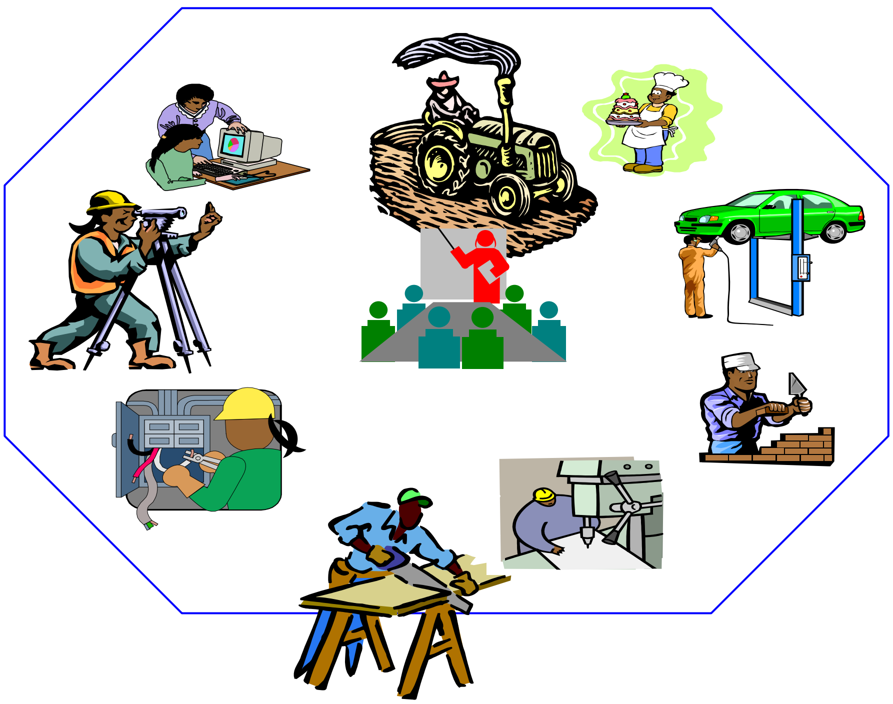
HOME/OFFICEELECTRICAL/ELECTRONICS EQUIPMENT SERVICING NTQF Level III

Based on may, 2011 Version1 OS and Feb, 2021 Version Curriculum



Module Title: Developing Basic Electronic System Design

TTLM Code: EEL HOS3 M05 LO (1-4) LG (14-17)

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Feb 2021

Bishoftu, Ethiopia

Table of Contents **page**

LG #14	**LO1: Prepare to develop basic electronics system design**

Instruction sheet

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

- Identifying OHS(occupational Health and Safety) *procedures*
- Establishing for planning project design procedure and *environmental requirement*
- Determine the project designing development proposal
- Planning project work schedule
- Requiring resources for the project work

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

- Identify OHS(occupational Health and Safety) *procedures*
- Establish for planning project design procedure and *environmental requirement*
- Determine the project design development proposal
- Plan project work schedule time linens
- Require resources for the project work

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the "Self-checks" which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to "Operation sheets
7. Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information Sheet-1	Identifying OHS procedures

This unit deals with the skills and knowledge required to implement occupational health and safety procedures in a range of settings within the electronic home office equipment service industries work place context. The Trainee will be able to implement occupational health and safety procedures in their work place

Learning Objectives of this information sheet are:

- Use safe work practices.
- Describe the purposes of legislation concerning safety in the workplace.
- Describe safety precautions and procedures pertaining to and working with electricity.
- Describe correct safety procedures for hand and power tools.
- Locate and describe shop safety equipment.
- Use safe work practices.

1. Occupational health and safety

Occupational safety and health **(**OSH), also commonly referred to as occupational health and Safety (OHS), occupational health, or workplace health and safety **(**WHS), is a multidisciplinary field concerned with the safety, health, and welfare of people at work. OSH may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment. The term occupational health and safety is referred to as occupational health and occupational and non-occupational safety and includes safety for activities outside of work. In common-law jurisdictions, employers have a common law duty to take reasonable care of the safety of their employees. Statute law may in addition impose other general duties, introduce specific duties, and create government bodies with powers to regulate workplace safety issues: details of this vary from jurisdiction to jurisdiction. All organizations have the duty to ensure that employees and any other person who may be affected by the organization's activities remain safe at all times.

As defined by the World Health Organization (WHO) "occupational health deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards.

2. The main focus in occupational health is on three different objectives:

1 The maintenance and promotion of workers' health and working capacity;

2 The improvement of working environment and work to become conducive to safety and health and

3 Development of work organizations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may enhance productivity of the undertakings.

The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies and quality management of the undertaking. Occupational health should aim at:

- the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations;
- the prevention amongst workers of departures from health caused by their working conditions;
- the protection of workers in their employment from risks resulting from factors adverse to health;
- the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize,
- the adaptation of work to man and of each man to his job

Fig. 1 thinks more about safety

Safe place instead of safe person

It should be remembered OHS legislation places substantial emphasis on the need for management to ensure: The workplace itself is safe. This means there needs to be safe equipment, safe practices and procedures and safe materials Full provision to staff of all information relevant to the safety of or dangers inherent in all tasks they perform. The major message is that management must collaborate with staff to provide a safe workplace. The aim is to make the workplace safe rather than trying to make the worker responsible for safety. Examples of OHS information to be explained to new personnel

Fig 2.safety

3. Make health and safety information accessible to trainees

Explanation of the OHS training available within the workplace explaining what training is mandatory and what is optional, and detailing how staff can access this training. Attention should also be paid to identifying work requiring the completion on in-house training Provision of OHS updates such as sharing information with new staff as provided by OHS authorities, manufacturers of equipment, suppliers of chemicals, or other reliable sources of safety information

It is part of the duty of care requirements for any business to ensure it provides up to date OHS information to its staff. Given OHS information is a dynamic field, constant attention must be paid to updating this workplace information and ensuring only current information is made available to trainees to know how and where safety

4. Identifying safety and health hazards

4.1. Hazard identification

Hazard identification or assessment is an important step in the overall risk assessment and risk management process. It is where individual work hazards are identified, assessed and controlled/eliminated as close to source (location of the hazard) as reasonably as possible. As technology, resources, social expectation or regulatory requirements change, hazard analysis focuses controls more closely toward the source of the hazard. Thus hazard control is a dynamic program of prevention. Hazard-based programs also have the advantage of not assigning or implying there are "acceptable risks" in the workplace. A hazard-based program may not be able to eliminate all risks, but neither does it accept "satisfactory" but still risky outcomes. And as those who calculate and manage the risk are usually managers while those exposed to the risks are a different group, workers, a hazard-based approach can by-pass conflict inherent in a risk-based approach.

4.1.Risk assessment

Modern occupational safety and health legislation usually demands that a risk assessment be carried out prior to making an intervention. It should be kept in mind that risk management requires risk to be managed to a level which is as low as is reasonably practical. This assessment should:

- Identify the hazards
- Identify all affected by the hazard and how
- Evaluate the risk
- Identify and prioritize appropriate control measures

2.2. Hazards can be identified in a number of ways:

- Consulting with HSRs

- Consulting with employees
- Undertaking workplace inspections
  - Examining workplace records of incidents and dangerous occurrences or near misses
  - Keeping up to date with safety-related matters and issues. The most effective methods of identifying hazards use a combination of these ways.

When developing inspection systems it is important to establish:

- The emphasis and scope of the inspections – what will be inspected and which areas will be inspected
- How they are to be conducted. A walk around" the workplace is an essential element of any inspection system
- How often they are to be carried out. Regular inspections are critical: once every month is best but inspections should occur at least every three months
- Who will be involved in the inspections? Workers should be involved together with the HSR and a management-level representative
- Who is responsible for ensuring suggested improvements are taken into account? This will normally be management or the owner
- What checks should be carried out to ensure corrective action has been taken once a problem has been identified, analysed and has had suitable control procedures developed for it?
- It is also important to check the implementation of risk controls has not, itself, introduced a new risk into the workplace
- How they are to be documented. Inspections should use a dedicated inspection checklist to record findings of the inspection.
- The main reasons for doing workplace OHS inspections are to identify the health and safety hazards in the workplace that exist or have emerged over time.

What should be inspected?

When deciding which aspects of the workplace are priority areas for routine inspection, it is important to consider: The existing and potential health and safety hazards within each workplace. Common sense is a good indicator, as is input from workers and analysis of workplace accident registers the types of processes, operations and occupations present in the workplace. Historically certain tasks carry with them greater risks. For example, the risks in a kitchen are more numerous and potentially dangerous than those involved in an office environment

Fig 3 inspection

Any OHS legislated requirements relating to particular hazards, occupations, industrial processes and operations which apply to individual work places. The introduction of anything new (process, product, equipment) has the potential to create a new or different risk or hazard. Remember the introduction of risk control measures may sometimes introduce a new/different hazard or risk Equipment, substances or situations causing injury or disease in the past using anecdotal staff evidence and accident/near miss registers as the basis for identifying these

The need to follow up and monitor any changes suggested or implemented during previous inspections – to ensure they are effective and are being implemented.

Checklists

Where areas for routine inspections have been established (such as the areas/departments which are the basis of DWGs) simple checklists which can be systematically completed during inspections should be prepared to facilitate and record findings.

These will help save time and ensure a thorough inspection is carried out which is consistent every time it is undertaken.

In practice, these checklists form the basis of a comprehensive review of workplace practices on a regular basis (every month or three months).

Checklists will vary according to the workplace environment.

The types of hazards present will determine the areas covered in the checklist. Some areas to consider and develop checklists for are:

- Manual handling hazards addressing any activities where there is a need to push, pull, carry, manipulate, carry, lift, or use anything

- Housekeeping practices relating to issues such as (but not restricted to) use of chemicals, bed making, cleaning of items (such as baths and toilets) and the vast variety of manual handling activities

- General tidiness of the workplace with attention to items being stowed in walkways, rubbish in the workplace, arrangement of items, storing of cartons and equipment

- Machinery with attention focussed on correct operation, presence of all required safety guards and cut-off switches, noise levels and stability of items

- Chemical hazards addressing issues such as fumes, gases, storage, labelling, handling, Material Safety Data Sheets, personal protective clothing and equipment

- Electrical safety ensuring electrical items have been tested, tagged and are safe to use

- Office safety relating to the layout of offices, furniture used, use of equipment (especially computers and related equipment), and lighting as well as personal practices of office staff when engaged in office work

- Fire safety addressing firefighting equipment, access and exits, alarm systems, instructions for employees and presence of suitable EMPs

- First aid provisions. Verify all the necessary items are present in workplace first aid kits, that the kits are located where they should be and all the facilities in any First Aid rooms are present and in working condition. This check should also verify any workplace first aid providers have current first aid qualifications, updated as required so they maintain currency and required skill and knowledge levels

- Registers. Ensure they are located where required and are being completed as necessary.

Because each workplace is different, it is important to develop checklists which match the actual design and processes of the workplace, and the products and services each area/DWG is involved in providing.

Tailoring inspection checklists to suit the workplace will ensure all existing and potential health and safety problems can be identified.

Codes of Practice/Compliance Codes may contain checklists which can be used (or modified) to help identify particular hazards and hazard areas.

Implement and monitor procedures for controlling hazards and risks

Previous notes have stressed the need for a collaborative and consultative approach towards workplace safety.

A key to this approach is the ongoing identification of workplace hazards before they result in accident or injury.

- What is involved?

Effective hazard identification requires application of all the techniques identified above (regular workplace inspections using checklists to record and document what is found) as well as close contact with staff and the operation of the business on a day by day basis. This close contact is necessary so: Employees understand safety is an ongoing concern for management and demonstrating management are actually involved and „walking the talk"

Fig.4. Shows information walking the talk

❖ Hazards with plant and equipment

Efforts to identify hazards in relation to, tools, appliances and equipment should focus on:

- ❖ Ensuring regular service and maintenance is provided for all plant and equipment, items and utensils in accordance with manufacturer's instructions and to address malfunctions
- ❖ Ensuring staff receive adequate training in the use of all plant and equipment, items and utensils they are required to use

Figure (5)electrical testing

- ❖ Ensuring electrical tests and checks are performed at least every 12 months to ensure the electrical safety of equipment and appliances, power points and switches
- ❖ Ensuring RCDs are fitted to portable electrical equipment to shut off power when an incident occurs where a person could be subject to an electric shock
- ❖ Ensuring staff are adhering to standard safe work practice when using electrical equipment/appliances such as:
  - ✓ Not operating electrical equipment while standing in water
  - ✓ Not using electrical equipment with wet hands
  - ✓ Not using appliances that are untagged as being tested and safe for use
  - ✓ Not using faulty appliances or items tagged as being „Out Of Operation/Service – Unsafe For Use‟
  - ✓ Not using electrical appliances for work they were not intended for
- ❖ Ensuring all malfunctioning tools and equipment are reported using verbal reporting mechanism or completing a workplace-based „Maintenance Request‟ form, and taking the faulty item out of service and tagging it as Out of Service
- ❖ Ensuring only enterprise tools and equipment are to be used for undertaking work at the workplace. This means staff cannot bring in and use their own electrical tools and equipment

- Ensuring all operational manuals, manufacturer‟s instructions and trouble-shooting guides are available to all users.

Hazards with working practices

- Attention should be paid to the following as they commonly raise workplace hazards in one form or another:
- Opening and closing procedures (procedures used by a business or department at the beginning and end of a day or shift.
- Special attention must be paid at closing times to ensure all doors and windows are locked and no unauthorized persons are left on the premises

Reporting hazards

Fig (6) riporting

- When workplace hazards are identified they must be immediately reported to the appropriate person such as a **supervisor** or **HSR.**
- A verbal report is usually the best option as it is quick and allows the other person to ask questions to clarify and better understand the issue.
- A written form such as a Hazard notification or Hazard report may also be required.

Summary

Provide information on health and safety procedures

- ❖ **When implementing OHS procedures:**

- **Be certain about legislated obligations Ensure duty of care obligations are addressed**

- ✓ **Understanding workplace OHS roles and responsibilities attaching to individual workplace positions**
- ✓ **Be aware of the generic OHS obligations on Trainees' and employees**
- ✓ **Encourage participative OHS arrangements where workers are engaged with workplace OHS issues and activities**
- ✓ **Develop a formal workplace structure to facilitate cooperation from workers regarding OHS matters**
- ✓ **Seek a collaborative OHS relationship between workers and management**
- ✓ **Provide necessary OHS information, training and advice to all staff as appropriate to their job position as part of their Induction and Orientation, and on an ongoing basis**
- ✓ **Ensure staff are trained, monitored and supervised to ensure they work safely**
- ✓ **Develop safe place as opposed to developing „safe persons‟**

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Part 1. Say true or false

1. One of most important responsibilities is to protect your Health and Safety as well as that of your co-workers
2. Your employer is responsible for providing you with safe and healthy working conditions
3. You must cooperate with your employer in making your workplace safe and healthy
4. Special Training is required for work on electrical equipment
5. Only Authorized Employees may conduct electrical work
6. Hazards exist in every workplace in many different forms
7. Employers are responsible for identifying and providing appropriate PPE for employees.
8. Employers are responsible for training employees in the use and care of the PPE.
9. Employees should Properly wear PPE,
10. Employees attend training sessions on PPE,

Answer the following question!	
Note: **Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
You can ask you teacher for the copy of the correct answers.	

Answer Sheet

Name: _________________________

1. True
2. True
3. True
4. True
5. True
6. True
7. True
8. True
9. True
10. True

Score = ____________
Rating: _____________

Date: _______________

Information Sheet -2	planning project design procedure and environmental requirement

2.1 planning project design procedure and environmental requirement

Learning Objectives

Determine Project planning steps:

1. Identifies specific community problems that stand in the way of meeting community goals.
2. Creates a work plan for addressing problems and attaining the goals.
3. Describes measurable beneficial impacts to the community that result from the project's implementation.
4. Determines the level of resources or funding necessary to implement the project...

- Project planning:

Project planning involves a series of steps that determine how to achieve a particular Community or organizational goal or set of related goals.This goal can be identified in a community plan or a strategic plan. Project plans can also be based on community goals or action strategies developed through community meetings and gatherings, tribal council or board meetings, or other planning processes. The planning process should occur before you write your application and submit it for funding.

- **Why is project planning important?**

Project Planning helps us to:	Project Planning helps to eliminate:
think ahead and prepare for the future clarify goals and develop a vision identify issues that will need to be addressed choose between options consider whether a project is possible make the best use of resources motivate staff and the community assign resources and responsibilities achieve the best results	poor planning overambitious projects unsustainable projects undefined problems unstructured project work plans

❖ **Project requirements**

- ✓ work-breakdown structure
- ✓ WBS
- ✓ Hierarchy of tasks required to complete project
- ✓ Each task is broken into smaller tasks that can be managed and estimated
- ✓ Define task dependencies
- ✓ Some tasks must begin at the same time, some must end at the same time and some cannot start until the other tasks have finished.
- ✓ Estimate task durations and cost
- ✓ May be inputted into project management software

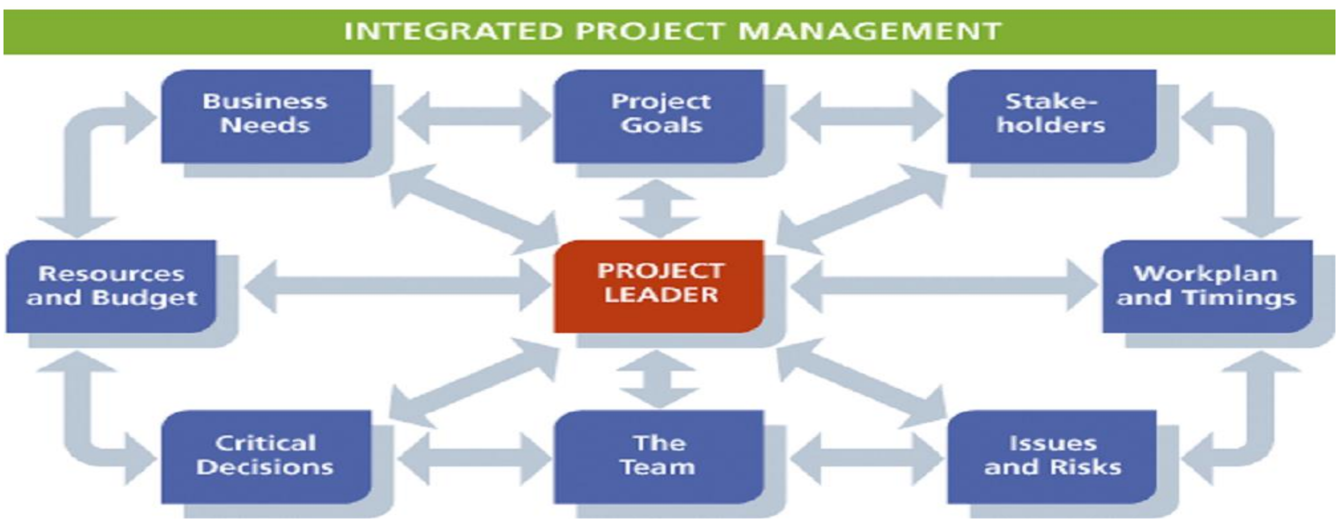


Fig 7.project manual

2.2. Maintenance manuals, schedules , component specifications & standards

2.3.component specifications & standards to create specified value

2.3.1. Resistors: are the most commonly used component in electronics and their purpose is to create specified values of current and voltage in a circuit. A number of different resistors are shown in the photos. (The resistors are on millimetre paper, with 1cm spacing to give some idea of the dimensions).

Resistors with power dissipation below 5 watt (most commonly used types) are cylindrical in shape, with a wire protruding from each end for connecting to a circuit

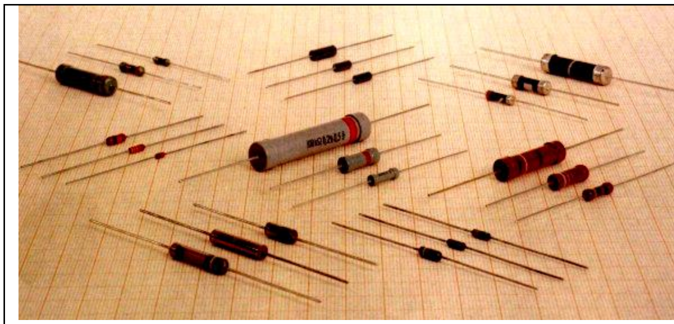


Fig. 1a: Some low-power resistors	Fig. 1b: High-power resistors and rheostats

(Fig.1.1-a). Resistors with power dissipation above 5 watt are shown below

The symbol for a resistor is shown in the following diagram (upper: American symbol, lower: European symbol.)

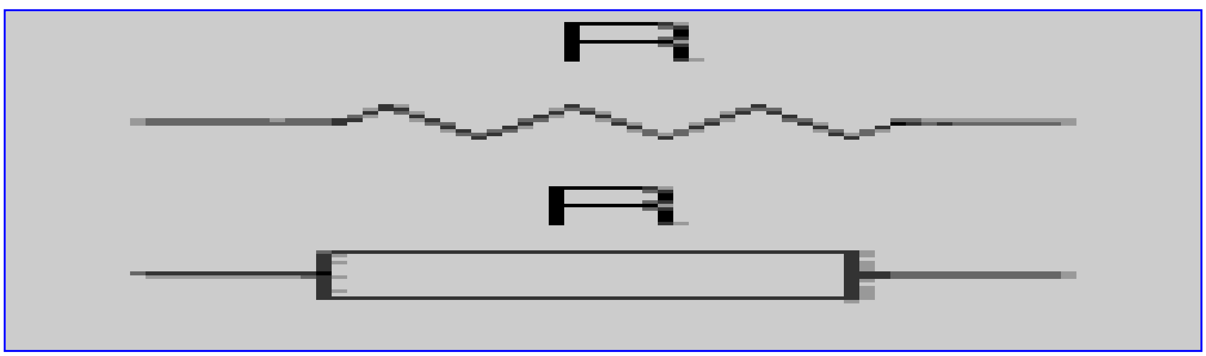


Fig. 9 Resistor symbols

The unit for measuring resistance is the **OHM**. (The Greek letter Ω - called Omega). Higher resistance values are represented by "k" (kilo-ohms) and M (Meg ohms). For example, 120 000 Ω is represented as 120k, while 1 200 000 Ω is represented as 1M2. The dot is generally omitted as it can easily be lost in the printing process. In some circuit diagrams, a value such as 8 or 120 represents a resistance in ohms. Another common practice is to use the letter E for resistance in ohms. The letter R can also be used. For example, 120E (120R) stands for 120 Ω, 1E2 stands for 1R2 etc.

2.3.2 RESISTORS MARKINGS

Resistance value is marked on the resistor body. Most resistors have 4 bands. The first two bands provide the numbers for the resistance and the third band provides the number of zeros. The fourth band indicates the tolerance. Tolerance values of 5%, 2%, and 1% are most commonly available.

The following table shows the colours used to identify resistor values:

COLOR	DIGIT	MULTIPLIER	TOLERANCE	TC
Silver		x 0.01Ω	±10%	
Gold		x 0.1Ω	±5%	
Black	0	x 1Ω		
Brown	1	x 10Ω	±1%	±100*10^{-6}/K
Red	2	x 100Ω	±2%	±50*10^{-6}/K
Orange	3	x 1 kΩ		±15*10^{-6}/K
Yellow	4	x 10 kΩ		±25*10^{-6}/K
Green	5	x 100 kΩ	±0.5%	
Blue	6	x 1 MΩ	±0.25%	±10*10^{-6}/K
Violet	7	x 10 MΩ	±0.1%	±5*10^{-6}/K
Grey	8	x 100 MΩ		
White	9	x 1 GΩ		±1*10^{-6}/K

Fig. 10 TC - Temp. Coefficient, only for SMD devices

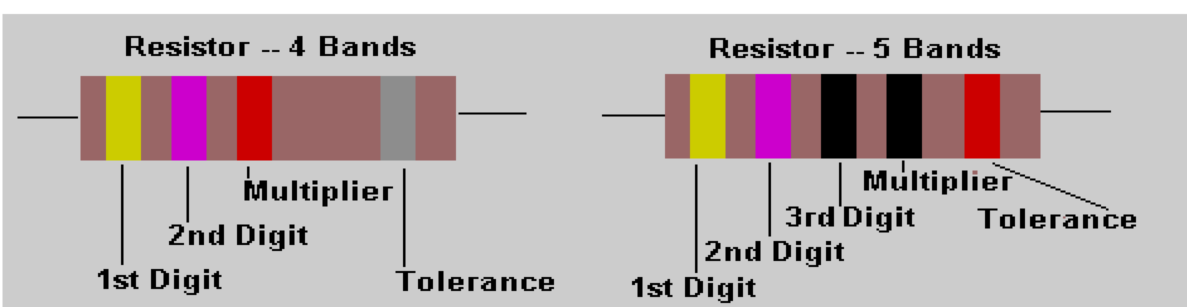


Fig. 11. Resistor 4bands and resistor 5bands

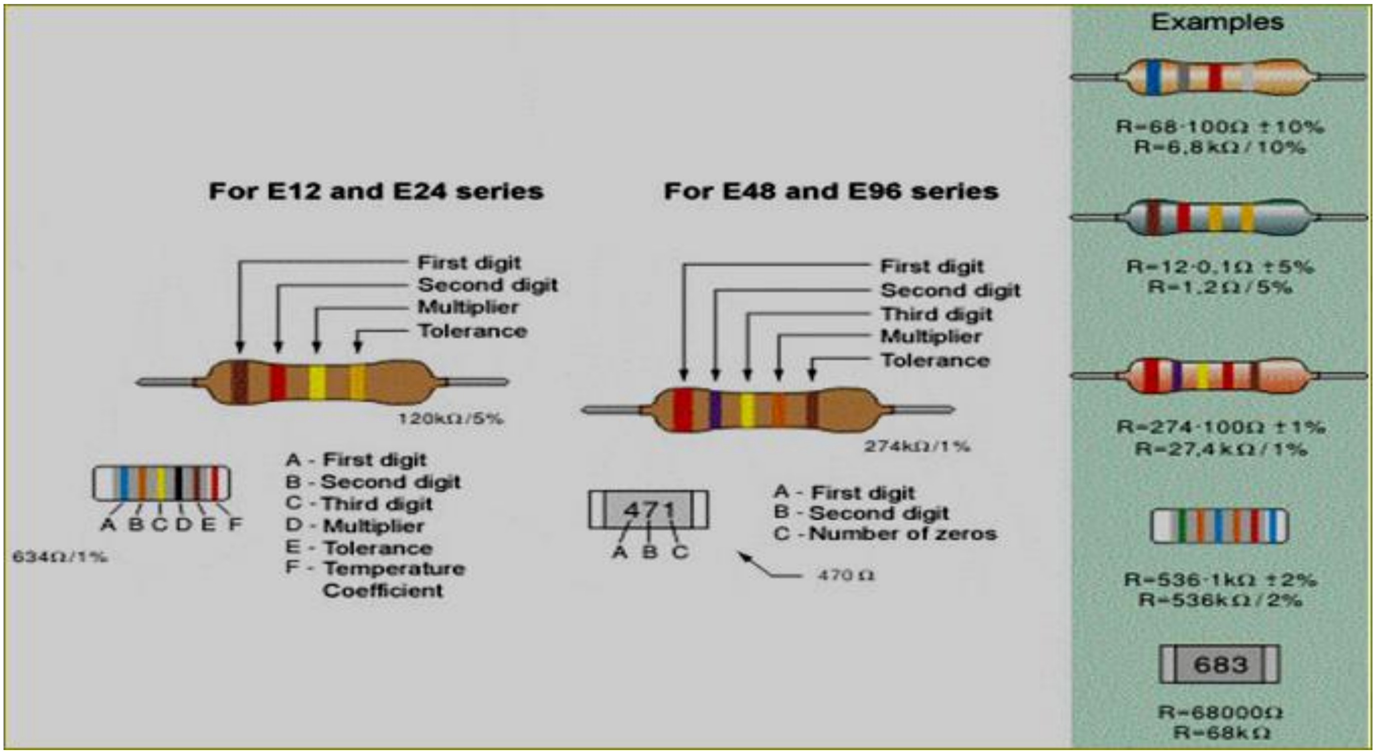


Fig.12 Resistor dissipation

If the flow of current through a resistor increases, it heats up, and if the temperature exceeds a certain critical value, it can be damaged. The wattage rating of a resistor is the power it can dissipate over a long period of time. Wattage rating is not identified on small resistors. The following diagrams show the size and wattage rating:

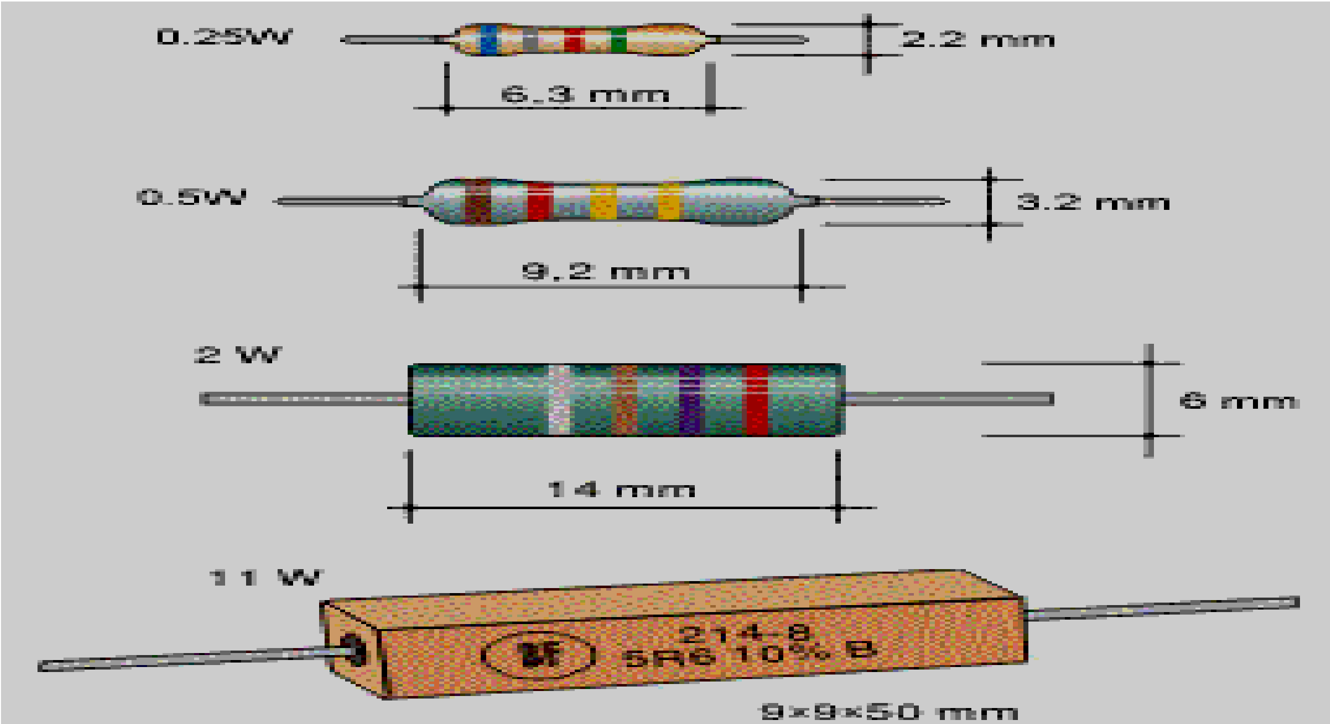


Fig. 13. Resistor dimensions

Most commonly used resistors in electronic circuits have a wattage rating of 1/2W or 1/4W. There are smaller resistors (1/8W and 1/16W) and higher (1W, 2W, 5W, etc). In place of a single resistor with specified dissipation, another one with the same resistance and higher rating may be used, but its larger dimensions increase the space taken on a printed circuit board as well as the added cost.

3.2.3. Two Main Categories of Resistors

3.2.3.1. LINEAR RESISTORS

Those resistances value which obey the ohms law.

- R=V/I, where
- R-resistance,
- V- voltage,
- I=current

3.2.3.2. NON-LINEAR RESISTORS

Resistance values detailed above are a constant and do not change if the voltage or current-flow alters. But there are circuits that require resistors to change value with a change in temperate or light. This function may not be linear, hence the name Non-Linear Resistors**.**

There are several types of nonlinear resistors, but the most commonly used include:

3.2.3.3. NTC resistors

Negative Temperature Co-efficient - their resistance lowers with temperature rise.

3.2.3.4. PTC resistors

Positive Temperature Co-efficient - their resistance increases with the temperature rise.

3.2.3.5. LDR resistors

Light Dependent Resistors - their resistance lowers with the increase in light.

3.2.3.6. VDR resistors

Voltage dependent Resistors - their resistance critically lowers as the voltage exceeds a certain value.

- **Symbols representing these resistors are shown below.**

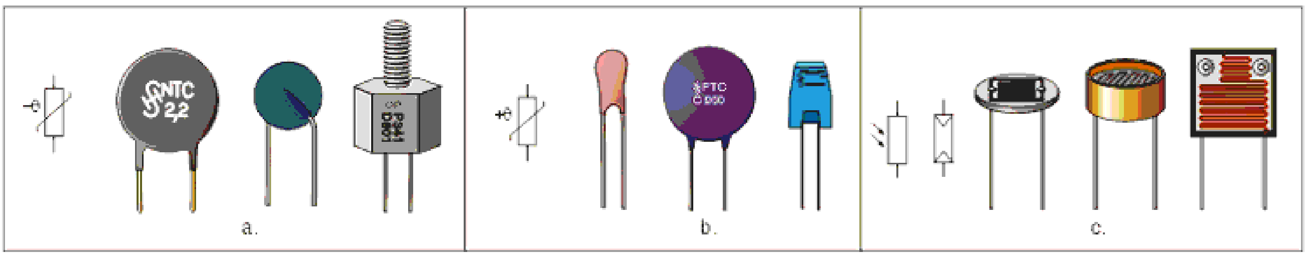


Fig .14 VDR resistors

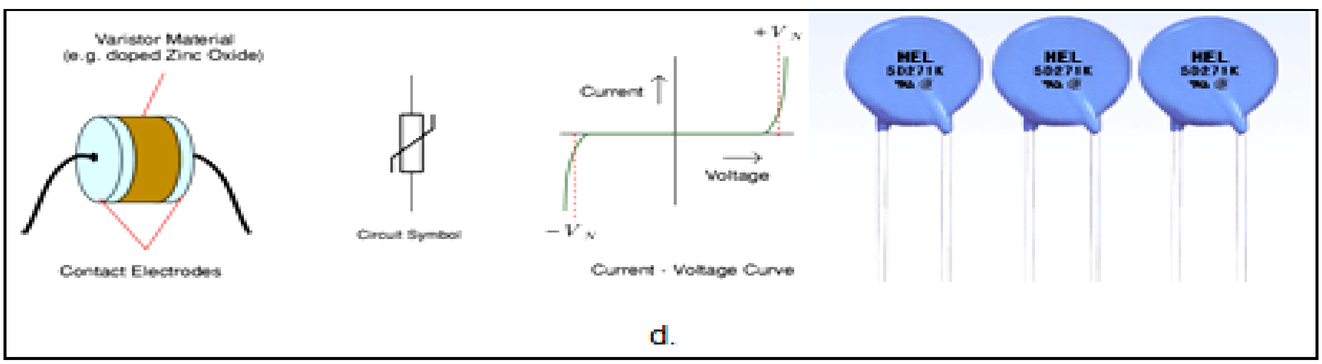


Fig. 15: Nonlinear resistors - a. NTC, b. PTC, c. LDR, d. VDR

3.2.3.7. Classification of Resistor

According to type of material	According to their tolerance
Carbon composition	General purpose, 5% or greater
Carbon film	Semi-precision, 1% to 5%
Metal film	precision, 0.5% to 1%
Wire wound	Ultra-precision, less than 0.5%

Carbon Composition Resistors are made either by hot or cold molding from mixtures of carbon and clay binder. These has become a dominant discrete resistor mainly for its low-cost reliability.

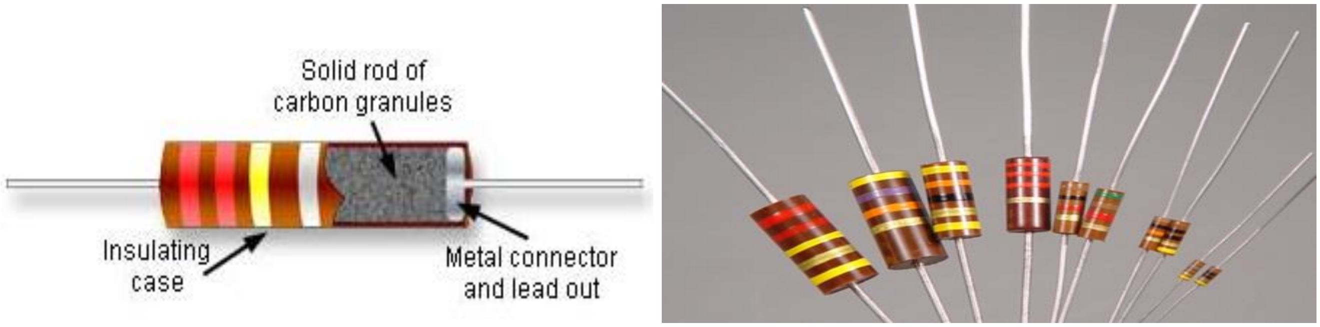


Fig. 16 Carbon Composition Resistors

Carbon Film Resistors is made from carbon graphite, mixed with powdered insulating materials. This type of resistor offers high resistance using low power.

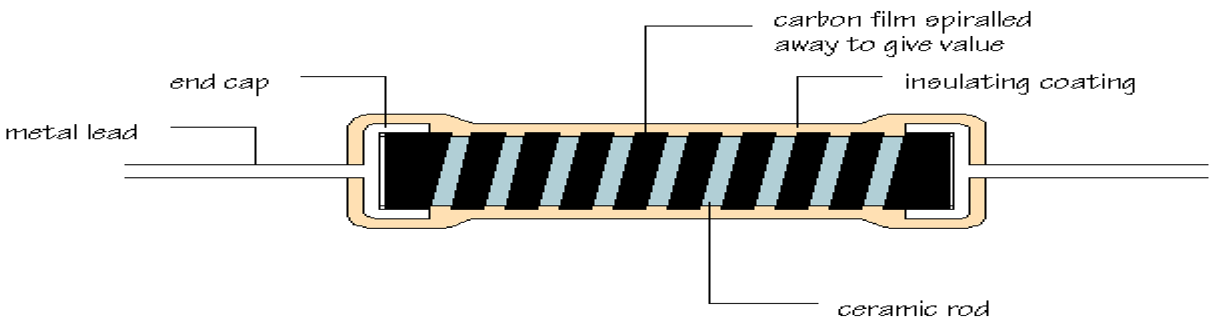


Fig. 17 fig Carbon Film Resistors

- **Three distinct types of carbon film resistors:**

The standard film resistor – a circular resistor with two pins extending from opposite sides or the barrel-shaped resistor

Fig. 18 the standard film resistor

The chip resistor – this type of resistor was introduced in the late 80's to accommodate for the ever shrinking computer components where there can be up to 6 layers per circuit board.

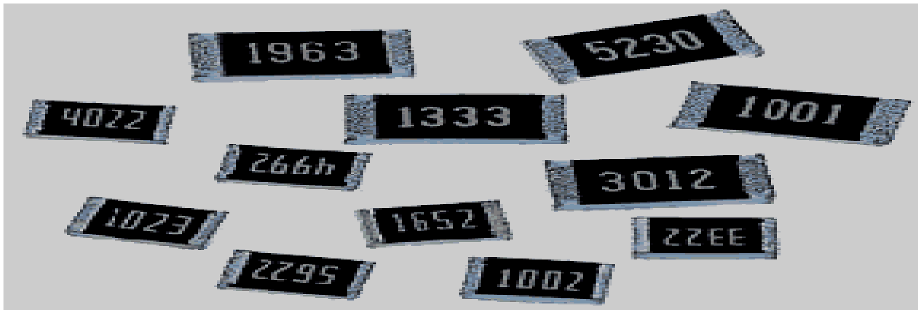


Fig.19 chip resistor

The network resistor – this type of resistor comes in compact form and can contain up to 12 resistors in a compact space.

Fig. 20. The network resistor

Metal Film Resistors are laser trimmed to obtain the desired resistance value before the protective coat is applied. These are formed by means of vacuum decomposition, a process by which any of a number of different metal or metal oxide films is deposited on a suitable insulating mandrel or core. Nickel and chromium are deposited on the alumina ceramic core and the unit is then subjected to laser trimming.

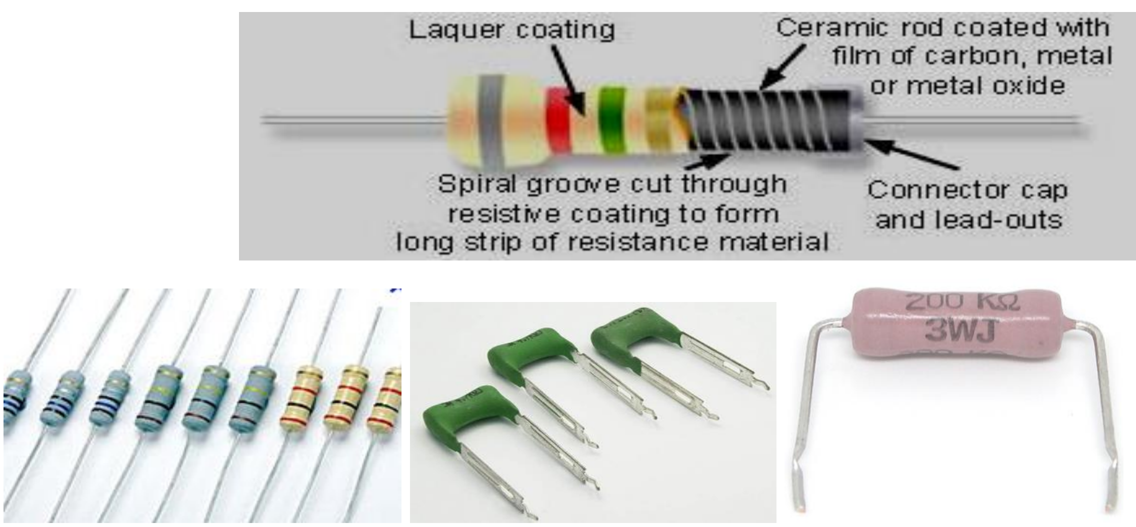


Fig. 21. Resistor types

Wire-wound resistors are very variable in construction and physical appearance. Their resistive elements are commonly lengths of wire, usually an alloy such as Nickel/Chromium (Nichrome) or Managing (Copper/Nickel/Manganese) wrapped around a small ceramic or glass fiber rod and coated in an insulating flameproof cement film. They are normally available in quite low values of resistance (single ohms to a few Kilo ohms) but can dissipate large amounts of power. In use they may get very hot.

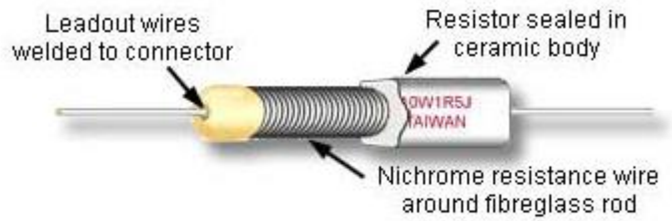


Fig. 22. Wire wound resistor

For this reason high power wire-wound resistors may be housed in a finned metal case that can be bolted to a metal chassis to dissipate the heat generated as effectively as possible. With all types of wire-wound resistor, fire protection is important and flame proof cases or coatings are vital. Lead-out wires are normally welded rather than soldered to the resistor.

Fig. 23.Wire-Wound Resistor Reading

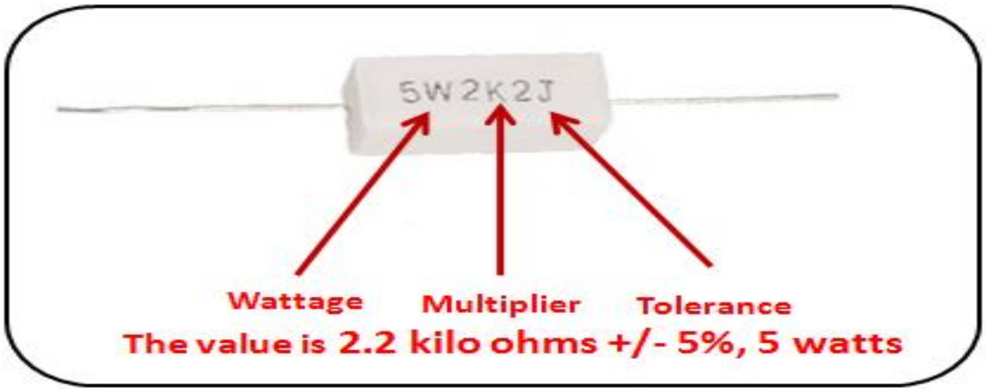


Fig. 24 Wire-Wound Resistor Coding

CODES	MULTIPLIER	TOLERANCE
F	---	+/-1%
G	---	+/-2%
J	---	+/-5%
K	1000	+/-10%
M	1000000	+/-20%
R	---	---

Potentiometers (also called *pots*) are variable resistors, used as voltage or current regulators in electronic circuits. By means of construction, they can be divided into 2 groups: coated and wire-wound.

Coated potentiometers, (figure 1.6a), insulator body is coated with a resistive material. There is a conductive slider moving across the resistive layer, increasing the resistance between slider and one end of pot, while decreasing the resistance between slider and the other end of pot.

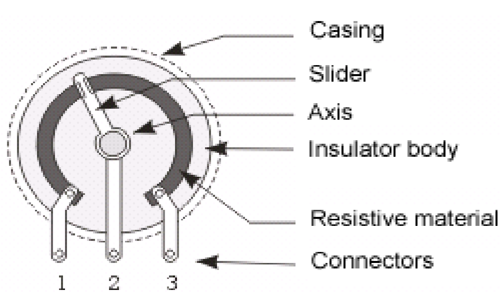


Fig. 25. Coated potentiometer

Wire-wound potentiometers are made of conductor wire coiled around insulator body. There is a slider moving across the wire, increasing the resistance between slider and one end of pot, while decreasing the resistance between slider and the other end of pot.

Coated pots are much more common. With these, resistance can be linear, logarithmic, inverse-logarithmic or other, depending upon the angle or position of the slider. Most common are linear and logarithmic potentiometers, and the most common applications are radio-receivers, audio amplifiers, and similar devices where pots are used for adjusting the volume, tone, balance, etc.

Wire-wound potentiometers are used in devices which require more accuracy in control. They feature higher dissipation than coated pots, and are therefore in high current circuits.

Potentiometer resistance is commonly of E6 series, including the values: 1, 2.2 and 4.7. Standard tolerance values include 30%, 20%, 10% (and 5% for wire-wound pots).

Potentiometers come in many different shapes and sizes, with wattage ranging from 1/4W (coated pots for volume control in amps, etc) to tens of watts (for regulating high currents). Several different pots are shown in the photo 1.6b, along with the symbol for a potentiometer.

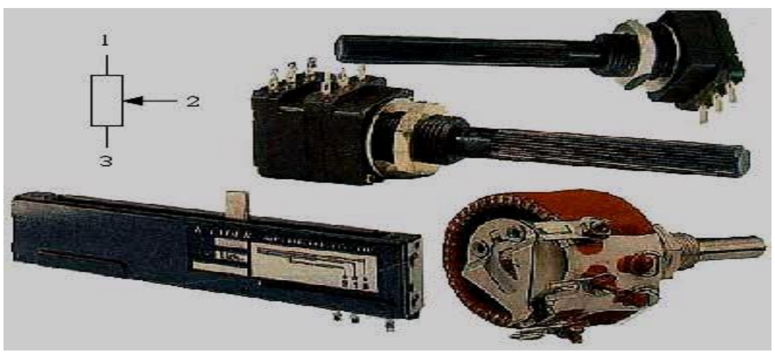


Fig. 26. Wire-wound Potentiometers

The upper model represents a stereo potentiometer. These are actually two pots in one casing, with sliders mounted on shared axis, so they move simultaneously. These are used in stereophonic amps for simultaneous regulation of both left and right channels, etc.Lower left is the so called slider potentiometer.

Lower right is a wire-wound pot with wattage of 20W, commonly used as rheostat (for regulating current while charging a battery etc).

For circuits that demand very accurate voltage and current values, ***trimmer potentiometers*** (or just *trim pots*) are used. These are small potentiometers with a slider that is adjusted via a screwdriver.

Trim pots also come in many different shapes and sizes, with wattage ranging from 0.1W to 0.5W. Image 1.7 shows several different trim pots, along with the symbol.

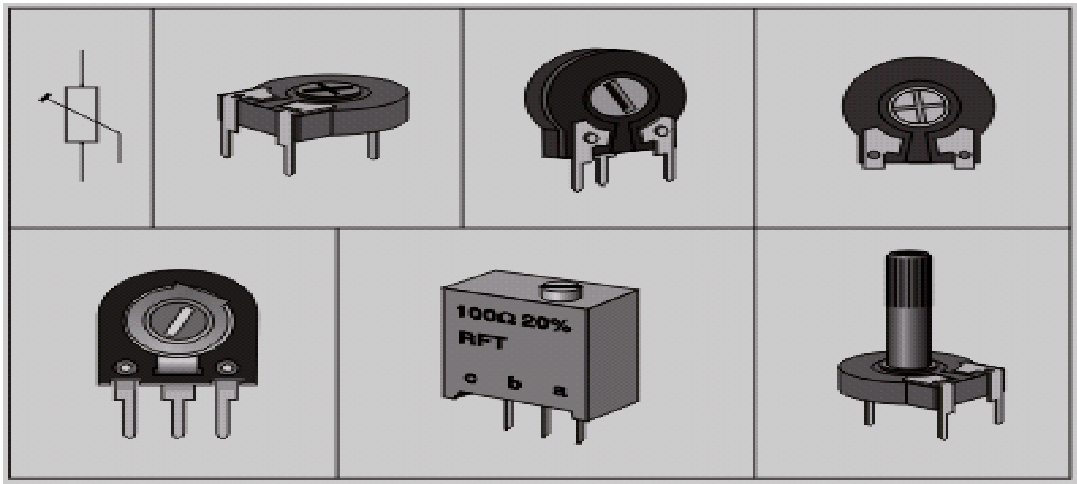


Fig. 27. Trim pots

Resistance adjustments are made via a screwdriver. Exception is the trim pot on the lower right, which can be adjusted via a plastic shaft. Particularly fine adjusting can be achieved with the trim pot in the plastic rectangular casing (lower middle). Its slider is moved via a screw, so that several full turns is required to move the slider from one end to the other.

Rheostat: is an adjustable or variable resistor. It is used to control the electrical resistance of a circuit without interrupting the flow of current. Rheostat has 3 terminals and usually consists of a resistive wire wrapped to form a toroid coil with a wiper that slides along the surface of the coil. It is most often designed with a ceramic core. Rheostats are used in applications that require high voltage and current.

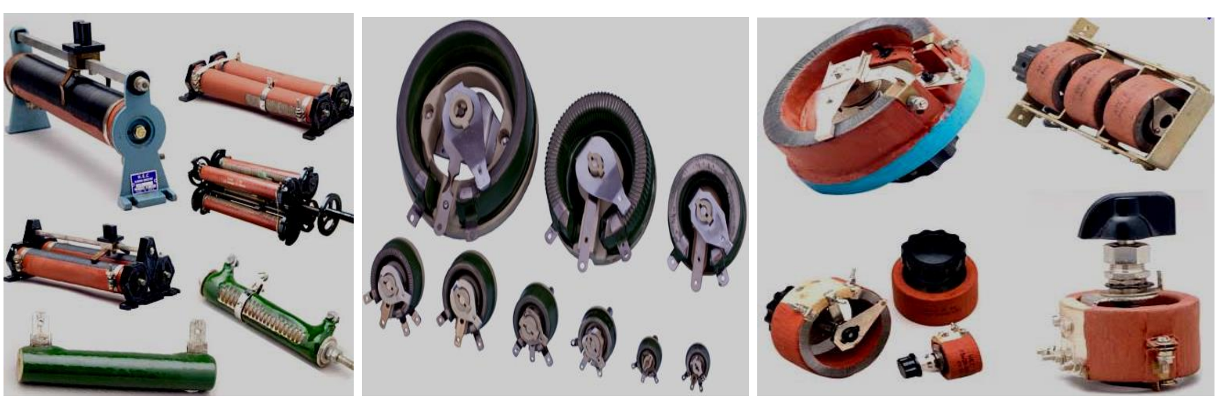


Fig. 28. variable resistor

Testing a Potentiometer

You can test the max-value of a potentiometer by measuring across the two 'ends' as shown here with a rotational 10KΩ pot. To find the 'range' look at the dial or selector knob.

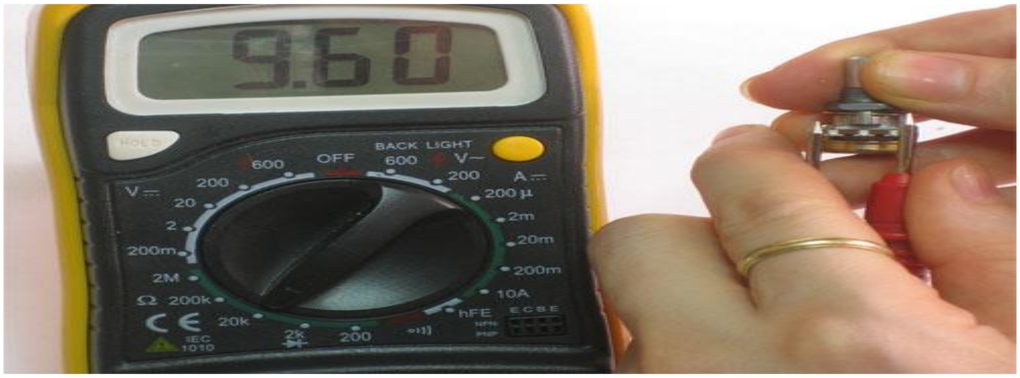


Fig. 29.testing potentiometer

You can also use a multimeter to tell whether the potentiometer is a linear or logarithmic (audio) pot. When the pot is centered, if the resistance between the wiper and one end is half of the total value, its linear. (I used clips instead of probes to make it easier to take these photos).

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at The end of the information sheet:

1. Define electronic component.
2. List different types of electronic components
3. Define passive component.
4. What are the characteristics of passive components?
5. What are the characteristics of active components?
6. Define active component
7. The different types of passive components include:
8. The different types of active components include:

Answer the following question!	
Note: **Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
You can ask you teacher for the copy of the correct answers.	

Answer Sheet

Name: _________________________

1. Electronic components are the basic building blocks of electronic system or electronic circuit.
2. Electronic components are mainly classified into two types:
- Passive components
- Active components
3. A passive component is an electronic component that consumes energy in the form of voltage but does not supply energy.
4. Passive components cannot increase the power of an electrical signal.
- Passive components temporarily store the electrical energy
5. Active components control the electric current flowing through them.
- Active components depend on the external voltage or current to work.
- Active components amplify the power of an electrical signal
- Active component is an electronic component that consumes energy in the form of voltage or current and supplies energy in the form of voltage or current
6. List different types of passive components
- Resistors
- Capacitors
- Inductors

8. List different types of active components
- Diode
- Transistor
- Integrated circuit

Score = ___________

Rating: ____________

Date: _______________

Information Sheet- 3	Determineing the project designing development

Introduction

Electronic systems design is the subject within electrical engineering that deals with the multidisciplinary design issues of complex electronic devices, such as cell phones and computers. Introduces and motivates the various chapters of this book.

Design Process and Its Fundamentals

This information sheet describes the basics of the development process for electronic systems. We present how service-proven standards and norms along with standard drawings and computer technology can be used to break down the design process into separate activities, which are then more easily performed.

Describe these design activities in detail and outline the requisite technical documentation (technical drawings, circuit diagrams, CAD models) that are required to produce successful electronic products.

Technical Drawings

Describe these design activities in detail and outline the requisite technical documentation that are required to produce successful electronic products

Guidance for Product design developments

Once given the green light, your first deliverable is our detailed project plan, showing time-scales of each sub-phase of the project. The project plan is reviewed internally weekly and re-issued to the client should any change have occurred. Time-scales can fluctuate mid-project, shortened by more expedient than anticipated client approval, or lengthened by a mid-project change; time-scale impacts presented through our ECR (engineering change request) system and, assuming approval, reflected dynamically within the project plan

Project Block diagrams *regulated dc power supply*

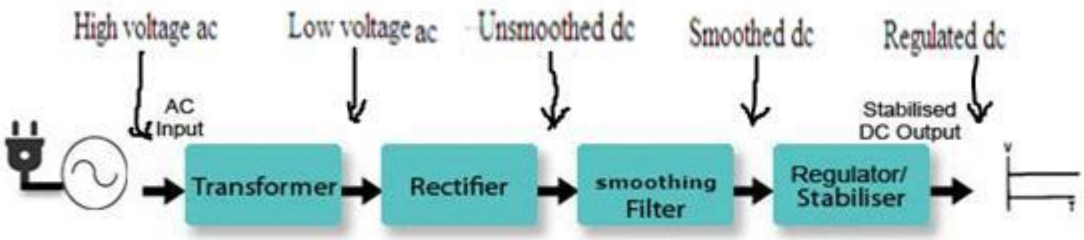


Fig 30. Project Block diagrams *regulated dc power supply*

Lout project Circuit Diagrams

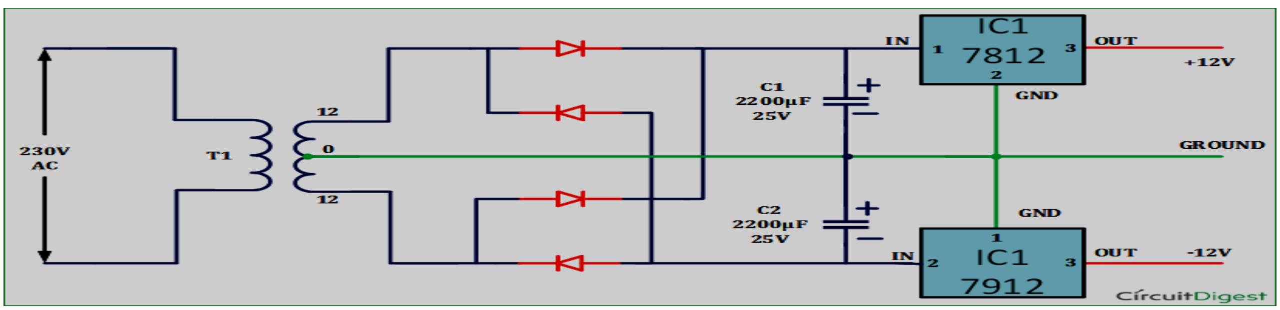


Fig 31.lout project circuit

Technical Circuit Diagrams

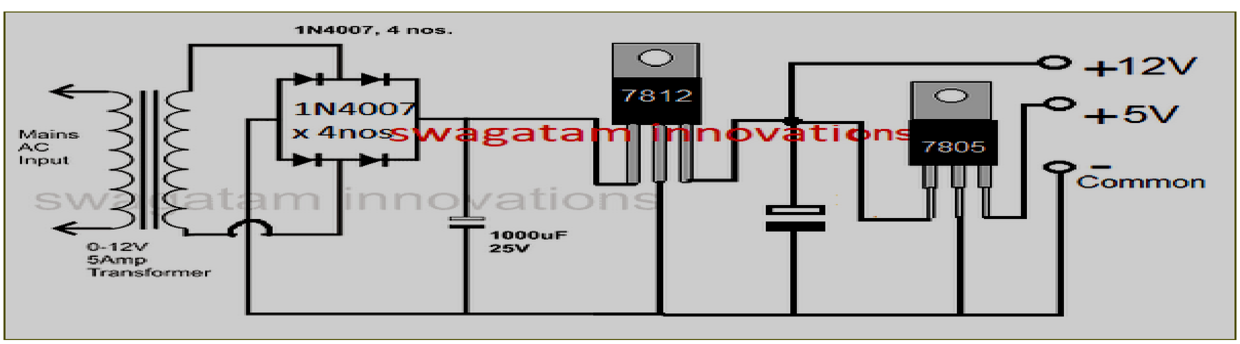


Fig32. **Technical Circuit Diagrams**

Computer-Aided Design (CAD)

Electronic device or circuit. Simulation software allows for modeling of circuit operation and is an invaluable analysis tool. Due to its highly accurate modeling capability, many colleges and universities use this type of software for the teaching of electronics technician and electronics engineering programs.

Process Simulation software for project design development

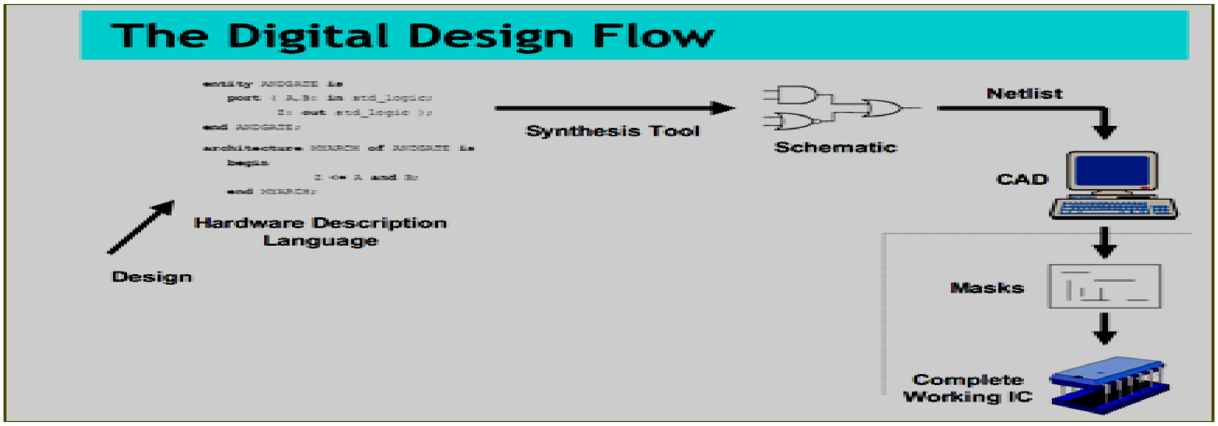
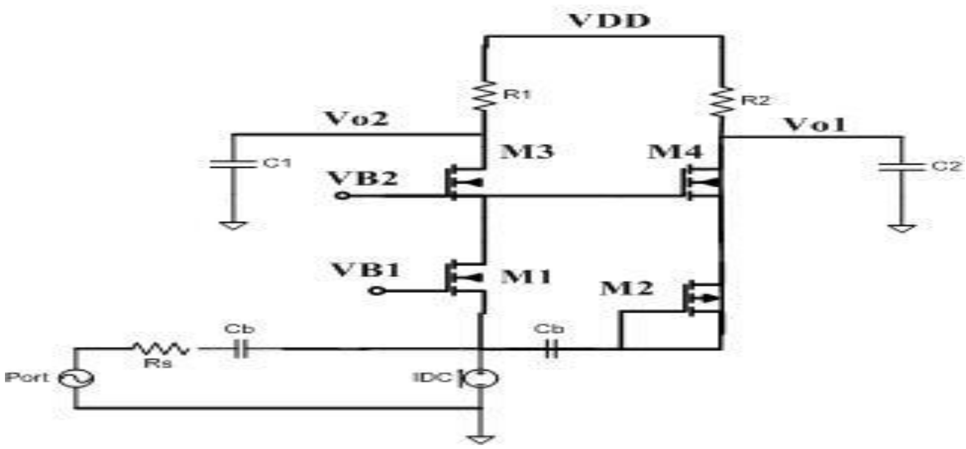


Fig 32. Life Cycle of Electronic Products

Self-Check -3	Skill Test

1. Should I use buffers before balun to match impedance, since V01 and V02 impedances are not 50ohm?
2. If I use buffers, I think it will affect the S21 and NF. So is there any other ways to measure S-parameters of this kind of circuit?



Answer the following question!	
Note: **Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
You can ask you teacher for the copy of the correct answers.	

Answer sheet

Name_______________________________________

For the differential output i would propose that you have two output ports one with positive phase and one for the negative phase. Assume that these output ports out1 and out2 every port has its S-parameters S22 AND S12 as well as S33 and S13 where 1 stands for the input port.

Information Sheet-4	Planning project work

4.1. Job Specification

DEFINITION

NOTE: The examples of work for this title are for illustrative purposes only. A particular position using this title may not perform all duties listed in this job specification. Conversely, all duties performed on the job may not be listed.

Job Specification

Job specification is defined as a statement about qualification and characteristics of employee required to perform the job task in a satisfactory manner. It is derived from job analysis and act as an important tool for the recruitment and selection of employee.

Job Spec is the skills, knowledge and abilities required to perform a particular job is articulated in job specification. It consists of information about requirements such as experience, education and attributes which will help the employee to reach the set goals of the job.

The ways How to write a job specification

Job specification is blue print for the recruitment selection process. Thus, job specification has to be drafted very carefully. The HR manager working on job specification should have vision to collect the information about the ideal candidate for the job.

There are four components of job specification:

- Educational qualification
- experience
- skills and knowledge
- characteristics and personality traits

Four Components of Job Specification

Fig 33.job specification

Technical Training

Technical Training teaches the skills needed to design, develop, implement, maintain, support or operate a particular technology or related application, product or service Provides home/office instruction in the techniques maintenance provides information regarding the home/office instruction services

Printers As a computer technician, you may be required to purchase, repair, or maintain a printer.
Printer to Computer Interfaces To access a printer, a computer must have an interface with it.
The following are common interface types:

- Serial
- Parallel
- Small Computer System Interface (SCSI)
- Universal Serial Bus (USB)

Job Specification

- EDUCATION**:** Graduation from an accredited college or university with a Bachelor's Degree.
- EXPERIENCE**:** One (1) year of experience in providing instruction or other social services to the blind.
- NOTE**:** Applicants who do not possess the required education may substitute additional experience as indicated on a year-for-year basis with thirty (30) semester hour credits being equal to one (1) year of experience.

- SPECIAL NOTE: Appointees will be required to successfully pass a Braille assessment test, administered by the Commission for the Blind and Visually Impaired.
- SPECIAL SKILL**:** Appointees must be able to read and teach Braille.
- LICENSE: Appointees will be required to possess a driver's license valid in New Jersey only if the operation of a vehicle, rather than employee mobility, is necessary to perform the essential duties of the position.
- **KNOWLEDGE AND ABILITIES:**

- Knowledge of current practices in the guidance, training, and rehabilitation of the blind and of social casework techniques.
- Knowledge of the emotional, vocational, social, economic, and other problems of the blind.
- Knowledge of current developments in the fields of education and social work as they apply to the home instruction of the blind.
- Knowledge of community resources available to provide needed Services to the blind.
- Ability to interpret the federal and state laws, regulations, and standards, and the policies of the Commission for the Blind and Visually Impaired, and the Department of Human Services pertaining to the blind and the rehabilitation of blind persons.
- Ability to organize assigned work involved in home training to perform the duties of this position.

- Ability to organize assigned field work, analyze home instruction service problems, and develop appropriate work methods.
- Ability to comprehend, analyzes, and interprets basic laws, regulations, policies, procedures, objectives, and techniques.
- Ability to comprehend the many problems arising from blindness.
- Ability to organize programs for individual clients designed to provide training, guidance, and counseling services to the blind.
- Ability to keep current with developments, trends of thought, and new methods in the fields of social casework, guidance, counseling, and home training as they relate to the problems of the blind.
- Ability to establish and maintain cooperative working relationships with local community organizations and other agencies interested in, or concerned with, the problems of the blind.

- Ability to establish rapport with newly blinded clients and provide assistance in their emotional, social, and other problems.
- Ability to compile the information required to prepare adequate intake records and to provide a basis for home instruction services.
- Ability to provide home instruction to newly blinded persons in household operation, communications skills, crafts work of varied types, and other independent living skills, and, where it is applicable, child and baby care.
- Ability to establish and maintain cooperative work relationships with local and other health, welfare, civic, educational, and other organizations, and to make the necessary referrals of clients.

❖ **The Project planning**

The process of planning and managing projects follows a logical, continuous cycle. Each phase of the project leads to the next.

- The identify stage includes a needs assessment process to determine the needs and problems in community.
- The design phase includes the actual planning and design of a project.
- The implement stage refers to the implementation of the project, whether it is a single-year or multi-year implementation period.
- The evaluation of project results occurs at the end of a project and involves determining whether the project's goal and objectives were achieved.
- The evaluation stage then leads to the identification of additional or persisting problems, allowing the cycle to begin again.
- Project monitoring occurs throughout all stages allowing for small Adjustments in the project's planning, design, and implementation in order to ensure the project's success.

Fig. 35. Management Planning Procedure

Self-Check -4	Written Test

1. The identify stage includes a needs assessment process to determine _____and ___inthe community.
2. At the same time, unit cost has fallen as sales volumes have____________________.
3. Electronic equipment is powered from __________________voltage DC supplies?
4. Electronic components require ___________________ is well regulated?
5. the global market a reality power supply system's operate from wide input ranges to cover worldwide ___________________supply

Answer the question	
Note: Satisfactory rating - 8 and 15 points	Unsatisfactory - below 8and 15points
You can ask you teacher for the copy of the correct answers.	

Answer sheet

Name____

1. needs and problems
2. increased
3. low
4. DC supply
5. AC mains

Score = ____________
Rating: _____________

Date______________________________

Information Sheet -5	Requiring resource for the project work

5. User Requirements and Engineering Specifications

Good user requirements are one of the key factors that lead to a successful design. User requirements capture the stakeholders' needs, desires, and expectations for a product and are the basis for developing engineering specifications--the statements upon which a design will be verified against. Engineering specifications serve as a collection of criteria that the design must meet in order to fulfill the user requirements that were elicited from the stakeholders.

After completing this block you will be able to:

- elicit and develop user requirements from stakeholders
- identify data collection strategies to inform user requirements
- prioritize user requirements
- translate user requirements to engineering specifications
- write specific and unambiguous user requirements and engineering specifications

What are User Requirements

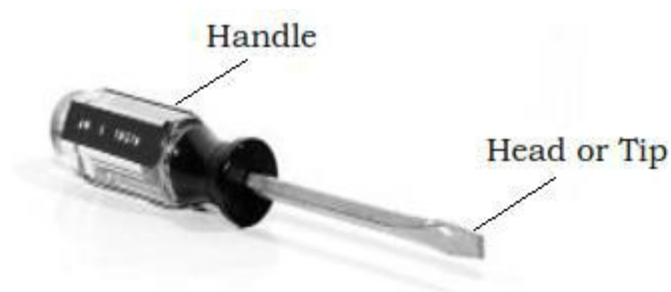
User requirements are any function, constraint, or other property required for a designed artifact to meet the needs or wants of stakeholders; the requirements are translated into engineerig specifications that are both quantifiable and measurable in order to guide engineering desin Processes.

5.1. Selecting appropriate tools and equipments for project work

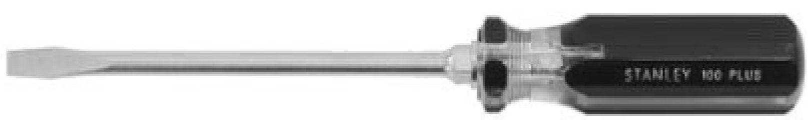
It is hard to do a good job of electronics construction unless proper electronic tools and knowledge of using them are adequate.

Driving of Tools

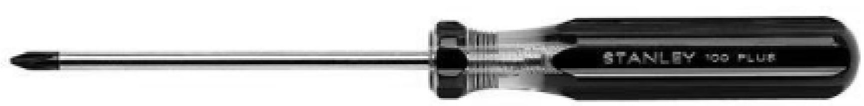
Screwdriver. It is a device specifically designed to insert and tighten or to loosen and remove screws. A screwdriver comprises a head or tip which engages with a screw, a mechanism to apply torque by rotating the tip and some way to position and support the screwdriver. A typical hand screwdriver comprises an approximately cylindrical handle of a size and shape to be held by a human hand and an axial shaft fixed to the handle, the tip of which is shaped to fit a particular type of screw. The handle and shaft allow the screwdriver to be positioned and supported when rotated to apply torque.



Flat Screwdriver. It is used to drive or fasten negative slotted screws.



Phillips Screwdriver. It is used to drive or fasten positive slotted screws. It is a screwdriver that could take greater torque and can provide tighter fastenings.



Hex (Allen Wrench). It is used to drive or fasten hexagonal screws. The head has a hexagonal hole turned by an allen key. An Allen key is a hexagonal shaped wrench bent in letter-L. The Allen key was invented by an American, Gilbert F. Heublein.

Precision Screwdriver Set. It is a set of small screw drivers composed of slotted and Philips screwdrivers.

Soldering Tools
Soldering Iron. It is a device used for applying heat to melt solder in attaching two metal parts. A soldering iron is composed of a heated metal tip and an insulated handle.
Heating is often achieved electrically, by passing a current, supplied through an electrical cord, through a heating element.
For electrical work, wires are usually soldered to printed circuit boards, other wires, or small terminals. A low-power iron (1530 Watts) is suitable for this work.

Soldering station

Working with surface-mount parts requires soldering tools that are capable of working with small parts and closely spaced leads. Soldering stations for surface-mount work can be rather pricey, particularly for the stations that also include a hot-air attachment. The good news is that a soldering station like the one shown in Figure below will handle a lot of SMT tasks if used with a fine tip and the appropriate temperature. Figure below shows a soldering station specifically designed for working with surface-mount parts. In addition to the soldering iron with a fine-point tip, it also has a hot-air blower with a selection of nozzles.

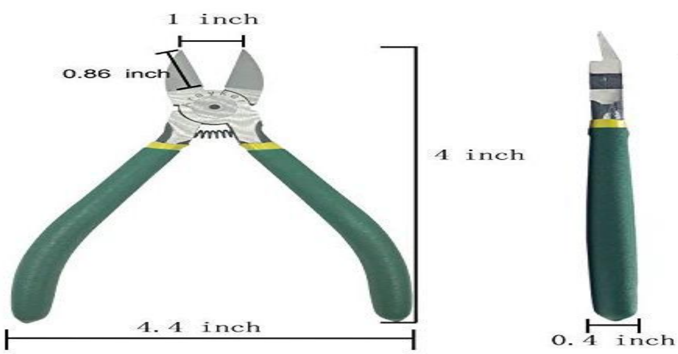
Soldering Tool Stand. It is a place of the soldering iron to keep them away from flammable materials. The stand often also comes with a sponge and flux pot for cleaning the tip.

Disordering tool. It is used for the removal of solder and components from a circuit when troubleshooting, repair purposes and to save components. Electronic components are often mounted on a circuit board and it is usually desirable to avoid damaging the circuit board, surrounding components, and the component being removed.

Splicing Tools

Long Nose. It is used for holding, bending and stretching the lead of electronic component or connecting wire.


Side Cutter. It is a wire-cutting plier, though they are not used to grab or turn anything, but are used to cut wire.



2.2.4. **Boring Tools**

12 Volt Mini-Drill. It is used to bore or drill holes in the printed circuit board (PCB).

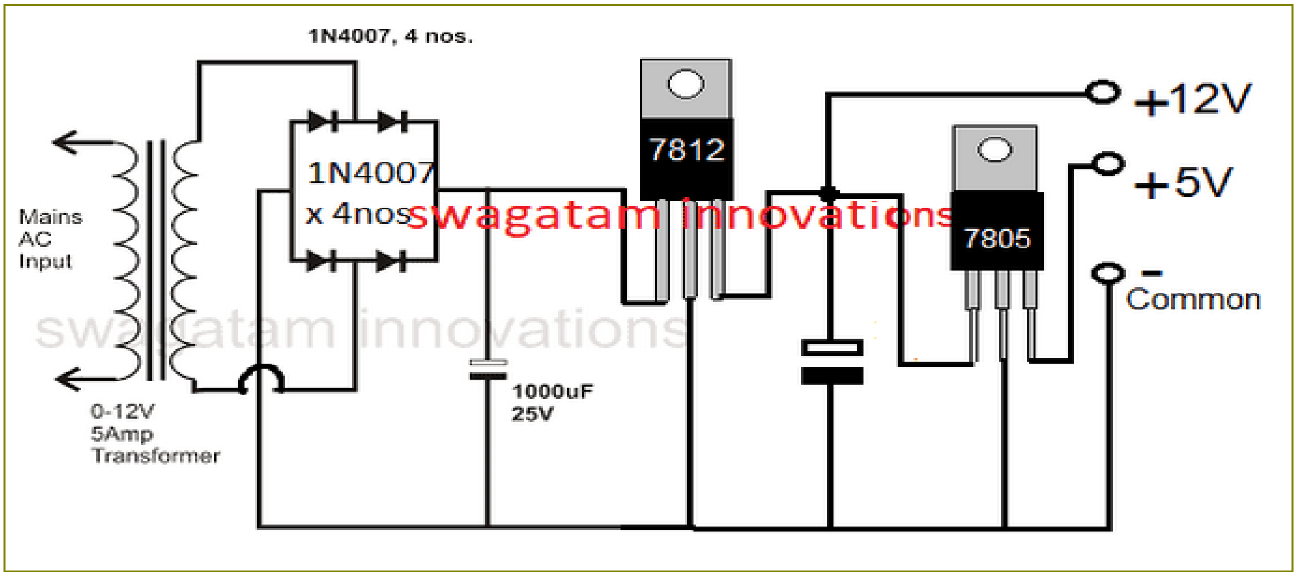
2.2.6. Designing tools

Design Tool CAD tools are usually tailored to a specific domain of application (for example “digital electronic circuits” or “mechanical machinery components”) and automate classical engineering approaches such as engineering drawing and investigation of a design by models of reduced size and reduced functionality

Design Process

Design process is regarded as creative problem solving through a series of steps or a sequence of activities, which lead from initial concept to realization

- ❖ **Electronic dual power supply Circuit project**



- ❖ **Using Circuit design and simulation software:**

Uses mathematical models to replicate the behavior of an actual electronic device or circuit. Simulation software allows for modeling of circuit operation and is an invaluable analysis tool. Due to its highly accurate modeling capability, many colleges and universities use this type of software for the teaching of electronics technician and electronics engineering programs. Electronics simulation software engages its users by integrating them into the learning experience.

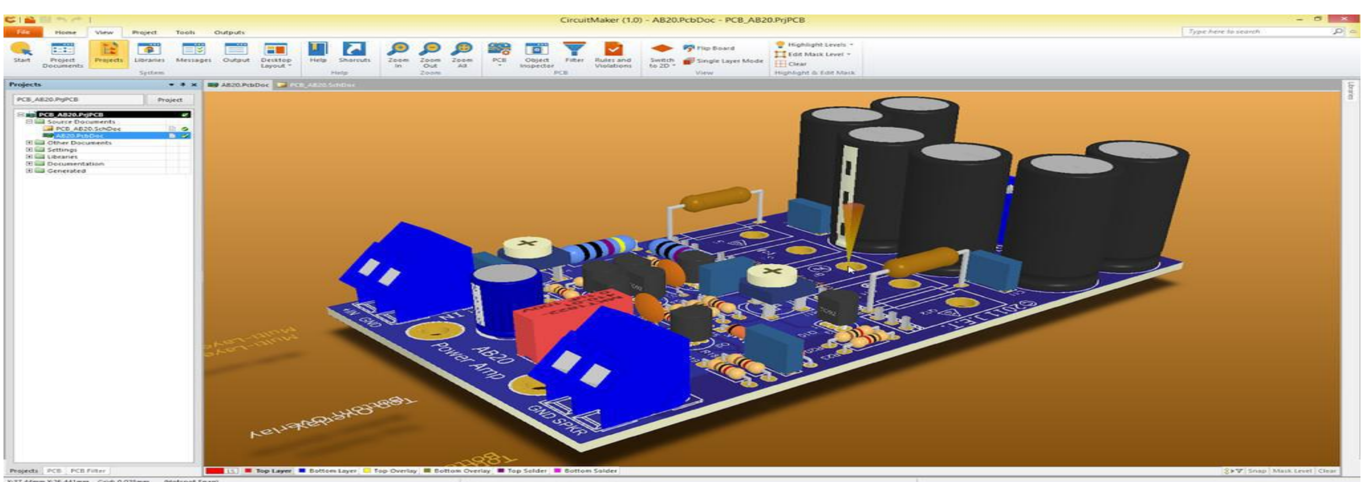


Fig 2. Circuit simulation on circuit-maker CAD software

Simulating a circuit's behavior before actually building it can greatly improve design efficiency

Examples of Electronic circuit design and simulation software:

- Circuit Maker
- Open Circuit Design Software
- ADS Circuit Design Software
- SuperSim Circuit Design Software
- Portus

Computer: is a device that accepts information (in the form of digitalized data) and manipulates it for some result based on a program, software, or sequence of instructions on how the data is to be processed.

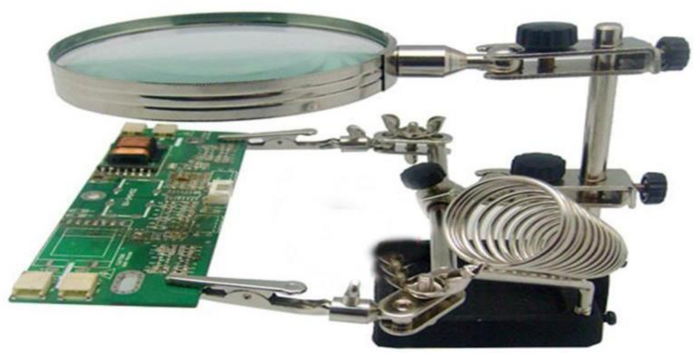
By installing Electronic circuit design and simulation software, we can use them to design and construct electrical/electronic circuit.

2.2.7. Auxiliary Tools

Ball-peen Hammer it is a type of hammer used in metalworking. The ball-peen hammer remains useful for many tasks such as tapping punches and chisels. The original function of the hammer was to "peen" riveted or welded material so that it will exhibit the same elastic behavior as the surrounding material. Specifically, striking the metal imparts a stress at the point of impact which results in strain-hardening of that area. Strain hardening raises the elastic limit of a material into the plastic range without affecting its ultimate strength. A strain-hardened material will not deform under the same low stresses as a non-hardened material. Most metals can be "worked" by such methods until they lose all of their ductile characteristics and become strong but brittle.

Fig 2.18. Ball pin hammer

Magnifying Glass It is a convex lens which is used to produce a magnified image of an object. The lens is usually mounted in a frame with a handle (see image). Roger Bacon is the original inventor of the magnifying glass. A magnifying glass works by creating a magnified virtual image of an object behind the lens.



Anti-Static Brush. It is made of bristles set in handle used for cleaning dirty parts of a circuit or an object.

Fig 2.20. Anti-static brush

Tweezers: tweezer is used to hold small components especially when doing soldering and de-soldering of surface mount components

Fig 2.21. Tweezer

2.3. Selecting testing instrument

Below are the list of measuring instruments used in electrical and electronic work.
Types of test equipment
1. The following items are used for basic measurement of voltages, currents, and components in the circuit under test.

Voltmeter (Measures voltage)

Ohmmeter (Measures resistance

Voltmeter (Measures voltage)

Ammeter, e.g. Galvanometer or Milli Ammeter (Measures current)

Multimeter e.g., VOM (Volt-Ohm-Millimeter) or DMM (Digital Multimeter) (Measures all of the above)

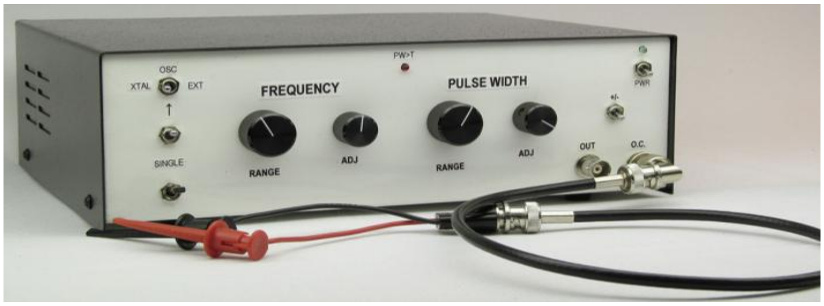
LCR Meter e.g., LCR meter or Resistance, Inductance and capacitance meter (measure LCR values)

Power supplies

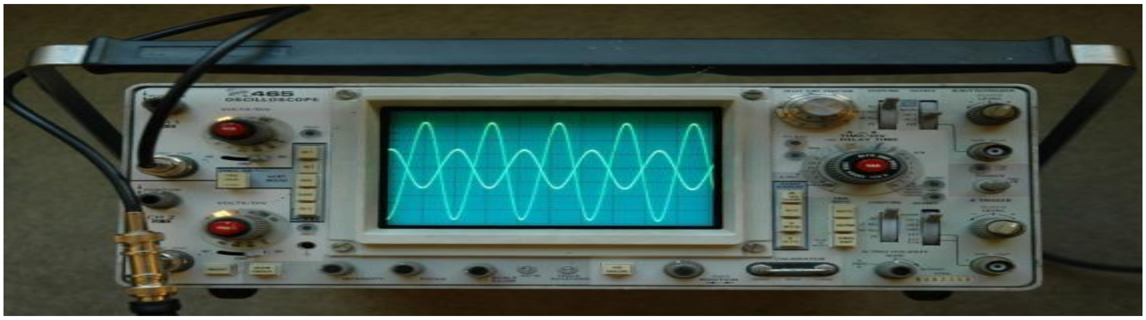
Signal generator

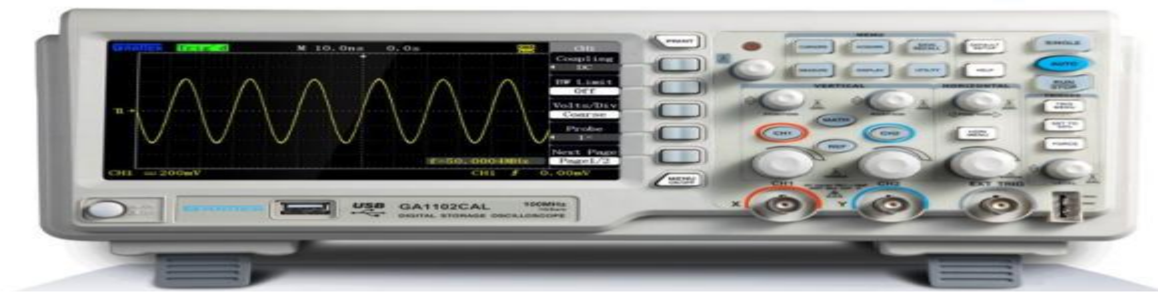
Digital pattern generator

Pulse generator



The following analyze the response of the circuit under test:
The calculation of risk is based on the likelihood or probability of the harm being realized and the severity of the consequences. This can be expressed mathematically as a quantitative assessment (by assigning low, medium and high likelihood and severity with integers and multiplying them to obtain a risk factor), or qualitatively as a description of the circumstances by which the harm could arise.
Oscilloscope (Displays voltage as it changes over time)





Frequency counter (Measures frequency) and connecting it all together


TF930 3GHz COUNTER
12.63720060
FREQUENCY
OPERATE
FREQUENCY COUNT
PERIOD RATIO
WIDTH DUTY
MEASUREMENT TIME
COUPLING DC/AC
IMPEDANCE
ATTENUATOR
POLARITY
FILTER NONE/LPF
INPUT A SETTINGS
INPUT A/B
HOLD RESET
Local
EXT REF IN
DC THRESHOLD

Test probes

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:Write the function of listed hand tools with their actual pictures.

Fill blacks and also choose true /false

1. It is okay to put a portable grinder in a vise as long as it is tightened securely. **true** or **false**
2. Most hazards associated with hand tools are easy to spot because we very seldom would use a tool in "day-to-day" life. **true or false**_
3. Tools requiring momentary on/off switches can never have a lock-on switch say **true** or **false**.
4. Never use electric tools in what kind of condition/conditions___________________________
5. You should always wear eye protection when using grinders. **true** or **false**
6. Which of the following parts should be guarded on tools________________________________
7. Because powder-actuated tools use small explosive charges, it is okay to use them in explosive atmospheres **true** or **false**
8. When not in use, power tools should be___________________..?

Answer the question	
Note: Satisfactory rating - 8 and 15 points	Unsatisfactory - below 8and 15points
You can ask you teacher for the copy of the correct answers.	

Answer Sheet

Name: ____

1. True
2. True
3. True
4. Wet
5. False
6. Electrical Outlet
7. False
8. Disconnected

Score = ____________

Rating: _____________

Date: ____________

LG #15	LO2: develop design brief prepares unit tools, equipment

Instruction sheet

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

- Establishing and developing project design requirement
- Developing project design with all relevant
- Identifying the competent person for the project design
- Reviewing and adjusting the project design
- Project designing proposal

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

- Establish and develop project design requirement
- Develop project design with all relevant
- Identify the competent person for the project design
- Review and adjusting the project design
- Project design proposal

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them
4. Accomplish the "Self-checks" which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to "Operation sheets
7. Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information Sheet -1	Establish and develop project design requirement

Requirements

Projects begin with understanding your detailed engineering and business requirements. This may be pre-defined or generated in discussions with your DSL team.

Design Proposal

The first step involves formally documenting the client's requirements, encompassing their application, required electronic and mechanical specifications alongside relevant environmental and power aspects. These are formalized into our initial Design Proposal for client acceptability sign off and thus achieve mutual agreement of expectation at this earlier stage.

See an example. Fig. (2) Simple Power Supply Schematic diagrams

Interpreting Schematic Symbols

In order to understand the functioning of an electrical or electronic circuit, you must be able to "read" the schematic diagram of that circuit. A schematic diagram is the road map of the circuit. In order to get from one point to another, you must be able to follow the appropriate route and understand the meanings of the various symbols found along the way.

1. Symbols. Just as the road map uses symbols to represent the highways, cities, interchanges, and other elements displayed, the schematic diagram uses symbols to represent the components used to make up a circuit. Symbols are used to indicate conductors, resistors, switches, motors, transistors, and other electrical and electronic parts. Components in a circuit schematic are generally represented by such a symbol and/or a letter designator. This part of the lesson reviews many of the symbols used by Army technical manuals in the schematic diagrams of the appropriate equipment.

2. **Conductors**. Basic to any schematic diagram is the use of straight lines to indicate conductors. The conductor is the "roadway" of the circuit map. The conductors interconnect the components of the circuit. Conductors often cross paths with one another in the circuit. This may occur with or without their making electrical contact. Figure 1-1 illustrates the typical methods for crossing conductors within a schematic diagram.

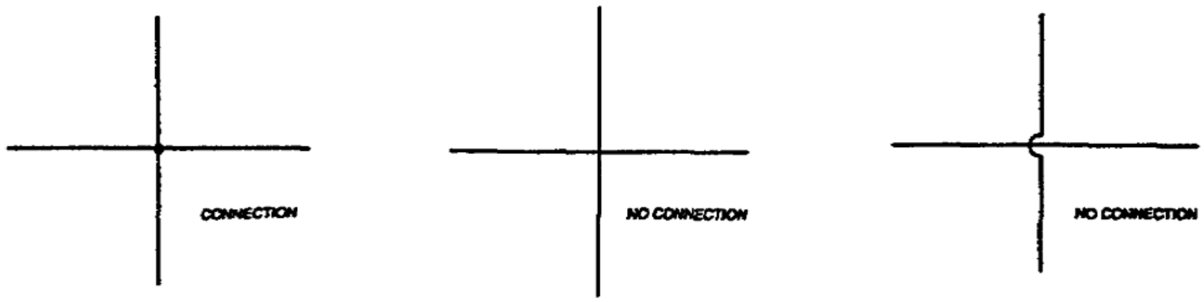


Figure.1 Crossing Conductors.

There are many types of conductors used in electrical and electronic circuits. They may range from the thin layers of metal foil used in printed-circuit boards to heavy cables used in power transmission.

Cables generally consist of two or more conductors, usually in the same insulation jacket.

A special type of conductor found in many electronic applications is the shielded wire or coaxial cable. Here, the conductor is surrounded by a metallic shield to protect against interference from adjacent electrical influence.

The shielding on the cable may or may not be grounded. Figure 1-2 shows some common symbols for shielded conductors.

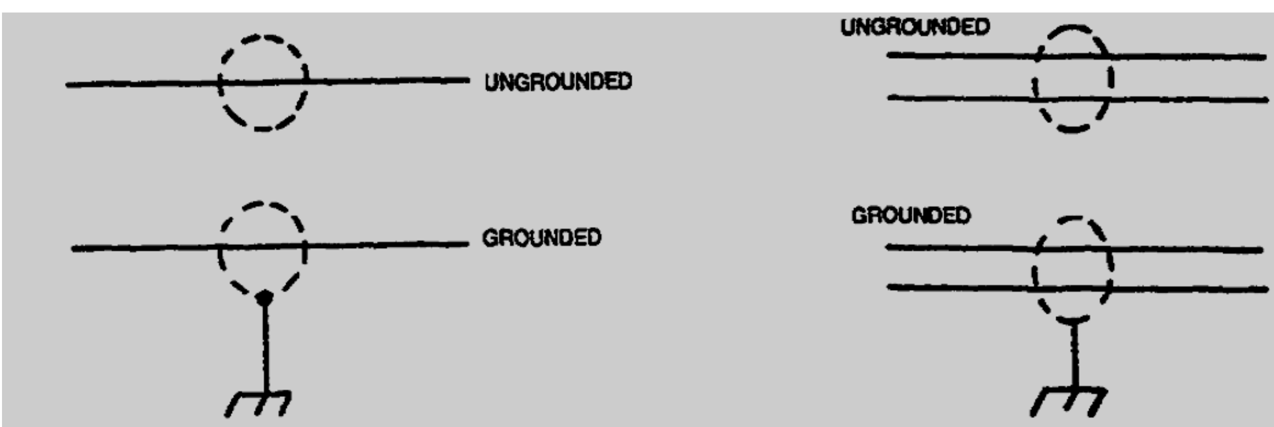


Figure. 2. Shielded Conductors.

1.1. Power Supplies

Like transformers, power supplies are not a true power source. They generally take an input from an external, power source and convert that source to usable voltages to operate the circuits they supply. Typically, a power supply will convert an AC input into one or more DC outputs. Most power supplies consist of four basic sections: a transformer; a rectifier; a filter; and a regulator. Figure2 shows a simple block diagram of a power supply and the effects of the basic components. Figure 1-15 illustrates a schematic of a simple power supply. Power supplies are labeled with the letters "PS."

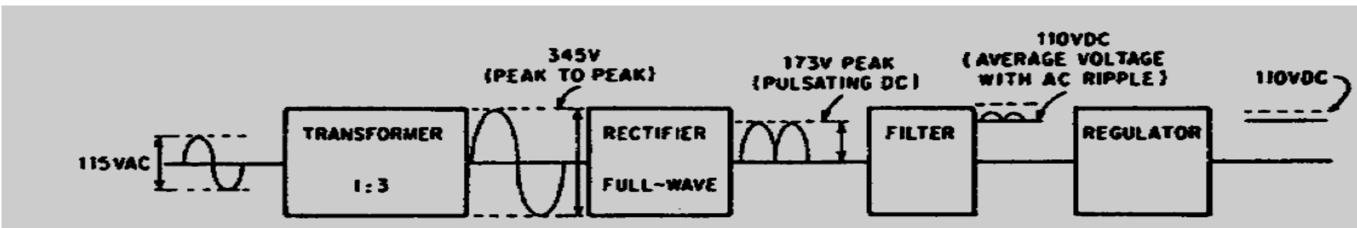


Figure.1 Basic Power Supply

Power supplies may be designed to produce one or several different output voltages. Depending on the complexity of the circuit demand, power supplies may be fairly simple or they may be quite extensive. Often the power supply for a circuit will require a separate schematic diagram to illustrate the **components and functional operation of the power supply**.

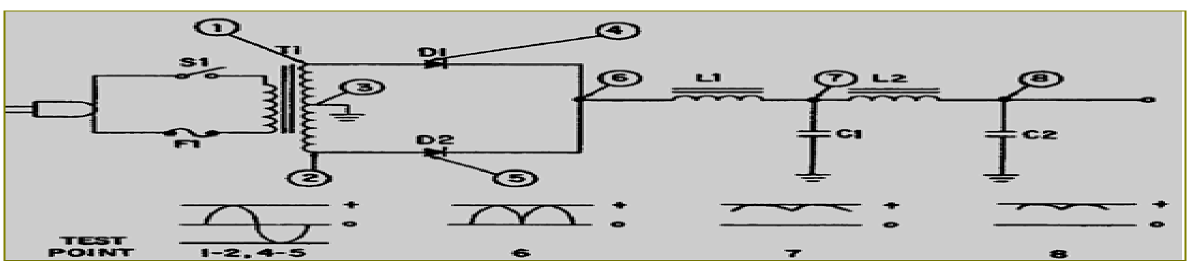


Figure. 2 Simple Power Supply (Schematic)

1. **Controls**

Many electrical and electronic circuits include controls and indicators to assist the operator in the use and repair of the equipment. These controls may consist of devices such as switches, relays, fuses, plugs and jacks, test points, and indicators. These operator aids are normally represented in the circuit schematic diagram to illustrate their effect on the circuit operation.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Part 1. <u>Say true or false</u>

1. In order to understand the functioning of an electrical or electronic circuit, you must be able to "read" the schematic diagram of that circuit

2. Symbols are used to indicate conductors, resistors, switches, motors, transistors, and other electrical and electronic parts

3. Components in a circuit schematic are generally represented by such a symbol and/or a letter designator

4. The conductor is the "roadway" of the circuit map

5. Conductors often cross paths with one another in the circuit

Answer the question!	
***Note:* Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
You can ask you teacher for the copy of the correct answers.	

Answer Sheet

Name: ____

1. :true
2. :true
3. :true
4. :true
5. :tru

Score = ___________
Rating: ____________

Date: _______________

Information Sheet- 2	Develop project design with all relevant requirements

Objective of this information sheet are trainees will be able to know

- Concept of design
- Design Proposal
- Project Plan
- Design Specification
- Schematic Design
- PCB Design
- Prototypes

2.1 Design Concept: - The Operating conditions/parameters on which the designer has based decisions and the method by which the functional requirements are to be met.

It is a master plan for the system in question.

- The process of taking a functional specification and producing a solution for this specification
- There may be many different solutions, but we are only ever interested in producing a single one! (Although an optimization criterion may be extensibility).

Implementation

Refers to the implementation of the project, whether it is a single-year or multi-year implementation period.

- **Requirements Definition**

Projects begin with understanding your detailed engineering and business requirements. This may be pre-defined or generated in discussions with your group.

Design Proposal /Outline

The first step involves formally documenting the client's requirements, encompassing their application, required electronic and mechanical specifications alongside relevant environmental and power aspects. These are forma listed into our initial Design Proposal for client acceptability sign off and thus achieve mutual agreement of expectation at this earlier stage.

See an example.

- **Design Proposal /Costs/Time-scales**

Once the specification is mutually approved, by harnessing our range of skills and experience we are able to provide you with accurate and realistic proposals for the complete design process at this early stage: Based on a detailed project plan, this will define our understanding of your requirements, estimate project costs and clarify the time-scales involved.

- Project Plan

Series of steps that determine how to achieve a particular community or organizational goal or set of related goals. This goal can be identified in a community plan or a strategic plan. Project plans can also be based on community goals or action strategies developed through community meetings and gatherings, tribal council or board meetings, or other planning processes.
The purpose of an plan is to confirm that the proposed project can be economically developed on the selected site, and to investigate and provide all data, calculations and outline plans based on the different investigations required for the project approval and detailed planning.

.

- Design Specification

The final specification provides a clear and concise description of the complete system design and its functionality, as well as how it will connect and interact with the 'outside world'.

See an example.

- Schematic Design

Once agreed, we then design the board to the Design Specification, employing techniques to meet with client type approvals such as EMC emissions, temperature range, vibration, and circuit protection. Completed schematics are then sent for approval before moving to the board layout stage.

See an example.

- PCB Design

Our Design Engineers then proceed to the board layout stage and this addresses and specific physical parameters as highlighted within the Design Specification document. DSL typically provide a 3D CAD model, or

Interactive 3D PDF (Note: To use 3D PDF functionality, download the PDF and open using Adobe PDF Reader to view. Does not work directly on browsers.), of the board to help clients visualise the final board layout.

- Prototypes

Once the board design and layout are approved we are ready to manufacture the first batch of prototypes. Fast-turn build options are available for projects working to constrained timescales. Prototypes are evaluated with a thermal camera to identify any potential hot spots.

2.1. The Problem

• It's the first day of your new job working for a large semiconductor company.

4.3. Hierarchical Approach- Introduction

• Hierarchical Approach to System Design

- Split the overall design into discrete blocks which have (typically) a single function and then connect these blocks together to form the complete system (see later).
- The process is repeated on each of the blocks in the design until a desired level of abstraction is achieved
- Eventually, we have a list of blocks (with inputs, outputs and required functionality)
- These then have to be implemented (see later).

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Part 1. <u>Say True or false</u>

1 One of your most important responsibilities is to protect your Health and Safety as well as that of your co-workers

2 Your employer is responsible for providing you with safe and healthy working conditions

3 You must cooperate with your employer in making your workplace safe and healthy

4 Special Training is required for work on electrical equipment

5 Only Authorized Employees may conduct electrical work

Answer the following question!	
Note: **Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
You can ask you teacher for the copy of the correct answers.	

Answer Sheet

Name: ___________________________

1. True
2. True
3. True
4. True
5. true

Score = ____________ Rating: ______________

Date: _______________

Information Sheet- 3	Requiring Competent persons for specific the project design

Project Consultant - The individual or firm that, is registered and delivers the design solution, provides contract administration services during construction, and as directed by the manager assists in the commissioning process, as required by the terms of the Prime Consultant Services Agreement and as directed by the manager.

Project Coordinator - project coordinator assigned to a project to coordinate, monitor and document the progress the work.

Start-up – A service normally provided by the Contractor as part of the normal scope of work Detailed in the construction contract. It includes building systems and equipment, or part(s) thereof.

Specification – The specific purpose/use for which the system/facility/equipment is intended to serve. It is a functional plan/program for the system and provides a complete description of the system's operation and performance.

Technical Service Inspectors

TW's site inspectors assigned to a project to monitor and document the technical progress of a specific discipline.

Definition and purpose of Consultation

Consultation: is an act of seeking and giving of advice, information, and/or opinion, usually involving a consideration. The purpose of a consultation is to get an advice in solving a problem. You want to change something, achieve something, attain something, or become something, you need help. The current state of things isn't how you want it to be. Therefore, your instructor or supervisors knows what desired state

1. Instructors or Immediate supervisor Responsibilities include:

- ✓ Working with the shop management team to identify and priorities tasks
- ✓ Day to day guiding and supervising the training
- ✓ Prioritizing, giving and control daily tasks
- ✓ Maintenance, conservation and return of machinery and tools

- ✓ Staff training
- ✓ Regular inspections
- ✓ Ensuring all H & S policies are adhered to and working with the H&S Manager
- ✓ Organizing, linking with and top head and management.
- ✓ Making sure projects run smoothly and on target/budge

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Part 1. Write your answer briefly

1. What is Consultation?

2. The purposes ofConsultation.2pts

3. List the Responsibilities of Instructors or Immediate Supervisors .4pts

Answer the following question	
Note: Satisfactory rating - 8 and 15 points	Unsatisfactory - below 8and 15points
You can ask you teacher for the copy of the correct answers.	

Answer Sheet

Name: ____

1. Is an act of seeking and giving of advice, information
2. Is to get an advice in solving a problem.
3. Responsibilities of Instructors

- ✓ Day to day guiding and supervising the training
- ✓ Prioritizing, giving and control daily tasks
- ✓ Maintenance, conservation and return of machinery and tools
- ✓ Staff training
- ✓ Regular inspections
- ✓ Ensuring all H & S policies are adhered to and working with the H&S Manager
- ✓ Organizing, linking with and top head and management.
- ✓ Making sure projects run smoothly and on target/budge

Score = ___________
Rating: ____________

Date: _______________

Information Sheet- 4	Reviewing the design

3.1.1 Reviewing the design

Students will be able to understand

Objective2:

- Demonstrate and interpreting electronic drawings
- Understand the use of drawings in architectural design
- And how those drawings relate to career opportunities.

4. Reviewing the design

What is Design Review?

Design Review is an independent and impartial evaluation process in which a panel of experts on the built environment assesses the design of a proposal. The projects that Design Review deals with are usually of public significance, and the process is designed to improve the quality of buildings and places for the benefit of the public.

Design Review

- is conducted by expert practitioners with current experience in design and development, a record of good design in their own projects and the skills to appraise schemes objectively.
- offers feedback and observations that will lead to the improvement of schemes, but does not redesign them.
- gives decision makers the confidence and information to support innovative, high quality designs that meet the needs of their communities and customers, and to resist poorly designed schemes.

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- Gives decision makers the confidence and information to support innovative, high quality designs that meet the needs of their communities and customers, and to resist poorly designed schemes.

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Part 1. <u>Write the sort answer</u>

1. What is Design Review?
2. What are the aims of reviewing the design**?**
3. what is the term feedback reviewing the design

Answer the question!	
Note: Satisfactory rating - 8 and 15 points	Unsatisfactory - below 8and 15points
You can ask you teacher for the copy of the correct answers.	

Answer Sheet

Name: _________________________

1. Design Review is an independent and impartial evaluation process in which a panel of experts on the built environment assess the design of a proposal
2. Design Review deals with are usually of public significance, mprove the quality of the building.
3. offers feedback and observations that will lead to the improvement

Score = ___________
Rating: ____________

Date: _______________

Information Sheet -5	Project designing proposal

Design Proposal

This paper presents the design and construction of a dual regulated ±0-12Volts DC power supply that will serve a dual purpose of providing a positive and negative DC output of different values for use in miniaturize electronic appliances such as laptops, TV, and Telephone. It may also be useful in various domestic and laboratory experimental purposes. LM312 and LM312 were used as positive and negative voltage regulators respectively. The circuit was built with preferred values of components with an AC input of 220Vrms, 50Hz that was step down using a designed center tapped transformer (12V 0 12V).

Keyword: AC voltage, Regulated DC voltage, Center tapped transformer, Full wave rectifier, Low Pass Filter

The following measures are often considered during the analysis phase of a project:

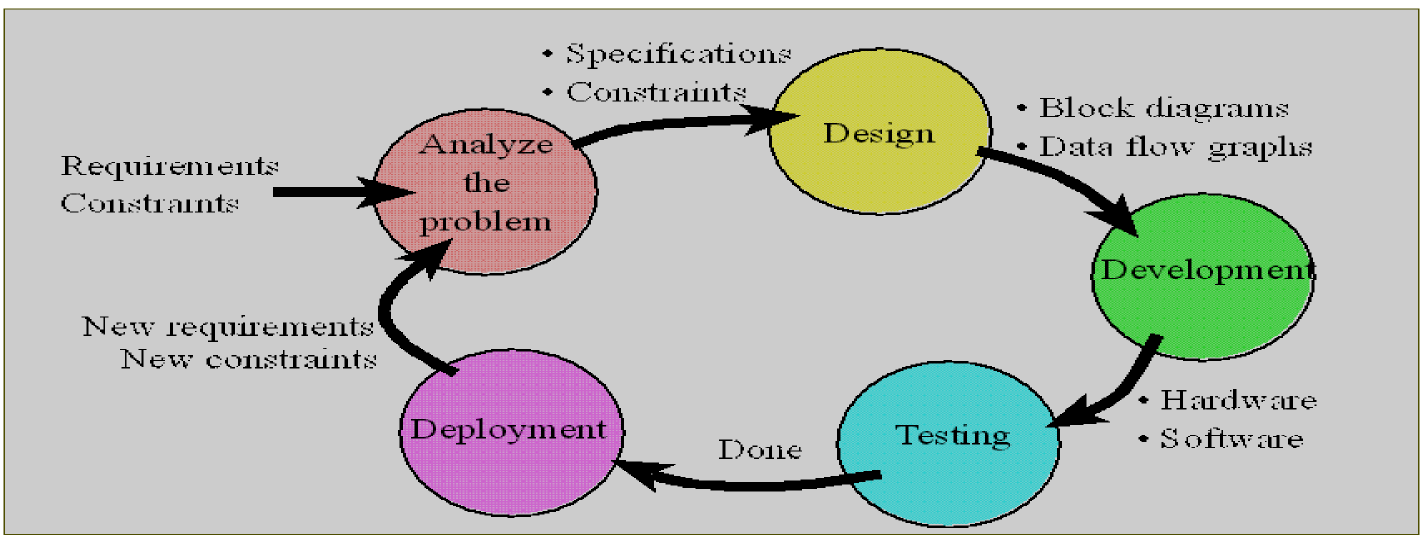


Fig project analysis phase

During the analysis phase, we discover the requirements and constraints for our proposed system. We can hire consultants and interview potential customers in order to gather this critical information.

Requirement is a specific parameter that the system must satisfy. We begin by rewriting the system requirements, which are usually written in general form, into a list of detailed

specifications. In general, specifications are detailed parameters describing how the system should work. For example, a requirement may state that the system should fit into a pocket, whereas a specification would give the exact size and weight of the device.

Constraint is a limitation, within which the system must operate. The system may be constrained to such factors as cost, safety, compatibility with other products, use of specific electronic and mechanical parts as other devices, interfaces with other instruments and test equipment, and development schedule.

1. INTRODUCTION

Electrical power is the rate of movement of electrons that create energy. As a result of the electronic age many products need electrical power to perform certain activities. Being able to manipulate electrical power comes at a cost. In today's world there is always the bottom line, cost. Power supplies are the devices that can manipulate electrical power to be used invarious applications. Power supplies can be expensive but there are cheaper alternative solutions that can produce the same output. A power supply includes conversion steps and has to be reliable enough not to damage what it is hooked up to. Both aspects need specific parts in a certain orientations to create those specific outputs. Throughout this note there where be many suggestion on how to create a cheap reliable power supply.

Objective

To create a cheap, reliable, and effective DC power supply. There is a basic design that can be adjusted to fit many applications. This supply needs to be small so it can be versatile to be Applied in many products.

2. MATERIALS AND METHODS

2.1 Design

The design of ±0-12Volts regulated dual DC power supply was based on figure 1

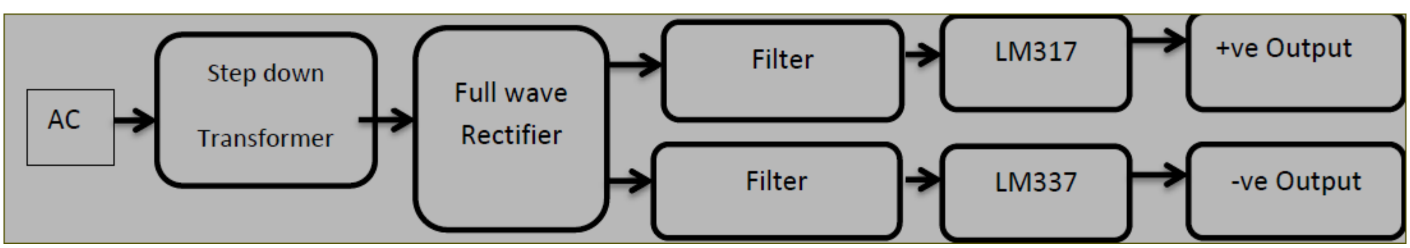


Figure 1: Block diagram of ±0-12Volts regulated DC power supply.

2.2. Transformer Design

A center tapped transformer (0V 12V) was designed and used in this project. The simple element of the transformer as shown in figure 2 consists of two coils having mutual induction and a laminated iron core insulated from each other by a thin layer of vanish which when dried adheres to the metal. The aim of laminating the core was to reduced eddy current loss induced by alternating magnetic flux. This type of configuration gives two phases through the two parts of the secondary coil. Additional wire was connected or grounded across the middle point of the secondary winding of the transformer. The wire was adjusted such that it falls in the exact middle point of the secondary winding thus at zero volt, forming the neutral point for the winding which allows the transformer to provide two separate output voltages which are equal in magnitude but opposite in polarity to each other.

$$P_{primary} = V_P I_P = 308W$$

$$P_{secondary} = V_S I_S = 259W$$

Figure 2: Center tapped transformer

2.3 Rectifier Circuit

A rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification (Akande *et al*., 2007). A full wave rectifier was used to design the dual polarity (±) power supply. This converts both the positive and negative halves of the input waveform to a single polarity (positive or negative) at its output as shown in figure 3.

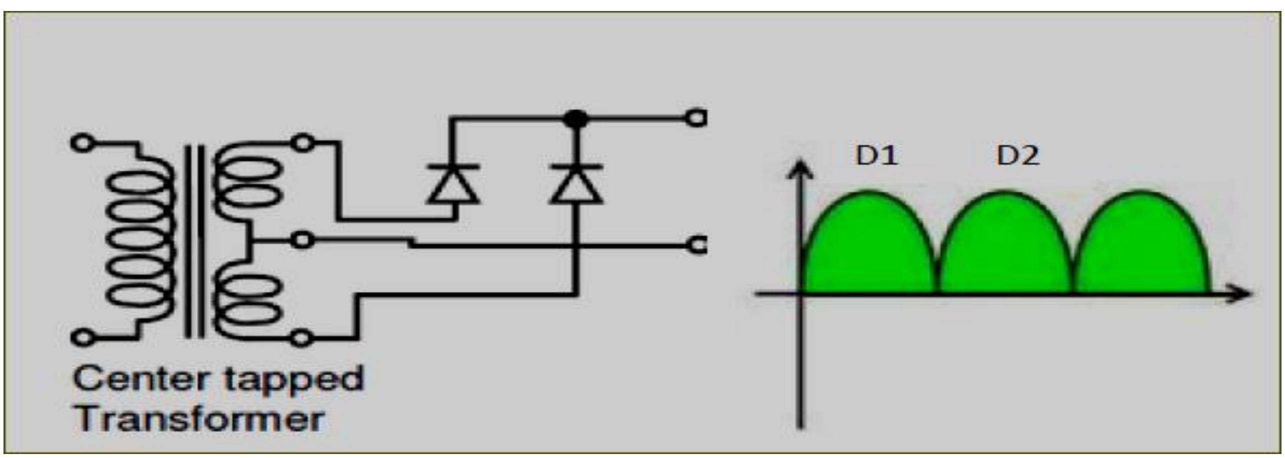


Figure 3. Full-wave rectifier using a center tapped transformer and 2 diodes

The second pair of diode to produce the negative polarity with respect to the center tapped transformer.

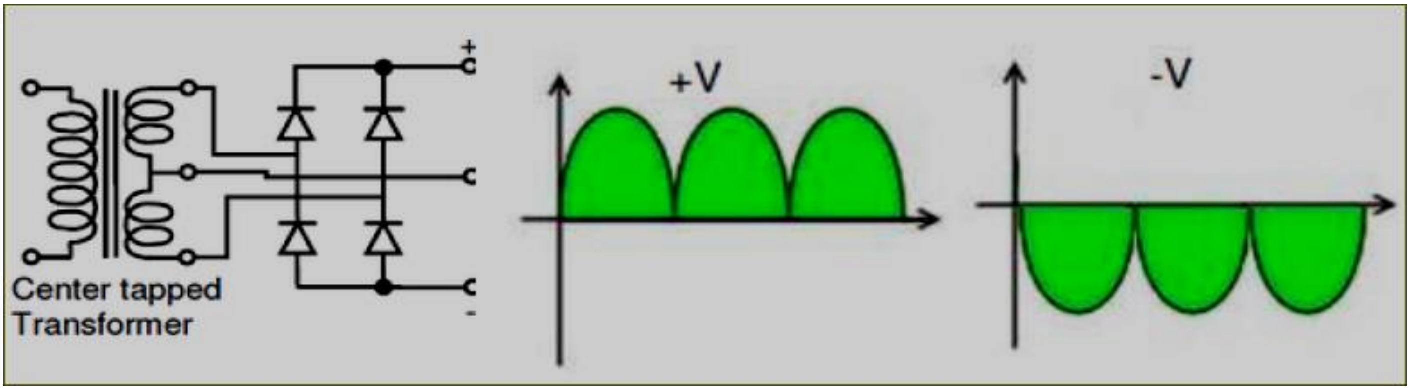


Figure 4. Dual polarity Full-wave rectifier using a center tapped transformer and 4 diodes.

The output voltage of a center-tapped full wave rectifier is one-half of total secondary voltage expressed as Where VB is the biased voltage of the diode. The peak inverse voltage (PIV) for a full wave center tapped rectifier is 2VP (out) Figure 4. Dual polarity Full-wave rectifier using a center tapped transformer and 4 diodes .The output voltage of a center-tapped full wave rectifier is one-half of total secondary voltage expressed as where VB is the biased voltage of the diode. The peak inverse voltage (PIV) for a full wave center tapped rectifier is 2VP(out)

Ripple factor: the ripple factor was used to measure the amount of ripples present in the output DC signal. Ripple factor is defined as the ratio of ripple voltage to the pure DC voltage express as

$$\gamma = \sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1} \quad = 0.48$$

A high ripple factor indicates a high pulsating DC signal

$$\text{DC output current } I_{DC} = \frac{2I_{MAX}}{\pi}$$

Where **Lmax** is the maximum DC load current

$$V_{dc} = \frac{2V_{max}}{\pi}$$

Where Amax is the maximum secondary voltage. Because of the full wave rectification, the period of the full wave signal was half the input period which was obtained as

$$T_{in}(input\ period) = \frac{1}{f} = \frac{1}{50Hz} = 20ms$$

$$T_{out} = \frac{20ms}{2} = 10ms$$

$$\text{The output frequency} = \frac{1}{T_{out}} = \frac{1}{10ms} = 100Hz$$

Therefore, the frequency of the full wave signal is double the input frequency.

2.4 Filter Circuit

In power supplies, capacitors or inductors (choke) are used to smooth (filter) the pulsating DC output after rectification. The pulsating output of the rectifiers has an average DC value and an AC portion that is called ripple voltage. Filter capacitors reduce the amount of ripple voltage to a level that is acceptable. In a filter circuit the capacitor is charged to the peak of the rectified input voltage during the positive portion of the input. When the input goes negative, the capacitor begins to discharge into the load. The rate of discharge is determined by the RC time constant formed by the capacitor and the load's resistance The voltage across the capacitor was determined

$$V_c = \frac{1}{1+RC} V_{in}$$

And the voltage across the resistor was determined by

$$V_R = \frac{RC}{1+RC} V_{in}$$

Transfer function from the input voltage to the voltage across the capacitor is expressed as

$$H_C = \frac{VC}{V_{in}} = \frac{1}{1+RC}$$

Transfer function from the input to the voltage across the resistor is expressed as

$$H_R = \frac{RC}{1+RC}$$

Since a full wave rectifier was connected to a capacitor input filter, the peak-to-peak ripple was cut in half and when the full wave voltage was applied to the RC circuit, the capacitor discharges for only half as long

$$V_R = \frac{I_{dc}}{2FC}$$

Where f is the ripple frequency, Idc is the dc current and C is the capacitor used. For LPF,

$$C = \frac{1}{2\pi FR}$$

$$R = \frac{1}{2\pi FC}$$

2.5 VOLTAGE REGULATORS CIRCUIT

In this work, two voltage regulators LM312 (positive voltage) and LM37 (negative voltage) were used to obtained a dual polarity (±) of DC output.

2.5.1 LM317 (Positive Voltage Regulator) The LM317 is a three terminal positive voltage regulator with an adjustable output voltage capable of supplying in excess of 1.5A over an output voltage range of 1.2V to 37V as shown in

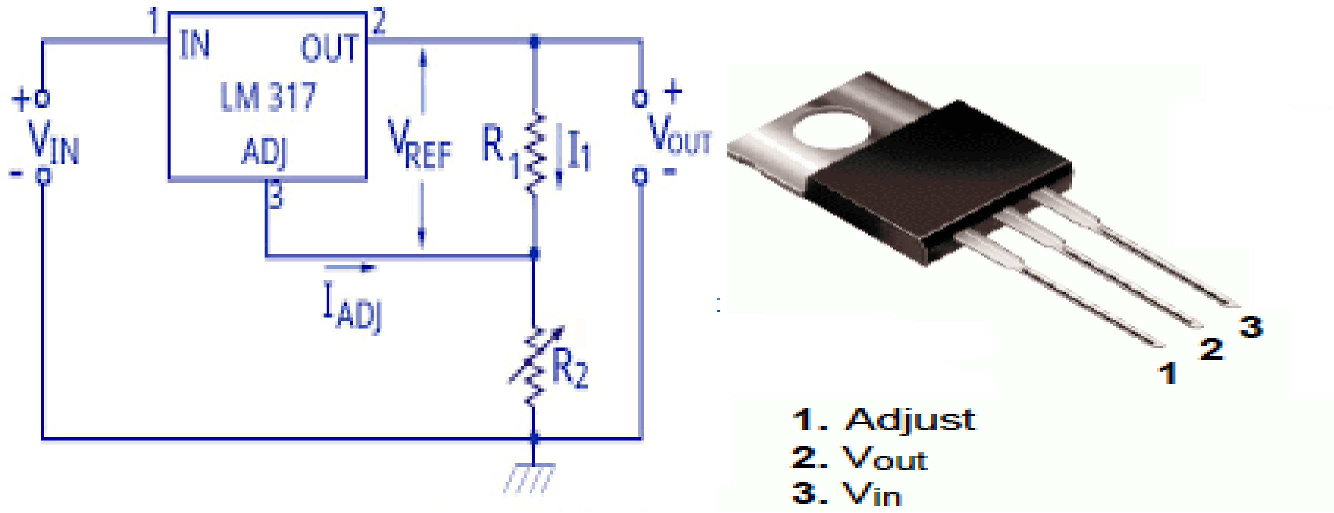


Figure 5: LM317 Positive Voltage regulator. .

The resistors R1 and R2 determine the output voltage Vout. The resistor R2 is adjusted to get the output voltage range between 0 volts to 35 volts. The required output voltage was calculated usin

$$V_{out} = V_{ref}\left(\frac{1+R_2}{R_1}\right) + I_{ADJ}R_2$$

where Vref is the reference voltage between the adjustment terminals and the output taken as 1.25 Volt. The value of Iadj was very small and also had a constant value. Thus equation (28) can be rewritten as

$$V_{out} = 1.25\left(\frac{1+R_2}{R_1}\right)$$

In equation (26), due to the small value of Iadj, the drop due to R2 was neglected

2.5.2 LM337 (Negative Voltage Regulator)

The LM337 is an adjustable 3−terminal negative voltage regulator capable of supplying in excess of 1.5A over an output voltage range of −1.2 V to −37 V as shown in Appendix B. This voltage regulator is exceptionally easy to use and requires only two external resistors to set the output voltage

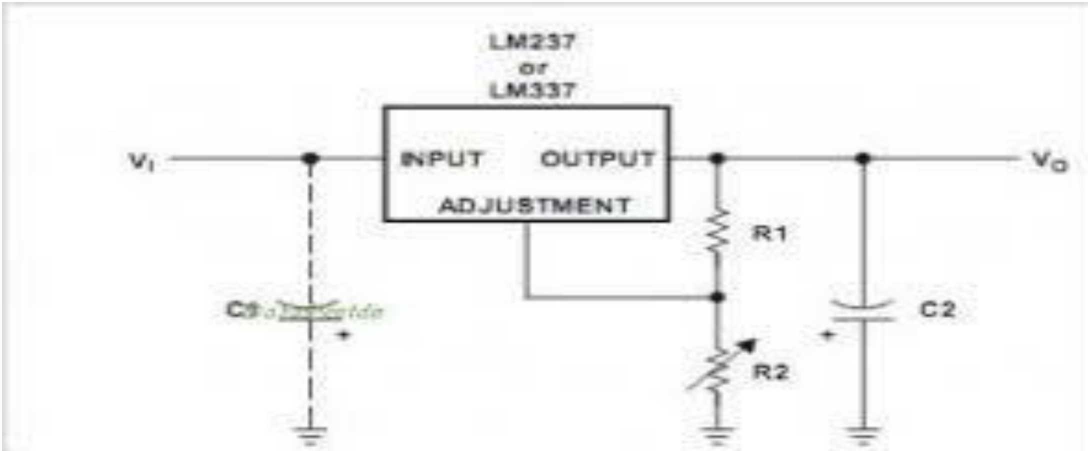


Figure 6: LM337 negative voltage regulator.

The internal fixed resistor R1 and the external variable resistor R2 provide the output voltage adjustment. The negative adjustable voltage regulators are available in the same voltage and current options as the LM 317 devices.

3.0 IMPLEMENTATION OF THE DUAL REGULATED DC POWER SUPPLY

The dual regulated DC power supply was developed and tested. The electrical circuitry of the system is shown in figure 7. The output currents and voltages were measured using digital multimeter and different values of load resistors (4.7Ω, 5.6Ω, 6.2Ω, 7.5Ω, and 8.2Ω) were used. The Power (P) was determined by

$$P = IV = \frac{V^2}{R}$$

Where V is the output voltage and R is the resistance. Using equation (30) with the measurement obtained in table 1, the output powers were computed.

The efficiency of the dual regulated DC power supply was determined using

$$\text{Efficiency } (\eta) = \frac{P_o}{P_{in}} \times 100\%$$

$$(\eta) = \frac{272.34}{308} \times 100\% = 88.42\%$$

Where Po and Pin are the output and input power respectively.

The total loss in the developed circuit was determined by

$$P_L = \frac{P_O}{\eta} - P_O$$

$$P_L = \frac{272.34}{0.8842} - 272.34 = 35.66W$$

3.1 Principle of Operation

Figure 7 is the complete circuit diagram of dual regulated ±0-35Volts DC power supply. LM317 and LM337 ICs were used as positive and negative voltage regulator respectively. The voltage regulators has internal feedback regulating and current passing element. Thus these two ICs form an independently adjustable bipolar power supply. The diodes D1, D12, D13, and D14 served as the full wave rectifier that converts the 220ACV to about 74VDC across the secondary coil of center tapped transformer providing +37VCD and -37VCD simultaneously. The input capacitor C1 and C2 were used to prevent unwanted oscillations either are filter capacitors that were used to smooth (filter) the pulsating DC output after rectification so that a nearly constant DC voltage is supplied to the load.

3.2 Construction

The construction consists of two sections, the casing and circuit. The designed circuit was arranged and soldered on a Printed Circuit Board (PCB). The second section was made of metal casing of 20cm by 10cm by 15cm which was used to house the complete circuit. Provision were made for external controls such as power ON/OFF, light indicator (LED), input AC cord, input AC meter, output terminals, air perforations, fuse, and control terminals.

4.0 RESULTS

Table 1 shows the measurements of the output currents (Io), output powers (Po), and load voltages (Vload) measured at various terminals using different load resistance (4.7Ω, 5.6Ω, 6.2Ω, 7.5Ω, and 8.2Ω). Figures 8 and 9 shows the graphical representation of the load voltages and output currents presented in Table 1. Table 3 indicated the voltage transfer function (Av) and the percentage error (P.E) computed from the measurement. Table 3 presents the calculated parameters of the DC power supply.

Table 1: Measurement at various output terminal using different load resistance.

	POSITIVE DC OUTPUT			NEGATIVE DC OUTPUT		
R(Ω)	V_{LOAD} (V)	I_o (A)	P_o (W)	V_{LOAD} (V)	I_o (A)	P_o (W)
4.7	11.06	2.35	26.02	11.00	2.34	25.7
5.6	14.17	2.53	35.50	14.19	2.53	35.95
6.2	18.11	2.92	52.89	18.29	2.95	53.95
7.5	22.75	3.03	69.00	22.10	2.94	65.12
8.2	27.60	3.36	92.89	27.41	3.34	91.62

Table 2: Comparison of measured and designed values at the positive and negative output terminals

V_{exp} (V)	$V_{no\text{-}Load}$	$A_v = \frac{V_{no-load}}{V_{in}}$	$P.E = \frac{V_{exp} - V_{no-load}}{V_{no-load}} \times 100\%$
+35V	33.83	0.966	3.45%
-35V	33.92	0.969	3.18%

Table 3: Calculated parameters of the power supply

S/NO.	Parameter	Value
1	Core area of the transformer	$0.0020m^2$
2	Turn per voltage of the transformer	1.876
3	Number of primary turns(N_P)	413 turns
4	Number of secondary turns (N_S)	140 turns
5	Power at the primary coil	308W
6	Power at the secondary coil	259W
7	Efficiency of the power supply	88.42%
8	Total power loss	35.66W

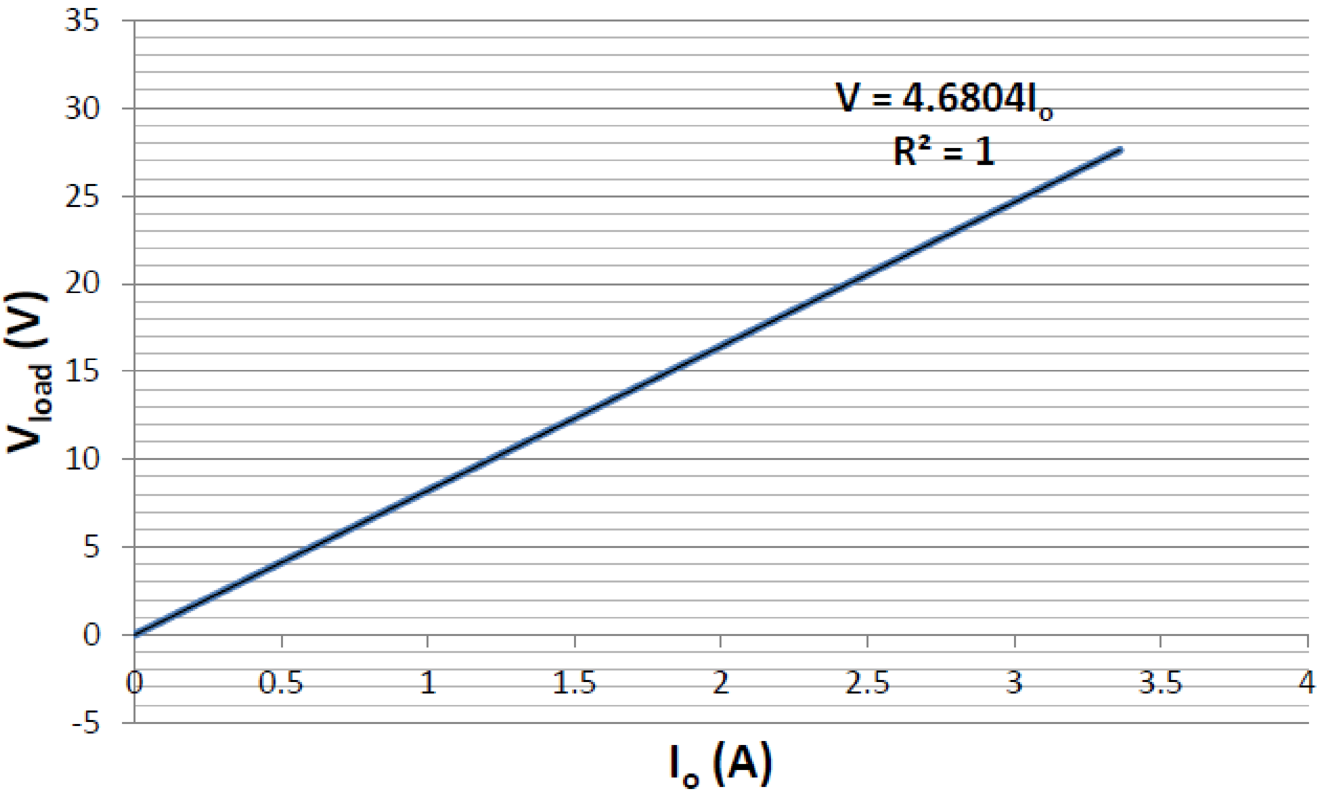


Figure 8: Graph of Vload versus Io for a load resistance of 4.7Ω

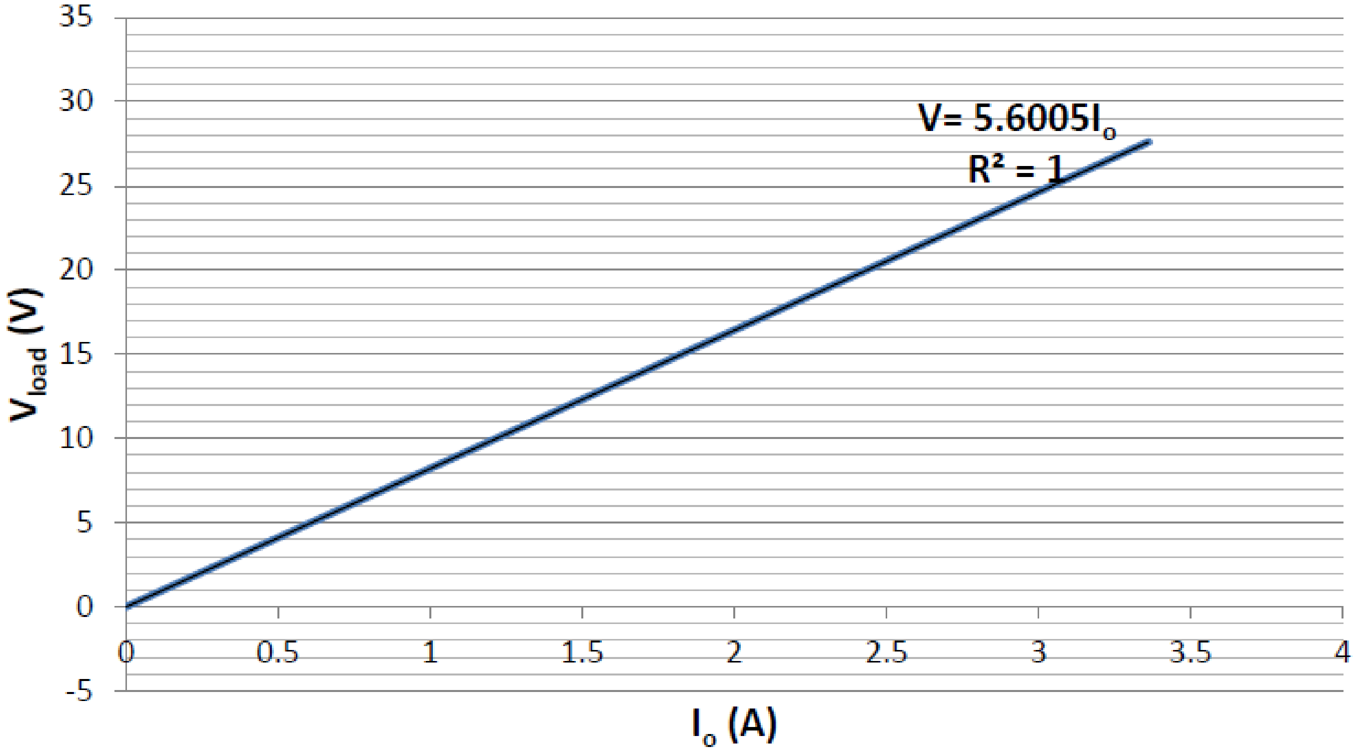


Figure 9: Graph of V_{load} versus I_o for the Load resistance of 5.6Ω

4.1 Discussion

The dual DC power supply was developed to provide a regulated voltage range of ±0-to-35Volts using LM317 and LM 337 voltage regulator though LM317 and LM337 have an in-built voltage range of +1.2V to +37V and -1.2V to -37V respectively. Therefore, a lower reference voltage was created to adjust the voltage regulators from 1.2V to 0V as shown in figure 7 either R1, D2, and D4 were made the reference voltage of +1.2V to the LM337 that adjust it to
0V (+1.2V -1.2V = 0V) and R2, D4, and D5 were made the reference voltage of -1.2V to the LM317 that adjust it to 0V (-1.2V +1.2V =0V). Figure 8, 9, 10, 11, and 12 are the characteristic linear plots for ohmic conductor. They show voltage-current proportionality which implies that voltages increase with increase in currents. The gradients obtained are positive. There was no current flow in the absence of applied potential difference. Thus, the plots pass through the origin. The slopesobtained from each of the graph corresponded to the values of the load resistances used. This shows that the developed circuit obeys ohms law. Table 1 indicated that

as the load resistances in direct proportion. Maximum output power was computed from the terminal and summed to obtain the overall output power of the dual regulated DC power supply. Table 2 indicated the relationship between theory and experiment. It compares the no-load voltages measured at the positive and negative terminal of the constructed circuit and that of the designed values. The voltages from the developed circuit have minor different from the designed values. This was determined to be 3.45% and 3.18% using the percentage error (P.E) method as

5.0 CONCLUSION

The components were first tested for viability and the sub-circuits were tested on bread board before soldering them on the printed circuit board. The developed dual DC supply produced values ranging from about ± 0V to 34.6V at a current of 3.5A. The two great achievements in this developed circuit are; Dual polarity of DC output was obtained using two pairs of full wave rectifier; and the voltage range of LM317 and LM337 were adjusted from ±1.2V-37V to the desired range value of ±0v-35V. This work would educate and enhance the populace towards efficient energy management.

APPENDIX B: (Datasheet catalog, 2015)

Electrical Characteristics LM337

(V_I - V_O = 5V, I_O = 40mA, 0°C ≤ T_J ≤ +125°C, P_{DMAX} = 20W, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ.	Max.	Unit
Line Regulation (Note1)	R_{line}	T_A = +25°C 3V ≤ I V_I - V_O I ≤ 40V	-	0.01	0.04	%/ V
		3V ≤ I V_I - V_O I ≤ 40V	-	0.02	0.07	
Load Regulation (Note1)	R_{load}	T_A = +25°C 10mA ≤ I_O ≤ 0.5A	-	15	50	mV
		10mA ≤ I_O ≤ 1.5A	-	15	150	
Adjustable Pin Current	I_{ADJ}	-	-	50	100	µA
Adjustable Pin Current Change	ΔI_{ADJ}	T_A =+ 25°C 10mA ≤ I_O ≤ 1.5A 3V ≤I V_I - V_O I ≤ 40V	-	2	5	µA
Reference Voltage	V_{REF}	T_A =+ 25°C	-1.213	-1.250	-1.287	
		3V ≤ I V_I - V_O I ≤ 40V 10mA ≤ I_O ≤ 1.5A	-1.200	-1.250	-1.300	V
Temperature Stability	ST_T	0°C ≤ TJ ≤ +125°C	-	0.6	-	%
Minimum Load Current to Maintain Regulation	$I_{L(MIN)}$	3V ≤I V_I - V_O I ≤ 40V	-	2.5	10	
		3V ≤I V_I - V_O I ≤ 10V	-	1.5	6	mA
Output Noise	e_N	T_A =+25°C 10Hz ≤ f ≤10KHz	-	0.003	-	V/10^6
Ripple Rejection Ratio	RR	V_O = -10V, f = 120Hz	-	60	-	
		C_{ADJ} = 10µF (Note2)	66	77	-	dB
Long Term Stability	ST	T_J = 125°C ,1000Hours	-	0.3	1	%
Thermal Resistance Junction to Case	$R_{\theta JC}$	-	-	4	-	°C/ W

Appendix C: Parts List

Self-Check-5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Part 1. <u>Write the sort answer</u>

1. What is Design?
2. Explain the work of voltage regulators
3. What is the deference between hardware design and software design?
4. Explain two sections of PCB construction
5. The total loss in the developed circuit was determined by
6. Explain the working principles of transformer

Answer the question!	
Note: Satisfactory rating - 8 and 15 points	Unsatisfactory - below 8and 15points
You can ask you teacher for the copy of the correct answers.	

Answer Sheet

Name: ____________________________

1. :
2. :
3. :

Score = ___________
Rating: ____________

Date: _______________

LG #16	LO3: Designing and Developing Basic Electronic System

Instruction sheet

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

- following OHS(occupational Health and Safety) *procedures*
- applying knowledge of device and system
- considering all alternative arrangement of design requirements
- incorporating safety budget consideration
- Constructing hardware design Requirements
- Rectifying and retesting effective operation
- Provide solution for unplanned events
- Document project design

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

- follow OHS(occupational Health and Safety) *procedures*
- apply knowledge of device and system
- consider all alternative arrangement of design requirements
- incorporate safety budget consideration
- Constructing and testing hardware design Requirements
- Rectifying and retesting effective operation
- Provide solution for unplanned events
- Document project design

Learning Instructions:

10. Read the specific objectives of this Learning Guide.
11. Follow the instructions described below.
12. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
13. Accomplish the "Self-checks" which are placed following all information sheets.
14. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
15. If you earned a satisfactory evaluation proceed to "Operation sheets
16. Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
17. If your performance is satisfactory proceed to the next learning guide,
18. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information Sheet-1	following OHS(occupational Health and Safety) *procedures*

The objective of this information sheet is to make the best use of human capabilities Without exceeding human limitations

The following guidelines should be adopted to prevent any undesirable effects resulting from the use of office copying equipment and electrical equipment

4. Safety in terms office equipments & person who working with

- **Design of equipment and workplace**

The copying machine selected, the workplace design and the work schedule should be such that they allow operators and maintenance personnel to work without risk of musculoskeletal discomfort. That is, the positioning and height of various components should be such that sustained and repetitive postures are avoided. Photocopying and collating should form only a part of a person's duties, and should not be carried out continuously for long periods. Automatic collators and electric stapling machines are recommended if a significant amount of collating is necessary.

- **Provide adequate ventilation**

All copying equipment should be located in well ventilated areas. Where this requires mechanical ventilation, it should conform to Australian Standard AS 1668. Diazo copiers and other wet copying equipment require special consideration, particularly if they are in heavy or continuous use. Rooms used for the drying of prints from wet processes should be well- ventilated. The exhaust air from copy processes should be ducted directly to the external atmosphere, not added to the general ventilation system. Photocopiers should be installed according to the manufacturer's instructions, with sufficient space and airflow around the machines. Air movement in copying areas should be monitored regularly.

- **Solvents and toners**

Whenever volatile fluids (toners, ammonia, methylated spirits) are being introduced to machines, skin contact and inhalation of vapours and dusts should be avoided. Adequate ventilation should be provided. Personal protective equipment should be available and used, and correct storage procedures followed, in accordance with MSDS information. Protective gloves should be used when cleaning up and disposing of spilt fluids or spent toner. Such material should be placed in sealed plastic bags marked ‘chemical waste’. Photocopiers which utilise containerised toner-filling systems and activate automatic shut-down devices when toner waste compartments are full are recommended. Toner wastes should be emptied regularly.MSDS on any chemicals involved should be obtained from the supplier or service contractor, andbe readily available for perusal by all.

Ozone

Concentrations of ozone in copy rooms should remain within acceptable levels if the photocopier is Serviced regularly, is fitted with a good quality ozone filter, is provided with adequate ventilation and is operated in accordance with the manufacturer's specifications. However, a combination of heavy use, poor maintenance and inadequate ventilation can result in excessive ozone levels. This may signal the need for assessment and recommendation of control measures by an appropriately qualified person.

Note: Some copiers, particularly older ones, may not have ozone filters.

Noise

Noise produced by office copying machines should be minimised as far as practicable. Where necessary, an evaluation by an appropriately qualified person may be undertaken. Replacing noisy machines, surrounding them with absorbent panels, providing they do not interfere with airflow and using special materials in the walls and ceilings of the room are some possible control measures.

Maintain the equipment

Arrangements should be made to ensure that machines are cleaned and maintained regularly.

A maintenance log should be kept for each machine and should be available to staff for inspection. Staff should be appropriately trained for their particular involvement, for example:

- a general operator - training in the correct operation of machines; and
- a person who co-ordinates the servicing of machines
- training in the correct handling and storage of all chemicals,
- the introduction of chemicals to copiers and the disposal of wastes.
- A trained technical service operator should maintain the equipment.
- The diagram and the following checklist illustrate the principles to adopt in order to provide and maintain a healthy working environment in the vicinity of office copying equipment.

A healthy working environment

Checklist for the Safe Use of Office Copying Machines:

1. Equipment should be installed in an adequately ventilated area to facilitate safe removal of any dusts, gases or vapors'.
2. If installed in an enclosed room, mechanical ventilation may be required (refer to Australian Standard AS 1668).
3. There should be adequate space around copiers, to allow for good airflow and to facilitate maintenance.
4. Equipment should be regularly maintained.
5. The working surface of the copier should be at a comfortable height for the operator.
6. Where necessary, a collating table, at a comfortable working height, should be provided.
7. For any chemicals used, MSDS should be available.

2. Safety in terms electrical equipments &person who working with

Safety

When you are working on the electrical system, safety should be your first priority. While most everyone has experienced static electricity shocks, and some may have been shocked by AC current or by an ignition system without serious injury that does not mean that when you are working around electricity you can ignore the dangers. Even small electrical shocks can be dangerous, if not to you then to the components on which you are working. When you experience an **electrical shock**, more happens than just the tingle or pain. Since resistance to current flow causes heat, you can experience not just external burns but also electrical burns that go deep beneath the skin.

Electric shock can also overcome the normal nerve pulses that control all aspects of our bodies.

An electric shock can disrupt the operation of the heart, causing fibrillation. This means that instead of a normal heartbeat, the heart flutters and does not adequately pump blood. This cannot quickly corrected, lead to death.

Though death from electric shock is not likely from working on most cars And trucks, the risk of injury is always present.

Getting shocked usually results in trying to pull away from the source very quickly. This movement can itself cause injury if you pull away but collide with something else.

Before working on a particular vehicle, especially one you are not familiar with, locate any service precautions in the service information, and check for warning labels, like that shown in

Figure 18-1. This is a warning label for a high intensity discharge or headlight system.

In addition, electrical burns are possible if you contact an overloaded circuit. This can occur from extended engine cranking, which can overheat the starter and battery cables.

Circuit breakers, though designed to open in the event of excessive current flow, sometimes

Figure 18-1. This is a warning label for a high intensity discharge or headlight system

Prevention and Control Measures

To establish appropriate prevention of significant health effects, an evaluation of work practices and conditions must be undertaken by qualified health and safety personnel. These practices should be considered an integral part of management. Good occupational hygiene promotes elimination of hazards, where practicable. Engineering controls to minimize hazards at their source, where practicable, and administrative controls should be adopted. The majority of the hazards outlined above can be satisfactorily controlled by ensuring adequate ventilation in the room and around the equipment, applying ergonomic design principles, correctly maintaining machines and exercising caution in the handling of chemicals. Potentially irritating or harmful concentrations of the various airborne contaminants are most likely to exist when a small room is used for copying, the number of air changes in the room is low and the office copying equipment is extensively used.

Self-Check-1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Part 1. Fill in the blank for questions listed below. Use the Answer sheet provided in the next page:

1. The main focus in occupational health is on three different objectives, those are: (6 points)

a.____

b.____

c.____

2. **What is meant by risk assessment? (4 points)**

____

____

____

Answer the question!	
Note: Satisfactory rating - 8 and 15 points	Unsatisfactory - below 8and 15points
You can ask you teacher for the copy of the correct answers.	

Answer Sheet

Name: ___________________________

1. :

2. :

3. :

Score = ____________

Rating: _____________

Date: _______________

Information Sheet-2	Applying knowledge of device and system

Designing and developing electronic circuits, devices and systems for a range of industries.

The role of the Electronic Systems Design and Development is to apply knowledge of electronics and software to the design of circuits or devices that provide a useful function, that are capable of being manufactured at a competitive cost, and that are reliable and safe in use. This involves the use of the engineer's knowledge of electronics and electronic principles, married to an expertise in the end use of the final product. In electronics this end user can cover a wide spectrum.

The role provides the basis of learning with potential to specialize as a Hardware Engineer, Software engineer or Systems Engineer can extend from design of integrated circuits through to complete systems.

The Electronic Systems Design and Development must be proficient in a wide range of skills, underpinned by academic understanding, to enable them to work across these sub-sectors and specialism's.

Apprentices will complete a Degree that will support the fundamental scientific and mathematical principles that equip them with the understanding required to operate effectively and efficiently at a high level within any of these sectors. This will be supported by vocational training to develop the required competencies specific to particular roles within the chosen sector

Electronic Systems Design and Development will meet the following requirements:

- ❖ **Electronic Systems Design and Development requiring knowledge**

Knowledge	What is required
Electrical circuit theory	Understanding of basic electrical theory
Electronic components	Knowledge of the method of operation of basic semiconductors and passive components including their most common uses. Also the basic formulas used in their application
Analogue and digital design techniques	Understanding of design of both analogue and digital circuits and the basic design rules for mixed analogue and digital circuit boards
Structured software	Comprehension of the fundamentals of structured software design
Company Specifics	Understanding key aspects of the employer's business and product applications – against a template to be generated by the employer

❖ **Electronic Systems Design and Development requiring skills**

Skills	What is required
Circuit design	Design functional electronic systems and circuits from component level
Circuit layout	Utilise modern CAD technology to implement circuit design with understanding of considerations for heat dissipation, electrical interference and other industry specific considerations affecting layout
Structured programming for embedded software	Write and document structured code to comply with industry norms and to allow others to understand and subsequently maintain/modify the code
Mathematical modelling	Utilise modelling techniques for circuit design, embedded software development and thermal management
Design for purpose	Ability to demonstrate an understanding of the principles and practice of design for market, design for manufacturability, design for testability and design for maintainability
Testing methodology	Ability to develop a test plan for a product that they have developed

❖ **Electronic Systems Design and Development requiring behaviors**

Behaviours	What is required
Motivation	Self-starter, organised thinker. Works safely and effectively without close supervision
Communication	Confident in oral, written and electronic methods. Ability to communicate effectively with all levels of stakeholder
Team ethos and leadership	Exhibits leadership behaviour and qualities. Demonstrable ability to work as a member of a team.
Continuous development	Committed to personal learning and development
Problem solving/practicality	Enjoys problem solving. Able to demonstrate practical capabilities in their professional role.
Responsibility	Accepts responsibility for own work and that of others

Definition of circuit

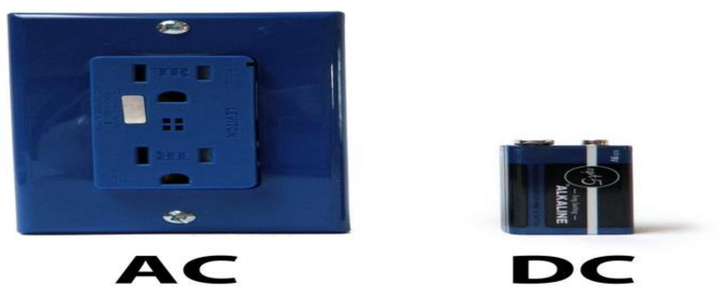
An electronic *circuit* is a complete course of conductors through which current can travel. Circuits provide a path for current to flow. To be a circuit, this path must start and end at the same point. In other words, a circuit must form a loop. An electronic circuit and an electrical circuit has the same definition, but electronic circuits tend to be low voltage circuits.

For example, a simple circuit may include two components: a battery and a lamp. The circuit allows current to flow from the battery to the lamp, through the lamp, then back to the battery

There are two types of electrical signals , those being alternating current (AC), and direct current (DC).

With alternating current, the direction electricity flows throughout the circuit is constantly reversing. You may even say that it is *alternating* direction. The rate of reversal is measured in Hertz, which is the number of reversals per second. So, when they say that the US power supply is 60 Hz, what they mean is that it is reversing 120 times per second (twice per cycle).

With Direct Current, electricity flows in one direction between power and ground. In this arrangement there is always a positive source of voltage and ground (0V) source of voltage

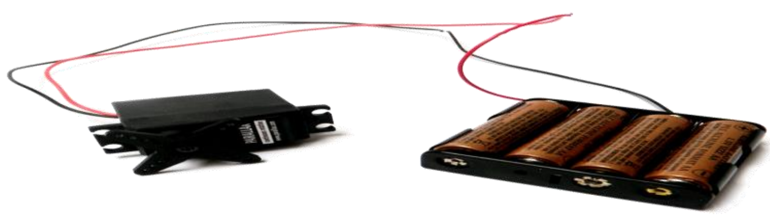


A circuit is a complete and closed path through which electric current can flow. In other words, a closed circuit would allow the flow of electricity between power and ground. An open circuit would break the flow of electricity between power and ground .Anything that is part of this closed system and that allows electricity to flow between power and ground is considered to be part of the circuit.

The next very important consideration to keep in mind is that electricity in a circuit must be used.

For instance, in the circuit above, the motor that electricity is flowing through is adding resistance to the flow of electricity. Thus, all of the electricity passing through the circuit is being put to use.

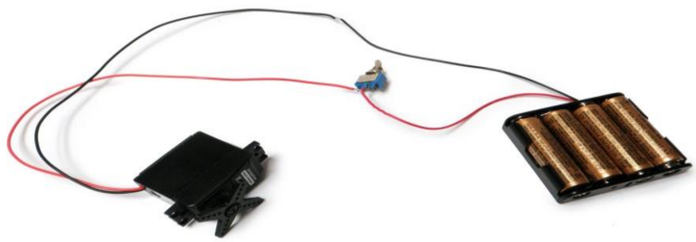
In other words, there needs to be something wired between positive and ground that adds resistance to the flow of electricity and uses it up. If positive voltage is connected directly to ground and does not first pass through something that adds resistance, like a motor, this will result in a short circuit. This means that the positive voltage is connected directly to ground.



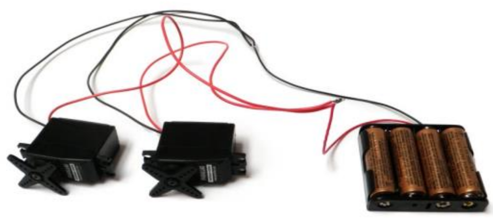
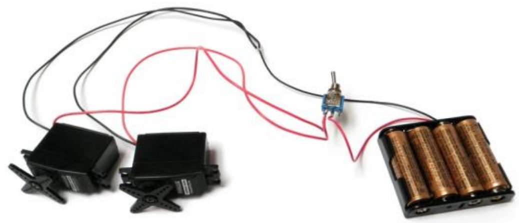
There are two different ways in which you can wire things together called series and parallel.

When things are wired in series, things are wired one after another, such that electricity has to pass through one thing, then the next thing, then the next, and so on.

In the first example, the motor, switch and battery are all wired in series because the only path for electricity to flow is from one, to the next, and to the next.



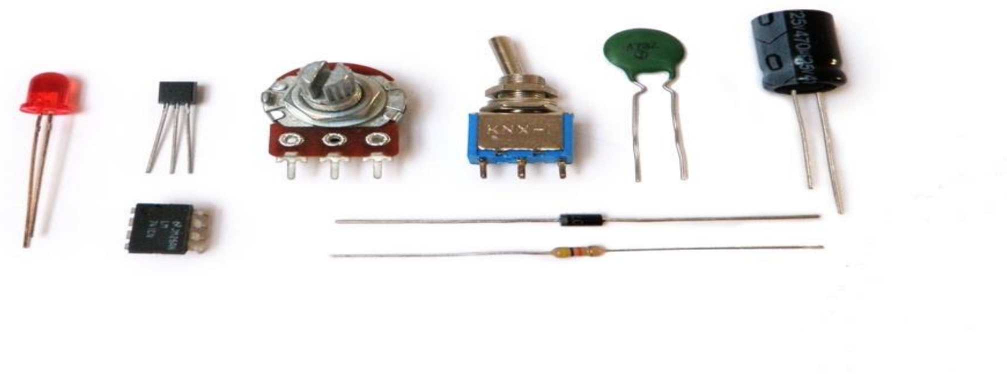
Principles of Series circui   and   Parallel circuit

Basic Components

In order to build circuits, you will need to become familiar with a few basic components. These components may seem simple, but are the bread and butter of most electronics projects. Thus, by learning about these few basic parts, you will be able to go a long way.

Bear with me as I elaborate as to what each of these are in the coming steps



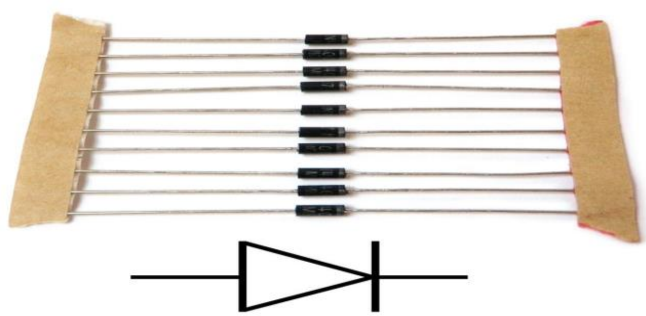
As the name implies, resistors add resistance to the circuit and reduces the flow of electrical current. It is represented in a circuit diagram as a pointy squiggle with a value next to it.

The different markings on the resistor represent different values of resistance. These values are measured in ohms.

Resistors also come with different wattage ratings. For most low-voltage DC circuits, 1/4 watt resistors should be suitable. You read the values from left to right towards the (typically) gold band. The first two colors represent the resistor value, the third represents the multiplier, and the fourth (the gold band) represents the tolerance or precision of the component.

A capacitor is a component that stores electricity and then discharges it into the circuit when there is a drop in electricity. You can think of it as a water storage tank that releases water when there is a drought to ensure a steady stream. Capacitors are measured in Farads. The values that you will typically encounter in most capacitors are measured in picofarad (pF), nanofarad (nF), and microfarad (uF). These are often used interchangeably and it helps to have a conversion chart at hand.

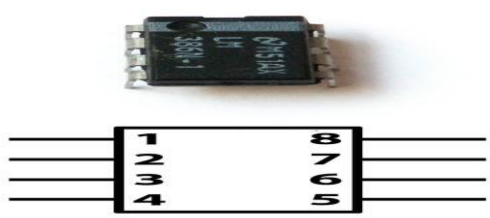
are components which are polarized. They only allow electrical current to pass through them in one direction. This is useful in that it can be placed in a circuit to prevent electricity from flowing in the wrong direction. Another thing to keep in mind is that it requires energy to pass through a diode and this results in a drop of voltage. This is typically a loss of about 0.7V. This is important to keep in mind for later when we talk about a special form of diodes called LEDs. The ring found on one end of the diode indicates the side of the diode which connects to ground. This is the cathode. It then follows that the other side connects to power. This side is the anode.



A transistor takes in a small electrical current at its base pin and amplifies it such that a much larger current can pass between its collector and emitter pins. The amount of current that passes between these two pins is proportional to the voltage being applied at the base pin. There are two basic types of transistors, which are NPN and PNP. These transistors have opposite polarity between collector and emitter. For a very comprehensive intro to transistors check out this page. NPN transistors allow electricity to pass from the collector pin to the emitter pin. They are represented in a schematic with a line for a base, a diagonal line connecting to the base, and a diagonal arrow pointing away from the base. PNP transistors allow electricity to pass from the emitter pin to the collector pin. They are represented in a schematic with a line for a base, a diagonal line connecting to the base, and a diagonal arrow pointing towards the base.

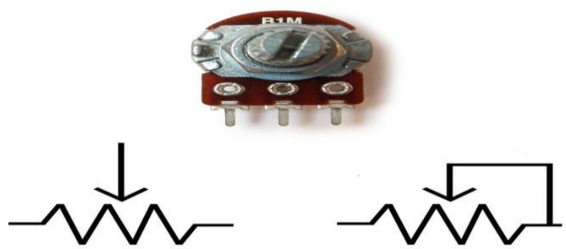
Integrated Circuits

An integrated circuit is an entire specialized circuit that has been miniaturized and fit onto one small chip with each leg of the chip connecting to a point within the circuit. These miniaturized circuits typically consist of components such as transistors, resistors, and diodes. For instance, the internal schematic for a 555 timer chip has over 40 components in it. Like transistors, you can learn all about integrated circuits by looking up their datasheets. On the datasheet you will learn the functionality of each pin. It should also state the voltage and current ratings of both the chip itself and each individual pin. Integrated circuits come in a variety of different shapes and sizes. As a beginner, you will be mainly working with DIP chips. These have pins for through-hole mounting. As you get more advanced, you may consider SMT chips which are surface mount soldered to one side of a circuit board.



Potentiometers

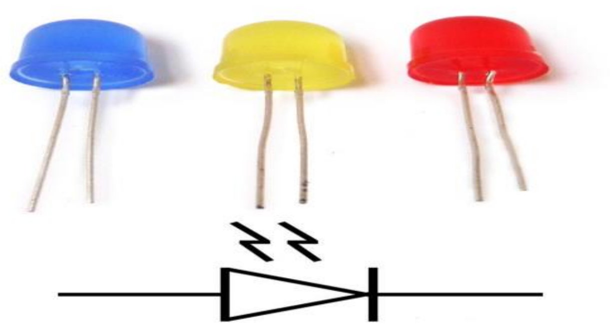
are variable resistors. In plain English, they have some sort of knob or slider that you turn or push to change resistance in a circuit. If you have ever used a volume knob on a stereo or a sliding light dimmer, then you have used a potentiometer. Potentiometers are measured in ohms like resistors, but rather than having color bands, they have their value rating written directly on them (i.e. "1M"). They are also marked with an "A" or a "B, " which indicated the type of response curve it has. Potentiometers marked with a "B" have a linear response curve. This means that as you turn the knob, the resistance increases evenly (10, 20, 30, 40, 50, etc.). The potentiometers marked with an "A" have a logarithmic response curve. This means that as you turn the knob, the numbers increase logarithmically (1, 10, 100, 10,000 etc.) Potentiometers have three legs as to create a voltage divider, which is basically two resistors in series. When two resistors are put in series, the point between them is a voltage that is a value somewhere between the source value and ground.



LEDs

Stands for light emitting diode. It is basically a special type of diode that lights up when electricity passes through it. Like all diodes, the LED is polarized and electricity is only intended to pass through in one direction.

There are typically two indicators to let you know what direction electricity will pass through and LED. The first indicator that the LED will have a longer positive lead (anode) and a shorter ground lead (cathode). The other indicator is a flat notch on the side of the LED to indicate the positive (anode) lead. Keep in mind that not all LEDs have this indication notch (or that it is sometimes wrong).



Switches

A switch is basically a mechanical device that creates a break in a circuit. When you activate the switch, it opens or closes the circuit. This is dependent on the type of switch it is.

Normally open (N.O.) switches close the circuit when activated.

Normally closed (N.C.) switches open the circuit when activated.

As switches get more complex they can both open one connection and close another when activated. This type of switch is a single-pole double-throw switch (SPDT).

If you were to combine two SPDT switches into one single switch, it would be called a double-pole double-throw switch (DPDT). This would break two separate circuits and open two other circuits, every time the switch was activated.

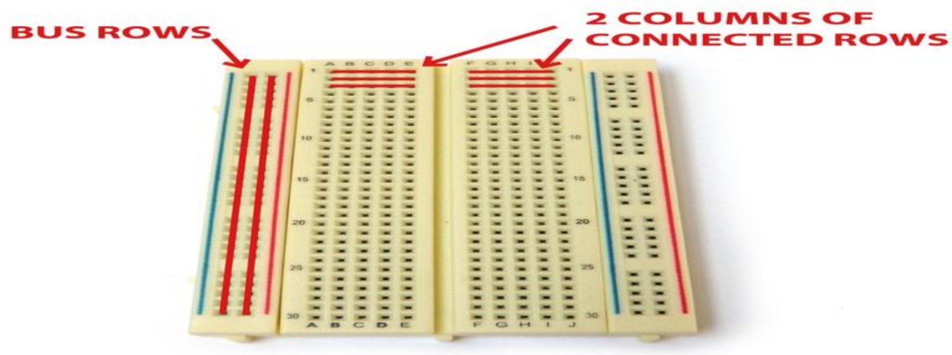
Batteries

A battery is a container which converts chemical energy into electricity. To over-simplify the matter, you can say that it "stores power." By placing batteries in series you are adding the voltage of each consecutive battery, but the current stays the same. For instance, a AA-battery is 1.5V. If you put 3 in series, it would add up to 4.5V. If you were to add a fourth in series, it would then become 6V.

.

Breadboards

Are special boards for prototyping electronics. They are covered with a grid of holes, which are split into electrically continuous rows.In the central part there are two columns of rows that are side-by-side. This is designed to allow you to be able to insert an integrated circuit into the center. After it is inserted, each pin of the integrated circuit will have a row of electrically continuous holes connected to it. In this way, you can quickly build a circuit without having to do any soldering or twisting wires together. Simply connect the parts that are wired together into one of the electrically continuous rows. On each edge of the breadboard, there typically runs two continuous bus lines. One is intended as a power bus and the other is intended as a ground bus. By plugging power and ground respectively into each of these, you can easily access them from anywhere on the breadboard.



Wire

In order to connect things together using a breadboard, you either need to use a component or a

Wires are nice because they allow you to connect things without adding virtually no resistance to the circuit. It is recommended that you use insulated 22awg (22 gauge) solid core wire for breadboards. Use to be able to find it at RadioShack, but instead could use the hookup wire linked to above. Red wire typically indicates a power connection and black wire represents a ground connection. To use wire in circuit, simply cut a piece to size, strip a 1/4" of insulation from each end of the wire and use it to connect points together on the breadboard.

Electronic Systems Design and Development requiring skill

Let us doing simple project exercise

This schematic may look daunting, but it is actually rather straight-forward. It is using all of the parts that we have just gone over to automatically blink an LED. Any general purpose NPN or PNP transistors should do for the circuit, but should you want to follow along at home.

using 2N3904 (NPN) and 2N3906 (PNP) transistors. Learne the pin layouts by looking up their datasheets. A good source for quickly finding datasheets is simply search for the part number and you should find a picture of the part and link to the datasheet. For instance, from the datasheet for the 2N3904 transistor, I was quickly able to see that pin 1 was the emitter, pin 2 was the base, and pin 3 was the collector. Aside from the transistors, all of the resistors, capacitors, and LED should be straight-forward to connect. However, there is one tricky bit in the schematic. Notice the half-arch near the transistor. This arch indicates that the capacitor jumps over the trace from the battery and connects to the base of the PNP transistor instead. Also, when building the circuit, don't forget to keep in mind that the electrolytic capacitors and LED are polarized and will only work in one direction After you finish building the circuit and plug in the power, it should blink. If it does not blink, carefully check all of your connections and orientation of all of the parts.

Component required for project

No	Items	Specification
1	Transistor	2N3904 PNP
2	Transistor	47 ohm - 1/4 Watt
3	Transistor	1K ohm - 1/4 Watt
4	Transistor	470K ohm - 1/4 Watt
5	electrolytic capacitor	10uF
6	ceramic disc capacitor	0.01uF
7	LED	5mm red
8	battery holder	3V AA
9	Resistor	10K ohm - 1/4 Watt
10	Potentiometer	1M

<table>
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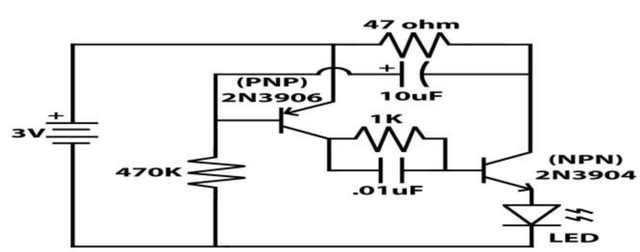
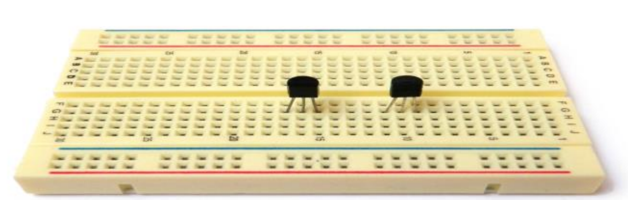
<tr><td>

schematic circuit</td><td>
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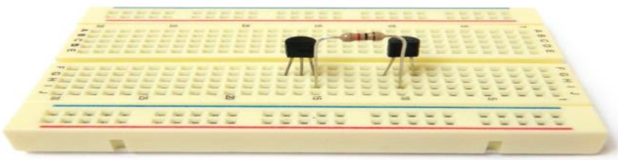

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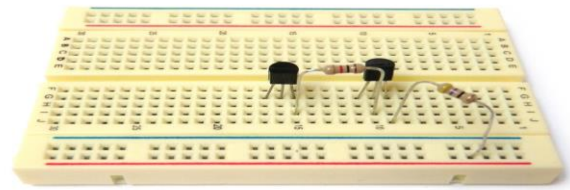
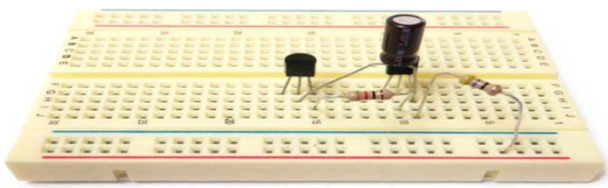
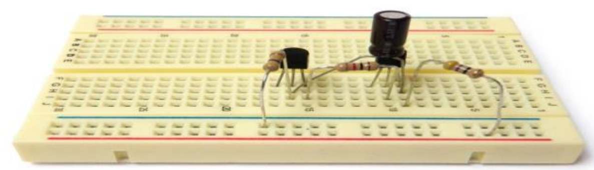


Step 3.



Step 4.

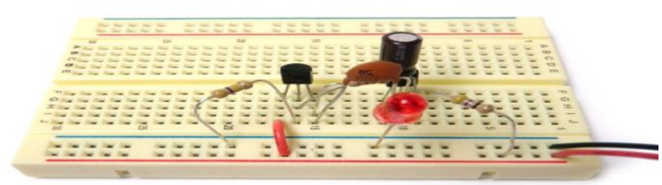


Step 5.

Step 6.

Step 7.

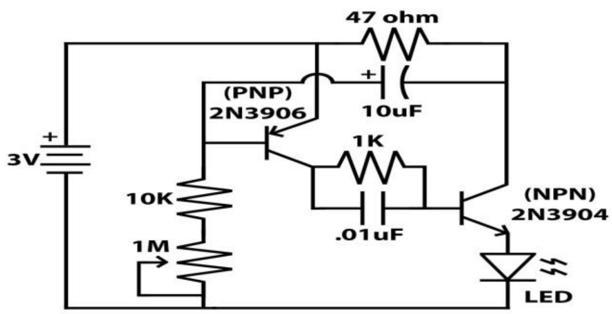
Step 8.



Step 9.

No	components	Specification
1	Timer	555 IC
2	Resistor	47 ohm - 1/4 Watt
3	Resistor	1K ohm - 1/4 Watt
4	Resistor	470K ohm - 1/4 Watt
5	electrolytic capacitor	10uF

Let us do simple project exercise



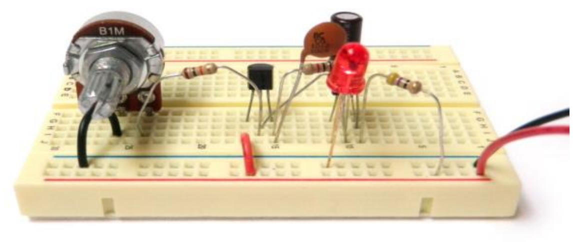


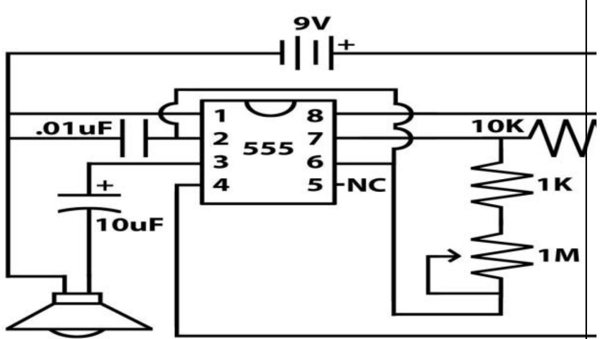
Fig (a) fig (b)

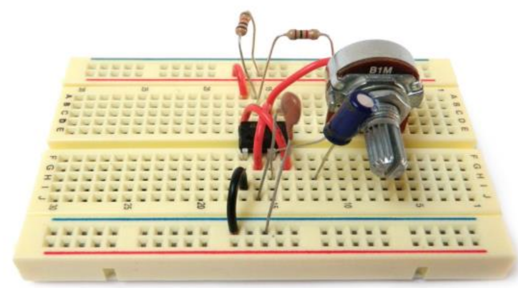
Second project

This last circuit is using a 555 timer chip to make noise using a speaker. What is happening is that the configuration of components and connections on the 555 chip is causing pin 3 to oscillate rapidly between high and low. If you were to graph these oscillations, it would look like a **(**a wave the alternates between two power levels). This wave then rapidly pulses the speaker, which displaces air at such a high frequency that we hear this as a steady tone of that frequency. Make sure that the 555 chip is straddling the center of the breadboard, such that none of the pins might get accidentally connected.

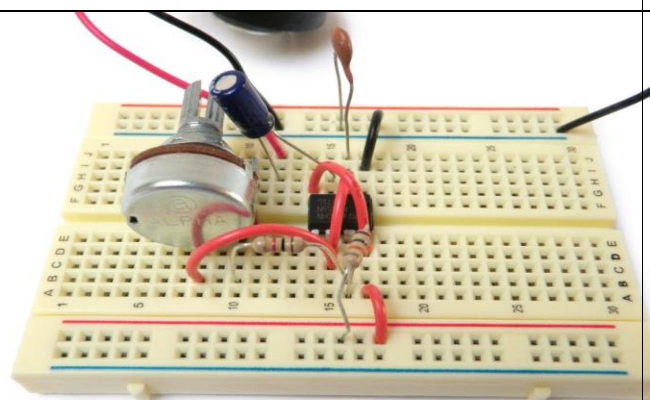
Component required for project two

This allows you to be flexible as to where you place parts because you can connect them together later with wire. It also allows you to connect a part to multiple other parts.

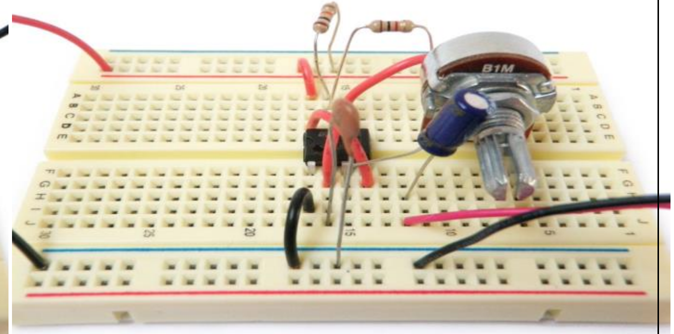




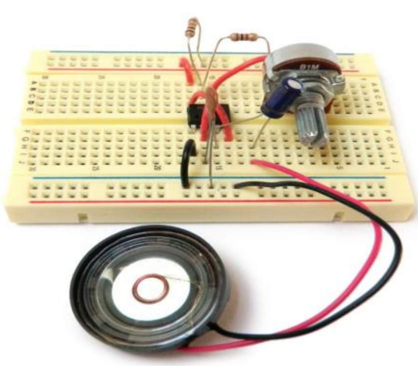
Step 1.



Step 2.

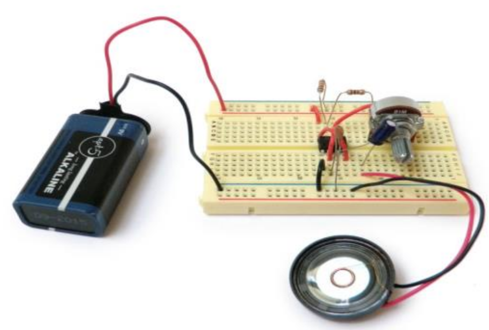


Step3.



Step 4.

Step5.



Self-Check-5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Part 1. Write the sort answer

1. What are the applications of ac voltage controllers?
2. What are the advantages of ac voltage controllers?

3. What are the two methods of control in ac voltage controllers

Part 2 <u>operation sheet of self-check-5</u>

Operation title: -building (assembling) schematic circuit to the PCB

Purpose	Follow step allows you to be flexible as to where you place parts because you can connect them together later with wire. It also allows you to connect a part to multiple other parts
Equipment ,tools and materials	Supplies and equipment needed or useful for building and assembling parts to PCB include these: • Resistor47 ohm - 1/4 Watt • Resistor 470k ohm - 1/4 Watt • Resistor 47 ohm - 1/4 Watt • Resistor 1k ohm - 1/4 Watt • Electrolytic capacitor 10uf • Ceramic disc capacitor0.1uf • LED • Transistor (NPN)2N3905 • Transistor (NPN)2N3904 • Potentiometer 1M • Wire • Lead • Soldering iron • PCB • Battery 3v
Conditions or situations for the operations	• All tools, equipment's and materials should be available on time when required. • Appropriate table, working area/ workshop to assemble electronic parts practice.
Procedures	1. Interprets schematic diagrams 2. Collect parts 3. Place parts on PCB 4. Connect by wiers 5. Start properly soledering usining soledering irons 6. Identifying input /output terminals 7. Testing parts conenction 8. now ready to use battery supply.
Precautions	• Care should be taken while connecting with electric power, assembling, and building circuit conection • Preparing materials, tools and equipment are according to inseminator command.
Quality criteria	• Did personal protective equipment worn while assembling and building electronic circuit • Did trainees building and assembling the component connection on the PCB properly without leakage /damage • The DC supply functional for home /office equipment oprations

Building and assembling electronic component parts on PCB training boards

LAP Test	**Practical Demonstration**

Name: ______________________________ Date: _________________

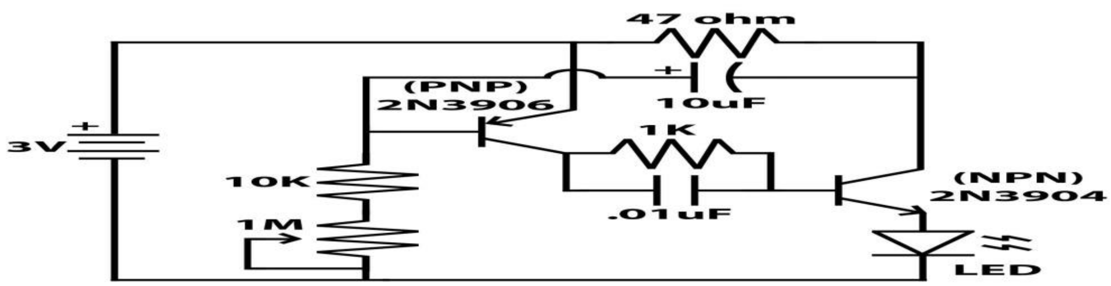
Time started: _________________________ Time finished: _________________

Instructions:

1. You are required to perform any of the following:

1.1. Building and assembling electronic power supply circuit applying on PCB

1.2. Prepare equipment and material for building and assembling electronic power supply circuit operate the propely by interpreting schematic diagram bellow



Part 1 Answer Sheet

Name: __________________________

1. What are the applications of ac voltage controllers
- ✓ Domestic and industrial heating
- ✓ Lighting control
- ✓ Speed control of single phase and three phase ac motors
- ✓ Transformer tap changing

2. What are the advantages of ac voltage controllers?
- ✓ High efficiency
- ✓ Flexibility in control
- ✓ Less maintenance

3. What are the two methods of control in ac voltage controllers
- ✓ ON-OFF control
- ✓ Phase contro

Information Sheet-3	considering all alternative arrangement of design requirements

Design requirements

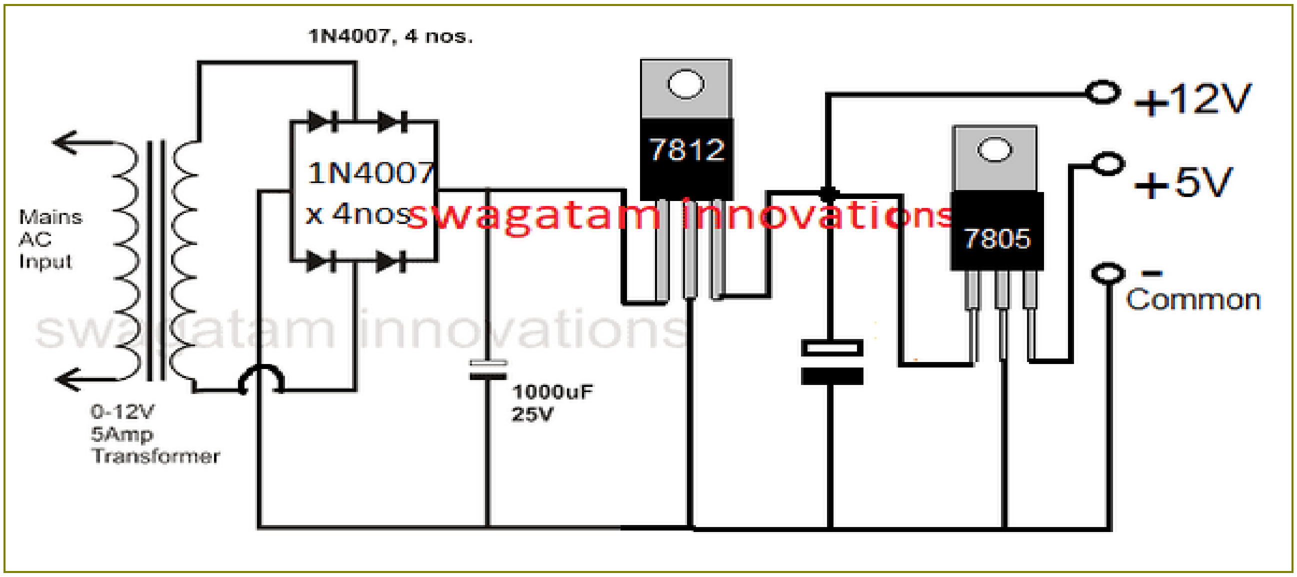
1.1. How to Design and Build Working Electronic Circuits Understanding the fundamental principles described in part I is only half the challenge in designing and building working electronic circuits. This is because electronic components are often non-ideal and the designs of electronic circuits are strongly constrained by the characteristics of available components. For example, resistors can only be so large, op amps can only be so fast, and transistors can only handle so much power. The practical design challenge is to meet the functional requirements of a circuit given limitations of available component.

3.2. Reading Datasheets

Every electronic component ranging from the simplest resistor to the most complex integrated circuit is described by a datasheet. Consequently, reading datasheets is one of the most important skills for an electronic circuit designer.

Datasheets contain information on electrical properties, reliability statistics, intended use, and physical dimensions of the component. The amount of information contained in datasheets, can be very extensive and truly bewildering for the newcomers.

Design considerations for power supply pubs now suppose you had circuit applications which needed a dual supply in the range of 12V fixed and also 5V fixed regulated supplies. For such applications the above discussed design could be simply modified by using a 7812 IC and then subsequently a 7805 IC for getting the required 12V and 5V regulated power supply output together, as indicated below:



Designing a Simple Dual Power Supply

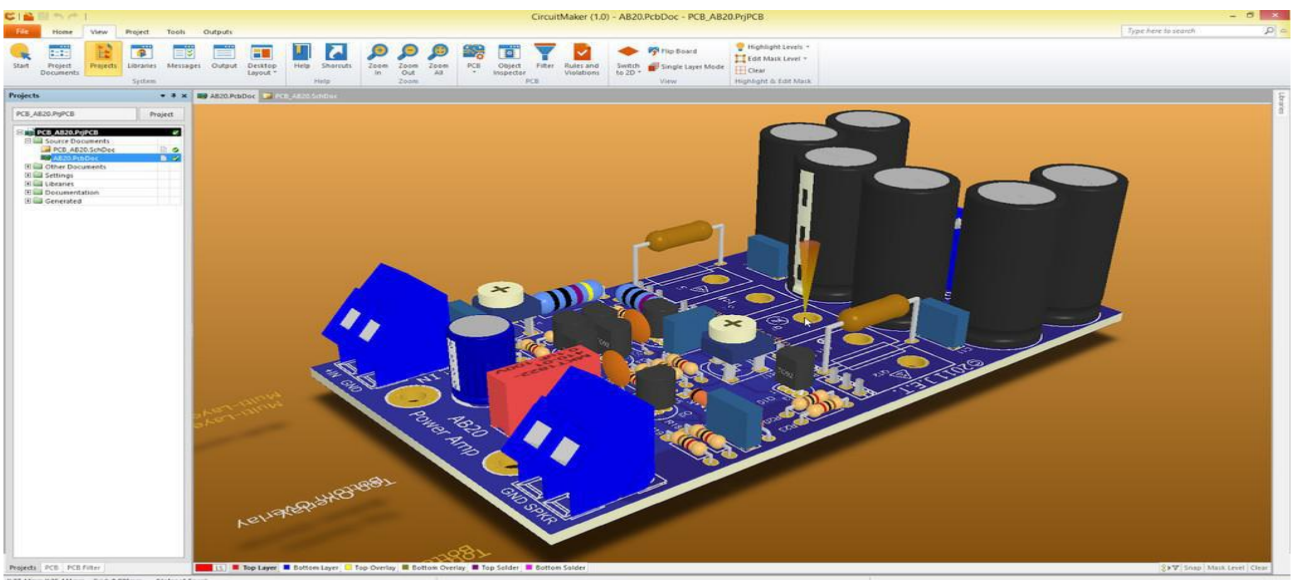
In many of the circuit applications, especially the ones using op amps, a dual power supply becomes mandatory for enabling the +/- and ground supplies to the circuit.

Designing a simple dual power supply actually involves a just a center tap power supply and a bridge rectifier along with a couple of high value filter capacitors as shown below:.

When it comes to designing power supplies, the importance of a well-laid out printed circuit board cannot be overstated. Furthermore, the designer has to understand the dynamics behind the operation of the power supply for making the effort a success. Even when CAD software is used to design PCBs, the use of an auto-router for automatically routing the traces on a PCB for a power supply circuit usually causes failures.

Computer: is a device that accepts information (in the form of digitalized data) and manipulates it for some result based on a program, software, or sequence of instructions on how the data is to be processed. By installing Electronic circuit design and simulation software, we can use them to design and construct electrical/electronic circuit.

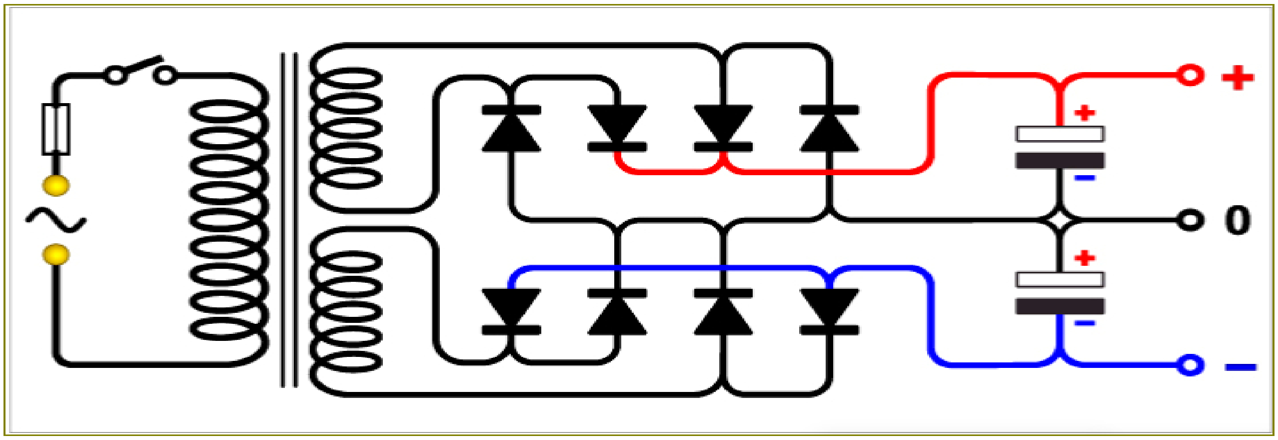
CAD software is used to design PCBs the use of an auto-router for automatically routing the traces on a PCB for a power supply circuit usually causes failures



Current loops and power supply   layouts

The fundamental requirement of the designer is to keep the different current loops separate and allow them to pass through as short a conductor as possible. Although the currents in the loops are largely DC, they do contain some AC components, which actually make up the conducted EMI. By keeping the conductor length short, the designer allows only a small part of the AC energy to radiate into the environment. Most of the current loops in the power switch and output rectifier of a switched mode power supply carry high peak pulsating DC currents with trapezoidal waveforms and sharp edges. The designer should lay out these loops such that they enclose a very small area and use traces of considerable width.

The Layout of a Dual Power Supply: Functional Characteristics



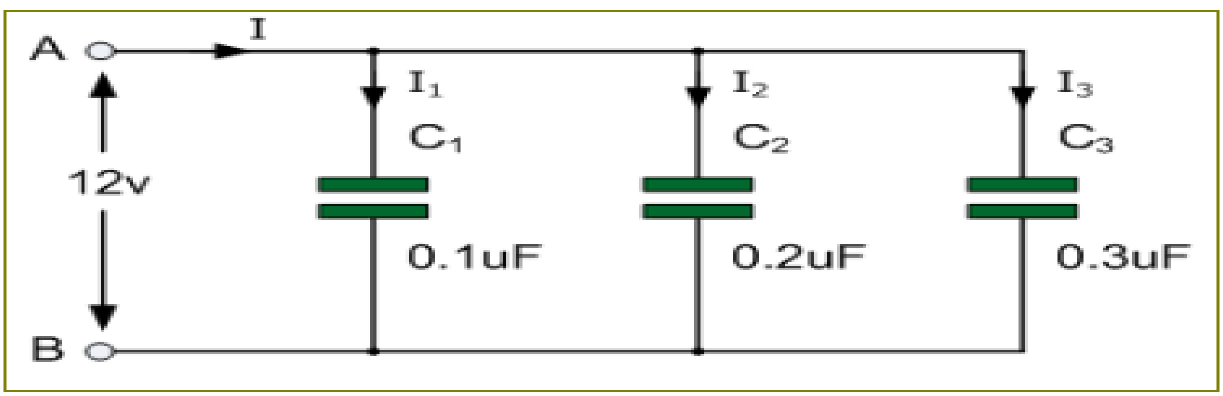
GROUNDING IN POWER SUPPLY LAYOUTS

The high current loops discussed above require separate grounding to prevent them from influencing each other. This is because grounds represent return paths with the lowest potential for the currents. The ground represents the reference potential from which designers measure the potential of all other signals.

It is necessary for designers to consider sections of the ground system separately, as the ground carries both AC and DC signals from various points in the circuit. Improper interconnection of these grounds can make the power supply unstable.

Layout for paralleling capacitors

The equivalent series resistance and equivalent series inductance of filter capacitors at the output of a power supply contribute to internal heating of the capacitor and the level of ripple current in the output. Therefore, designers try to lower the ESR and ESL by using several capacitors in parallel.



1. Firstly, 220V AC is converted into 12V AC by using simple step-down (220V/12V) transformer.
2. Secondly, output of this transformer is given to the rectifier circuit, which will convert the ac supply into dc supply. The output of the rectifier circuit that is DC contains the ripples in the output voltage. To filter out these ripples, capacitor of 2200 uf, 25V is used.

Lastly, the output of the capacitor that is pure DC is given to voltage regulator IC 7812 and IC7912 which will regulate the output voltage at 12V and -12V DC, despite the change in input voltage. Required Components:

Centre tapped transformer (220V/12V)

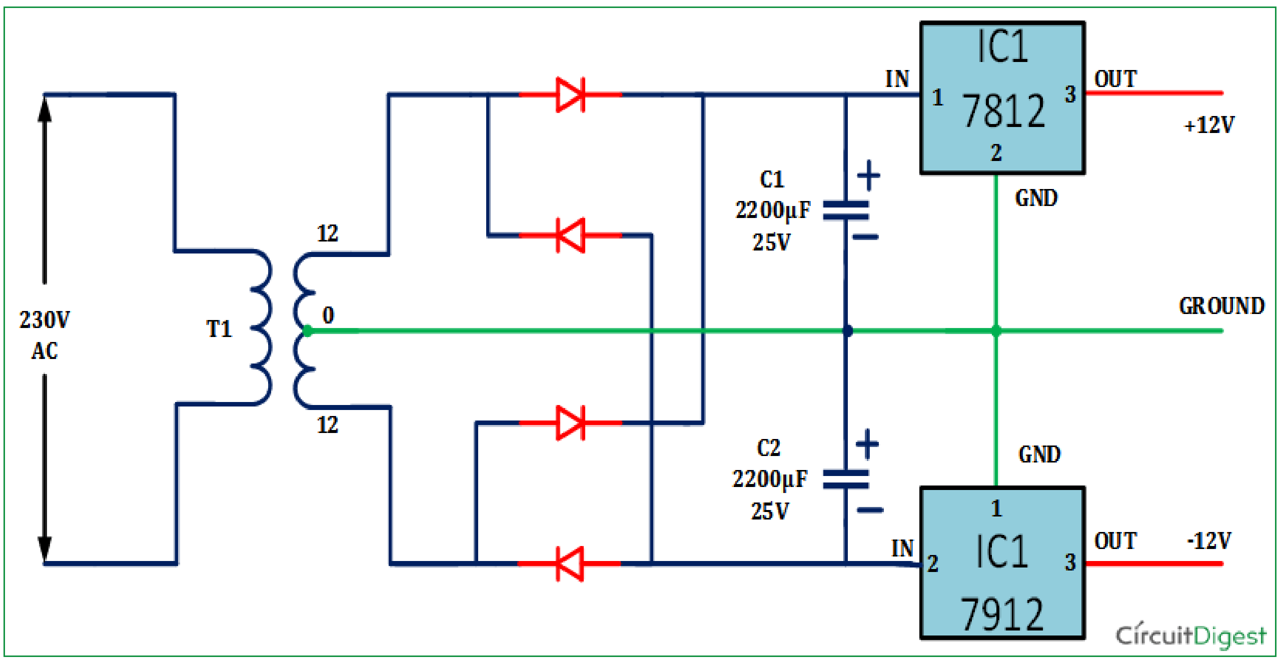
Power Diodes (6A) – 4No.

Capacitor   (2200µF, 25V) – 2No.

Voltage regulator (IC 7812 & 7912)

Toggle switch

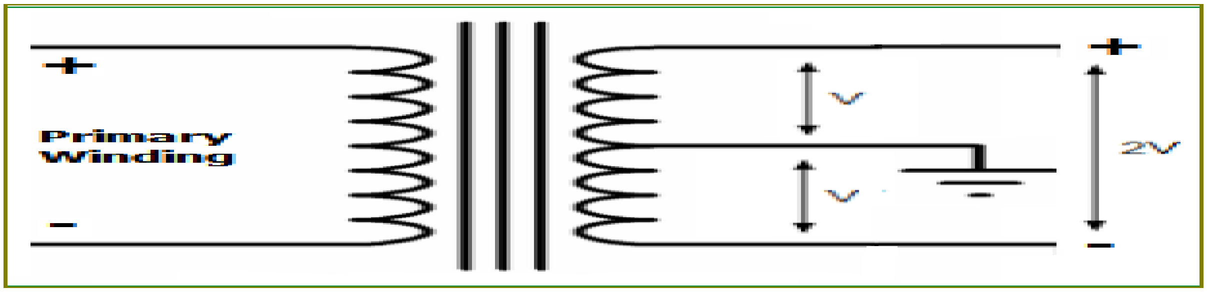
DC load (DC motor)



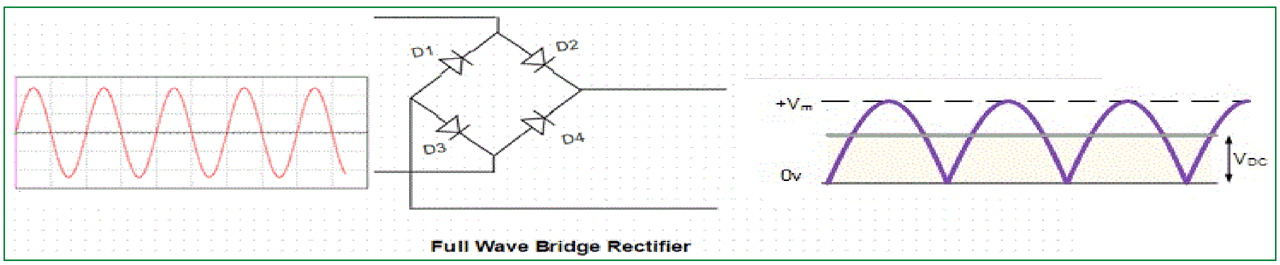
Constructing Dual Power Supply Circuit:

Step-I: Converting 220v AC into 12v AC using Step down Transformer

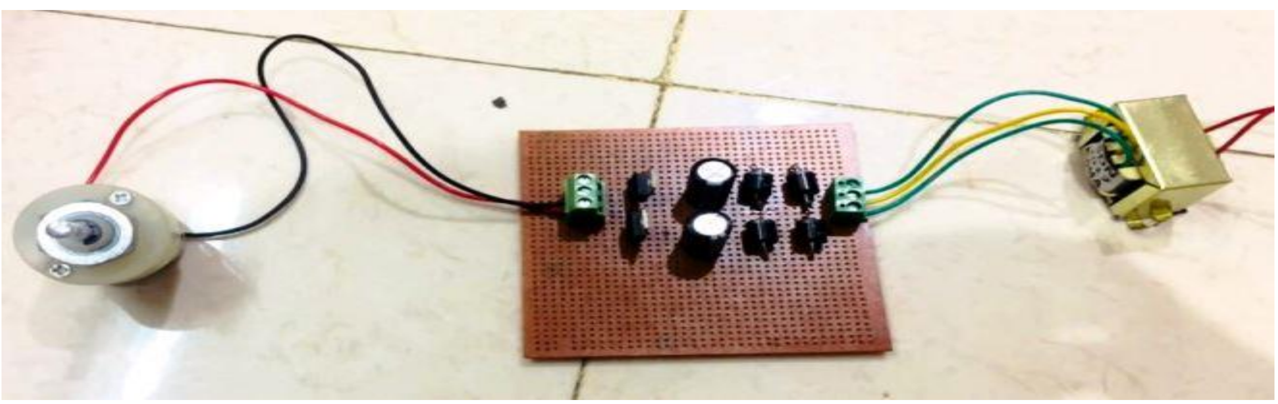
The primary terminals of the centre tapped transformer are connected with household supply (220V *ac*, 50Hz) and output is taken from secondary terminals of the transformer. The centre tapped describes the voltage output of a center tapped transformer. For example: A 24V centre tapped transformer will measure 24V *ac* across the outer two taps (winding as a whole), and 12V *ac* from each outer tap to the center-tap (half winding). These two 12V *ac* supplies are 180 degrees out of phase with each other, thus making it easy to derive positive and negative 12 volt *dc* power supplies from them. The advantage of using a centre tapped transformer is we can get the both +12V and -12V *dc* supply using only one transformer. Center Tapped Transformer



The **waveform of input and output voltage of full bridge rectifier** is as shown below.



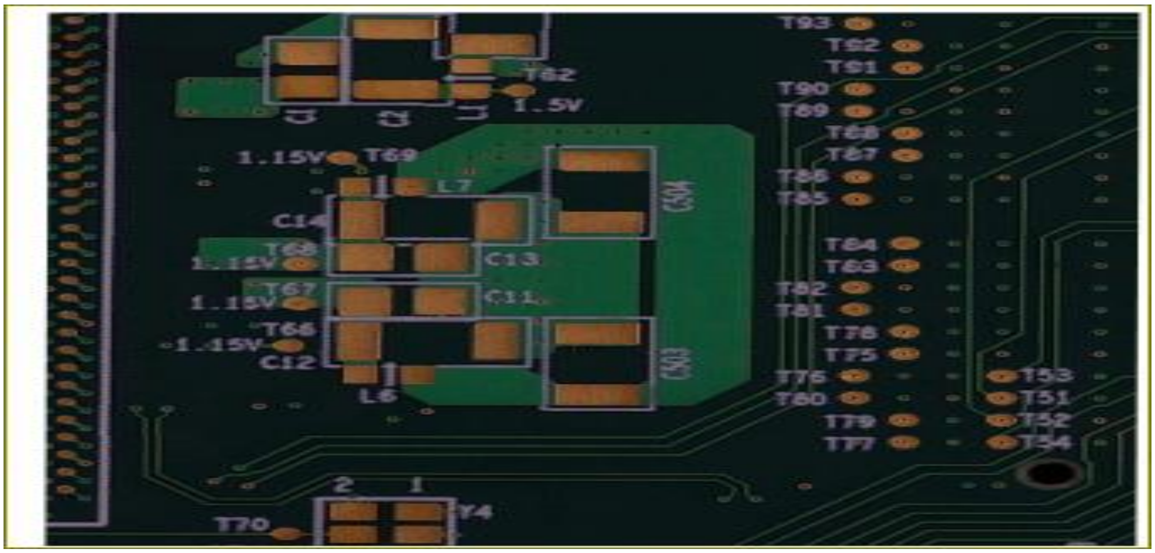
ASSEMBLY OF POWER SUPPLY PCBS



Assembly of such large components on the PCB requires careful handling when soldering them using reflow machines. In the reflow machine, the PCB assembly with all components on board passes through preheating zones before the actual soldering takes place. After the soldering is over, the assembly must cool down.

The temperature at which soldering takes place for lead-free solder is higher than that required for leaded solder. Therefore, the PCB assembly must undergo preheating to a higher temperature as well. The presence of components with large volume and mass presents a problem with pre heating.

Large components take more time to heat up as they have a larger mass. Until they have adequately heated up, other components around them are starved of heat. The shadow effect thus created by a large component does not allow the neighboring small components to heat up adequately, resulting in improper soldering. The mass being higher, the copper requires more heat to reach the required temperature before soldering. If the heavy copper tracks do not reach the necessary preheat temperature, the solder on their pads will not melt properly, and components will not adhere to them



Designing PCBs and assembling them for power supplies is not a simple task, it is no black magic either.Following the best practices evolved after long hours or trial and error, reaching the final design that works effectively and efficiently is not a difficult task. Likewise, proper assembly of power supply PCBs with heavy copper and large components may require some expertise, but it is possible to achieve success.

Operation title: -building (assembling) schematic circuit to the PCB

Purpose	Follow step allows you to be flexible as to where you place parts because you can connect them together later with wire. It also allows you to connect a part to multiple other parts
Equipment ,tools and materials	Supplies and equipment needed or useful for building and assembling parts to PCB include these: • Centre tapped transformer (220V/12V) • Power Diodes (6A) – 4No. • Capacitor (2200μF, 25V) – 2No. • Voltage regulator (IC 7812 & 7912) • Toggle switch • DC load (DC motor) • Wire • Lead • Soldering iron • PCB
Conditions or situations for the operations	• All tools, equipment's and materials should be available on time when required. • Appropriate table, working area/ workshop to assemble electronic parts practice.
Procedures	9. Interprets schematic diagrams 10. Collect parts 11. Place parts on PCB 12. Connect by weirs 13. Start properly soldering using soldering irons 14. Identifying input /output terminals 15. Testing parts connection 16. Now ready to use battery supply.
Precautions	• Care should be taken while connecting with electric power, assembling, and building circuit connection • Preparing materials, tools and equipment are according to inseminator command.
Quality criteria	• Did personal protective equipment worn while assembling and building electronic circuit • Did trainees building and assembling the component connection on the PCB properly without leakage /damage • The DC supply functional for home /office equipment oprations

Building and assembling dual electronic power supply circuit parts on PCB boards

LAP Test	Practical Demonstration

Name: ______________________________ Date: ________________

Time started: _________________________ Time finished: ________________

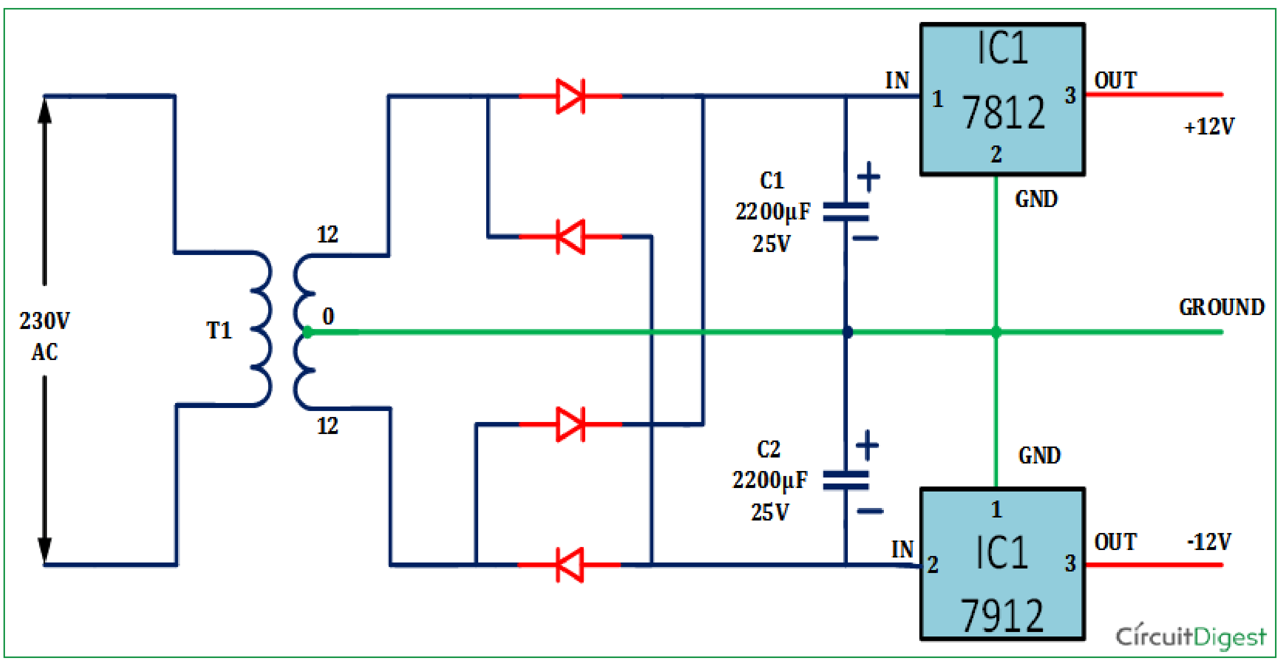
Instructions:

1. You are required to perform any of the following:

1.1. Building and assembling dual power supply circuit on PCB

1.2. Prepare equipment and material for building and assembling dual electonic power supply circuit operate the properly by interpreting schematic diagram bellow Feg1.

Circuit Diagram:



Information Sheet-4	Incorporating safety ,functional and budget consideration

4.1. Safety considerations

Before we outline the basic steps for fault finding on some simple electronic circuits, it is vitally important that you are aware of the potential hazards associated with equipment which uses high voltages or is operated from the a.c. mains supply.

Whereas many electronic circuits operate from low voltage supplies and can thus be handled quite safely, the high a.c. voltages present in mains operated equipment represent a potentially lethal shock hazard.

The following general rules should always be followed when handling such equipment:

1. Switch off the mains supply and remove the mains power connector whenever any of the following tasks are being performed:

- ✓ Dismantling the equipment.
- ✓ Inspecting fuses.
- ✓ Disconnecting or connecting internal modules.
- ✓ De-soldering or soldering components.
- ✓ Carrying out continuity tests on switches, transformer windings, bridge rectifiers, etc.

2. When measuring a.c. and d.c. voltages present within the power unit take the following precautions:

- ✓ Avoid direct contact with incoming main wiring.
- ✓ Check that the equipment is connected to an effective earth.
- ✓ Use insulated test prods.
- ✓ Select appropriate meter ranges before attempting to take any measurements.
- ✓ If in any doubt about what you are doing, switch off at the mains, disconnect the mains connector and thin

4.2. Fault Finding Procedures

Fault finding is a disciplined and logical process in which 'experimental fixing' should never be anticipated. First you need to verify that the equipment really is faulty and that you haven't overlooked something obvious (such as a defective battery or disconnected signal cable). This may sound rather obvious but in some cases a fault may simply be attributable to maladjustment or misconnection. Furthermore, where several items of equipment are connected together, it may not be easy to pinpoint the single item of faulty equipment.

The second stage is that of gathering all relevant information. This process involves asking questions such as:

- ✓ In what circumstances did the circuit fail?
- ✓ Has the circuit operated correctly before and exactly what has changed?
- ✓ Has the deterioration in performance been sudden or progressive?
- ✓ What fault symptoms do you notice?

The answers to these questions are crucial and, once the information has been analyzed, the next stage involves separating the 'effects' from the 'causes'. Here you should list each of the possible causes. Once this has been done, you should be able to identify and focus upon the most probable cause. Corrective action (such as component removal and replacement, adjustment or alignment) can then be applied before further functional checks are carried out. It should then be possible to determine whether or not the fault has been correctly identified. Note, however, that the failure of one component can often result in the malfunction or complete failure of another.

4.2. *Prevention*, health protection and safety

General objectives of OHS

While the responsibility for workers' safety and health rests with the employer,

The OHS will be required to give expert advice to employers, individual workers and their representatives, and to carry out essentially preventive functions.These functions should aim at:

- ⊗ establishing and maintaining a healthy and safe work environment;
- ⊗ maintaining a well-performing and motivated workforce;

- ⊗ the prevention of work-related disease and accidents; and
- ⊗ The maintenance and promotion of the work ability of workers. They hence may comprise the following:
- ⊗ identification and assessment of the health risk in the workplace;
- ⊗ surveillance of the work environment factors and work practices that affect workers' health, including sanitary installations, canteens and housing, when such facilities are provided by the employer;

4.3. Budget consideration for work place safety

In order for a health and safety system to be set in place and then efficiently managed, a budget will need to be in place. Financial planning is critical to the success of the health and safety programs me in the workplace. The employer retains the ultimate legal responsibility for health and safety matters in the workplace, including that of budget allocations. According to the Occupational Health and Safety Act (85 of 1993) of South Africa, every employer must provide and maintain a safe working environment without any risks to employers. It further sets a clear outline of the exact instances where safety is required for employers.

Maintenance of plant & machinery so that they can be used without any health risk to the operators Adequate supervision when plant & machinery is being used by a person that has been trained to understand the hazards of the machinery Taking the right steps to remove any potential hazard to employees before resorting to personal protective equipment Taking the right steps to remove any health risk for employees who produce, process, use, handle, store or transports and substances

Self-Check _3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet: written test on general Electrical Safety Training Courses!

One of the main functions of personal protective grounds is to provide a _______ impedance path for a short circuit.

A) High **B) Low**

C) Smooth D) Adequate

2. A Safety Electrical One Line Diagram should be used to ______________ all sources of electrical energy.

A) Identify B) Castigate

C) Evaluate D) Modify

3. Work performed on an electrical system within reaching distance of energized components is________work.

A) Energized B) Essential

C) Safe D) Unavoidable

. The Prohibited Approach Boundary is considered the same as making_____________.

A) Insulation B) Confluence

C) Contact D) Pastry

5. The minimum allowable work space around electrical equipment is ________ inches deep.

A) 36 B) 48

C) 24 **D) 30**

6. The secondary of a current transformer must never be ____________ while energized.

A) Grounded **B) Opened**

C) Examined D) Shortened

7. Which is the "Can't Let Go" range of current flow?

A) 3-9 ma **B) 9-25 ma**

C) 25-60 ma D) 1-3 ma

Answer the following question!	
Note: Satisfactory rating - 8 and 15 points	Unsatisfactory - below 8and 15points
You can ask you teacher for the copy of the correct answers.	

1. B
2. A
3. A
4. C
5. D
6. B
7. B

Information Sheet-5	Constructing prototype and testing hardware design Requirements

The next phase involves developing an implementation. An advantage of a top-down design is that implementation of subcomponents can occur simultaneously.

During the initial iterations of the life cycle, it is quite efficient to implement the hardware/software Using simulation.

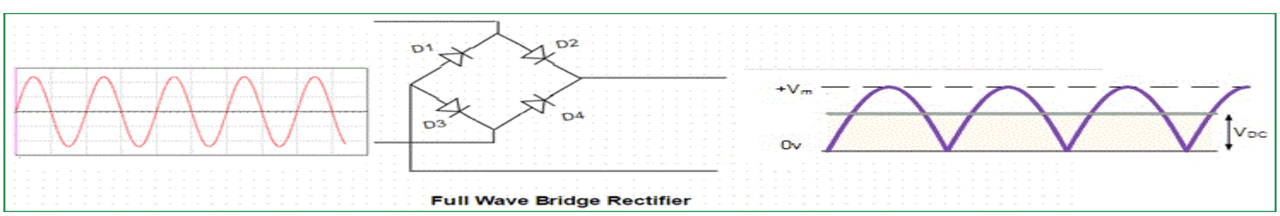
One major advantage of simulation is that it is usually quicker to implement an initial product on a simulator versus constructing a physical device out of actual components.

Rapid prototyping is important in the early stages of product development. This allows for more loops around the analysis-design-implementation-testing-deployment cycle, which in turn leads to a more sophisticated product.

Recent software and hardware technological developments have made significant impacts on the Software development. The simplest approach is to use a cross-assembler or cross-compiler to convert source code into the machine code for the target system. The machine code can then be loaded into the target machine. Debugging embedded systems with this simple approach is very difficult for two reasons.

- First, the embedded system lacks the usual keyboard and display that assist us when we debug regular software.
- Second, the nature of embedded systems involves the complex and real-time interaction between the hardware and software. These real-time interactions make it impossible to test software with the usual single-stepping and print statements.

During the testing phase we evaluate the performance of system. First debug the system and validate basic functions.



Use careful measurements to optimize performance such as static efficiency (memory requirements), dynamic efficiency (execution speed), accuracy (difference between expected truth and measured), and stability (consistent operation.) Debugging techniques will be presented at the end.

1. The Concept Design process documents and reports on the building systems proposed (or Alternatives under evaluation), taking into consideration the client's program needs,

Economy, durability, capital cost, and requirements of relevant codes and authorities.

2. The Concept Design documentation shall be assembled in such a way to facilitate its Updating and expansion to incorporate:

- ❖ the requirements of the project design report at the conclusion of the design Development stage
- ❖ the systems description and operating principles required in the preparation of system operation manuals

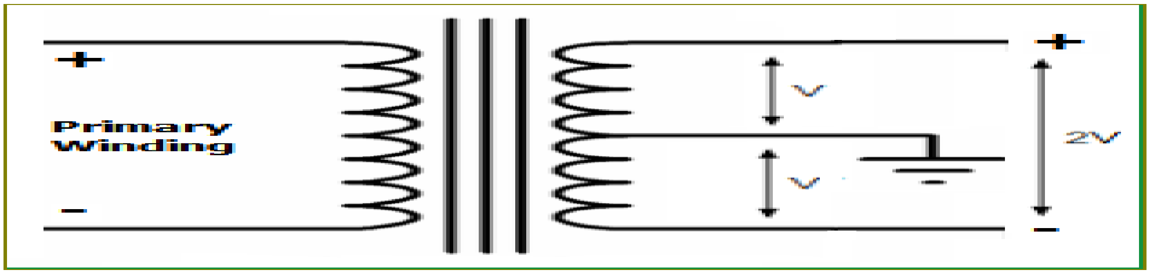
1. Constructing prototype

Solder Breadboard or Plug board. This is what we’ve been using in lab.

Fig Dual Power Supply Circuit:

Step-I: Converting 220v AC into 12v AC using Step down Transformer

The primary terminals of the centre tapped transformer are connected with household supply (220V *ac*, 50Hz) and output is taken from secondary terminals of the transformer. The centre tapped describes the voltage output of a center tapped transformer. For example: A 24V centre tapped transformer will measure 24V *ac* across the outer two taps (winding as a whole), and 12V *ac* from each outer tap to the center-tap (half winding). These two 12V *ac* supplies are 180 degrees out of phase with each other, thus making it easy to derive positive and negative 12 volt *dc* power supplies from them. The advantage of using a centre tapped transformer is we can get the both +12V and -12V *dc* supply using only one transformer

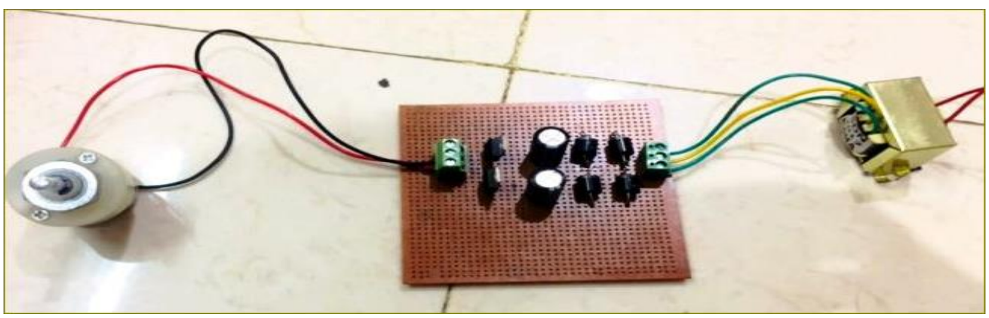


OUTPUT: Between outer terminal and middle terminal: 12V *ac, 50 Hz* Between two outer terminals: 24V *ac.* 50 Hz

Step – II: Converting 12v AC into 12v DC using Full Bridge Rectifier

Step-III: Filter the Ripples from the output:

Now, 24V *dc* output which contains peak to peak ripples can't be connected directly to the load.



Remove ripples from the supply, filter capacitors are used. Now, two filter capacitor of rating 2200uF and 25 V are used as shown in circuit diagram.

The connection of both capacitors is such that the common terminal of the capacitors is connected directly to the centre terminal of the centre tapped transformer. Now, this capacitor will get charged up to 12V *dc* as both are connected with the common terminal of a transformer. Furthermore, the capacitors will remove the ripples from the *dc* supply and give a pure *dc* output. But, the outputs of both the capacitors are not regulated. So, to make the supply regulated, output of the capacitors is given to the voltage regulator ICs which is explained in next step.

INPUT**:** 12V *dc* (with ripples, not pure)

OUTPUT**:** Voltage across capacitor C_1 =12V *dc* (pure *dc,* but not regulated)

Voltage across capacitor C_2 =12V *dc* (pure *dc,* but not regulated

Step-IV: Regulate the 12v DC Power Supply

The next important thing is to regulate the output voltage of the capacitors which will otherwise be varying as per the input voltage change. For that depending upon the output voltage requirement, regulator ICs is used**.** If we need the output voltage +12V then IC 7812 is used. If required output voltage is +5V, then 7805 IC is used. Last two digits of the IC give output voltage rating. Third last digit shows voltage is positive or negative.

For positive voltage 8 and for negative voltage 9 numbers is used. So IC7812 is used for +12v regulation and IC7912 is used for -12v voltage regulation.

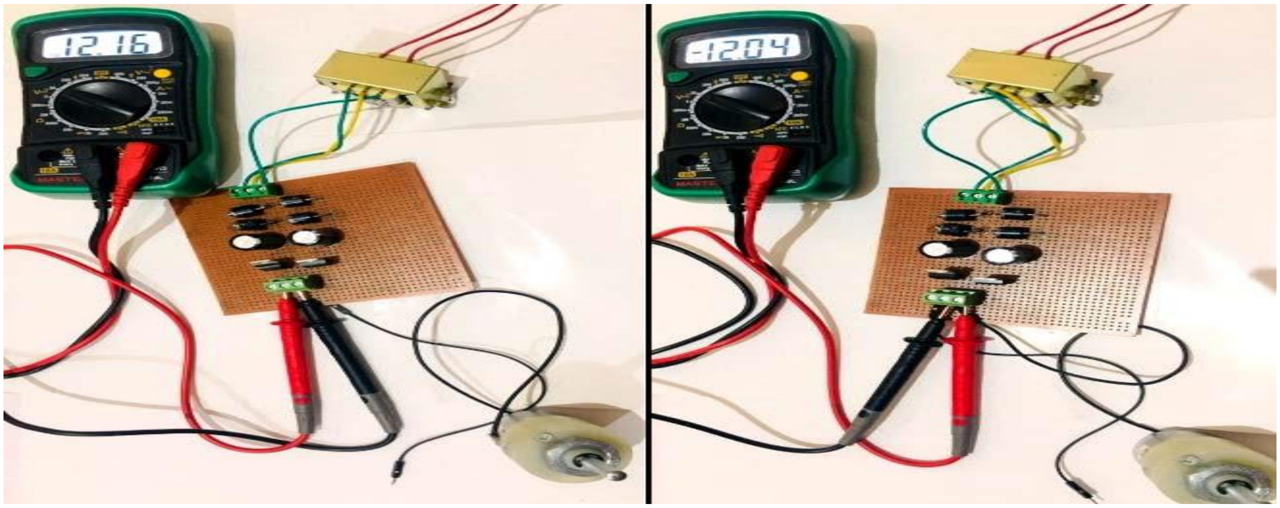
Now connection of two ICs is done as shown in circuit diagram. The ground terminal of both ICs is connected with the centre tap terminal of the transformer in order to create a reference. Now, the output voltages are measured between the output terminal and ground terminal for both ICs.

INPUT: 12V *dc* (pure *dc* but not regulated)

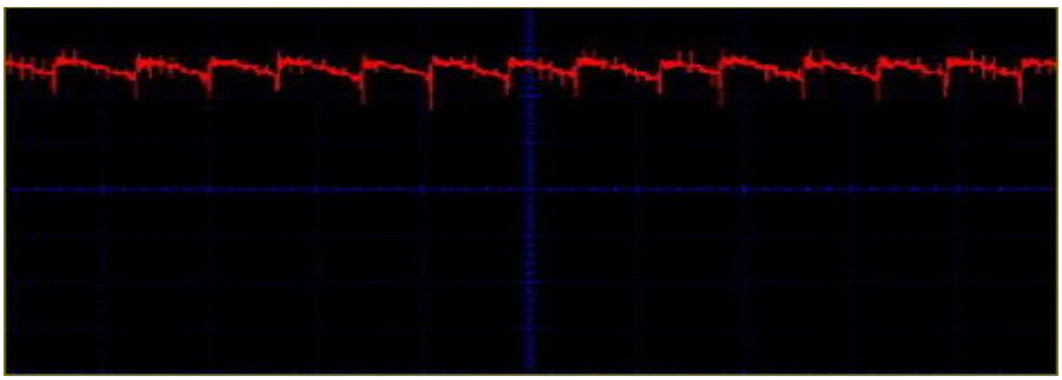
OUTPUT: +12V *dc* between output terminal of 7812 and Ground (pure *dc* and regulated) -12V *dc* between output terminal of 7912 and Ground (pure *dc* and regulated)

Testing our circuit

Now that our circuit is ready, it's time to take it for a spin. We will connect the board to our Ac mains through a VARIAC and load the output side with a load machine and measure the ripple voltage to check the performance of our circuit. Full testing procedure can also be found at the end of this page.



Measuring Ripple Voltage using Oscilloscope



Applications of Dual Power Supply Circuit:

- Operational amplifiers need two power sources (usually one +ve source and one -ve source) because the op-amp must operate in both polarities of the incoming signal. Without the negative source, the op-amp won't swing into action during the negative cycle of the signal. So that signal portion's output will "clipped", that is, remain at ground itself; which is obviously not recommended.

- If DC motors are used as a load, then for +12V it will rotate in clockwise direction and for -12V it will rotate in opposite direction. For example, motors which are used in toys (car, bus etc), will move forward in case of +12V and it will move reverse in case of -12V. We have shown the motor rotation in both the directions, using this Dual Power Supply circuit, in this final construction work

This is what is used virtually universally in production of electronics.

- ❖ Advantages

- Easy to build in production.
- Repeatable, controllable stray L, C.
- Can handle virtually any component, power level.
- Highly reliable.
- Can make very compact.
- Design can be (somewhat) automated from a schematic you have entered.

- ❖ Disadvantages

- Laying out the board and getting it fabricated takes time, although you can pay for fabrication in a few days if you can afford it.
- Expensive, on the order of hundreds of dollars for one, but with almost no increase in cost to make many.
- Hard to make changes, but making changes may be easier than building another type of prototype.

Self-Check _5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Briefly write correct answer for the following question

1. If circuit output voltage is +5V   regulated IC required in circuit
2. If circuit voltage +12V regulated IC required in circuit
3. Write the advantages of dual power supply
4. Where Linear Power Supplies be used
5. what is applications of transformer in power supply system
6. DC power sources are produced by

Question Answer	
***Note:* Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
.	

Answer sheet

Name____

1. IC7812 is used
2. IC7812 is used
3. Advantage of dual power supply are

- Easy to build in production.
- Repeatable, controllable stray L, C.
- Can handle virtually any component, power level.
- Highly reliable.
- Can make very compact.
- Design can be (somewhat) automated from a schematic you have entered.

4. Linear power supplies are typically only used in specific applications requiring extremely low noise, or
in very low power applications where a simple transformer rectifier solution is adequate and provides
the lowest cost.

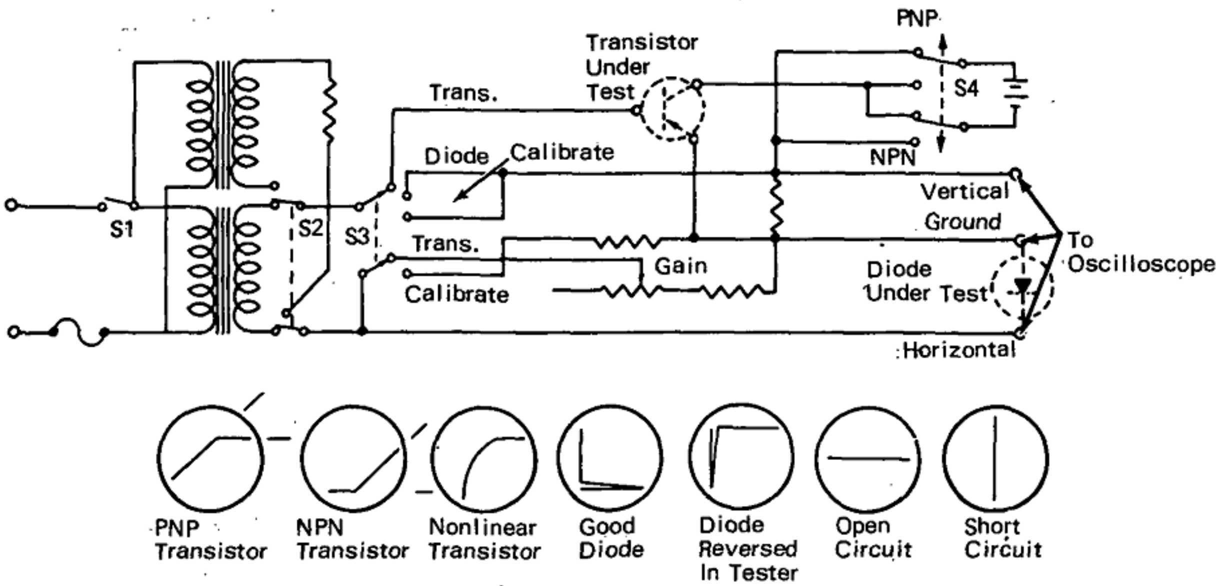
5. The transformer's ability to step AC voltage up or down gives AC an advantage unmatched by DC in power distribution.

6. DC power sources are produced by rectifying an AC source, an electrochemical reaction in the form Of a battery or by a DC generator.

Information Sheet-6	Rectifying and retesting effective operation

2. **Rectifying prototype malfunctions and re-testing**

TESTING SEMICONDUCTORS WITHOUT DISCONNECTING THEM FROM CIRCUIT



Rectifying prototype malfunctions and re-testing prototype operation use Electrical/electronic equipments and test instrument

Electrical tools normally refer to electrical hand tools - typically tools used in construction activities such as electrical drills, wire strippers, and can also include electrician tools such as electrical meters (voltmeters, multimeters, etc.). Electrical tools are plentiful and you can find them for tool shops.

Electrical equipment refers to manufactured systems that distribute, transform, protect, or convert electrical energy. Electrical equipment includes motors, generators, transformers, switches and switchgear, and more, and ranges from low voltage (up to 600V), medium voltage (1kV to 38kV) or high voltage.

Testing equipment used to detect faults in the operation of electronic devices by creating stimulus signals and capture responses from electronic devices under test is known as electronic test equipment. They include voltmeter, ammeter, ohmmeter, multimeter, power supply, signal generator; If any faults are detected, then identified faults can be traced and rectified using electronic testing equipment. Most often all electrical and electronic circuits are tested and troubles hooted to detect faults or abnormal functioning if any.

An oscilloscope, together with the test circuitry shown in the figure, can be used to check (Semiconductors that are wired into a circuit. For transistors, approximate gain and linearity can be determined; for diodes, open circuits, short circuits, and reversed polarity are indicated clearly. The quality and breakdown point of low-voltage (<10 V) zanier diodes can be measured.

The idealized oscilloscope traces show the types of waveforms to be expected under various circumstances, provided that the impedance of the external circuit is much greater than that of the component under test. If -this is not so, the waveforms obtained will vary, depending on the external circuit properties. In either case when an assembly to be tested contains multiple identical circuits, the tester may be employed comparatively to identify a defective component.

Self-Check _6	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Parte one writes only the name of instruments used for measuring applications

1. Write two measuring instruments used to measure voltage

a.____

b.____

2. Write two instruments that are used for stimulus of the circuit under test.

a.____

b.____

3. What is the instrument used to measure LCR values

a.____

Parte two choose the correct answer for their alternatives

1. In a controlled rectifier a freewheeling diode is necessary if the load is
    a. inductive
    b. resistive
    c. capacitive
    d. any of the above
2. In practice the output from the diode rectifier has
    a. AC component only
    b. DC component only
    c. AC + DC component
    d. None of the mentioned
3. A fully controlled converter uses
    a. diodes only
    b. thyristors only
    c. both diodes and thyristors
    d. none of the mentioned
4. Single phase half bridge inverters requires
    a. two wire ac supply
    b. two wire dc supply
    c. three wire ac supply

d. three wire dc supply

5. The output of a single-phase half bridge inverter on R load is ideally
    a. a sine wave
    b. a square wave
    c. a triangular wave
    d. constant dc

Question Answer	
Note: **Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
.	

Answer sheet

Name ___________________________________

Part one

1.

a. Volt-Ohm-Millimeter

b. Digital Multimeter

2.

a. Oscilloscope copy

b. Frequency counter

3.

A .Resistance,

b. Inductance

C. capacitance meter

part two

1. A
2. C
3. B
4. D
5. B

- Electronic equipment is powered from low voltage DC supplies. The source will be a battery, a combination of battery and DC/DC converter or a power supply converting AC mains into one or more low voltage DC supplies.
- Electronic components require a DC supply that is well regulated, has low noise characteristics and provides a fast response to load changes. AC power supplies, and most DC/DC converters, also provide isolation from the input to the output for safety, noise reduction and transient protection.
- As electronic equipment becomes smaller and smaller, the market demands that power converters do the same. Since the introduction of switch mode techniques, this has been an evolutionary rather than a revolutionary process.
- It will not be cleared by an overload as the power supply will have some other form of overload protection, usually electronic. The fuse will often be soldered into the PCB rather than being a replaceable cartridge type fuse.
- The power supply fuse is listed as a critical part of the safety approval process and is used to ensure that the power supply does not catch fire under a fault condition. If the fuse clears the most likely cause is that the converter has failed short circuit presenting a short circuit to the mains supply. In this event the fuse will clear very quickly.
- As previously discussed, the fuse in the power supply is not intended to be field-replaceable, and should only be replaced by competent service personnel following repair. When using a component power supply, there will be additional mains wiring within the enclosure before the power supply and its fuse. This is where an additional fuse or circuit breaker as a protection device is fitted to ensure that the wiring and associated components do not present a hazard. When the end equipment is tested for safety it will also go through fault analysis to ensure that it will not present a, fire hazard under a fault condition. If a fault were to occur many hundreds of Amps can flow causing wires to heat up very quickly, causing noxious fumes from the melting plastic insulation and creating a potential fire hazard.

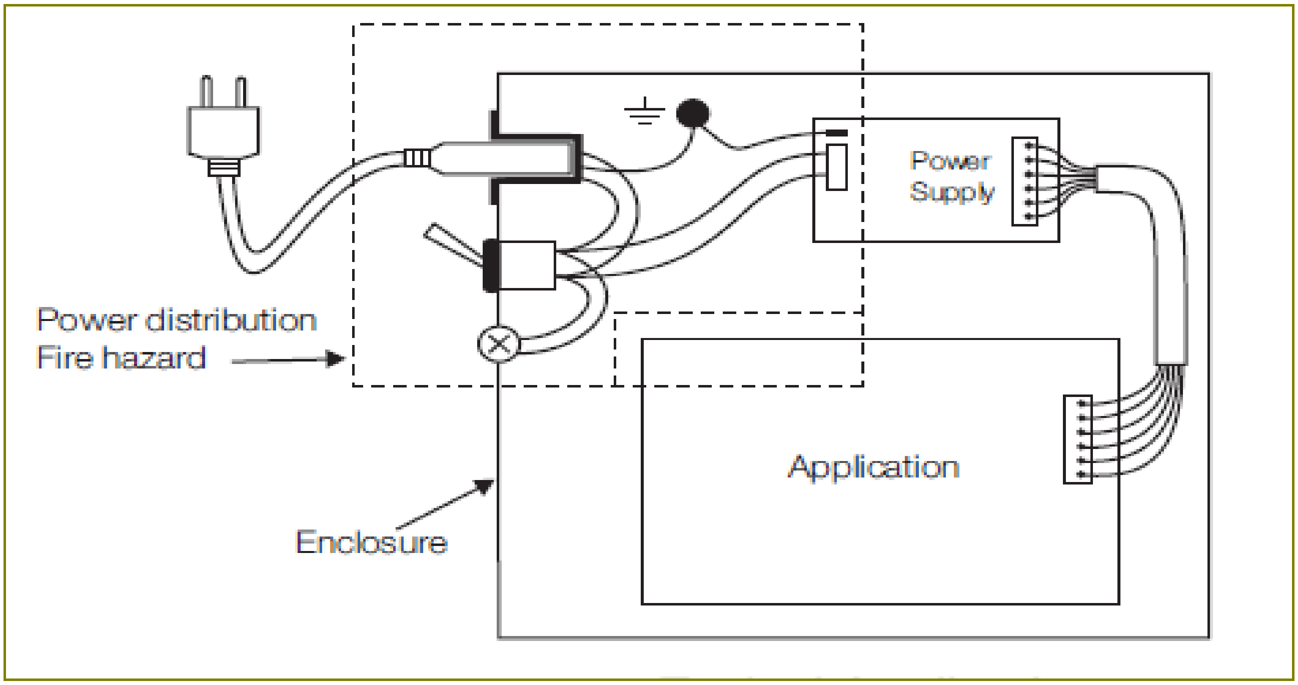


Fig Typical Application

Why is Harmonic Distortion a Problem?

The utility provider must supply the voltage and all of the current, even though some of the current is not turned into useful output power – *See the section entitled Real and Apparent Power* The provider has no means of charging for the extra current because the power is charged in kWh. The combined effect of millions of power supplies is to clip the AC voltage because all of the current is drawn at the peak of the sine wave. Power conductors must be sized to carry the extra current caused by the low power factor. Neutral conductors can overheat because they are typically not sized to carry all of the harmonic currents which do not exist for high power factor loads.

Solutions for Power Supplies

In order to meet the legislation for harmonic distortion there are two main solutions available for power supplies:

Passive Power Factor Correction

Passive power factor correction typically involves the addition of a line frequency inductor or resistor into the AC line. The effect of the inductor is to squash the current wave shape as the inductor is a reactive component which resists change in current. The effect of the resistor is to reduce the peak current.

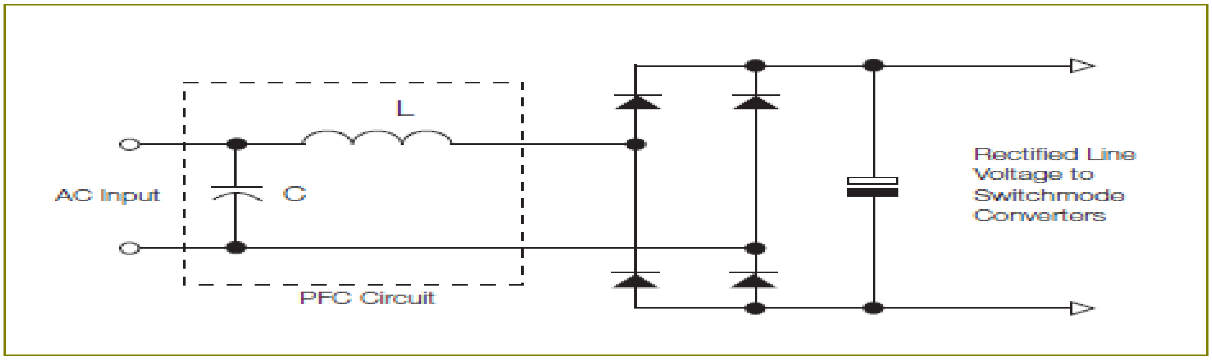


Fig shows the effect of the resistor is to reduce current

This is a very simple solution which has some advantages and some disadvantages. It is not really practical in power supplies above 300 W due to the size of the components required to provide adequate inductance at 50/60 Hz and to keep the resistive losses low enough. This solution is not adequate in lighting, personal computing or color television applications, but is a viable solution for Class A equipment. The diagram below shows real time measurement of passive power factor correction and the harmonic current levels.

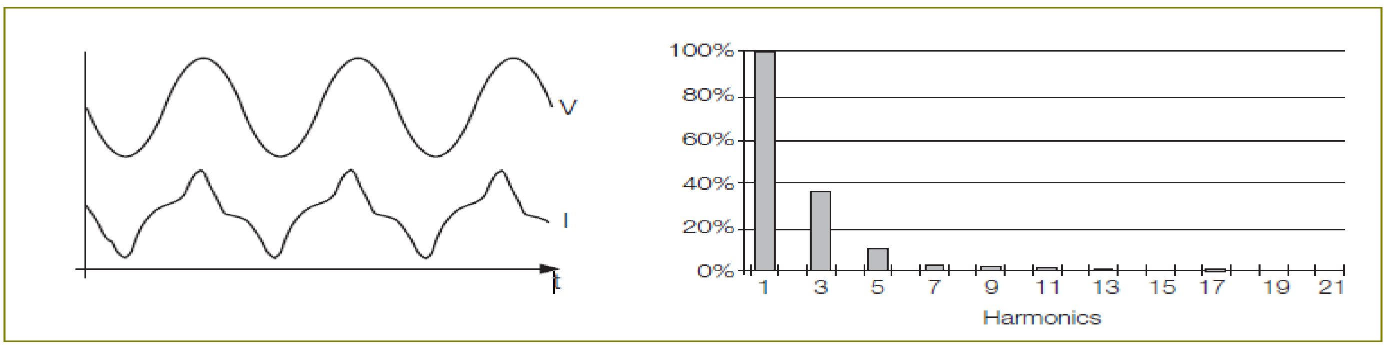


Fig real time measurement of passive power factor correction

Active Power Factor Correction

Active power factor correction uses a boost converter running at high frequency to electronically control the wave-shape of the input current. The incoming AC voltage is monitored and used as a reference to determine the pulse width of each current pulse of the high frequency switched current.

Comparison between Active and Passive Power Factor Correction

Advantage	Disadvantage
Simple	Heavy and bulky components
Cost effective	AC range switching required
Rugged and reliable	Low power factor
Noise (EMI)	Cannot use multiple PSUs in a system
Assists filtering	

Active Power Factor Correction

Advantage	Disadvantage
High power factor >0.9	High cost
Low input current	High complexity
Universal input	High component count
Regulated high Voltage Bus	Lower calculated MTBF
Hold up time	
Multiple PSUs can be used	

Self-Check _7	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet

Parte one answer the following question by reading information sheet

1. What is the effect of the inductor in power supply circuit?

2. AC power supplies, and most DC/DC converters, also provide isolation from the input to the output why?

3. Why is Harmonic Distortion a Problem?

4. In order to meet the legislation for harmonic distortion there are two main solutions available for power supplies

5. Advantages of Passive Power Factor Correction

6. Write two main solutions available for power supplies In order to meet the legislation for harmonic distortion:

Question Answer	
Note: **Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
.	

Answer sheet

Name_________________________________

1. a reactive component which resists change in current
2. for safety, noise reduction and transient protection.
3. utility provider must supply the voltage and all of the current, even though some of the current is not turned into useful output power
4. active power factor correction and Passive Power Factor Correction
5. simple,cost effective,rugged and reiliable noisassests filtering

❖ Active power factor correction

✓ usesed control the wave-shape of the input current

❖ Passive Power Factor Correction

✓ reactive component which resists change in current

Information Sheet-8	Documentation

1. Introduction to Documentation

It is a record or the capturing of some event or thing so that the information will not be lost.

2. Maintenance documentation

Service contract or in-house preventive maintenance is documented. This documentation is required for annual maintenance. Maintenance performed at other times, with the exception of routine cleaning, is documented. The documentation includes:

- description of the maintenance;
- date it was done; and
- name of the service representative and company, or name of
- the analyst if maintenance provided internally.

Repair equipment are documented
The documentation includes:
Initials of the analyst, and the date the problem was observed,

- Description of the problem;
- date and initials of the analyst or service represent at performing the repair;
- Synopsis of the repair; and cost of repair, copy of the invoice and any additional information (not required).

Reading the service manual
It is difficult to repair any piece of complicated equipment without some service literature. It is possible to repair electronic equipment without the service manual, but it can be very time-consuming. You can lose a lot of valuable servicing time if you are without a good service manual. The service manual is a set of document prepared by the manufacturer to help the service technician to repair or service that set of equipment.

A well written manual is the best servicing aid. It contains the following information:

- ✓ Describe how a circuit works
- ✓ Block diagram of the equipment
- ✓ Circuit diagrams
- ✓ Signal and voltage test points
- ✓ Adjustment procedure
- ✓ List of accessories

- ✓ List of spare parts with the part numbers, values, tolerances and ratings
- ✓ Fault diagnosis steps, generally in the form of flow charts
- ✓ Preventive maintenance layout
- ✓ Safety precautions to be observed while handling the equipment.

A service manual can be very expensive, but it is worth the investment. With the help of a service manual, a service technician or engineer can:

- ✓ Align, calibrate and test the equipment correctly to get the optimum output
- ✓ Locate a fault quickly
- ✓ Use the correct replacement part Conduct preventive maintenance correctly By using the right service manual, as well as with the assistance of good tools, testing equipment and your own experience, you are set to multiply your troubleshooting power!!!

Testing and recording power supply

An electronic switching circuit enables measuring the full-load recovery time of solid state power supplies. Because of the high current and short time element (recovery times of 1000/s or less are not uncommon), this parameter has not been easy to ‘measured for large power supplies.

No mechanical switch combines sufficient current handling capability with high enough speed.

The illustrated circuit, on the other hand, uses a high-current silicon controlled rectifier, has switching times on the order of 1 MS, and can handle currents up to 35 A. As shown, the circuit is mounted in a small metal box which also serves as a heat sink for the rectifier.

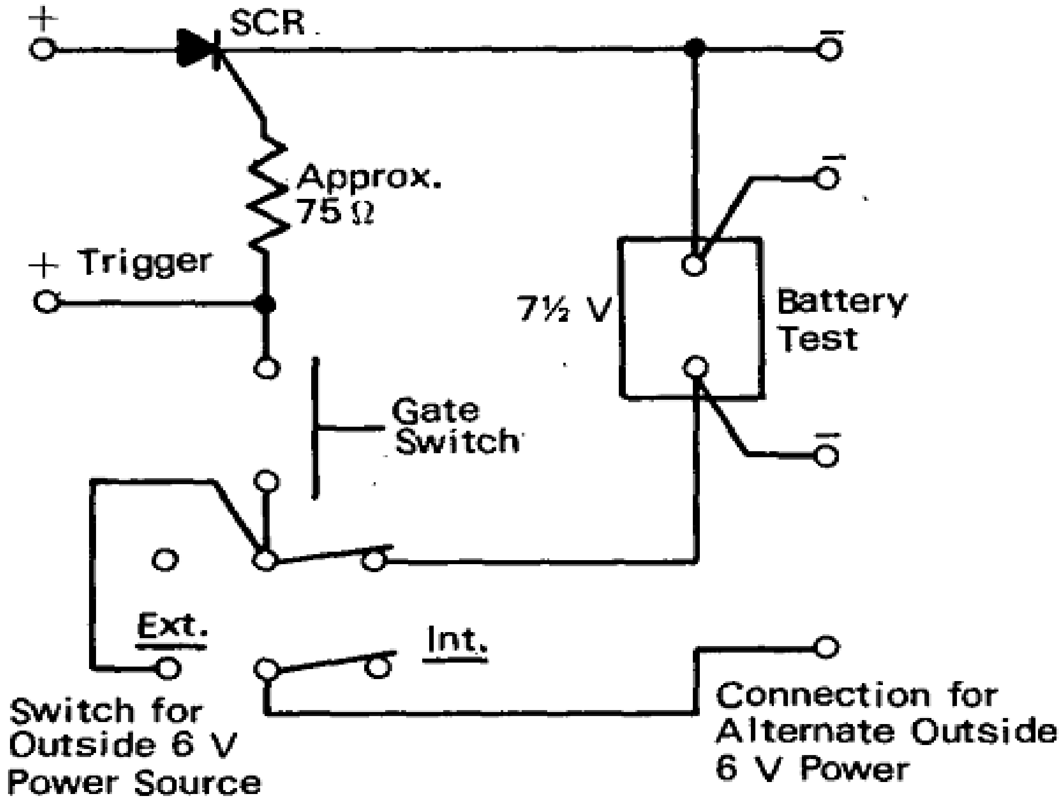


Fig. 1 Testing and documenting circuit node

Self-Check _1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Direction Say true or False:

1. A Safety precautions to be observed while handling the equipment
2. document prepared by the manufacturer to help the service technician to repair or service that set of equipment
3. It is possible to repair electronic equipment without the service manual
4. An electronic switching circuit enables measuring the full-load recovery time of solid state power supplies
5. Documentation is only required for annual maintenance.

Question Answer	
Note: **Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
.	

Answer of the question

Name____

3. True
4. True
5. True
6. True
7. true

LG#17	LO4: Obtaining approval for the Design

Instruction sheet

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

- Presenting and explain to relevant person
- Negotiating request design modification design
- Obtaining document and approval process
- Monitoring work quality

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

- Present and explain to relevant person
- Negotiate request design modification design
- Obtain document and approval process
- Monitor work quality

Learning Instructions:

19. Read the specific objectives of this Learning Guide.
20. Follow the instructions described below.
21. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
22. Accomplish the “Self-checks” which are placed following all information sheets.
23. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
24. If you earned a satisfactory evaluation proceed to “Operation sheets
25. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,

26. If your performance is satisfactory proceed to the next learning guide,

27. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information Sheet-1	Presenting and explain to relevant person

1. Presentation

A simple electric circuit is shown in Fig.1. It consists of three basic elements: a battery, a lamp, and connecting wires. Such a simple circuit can exist by itself; it has several applications, such as a flash- light, a search light, and so forth.

A complicated real circuit is displayed in Fig. 2, representing the schematic diagram for a radio receiver. Although it seems complicated, this circuit can be analyzed using the techniques we cover in this book.

Our goal in this text is to learn various analytical techniques and computer software applications for describing the behavior of a circuit like this.

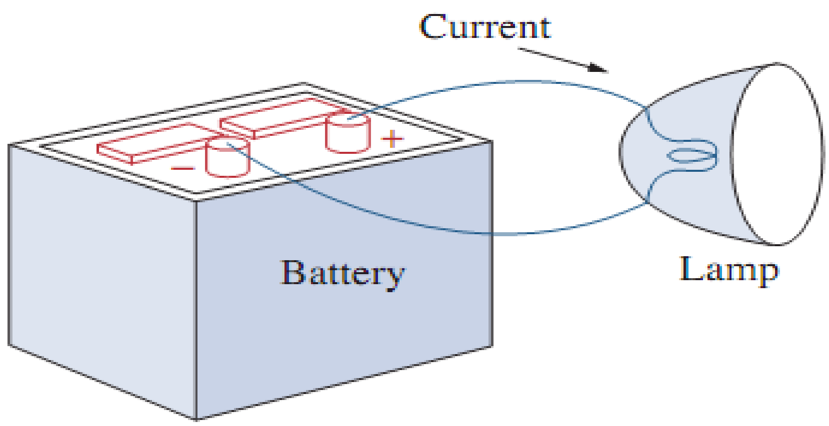


Fig1. A simple electric circuit

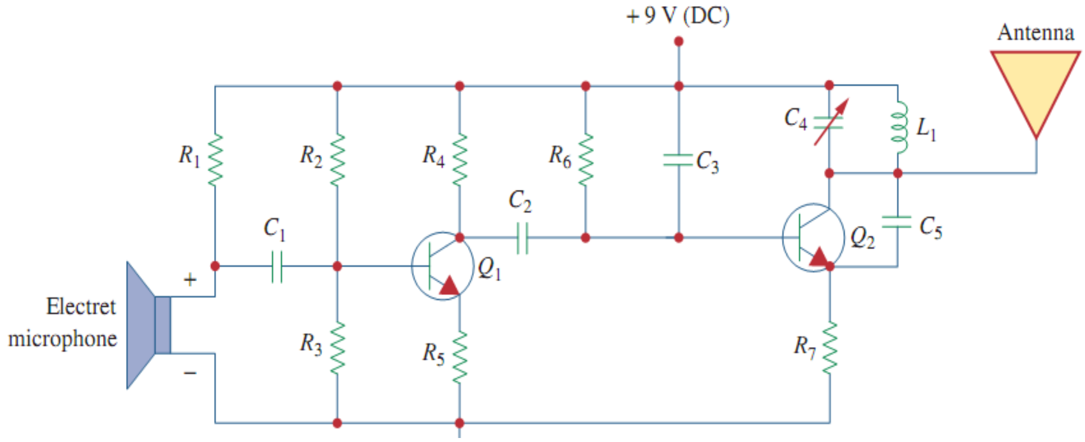


Fig. 2 Electric circuit of a radio transmitter

Electric circuits are used in numerous electrical systems to accomplish different tasks. Our objective in this book is not the study of various uses and applications of circuits. Rather, our major concern is the analysis of the circuits. By the analysis of a circuit, we mean a study of the behavior of the circuit: How does it respond to a given input? How do the interconnected elements and devices in the circuit interact?

We commence our study by defining some basic concepts. These concepts include charge, current, voltage, circuit elements, power, and energy. Before defining these concepts, we must first establish a system of units that we will use throughout the text.

Self-Check _1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

<u>Say True or False:</u>

1. Electric circuits are used in numerous electrical systems to accomplish different tasks
2. A simple electric circuit consists of three basic elements: a battery, a lamp, and connecting wires
3. analysis of a circuit, we mean a study of the behavior of the circuit: How does it respond to a given inpu
4. circuit can exist by several applications, such as a flash- light, a search light,

Question Answer	
Note: **Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
.	

Name____

1. True
2. True
3. True
4. True
5. true

Information Sheet-2	Negotiating request design modification design

2. design Modification

One of the great things about electronics is that it teaches you about all kinds of things you can use in your life. For example, you discover

- ✓ How electricity works and how to stay safe when working with it
- ✓ How to read an electronic circuit and build it on a breadboard like the one shown in Figure 1
- ✓ How to use a variety of tools to solder, build, and customize casings to hold your gadgets How to work with integrated circuits
- ✓ A bit about wiring (which can give you a head start when you decide to learn how to add an outlet to your kitchen someday).

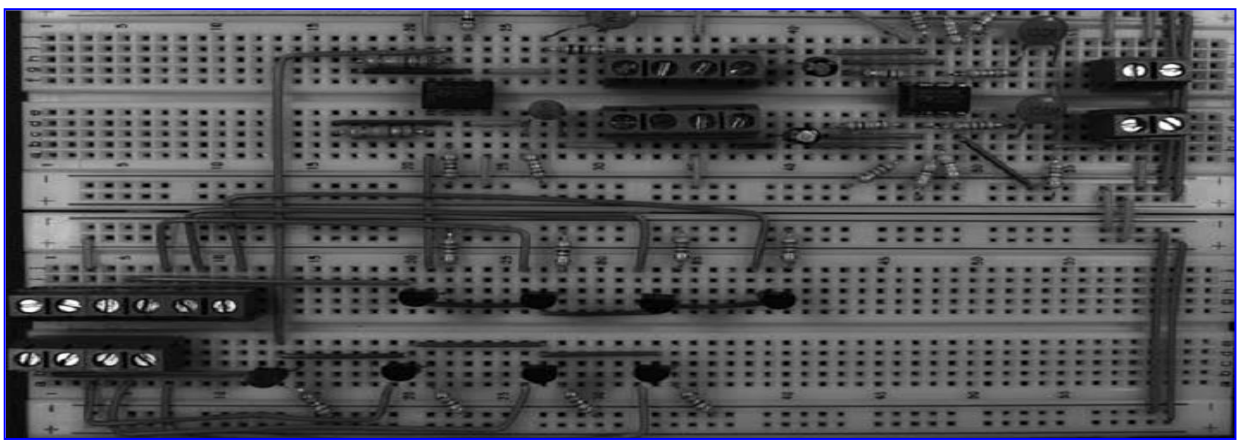


Fig. 1 Here's what the breadboard for Dance to the Music

What You Need to Get Started

Now that you're all excited about the benefits of working on electronics projects, you're probably wondering what this will cost you in dollars and Workspace.

How much will it cost?

We tried to keep the cost of the projects in this book to under $100; in many cases, the materials and parts will cost you under $50 or so.

Depending on what you have lying around the house already, you might not have to invest in some of the basic tools, such as pliers or a screwdriver. You will probably have to spend $50 or so for electronics-specific tools and materials such as a soldering iron, solder, and a multimeter like the one shown in Figure 2.

Figure 2 A multimeter is a measuring device that you'll use often.

Self-Check _2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Write short answer:

1. How electricity works and how to stay safe when working with it?
2. How to read an electronic circuit and build it on a breadboard?
3. How to use a variety of tools to solder, build, and customize casings to hold your gadgets?
4. How to work with integrated circuits?

Question Answer	
***Note:* Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
.	

Name____

1. True
2. True
3. True
4. True
5. true

Information Sheet-3	Approval

Design Process and Its Fundamentals

This chapter describes the basics of the development process for electronic systems. We present how service-proven standards and norms along with standard drawings and computer technology can be used to break down the design process into separate activities, which are then more easily performed. We describe these design activities in detail and outline the requisite technical documentation (technical drawings, circuit diagrams, CAD models) that are required to produce successful electronic products.

Approval

Multimeter

A multimeter is essentially an electronics troubleshooting tool that you can't do without. You could use it to hunt down the defective part of a circuit for example, where the voltage is too low to get your circuit going. A multimeter is a combo type of testing tool in that it combines the functions of a few others meters (a voltmeter, an ammeter, and an ohmmeter) in one package. By using a multimeter, you can take certain electrical measurements, such as Current: The flow of electrons through your circuit

Voltage: The force your battery uses to push the electrons through your Circuit Resistance: The amount of fight your circuit puts up when voltage pushes the electrons through your circuit

To use a multimeter to test these various measurements, you set a multi-position switch on the meter to have it measure the appropriate range of volts, amperage, or resistance. Check out Chapter 4, where we tell you exactly how to use a multimeter for more about the various test types it offers and how it works.

Information Sheet-4	Monitoring work quality

1. Monitoring

a. Monitoring and Evaluation

• What is ‘monitoring’?

• What is ‘evaluation’?

Monitoring

• The routine process of data collection (monthly, quarterly, annually) intended to measure whether the program is doing what is set out to do.

Evaluation

• The systematic investigation of whether a program is effective: whether the activities implemented are having the desired effect.

• Evaluations are carried out periodically (mid project/end of project).

Results Framework

- The Results Framework is your NTDP roadmap.
- It links the intervention (programme activities) to programme goals and objectives. Where you are going and how you will get there
- Based on this you chose measures that will tell you if you have achieved the programme goals and objectives. Measures of whether you are going in the right direction and have you arrived

How Do We Collect the Data to Measure the Indicators?

- Different types of data:
  - ✓ Quantitative
  - ✓ Qualitative
  - ✓ Secondary
- Programme routine records
  - ✓ Treatment reporting forms
  - ✓ Drug reporting formsetc
- Interviews with district/community level
- Survey protocols – diagnostic tools, sampling strategies

What are standards?

Standards are an important part of our society, serving as rules to measure or judge capacity, Quantity, content, extent, value and quality. Some standards take the form of an actual item such as the atomic clock which serves as the reference for measuring time throughout the world. Others set criteria for use and practice in industry and for products used in everyday life. This introduction, however, deals primarily with standards that set a level of adequacy for structures and machines. It is these standards, above all others, which must be addressed before any engineering design project can be started.

How are standards developed?

The International Standards Organization (ISO) coordinates standards world-wide. Under this umbrella are representative organizations from many countries; for the U.S., it is the American National Standards Institute. ANSI coordinates many national technical standards organizations (for a listing of some organizations and their acronyms see Table 1). Within ANSI guidelines, each standards-writing and -issuing organization has its own method for developing standards. The American Society of Mechanical Engineers is one such approved organization, and what follows is a brief description of their standards-development process. After a new standard is suggested, the Council on Codes and Standards decides if ASME should investigate it. If the Council decides the project is worthy, it then determines the scope of the project and assigns it to the appropriate committee. The committee then develops the criteria needed to address the scope and purpose of a code or standard. Finally, after many drafts and votes, the standard is accepted by the committee. From there it is announced in ASME's Mechanical Engineering Magazine and the ANSI Reporter so that the public can review and comment on the standard. If a comment cannot be resolved by the proposing committee, then there"shall be a system of hearings and appeals" to settle the matter.

How does the numbering system for standards work?

There are almost as many different ways of numbering standards as there are standards-is suing organizations, although many follow a similar format. First comes the acronym of the organization which issued the standard. For example, ASTM comes before those standards originating from the American Society for Testing and Materials. This is usually followed by a letter designation that denotes the general classification of the standard. ASTM uses letters to denote certain materials:

A -- Ferrous metals and products

B – Non-ferrous metals and products

C -- Cementations, ceramic, concrete and masonry materials

D -- Miscellaneous materials and products

E -- Miscellaneous subjects

F -- End-use materials and products

AG -- corrosion, deterioration, weathering, durability and degradation of materials and Products

ES -- emergency standards.

Self-Check _4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided at the end of information sheet:

Say True or False:

1. Measurement is the act, or the result, of a quantitative comparison between a given quantity and a quantity of the same kind chosen as a unit
2. The device or instrument used for comparing the unknown quantity with the unit of measurement or a standard unityis called a measuring instrument.
3. The value of the unknown quantity can be measured by direct or indirect methods

Question Answer	
Note: **Satisfactory rating - 8 and 15 points**	**Unsatisfactory - below 8and 15points**
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Name____

1. True
2. True
3. True
4. True
5. true