No.	Major section in UPS
1.	
2.	
4.	
5.	
6.	

5 Get the work checked by the instructor.

— — — — — — — —

TASK 2 : **Identification of components used in computer UPS**

1 Remove the circuit board(PCB) from the UPS cabinet.

2 Identify the listed components in the circuit board as shown in Fig 3. Record the label of the identified components in TABLE 2 by referring to related theory

3 Repeat steps for all the other major components.

Fig 3

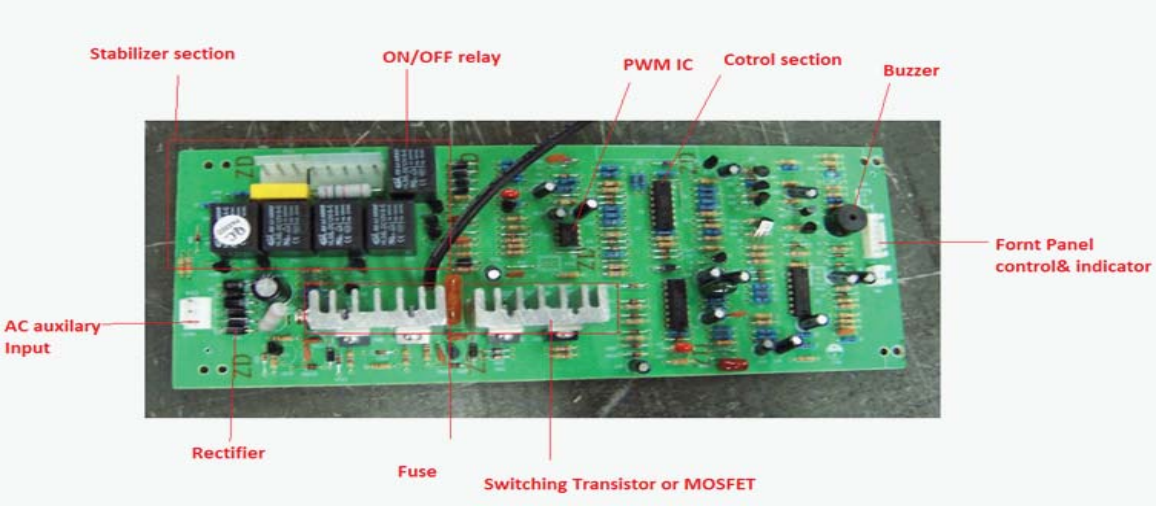


TABLE 2

Sl.No.	Name of sections	Components/Parts/Devices	Remarks
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

4 Get the work checked by the instructor.

— — — — — — —

Identify the various test points and verify the voltages on the UPS

Objective : At the end of this exercise you shall be able to
- **measure the voltage at various test points of the UPS.**

Requirements

Tools/Equipments/Instruments

- Trainees tool kit - 1 set.
- Digital multimeter with probes - 1 No.

Materials/Components

- Safety gloves - 1 set
- UPS with battery
- and intruction manual - 1 set

Note: Remove the power cord from the AC mains supply before starting this task

The Instructor has to mark the test points numbers using permanent marker pen.

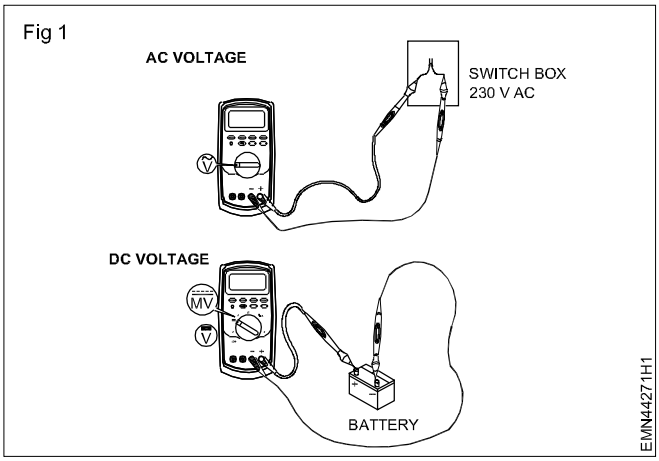
PROCEDURE:

TASK 1 : **Measurement of the voltages at various test points of UPS**

1 Open the UPS unit as demonstrated by the instructor.

2 Identify the major components/devices and sections on the assembled circuit board of UPS.

Fig 1



3 Draw the sketch of layout of the sections and mark the major/important test points in each section.

4 Connect the power cord to mains supply and switch ON the UPS.

5 Measure the AC input voltage in the wall socket as shown in Fig 1.

6 Measure the voltage at transformer output section and the readings in TABLE 1.

7 Select the DC voltage function on multimeter and measure the rectifier voltage and note down in TABLE 1.

8 Measure the battery voltage by referring the Fig 1 and note down in TABLE 1.

TABLE 1

Sl.No.	Name of the test point	Voltage	Remarks
1	AC input supply		
2	Transformer secondary		
3	Rectifier output		
4	Battery voltage		
5	UPS output		
6			
7			

9 Get the work checked by the Instructor.

— — — — — — —

Identify various circuit boards in UPS and monitor voltages at various test points

Objectives: At the end of the exercise you shall be able to
- **Identify various sectionsof UPS and locate test points on the circuit boards.**
- **measure the voltage/waveform at various circuit boards in UPS.**

Requirements	
Tools/Equipments • Trainees tool kit - 1 set. • Digital multimeter with probes - 1 No. • CRO 0-20MHz - dual channel	**Materials/ Components** • UPS with battery - 1 set • Safety gloves - 1 set • UPS with battery and mark - 1 set

Note: The Instructor has to select and mark number of test points in each section based on the importance/functions on the UPS available in Lab.

PROCEDURE

1 Keep the power cord disconnectedf from mains supply and open the UPS unit as demonstrated by the instructor.

2 Identify the major sections on the circuit the boards of UPS referring circuit (Fig.1)

3 Trace the circuit and identify/ loacate the test points on the UPS by referring to the circuit diagram and record them in Table -1.

4 Mark the test points on each board/section using sketch pen.

5 Connect AC mains supply to UPS and measure test point voltages of each section and record in Table-2.

6 Prepare the CRO for measurements and check the output waveform at the oscillator section.

7 Get the work done checked by the Instructor.

Table-1

Type of UPS		
Sl.No.	**Name of the Board/Section**	**Purpose**

Table - 2

Name of the Section	**Test Point number**	**Description/ Function of the section/circuit**	**Voltage/ waveform**	**Remarks**
Mains to Inverter change over section Battery status indicator section	TP-1 TP-2 TP-3 TP-4	AC mains input Rectified DC output Battery voltage Battery status indicator section		

Name of the Section	Test Point Number	Description/ Function of the section/ Circuit	Voltage	Remarks
Oscillator and driver section	TP-5 TP-6 TP-7	Input to regulator IC Regulator IC output Oscillator out voltage (AC) (observe waveform using CRO)		
	TP-8	Triggering pulse input to upper bank driver (AC)		
	TP-9	Triggering pulse input to upper bank driver (AC)		
	TP-10	Triggering pulse input to upper bank switching transistor (AC)		
	TP-11	Triggering pulse input to lower bank switching transistor (AC)		
Inverter section	TP-12	DC input to inverter section (upper bank)		
	TP-13	DC input to inverter section (lower bank)		
	TP-14	Output inverter voltages at transformer secondary tappings		
	TP-15			
	TP-16			
	TP-17			
	TP-18			
	TP-19			

7 Get the work checked by the Instructor.

Perform load test to measure backup time

Objectives: At the end of the exercise you shall be able to
- **perform load test of battery using UPS**
- **measure the back-up time of the UPS with battery.**

Requirements	
Tools / Equipments/Instruments • Trainees tool kit - 1 Set. • Computer UPS (around 600VA) with operating instruction manual - 1 No. • DMM with probes - 1 Set. • Voltmeter 0-30VDC - 1 No. • Safety gloves - 1 Pair. • Stop watch - 1 No.	**Materials/ Components** • 100W/240V incandescent lamp (Test lamp) - 1 No. • 12V/7AH, maintenance free rechargeable battery - 1 No.

Safety precaution

1 Before connecting the battery to UPS, in spect the electrode terminals for symbols/ colour codes on the battery.

2 Ensure that the UPS is kept in switched OFF condition

3 Connect the leads with correct polarity and tighten them.

PROCEDURE

1 Use Dc voltmeter measure the terminal voltage and verify with the specification on the battery.

2 Take out the terminals of the battery cable from the UPS.

3 Observe the colour code of the cables and tightly connect the battery with correct polarity.

4 Connect the DC voltmeter across the battery, measure the voltage and record the observation in Table-1 as no load voltage.

5 Connect the lamp load to the UPS output as shown in Fig.1

6 Reset the stop watch at starting point.

7 Start the stop watch and switch ON the UPS simulataneously, with voltmeter probes kept across the battery terminals.

8 Observe the readings on the meter and terminals record in Table-1.

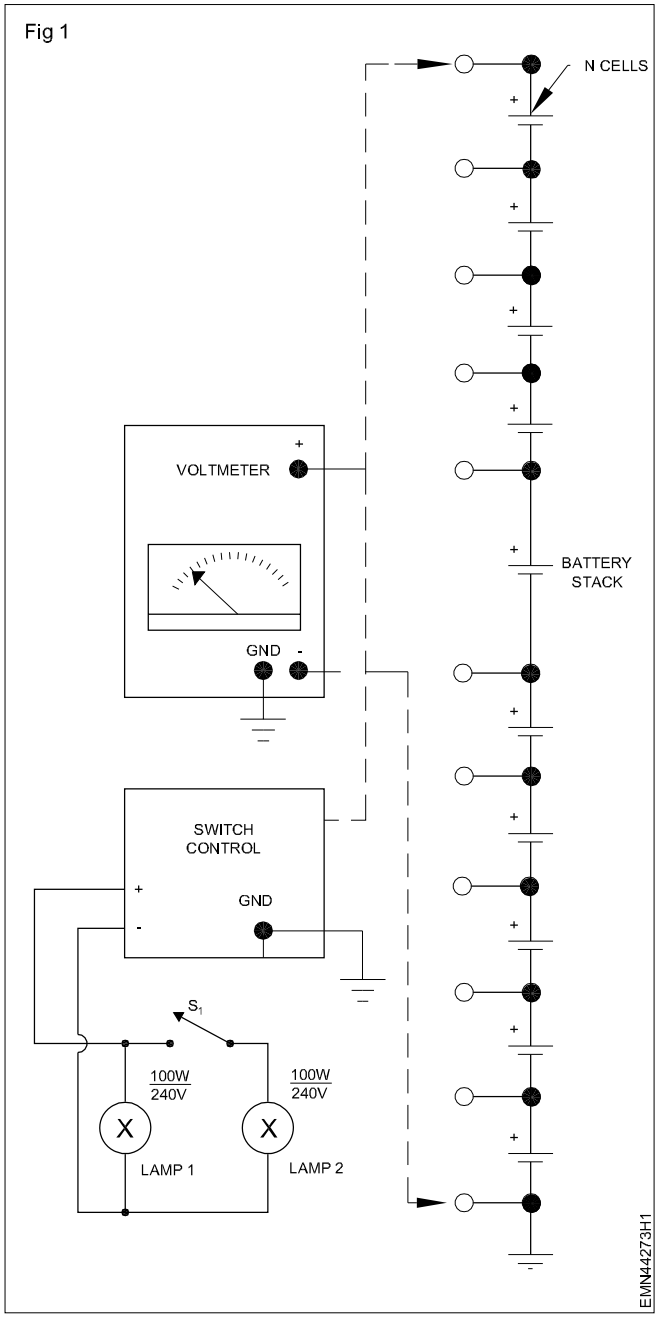
9 Observe the lamp glow with beep sound carefully and stop the clock immediately when the lamp goes off.

10 Note down the readings on the voltmeter and stop watch in Table-1.

Table - 1

Status of UPS	**Battery voltage**		**Full load**
	No load	**Light load**	
UPS OFF			
UPS ON			

Fig 1



11 Get the work checked by the Instructor.

Perform all above experiment for three phase UPS

Objectives: At the end of the exercise you shall be able to
- **identify front and rear pound controls & indicators of 3∅ UPS**
- **measure the input and output voltages**
- **perform load test using lamp loads.**

Requirements	
Tools / Equipments/ Instruments • Trainees tool kit - 1 Set. • 3∅UPS with operating manual - 1 No. • Digital multimeter with probes - 1 No. • Safety gloves - 1 No.	**Materials/ Components** • Cotton waste - 1 No. • Incandescent 230V, 100W - 3 Nos. • Pendent holder - 3 Nos. • Connecting wires - as reqd • Hook up wires - as reqd

Safety precaution

1 Earth conection is critical before connecting the input supply. Hence, ensure proper earth connection.

2 Wait five minutes before opening the UPS to allow the capacitor to dicharge

3 Do not kept open the terminal block cover while the inverter is ON.

PROCEDURE

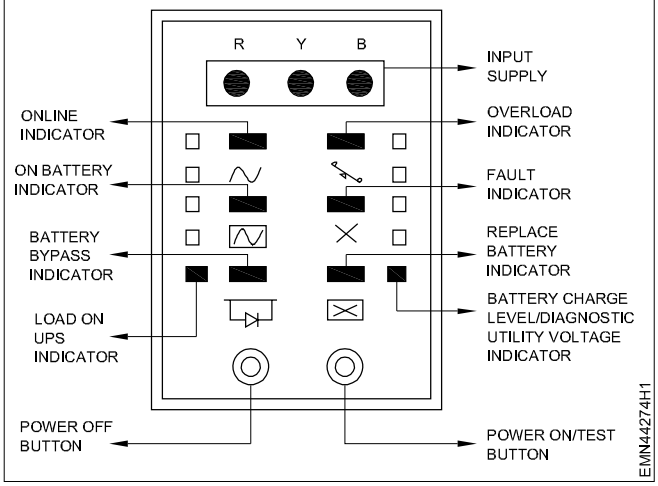
TASK 1 : **Identify front and rear panel controls**

1 Note down and record the specification of the UPS

2 Draw the front panel of the UPS with all indicators and switch.

3 Identify each indicator and control on the front panel by referring to Fig.1

Fig1



4 Record the observation in Table-1.

Table - 1 (Front side)

SL. No	Name of the indicator & switch	Purpose

5 Identify and record the rear panel switches and connectors in Table - 2 by referring to Fig.2

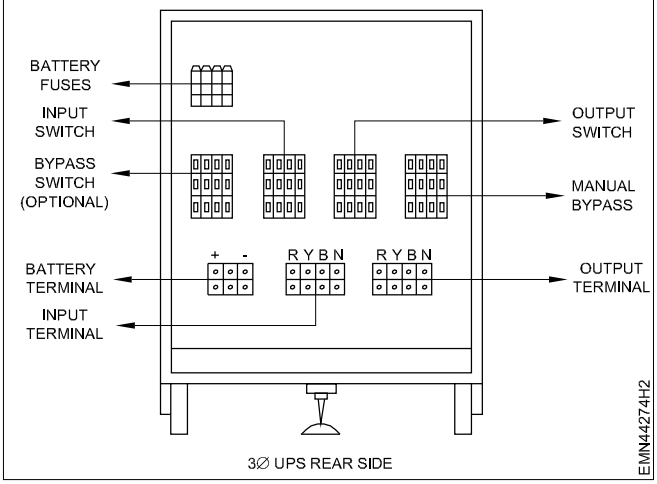
Table - 2 (Rear side)

SL. No	Name of the switch & connector	Purpose

6 Referring to the operating mounted record a brief function of the indicators, controls, switches and connectors.

7 Get the work checked by the Instructor.

Fig 2



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TASK 2 : **Measurement of the input and output voltages**

1 Open the rear panel cover of the UPS under supervision of the instructor.

2 Switch ON the input and output switch

3 Switch ON the inverter of the UPS

4 Measure the AC input voltage and AC output voltage.

5 Measure the battery voltage and record the values in the table-3.

6 Get the work checked by the instructor.

Table - 3

Sl.No	Various test point	Voltage levels

— — — — — —

TASK 3 : **Performing load test using lamp loads**

1 Connect the lamp load to the UPS output terminals as shown in Fig.3

2 Switch ON the input & output switch and start the inverter.

3 Check and observe the condition of the lamp load.

Incandescent groups deliver core heat radiation hence keep the lamp on a separate metal table with proper ventilation.

4 Switch OFF the input mains supply now the UPS load is under battery voltage.

5 Observe the performance of the load and battery voltage

6 Get the work checked by the instructor.

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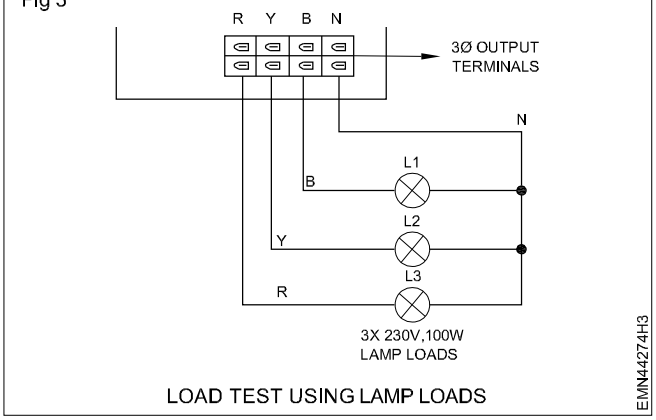
Fig 3



Install a solar panel to a roof

Objectives : At the end of this exercise you shall be able to
- **select the suitable location on the roof to install solar PV panel**
- **prepare frame setup to mount the SPV panel**
- **select the correct position/angle and install the solar panel on a roof.**

Requirements	
Tools/ Equipments/ Instruments • Power drilling/hammering machine with suitable drill bits - 1 set. • Trainees tool kit - 1 set. • Solar panel - 1 No. • Safety helmet - 1 No. • Safety harness - 1 No. • Safety gloves - 1 No.	**Material/ Components** • Base pipe - as required • Contact pipe - as required • Supporting pipe - as required • Rail splice - as required • Rail - as required • Rail contract AC - as required • End clamp - as required • Mid clamp - as required • M8 x 25 mm screws - as required • Bolt x Nuts - as required

PROCEDURE

Safety precaution:

	All instructions should be read and understood before attempting to install, wire, operate and/or maintain the PV module and the other electrical equipments. PV Module interconnects pass direct current (DC) when exposed to sunlight or other light sources. Contact with electrically active parts of the module, such as terminals, can result in injury or death, whether the module andthe other electrical equipments are connected or disconnected.
	Wear suitable protection (non-slip gloves, clothes, etc.) to prevent direct contact with 30V DC or greater, and to protect your hands from sharp edges during the installation.
	Remove all metallic jewellery prior to installation to reduce the chance of accidental exposure to live circuits. Use electrical insulated tools to reduce the risk of electric shock. Cover the front of the modules in the PV array with an opaque material to halt production of electricity when installing or working with a module or wiring.

TASK 1 : **Selection of location on the roof to install solar PV panel**

1 Select the roof without shading for the solar panel installation.

2 Leave a safe working area between the edge of the roof and the external edge of the solar array for installation.

3 Make sure the direction of installation of the solar panels takes sun into consideration.

4 Pick an area of your roof to install the solar panels that gets the sun light rays as long as possible each day.

5 The solar panels can either be mounted flush on the roof or stand, or mounted at an angle to maximize the position of accessibility to the sun's direct rays.

6 Get the work checked by the Instructor.

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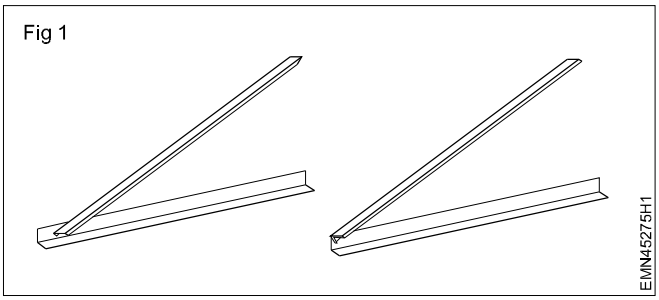
TASK 2 : **Preparation of frame setup to mount the SPV panel**

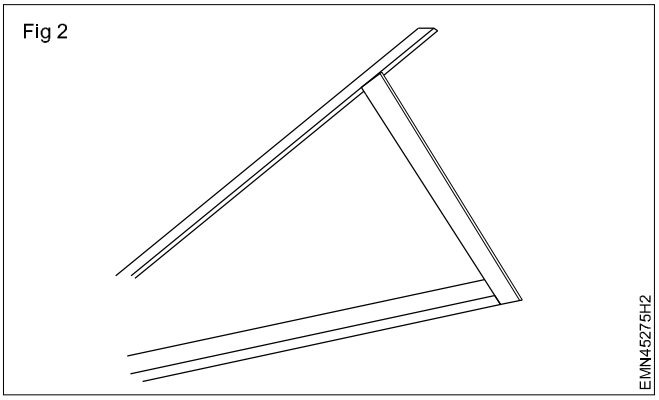
1 Contact pipe with M8 x 25 contact base pipe as shown in Fig 1.

Fig 1



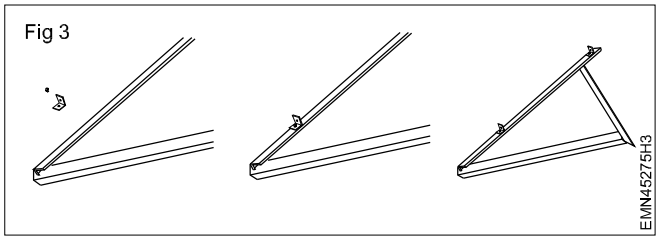
2 Use M8 x 25 contact support pipe as shown in Fig 2.

Fig 2



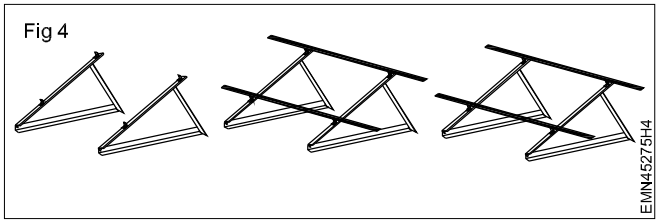
3 Rail AC with M8 x 25 fixed on contact pipe as shown in Fig 3.

Fig 3



4 Take 2 fixed tile rack and position them with rail as shown in Fig 4.

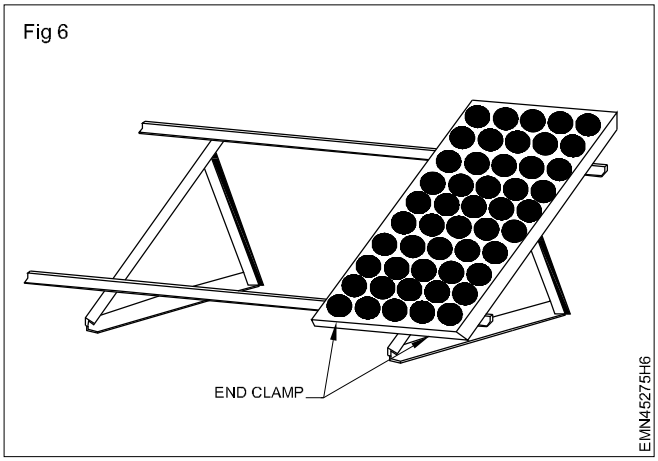
Fig 4



5 Slide the splice on the rear side of the pre-assembled rails. Fasten the first bolt. Then slide the next rail into the splice as shown in Fig 5.

6 Put one panel on the rack, use 2 end clamps to hold and fix by following the picture as shown in Fig 6 (Attention: End of Rail distance must < 25 mm to 30 mm).

Fig 6



7 Install the method for mid clamp and end clamp as shown in Fig 7.

8 Follow and use mid clamp fixed between panels as shown in picture of Fig 8.

Fig 5

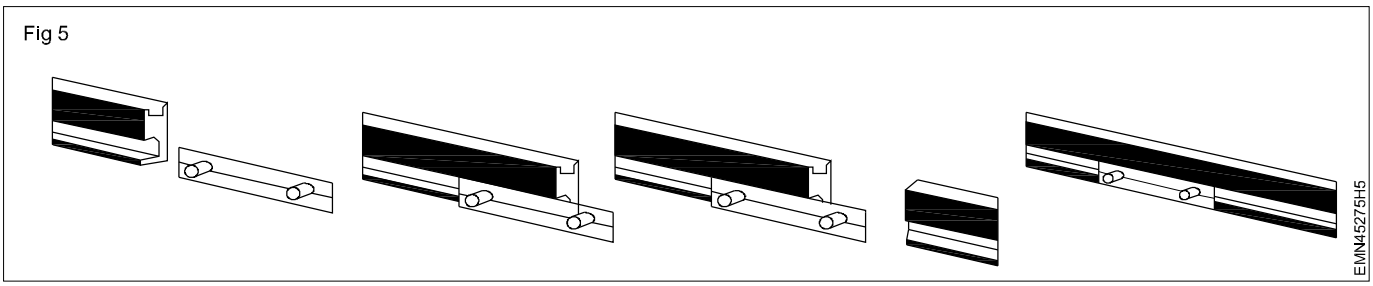


Fig 7

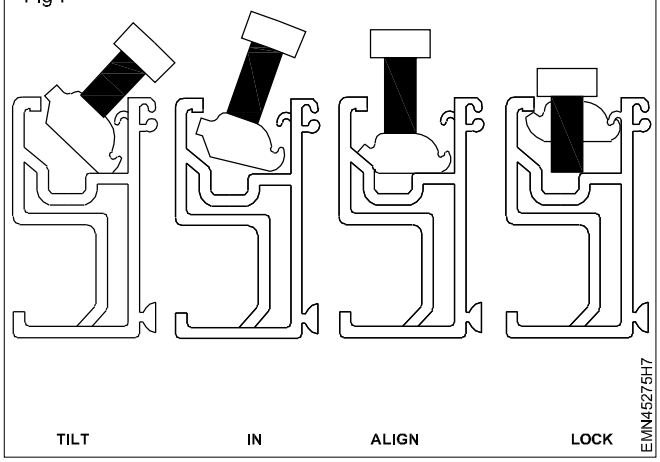
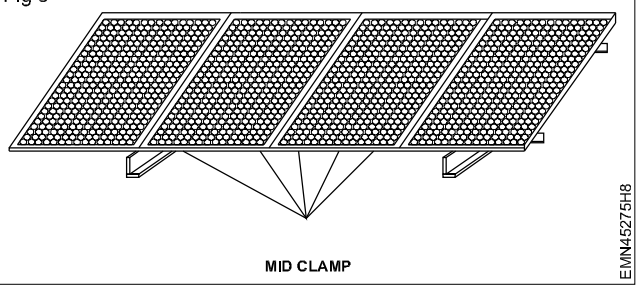


Fig 8



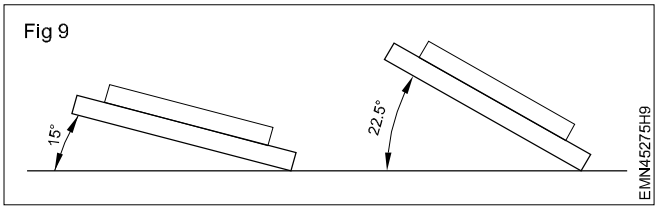
9 Get the work checked by the instructor.

TASK 3 : **Selection of correct position of solar panel and installation**

1 Select the best/perfect angle for solar panels with the help of manual to produce the maximum power.

2 Refer to the perfect angle for standard roof pitch angle as shown in Fig 9.

Fig 9



3 Mark the holes as shown in Fig 10 after selecting the place and angle of inclination.

Fig 10

4 Drill the hole on the roof with the help of drilling machine as shown in Fig 11.

5 Fix the frame with the help of screw as shown in Fig 12.

6 Place the panel on frame as shown in Fig 13.

Fig 11

Fig 12

Fig 13

7 Get the work checked by the instructor.

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Wire a solar controller to a battery storage station

Objective : At the end of this exercise you shall be able to
- **prepare wires for connection**
- **wire the terminals of charge controller & batteries properly.**

Requirements	
Tools/ Equipments/ Instruments	**Material/ Components**
• Trainees tool kit - 1 set. • Solar panel 12V - 3 Nos. • Solar charge controller - 1 No. (with operating instruction leaflet)	• Connecting wires with lug - as required • Battery 12V /10AH(minimum) - 3 Nos.

PROCEDURE

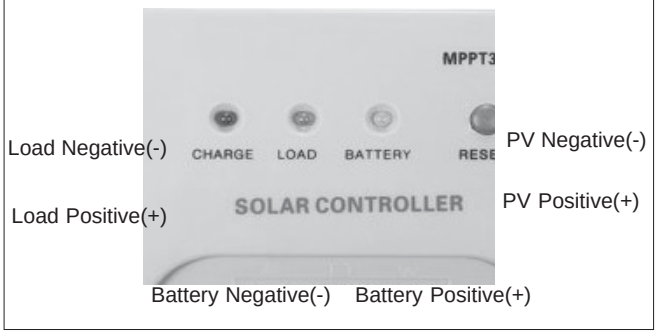
TASK 1 : **Wiring of charge controller to battery station**

1 Pick the solar charge controller available in the lab.

2 Select Lead-Acid or Gel-cell battery as per requirement.

3 Connection details of the controller as shown in Fig 1.(Refer to the instructions provided by the manufacturer)

Fig 1



4 Connect the terminal marked battery negative (-) on the solar charge controller to the negative (-) of battery terminal and tighten the screw.

5 Install a DC Breaker or a DC fuse holder in the positive wire as shown in Fig 2.

6 Use two battery cables. Remove insulation sleeve 12 mm and insert conductor into cable lug terminal as shown in Fig 3.

7 Connect the terminal marked battery positive (+) on the solar charge controller to the positive (+) battery terminal and tighten the screw.

8 If more voltage is required, connect the batteries, in series as shown in Fig 4.

Fig 2

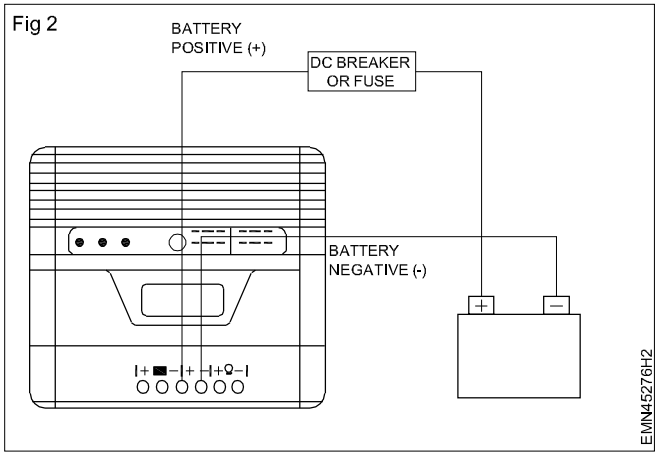


Fig 3

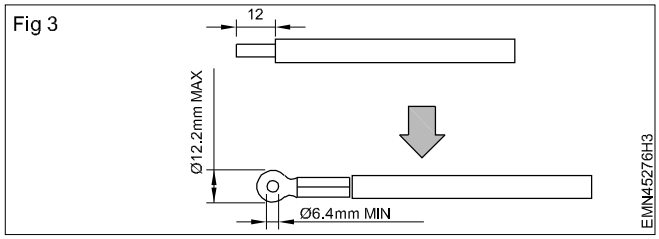
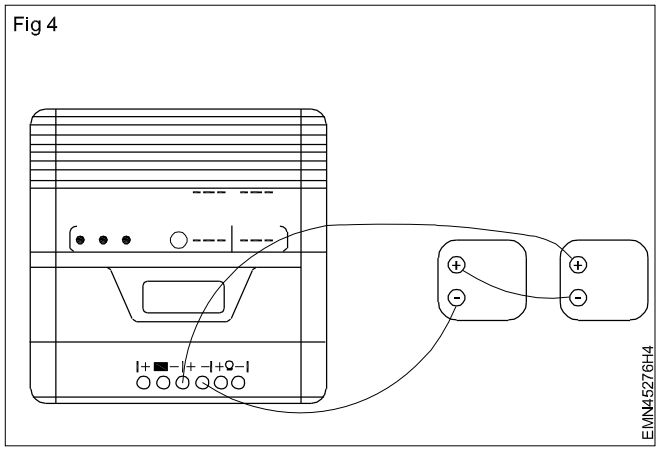
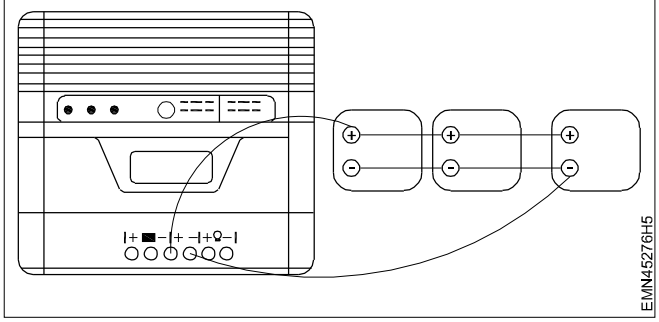


Fig 4



9 If more current is required, connect batteries in parallel as shown in Fig 5.

Fig 5



10 Get the work checked by the instructor.

Install a solar power 500 Wp panel to directly 12V DC applications

Objectives: At the end of the exercise you shall be able to
- **install a solar power panel 500 Wp for 12V DC application.**
- **construct an application circuit for 12V DC application.**

Requirements	
Tools/ Equipments/ Instruments • Digital multimeter with probes - 1 No • Trainees tool kit - 1 Set. • Solar application trainer kit with PV panel 500Wp - 1 No.	**Material/ Components** • Connecting wires and patch cords - as reqd. • LED lamps -3W - 2 Nos. • CFL lamps -15W - 2 Nos. Insulation tape - as reqd.

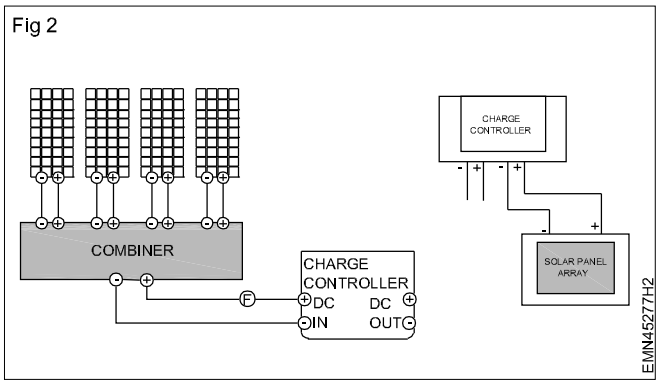
PROCEDURE

1 Follow connection details of the controller as shown in fig.1.

Fig1

2 Connect the PV array's positive (+) output to the terminal marked PV positive (+) on the solar charge controller and tighten the screw as shown in Fig.2

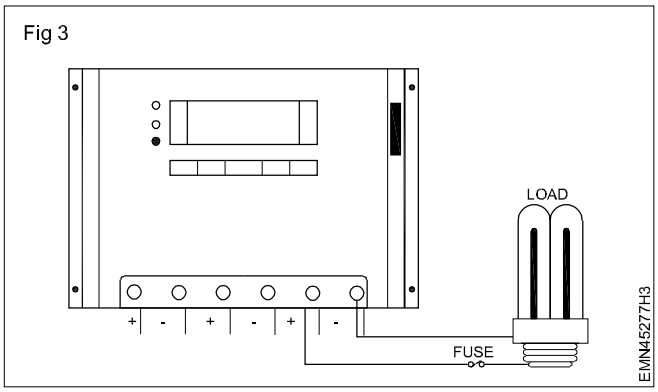
Fig 2



3 Connect the PV array's negative (-) output to the terminal marked PV negative (-) on the solar charge controller and tighten the screw.

4 Similarly connect the DC output load terminals positive (+) to positive (+) terminal of DC load LED/CFL bulbs and negative (-) terminal to negative terminal (-) of DC load LED/CFL bulbs to as per instruction manual of the solar application trainer kit as shown in Fig.3

Fig 3



5 Record the results in the observation table 1.

Table 1

Sl.No.	Solar PV panel Output (Volts)	Load output (Lamp status - ON/OFF)	Remarks
1			
2			
3			
4			

6 Get the work checked by the instructor.

Connect storage batteries to a power inverter

Objectives: At the end of the exercise you shall be able to
- **install the storage battery and charge controller to inverter.**

Requirements	
Tools/Equipments/ Instruments • Trainees tool kit - 1 set. • Solar charge controller - 1 No. • Solar inverter with user manual - 1 No.	**Materials/ Components** • Battery 6V/10A - 1 No. • Fuse 1A - 1 No. • Circuit breaker - 1 No. • Connecting wires with lugs - as required

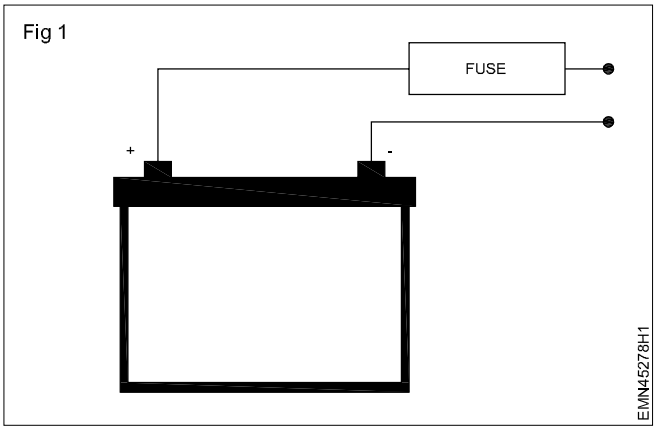
PROCEDURE

TASK 1 : **Connection of storage battery and charge controller to inverter**

Note: Before connecting to PV modules, install separately a DC circuit breaker between inverter and PV modules.

1 Connect the battery +ve terminal to fuse holder as shown in Fig 1.

Fig 1



2 Connect the fuse holder to DC circuit breaker one end as shown in Fig 2.

3 Remove wiring cover in the inverter ,you will see as shown in Fig 3.

Attention

- The wire connection can only be done after the inverter is fixed in proper position on the wall.
- Make sure the max. open circuit voltage and short circuit current of solar arrays are not exceeded the stipulated range of the inverter.

Fig 2

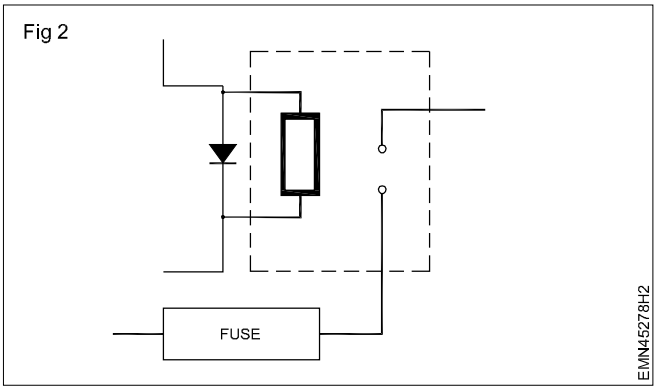
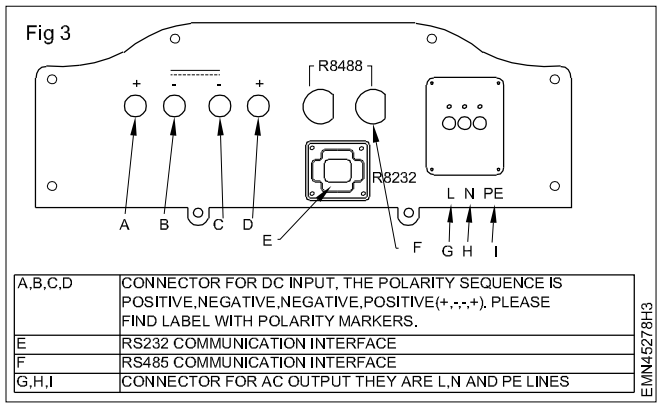


Fig 3



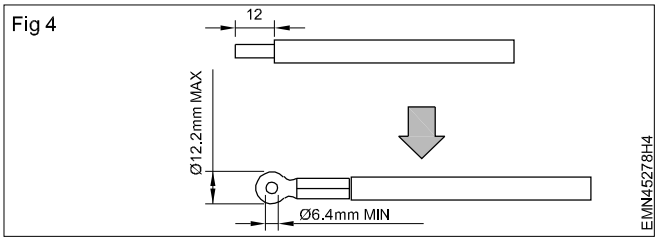
A,B,C,D	CONNECTOR FOR DC INPUT, THE POLARITY SEQUENCE IS POSITIVE,NEGATIVE,NEGATIVE,POSITIVE(+,-,-,+). PLEASE FIND LABEL WITH POLARITY MARKERS.
E	RS232 COMMUNICATION INTERFACE
F	RS485 COMMUNICATION INTERFACE
G,H,I	CONNECTOR FOR AC OUTPUT THEY ARE L,N AND PE LINES

- Choose proper cable for power input and output lines.
- While connecting the inverter, make sure no connection among AC, DC and any power resources are disconnected.
- Identify the polarity of wires and connection ports first, then connect the inverter with solar arrays in proper polarity.

4 Check the nominal voltage of batteries.

5 Use two battery cables. Remove insulation sleeve 12 mm and insert conductor into cable lug terminals, as shown in Fig 4 and fix it on both cables.

Fig 4



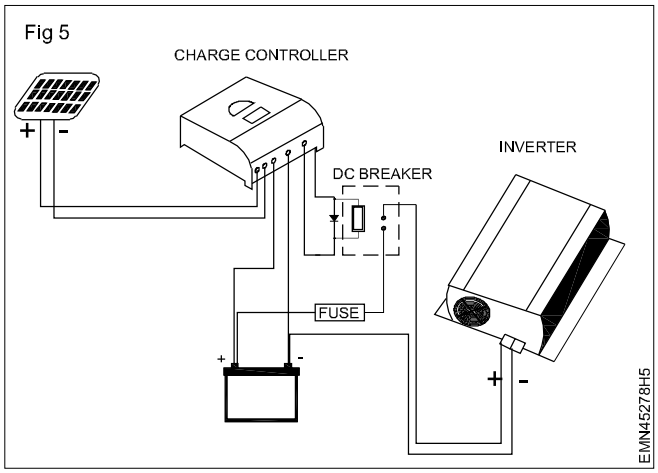
6 Connect the terminal marked battery negative (-) on the Solar inverter to the negative (-) battery terminal and tighten the screw.

7 Connect the DC breaker one end to solar inverter (+) terminal and tighten the screw as shown in Fig 5.

8 Make sure the wires are securely connected.

9 Get the work checked by the instructor.

Fig 5



Connect and test solar panel and run the load

Objectives: At the end of the exercise you shall be able to
- **install the storage battery and charge controller to inverter.**

Requirements	
Tools/ Equipments/ Instruments	**Materials/ Components**
• Trainees tool kit - 1 set. • Solar charge controller - 1 No. • Solar inverter with user manual - 1 No. • DC load - 1 No. • Solar panel - 1 Set. • Digital multimeter with probes - 1 No. • AC load - 1 No.	• Battery 6V/10A - 1 No. • Fuse 1A - 1 No. • Circuit breaker - 1 No. • Connecting wires with lugs - as required • Solar panel 12V with manual - 1 No.

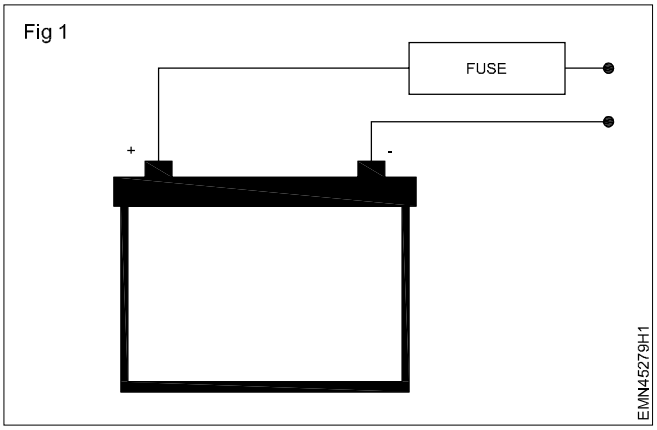
PROCEDURE

TASK 1 : **Connect solar panel to the inverter**

1 Before connecting to PV modules, please install separately a DC circuit breaker between inverter and PV modules.

2 Connect the battery +ve terminal to fuse holder as shown in Fig 1.

Fig 1



3 Connect the fuse holder to DC circuit breaker one end as shown in Fig 2.

4 Remove wiring cover in the inverter ,you will see as shown in Fig 3.

Attention

- The wire connection can only be done after the inverter is fixed in proper position on the wall.
- Make sure the max. open circuit voltage and short circuit current of solar arrays are not exceeded the stipulated range of the inverter.

Fig 2

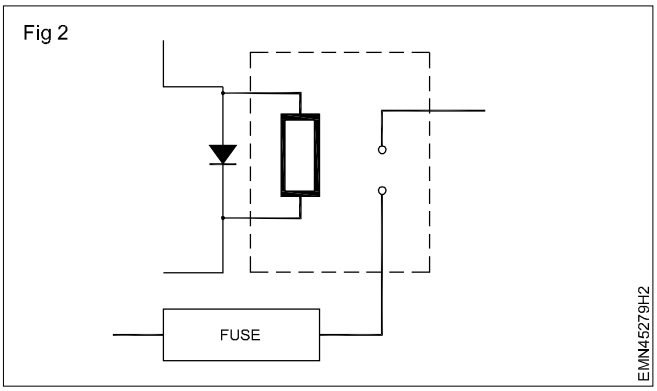
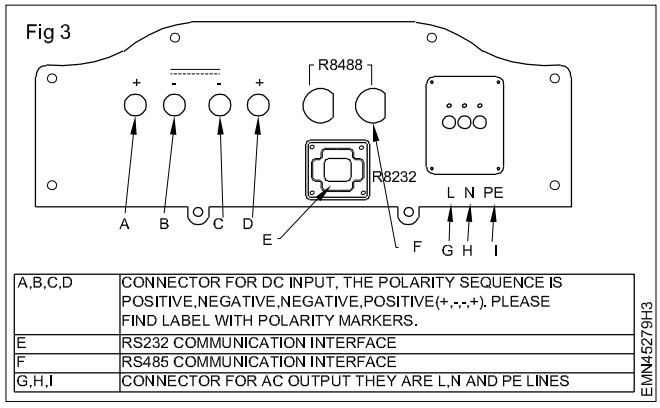


Fig 3



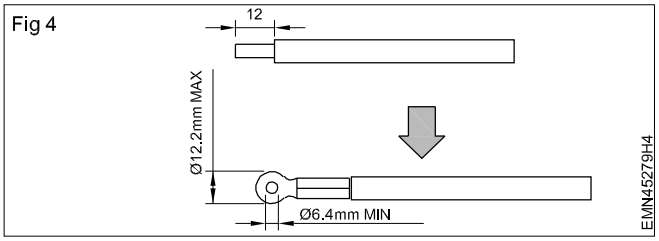
A,B,C,D	CONNECTOR FOR DC INPUT, THE POLARITY SEQUENCE IS POSITIVE,NEGATIVE,NEGATIVE,POSITIVE(+,-,-,+). PLEASE FIND LABEL WITH POLARITY MARKERS.
E	RS232 COMMUNICATION INTERFACE
F	RS485 COMMUNICATION INTERFACE
G,H,I	CONNECTOR FOR AC OUTPUT THEY ARE L,N AND PE LINES

- Choose proper cable for power input and output lines.
- While connecting the inverter, make sure no connection among AC, DC and any power resources are disconnected.
- Identify the polarity of wires and connection ports first, then connect the inverter with solar arrays in proper polarity.

5 Check the nominal voltage of batteries.

6 Use two battery cables. Remove insulation sleeve 12 mm and insert conductor into cable lug terminals, as shown in Fig 4 and fix it on both cables.

Fig 4



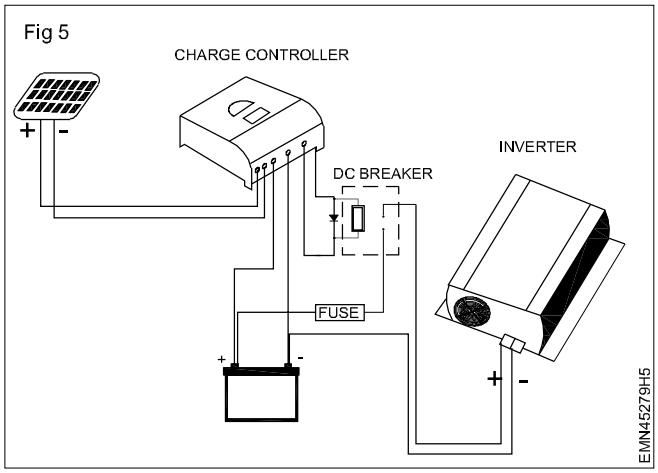
7 Connect the terminal marked battery negative (-) on the Solar inverter to the negative (-) battery terminal and tighten the screw.

8 Connect the DC breaker one end to solar inverter (+) terminal and tighten the screw as shown in Fig 5.

9 Make sure the wires are securely connected.

10 Get the work checked by the instructor.

Fig 5



TASK 2 : **Test the solar panel**

Caution

Observe polarities when connecting solar panels and batteries.

Photovoltaic panels produce electricity when exposed to light, so it is recommended to cover the front of the solar panel at outdoors to help avoid shocks. This is particularly important for higher voltage panels.

A) Open circuit test

1 Disconnect the solar panel completely from the battery and regulator.

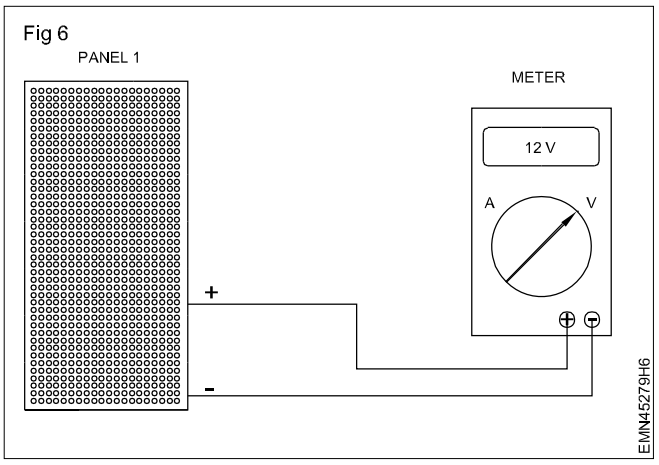
2 Change position of the solar panel towards the sun or any light source.

3 Set the DMM to measure DC voltage at 20V range.

4 Connect the multimeter probes to the SPV panel by observing the correct polarity as shown in Fig 6.

5 Measure the open circuit SPV voltage.

Fig 6



B) Short circuit test

1 Disconnect the solar panel completely from the battery and regulator.

2 Change position of the solar panel towards the sun or light source.

3 Ensure that the multimeter is set at 10A, at least to start with. If needed change the setting later.

4 Measure the current by connecting +ve lead on the multimeter to the +ve on the panel and the -ve from the multimeter to the -ve on the panel and record the readings in TABLE 1.

5 Calculate the maximum wattage that can be dissipated by the SPV panel using the formula.

P = V x I watts

6 Get the work checked by the instructor.

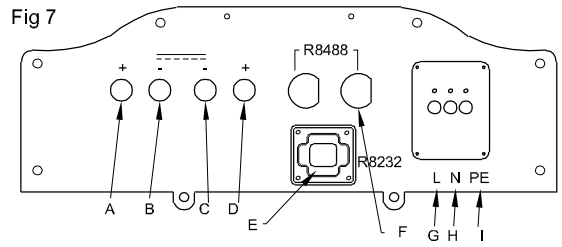
TABLE 1

Solar panel voltage and current	
Voltage	: _____ (V)
Current	: _____ (A)
Power	: _____ (W)

TASK 3 : **Run the AC load**

1 Remove wiring cover in the inverter as shown in Fig 1.

Fig 7



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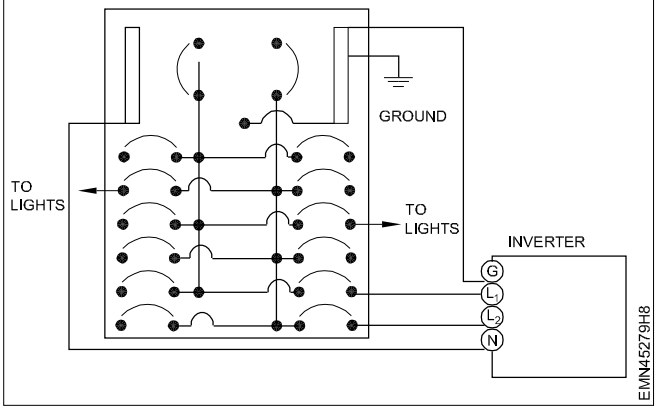
E	RS232 COMMUNICATION INTERFACE
F	RS485 COMMUNICATION INTERFACE
G,H,I	CONNECTOR FOR AC OUTPUT THEY ARE L,N AND PE LINES

EMN45279H7

2 Connect the AC output socket to circuit breaker as shown in Fig 2.

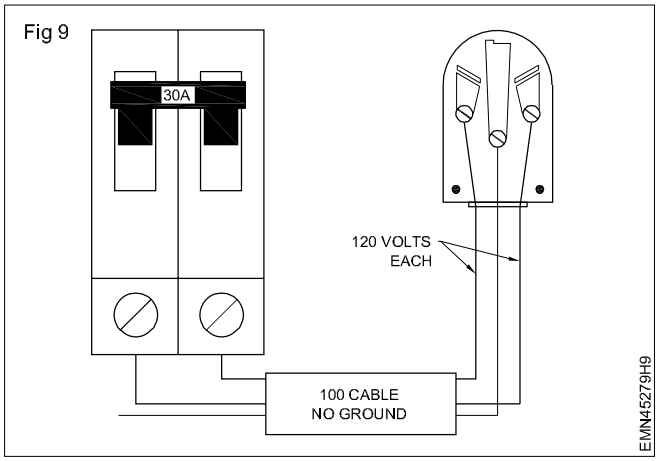
Fig 8



EMN45279H8

3 Connect the circuit breaker to the load as shown in Fig 3.

Fig 9



EMN45279H9

4 Get the work checked by the instructor.

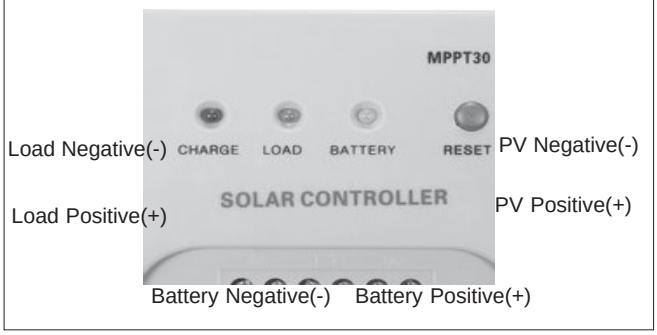
— — — — — — —

TASK 4 : **Run the DC load**

1 Carryout the steps 1 to 5 from exercise 4.4.18

2 Follow the connection details of the controller as shown in Fig 4.

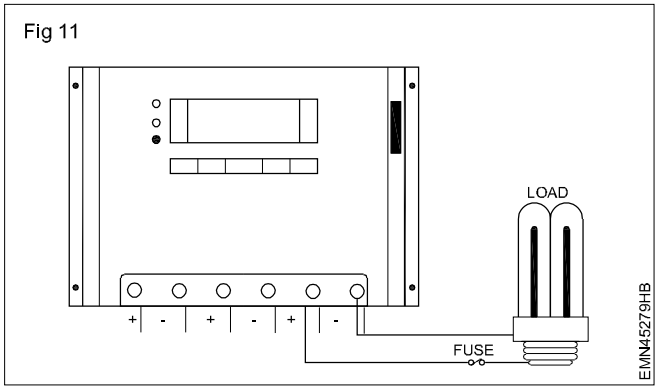
Fig 4



3 Connect the terminal marked load negative (-) on the solar charge controller to the negative (-) load terminal and tighten the screw.

4 Connect the terminal marked load positive (+) on the solar charge controller to the positive (+) battery terminal and tighten the screw as shown in Fig 5.

Fig 11



EMN45279HB

5 Switch ON the charge controller and observe the bulb. The bulb should be illuminated.

6 Get the work checked by the instructor.

— — — — — — —

Install a solar panel to charge a rechargeable 12V DC battery and find out the charging time

Objectives: At the end of the exercise you shall be able to
- **install a solar power panel for 12V DC application**
- **assemble an application circuit for 12V DC application.**

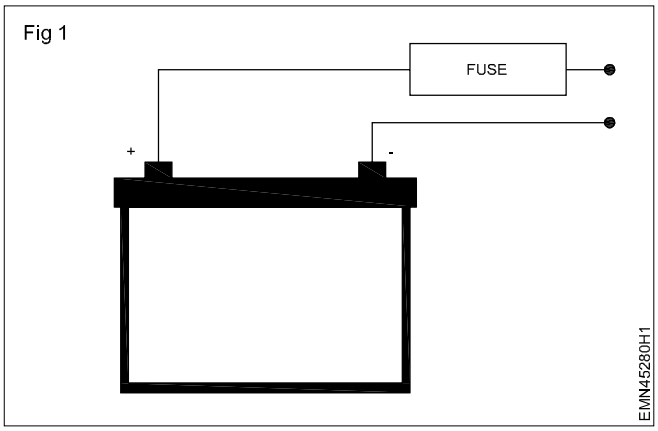
Requirements	
Tools / Equipments/ Instruments • Trainees tool kit - 2 Nos • Digital multimeter with probes - 1 No. • Solar charge controller trainer with manual - 1 No. • Solar battery 12V DC/ 100 AH - 1 No.	**Materials/ Components** • Wires with lugs and patch cords - 1 Set. • Insulation tape - 1 No.

PROCEDURE

Note: Before connecting to PV modules, please install separately a DC circuit breaker between inverter and PV modules.

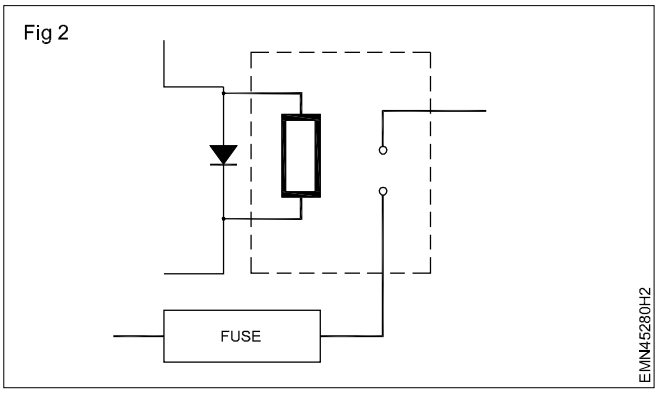
1 Connect the battery +ve terminal to fuse holder as shown in fig.1

Fig 1



2 Connect the fuse holder to DC circuit breaker as shown in Fig.2

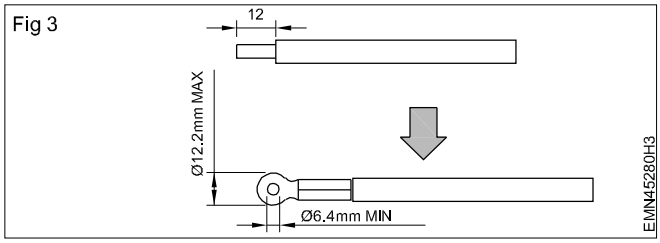
Fig 2



3 Check the nominal voltage of batteries.

4 Use two battery cables. Remove insulation sleeve 12mm and insert conductor into cable lug terminals, as shown in Fig 3 and fix it on both cables.

Fig 3

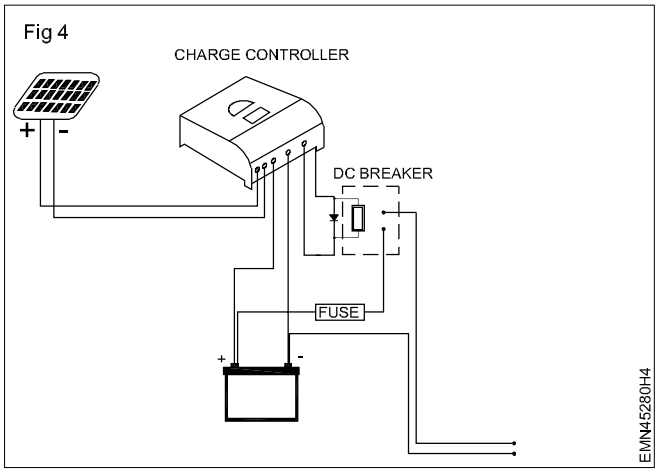


5 Connect the terminal marked battery negative (-) on the solar inverter to the negative (-) battery terminal and tighten the screw.

6 Connect the DC breaker one end to solar inverter (+) terminal and tighten the screw as shown in Fig.4

7 Make sure the wires are securely connected.

Fig 4



8 Get the work checked by the instructor.

Install a solar inverter

Objectives : At the end of this exercise you shall be able to
- **install the solar inverter**
- **connect the solar inverter to grid(AC)**
- **commission the solar inverter.**

Requirements

Tools/ Equipments/ Instruments

- Trainees tool kit - 1 set.
- Electric drilling machine with drill bit - 1 set.
- Solar inverter with user manual - 1 No.
- Digital multimeter with probes - 1 No.

Materials/ Components

- Ruler or measuring tape - 1 No.
- Pencil - 1 No.
- Connecting wires - as required
- User manual of given solar inverter - 1 set.

PROCEDURE

TASK 1 : **Install the solar inverter**

Planning the installation: (Fig 1)

1 Choose your installation location carefully.

2 Check that the wall is capable of bearing the heavy load of the device and vibration-free to avoid disruptive vibrations.

3 Lift and move the solar inverter with the help of atleast two to three people.

4 Select correct size of dowels and screws that are suitable for the wall material and the heavy weight.

Do not mount the inverter on flammable construction materials.

Always use the mounting plate supplied with the solar inverter.

This inverter can make noises during operation which may be perceived as a nuisance in a living area.

5 Measure the dimension of the solar inverter and mark the hole in wall.

6 Drill four holes in the marked location with four screws as shown in Fig 2.

7 Place the unit on the surface and align the mounting holes with the four screws as shown in Fig 3 and mount the solar inverter.

8 Check if the solar inverter is firmly secured as shown in Fig 4.

Fig 1

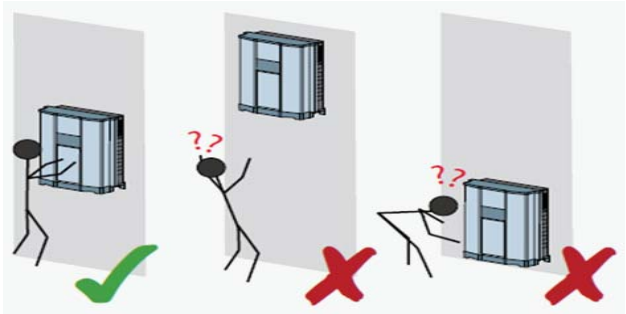
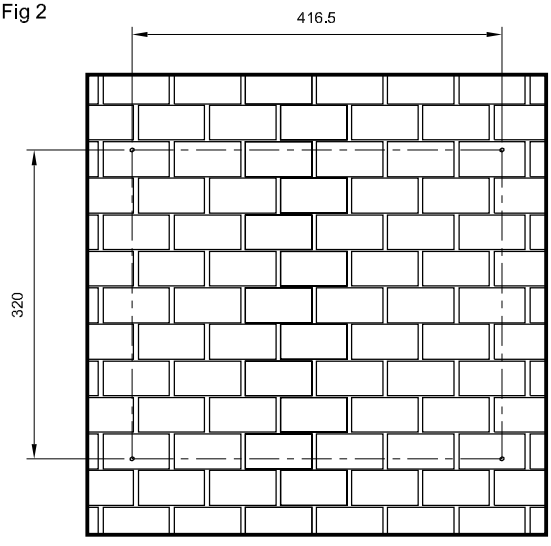


Fig 2



9 Get the work checked by the instructor.

Fig 3

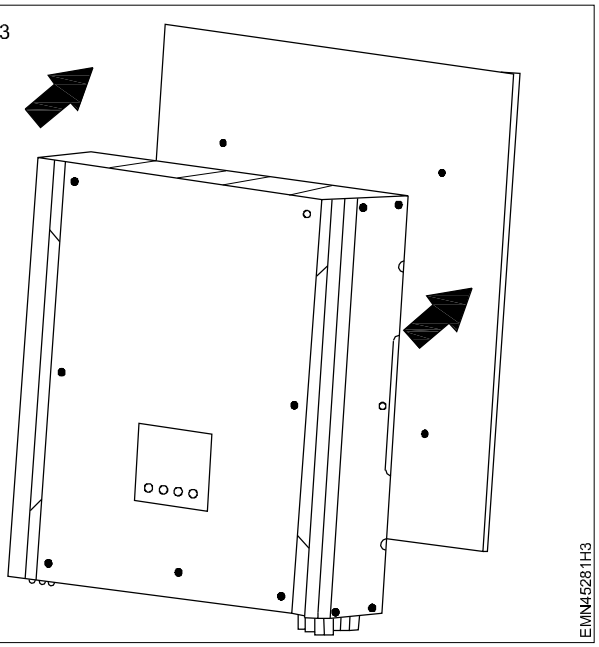
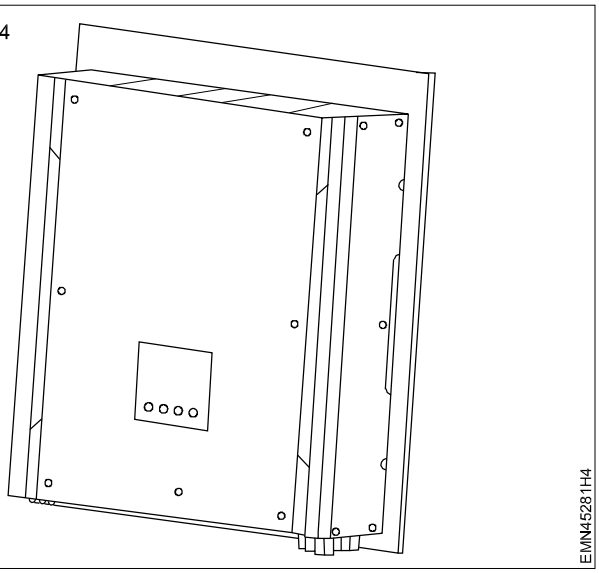


Fig 4



TASK 2 : **Connecting the solar inverter to the grid (AC)**

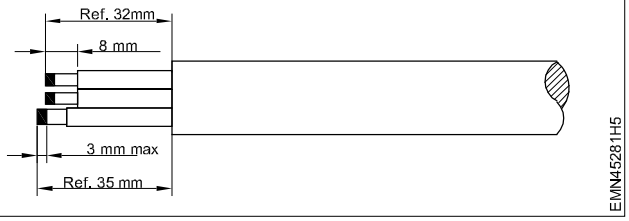
1 Read label and note down rated voltage and current of the given solar inverter.

2 Check the grid voltage and frequency with DMM it should be the same to "VAC" value on the product label.

3 Turn off the circuit breaker.

4 Remove the insulation sleeve 8 mm for three conductors, and shorten the phase L and neutral conductor N 3 mm as shown in Fig 5.

Fig 5



5 Connect wires according to polarities indicated on terminal block, be sure to connect PE protective earth conductor ⏚ first.

L - LINE (brown or black) next

⏚ - ground (yellow - green) and

N - Neutral (blue)

6 Make sure the wires are securely connected. the reference tightening torque is 0.82N.M

Its only allowed to connect load to "AC output connector". Do NOT connect the utility to "AC output connector".

Be sure to connect L terminal of load to L terminal of "AC output connector" and N terminal of load to N terminal of "AC output connector". The G terminal of "AC output connector" is connected to grounding of the load. Do NOT interchange the wires.

This inverter is not allowed to operate in parallel. Please do NOT parallel connect more than one unit in AC output connector. Otherwise, it will damage this inverter.

7 Get the work checked by the instructor.

TASK 3 : **Commissioning of solar inverter**

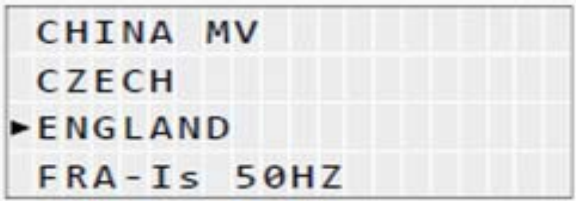
1 Connect power either by AC (the grid) or DC (the solar modules) to the inverter for commissioning.

2 Select after powering up the inverter for the first time, the language dialog as shown in Fig 6.

Fig 6

3 Use the buttons ▼ and ▲ to select language English. To confirm your selection, press the button ENT.

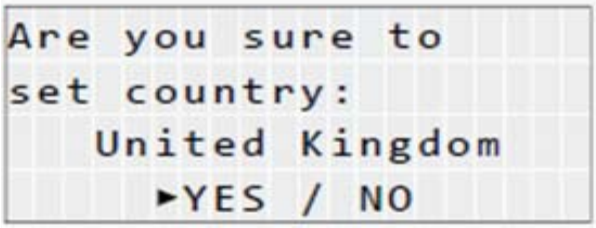
Fig 7



4 Use the buttons ▼ and ▲ to select the entry YES. To confirm your selection, press the button ENT. If you want to change your selection, press the button ESC.

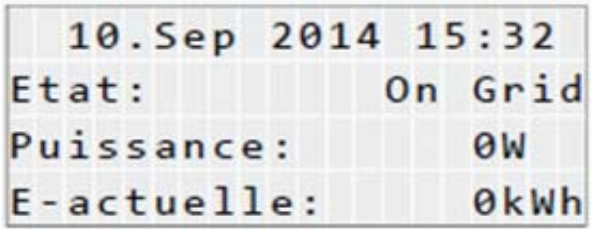
The inverter starts a self-test which takes approximately 2 minutes. A countdown shows the remaining time on the display. (Fig 8)

Fig 8



5 The basic setup is finished. The standard menu is shown in Fig 9.

Fig 9



6 Get the work checked by the instructor.

Dismantle, Identify the parts and assemble different types of smart phones

Objectives : At the end of this exercise you shall be able to
- **dismantle the given cell phone/smart phone**
- **identify the different sections/parts of the cell phone/smart phone**
- **list the different sections/parts of the cell phone/smart phone**
- **reassemble the given cell phone/smart phone.**

Requirements	
Tools/Equipments/Instruments • Cell phone/ Smart phone - 1 No. • Precision screw driver set - 1 set. • Trainees tool kit - 1 set. • Digital multimeter with probes - 1 No. • User manual - as reqd.	**Materials/ Components** Nil

PROCEDURE

TASK 1 : **Dismantling the cell phone / smart phone**

1 Switch OFF the cell phone/smart phone and locate small hole next to headphone jack. Push the tip of a needle or paperclip into hole to eject sim tray. (Fig 1)

Fig 1

2 Hold your device on end to locate two small screws on either side of the back cover. Remove the screws using a small star screwdriver. (Fig 2)

3 Insert a spudger between the chrome ring and front panel glass directly above one of the screw holes. Try gently to separate the display from the back panel. (Fig 3)

4 Lift the panel up from the back cover end be careful not to tear or break any ribbons connected near the other end.(Fig 4)

5 Continue to hold the display panel with one hand, and use your other hand and a spudger to disconnect the black ribbon cable labeled "1".(Fig 5)

Fig 2

Fig 3

6 Rotate the display assembly up until it is roughly vertical. This will allow easier access for removing the remaining cables. (Fig 6)

Fig 4

Fig 5

Fig 6

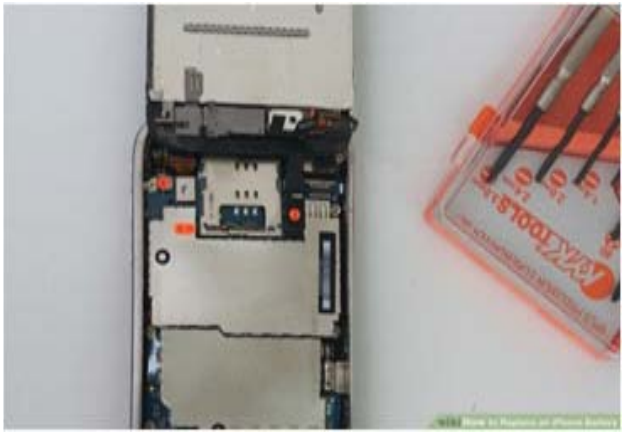


Fig 7

Fig 8

Fig 9

7 Use a spudger to disconnect the black ribbon cable labeled "2." (Fig 7)

8 Use a spudger to flip up the white plastic tab holding the remaining ribbon cable in place. The white tab will rotate up 90 degrees, releasing the ribbon cable. (Fig 8)

9 Slide the black ribbon cable out of its connector, and remove the display assembly from the cell phone. (Fig 9)

10 **Remove the screws surrounding the motherboard:**

Remove the screws 2-3 mm star screws with partial threads securing the logic board to the rear panel. (Fig 10)

11 Remove the screws using 2-3 mm star screws with full threads securing the logic board and camera. (Fig 11)

12 Remove the screws using 2-3 mm star screw from beneath the "Do not remove" sticker. (Fig 12)

Fig 10

Fig 11

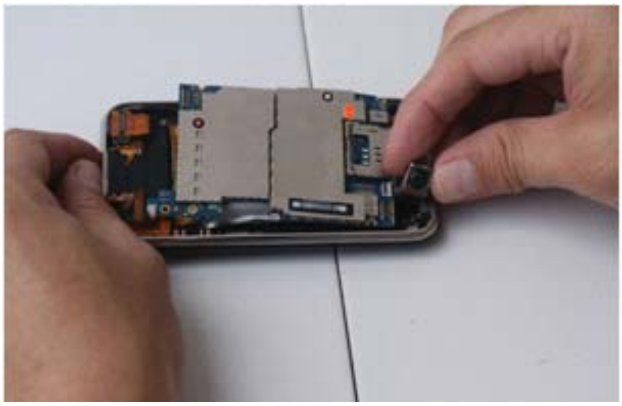


Fig 12

Fig 13

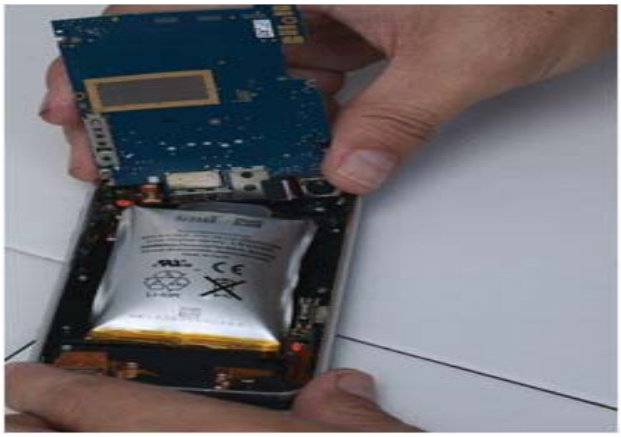


Fig 14

Fig 15

Fig 16

13 Unplug ribbon,whcih is connected to display and other parts.(Fig 13)

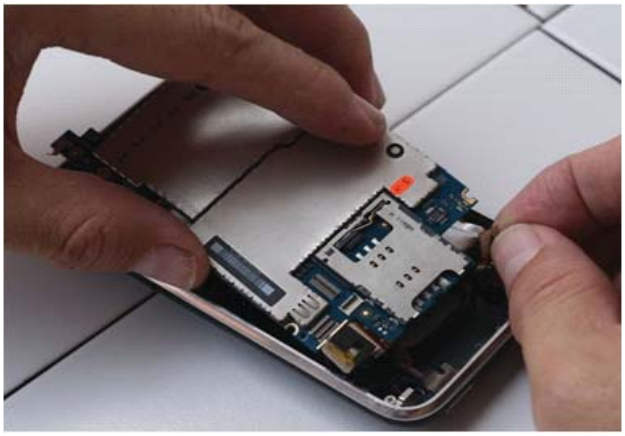
14 Unplug this connecting ribbon and place the mother board aside. (Fig 14)

15 Use a spudger to gently pull the camera up and out of its housing in the rear panel. The camera cannot be removed entirely yet because its connected to the bottom of the logic board. (Fig 15)

16 Use a spudger to gently try up the end of the logic board closest to the dock connector. If the board won't lift up, double check to make sure all the screws securing the logic board have been removed.(Fig 16)

17 Slide the logic board towards the back side connector and out of the cell phone.(Fig 17)

Fig 17



18 Use a little force, pull up and remove the attached tab on the battery. (Fig 18)

Fig 18

19 Replace battery and repeat steps in reverse to reassemble! (Fig 19)

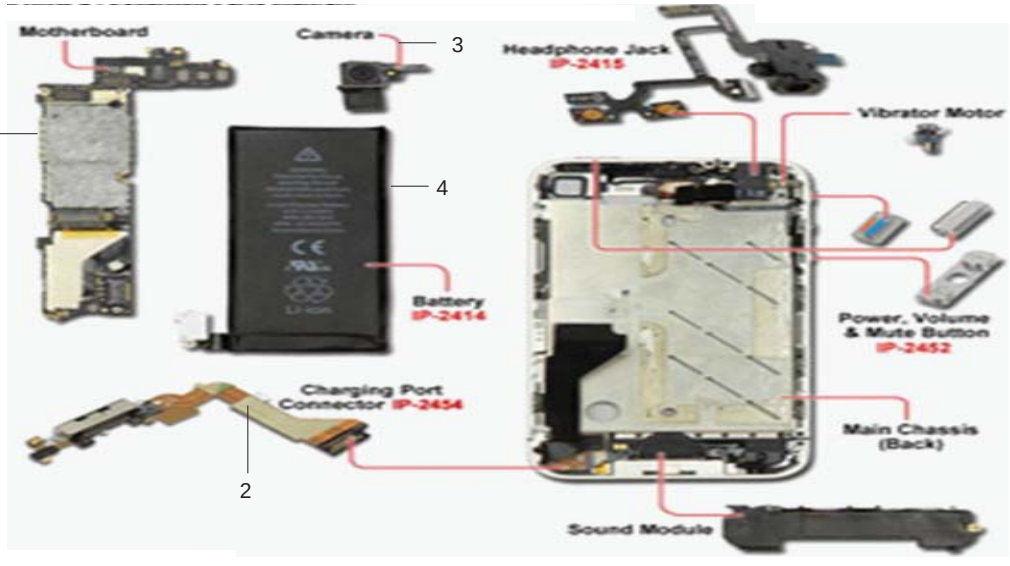
Fig 19

20 Dismantling of the cell phone has been completed.

21 Get the work checked by the Instructor.

TASK 2 : **Assembling the cell phone / smart phone**

Fig 20



1 Identify the parts of a cell phone given in Fig 20 and record names of each part in the TABLE 1.

2 Follow the step by step procedure done in TASK 1 in the reverse order to re-assemble the cell phone/smart phone.

3 Observe correct position and insert the ribbon cable/ connector,etc. carefully. [They are very delicate and will get damaged easily.]

4 Ensure that the assembling is done correctly and all the boards are fixed in their respective positions.

5 Switch on the cell phone and check the working condition.

TABLE 1

Sl. No.	Type of phone / smartphone	Section/Part

6 Get the work checked by the Instructor.

— — — — — — —

Dismantle the cell phone / smart phone remove the keypad and clean it , test the continuity of the matrix/tracks

Objectives : At the end of this exercise you shall be able to
- **remove key pad of the cell phone and clean it**
- **replace the display and keypad of the given cell phone**
- **remove touch screen of the smart phone and clean it.**

Requirements	
Tools/Equipment/Instruments • Cell phone/ Smart phone - 1 No. • Precision screw driver set - 1 set. • Tweezers with antistatic wrist strap and hand gloves • Digital multimeter with probes - 1 No.	**Materials/ Components** • Cotton cloth - as required • CTC/IPA Solution - as required • User manual - as required

PROCEDURE

TASK 1 : **Remove the keypad and clean it**

1 Dismantle the cell phone by referring the previous exercise.

2 Make a mixer of half rubbing alcohol and half distilled water.

3 Wipe the phones keypad with a soft cloth and remove dust.

4 Allow the cell phone to dry before reinserting the battery or putting it back in its case.

5 Check the continuity of row and column pins using DMM.

6 Place the key pad in the right position while closing the front cover for the reassembly. Do not assemble the phone of display has to be replaced.

7 Switch ON the phone and check the working condition.

— — — — — —

TASK 2 : **Replace the display**

1 Dismantle the cell phone by referring the previous exercise.

2 Remove the display by removing the small star head screw and lift the LCD display out of the cell phone.

3 Install the new display into your cell phone and follow the procedure in reverse order.

4 Insert the battery and battery cover. Switch ON the phone and check for its working.

— — — — — —

TASK 3 : **Removing and cleaning the touch screen**

1 Turn the device off.

2 Cover the whole screen with some clear packaging tape.

3 Remove the back cover.

Removing the broken glass panel

1 Heat the glue holding the glass in place.

2 Use the painter's tape to take out flecks of glass.

3 Gently lift the edges of the glass off.

4 Work your way downward.

5 Remove the touch buttons carefully.

6 Remove the glass.

7 Take out the metal earpiece from the old glass.

Applying the new glass panel

1 Wipe away the remaining glue on the edges of the front of the phone.

2 Apply double-sided tape to the top and bottom of the front panel.

3 Wipe the display with a lens cleaner.

4 Remove the protective cover from your replacement glass carefully.

5 Put the touch buttons back in place.

6 Connect the metal earpiece to the new glass.

7 Apply the replacement glass onto your phone.

8 Heat the panel again.

9 Get the work checked by the instructor.

— — — — — —

Interface the cell phone/smart phone to PC and transfer the data card.

Objectives : At the end of this exercise you shall be able to
- **transfer data from phone memory to SD card**
- **transfer data from phone to PC.**

Requirements	
Tools/Equipments/Instruments • Cell phone/ Smart phone with SD card - 1 No. • Personal computer - 1 No.	**Materials/ Components** • USB cable - 1 No. • User manual - as required

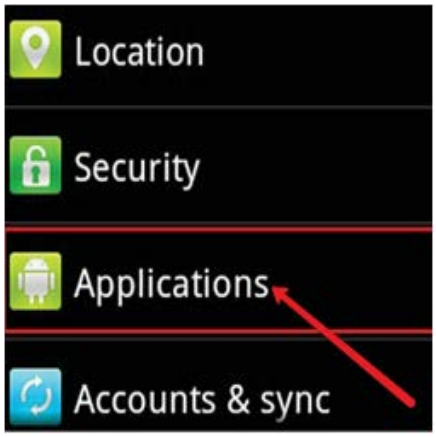
PROCEDURE

TASK 1 : **Transfer app from phone memory to SD card**

1 Select the setting tab on screen. (Fig 1 & 2)

Fig 1

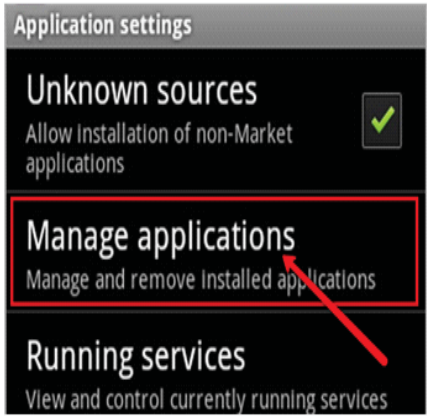
Fig 2



Setting can access from tab scrolling also.

2 Scroll the settings menu and select manage application tab -> Settings. (Fig 3)

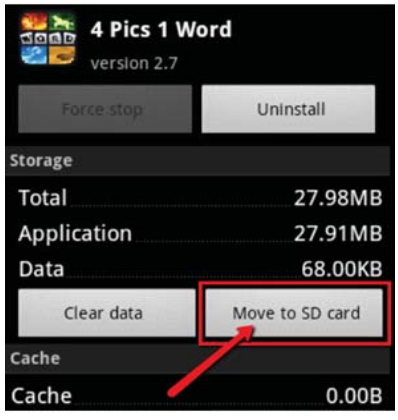
Fig 3



3 Now select app needed to move from phone to SD memory card.

4 Now select move to SD card option tab.(Fig 4)

Fig 4



5 Press tab and select OK button on warning menu.

6 Now observe tab changing move to phone.

Same can repeat for moving, app from memory to phone.

— — — — — — —

TASK 2 : **Moving data (Files and Folder) from phone to SD memory card and vice versa**

1 Go to the home screen.

2 Then select the File manager and then tap on local.

3 Choose the external SD folder.

4 Tap on the folder or file to which you want to move to the SD card.

5 Copy the folder or file to the external SD folder by clicking on paste option.

6 Tap on the STORAGE on setting menu scroll the screen for SD card.

7 Check the file/folder is copied into SD card.

— — — — — — —

TASK 3 : **Transfer data from phone to PC using data card / USB port**

1 Use a data cable to connect your phone to your computer's USB port. (Fig 5)

Fig 5

2 Make sure your memory card is in your phone. (Fig 6)

Fig 6

3 Touch the USB Connected notification on your phone's screen. (Fig 7)

Fig 7

4 Turn on USB storage in some model the screen as shown in Fig 9 will appear and select the option as per require menu in the PC. (Fig 8)

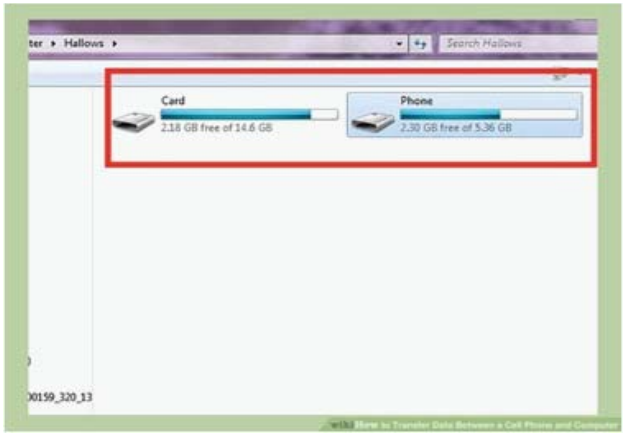
Fig 8

5 Click on My Computer and find removable storage. (Fig 9)

Fig 9

6 Drag and drop the files you want from your phone to your computer. (Fig 10)

Fig 10



7 If the files are transformed go to Notifications and select Turn Off USB Storage.

8 Disconnect the data cable from your phone and your computer.

Flash the various brands of cell phones/smart phones

Objectives : At the end of this exercise you shall be able to
- **identify the flashing tools**
- **perform a flashing process**
- **flash the various brands of cell phones/ smart phones.**

Requirements	
Tools/Equipment/Instruments • Cell phone/ Smart phone with SD card - 1 No. • Data connection to the Cell phone - 1 No.	**Materials/ Components** • User Manual - as required

PROCEDURE

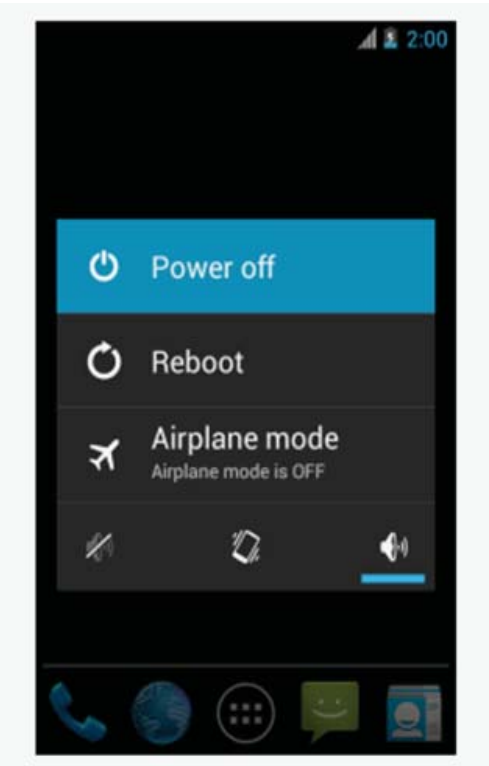
TASK 1 : **Flashing the various brands of cell phone/smart phone**

1 Download and install Android USB driver on your computer.

In case Android USB drivers are already installed on your computer then do the step 2.

2 Power off your Android smartphone and remove the battery. (If it is removable)(Fig 1)

Fig 1



Precaution

1. Brand and model must be same you can verify/ net confirm your smart phone.
2. Never downgrade android version of your smart phone.
3. Before trying anything make a complete backup of your data in a computer.
4. The above tutorial only works with the stock firmware or custom ROM which comes with the scatter file in it.
5. Take a backup of your important data before using the smart phone flash tool because during the flashing process your personal data will be removed permanently.

3 Download the stock ROM or custom ROM software that you want to flash on your Android smartphone and copy it on your computer.

4 Download and copy smart phone flash tool on your computer. (Fig 2)

5 Now open Flash_tool.exe (Fig 3)

6 Click on the Download tab.(Fig 4)

7 In the download tab, now click on the scatter-loading button.(Fig 5)

8 Now, locate the scatter file (you will find the scatter file in the stock rom folder).

9 Now, click on the download button to begin the flashing process.(Fig 6)

10 Now, connect your smartphone to the computer using USB cable (without battery - if it is removable).

TASK 4 : **Connect a smartphone in Wi-Fi / hotspot**

1 Goto setting as shown in Fig 5.

Fig 5

2 Click personel hotspot.

3 Click on wi-fi password enter password (first time connect, you enter the password and save) as shown in Fig 6.

4 Click to connect using Wi-Fi shown in Fig 7.

5 Now the internet is connected.

6 Browse the internet, the same way as do in computer.

7 Get the work checked by the instructor.

Fig 6

Fig 7

Format the cell phone/smart phone for virus(approch the mobile repair shop, service center)

Objectives : At the end of this exercise you shall be able to
- **format the android phones using basic reset option**
- **format the android phone using recover reset option.**

Requirements

Tools/Equipments/Instruments
- Cell phone/ Smart phone with SD card - 1 No.
- Precision screw driver set - 1 set.

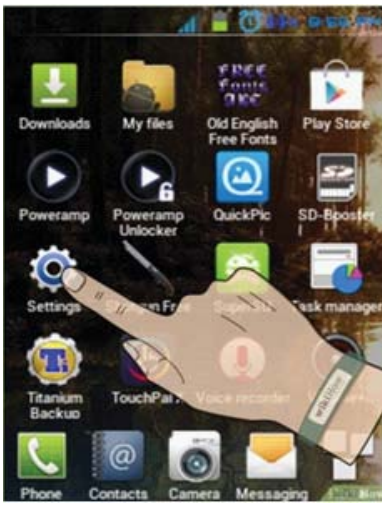
Materials/ Components
- User Manual - as required

PROCEDURE

TASK 1 : **Formatting the android phones using basic reset option**

Caution : Backup all data before resetting operation.

Fig 1



1 Press menu button and select setting option. (Fig 1)

Setting can access from tab scroll also.

2 Scroll the menu and select the privacy option. (Fig 2)

3 Scroll the menu and select factory reset option. (Fig 3)

4 Press the warning message OK.

5 Select SD card if it need format and select everything erase option.(Fig 5 and 6)

6 After few seconds, phone will reset.

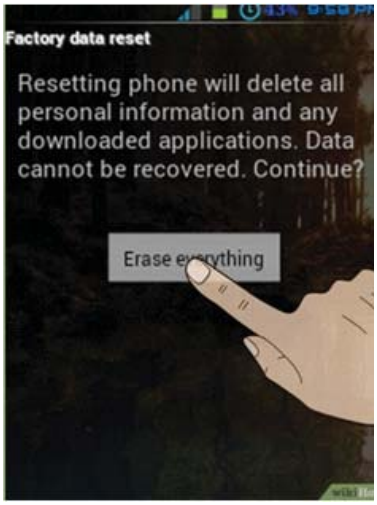
7 Check the screen. It looks like new phone memory.

Fig 2

Fig 3

Fig 5

Fig 6



TASK 2 : **Format the android smart phone by using recovery reset option**

1 Press the ON/OFF button for the power OFF option to appear on your device as shown in Fig 7.

Before you begin the reset procedure, you will need to completely power your device off.

2 Press and hold the recovery buttons. (Fig 8)

Buttons will vary from device to device. So you refer to the instruction for a particular phone. If you want to press and hold the buttons for a few seconds. Some common button combinations include:

Volume Up + Home + Power

Volume Down + Power

Home + Power

3 Select factory reset option.

Once the recovery menu opens, you can navigate the menu with the volume buttons. You may need to open the recovery menu to find the factory reset mode. Use the power button, some models use the camera button, to select your menu options.

4 Select to confirm the factory reset.

5 Wait for the restore process to compete. After your phone resets, it will be set back to factory defaults and will be like new phone.

6 Get the work checked by the instructor.

Fig 7

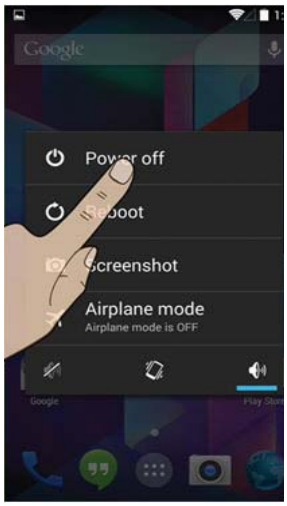


Fig 8

Unlock the handsets through codes and software

Objectives : At the end of this exercise you shall be able to
- **perform different types of locks in cell phone / android cell phone**
- **make user lock functions and unlock functions in your cell phone / android cell phone**
- **make provide lock functions and unlock functions in your cell phone / android cell phone.**

Requirements	
Tools/Equipments/Instruments • Cell phone / Android mobile - 1 No. • Sim card - 1 No.	**Material/ Components** • User Manual - as required

Caution : Lock buttons are different from phone to phone.

PROCEDURE

TASK 1 : **Lock and unlock keypad of a cell phone**

Lock function

1 Press the menu key and the same time press the # key.

2 Now your keypad has been locked.

Unlock function

1 Press the menu key and the same time press the # key.

2 Now your keypad has been unlocked.

— — — — — — —

TASK 2 : **Lock and unlock sim card**

Lock function

1 Go to settings in your cell phone menu function.

2 Go to security settings in the setting menu.

3 Enter a new code number.

4 Switch ON the security settings.

5 Now your SIM card has been locked by security code.

Unlock function

1 Go to settings in your cell phone menu function.

2 Go to security settings in the setting menu.

3 Enter the same security code that you have entered while locking the SIM card.

4 Switch OFF the security settings.

5 Now your SIM card has been unlocked.

— — — — — — —

TASK 3 : **Lock and unlock the cell phone**

Lock function

1 Go to settings in your cell phone menu function.

2 Go to call settings.

3 Fix dial.

4 Switch ON the fix dial.

5 Now your phone has been locked, you can receive incoming calls but you cannot make outgoing call after your phone has been locked.

Unlock function

1 Go to settings in your cell phone menu function.

2 Go to call settings.

3 Then go to Fix dial.

4 Switch OFF the fix dial.

5 Now your phone has been unlocked.

— — — — — — —

TASK 4 : **Lock and unlock PUK (Provider lock)**

Lock function

- **If you enter wrong security code 3 times, then your phone becomes locked.**
- **If you enter wrong security code 10 times, then your SIM card becomes locked.**
- **If you enter wrong security code 10 to 100 times, then your cell phone locked by PUK code.**

Keep ready SIM card or SIM box for information.

Unlock function

1 Make call to the service provider. (customer care)

2 Explain them about your problem, they will ask your SIM number.

3 Tell the SIM number (first 20 numbers), which is printed in your SIM card.

4 The service provider will give some code number.

5 Enter the code number which was given by the service provider, first time the phone shows enter a new number, second time follow the same code number, third time the PUK lock will be open.

— — — — — — —

Perform the interfacing of Cell phone/Smart phone to the PC and dismantle the cell phone and identify the power section and test its healthiness

Objectives: At the end of the exercise you shall be able to
- **perform the interfacing of cell phone/smart phone to the PC**
- **dismantle the cell phone and identify the power section**
- **test its healthiness of power section of smart phone.**

Requirements	
Tools / Equipments/ Instruments • Trainees tool kit - 1 Set. • Digital multi-meter with probes - 1 Set. • Mobile opener tools - 1 Set.	**Materials/ Components** • Smart phone with data cable - 1 No. • PC/Laptop - 1 No.

PROCEDURE

TASK 1 : **Perform the interfacing of Cell phone/Smart phone to the PC**

1 Switch ON the PC and install the “Phone companion” App in your PC. The phone companion app is built directly into window 10.

If windows 10 version is not available, download the app from internet and use it for exercise.

2 Enter your phone number for registering/adding your phone in the app. Then one time automated message will be sent from the microsoft to your registered cell phone number. Consent is not necessary to get or use the app.

3 When the app launches, you will see the first phone companion screen, as shwon in Fig.1 on the monitor.

4 Click on your type of phone (like, windows/android/ IPhone), and then connect your cell phone to your computer. After selection of the phone type, phone companion app will show the display as shown in Fig.2.

Fig 1

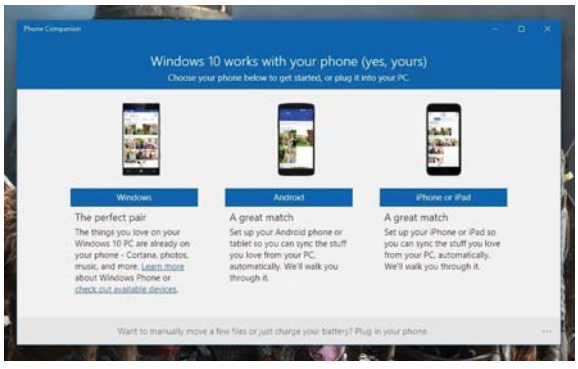


Fig 2

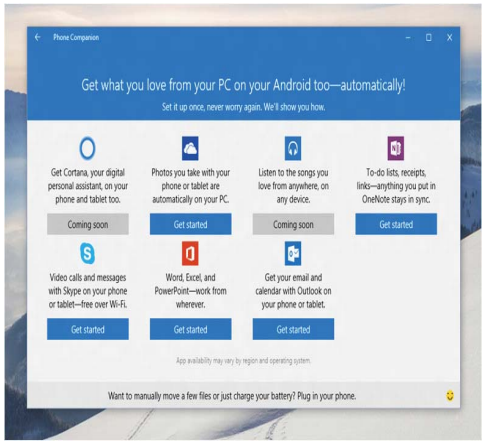


Fig 3

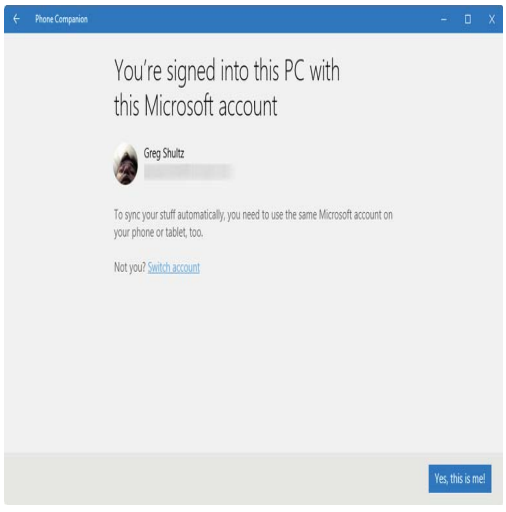
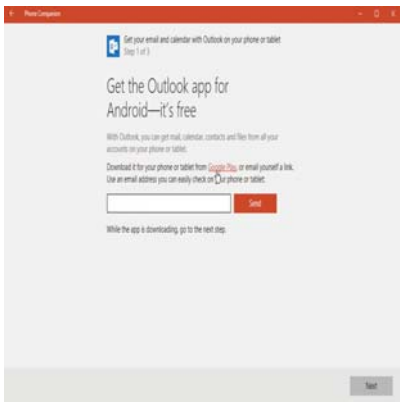


Fig 4



5 Select the desired application say onenote to set up in the PC sign into that one application, phone companion will identify that you are signed into your windows system with a microsoft account and prompt you to confirm, as shown in Fig.3.

6 Verify your microsoft account, you will be prompted to begin the procedure of getting the one note app for the smart phone, as shown in Fig.4

7 Access all the notes that you have created in windows, the onenote app is synched up.

8 Get the work checked by the Instructor.

TASK 2 : **To synchronise the photos and folders of the cell phone to the PC**

1 Connect the USB data cable from your computer's USB port to your cell phone. The phone companion lists you phone's available storage space and available apps as shown in the Fig.5 to synch the photos & folders.

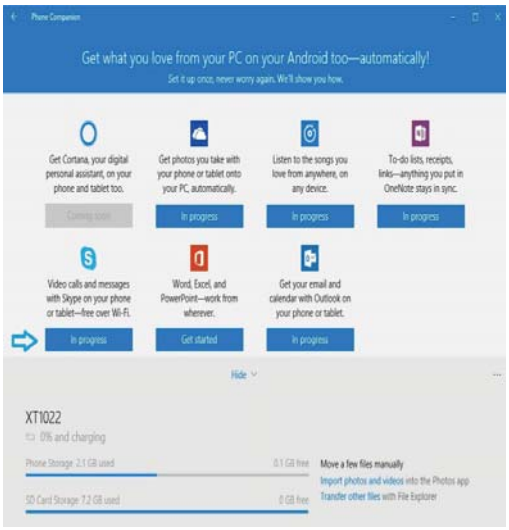
2 Choose which app to install, and whether to transfer photos or files. The phone companion leaves you with three options.

Install Apps: The phone companion lists the windows apps available your phone. Install the onedrive app, for example, to give yout phone access to your onedrive files. You can also install cortana, music, onenote, skype, word, Excel, powerpoint, and outlook - the same apps that work on your PC. By installing the apps, you can edit your onedrive files with word, both on your phone and your PC.

Import photos and videos: Choose this option to copy your photos and videos from your phone or tablet to your PC.

Transfer other files: This option brings up file explorer, where you can view the files and folders on your tablet. Then you can transfer items from your phone or tablet to your PC or vice versa.

Fig 5



TASK 3: **Dismantle the cell phone and identify the power section**

1 Switch OFF the cell phone and remove the battery cover and back facial of the cell phone.

The screws must be kept very carefully for reassemble the cell phone

2 Remove the battery, SIM card and memory card carefully.

3 Using suitable screwdriver, unscrew and remove all the screws and keep them in a safe box.

4 Once all the screws are open, remove the front cover or the front fascia of the mobile phone.

The phone PCB is attached with the internal fasica or skeleton of the mobile phone using screws.

5 Unscrew and open all the screws of the main assembly.

Safety: It is very delicate part, handle with care.

6 Remove connectors for display, camera and pull the display and the camera out as shown in Fig.6

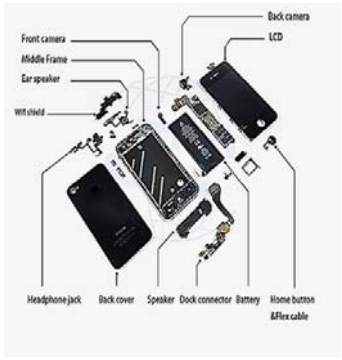
7 Identify the power IC, and other supporting ICs.

8 Record the IC numbers/details in Table-1.

9 Get the work checked by the instructor.

The IC around which there are several capacitors is called power IC. In some cell phones there are 2 power ICs.

Fig 6

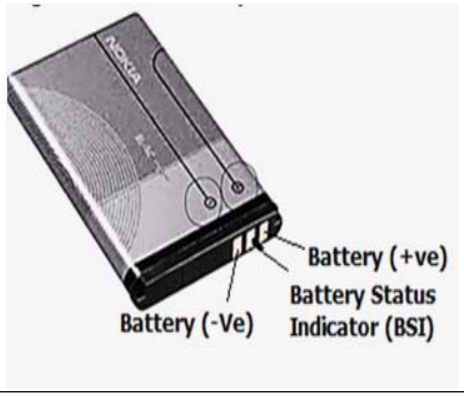


TASK 3: **Test the healthiness of cell phone power**

1 Keep the battery separately and set it down on flat surface such that the terminals are facing you.

2 Note the specification of the battery and identify the two terminals on the battery that are labeled with '+' and '-' sign as shown in Fig.7

Fig 7



3 Measure and record the battery voltage, using multi-meter in Table-1.

4 Compare with the rating of battery and observe the healthiness of the power supply of the cell phone.

5 Get the work checked by the instructor.

6 Carefully insert the display, camera and its connectors carefully.

7 Reassemble the cell phone, with respective screws.

8 Insert the memory card, SIM card and battery.

9 Switch ON the cell phone and check its working condition.

10 Get the work checked by the instructor.

Table 1

SI.No	IC No.	Function	Remarks

Table 2

Battery voltage Rating	Measured voltage of battery	Remarks

Find out the fault of basic cell phone system. Rectify the fault in ringer section and check the performance

Objectives : At the end of this exercise you shall be able to
- **identify the defective parts of cell phone/smart phone**
- **rectify the defective parts of cell phone/smart phone**
- **replace the defective parts of cell phone/smart phone.**

Requirements	
Tools/Equipments/Instruments	**Materials/ Components**
• Cell phone/ Smart phone with SD card - 1 No. • Precision screw driver set - 1 set. • Soldering and desoldering station - 1 No. • Digital multimeter with probes - 1 No. • Trainees tool kit - 1 Set.	• IPA solution - 1 bottle. • Elma solution bottle - 1 No. • Required materials - as required • Jumper wire - as required • User manual - as required

PROCEDURE

TASK 1 : **Fault finding on phone**

1 Pick the defective phone and its manual.

2 Check the physical defects and problems on phone note and record your observations in TABLE 1.

TABLE 1

Make _____		**Model No** _____
Sl. No.	**Observed**	**Defects/Problems**

3 Note the symptoms given by instructor. (or customer)

4 Switch ON the phone [For possible phones only]

5 Observe the health function like sound, speaker, screen, keypad, etc.

6 Note down the observed problems/defects.

7 Refer to the troubleshooting chart TSC-1 comprising of list of probable faults and their remedies.

8 Now refer the given table for tracing the fault.

9 Switch OFF the phone and remove the battery.

10 Dismantle the phone as given in previous exercise

11 Trace the section and defective parts.

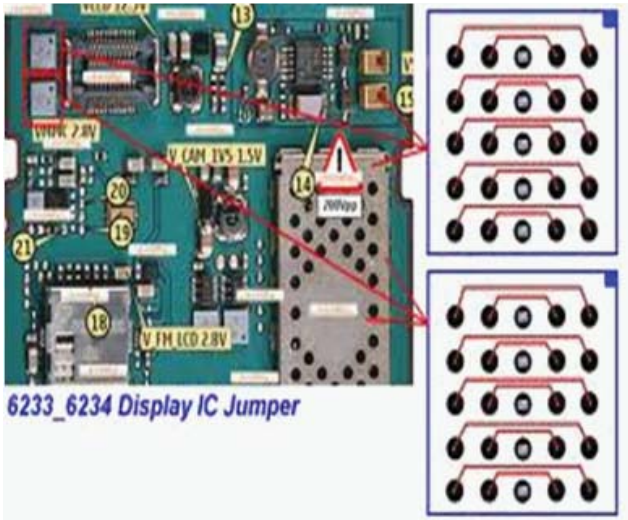
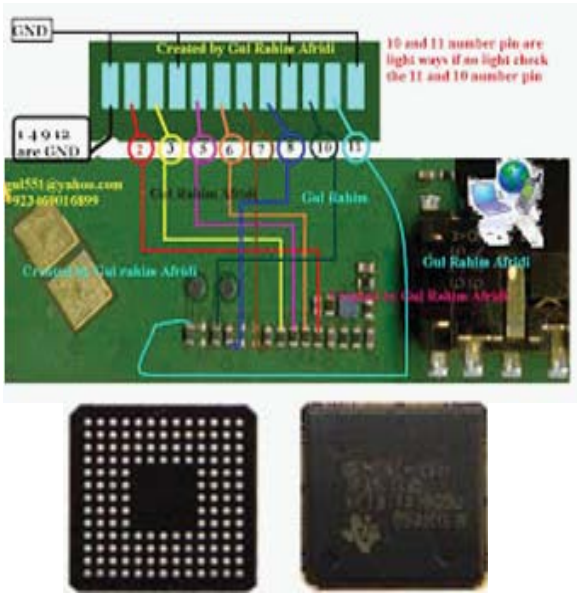
12 Replace them.

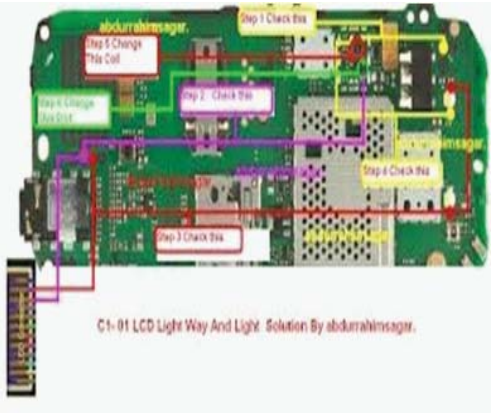
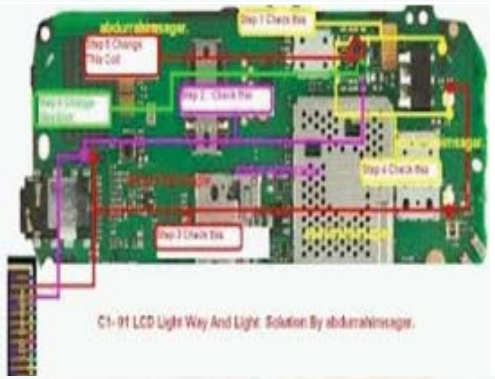
13 Assemble the phone and check the function/working condition.

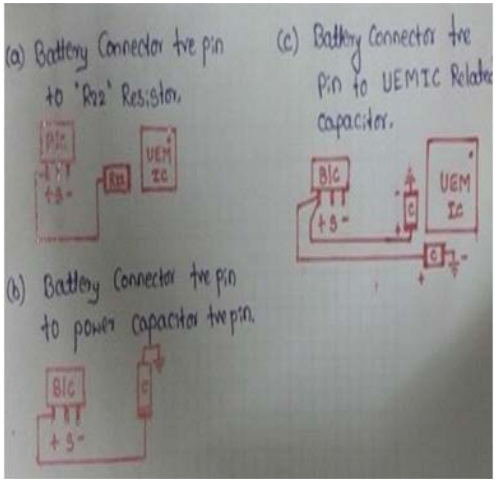
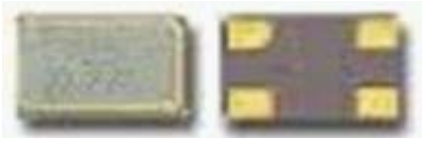
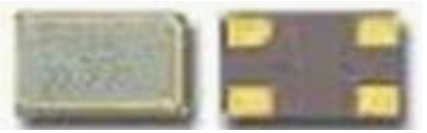
14 Get the work checked by the instructor.

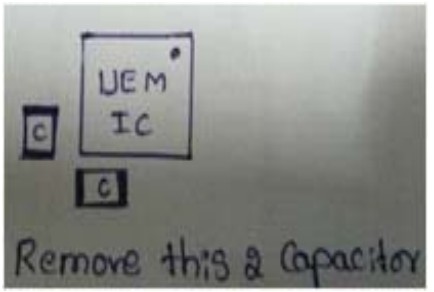
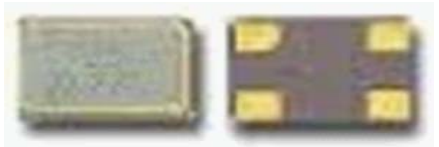
— — — — — — —

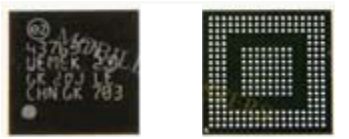
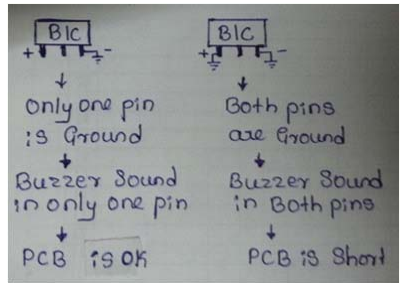
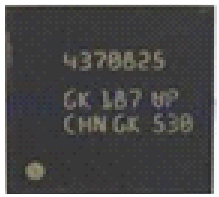
LIST OF PROBABLE FAULTS AND THEIR REMEDIES

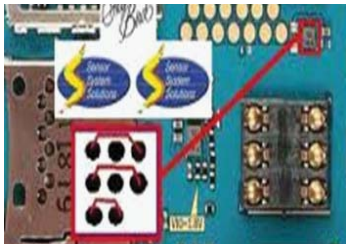
Sl.no	Faults	Remedies	Section figures
1.	**Display related complaints** Ink display Line display Half display Mirror display Blink display Blank display and blue display	• Change the display directly. • Check & change the display. • Clean the display connector in case if found any dry-solder, solder again. • In sliding or folding handset. Change the strip.	 6233_6234 Display IC Jumper
	Blank display and Blue display	• Check & change display. • Clean the display connector in case, if found any dry-solder, solder again. • Heat the display IC. • If not ok then change the display IC. • Check the display related tracks. • If tracks are open then join the track. • If all tracks are ok but problem is same then heat the CPU IC (20 Sec to 30 Sec) Set the soldering station temp at 250ºC Blower at 5.	

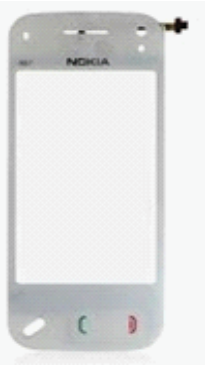
2.	**Keypad related complaints** • Keypad Not Working	• Check & Change Outer and Inner Keypad. • Clean the Keypad Tips by using Rubber. • Check Keypad tip voltage = 1.7V to 1.82V • If no voltage in Keypad tips it means keypad IC is damaged. Then change the keypad IC	
3.	**Back Light fault**	• Change display. • Check & change LED. • Clean the display connector in case if found any dry-solder, solder again. • Check the LED tracks.	 
	Back Light fault (For all type)	• If tracks are open then to join the tracks. • If all tracks are ok but problems same then heat the light IC. • If not ok then change the light IC.	

14.	**Auto Dead**	• Check & change battery • PCB cleaning & heating • Check Battery connector or clean the battery connector. • Check the Battery connector voltage =1.5V to 3.6V 1.5V to 3.6V (correct voltage) Less then 1.5V (low voltage) More than 3.6 (high voltage) **Correct Voltage (1.5V to 3.6 V) = software complaint** • Flash the Handset through the software. Low Voltage (Less than 1.5 V) = Hardware complaint • Check the voltage tracks • If tracks are open then to join the tracks. • If all track are ok. But problem is same then change the Crystal IC. • If not ok then change power amplifier IC. • If not ok it means problem in Power IC (UEM IC). • Then Heat the UEM IC (20 Sec to 30 Sec) Set the soldering station temp at 250ºC Blower at 5 **High voltage: (More than 3.6 V) = Hardware Complaints** • Change the crystal IC	    

		If not ok then remove the UEM IC related capacitor. • After removing capacitor, check the Battery connector Voltage. If voltage is drop then switch on the Handset. If not ok it means problem is in power IC (UEM IC) • Heat the UEM IC (20 Sec to 30 Sec). Set the soldering station temp at 250ºC Blower at 5	  
4.	**Auto Dead** **(For low voltage)**	• Check & change Battery • PCB cleaning & heating by using IPA solution. • Check Battery connector voltage = 3.6 V Less than 3.6V • Software complaint. • Flash the hardset through the software. • Change the Battery connector. • Change crystal IC. • Check and change the power capacitor. • Check and replace the PA IC	  

		• Heat the power IC.(20 sec to 30 sec). Set the soldering station temp at 250ºC Blower at 5.	 
5.	**Water Damaged Dead (PCB Short)**	Check battery connection short • PCB cleaning & heating by using Elma & IPA solution 1st time = Elma 2nd time = IPA solution • Change the Battery connector • Change crystal IC. • If Not ok then change the power capacitor. • If not ok then remove the Power Amplifier IC. • If not ok then heat the power IC.(20sec to 30sec) Set the soldering station temp at 250ºC Blower at 5.	  

6.	**Sim Related Complaint**	• Check & change sim card. • Check bad contact of sim card and sim slot pins. • Clean the battery connector sensor pin if found any dry solder properly. • If not ok then Heat the sim IC. • If not ok then change the sim IC.	
7.	**Memory Card Related complaint.** Insert Memory Card	• Check & change memory card. • Check bad contact of memory card and memory card slot pins. • If not ok then heat the memory card Glass Type IC (Grey Colour). • If not ok then change memory card Glass Type IC (Grey Colour)	
8.	**No memory card option and Memory card Currupted**	• Check and change memory card. • Format the hand set. • If not ok then heat the memory card ceramic ic (black). • If not ok then change the memory card ceramic ic (black)	
9.	**Format Memory Card**	• Check and change memory card. • Format the hand set. • If not ok then heat the memory card glass type ic (grey colour) • If not ok then change the memory card glass type ic (grey colour)	

10.	**Touch Screen Complaint** **Touch pad not working.**	• Check and change Touch pad. • Clean touch pad connector for dry soldring. • Flash the handset through the Software. • If not ok then Change the touch pad IC.	 

Replace various faulty parts like mic, Speaker, charging/audio jack etc.

Objectives: At the end of the exercise you shall be able to
- **identify the nature of audio related fault in the given cell phones**
- **dismantle the faulty cell phone/smart phone**
- **torubleshoot/ replace the defective parts of given cell phone.**

Requirements	
Tools/Equipments/Instruments • Cell phone/ Smart phone with SD card - 1 No. • Precision screw driver set - 1 set. • Digital multimeter with probes - 1 No. • Trainees tool kit - 1 set.	**Materials/ Components** • Ultrasonic tub - 1 No. • IPA or CTC solution - as required • User manual - as required • Spare parts(Speaker/Mic/Jack) - as required

PROCEDURE

TASK 1 : **Checking and replacing the speaker of a cell phone**

1 Switch ON the cell phone and operate volume keys, check speaker sound by play any sound file like music.

2 Switch OFF the phone now and dismantle the phone by referring Exercise 4.5.03

3 Remove the speaker connection and check the continuity.

4 Replace the speaker with similar one if found defective.

5 Check the tracks of speaker upto the audio IC.

6 Clean the track using CTC solution.

7 Check the continuity of track using multimeter.

8 Join the defective tracks.

9 Warm the audio IC by using test lamp or by soldering station temp. at 250ºC and blower at 5.

10 Now assemble the phone and switch ON.

11 Check phone sound. If not proper discuss with the instructor for replacing of IC.

— — — — — — —

TASK 2 : **Testing and replacing of mic**

1 Check the mic healthness by recording voice or by making a call.

2 Switch OFF the phone and dismantle the phone by referring exercise 4.5.03

3 Remove the MIC connection and clean the dust using pump blower.

4 Check the continuity of MIC with the help of your instructor.

Condenser MIC will not give continuity.

5 Check tracks of MIC upto the audio IC.

6 Replace the MIC with similar one if found defective.

7 Clean the track using CTC or IPA solution.

8 Check the continuity of track using multimeter.

9 Join the defective tracks.

10 Warm the audio IC by using test lamp or by soldering station temp. at 250ºC and blower at 5.

11 Now assemble the phone and switch ON.

12 Check the phone sound. If sound is not proper contact instructor for replace IC.

For audio IC defect, mostly speaker and MIC will not functioning.

— — — — — — —

TASK 3 : **Testing and replacing data/charging/audio jack**

1 Connect the charger to phone and check the signal of charging indication on the screen.

2 Transfer the data from phone to PC using data cable by referring exercise 4.5.04(TASK 3).

3 Switch OFF the phone if the jack is found to be defective and dismantle by referring the previous exercise.

4 Desolder the audio jack and replace it with similar one.

5 Switch ON the phone and check the healthyness of phone.

6 Get the work checked by the instructor.

— — — — — — —

Dismantle the LED light, identify the connections of LED stacks, protection circuit and regulator

Objectives : At the end of this exercise you shall be able to
- **dismantle the LED light and identify the connection of LED stack**
- **identify the protection circuit components in the LED driver boards.**

Requirements	
Tools/Equipments/Instruments	**Materials / Components**
• Trainees tool kit - 1 set • Digital multimeter with probes - 1 set • Magnifying lenses with lamp - 1 set	• LED lamp - as reqd. • LED driver boards (different wattage ratings) - as reqd.

PROCEDURE

TASK 1 : **Dismantling the LED light, identification of connections and the regulator section in LED light**

1 Remove the screw from the LED light as shown in Fig 1.

Fig 1

2 Dismantle the LED driver from the LED lamp as shown in Fig 2 under the guidance of the Instructor.

Fig 2

3 Remove the driver board from the LED lamp as shown in Fig 3.

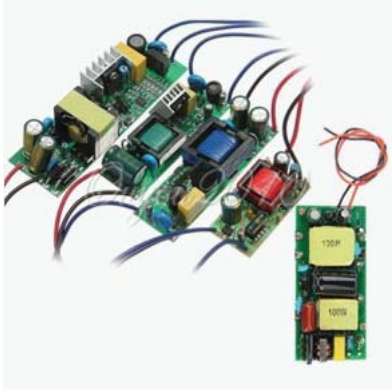
Fig 3

4 Identify the anode, cathode terminals of each LED in the series stack and draw the circuit connection.

5 Get the traced circuit checked by the Instructor.

6 Compare the different wattage and types of LED driver boards as shown in Fig 4.

Fig 4



7 Identify the regulator IC/ Protection IC and other devices in the LED driver boards record the observations in Table - 1.

8 Repeat the step 1 to step 7 for all other LED driver.

9 Get the work checked by the instructor.

TABLE 1

Sl.No.	Name of the regulator IC/ Protection IC or diode

— — — — — — —

Identify the rectifier, controller part of LED lights

Objectives : At the end of this exercise you shall be able to
- **dismantle the LED lamp identify the rectifier circuit**
- **identify the Controller/ Regulator part of LED light.**

Requirements	
Tools/Equipments/Instruments • Trainees tool kit - 1 Set • Digital multimeter with probes - 1 No. • Magnifying lenses with lamp - 1 No.	**Materials / Components** • Different type and wattage LED - as required • LED driver circuit - 1 No. • LED Lamp - 1 No.

PROCEDURE

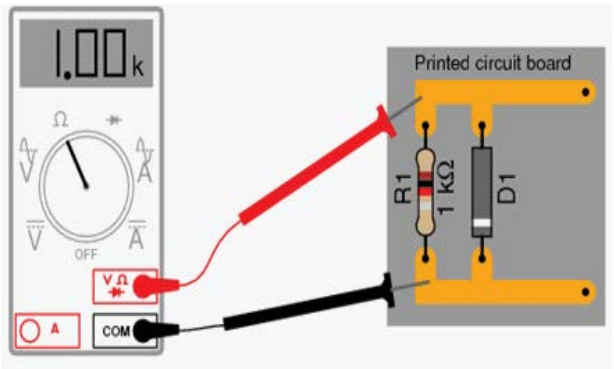
TASK 1 : **Dismantle the LED lamp and identify the rectifier section**

1 Follow the step 1 to 5 of Task 1 in the Exercise 4.7.291.

2 Identify the AC input section in given LED stack or driver.

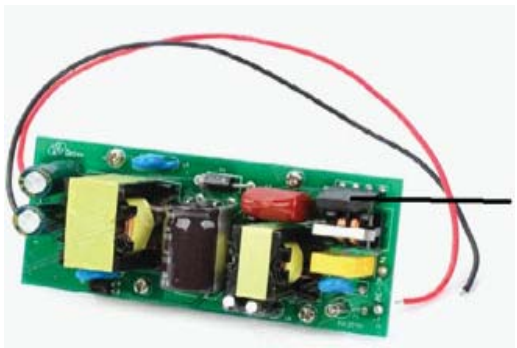
3 Check if any current limiting resistor is available in the circuit board. Note the value of resistor as shown in Fig 1 otherwise take the multimeter set ranges in resistor mode to measure the value of resistor and note down value and wattage in TABLE 1.

Fig 1



4 After the current limiting resistor section if any diode or bridge rectifier IC present means note down the diode name or IC name in TABLE 1.

Fig 2



5 Observe the other driver circuit as shown in Fig 2 and record your observations in TABLE 1.

6 Repeat the steps for all other LED stacks or driver.

7 Get the work checked by the instructor.

TABLE 1

Sl.No.	Current limiting resistor value	Rectifier IC name	Rectifier diode

TASK 2 : **Identify the control section/ regulator in LED driver PCB**

1 Identify the rectifier circuit as shown in Fig 3 and note down the parts name in TABLE 2.

Fig 3

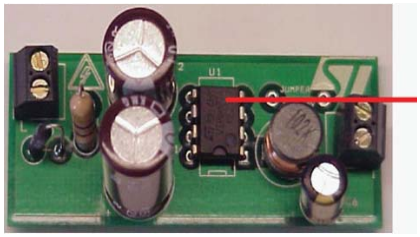


TABLE 2

Sl.No.	Control section part name/number

2 Get the work checked by the instructor.

— — — — — — —

Make series strings connection of six LEDs and connect four series strings in parallel

Objectives: At the end of the exercise you shall be able to
- **construct a series string connection of 6 LEDs and connect 4 series strings is parallel**
- **test and observe the circuit operation.**

Requirements	
Tools / Equipments/ Instruments • Trainees tool kit - 1 Set. • Digital multimeter with probes - 1 No.	**Materials/ Components** • Step down transformer 230V/24V, 1A - 1 No. • Diode - IN4007 - 4 Nos. Electrolytic capacitor 1000µF/50V - 1 No. White LED 5mm - 24 Nos. Resistor 120Ω, 1/2 W - 4 Nos. Power cord, 2 mtrs - 1 No. Hook - up wire - as reqd. General purpose PCB/Bread Board - 15W.

PROCEDURE

1 Collect the components and check them for its good working condition.

2 Connect the components and construct a series string connection of six LEDs and connect four series strings in parallel as shown in Fig.1

3 Avoid loose connections when connecting the LED strings.

4 Connect AC mains to the transformer and switch ON the mains.

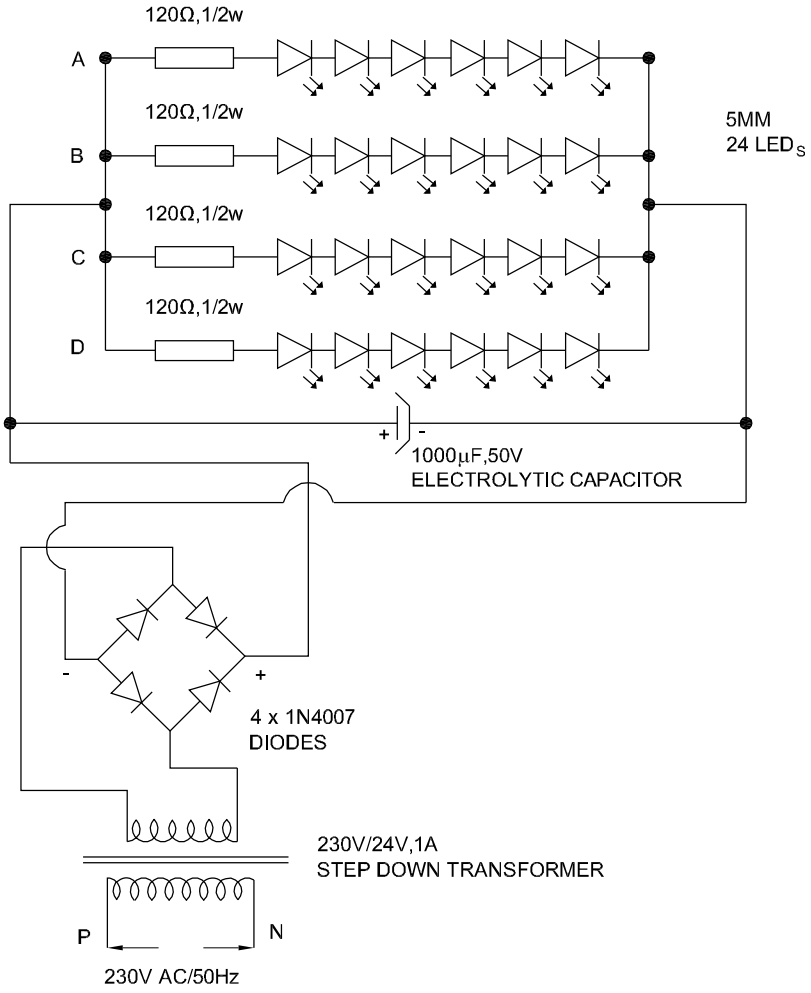
5 Measure and record the LED voltage and string voltage in the Table -1

Table 1

Voltage across LED	Voltage across series string				Voltage across parallel string
	A	B	C	D	

Retain the wired 6x4 matrix LED circuit as the soure is required to carry out the exercise 4.7.294. You may disconnect the transformer and bridge circuit as these are not required.

Fig 1



6 Get the work checked by the instructor.

Connect to such parallel sets in series to create a matrix of LEDs

Objectives: At the end of the exercise you shall be able to
- **construct a 6x4 matrix LEDs (End product of Ex.4.7.293)**
- **assemble 4 Nos. of 6x4 matrix LEDs to create a LED array.**

Requirements	
Tools / Equipments/ Instruments • End product of Ex.4.7.293 • Regulated DC power supply unit (0-30)V, 2A - 1 No. • Digital multimeter with probes - 1 No.	**Materials/ Components** • Connecting wires - as reqd.

PROCEDURE

1 Construct four number of 6x4 matrix LEDs

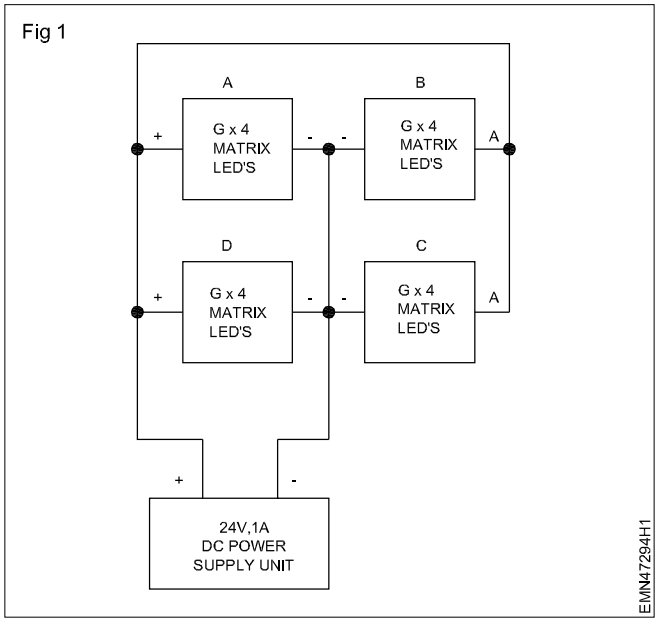
Use end products of exercise 4.7.293/Previous Exercise

2 Interconnect the matrix LEDs using Hook up wires by referring the Fig.1

3 Set the DC PSU voltage at 24V and connect with the wired LED array.

4 Switch ON the DC PSU and check the uniform intensity of the LED.

Fig 1



Do not dismantle the circuit use the same assembled a circuit for exercise 4.7.295

5 Get the work checked by the instructor.

Apply suitable voltage and check voltage across series strings

Objectives: At the end of the exercise you shall be able to
- **construct 4 numbers of 6x4 matrix LEDs to create a LED array**
- **apply suitable voltage to the LED array and check voltage across series strings.**

Requirements	
Tools / Equipments/ Instruments • End product of Ex.4.7.293 • DC power supply 0-30V/2A - 1 No. • Digital multimeter with probes - 1 No.	**Materials/ Components** • Connecting wires - as reqd. • Patch cords - as reqd.

PROCEDURE

1 Construct four number of 6x4 matrix LEDs to create a LED array by referring the Fig.1

2 Set the DC PSU voltage at 24 V and apply to the wired circuit.

3 Measure and record the following

  a Circuit input DC voltage

  b Voltage across each 6x4 matraix LED

  c Voltage across series strings

  d Voltage across LEDs.

4 Tabulate the readings and observe voltage levels at different points of the circuit.

5 Switch OFF the DC power supply unit.

Fig 1

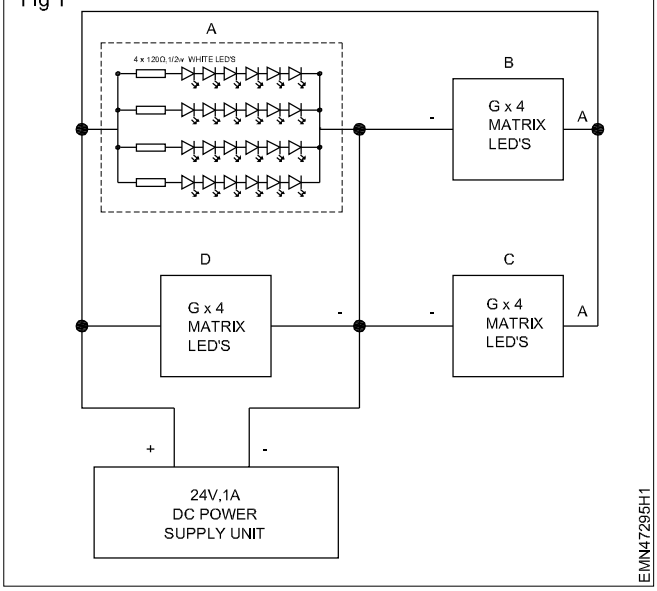


Table - 1

Input DC voltage	**Voltage across**				**Voltage across series string**	**Voltage across any LED.**
	A	**B**	**C**	**D**		

Identify and operate different controls on LCD, LED TV

Objectives : At the end of this exercise you shall be able to
- **identify the different indicators/controls on LCD and LED TV**
- **identify the different connectors in LCD and LED TV.**

Requirements

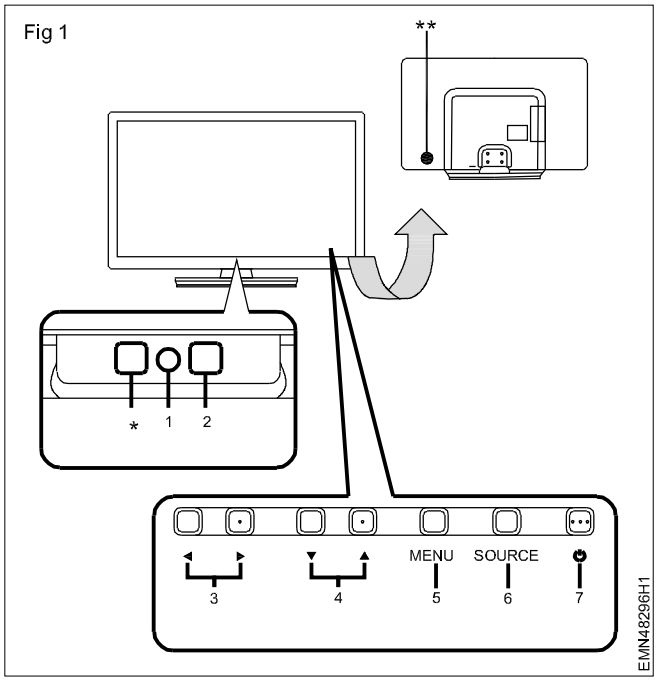
Tools/Equipments/Instruments	Materials/ Components
• LCD or LED TV with user manual - 1 No.	Nil

PROCEDURE

TASK 1 : **Identify the different front panel indicators/controls LCD and LED TV**

1 Pick up any one of the TV from the Lab, see the front panel as shown in Fig 1.

Fig 1



2 Identify the various front panel indicators/controls available in TV note down in the TABLE 1.

3 Get the work checked by the instructor.

4 Repeat the above steps for other TVs.

TABLE 1

Sl.No.	Front panel Controls name
*/**	
1	
2	
3	
4	
5	
6	
7	

— — — — — — —

TASK 2 : **Identify the different input and output or audio and video connectors in LCD TV**

1 Pick up any one of the TV from the lab, see the back side and side view of the TV panel as shown in Fig 2.

2 identify the input and output connector or audio and video connectors in TV note down your observations in the TABLE 2.

3 Get the work checked by the instructor.

4 Repeat the above steps for other TVs.

Fig 2

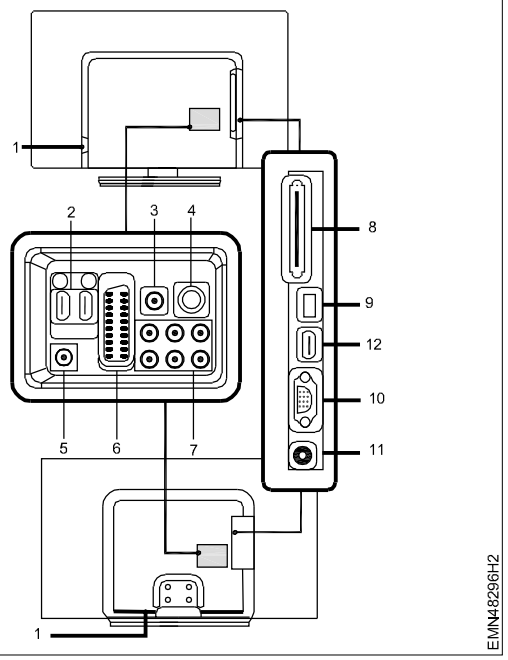


TABLE 2

Sl.No.	Connector name
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

Identify components and different sections of LCD and LED TV

Objectives : At the end of this exercise you shall be able to
- **dismantle the back panel cover of the LCD TV**
- **identify the internal sections in LCD TV.**

Requirements	
Tools/Equipments/Instruments • LCD TV with user manual - 1 No. • Trainees tool kit - 1 set. • ESD table - 1 No.	**Materials/ Components** • Soft cloth (to keep the screen protected from scratches) - as required

PROCEDURE

TASK 1 : **Remove the back panel cover of the LCD TV and identify the sections**

1 Unplug the LCD TV from its power supply and remove any other cables from the TV as shown in Fig 1.

Fig 1

2 Prepare the ESD table or any other flat surface and lay the soft cloth on it.

3 Turn the LCD TV face down on the soft cloth, to protect the screen from being damaged.

4 Remove the four screws that hold the base in place. The screws are located in the centre of the TV near the bottom as shown in Fig 2.

Fig 2

5 Remove the stand from the back of the LCD TV and keep it aside.

6 Place the screw driver in between the covers as shown in Fig 3 and with little force twist and open a gap.

Fig 3

7 Turn the screw driver to unlock/and open the panel. Use this technique around all the sides of the TV monitor as shown in Fig 4.

Fig 4

8 Remove the outer cover to show the main body of the TV monitor as shown in Fig 5.

Fig 5

9 Remove the side panel screws as shown in Fig 6.

Fig 6

10 Get the work checked by the instructor.

— — — — — — —

TASK 2 : **Identify the different components used in LCD TV**

1 Identify the different internal section in LCD TV as shown in Fig 7.

2 Note down the name of different section in TABLE 1.

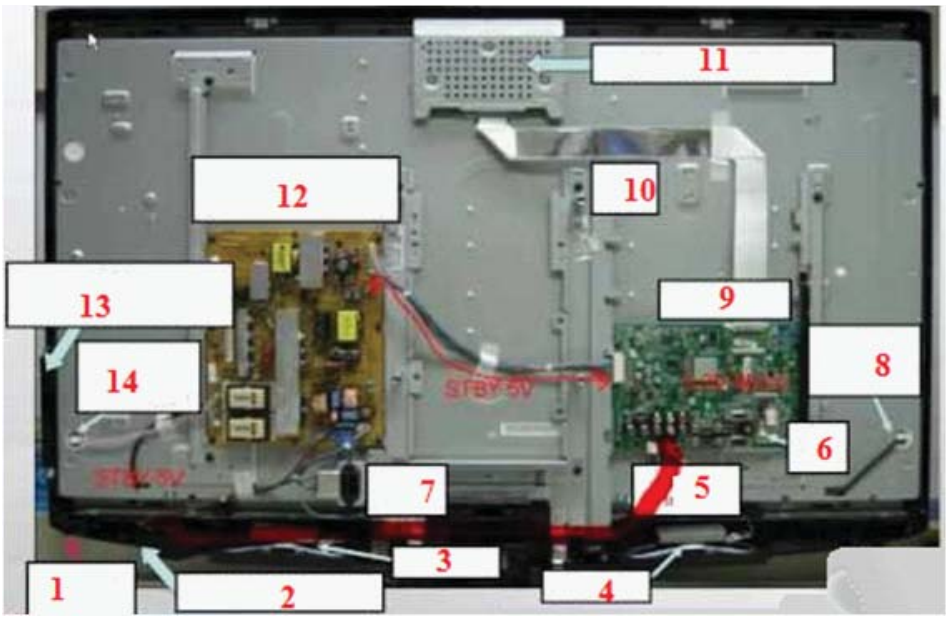
Don't remove any cables from the TV.

3 Get the work checked by the instructor.

TABLE 1

Sl.No.	Name of the Section
1	
2	
3	
....	
....	
14	

Fig 7



— — — — — — —

Dismantle, identify the parts of TV remote control

Objective : At the end of this exercise you shall be able to
- **identify the remote control model and the function keys**
- **dismantle the TV remote control handset**
- **identify the internal section of TV remote control and assemble it.**

Requirements	
Tools/Equipments/Instruments • Trainees tool kit - 1 Set. • Magnifier lens - 1 No. • TV Remote control handset with user manual - 1 No.	**Materials/ Components** • Cleaning brush - 1 No • Remote control checker, tester - 1 No. • IPA cleaning solution - 1 bottle.

Note: The instructor has to label all the remote control handsets used for this exercise

PROCEDURE

TASK 1 : **Identify the remote control model and the function keys**

1 Pick any one of the labeled TV remote control from the lab.

2 Note down the model number of the TV remote control record the observations in TABLE 1.

TABLE 1

Sl. No.	Label No.	Model/Serial No	Type
1			
2			
3			
4			
5			

3 Repeat the above step for the remaining labeled items

4 Take one of the labeled remote control handset, identify the name/function of the keys as shown in Fig.1 with reference to the user manual.

5 Record the name of each key on the remote control keypad and its function in TABLE 2.

Fig 1

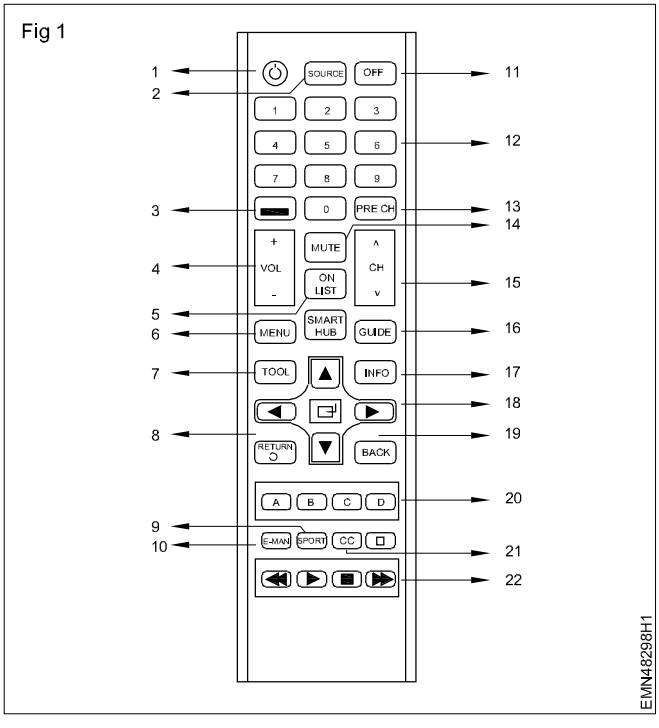


TABLE 2

Sl.No.	Button Name	Function
1		
2		
3		
4		

20		
21		
22		

6 Get the work checked by the Instructor.

— — — — — — —

TASK 2 : **Dismantle the TV remote control handset**

1 Open the battery compartment cover handset and remove batteries out of the TV remote control.

2 Locate and remove the fixing screws from the back cover as shown in Fig 2.

In some models there is no screws used for fitting both top and bottom cover. Only press type locking is used. Open it carefully without damaging the locking arrangement.

3 Open the remote control from its side by using a blunt knife or similar tool as shown in Fig 3.

4 Take out the moulded rubber key pad from its PCB.

5 Clean the tracks and contact points on the PCB and the rubber keypad using cleaning solution with brush.

6 Identify all the components on the PCB and record them in Table-3.

TABLE 3

Sl.No.	Name of the component
1.	
2.	
3.	
4.	
5.	

7 Insert the keypad buttons correctly into the slotted holes on the front panel cover of the remote control.

8 Align the PCB over the rubber keypad, insert the battery contacts into the back cover and fix the remote control handset.

9 Insert batteries, close cover and test the functioning of buttons using the remote control checker/tester.

Fig 2

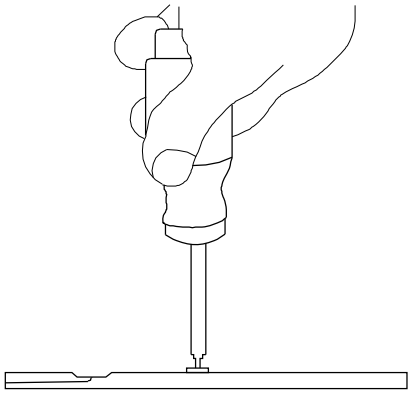


Fig 3

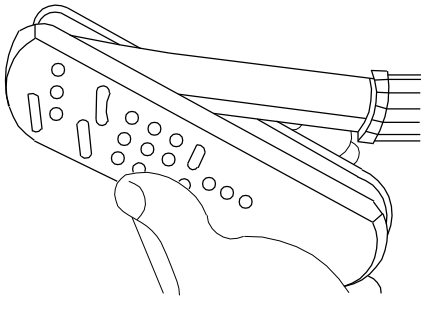
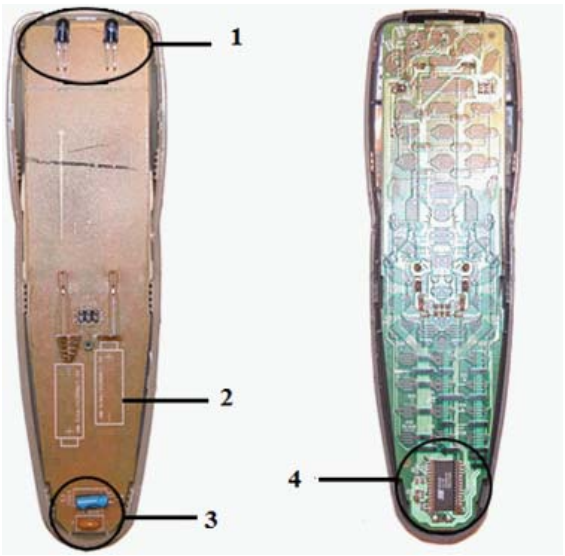


Fig 4



11 Get the work checked by the instructor.

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Dismantle the given LCD/LED TV to find faults with input stages through connectors

Objectives : At the end of this exercise you shall be able to
- **remove the back panel cover of LCD/LED TV**
- **Identify the input terminals and check them**
- **troubleshoot the input terminal through connectors.**

Requirements	
Tools/Equipments/Instruments • Trainees tool kit - 1 Set. • Magnifier lens - 1 No. • LCD/LED TV - 1 No. • Home theatre system - 1 Set. • DVD player with remote controls & user manual - 1 Set. • Set-top box with user manuals - 1 No.	**Materials/ Components** • HDMI cable - 2 Nos • RCA cable 3RCA - 3RCA - 1 set • Optical cable(S/PDIF) - 1 No • Coaxial cable 2RCA - 2RCA - 1 set

Note: The instructor has to provide the LCD/ LED TV with known faults in input stages

PROCEDURE

TASK 1 : **Remove the back panel cover of the LCD/LED TV**

1 Unplug the LCD/LED TV from its power supply and remove any other cables from the TV as shown in Fig 1.

Fig 1

2 Prepare the ESD table or any other flat surface and lay the soft cloth on it.

3 Turn the LCD/LED TV face down on the soft cloth, to protect the screen from damage.

4 Select the correct size tip for screw driver and remove the four screws that hold the base stand in place. The screws are located in the centre of the TV near the bottom as shown in Fig 2.

Keep the screws and stand aside carefully

Fig 2

5 Place the screw driver in between the covers as shown in Fig 3 and with little force twist and open a gap.

6 Turn the screw driver to unlock/and open the panel. Use this technique around all the sides as shown in Fig 4.

7 Remove the outer cover to show the main body of the TV as shown in Fig.5 and remove the side panel screws as shown in Fig 6.

8 Get the work checked by the Instructor.

Fig 3

Fig 4

Fig 5

Fig 6

— — — — — — —

TASK 2 : **Identify different type terminals/connectors of input stage of LCD/LED TV**

1 Note down the type of socket/connector provided on the input stage of LCD/LED

2 Record your observations in Table-1 for all the input sockets.

Table-1

Sl. No	Name of the scoket/connector	Uses/Purpose	Remarks
1			
2			
3			
4			
5			

3 Use magnifying lens and locate the fault by visual inspection for any desoldered/disonnected wires at the terminal sockets/connecting wires to the motherboard of the LCD/LED TV.

4 Resolder/rectify the identified fault and get the work checked by the instructor.

5 Lift the LCD/LED TV and position it firmly at 45 with full support.

6 Connect the signal source using the particular type of connecting cable to the input stage of LCD/LED TV.

Note: DVD player/set top book/laptop computer with HDMI output may be selected as the signal source for the above step

7 Switch ON the setup and confirm the reception of the LCD/LED TV.

8 Get the approval of the instructor, switch OFF the setup, diconnect the signal source/cable.

9 Reposition, close the back cover on the LCD/LED TV and fix the base stand.

10 Get the work checked by the instructor.

— — — — — — —

Detect the defect in a LED/LCD TV receiver given to you. Rectify the fault.

Objectives : At the end of this exercise you shall be able to
- **identify the internal sections in LCD/LED TV**
- **dismantle the back panel cover of the LCD/LED TV.**

Requirements

Tools / Equipments/ Instruments

- LCD/LED TV - 1 No.
- Trainees tool kit - 1 Set.
- Digital multimeter with probes - 1 No.
- User manual of LCD/LED TV - 1 No.

Materials/ Components

Nil

Precaution

1 **Remove the power cord from the mains before attempting to remove the back cover of LCD TV/ Trainer kit.**

2 **Note down the colours of wires and position/location of connectors on the main board.**

3 **Avoid touching the screen at all times as this may result in damage to the screen.**

4 **Use soft cloths to keep the screen protected from scratches.**

PROCEDURE

TASK 1: **Back panel cover removing**

1 Unplug the LCD/LED TV from its power supply and remove any other cables from the TV.

2 Prepare the ESD table or any other flat surface and lay the soft cloth on it.

3 Turn the LCD/LED TV face down on the soft cloth to protect the screen from being damaged.

4 Remove the four screws that hold the base in place. The screws are located in the centre of the TV near the button.

5 Remove the stand from the back of the LCD/LED TV and keep it aside.

6 Place the screw driver in between the covers and with little force twist and open a gap.

7 Turn the screw driver to unlock/and open the panel. Use this technique around all the sides of the TV monitor.

8 Remove the outer cover to show the main body of the TV monitor.

9 Remove the side panel screws.

— — — — — —

TASK 2: **Internal sections identifications**

1 Identify the different internal sections in LCD/LED TV as shown in Fig.1

2 Note down the name of different sections in Table-1.

Note: Don't remove any cables from the TV.

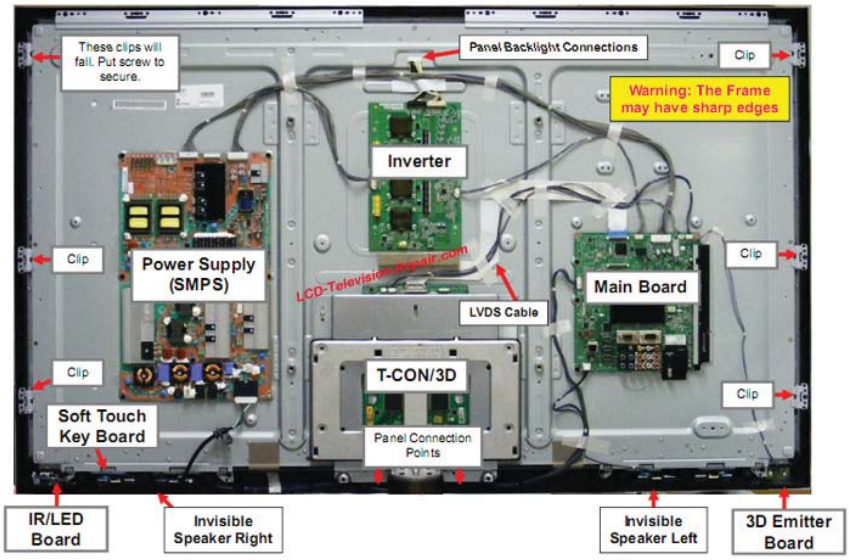
3 Assemble the cover after identifications and check its working condition.

Table-1

Sl.No.	Name of the internal section	Description
1	SMPS Board	
2	Main Board	
3	T-CON Board	

4	Soft touch keyboard	
5	Speakers	
6	IR/LED board	

Fig 1



Troubleshook the faults in the given LED/LCD TV receiver - Locate and rectify the faults

Objectives : At the end of this exercise you shall be able to
- **identify the faults in the LED TV**
- **rectify the fault in LCD/LED TV using flowchart method.**

Requirements	
Tools/ Equipments/ Instruments • LCD/LED TV - 1 No. • Trainees tool kit - 1 Set. • RF cable/set top box with DTH & remote - 1 Each. • Digital multimeter with pipe - 1 No.	• Pattern generator with operating/instruction manual - 1 No. • ESD table - 1 No. • User manual of LCD/LED TV - 1 No. **Materials/ Components** Nil

PROCEDURE

TASK 1 : **No power**

1 Connect the colour pattern generator output to LCD/ LED TV.

2 Switch ON this setup and observe the screen whether any display present or not.

3 Switch OFF this setup and remove the back cover of the LCD/LED TV.

4 Unscrew the chassis/main PCB fitting screw, keep all screws, nuts, fasteners, etc. satisfy in a transparent cover.

5 Detach the connectors wherever possible and take the PCB out of the cabinet without stretching the soldered wire too much.

6 Position the PCB such that all components side face towards you.

7 Refer the circuit diagram of the SMPS stages of the LCD/LED TV and follow the troubleshooting flow chart shown in figure.

8 Locate the components of SMPS stage & check the output voltage 24V is present.

9 Check SMPS output voltages and record the observations in Table-1.

Table - 1

No power	Yes/No
Whether display present	
Power board output	
Power key under control	
IR receiver normal	

Fig 1

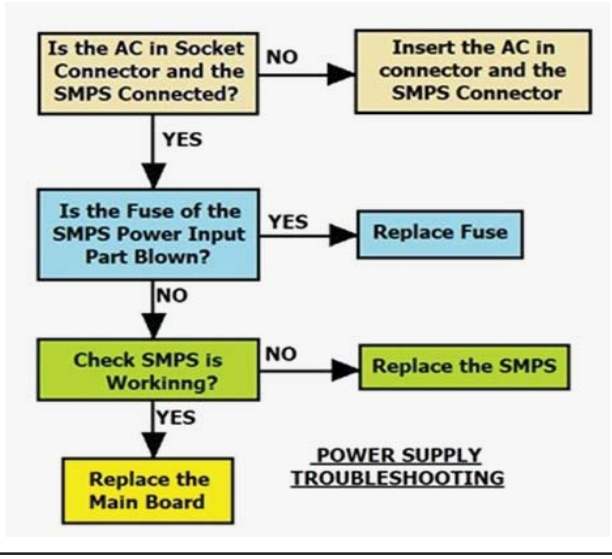
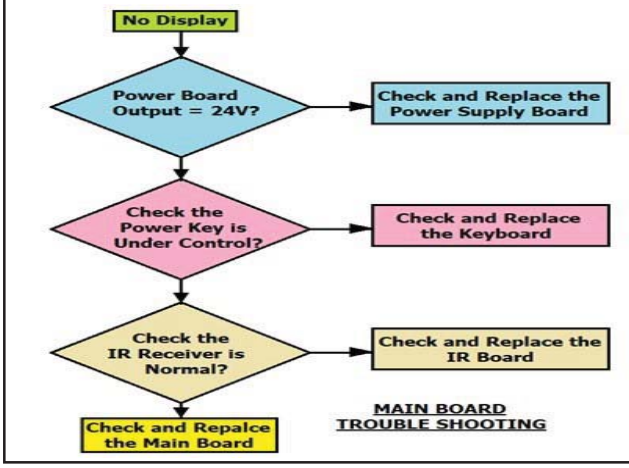


Fig 2



TASK 2 : **No picture and sound**

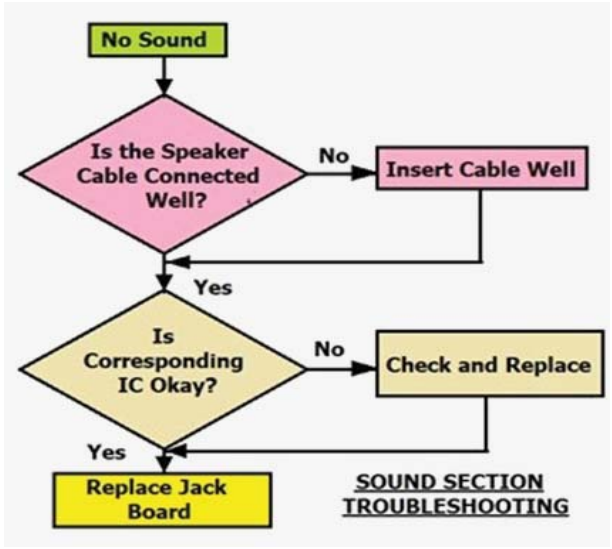
1 Connect the colour pattern generator output to LCD/ LED TV.

2 Switch ON this set up and check whether sound and visual display present or not.

3 Switch OFF and remove the back cover of LCD/LED TV and unscrew the chassis/main PCB fitting screw, keep all screw, nuts, fasteners, etc. safely in a transparent cover.

4 Detach the speaker wire and check the speaker.

Fig 3

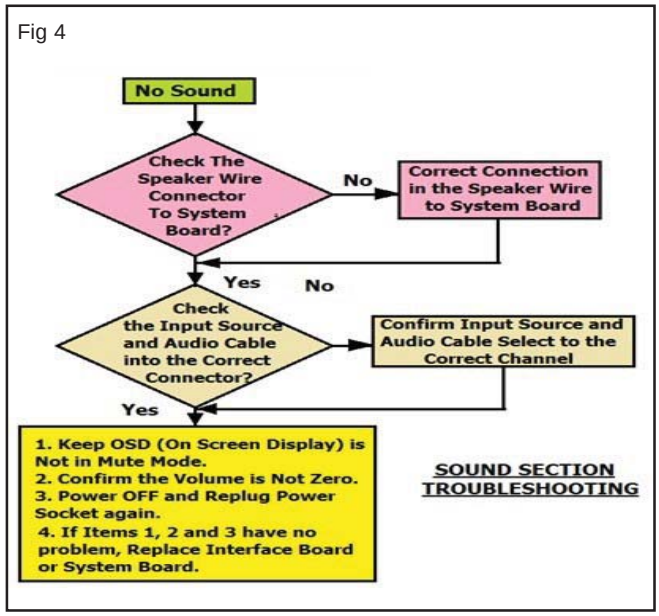


5 Check the speaker cable if it is not connected well, connect it.

6 Check the corresponding IC voltages if voltages not available, replace it.

7 Follow the given troubleshooting chart and rectify the possible fault in the given TV set.

Fig 4



Other trouble shooting chart for general faults

Sl. No	Symptom	Solutions
1	No picture on screen but LCD/LED TV still has sound.	The problem is cause by defective SMPS/PS board and replacing SMPS/Power supply board will solve the problem
2	Screen flash ON and OFF between 1/2 to a few seconds, but power indicator light stays ON and TV still has sound.	The problem is caused by defective mother board
3	Blue screen but no picture.	The problem is caused by defective main board (AD board). In some cases, this problem may cause by defective screen controller board. (I CON) board T CON board this board is mounting on the back of LCD TV screen.
4	Power light stays ON but no display and sound.	The problem is caused by defective main board. (AD board) or power supply board.
5	No power or power indicator light does not lits.	The problem could either by defective power supply board or defective main board (AD board).

6	No picture but TV still has sound	Check the driver output voltage to side LED/Back light LED. If there is no voltage from the driver board. check the test point at the board and replace it If voltage is available in the driver board, then problem in display. Replace the suitable display
		Check the power supply T-COW board and main board and replace it.

8 Get the work checked by the Instructor.

— — — — — — —

Test LED/LCD TV after troubleshooting the defects

Objectives : At the end of this exercise you shall be able to
- **switch ON TV and setting the primary information**
- **connect and test the LCD/LED TV with media device using HDMI, RCA, USB cable.**

Requirements	
Tools / Equipments/ Instruments • LCD/LED TV - 1 No. • Trainees tool kit - 1 Set. • Media source with HDMI, RCA, USB output - as reqd. • Digital multimeter with probes - 1 No	**Materials/Components** Nil

Safety precaution

1 **Make sure to connect mains cable is properly connected with ground earth pin.**

2 **Do not plug too many electrical devices into a single multiple electrical outlet. Otherwise, this may result in fire due to over-heating.**

3 **Install the TV where there is proper ventilation. Do not cover the product with cloth or other materials while plugged.**

4 **Prevent "images burn" or "Burn - in" on the TV screen. (If a fixed image displays on the TV screen for a long period of time, it will be imprinted and become a permanent disfigurement on the screen. This is called as " image burn" or "burn-in").**

5 **Avoid touching the screen at all time, as this may result in damage to the screen.**

6 **Disconnect the power card from the power outlet when you do not use the TV for long period of time.**

7 **To prevent the damage of TV, never plug the power cords until finished the work.**

PROCEDURE

TASK 1 : **Turning the TV ON for the first time**

1 Connect the power cord to a power outlet. The power indicator turns red and the TV switches to standby.

2 In standby mode, press the power button on the remote control or local key to turn the TV ON. The initial setting screen appears if you turn the TV ON for the first time.

Note: You can also access inital setting by accessing Option in the main menu.

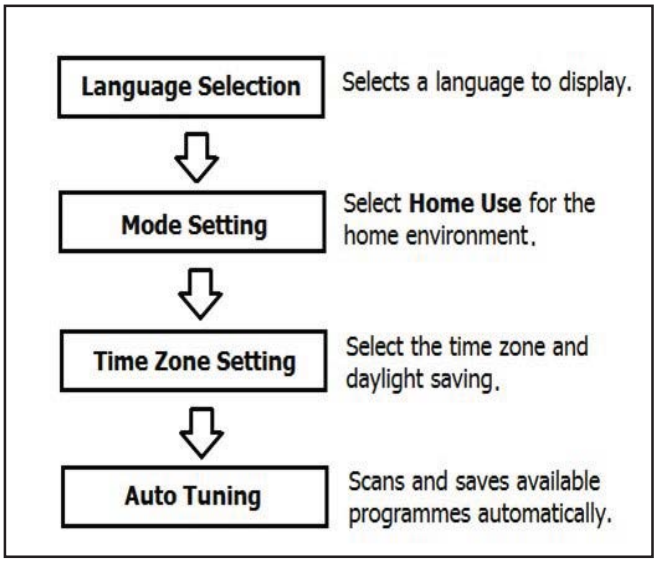
3 Follow the on-screen instructions to customize the TV settings according to the preferences.

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

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

Watching TV

1 In standby mode, press ⏻/I (power) to turn the TV ON.



2 Press Input and select TV

3 To turn the TV OFF, press ⏻/I(Power). The TV switches to standby mode.

Managing programmes:

a Automatically setting up programme

1 Press Settings and the navigation buttons to scroll to Setup and press OK.

2 Press the navigation buttons to scroll to Auto tuning and press OK.

3 Press the navigation buttons to scroll to 'To start' and select 'To start' to begin auto tuning. The TV scans and saves available programmes automatically.

4 When you return to the previous menu, press, Back.

b Manually setting programme

1 Press settings and the navigation buttons to scroll to setup and press OK.

2 Press the navigation buttons to scroll to manual tuning.

3 Press the navigation buttons to scroll to storage.

4 Press the navigation buttons or number buttons to select the desired programme number.

5 Press the navigation buttons to scroll to system.

6 Press the navigation buttons to scroll to TV system

7 Press the navigation butttons to scroll to band.

8 Press the navigation buttons to scroll to channel.

9 Press the navigation buttons to scroll to V/UHF or Cable.

10 Press the navigation buttons and then select the desired channel number with the navigations buttons or numbers.

11 Press the navigation buttons to scroll search.

12 Press the navigation buttons to scroll and start searching.

13 Press the OK to store it.

14 When you return to the previous menu, press, Back.

15 To store another programme, repeat steps 3 to 13.

Customizing TV setting

1 Practice and familiarize the following customize setting

a Picture settings

b Audio settings

c Time settings

d Option settings

e Lock settings

Other functions

1 Practice and familiarize the following functions in the LED television

a Assigning a Station Name

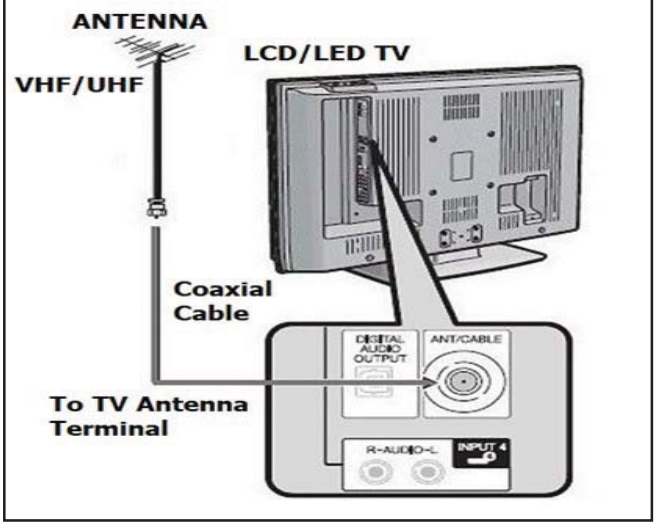
b Fine tuning

c Adjusting aspect ratio

d Browsing files from USB

1 Connecting LED television with an antenna or cable as shwon in Fig.1

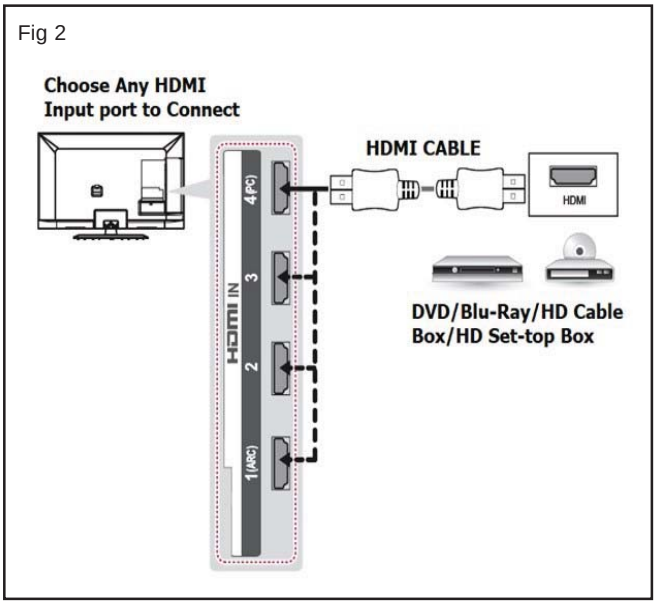
Fig 1



2 HDMI cable connection as show in Fig.2

- Connect the HDMI cable in the input position of the TV.
- Take one end of the HDMI cable and plug terminal at the HDMI output on the media device.
- Connect the other end of HDMI cable to the HDMI input on TV.

Fig 2



3 RCA cable connection as shown in Fig.3 and 4

- To connect TV using RCA (Composite video) match the colours of the cable and the connector of the TV.

Fig 3

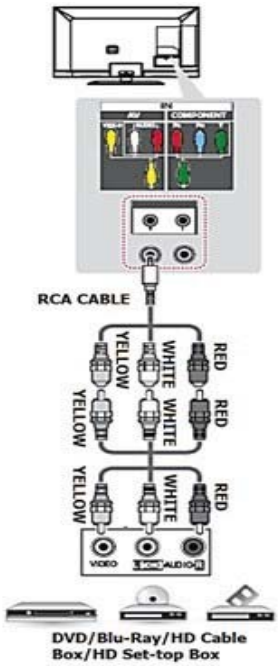
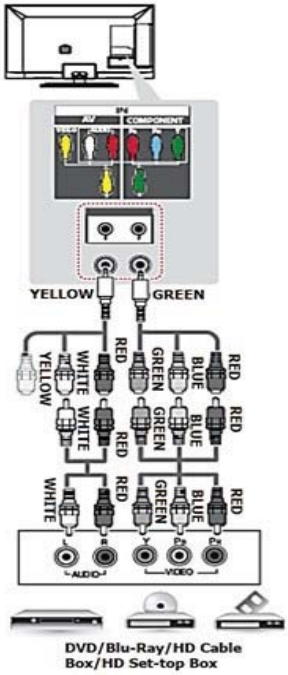


Fig 4

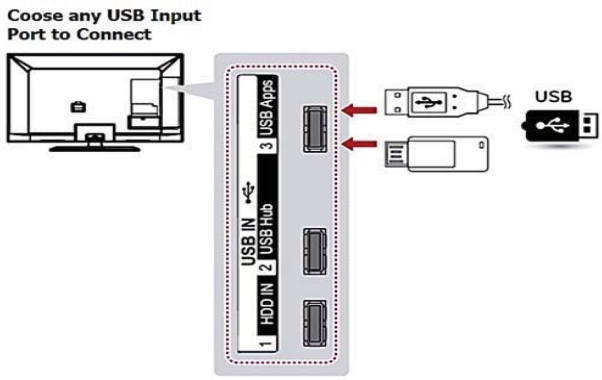


4 Component connection

- Transmits analog video and audio signals from an external device to the TV.

5 Connecting to a USB Fig.5

Fig 7



6 Connecting SET-Top box as shown in Fig.6

- Connect the cable TV coaxial cable to the input of the set-top box.

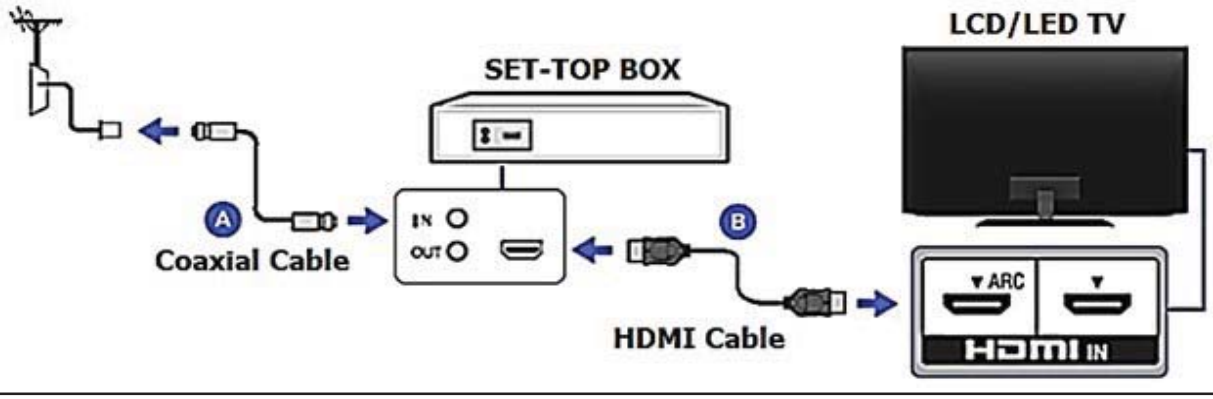
RCA cable method

- Select the 3 RCA cable, follow colour coding for audio and video signal

HDMI cable method

- Connect the HDMI cable into the HDMI output terminal of set-top box to the TV.
- Power ON both devices and select the input of TV either RCA or HDMI.
- Tune the set-top box to the desired channel.
- Get the work checked by the Instructor.

Fig 6



Identify various connectors and connect the cable operators external decoder (Set-top box) to the TV

Objectives : At the end of this exercise you shall be able to
- **identify different input/output connectors in set-top box**
- **identify different front panel indicators/controls on set-top box.**
- **connect the set top box to the TV.**

Requirements	
Tools / Equipmments/ Instruments • Trainees tool kit - 1 Set. • Set - top box with user manual and cable set (3 RCA to 3 RCA/ HDMI cable) - 1 Set. - as reqd.	**Materials/ Components** • LCD/LED TV with remote control handset - 1 Set. • DTH connectivity - as reqd.

Note: The Instructor has to label the input/output connectors on the front panel/rear panel of the set top box using permanent marker pen

PROCEDURE

TASK 1 : **Identification of different input/output connectors in set-top box**

1 Pick any one of the set-top box from the lab, see the rear panel as shown in Fig 1.

2 Identify different input /output connectors labelled for audio/ video connectors in set-top box and note down in TABLE 1.

3 Repeat the above steps for other set-top box if available in the lab.

Fig 1

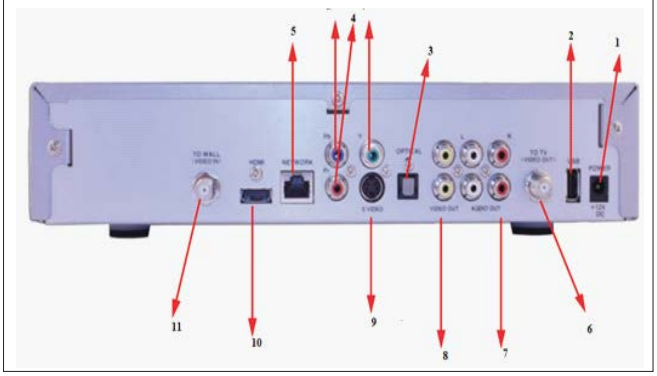


TABLE 1

Sl.No.	Name of the rear connector/socket	Remarks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

4 Get the work checked by the Instructor.

— — — — — —

Fig 2

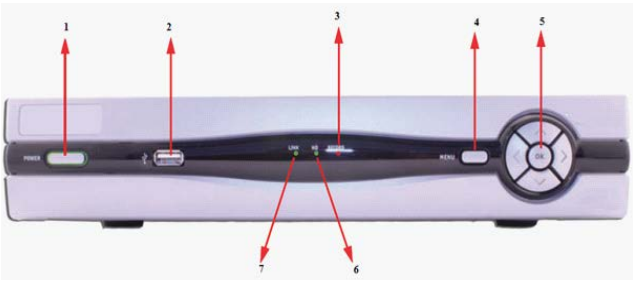


TABLE 2

Sl.No.	Name of the front panel control/indicator	Remarks
1		
2		
3		
4		
5		
6		
7		

— — — — — —

TASK 3: **Connecting the set-top-box to the TV**

1 Place the set-top box near the TV receiver at a convenient location.

2 Use the 3RCA to 3RCA cable, connect the output of set-top box following the colour code, connect the video input, left channel and right channel of audio inputs on the TV as shown in Fig.3

If HDMI terminal is available on the set-top box, use HDMI cable and connect it to the HDMI-1 input of LCD/LED TV.

3 Connect the coaxial cable from dish antenna terminated with the F-connector to the set-top box and plug the mains cord to AC supply.

4 Get the connections checked by the instructor.

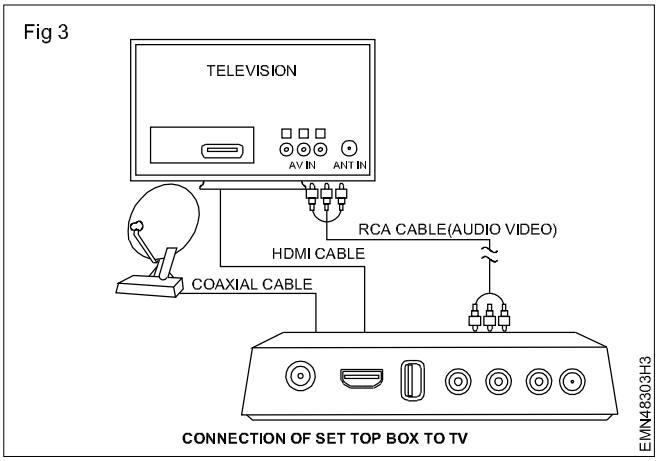
5 Switch ON the LCD/LED TV and Set-top box, use the remote control and select the AV input/HDMI-1 mode.

6 Use the remote control of the set-top box and select the organize button, view the channel on the LCD/ LED TV

7 Change channels using the remote control of the set-top box and get the work checked by the instructor.

8 Switch OFF both the set-top box and LCD/LED TV.

Fig 3



CONNECTION OF SET TOP BOX TO TV

— — — — — —