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MINISTRY OF SKILL DEVELOPMENT
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Participant Handbook

Sector
Electronics

Sub-Sector
Industrial Electronics

Occupation
Sales and After Sales Service

Reference ID - **ELE/Q7201, Version 1.0**
NSQF Level 4

Field Technician - UPS and Inverter

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

Shri Narendra Modi
Prime Minister of India

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Certificate

COMPLIANCE TO

QUALIFICATION PACK - NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

ELECTRONICS SECTOR SKILL COUNCIL OF INDIA

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/ Qualification Pack: **"Field Technician - UPS and Inverter"** QP No. **"ELE/Q7201, NSQF Level 4"**

Date of Issuance : March 10th, 2018
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*Valid up to the next review date of the Qualification Pack or the 'Valid up to' date mentioned above (whichever is earlier)

Authorised Signatory
(Electronics Sector Skill Council)

Acknowledgements

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

I would like to take the opportunity to thank everyone who contributed in developing this Handbook for the QP Field Technician – UPS and Inverter.

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

I would like to thank the team of KontentEdge for their support to develop the content, the SME and the team at the ESSCI along with the industry partners for the tireless effort in bringing the Handbook in the current format.

CEO

Electronics Sector Skills Council of India

About this Book

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

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS.

- Explain the basics of electronics
- Identify the electronic components
- Explain fundamentals of electricity
- Describe UPS and Inverter
- List tools and equipment used for installing and repairing UPS/Invert er
- Determine the responsibilities of a field technician
- Analyse the customer requirements
- Adhere to the reporting and documentation process
- Follow the health and safety norms
- Identify ways to improve the work process
- Identify the installation process of UPS/Inverter
- Identify the faults and repair the faulty modules of UPS/Inverter
- Identify the correct way of interacting with supervisors and colleagues
- Identify soft skills required for doing the job of a technician

The symbols used in this book are described below.

Symbols Used


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1. Basics of Uninterrupted Power Supply (UPS) and Inverter

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Unit 1.1 – Basics of Electronics and Electronic Components

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Unit 1.3 – Introduction to UPS and Inverters

Unit 1.4 – Tools and Equipment

ELE/N7201, ELE/N0061
ELE/N7202

Key Learning Outcomes

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

1. Explain the basics of electronics
2. Identify the electronic components
3. Explain fundamentals of electricity
4. Describe UPS and Inverter
5. List tools and equipment used for installing and repairing UPS/Invert er

UNIT 1.1: Basics of Electronics and Electronic Components

Unit Objectives

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

1. Define basic electronics
2. List electronic components

1.1.1 Understanding Basics of Electronics

Electronics is the branch of science where electrical energy is controlled electrically, through the flow of electrons. The study of this branch deals with electrical circuits involving active electronic components such as vacuum tubes, transistors, diodes and integrated circuits and passive electronic components such as resistors, capacitors and inductors, along with its interconnection technologies.

The following figure shows concepts covered in basics of electronics:

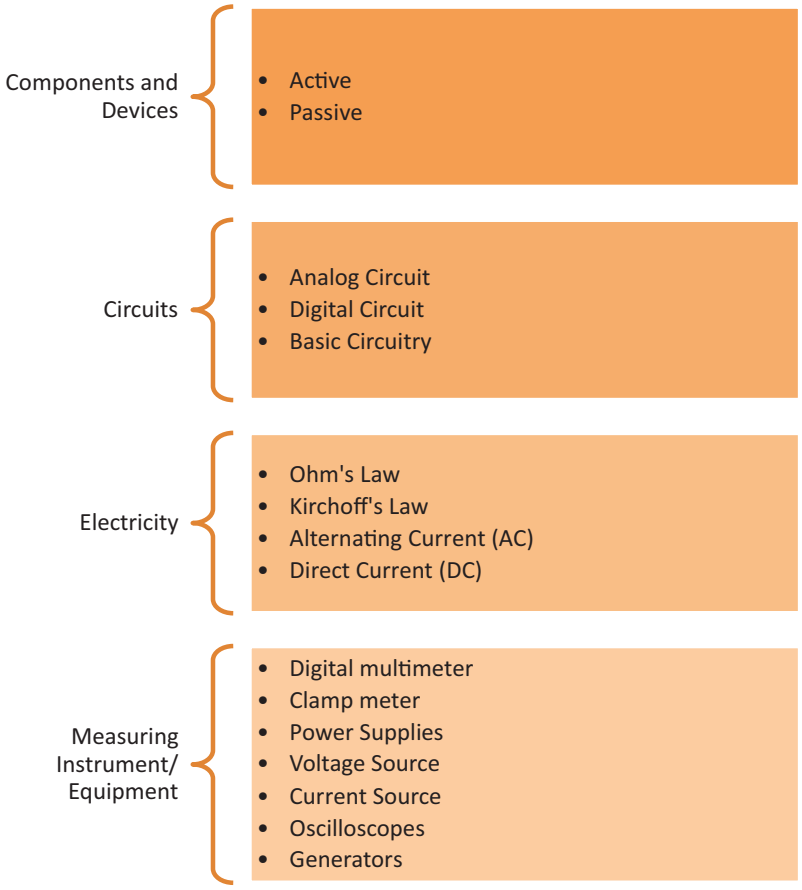
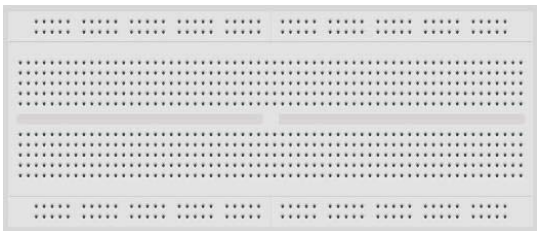


Fig 1.1.1: Concepts of basic electronics

1.1.2 Electronic Circuits and Components

In an electronic circuit, components are embedded on a printed circuit boards (PCBs). A PCB acts as a base for the components that are mounted on its surface and soldered. The components are generally soldered on the circuit board according to a specified design. The circuits are initially build and tested on a breadboard before being embedded on a PCB. The following images show a breadboard and a printed circuit board:



Breadboard

PCB

Fig 1.1.2: Breadboard and PCB

Electronic components are of two types:

- Active
- Passive

Active Components

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

The following figure represents list of active components:

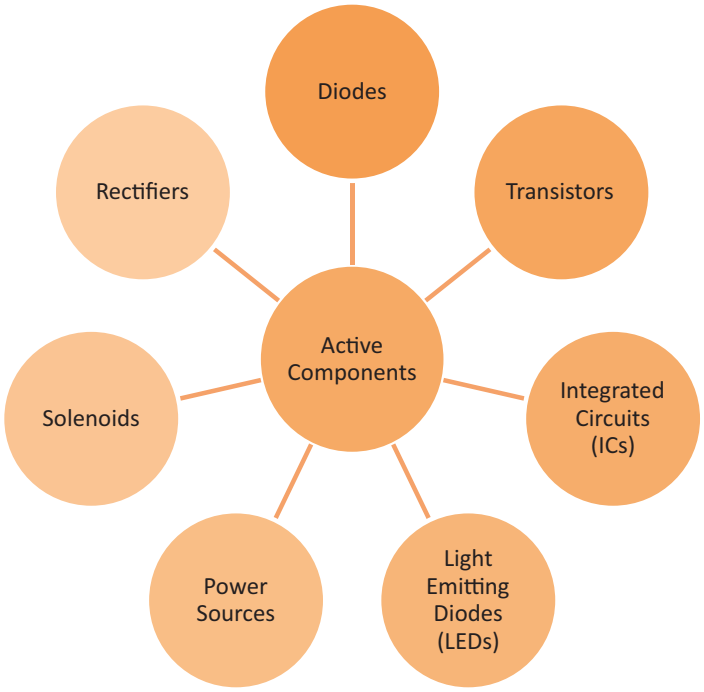


Fig 1.1.3: Active components

Diodes

A diode is a specialized electronic component with two terminals known as the anode and the cathode. It has asymmetric conductance, which means that it conducts mainly in one direction. It has very less resistance (ideally zero), to the flow of current in one direction. It has high resistance (ideally infinite), in the other direction. Diodes are usually made up of semiconductor materials such as germanium, silicon or selenium. The following image shows diodes:

Fig 1.1.4: Diodes

Transistors

A transistor is an electronic device, made up of semiconductor material. Usually, it has at least three terminals to connect to an external circuit. It is used to amplify or switch electrical power and electronic signals

The following image shows a transistor:

Fig 1.1.5: Transistor

IC

An IC, also known as a microchip, is a semiconductor wafer on which a number of small resistors, capacitors and transistors are fabricated. It can work as an oscillator, an amplifier, a timer, a counter, a microprocessor or as computer memory. The foll owing image shows an IC:

Fig 1.1.6: IC

LED

A LED is a p-n junction diode which gives out light when it is activated. It is a two-lead semiconductor source of light. Energy is released as photons when a suitable voltage is applied to the leads. The following image shows a LED:

Fig 1.1.7: LED

Power Sources

A power source is a source which provides power to a circuit. Generally, it is a generator or a battery.

The following image shows a battery:

Fig 1.1.8: Battery

Passive Components

Passive components are those components which do not require any power source to perform their specific functions. These components are not capable of controlling current.

Solenoid

A solenoid is an insulated or enamelled wire coil wrapped around a cylindrical solid core. The solid core may be of iron, steel or powdered iron. Solenoids can be used as electromagnets and inductors in electronic circuits. The following image shows a solenoid:

Fig 1.1.9: Solenoid

Rectifier

A rectifier is an electrical device that converts AC, which periodically reverses direction, to DC, which flows in only one direction. The following image shows a rectifier:

Fig 1.1.10: Rectifier

The following figure lists different passive components in a circuit:

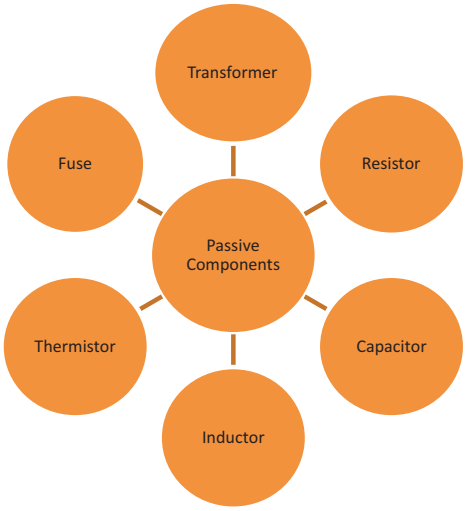


Fig 1.1.11: Passive components

Transformer

A transformer consists of a metal core with coils of wire around it. It is a device used to convert AC to the required values by decreasing or increasing the alternating voltages in an electronic or electric system. The following image shows a transformer:

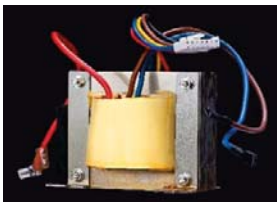


Fig 1.1.12: Transformer

Resistors

A resistor is a component in an electronic circuit which is built to resist or limit the flow of current in that circuit. It may be a small carbon device or a big wire-wound power resistor. Its size varies in length from 5mm up to 300mm. The following image shows resistors:

Fig 1.1.13: Resistors

Capacitors

A capacitor is a device which is made up of one or more pairs of conductors and an insulator separating them. It is used to store electric charge. The following image shows capacitors:

Fig 1.1.14: Capacitors

Inductors

An inductor consist of a coil or a wire loop. This component is used to store energy in form of magnetic field. The more the turns in the coil, the more will be the inductance. The following image shows inductors:

Fig 1.1.15: Inductors

Fuse

Fuse is a device used to protect electrical systems against excessive current. The following image represents a fuse.

Fig 1.1.16: Fuse

Types of Electronic Circuit

An electronic circuit is a combination of electronic components that are connected to provide flow of current. The different combination of wires and components allows different operations, such as amplification of signals, computation and transmission of data, to be performed. The following figure represents types of electronic circuits:

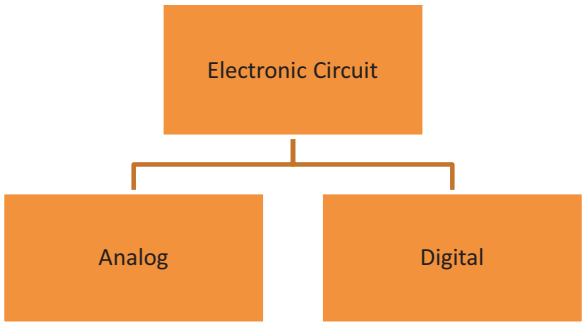


Fig 1.1.17: Classification of electronic circuits

Analog Circuits

In analog circuits, there is a continuous variation of voltage or current with time.

These circuits are a combination of basic components such as resistors, capacitors, diodes, inductors and transistors. The following figure represents an analog circuit:

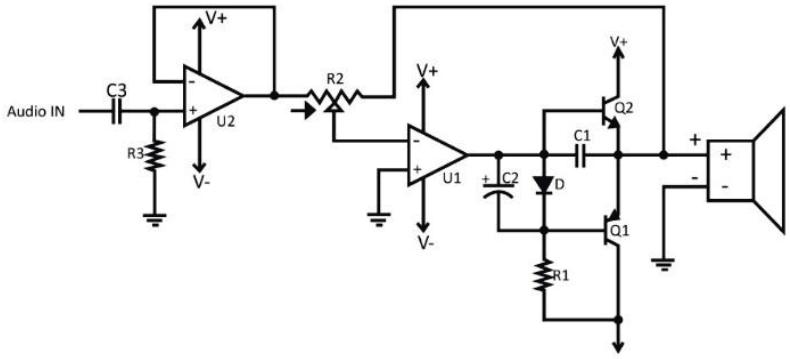


Fig 1.1.18: An analog circuit

The fundamental building blocks of analog circuits are:

- Series connection
- Parallel connection

Series Connection

In series connection, the magnitude of current is same through all the connected components. The following figure shows a series circuit and in the figure, $R = R_1 + R_2 + R_3$, where, R represents the resistance in the circuit:

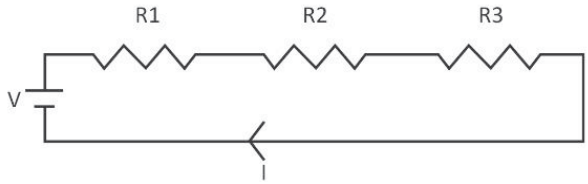


Fig 1.1.19: Series Connection

Parallel Circuit

In a parallel connection, the magnitude of voltage is same through all the connected components and the current is divided among the various components.

The following figure represents a parallel circuit. In the following figure, $1/R = 1/R_1 + 1/R_2 + 1/R_3$, where, R shows the resistance in the circuit and I represents the current:

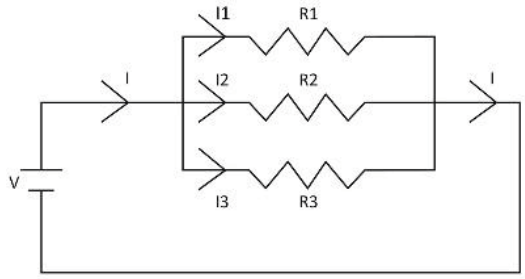


Fig 1.1.20: Parallel circuit

Digital Circuits

A binary scheme is used by digital circuits for digital signalling. Two different voltages (high or low) are represented by different logic levels. High voltage, generally 5V, represents one value and the other value represents low voltage that is generally 0V. The following figure shows a digital circuit:

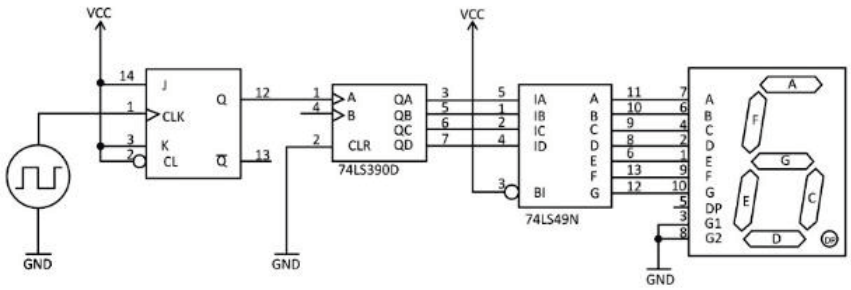
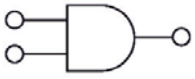
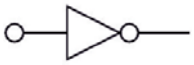


Fig 1.1.21: A digital circuit

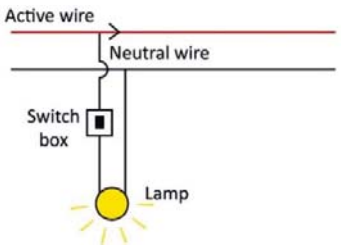
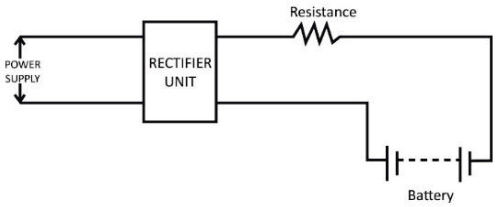
The following table describes basic building blocks of digital circuits:

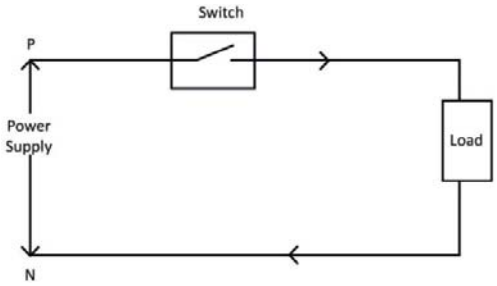
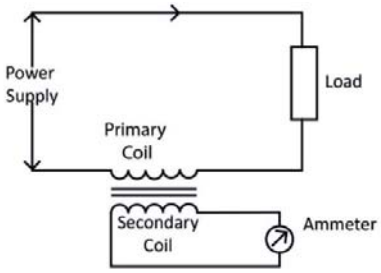
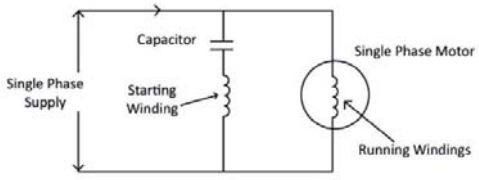
Logic Gates These are elementary blocks of a digital circuit. At any moment, the terminal voltage level is either high represented by 1 or low represented by 0	OR Gate The output terminal is at 1 when any of the inputs is 1 and is at 0 when all the inputs are at 0.	
	AND Gate The output terminal is at 1 when all the inputs are at 1, otherwise the output is 0.	

	NOT Gate/Inverter The output is 0 when the input is 1 and vice-versa.	
Microprocessor/Chip	An IC containing all the functions of a computer's central processing unit.	
Microcontroller	Is a small computer on an IC which controls devices that contain the microprocessor such as remote controls, office machines and appliances	

Basic Circuits

The following table describes some basic electronic circuits:

Circuit	Circuit Diagram	Description
AC circuit for Lamp		For connecting a lamp, two wires, neutral and active are connected to the main supply panel. There is a switch between the supply and lamp in the live wire. When the switch is ON, it closes the electric circuit allowing the lamp to glow. If the switch is OFF, the opposite will happen.
Battery Charging Circuit		In this circuit, a rectifier converts AC supply into DC. Resistance is added to the rectifier circuit to limit the current flow. When the AC supply is provided to the rectifier by means of a step-down transformer, it converts the AC supply into direct current, which then charges the battery.

Circuit with a switch		A switch is a component used to complete the circuit between the load and the supply. The power supply passes through the switch to the load and, therefore, by keeping the switch open, it can be cut off.
Current Transformer Circuit		The current transformer steps down the high voltage current and provide safe monitoring of the actual current flowing in the circuit. The primary coil of the transformer is connected to the power circuit in a way that the current can pass through it. The secondary coil is connected to the ammeter.
Single Phase Motor Circuit		A single-phase motor contains two terminals in the outer casing terminal box. One terminal is connected to the active wire and the other terminal is connected to the neutral wire. The motor will run till it continues to get power in the circuit.

UNIT 1.2: Fundamentals of Electricity

Unit Objectives

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

1. Define Ohm's law and Kirchhoff's law
2. Explain electrical polarity, AC/DC and serial and parallel circuit
3. Describe electric energy consumption

Electricity is a natural force that comes into existence whenever there is a flow of electric charge between any two components. The flow of electric charge is called current. Voltage is the potential difference between negative and positive charged components. When working with circuits, basic knowledge of electricity is very important to ensure that all connections are correct. A wrong connection in a circuit may cause high damage to people and the circuit components.

1.2.1 Ohm's Law

According to Ohm's law, current flowing through a conductor is directly proportional to the voltage across the conductor. The mathematical equation of Ohm's law is as follows:

$$I=V/R$$

Where,

I is current flowing through the conductor,
V is the potential difference or voltage across the conductor, and
R is proportionality constant, known as the resistance of the conductor.

Resistance of the conductor is independent of current flowing through it as shown in the following figure:

Fig 1.2.1: Simple electric circuit

Kirchhoff's law deals with current flow and voltage in an electrical circuit.