# DESIGN OF A REGULATED DC POWER SUPPLY

BY

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AN ENGINEERING PROJECT REPORT SUBMITTED TO THE FACULTY OF ENGINEERING, TECHNOLOGY, APPLIED DESIGN AND FINE ART KABALE UNIVERSITY (KAB) IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF ELECTRICAL ENGINEERING IN ELECTRICAL DEPARTMENT

JANUARY, 2021

DESIGN OF A REGULATED DC POWER SUPPLY

by

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For The Degree of

Bachelor of Electrical Engineering

in

Department of Electrical

Supervisors

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# ACKNOWLEDGEMENTS

This project report was made possible through the immense contribution of Kabale University Electrical department. I would want to convey my special thanks to Dr Sabo Miya Hassan my supervisor who guided me throughout the project design and prototyping.

Also deserving special mention are my friend Owembabazi Justus it was a privilege and enjoyable moment to be with you.

Special thanks also go to my parents, brothers, sisters and guardians for continuously encouraging me throughout my studies.

# DEDICATION

I Twinomugisha Jackline dedicate my project report to my parents, friends and my brothers who supported me financially towards the accomplishment of this report. .

# ABSTRACT

A regulated power supply is an embedded circuit; it converts unregulated AC (Alternating Circuit) into a constant DC. Its function is to supply stable voltage. Frequent damages to electrical equipment and appliances have been occurring during charging due to unregulated power supply. Also people have been spending a lot of money buying different chargers for different components. The project is guided by the following objectives which are to design a regulated dc power supply that can be used to charge phones, power radio and decoders,To simulate the circuit using multism-, to reduce the costs incurred in having unregulated power flow and to test the circuit. Ritvikdave in design of a –Regulated Linear DC power supply‖ involves a number of steps such as process, rectification, Filter Circuit and voltage regulation. But this project only out puts a fixed voltage output of 5v. The methodology contains the measures and methods that I used to build the circuit in order to achieve the desired output. In conclusion a well-functioning project was achieved.

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# CHAPTER ONE

## 1.0 Introduction

A regulated power supply is an embedded circuit; it converts unregulated AC (Alternating Circuit) into a constant DC. Its function is to supply stable voltage.

A regulated DC power supply is also known as a linear power supply, it is an embedded circuit and consists of various blocks.

Almost all basic household electronic circuits need an unregulated AC to be converted to constant DC, in order to operate the electronic device. All devices will have a certain power supply. In any electrical supply system there is always a need for a stable power flow in the circuit which always requires a regulated power supply.

### 1.1 Background

Around the community am leaving in majorly in urban areas where by, they spend a lot of money to purchase two different devices to supply power to their equipment like chargers for the phone, adapters for the decoders, LCD Screen, and many others.

This project will be used to produce Regulated power supply of two outputs i.e 5V and 12V for charging, powering radio, and power other electronic devices which uses 12 volts for DVD players, cobby, LCD flat screens and DC lights in absence of battery.

I decided to produce this project because of the research I did. That's why I came up with the new design of Regulated power supply which has two outputs in order to minimize the amount used to purchase one unity instead of two devices.

## 1.2 Problem Statement

Frequent damages to electrical equipment and appliances have been occurring during charging due to unregulated power supply.

Also people have been spending a lot of money buying different chargers for different components.

### 1.3.1 Objectives

**General objective**

To design a regulated dc power supply that can be used to charge phones, power radio and decoders. [1]

**Specific objectives**

i. To simulate the circuit using multism

ii. To reduce the costs incurred in having unregulated power flow.

iii. To test the circuit

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Background

This chapter discusses the current projects which have already been done under regulated DC power supply and it also discusses information on different components used in the design.

## 2.2 Review of the existing projects.

Ritvikdave in design of a –Regulated Linear DC power supply‖ involves a number of steps such as process, rectification, Filter Circuit and voltage regulation. But this project only out puts a fixed voltage output of 5v. In this project it involves two out puts of 5v and 12v. A Fixed Regulated Power Supply, a Variable Regulated Power Supply and a Dual Regulated Power Supply are constructed by using transformers ( INPUT 240V AC, OUTPUT 12V AC, OUTPUT 24V AC), 1N 4001 Diodes, Capacitors, ICs (7805) and Variable resistors. The regulated power supply can be used with circuits containing linear integrated circuit elements. The DC voltage produced by a power supply is used to power all types of electronic circuits, such as television receivers, stereo systems, VCRs, CD players and laboratory equipment. A dual-polarity power supply is to be used for FM receiver. Two regulators, one positive and the other negative, provide the positive voltage required for the receiver circuits and dual-polarity voltages from the op-amp circuits.[2]

Power supplies are used in all types of digital displays and cathode ray tube (CRT) colour display. Any equipment that has electronic circuits in it must have a DC supply voltage available. Since all power in the factory originates as an AC voltage, converters must be used in the power supplies to convert an AC to DC power. The regulated power supplies are typically used with circuits containing linear integrated with circuit elements. It is necessary to supply DC at various voltages to the whole or a part of electronic equipment. The power source is usually the main electricity supply of 240V AC. [3]

There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, and each of which performs a particular function.

The elements of a DC power supply

1. Protection devices at the input, including fuses, transient suppressors and line filters

2. A transformer to produce the desired voltage from the 240V supply

3. A bridge rectifier and smoothing capacitor to produce unregulated DC with 10% ripple.

4. A voltage regulator to keep the voltage down to the specified value without ripple

Some apparatus needed in the design are shown below with the specifications are Transformer (INPUT 220V AC, OUTPUT 12V AC, 24V AC), Rectifier, Capacitors (1000 µF, 1.0µF , 0.1µF), Filter circuit Regulator, Resistors and ICs (1N 4007, 7805 IC, LM 337 IC, LM 317 IC A number of different designs and constructions of power supplies [4]

Design and construction of a fixed regulated power supply

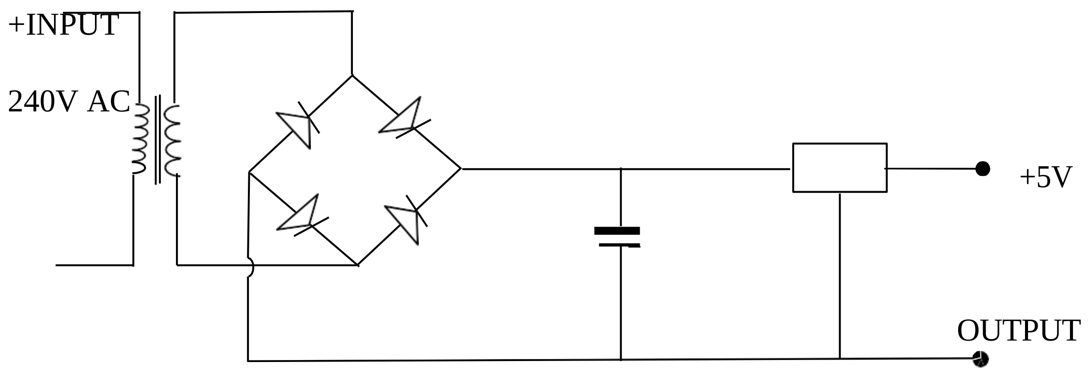



**Figure 1:Design and construction of a fixed regulated power supply**

Result and Discussion

Minimum DC output voltage = 5V

Maximum DC output voltage = 5V

The regulated power supply can be used with circuits containing linear integrated circuit elements. It is constructed to get necessary voltage of 5V to supply DC at electronic equipment. The power source is usually the main electricity supply of 220V AC..

Fixed regulated power supply

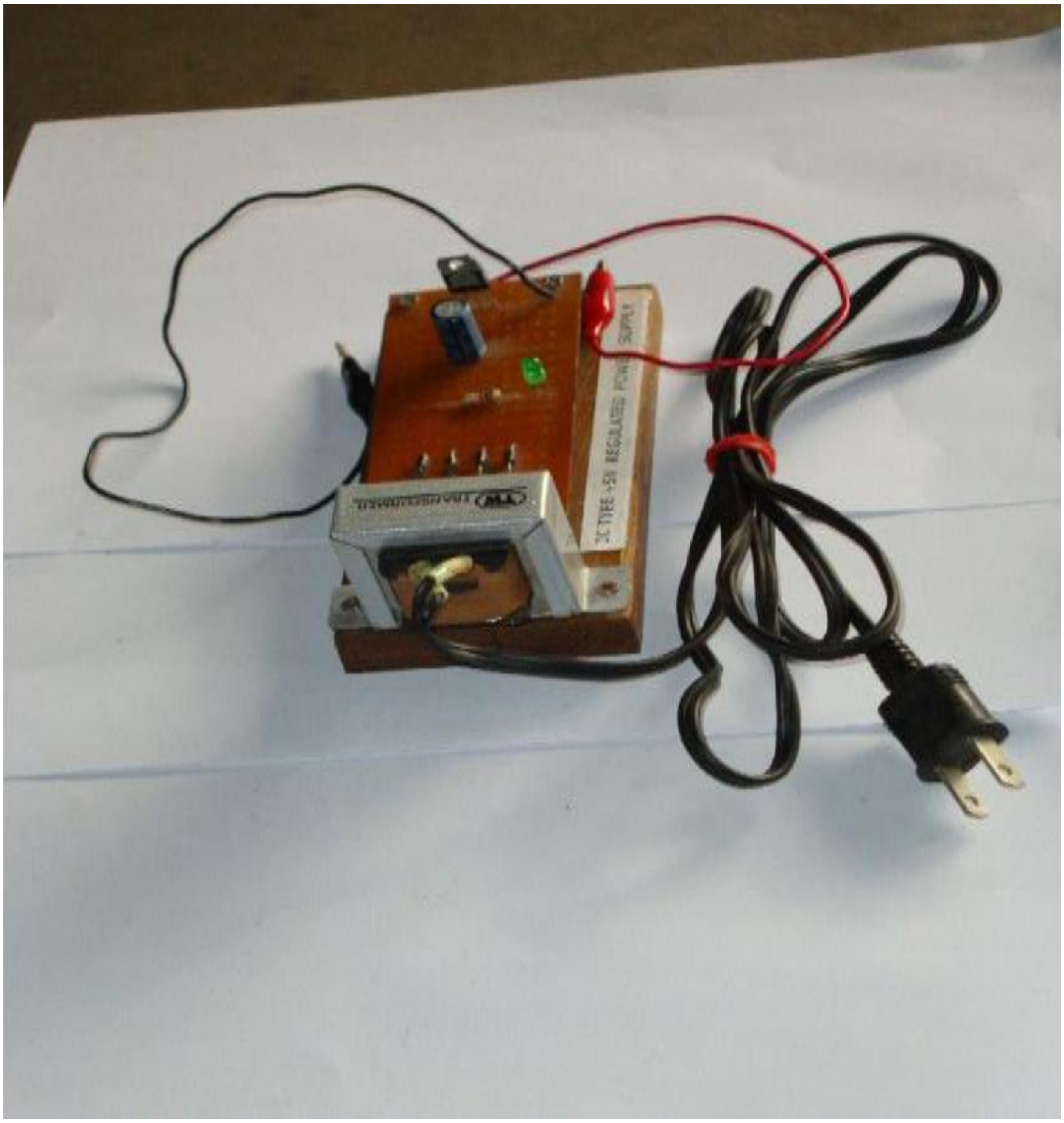


**Figure 2: Fixed regulated power supply**

2. Design and Construction of a Variable Regulated Power Supply

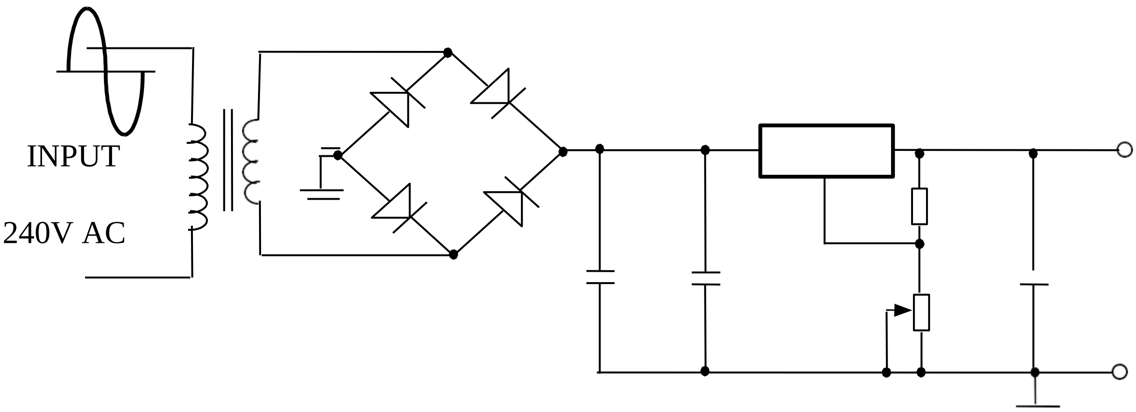



**Figure 3: showing a 24V regulated power supply**

Result and Discussion

Minimum DC output voltage = 2V

Maximum DC output voltage = 24V

The power source is usually the main electricity supply 220V AC.

3. **Design and Construction of a Dual Regulated Power Supply**

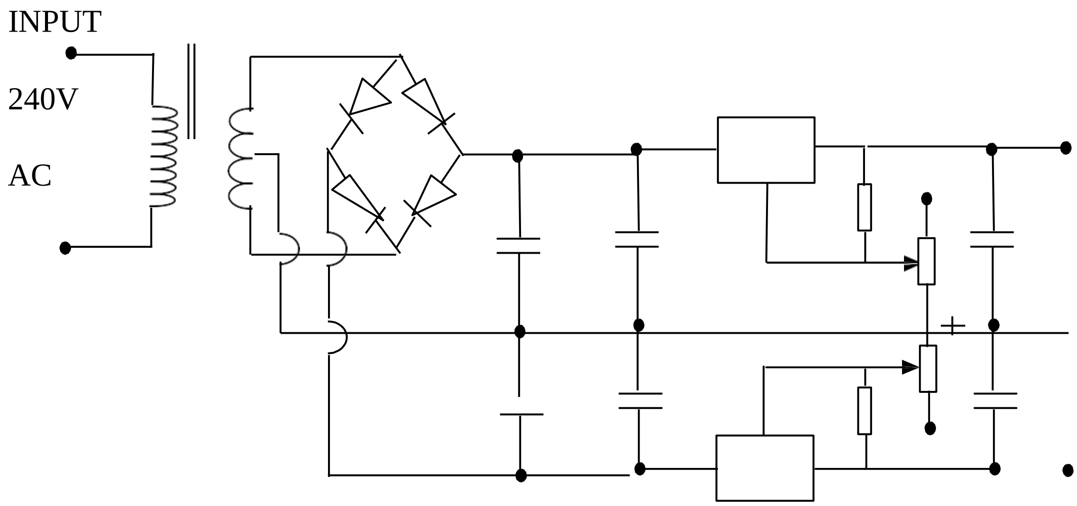



**Figure 4: Design and construction of a Dual Regulated Power supply**

Result and Discussion

Maximum DC output voltage 6.8 V

Minimum DC voltage 1.2V, for FM receiver

Two regulators: one positive and the other negative, the positive voltage is required for the receiver circuits the dual-polarity voltage for the operational –amplifier.

The regulated power supply can be used with circuits containing linear integrated circuit elements. It is constructed to get necessary voltage of 5V to supply DC at electronic equipment. The power source is usually the main electricity supply 220V AC. The variable regulated power supply can be easily constructed with an adjustable positive linear voltage regulator (LM 317 IC). The output voltage can be varied from 2V (DC) to

24V (DC) depending on the resistor values. This dual regulated power supply produces the maximum DC output voltage ±6.8 V and the minimum DC voltage ±1.2V. Modern electronic equipment needs a wide variety of DC voltage for its operation. The purpose of a power supply is to provide the primary source. The basic element of this power supply is the AC to DC converter, which consists of a transformer that converts the standard 240V, 50Hz AC. It is suitable for using in any low power electronic circuits, especially the most

Of the circuit using op-amp ICs. A dual polarity power supply is used for FM receiver. Two regulators, one positive and the other negative, provide the positive voltage required for the receiver circuits and the dual-polarity voltage for the operational – amplifier (op-amp) circuits.

## 2.3 Review on the different components used.

**Resistors**

A **resistor** is a passive two-terminal electrical component that implements electrical resistance as a circuit element.

Resistors act to reduce current flow, and, at the same time, act to lower voltage levels within circuits. In electronic circuits resistors are used to limit current flow, to adjust signal levels, bias active elements, terminate transmission lines among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components

Can be composed of various compounds and forms. Resistors are also implemented within integrated circuits.

The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude.

The nominal value of the resistance will fall within a manufacturing tolerance.

### 1.1 Electronic symbols and notation

Main article: Electronic symbol

Two typical schematic diagram symbols are as follows;

_ (a) resistor, (b) rheostat (variable resistor), and (c) potentiometer

_ IEC resistor symbol

The notation to state a resistor’s value in a circuit diagram varies, too. The European notation BS 1852 avoids using a decimal separator, and replaces the decimal separator with the SI prefix symbol for the particular value. For example,

*8k2* in a circuit diagram indicates a resistor value of 8.2 kω. Additional zeros imply tighter tolerance, for example *15M0*. When the value can be expressed without

The need for an SI prefix, an 'R' is used instead of the decimal separator. For example, *1R2* indicates 1.2 Ω, and *18R* indicates 18 Ω. The use of a SI prefix symbol or the letter 'R' circumvents the problem that decimal separators

Tend to 'disappear' when photocopying a printed circuit diagram.

## 1.2 Theory of operation

### 1.2.1 Ohm’s law

Main article: Ohm’s law

The behavior of an ideal resistor is dictated by the relationship specified by Ohm’s law:

$V = I \_ R:$

Ohm’s law states that the voltage (V) across a resistor is proportional to the current (I), where the constant of proportionality is the resistance (R). For example, if a 300 ohm resistor is attached across the terminals of a 12 volt

RESISTOR

Hair in pipe

Same flow **Large R**

Higher pressure

Lower pressure **Small R**

The hydraulic analogy compares electric current flowing through circuits to water flowing through pipes. When a pipe (left) is filled with hair (right), it takes a larger pressure to achieve the same flow of water. Pushing electric current through a large resistance is like pushing water through a pipe clogged with hair:

It requires a larger push (voltage drop) to drive the same flow (electric current). Battery, then a current of 12 / 300 = 0.04 amperes flows through that resistor.

Practical resistors also have some inductance and capacitance which will also affect the relation between voltage and current in alternating current circuits. [4]

The ohm (symbol: Ω) is the SI unit of electrical resistance, named after Georg Simon Ohm. An ohm is equivalent to a volt per ampere. Since resistors are specified and manufactured over a very large range of values, the derived units of milliohm (1 mω = 10−3 Ω), kilohm (1kω = 103 Ω), and megohm (1 MΩ = 106 Ω) are also in common usage.

**Series and parallel resistors**

Main article: Series and parallel circuits

The total resistance of resistors connected in series is the sum of their individual resistance values.

The total resistance of resistors connected in parallel is the reciprocal of the sum of the reciprocals of the individual resistors.

So, for example, a 10 ohm resistor connected in parallel with a 5 ohm resistor and a 15 ohm resistor will produce the inverse of 1/10+1/5+1/15 ohms of resistance,

Or 1/(.1+.2+.067)=2.725 ohms.

A resistor network that is a combination of parallel and series connections can be broken up into smaller parts that are either one or the other. Some complex networks of resistors cannot be resolved in this manner, requiring more sophisticated circuit analysis. Generally, the Y-Δ transform, or matrix methods can be used to solve such problems. [3]

**Power dissipation**

At any instant of time, the power $P$ (watts) consumed by a resistor of resistance $R$ (ohms) is calculated as: $P = I^2R = IV = V\,2$

$R$ where $V$ (volts) is the voltage across the resistor and $I$ (amps) is the current flowing through it. Using Ohm’s law, the two other forms can be derived.

This power is converted into heat which must be dissipated by the resistor’s package before its temperature rises excessively.

Resistors are rated according to their maximum power dissipation. Most discrete resistors in solid-state electronic systems absorb much less than a watt of electrical power and require no attention to their power rating.

Such resistors in their discrete form, including most of the packages detailed below, are typically rated as 1/10, 1/8, or 1/4 watt.

An aluminum-housed power resistor rated for 50 W when heats inked

Resistors required to dissipate substantial amounts of power, particularly used in power supplies.

**FIXED RESISTOR:** Version circuits, and power amplifiers, are generally referred to as *power resistors*; this designation is loosely applied to resistors with power ratings of 1 watt or greater. Power resistors are physically larger and may not use the preferred values, color codes, and external packages described below.

If the average power dissipated by a resistor is more than its power rating, damage to the resistor may occur, permanently altering its resistance; this is distinct from the reversible change in resistance due to its temperature coefficient when it warms. Excessive power dissipation may raise the temperature of the resistor to a point where it can burn the circuit board or adjacent components, or even cause a fire. There are flameproof resistors that fail (open circuit) before they overheat dangerously.

Since poor air circulation, high altitude, or high operating temperatures may occur, resistors may be specified with higher rated dissipation than will be experienced in service.

Some types and ratings of resistors may also have a maximum voltage rating; this may limit available power dissipation for higher resistance values.

**Non ideal properties:** Practical resistors have a series inductance and a small parallel capacitance; these specifications can be important in high-frequency applications. In a low-noise amplifier or pre-amp, the noise characteristics of a resistor may be an issue.

The temperature coefficient of the resistance may also be of concern in some precision applications.

The unwanted inductance, excess noise, and temperature coefficient are mainly dependent on the technology used in manufacturing the resistor. They are not normally specified individually for a particular family of resistors manufactured using a particular technology.[5]

A family of discrete resistors is also characterized according to its form factor, that is, the size of the device and the position

Of its leads (or terminals) which is relevant in the practical manufacturing of circuits using them.

Practical resistors are also specified as having a maximum power rating which must exceed the anticipated power dissipation of that resistor in a particular circuit: this is mainly of concern in power electronics applications. Resistors with higher power ratings are physically larger and may require heat sinks. In a high-voltage circuit, attention must sometimes be paid to the rated maximum working voltage of the resistor. While there is no minimum working voltage for a given resistor, failure to account for a resistor's maximum rating may cause the resistor to incinerate when current is run through it.

**Fixed resistor:** A single in line (SIL) resistor package with 8 individual, 47 ohm resistors. One end of each resistor is connected to a separate pin and the other ends are all connected together to the remaining (common) pin – pin 1, at the end identified by the white dot.

**Lead arrangements:** Resistors with wire leads for through-hole mounting.

Through-hole components typically have leads leaving the body axially. Others have leads coming off their body radially instead of parallel to the resistor axis. Other components may be SMT (surface mount technology) while high power resistors may have one of their leads designed into the heat sink.

**Carbon composition:** Carbon composition resistors consist of a solid cylindrical resistive element with embedded wire leads or metal end caps to which the lead wires are attached. The body of the resistor is protected with paint or plastic. Early 20th-century carbon composition resistors had un insulated bodies; the lead wires were wrapped around the ends of the resistance element rod and soldered. The completed resistor was painted for color-coding of its value.

The resistive element is made from a mixture of finely ground (powdered) carbon and an insulating material (usually ceramic). A resin holds the mixture together.

The resistance is determined by the ratio of the fill material (the powdered ceramic) to the carbon. Higher

**RESISTOR**

Three carbon composition resistors in a 1960s valve (vacuum tube) radio concentrations of carbon— a good conductor— result in lower resistance. Carbon composition resistors were commonly used in the 1960s and earlier, but are not so popular for general use now as other types have better specifications, such as tolerance, voltage dependence, and stress (carbon composition resistors will change value when stressed with over-voltages). Moreover, if internal moisture content (from exposure for some length of time to a humid environment) is significant, soldering heat will create a non-reversible change in resistance value. Carbon composition resistors have poor stability with time and were consequently factory sorted to, at best, only 5% tolerance.[6] These resistors, however, if never subjected to overvoltage nor overheating were remarkably reliable considering the component's size.[7]

Carbon composition resistors are still available, but comparatively quite costly. Values ranged from fractions of an ohm to 22 megohms. Due to their high price, these resistors are no longer used in most applications. However, they are used in power supplies and welding controls.[7]

**Carbon pile**

A carbon pile resistor is made of a stack of carbon disks compressed between two metal contact plates. Adjusting the clamping pressure changes the resistance between the plates. These resistors are used when an adjustable load is required, for example in testing automotive batteries or radio transmitters. A carbon pile resistor can also be used as a speed control for small motors in household appliances (sewing machines, hand-held mixers) with ratings up to a few hundred watts.[8] A carbon pile resistor can be incorporated in automatic voltage regulators for generators, where the carbon pile controls the field current to maintain relatively constant voltage.[9] The principle is also applied in the carbon microphone.

**Carbon film**

A carbon film is deposited on an insulating substrate, and a helix is cut in it to create a long, narrow resistive path. Varying shapes, coupled with the resistivity

Of amorphous carbon (ranging from 500 to 800 μω m), can provide a wide range of resistance values. Compared to carbon composition they feature low noise, because

Of the precise distribution of the pure graphite without binding.[10] Carbon film resistors feature a power rating range of 0.125 W to 5 W at 70 °C. Resistances available range from 1 ohm to 10 megohm. The carbon film resistor has an operating temperature range of −55 °C to 155°C. It has 200 to 600 volts maximum working voltage range. Special carbon film resistors are used in applications

Requiring high pulse stability.[7]

**Printed carbon resistor**

Carbon composition resistors can be printed directly onto printed circuit board (PCB) substrates as part of the PCB manufacturing process. Although this technique is more common on hybrid

PCB modules, it can also be used on standard fibre glass pcbs. Tolerances are typically quite large, and can be in the order of 30%. A typical application would be non-critical pull-up resistors.

### Thick and thin film

Thick film resistors became popular during the 1970s, and most SMD (surface mount device) resistors today are of this type. The resistive element of thick films is 1000 times thicker than thin films,[11] but the principal difference

Is how the film is applied to the cylinder (axial resistors) or the surface (SMD resistors).

## Heat sink

### BASIC PRINCIPLE OF HEAT SINK

Fourier's law of heat conduction states that if temperature gradient is present in a body, then the heat will transfer from a high-temperature region to allow- temperature region. And, this can be achieved in three different ways, such as convention, radiation and conduction.

A heat sink is an object that transfers thermal energy from a higher temperature to a lower temperature fluid medium. The fluid medium is frequently air, but can also be water or in the case of heat exchangers, refrigerants and oil. If the fluid medium is water, the 'heat sink' is frequently called a cold plate. To understand the principle of a heat sink, consider Fourier's law of heat conduction. Joseph Fourier was a French mathematician who made important contributions to the analytical treatment of heat conduction. Fourier's law of heat conduction, simplified to a one-dimensional form in the *x*-direction, shows that when there is a temperature gradient in a body, heat will be transferred from the higher temperature region to the lower temperature region. The rate at which heat is transferred by conduction, $q_k$, is proportional to the product of the temperature gradient and the cross-sectional area through which heat is transferred.

**Material-** Heat sinks are designed using materials that have high thermal conductivity such as aluminum alloys and copper. Copper offers excellent thermal conductivity, antimicrobial resistance, befouling resistance, corrosion resistance, and heat absorption. Its properties make

it an excellent material for heat sinks but it is more expensive and denser than aluminum.

Diamond offers a high thermal conductivity that

makes it a suitable material for thermal applications. Its lattice vibrations account for its outstanding thermal conductivity. Composite

materials such as AlSiC, Dymalloy, and copper-tungsten pseudo-alloy are also commonly used in thermal applications.

**Arrangement, Shape, Size, and Location of Fins-** The flow of the coolant medium is greatly impacted by the arrangement of fins on a heat sink. Optimizing the configuration helps to reduce fluid flow resistance thus allowing more air to go through a heat sink. The heat sink's performance is also determined by the shape and design of its fins. Optimizing the shape and size of the fins helps to maximize the heat transfer density. Through modeling, the performance of different fin shapes and configurations can be evaluated.

**Fin Efficiency-** A heat sink fin receives heat from an electronic device and dissipates it into the surrounding coolant fluid. The heat transferred by a fin to the coolant medium decreases as the distance from the base of the heat sink increases. Using a material that has a higher thermal conductivity and decreasing the aspect ratio of the fins help to boost the fins' overall efficiency.

Heat sinks are essential parts of most electronic assemblies, power electronic devices, and optoelectronic components.

These passive heat exchangers dissipate heat generated by electronic devices to ensure that they are operating within the limits specified by manufacturers.

Some of the key factors that should be considered when designing a heat sink include thermal resistance, material, fin configuration, fin size and shape, fin efficiency, heat sink attachment method, and thermal interface material.

Geometries and parameters that provide maximum heat dissipation are obtained by analyzing different heat sink models.

**Regulated power supply**

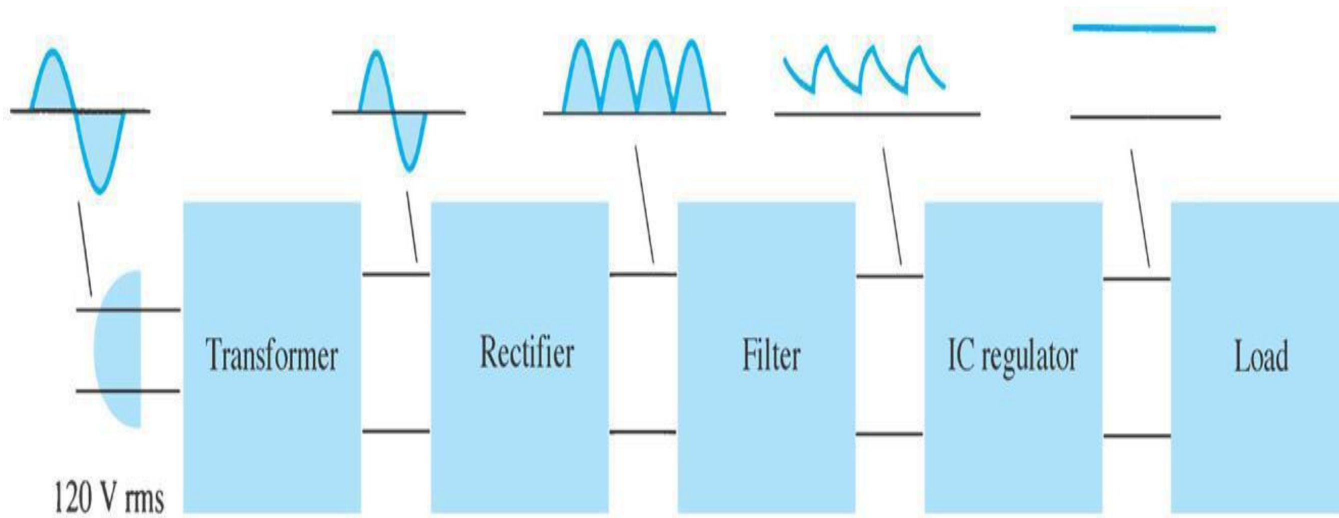



**Figure 5: Showing the block diagram representation of the regulated power supply**

Power supply: a group of circuits that convert the standard ac voltage (120 v, 60 hz) provided by the wall outlet to constant dc voltage.

Transformer: a device that step up or step down the ac voltage provided by the wall outlet to desired amplitude through the action of a magnetic field

Rectifier: diode circuits that convert the ac input voltage to a pulsating dc voltage

The pulsating dc voltage is only suitable to be used as a battery charger, but not good enough to be used as a dc power supply in a radio, stereo system, and computer and so on.

There are two basic types of rectifier circuits:
Half-wave rectifier

Full-wave rectifier - Center-tapped & Bridge full-wave rectifier

In summary, a full-wave rectified signal has less ripple than a half-wave rectified signal and is thus better to apply to a filter.

Filter: a circuit used to reduce the fluctuation in the rectified output voltage or ripple. This provides a steadier dc voltage.

Regulator: a circuit used to produces a constant dc output voltage by reducing the ripple to negligible amount. One part of power supply.

Regulator - Zener diode regulator [2]

For low current power supplies - a simple voltage regulator can be made with a resistor and a Zener diode connected in reverse.

Zener diodes are rated by their breakdown voltage Vz and maximum power Pz (typically 400mW or 1.3W)

Two basic categories of voltage regulation are:

Line regulation

Load regulation

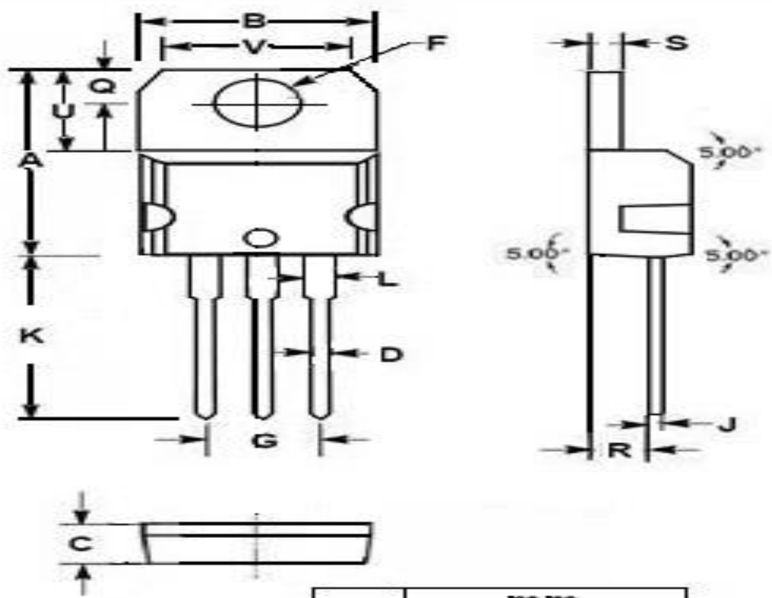
The purpose of line regulation is to maintain a nearly constant output voltage when the input voltage varies.

The purpose of load regulation is to maintain a nearly constant output voltage when the load varies .

Line regulation: A change in input (line) voltage does not significantly affect the output voltage of a regulator (within certain limits).

**VOLTAGE REGULATORS**

**LM7812**




| DIM | mm | |
|---|---|---|
| | MIN | MAX |
| A | 15.65 | 15.75 |
| B | 10.15 | 10.25 |
| C | 3.95 | 4.50 |
| D | 1.27 | |
| F | 3.80 | |
| G | 5.08 | |
| J | 0.50 | |
| K | 13.50 | 13.60 |
| L | 1.28 | 1.32 |
| Q | 2.80 | |
| R | 2.50 | 2.60 |
| S | 1.29 | 1.31 |
| U | 6.45 | 6.55 |
| V | 7.65 | 7.85 |

**Figure 6: Showing the detailed data sheet of LM7812**

**FEATURES**

·Output current in excess of 1.5A

·Output voltage of 12V

·Internal thermal overload protection

·Output transition Safe-Area compensation [3]

Basic parameters

Some of the basic parameters to consider when using a voltage regulator are the input voltage, output voltage, and output current. These parameters are used to determine which VR topology is compatible with a users IC.

Other parameters –including quiescent current, switching frequency, thermal resistance and feedback voltage may be relevant depending on the application.

Quiescent current is important when efficiency during light –load or standby modes is a priority. When considering switching frequency as a parameter maximizing the switching frequency leads to smaller system solutions.

**Linear and switching Regulator Applications**

Linear regulators are often used in applications that are cost-sensitive, noise sensitive, low current, or space constrained. Some examples include consumer electronics such as head phones, werables, and internet of things (IOT) devices. For instance, applications such as a hearing aid could use a linear regulator because they don't have a switching element that could create unwanted noise and interfere with the device's performance.

Moreover, if designers are mainly in creating a low-cost application, they need not be as concerned with power dissipation, and can rely on a linear regulation.

Limitation of Voltage regulators

One of the main disadvantages for linear regulators is that they can be inefficient , as they dissipate large amounts of power in certain use cases. The voltage drop of a linear regulator is comparable to a voltage drop across a resistor.

It is import to consider the estimated power dissipation of a linear regulator in application, since using large input voltages results in high power dissipation that can overheat and damage components. [4]

# CHAPTER THREE: METHODOLOGY

## 3.0 INTRODUCTION

This chapter contains the measures and methods that I used to build the circuit in order to achieve the desired output.

Below is a table containing the column of objectives, method used to achieve the objective and the deliverables.

**Table 1: Showing the objectives, methods and deliverables**

| **Objective** | **Method** | **Deliverables** |
|---|---|---|
| To design a regulated power supply that one can be used to charge phones, power radio and decoders. | The process shall begin with gathering information, followed with the system design, budget and building of the circuit.<br>Testing shall be carried out using a multimeter. | The collation of data shall help in knowing the different components to use. The system design shall enable me in knowing the how it will look.<br>Building of the circuit shall give us the desired results.<br>Testing shall enable us have a well-functioning system. |
| **Specific objective**<br>To simulate the circuit using multism | The circuit simulation involved connecting the different components in the software. | A well connected and running simulation was obtained. |
| To reduce the costs incurred in having an un regulated power flow. | The circuit was designed to give a nominal output. | A well-functioning circuit was achieved in the simulation. |
| To test the circuit | Ensuring a well-functioning circuit. | The different tests enabled me to have a proper functioning system. |

The block diagram for the regulated power supply

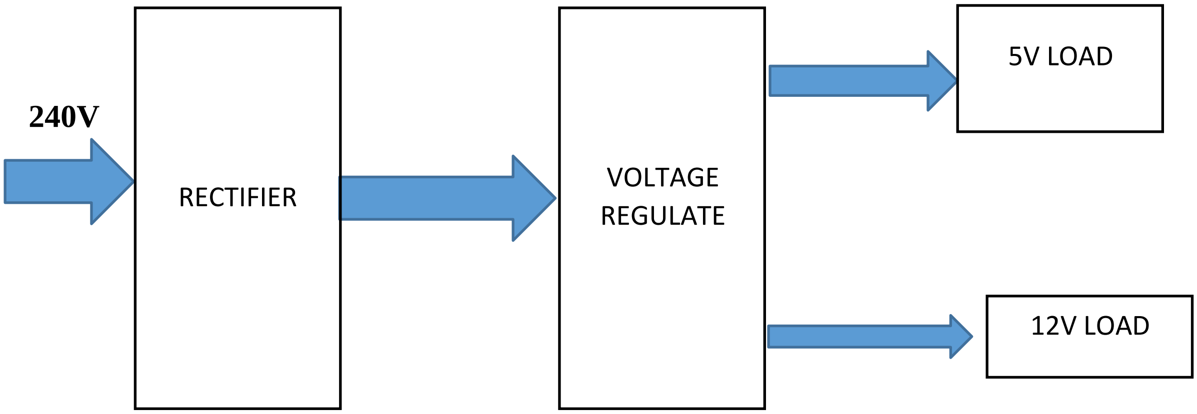



**Figure 7: block diagram for the regulated power supply**

## 3.4 SIGNIFICANCE OF THE RESEARCH

- The project well produces a stable output voltages and currents
- Increases workability of the electrical appliances.
- Overcomes malfunctioning of equipment. [5]

## 3.1 CIRCUIT DESIGN

**SIZING OF THE COMPONENTS**

**CHOOSING OF THE REGULATOR;**

When you are choosing the regulator, you consider the output voltage and the input voltage.

1. Regulator represents output of 5v dc

$2^{nd}$ Regulator represents output of 12V dc

Positive series linear regulators are in the form of LM 78XX

The minimum voltage input is the first digit and the last digit is the out put

1. Regulator : LM7805
2. Regulator : LM7812 [6]

**CHOOSING THE TRANSFORMER**

Supply single phase voltage = 240V

Ranges of the voltage to be rectified single phase transformer ranges from (7-2)V, (7-24) (single phase transformer center tapped. Therefore a step down transformer is used.

$P = 30VA$

$P= I_1V_1$, $I_1= 30/220 = 0.136A$

From Pout put = P input

$P\ output = I_2V_2$

$I_2 = 30/24 = 1.25A$

Turns ratio $= V_1/V_2 = N_1/N_2 = I_2/I_1$

$= 1.25/ 0.136 \quad = 9.3$

**RECTIFICATION**

Full wave, Full wave rectifier with two diodes

Bridge rectifier with four diodes

A bridge rectifier was chosen because it is more power efficient .The DC output signal of the bridge rectifier is smoother than the output DC signal of a half wave rectifier.

**CHOOSING OF DIODES:**

-The diodes must have a current rating higher than output load current.

IN 4001, IN4158, IN4007

IN4001, Current rating 1 A, with a peak repetitive voltage =50V

IN4158, current rating 1A, with a peak repetitive voltage =1000V

I choose in4007 because it can withstand high voltages up to 1000V.

CHOOSING OF CAPACITORS FOR FILTERING

$Q=CV$ ..............................(i)

$V = IR$

$Q= C\ IR$

But $Q = IT$

$CV = IT$

$T = 1/2$

$C = IT / V$

$C = I * 1/2 / V$

After putting in the values in the formula,

I decide to use 1000µf, 25v capacitor

# CHAPTER FOUR: RESULTS AND FINDINGS

## 4.1 INTRODUCTION

This Chapter gives results obtained from the prototype.

The system began with designing of the power supply to system using Multism software. It was simulated, measured the output voltage, current and the output wave form displayed using the oscilloscope. The system output voltage depended in the type of components used such as voltage regulators, transformer, rectifier.

The 5v output was obtained by using the LM7805 voltage regulator. The 5v obtained where measured using the oscilloscope and voltmeter in the simulation.

The 12v output was obtained by using the LM7812 voltage regulator. The 12v obtained where measured also using an oscilloscope or voltmeter.

## 4.2 System design.

The design in multism begun with the opening of the multism software. It was latter followed by selection of the different components to use in the prototype. The selection of components was based on reading of the different data sheets of the components.

Then the AC power supply was covered to DC by designing a full wave bridge rectifier and after the bridge rectifier, a capacitor for smoothing was connected across the supply. Then the voltage regulator was connected in series with the supply voltage in order to obtain a regulated output voltage. The system design is as shown in the figures below.

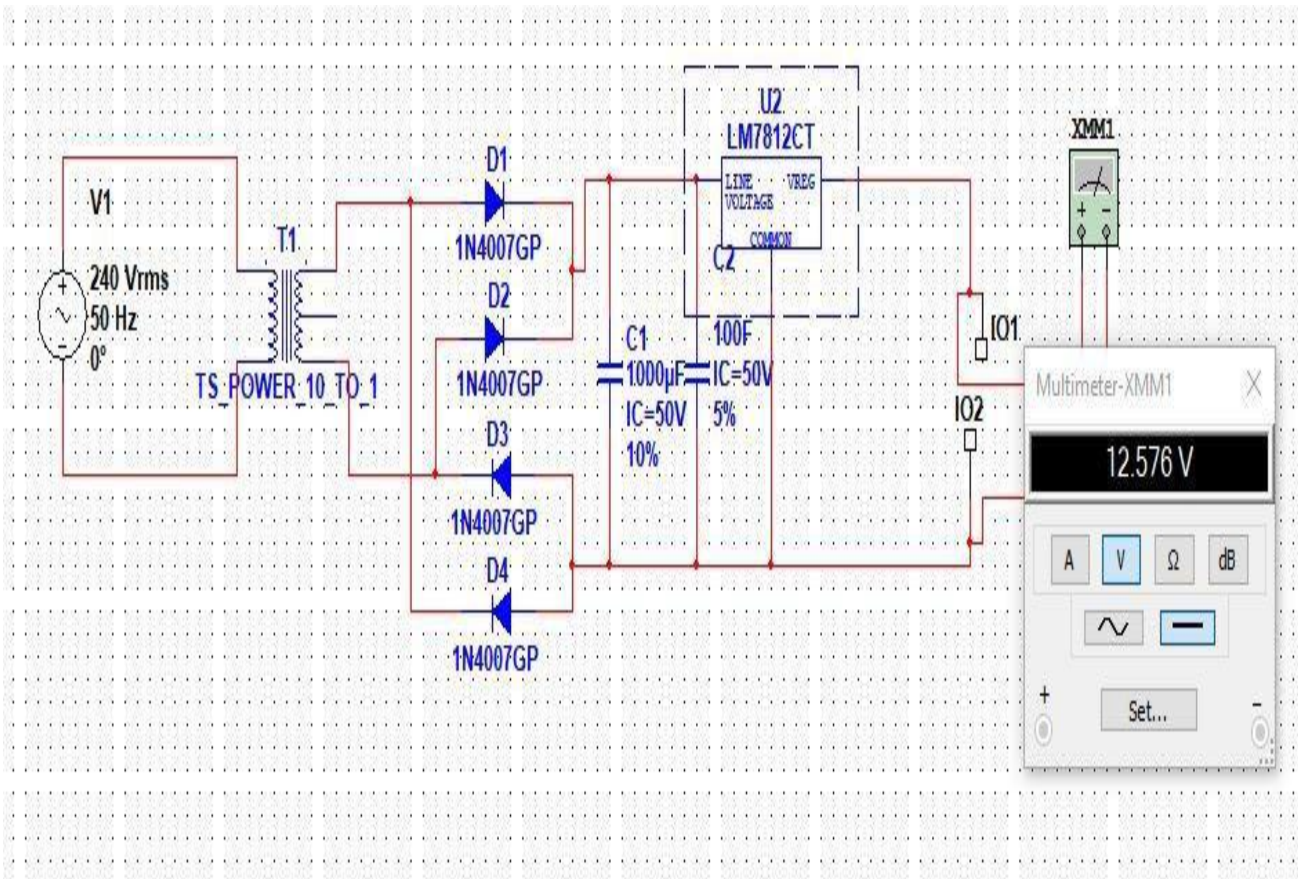



**Figure 8: Simulation of 12V output of the system**

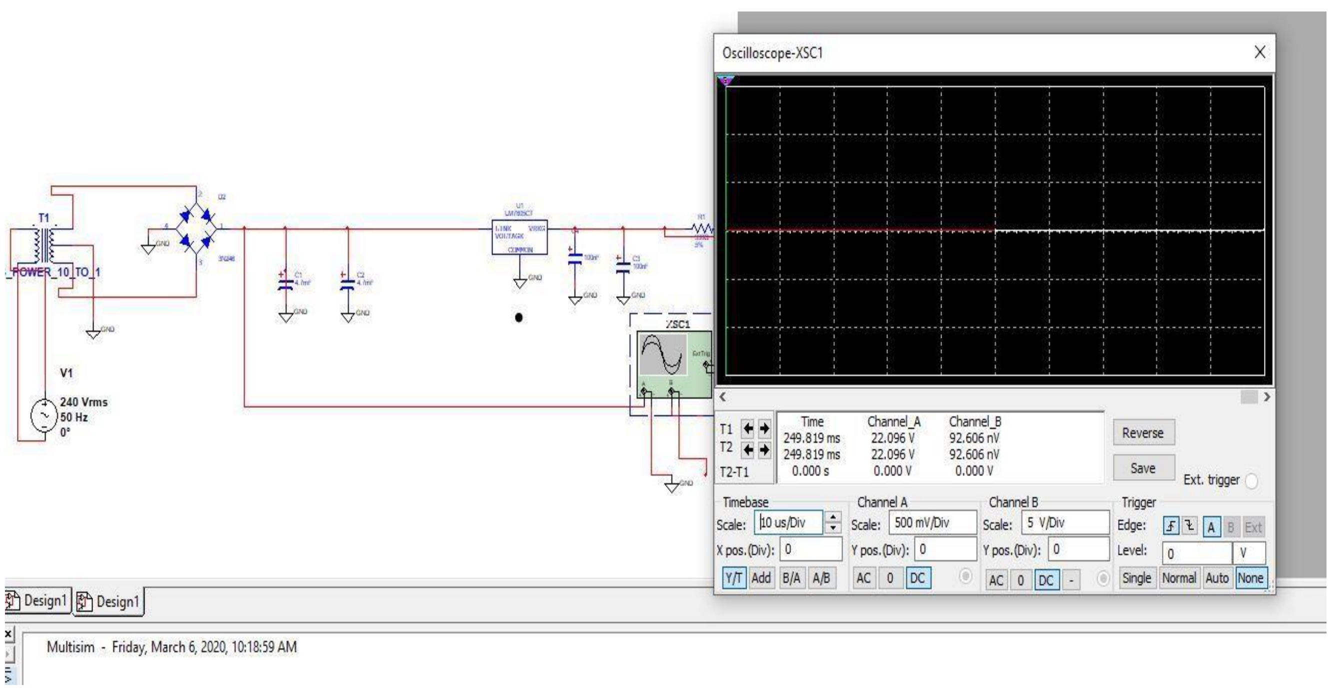



**Figure 9: Simulation showing pure dc out put**

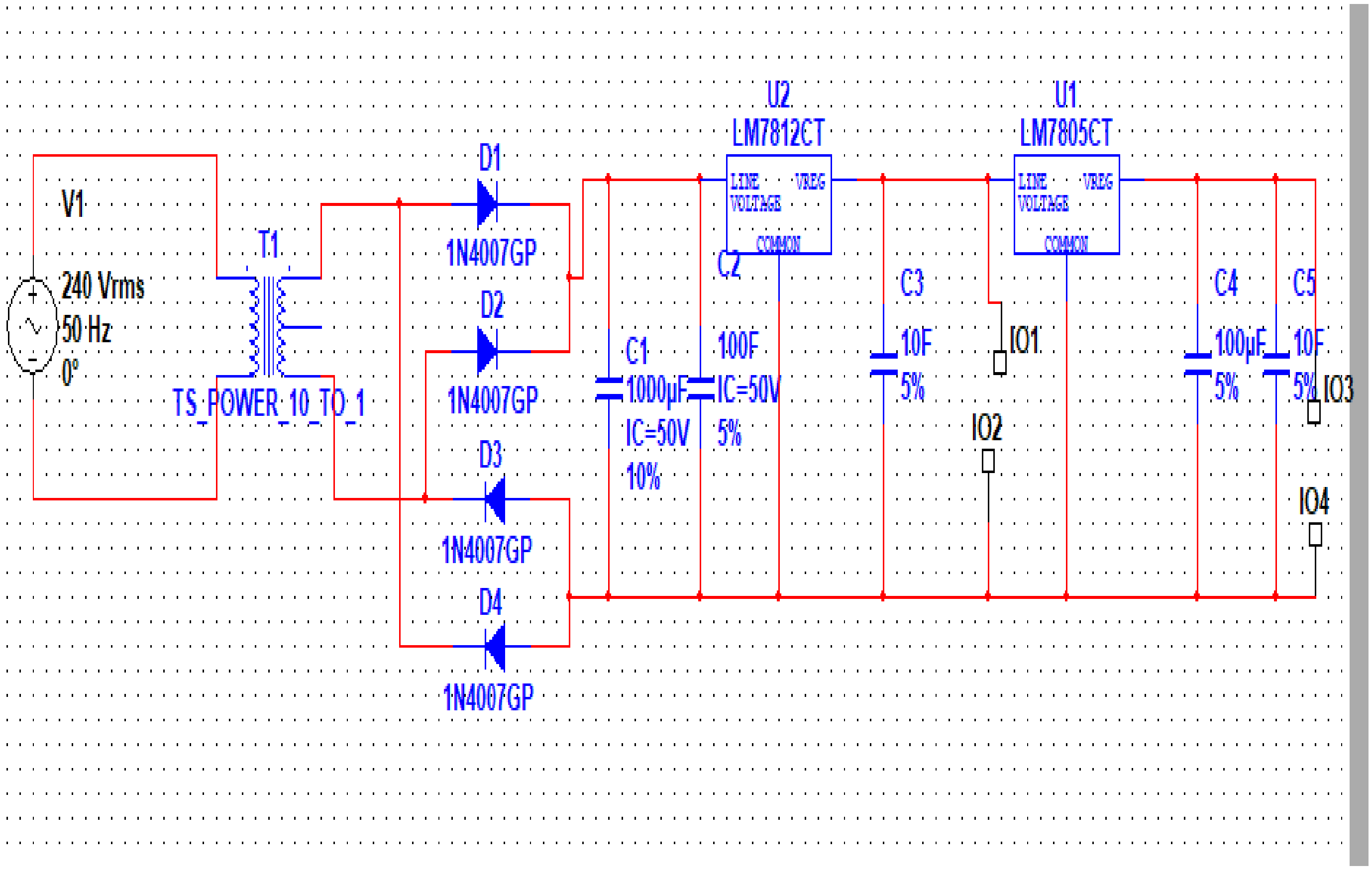



**Figure 10: Final Circuit diagram**

### 4.3 Prototyping

The prototyping begun with mounting of the selected components on the Bread board and testing them whether they are functioning fully.

After testing the system on the bread board, it was mounted and soldered on the velo board.

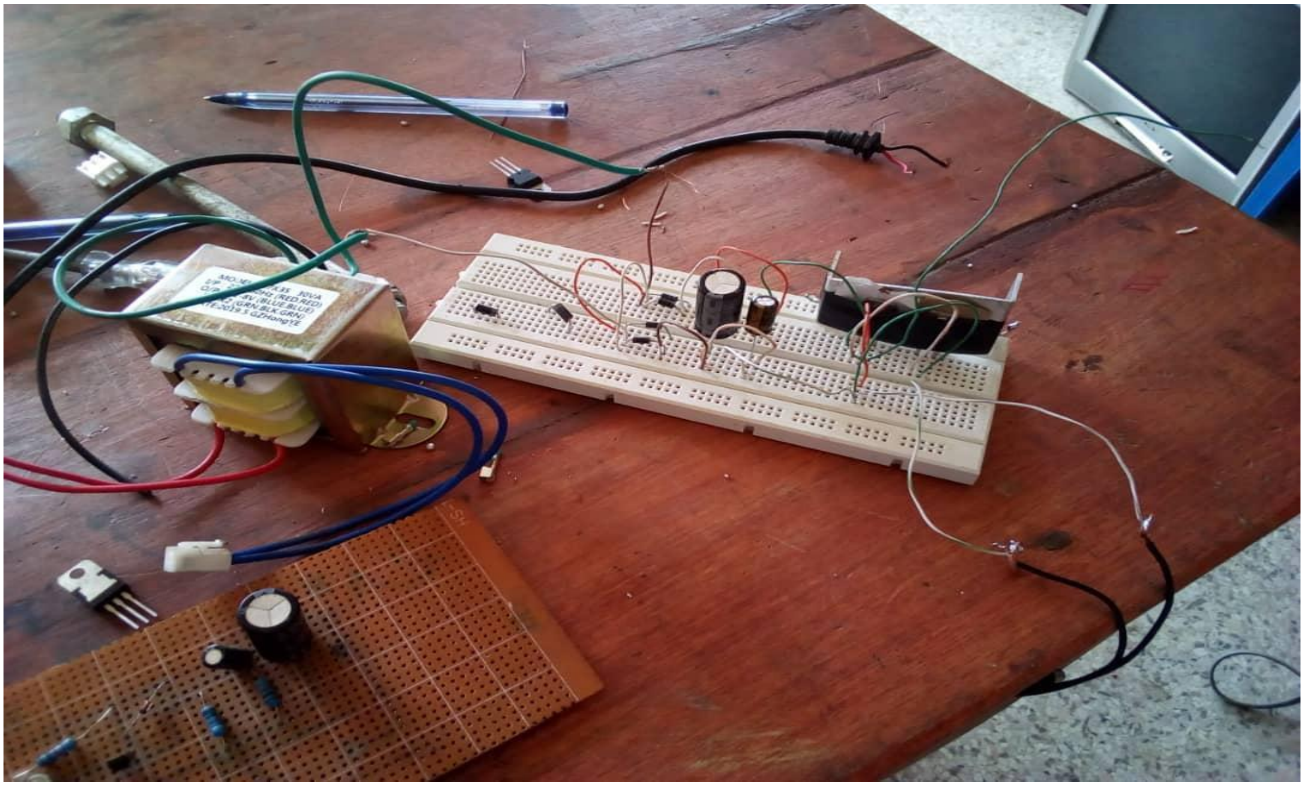


**Figure 11: components on bread board**

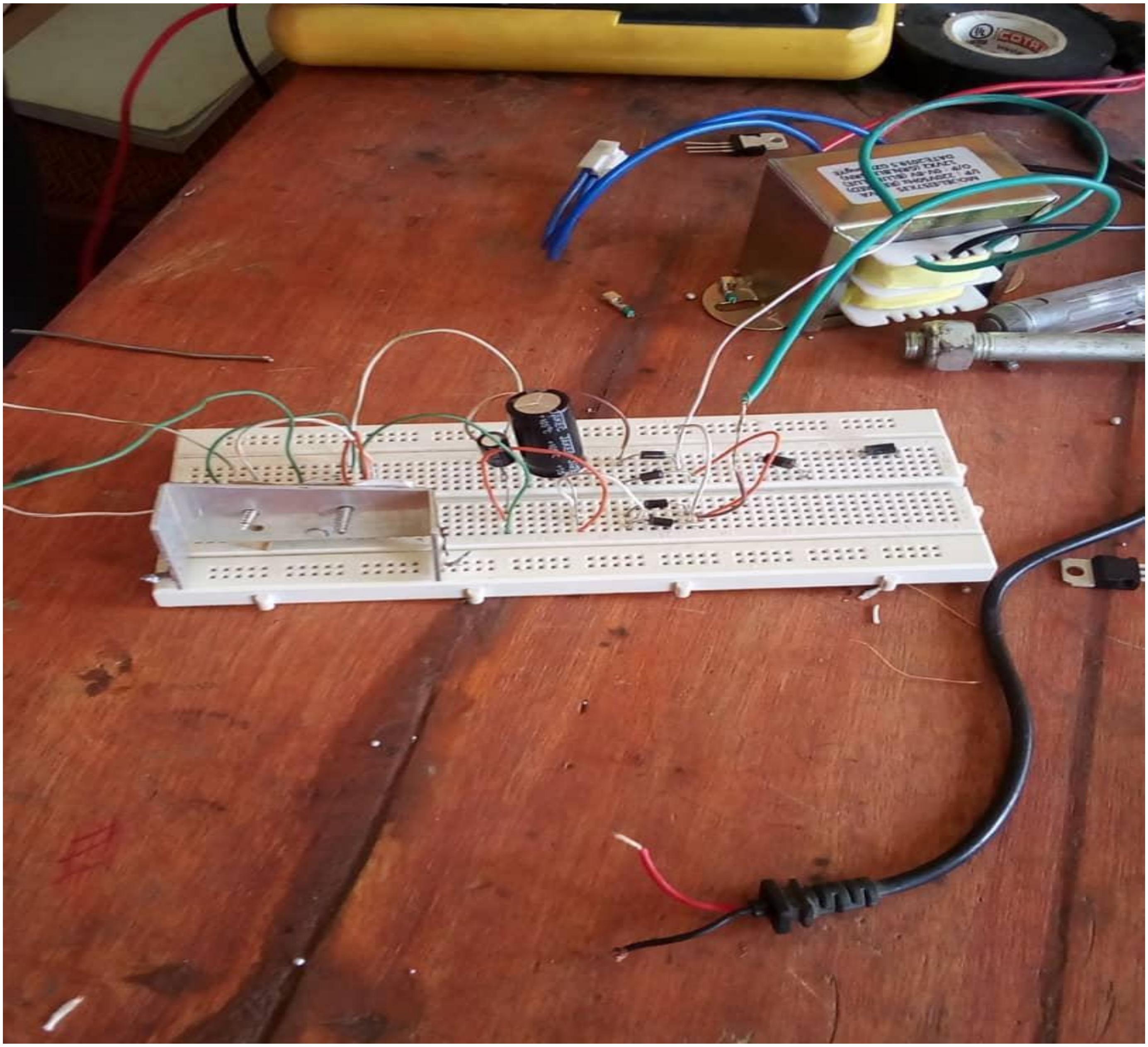


**Figure 12: Connection of the components on the bread board**

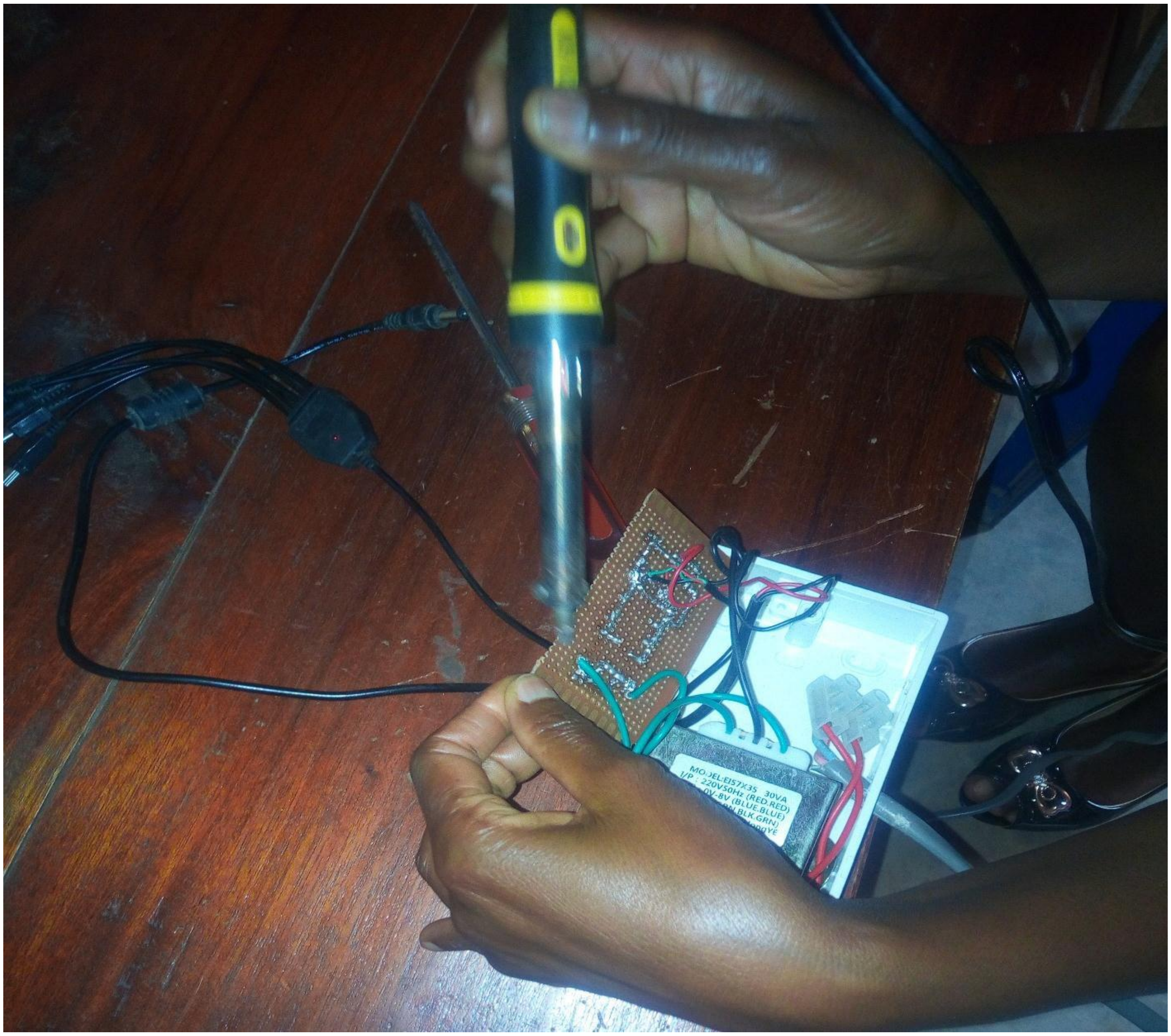



**Figure 13: Mounting of the components and soldering**

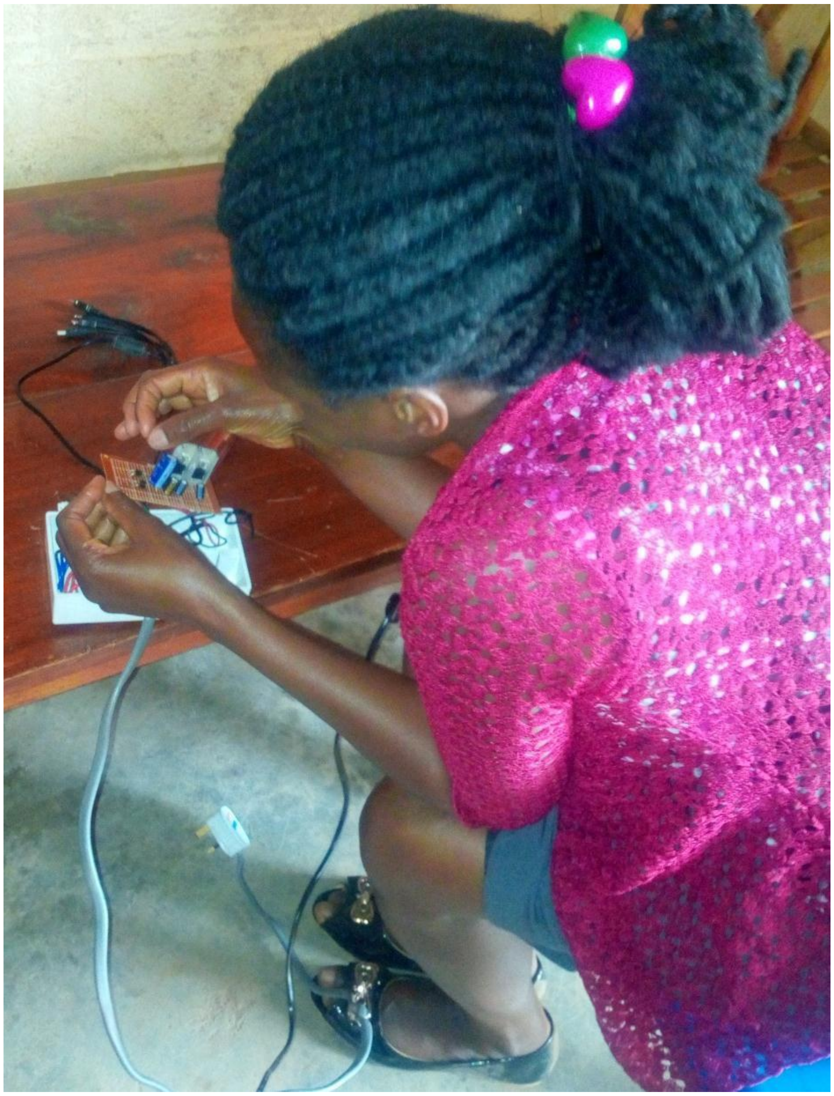


**Figure 14: Inserting components in the casing**

**Figure 15: Testing of the different mounted components**

**4.4 RESULTS**

An out of 12v and different terminals with 5v out put was successfully achieved.

The system able to connect different devices like phones, laptops, DVD players and Television sets at the same type.

The final prototype is shown in the figure below.

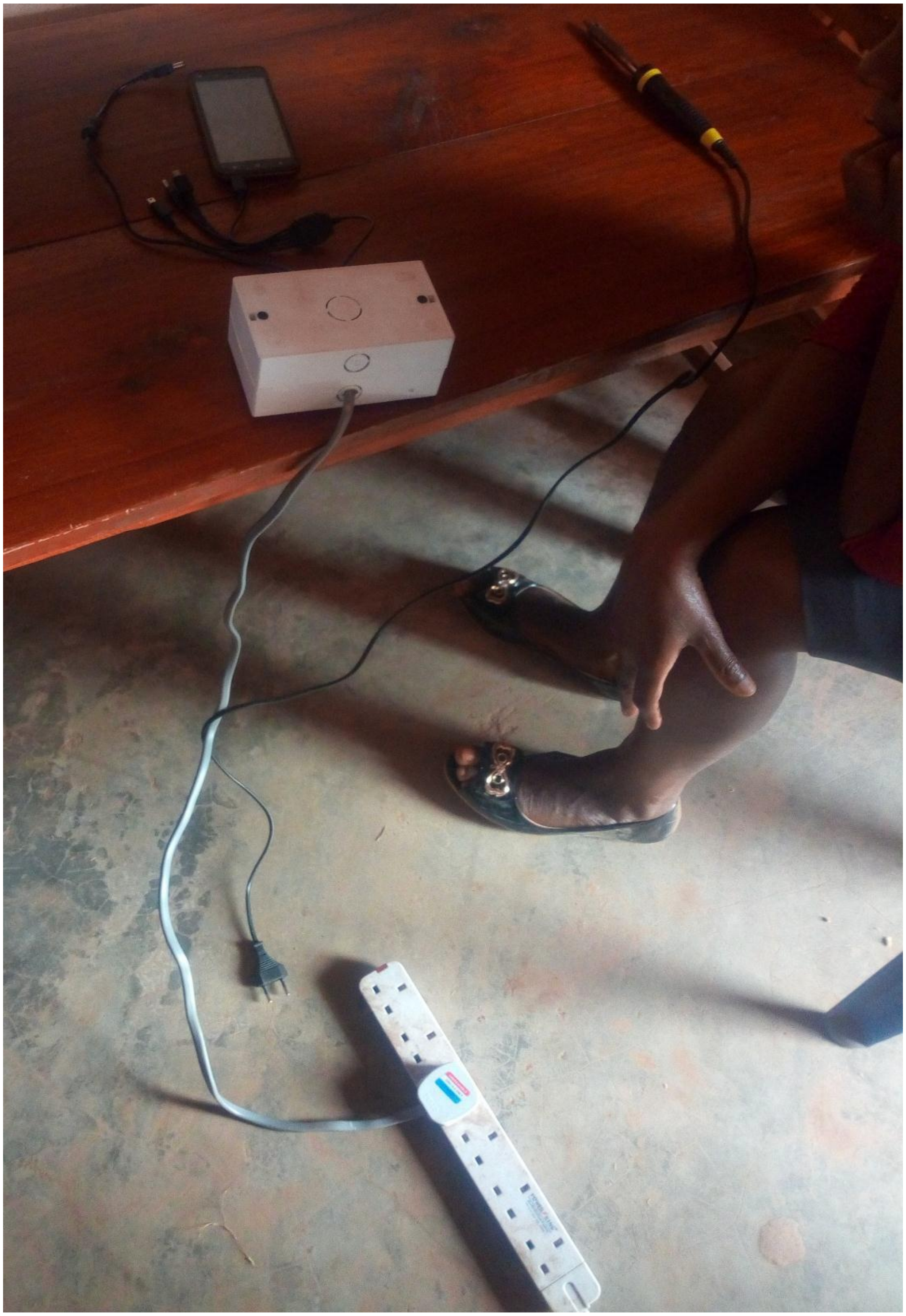


**Figure 16: Shows final testing of the circuit**

# 5.0 CHAPTER FIVE: LIMITATIONS, RECOMMENDATIONS AND CONCLUTIONS

## 5.1 INTRODUCTION

The main objective of this project was to design and prototype a regulated DC power supply.

## 5.2 LIMITATIONS OF THE PROJECT.

(a) Its suitable for devices that consume 5v and 12v Dc

## 5.3 RECOMMENDATIONS

I recommend this system because of the following reasons:

(a) It reduces costs incurred in buying of different adapters for different electronic devices.

(b) It reduces on burning of devices due to over voltages that result from unregulated power supply.

(c) It is easy to trouble shoot incase of any fault.

## 5.4 CHALLENGES

(a) High costs due the Covid -19 pandemic which led to closure of electronic shops that sell components and stopping of transportation companies.

## 5.5 CONCLUSION

The aims and objectives of the project were met in the developed prototype. The system shall be of great use to the community.

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