DESIGN AND CONSTRUCTION OF A 1.5kV HYBRID MODULAR INVERTER TRAINER KIT

BY

ADEBAYO ADESOLA EMMANUEL

(MATRIC NO: EEE/13/1089)

A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, FEDERAL UNIVERSITY OYE-EKITI, IKOLE EKITI CAMPUS.

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG) IN ELECTRICAL AND ELECTRONICS ENGINEERING.

FEBRUARY, 2019

DECLARATION OF ORIGINALITY

This project is all my own work and has not been copied in part or in whole from any other source except where duly acknowledged. As such, all use of previously published work (from books, journals, magazines, internet, etc) has been acknowledged within the main report to an entry in the References list.

I agree that an electronic copy or hardcopy of this report may be stored and used for the purposes of plagiarism prevention and detection. I understand that cheating and plagiarism constitute a breach of University Regulations and will be dealt with accordingly.

Copyright

Signed: Date:

Office Stamp

CERTIFICATION

This is to certify that this project titled, by ADEBAYO ADESOLA EMANUEL meets the minimum requirements governing the award of Bachelor Degree in Electrical and Electronics Engineering of Federal University Oye-Ekiti, Nigeria.

_____ _____

Engr. K.O OLUSUYI DATE

Project Supervisor

_____ _____

Dr (Engr.) J.Y ORICHA DATE

Head of Department

_____ _____

External Supervisor DATE

ACKNOWLEGDEMENT

All glory, adoration, and glorification is to almighty God for sparing my life throughout this academic institution. I greatly acknowledge the help of all the staff (Academic, Technologist, and non -Academics) in the department of Electrical and Electronics Engineering for their great impact in my life. My sincere gratitude goes to my Supervisor Engr.K.O Olusuyi for his advice, guidance and unflinching support throughout the duration of this project work. And also to a great lecturer, father, and mentor Mr Sanni who has greatly supported the success of this project work.

DEDICATION

This project is dedicated to Almighty God who has spared my life throughout my stay in the university, and also to my lovely parent (Mr Jide Adebayo and Mrs Christiana Adebayo) who have helped me so greatly towards my academic pursuit.

ABSTRACT

The design and construction of a 50HZ, 240V 1kVA inverter is primarily based on an inverter circuit which inverts the D.C. source voltage from a battery, AC voltage for AC powered appliances. The overall operation of this system comprises inter connections of many sub-circuits to give optimum performances. The sub circuit include; the oscillator circuit, PWM circuit, driver circuit, low battery/overload shutdown circuit, charging control/soft charging circuit, surge protection circuit, changeover/power supply circuit, and the output circuit . The focus is on designing an inexpensive, noiseless, no weather (environmental) pollution and efficient inverter that give a modified sine wave at the output. The project can as well be used to train students.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF PROJECT

Solar technologies are characterized as either passive or active depending on the way the energy captured converts & distributed. Active solar techniques use photovoltaic panel which was used. Electrical power supply from renewable sources is advantageous as the increasing electrical demand is a scientific contribution to the peak demand on the grid. As individuals and companies generate their power through renewable energy, the stress on the grid is reduced. The solar resource is so massive that it dwarfs every other resource on the planet. The DC electricity from the panels passes through DC distribution network to an inverter, which converts the DC electricity into AC for Single phase operation by using state of the art technology with MOSFET methodology and fed through A/C distribution system linked to the consumer load.

Most of the electrical appliances operate with an AC power supply of 220V and at 50Hz frequency. But in case of power failure, AC power cannot be stored due to repetitive change in polarity of electric current. The batteries can be charged through a solar panel using a charge controller and AC power supply from the utility which makes it hybrid powered.

An inverter is designed and obtainable in order to provide an AC output from a DC source. The AC could be at any required voltage and frequency with the use of appropriate transformers, switching and control circuits. It maintains a continuous supply of electric power to connected equipment or load by supplying power from a separate source, like battery, when utility power is not available. It is inserted between the source of power and the load is protecting.

1.2 MOTIVATION

With the vast amount of renewable energy in Nigeria, Electric power generation should not be a major concern in the country. It has been confirmed that Nigeria receives 5.08×10^{12} kWh of energy per day from the sun and if solar energy appliances with just 5% efficiency are used to

cover only 1% of the country's surface area then 2.54 x 10^6 MWh of electrical energy can be obtained from solar energy. This amount of electrical energy is equivalent to 4.66 million barrels of oil per day (Sambo 2005).With the abundance of solar energy, the current state of exploitation and utilization of the inexhaustible energy resources in the country.

According to UNESCO, there is a link between education and electricity. Most of the activities been carried out involves the use of electrical power supply ranging from teaching, research, experimental test. Diesel and petrol generator requires steady maintenance due to its moving part compare to other source of energy.

1.3 SIGNIFICANCE OF THE PROJECT

Power inverter has become a major power source due to its environmental and economic benefits and proven reliability using battery backup. Since the solar power system does not have moving parts, virtually it does not require any kind of maintenance once installed. The whole energy conversion process is environmentally friendly. It produces no noise, harmful emissions or polluting gases. The burning of natural resources for energy can create smoke, cause acid rain and pollute water and air. Carbon dioxide, CO2, a leading greenhouse gas, is also produced in the case of burning fuels. Power inverter uses only the power of the battery as its fuel. It creates no harmful by-product and contributes actively to the reduction of global warming. The hybrid solar inverter produce 230vac output by connecting the device to12vdc battery and any other electrical energy sources thereby making it more versatile compared to other forms to produce 230vac as the required output. Solar energy utilization can help countries meet their sustainable development goals through provision of access to clean, secure, reliable and affordable energy to expand electricity access and promote development.

1.4 STATEMENT OF PROBLEM

Shortage of electrical power supply in the country has resulted to the purchase of fuel generator for domestic and industrial use.]The burning of fuel for generation of electrical energy discharge

harmful gas which are not eco-friendly. The fuel generator require constant maintenance and purchasing of fuel

1.5 AIM AND OBJECTIVES

The aim of this project is to design and construct a 1.5kVA hybrid modular inverter trainer kit which can be powered from solar energy with a backup battery to produce an output of 230vac
The following are the main objectives of this project

1. The objective of this project is to solve the problem of erratic power supply usually encounter in the departmental laboratory which at times usually cause delay in carrying out test on practical work done during practical classes.
2. Harness energy which does not pose any threat to human health
3. Construction of a reliable, available and cost effective alternate source of energy
4. This project will also be packaged in modules which can serve as a training kit for students and for consultation.

1.6 SCOPE OF THE PROJECT

The scope of this project is typically based on the specific objectives which are checking the problem of the unstable power supply in the laboratory, purchasing a solar panel and battery, studying the major electronic component to be used in the inverter circuit, coupling the inverter, testing it with the batteries and fully installing.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

An inverter is a device that converts the DC sources to AC sources. The purpose of a DC/AC power inverter is typically to take DC power supplied by a battery, such as a 12 volt car battery, and transform it into a 240 volt AC power source operating at 50 Hz, emulating the power available at an ordinary household electrical outlet. Inverters are used in applications such as adjustable-speed ac motor drivers, uninterruptible power supplies (UPS) and ac appliances run from an automobile battery.

At the early stage, sun was the source of energy for generating power. Due to the inadequacy of the power generated through this source, there was a need to find other ways to improve the power supply when the generating station could not meet the demand of the people. As the technology advances, the hydroelectric generation was developed, gas firing generating station, and wired tubing methods of generating power supply were developed. In spite of all these developments, there was still failure in electrical power generation as a result of obsolete equipment at the generating stations. There was still need to find alternative for solving the problem. As a result of this, some options like alternators, inverters and others were developed. The electrical inverter is a high power electronic oscillator.

The inverter basically involves a signal generating stage with desired signal waveform and frequency of 50HZ (in Nigeria). The signal is inverted to form two alternate waveforms (pulses) usually employed in push pull fashion. Transistor or MOSFETs then drives current (i.e. D.C source) through the step up transformer. The current is driven through the transformer alternately by the two stages of MOSFETs; emf is generated at the output of the Step-up transformer. This inverted alternate pulses then allows to drive two sets of power devices either transistor in ladder network (depending on power aiming at) or power MOSFET.

2.2 TYPES OF INVERTER

Inverter is broadly divided into three types but the first two types are mostly available in the market today. The three types are listed below, which are:

- Modified sine wave inverter

- Pure sine wave inverter
- Square wave inverter

2.2.1 MODIFIED SINE WAVE INVERTER

A modified sine wave is similar to a square wave but instead has a "stepping" look to it that relates more in shape to a sine wave. The waveform is easy to produce because it is just the product of switching between three values at set frequencies, thereby leaving out the more complicated circuitry needed for a pure sine wave hence provides a cheap and easy solution to powering devices that need AC power. However it does have some drawbacks as not all devices work properly on a modified sine wave, products such as computers and medical equipment are not resistant to the distortion of the signal and must be run off of a pure sine wave power source. Modified sine wave inverters approximate a sine wave and have low harmonics that do not cause problem with household equipment's. The main disadvantage of the modified sine wave inverter is that peak voltage varies with the battery voltage.

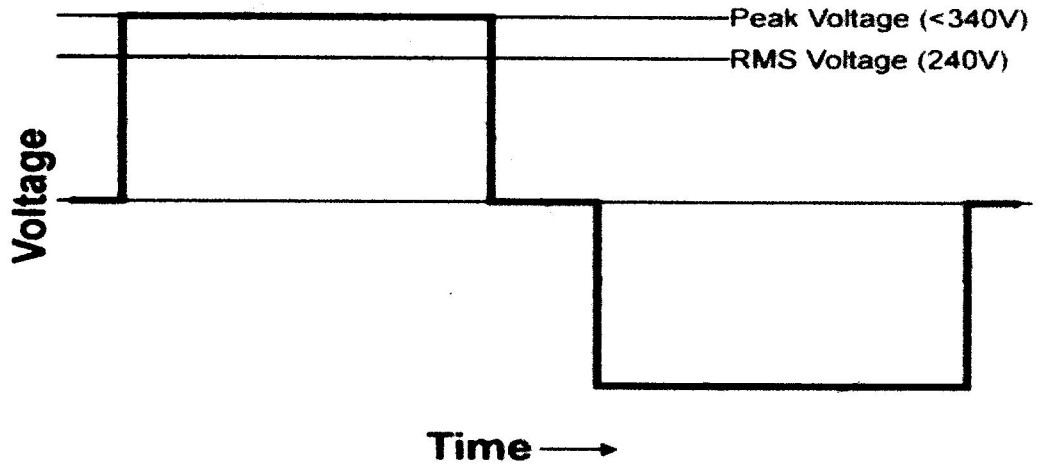


Fig.2.1: modified sine wave

2.2.2 PURE SINE WAVE INVERTER

Pure sine wave inverter represents the latest inverter technology. The waveform produced by these inverters is same as or better than the power delivered by the utility. Usually sine wave inverters are more expensive than the modified sine wave inverters due to their added circuitry. There are two methods in which the low voltage DC power is inverted to AC power;

- The low voltage DC power is first boosted to high voltage power source using a DC-DC booster then converted to AC power using pulse width modulation.
- The low voltage DC power is first converted to AC power using pulse width modulation then boosted to high AC voltage using a boost transformer.

The second method is used in modern inverters extensively because of its ability to produce a constant output voltage compared to the first method that require additional circuit to boost the voltage.

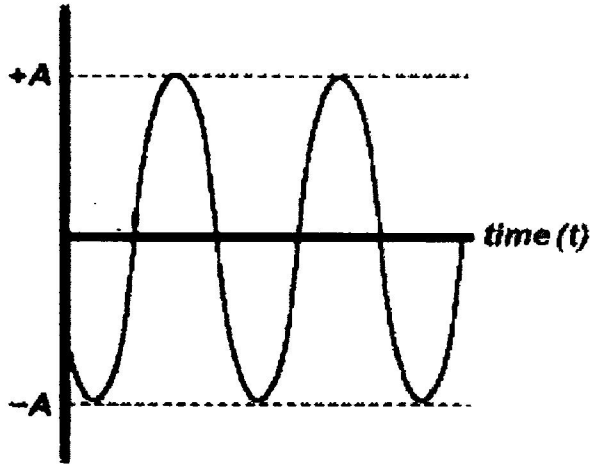


Fig.2.2: sine wave

2.2.3 SQUARE WAVE INVERTER

A square wave inverter is a type of electrical inverter that produces a square wave output; it consists of a DC source and power semiconductor switches that can carry a large current and withstand a high voltage rating. The switches are turned on and off in correct sequence, at a certain frequency. The square wave inverter is the simplest and the least expensive type of inverter, but it produces the lowest quality of power. The square wave will not be appropriate for some load because of large harmonics content which cause interference, it find its application in motors.

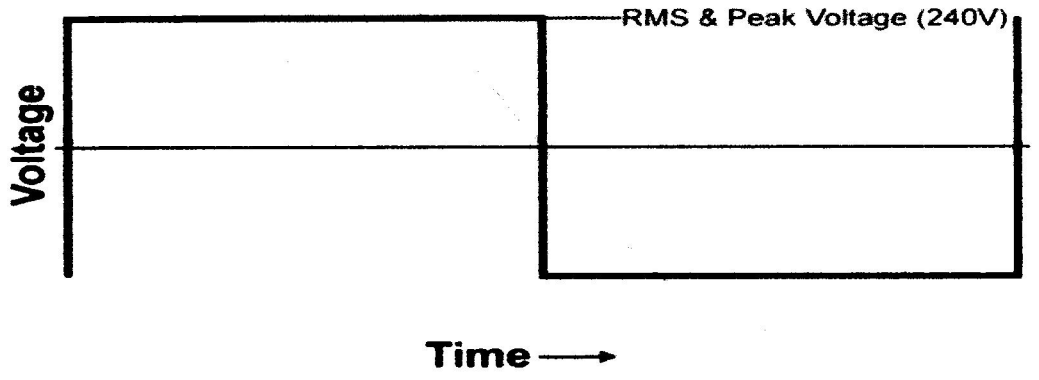


Fig.2.3: square wave

2.3 REVIEW OF THE RELATED WORKS

Babarinde, O. O. worked on the design he design and construction of a 50HZ, 240V 1kVA inverter which is primarily based on an inverter circuit which inverts the D.C. source voltage from a battery, AC voltage for AC powered appliances. The overall operation of this system comprises inter connections of many sub-circuits to give optimum performances. The sub circuit include; the oscillator circuit, PWM circuit, driver circuit, low battery/overload shutdown circuit, charging control/soft charging circuit, surge protection circuit, changeover/power supply circuit, and the output circuit (MOSFET and transformer section). This project incorporates monitoring circuit that employs visual display components such as light-emitting diodes and voltmeter to communicate the state of the system to the user.

Mburu, m.b (2014)., worked on the design of a microcontroller based pure sine wave inverter using Pulse Width Modulation (PWM) switching scheme to supply AC utilities with emergency power. It involves generating of unipolar modulating signals from a Programmable Interface Computer (PIC16F887A) and using them to modulate a 12V dc MOSFET based full H-Bridge. The focus is on designing an inexpensive, versatile and efficient pure sine wave inverter that gives a 240V, 600W pure sine wave output.

Purification, P. (2010)., worked on the power generated from the renewable sources, like solar energy, that produces a DC power which can be stored in batteries. This DC power was

converted to AC power as most of the appliances used in our daily life are dependent on AC power. To overcome this obstacle, DC-AC Inverter took birth.

Fashina Olugbenga E. and et al. (2017)., worked on the production of photovoltaic system in which solar cell or module is used to power an inverter, which serves as a means of empowering our youth for nation's socio-economic development through alternative power generation. The system consists of solar modules, solar charge controller, 12V.d.c battery and an inverter (0.5 HP). Solar modules serve as source of charger through solar charge controller to the battery and inverter are used in converting the direct current into an alternating current for the domestic appliance. Self-charging inverter is more economical, noiseless, emission free, portable, rugged and uninterrupted alternate source of electricity which requires less maintenance and no fossil fuel. The estimated energy cost is comparable and competitive with the other inverters and renewable energy sources for both commercial power companies and technology suppliers. The 2KVA inverter with the alternator was able to power a table top refrigerator, Air-conditioning system, plasma TV, and ten 60watts bulbs for 7 hours continuously, before recharged.

Sayat Moldakhmetov and et al (2016)., proposed one of the methods for multilevel power inverter implementation with capacity up to 30 kW. The method was based on a special topology for construction of multilevel inverter consisting of H-bridge and level switch. In accordance with the proposed topology H-bridge inverts voltage and a switch enables to get any number of voltage levels. In addition, the characteristic feature of this inverter is the use of converters as sources where multilevel voltage is generated. This allows reducing a number of accumulator batteries being used, decrease the dependence of the form of the inverter output voltage from the accumulators charging rate, as well as the dimensions of the whole unit. 17-level inverter was been developed following the proposed topology and methodology.

Neelashetty Kashappal, Ramesh Reddy K (2012)., worked on the implementation of a new low cost five level inverter which converts the 9V DC to 9V AC. Complexity and cost of the system are reduced as compared to other configurations by using only five switches, eight diodes and two capacitors. In the proposed scheme, control circuit was designed using 89C51 microcontroller to produce sinusoidal pulse width modulation (SPWM). The developed system

can be operated at very high modulation frequencies of up to 200kHz producing sustained output. This single-phase five level low cost inverter is developed and tested in power electronics laboratory. The waveforms are recorded and analyzed using Digital Storage Oscilloscope TDS2024B. The proposed scheme is very economic and less complex and the experimental results shows that it has low total harmonic distortion.

Olusegun O. Omitola and et al. (2014)., purposed on the design and construct of a 1000Watts (1KW), 220Volts Inverter at a frequency of 50Hz. The device was constructed with locally sourced components and materials of regulated standards. The basic principle of its operation is a simple conversion of 12V DC from a battery using integrated circuits and semiconductors at a frequency of 50Hz, to a 220V AC across the windings of a transformer. An additional power supply to the public power supply with the same power output is thus provided at an affordable price.

Ankit Kamani, Jaideep Satapara. (2018)., experimented on the simulation and generation of Modified Sine Wave from 12V Battery of 7Ah capacity. The whole circuit was divided into two parts i.e., Gate Driver Circuit and Inverter Circuit. The Gate Driver Circuit is obtained using two methods. First method deals with the use of IC 555 Timer and IC CD4017 which provides gate pulses to the Inverter Circuit. Second method deals with the use of Arduino UNO as a gate pulse generator which is provided to the Inverter Circuit. Using any of the two methods, output of 230V, 50Hz, 500W can be obtained from the secondary of the center tapped transformer.

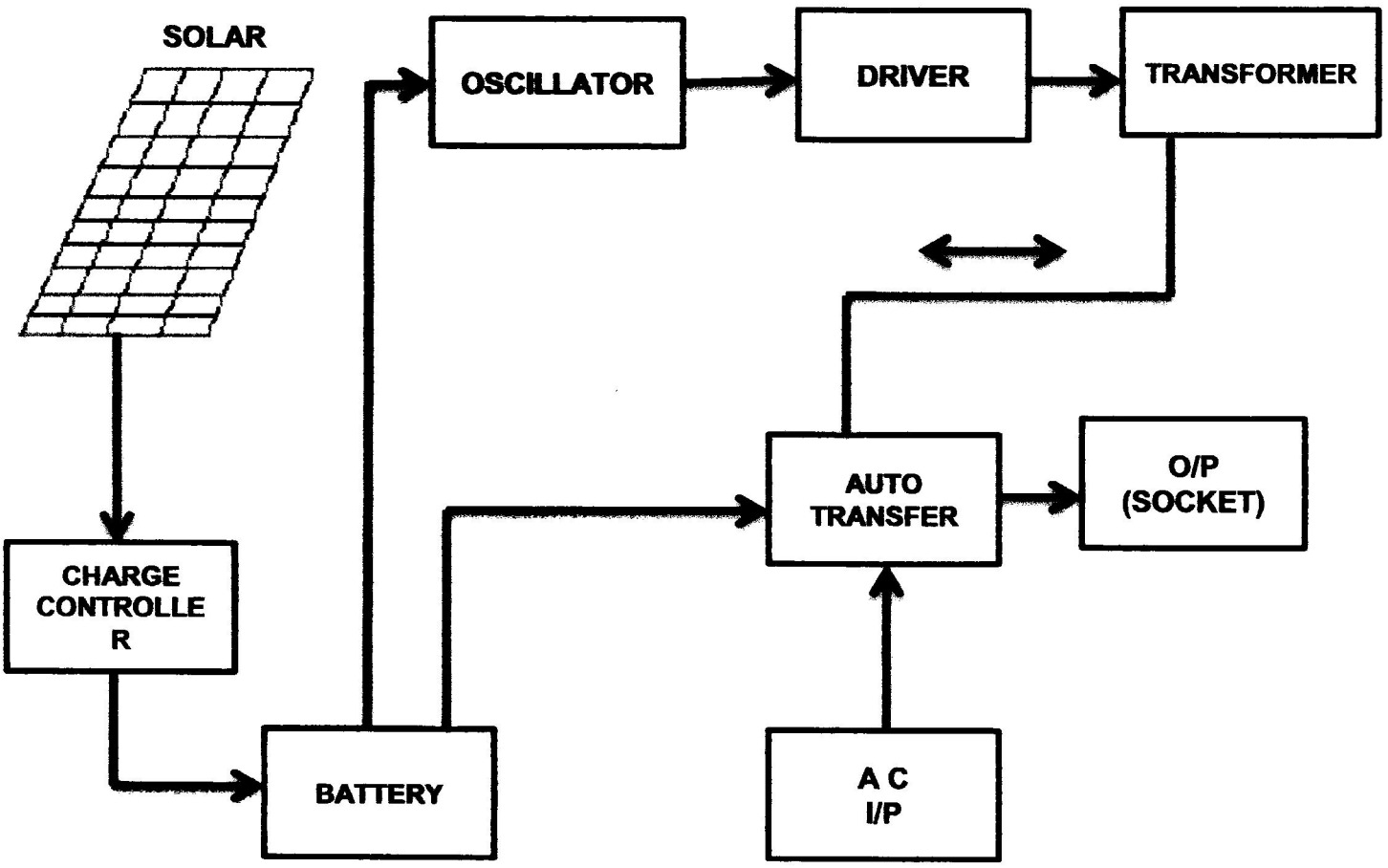
Oluwakemi, F. O. (2016)., purposed on the design and construct of a 1600W (2kVA), 220V inverter at a frequency of 50Hz. The device was constructed with locally sourced materials of regulated standards. The basic principle of its operation is a simple conversion of 12V Direct Current (DC) from a battery using semiconductors at a frequency of 50Hz, to a 220V Alternating Current (AC) across the windings of a transformer. An additional power supply to the public power supply having the same power output was thus provided at an affordable price. The project was based on the design of 2kVA (1.6 kW) inverter system and incorporate the use of switching scheme automatic voltage regulator. The inverter was set to shut-down if the threshold voltage of 11.5V (Min.) is reached and more 13.5V (Max.) during the charging. The switch

mode of a modified wave-switching scheme uses an Astable Multivibrator to switch on the semiconductor switches-Metal Oxide Semiconductor Field Effect Transistor (MOSFET).

CHAPTER THREE

3.1 METHODOLOGY

The availability and stability of electrical energy is necessary for academic activities. In the event of power failure from public utility, there is need for alternative sources of electricity supply. Hybrid inverter supply steady power supply with the use of battery backup which can be charged through a solar panel using a charge controller and AC power supply from the utility. Hybrid Inverters could be used to power appliances and machines in homes, offices. The hybrid inverter makes use of solar energy or electrical power supply from utilities at a more reduced operating cost compare to electric generator.

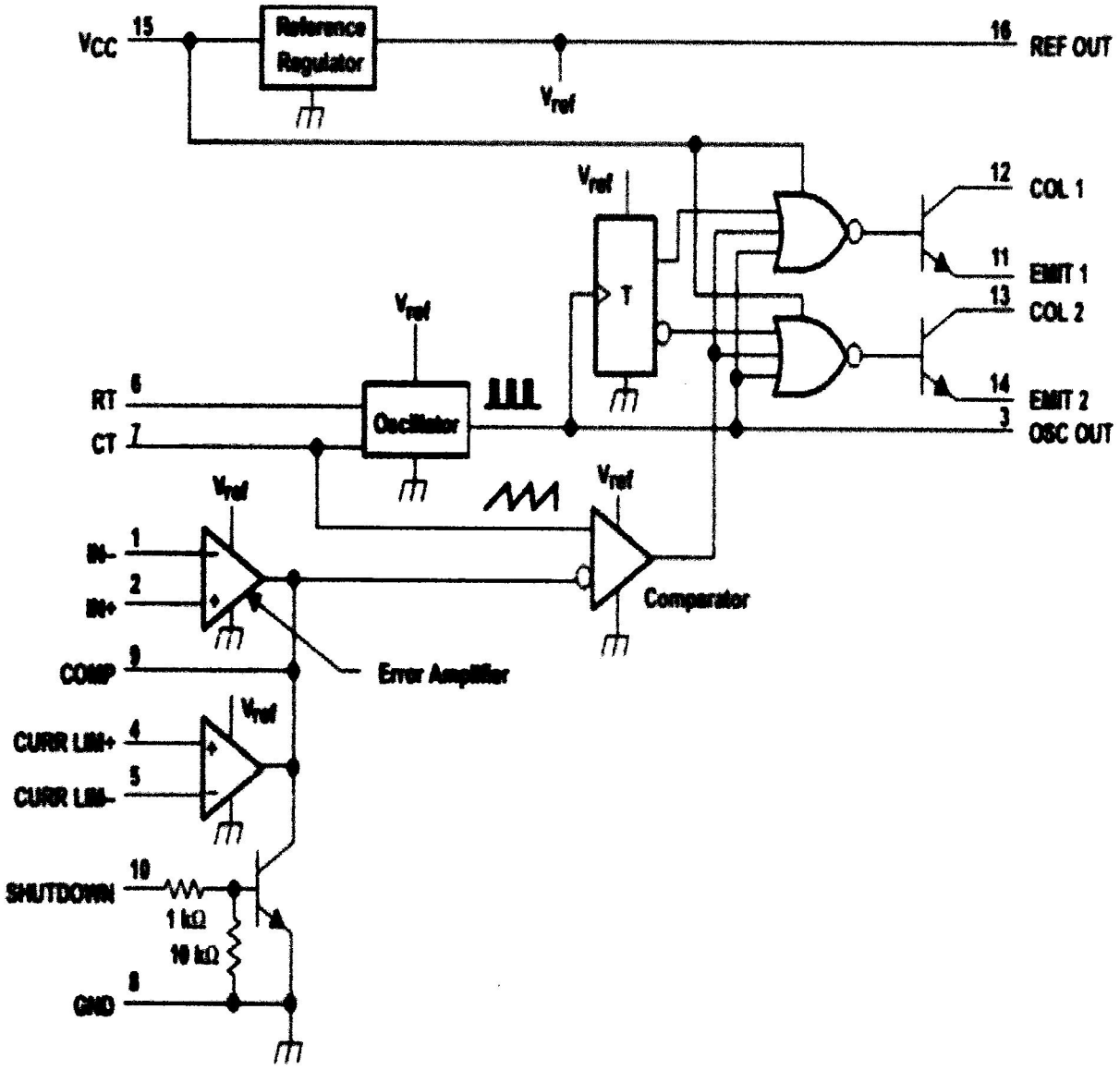


The figure below shows a complete block diagram of a hybrid inverter.

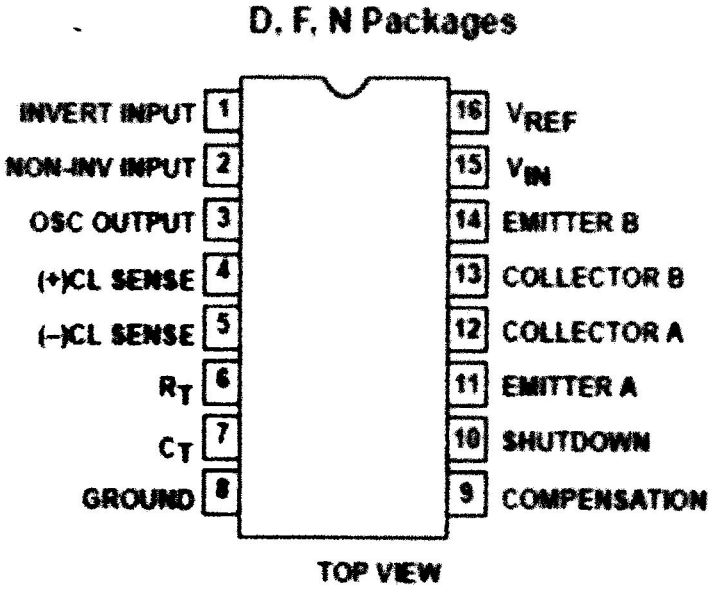
Under this section, details of oscillator design and construction of the project is discussed.

3.1 THEORY OF OPERATION OF AN OSCILLATOR

Sg3524 consist of error amplifier which share the same terminal with current limiting circuitry and short down circuitry at the comparator input, this common terminal is called the compensation pin, and this pin can be used to either control the gain of the error amplifier or to compensate the error amplifier. It can also be used to provide additional control to the regulator. The frequency of the Sg3524 is determined by the timing resistor (Rt) and the timing capacitor (Ct) and this establish a constant charging current for the timing capacitor (Ct) leading to a linear voltage ramp at (Ct) which is fed to the comparator input and a linear control of the output pulse width produced by the error amplifier. External ladder network divides the internal reference voltage to provide a reference within the common mode range of the error amp and the output error signals is amplified; this amplified error signal voltage is compared to the linear voltage ramp at the timing capacitor (Ct) by the comparator. Oscillator output pulse (also known as blank pulse) ensure that both output are never ON simultaneously during the transition time, the duration of the pulse (blank pulse) is controlled by the value of the timing capacitor (Ct). The resulting modulated pulse from the output of the high gain comparator is steered to appropriate output pass transistor by a pulse steering flip flop which is synchronously toggled by the oscillator output. The image of the internal circuit configuration of Sg3524 is shown below



Showing Internal Circuit Configuration of SG3524 datasheet



SG3524 pin configuration

The push-pull transformer coupled circuit configuration is used in the circuit diagram given above with little modification with respect to the datasheet. Modification in pin 6 and pin 7 is done to calculate the frequency. Modification in pin 11, 12, 13 and 14 is done in order to reduce cost. Modification in pin 10 is done to compensate the push pull transformer coupled circuit diagram. Modification in pin 1 is done in order to vary the error amplifier inverting input voltage.

soldering process


OSC

CHAPTER FOUR

TESTING, ANALYSIS OF RESULTS AND DISCUSSION

4.1 TESTING

After carrying out all the paper design and analysis, this project was implemented and tested to ensure it's working ability, and was finally constructed to meet desired specifications. Stage by stage testing was done according to the block representation.

The process of testing and implementation involved the use of some test and measuring equipment which are listed below:

1) Digital Oscilloscope: The digital oscilloscope as shown in Fig. 4.1 below was used to visualize and analyze the output waveform

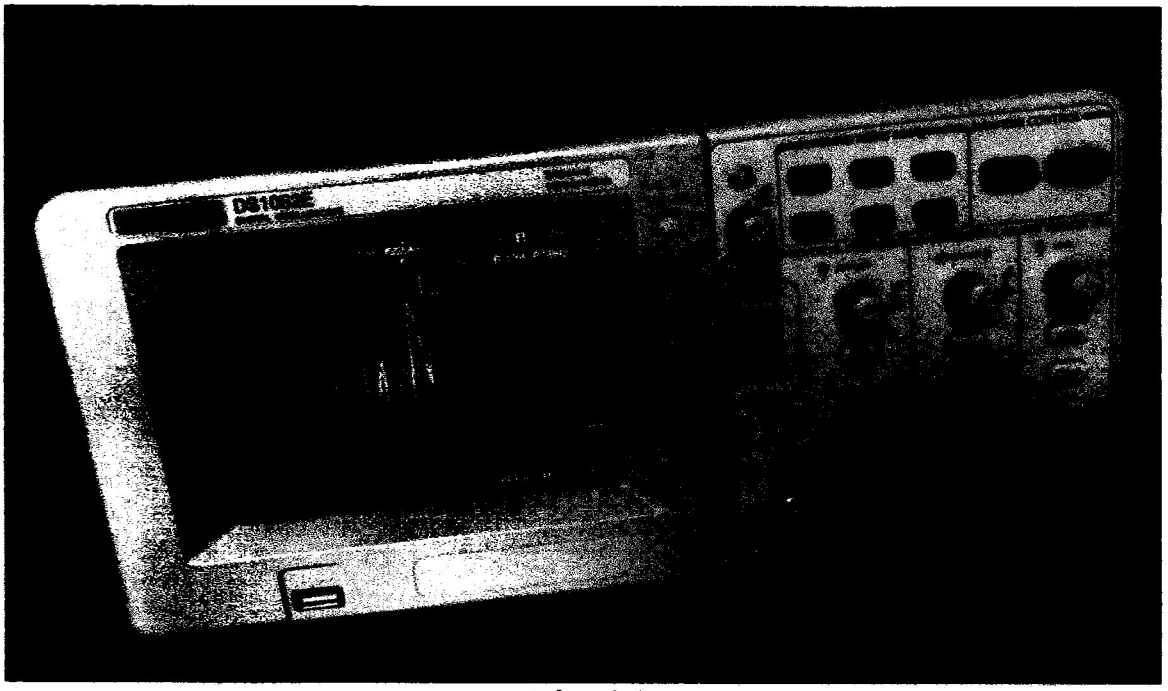


Fig. 4.1

2) Digital Multimeter: The digital multimeter was used to measure the output voltage and current

3) Clamp meter: the clamp meter was used to measure the current of the battery

4.2 RELIABILITY TEST

When tested with various loads such as resistive loads and inductive loads such as electric hand drilling machine, 200watts filament bulb, the inverter worked perfectly.

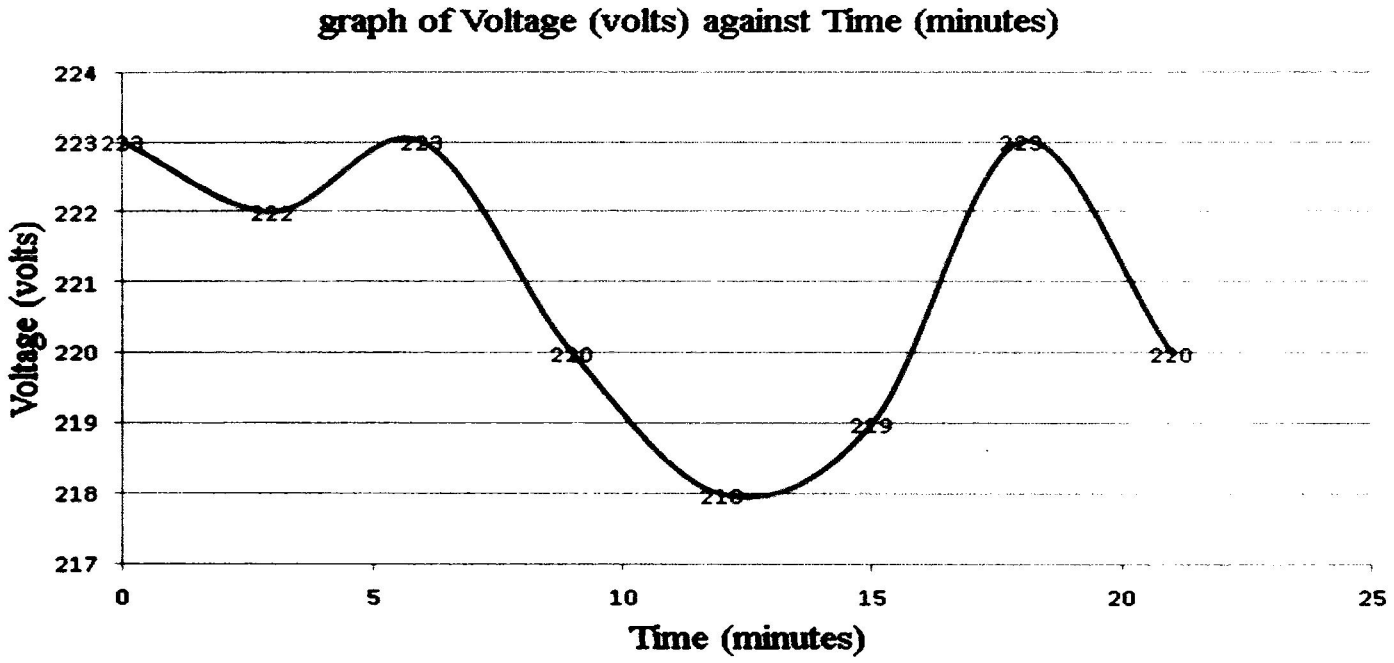
4.3 STABILITY ANALYSIS

This was done by examining the inverter system for a period of 21 minutes under no load condition and load condition.

Stability test under no load

Time (min)	Voltage (V)
0	214
3	214
6	214
9	214
12	214
15	213
18	213
21	213

The Graph of voltage (v) against time (min)



stability test

From Figure 4.1, it was discovered that the output voltage is still within the range of the expected output voltage (±5%).

4.4 LOAD ANALYSIS

The inverter was loaded up to 900W by a mixture of three 200W and three 100W tungsten filament bulbs and the inverter still worked perfectly.

Load analysis

Load (watts)	Current (ampere)
100	0.31
200	0.49
300	0.78
400	0.93
500	1.19
600	1.42
700	1.55

800	1.75
900	1.94

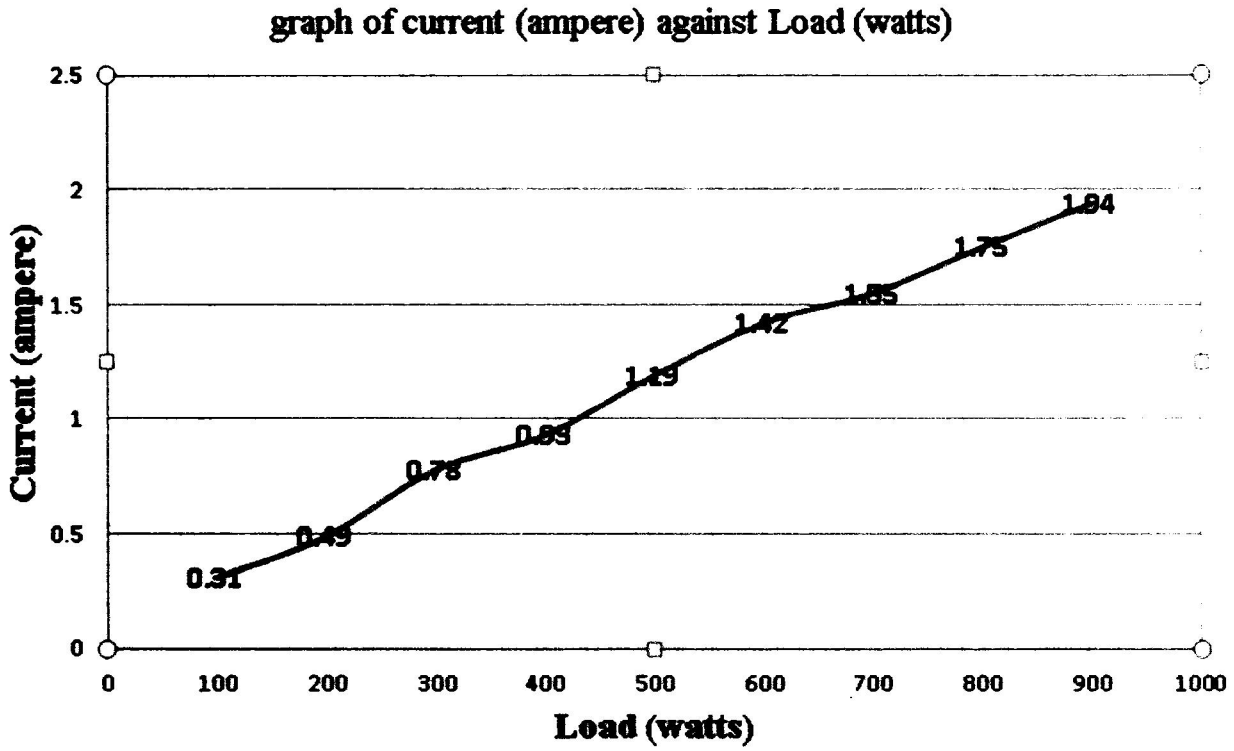


Fig. 4.2: Load analysis

From Figure 4.2 above, it is discovered that the current drawn for the inverter system is directly proportional to the load drawing the current which follows that it obeys the equation 1:

$P=IV$ ..... (1)

When Voltage is constant, as P increases, I increases. Where P is the power, V is the Voltage and I is the Current

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

The purpose of supplying electricity is to meet the variable and instantaneous demand for electricity by wide and variety consumers at the most economic cost, and to satisfy consumers by a good standard reliability and quality typical in terms of voltage and frequency.. Hence, the need for new and alternative schemes in supplying power. The construction of this 1500Watts (1kVA), 220Volts inverter at a 50Hz frequency was a gradual process from gathering of materials to testing of components.

5.2 CONCLUSION

This project has successfully achieved its objective. We have come up with a solution of erratic power supply in the school laboratories which is easy to implement, cost efficient and reliable.

The hybrid inverter circuit takes the DC power stored in the battery and successfully converts it into 220V/50Hz AC supply. We plan to extend this work as mentioned in future work and present a better solution for more sensitive device.

5.3 RECOMMENDATION

Solar panel with inverter would be recommended since it is a noiseless electric power generator. It does not require burning of fossil fuel and it is environment friendly. The solar power system was a convenient way of producing an alternative means of power supply to supplement the main s failure. It is advantageous to user who could afford its initial cost of installation. This project is recommended for expansion if the need arise. There would be need to add up more batteries to meet up with the running time and the system load capacity since the system had an adjusted wattage, more load could be added only with addition of more batteries to meet up with the capacity.

REFERENCE

[1] Miraj H, Junaid M, Mirza Q*, Syed M , Salman A Design & Implementation of Single Phase Pure Sine Wave Inverter Using Multivibrator IC

[2] Babarinde, O. O., Adeleke, B. S., Adeyeye, A. H., Ogundeji, O. A., and Ganiyu A. L. (2014). Design and Construction of 1kVA Inverter. International Journal of Emerging Engineering Research and Technology, Volume 2, Issue 3, PP 201-212

[3] Abatan O.A., Adewale A.O., Alabi A.A, " Constant Electricity Generation From Self-Charging Inverter," International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 12; pp 694-698, 2013.

[4] Coker, J.O and Ogunji, B.A, "Design and construction of an inverter using solar cell as a source of charger," Journal of Applied and Natural Science. 5(1) pp 30-36, 2013.

[5] Sambo A.S , "Renewable Energy Resources in Nigeria .Energy Issues in Nigeria, Today and Tomorrow (Sariki, O.A and Adegbulugbe A.O (Ed)" pp 36-62, Gispar Press.

[6] Olusegun, O. (2014). "Design and construction of (1000VA) Power Inverter" published journal, Afe Babalola Ado- Ekiti

[7] Shue, A. L and Alade, O.M, (2015). "Design, construction and performance evaluation of 1kVA pure sine wave power inverter" Published journal, Ladoke Akintola University of Technology.

[8] Abolarinwa, J., Gana P. "Design and Development of Inverter with AVR Using Switch Mode Square Wave Switching Scheme" PP 249-257.2010.

[9] Ganiyu, S. (2004). Design and Construction of a 1KVA Power Inverter, Unpublished B.Tech Thesis, LAUTECH, Ogbomoso.

[10] International rectifiers IRFP260N MOSFET datasheet.

[11] Theraja, B.L and Theraja, A.K (2003). A Textbook of Electrical Technology. New Delhi: S. Chand & Company Ltd. (pp 1029 – 1030, 1964 – 1966, 2145 -2147).

[12] Gupta, J.B (2008). A Course in Power Systems. New Delhi: S.K Kataria and Sons. (pp 1 –6)

[13] Usifo, O. (2002) Fundamentals of Electro–mechanical Devices and Machines. Fredorus Ltd

[14] Ankit Kamani, Jaideep Satapara. (2018). Study of Modified Sine Wave Inverter. International Research Journal of Engineering and Technology, Volume: 05, 72.

[15] Fashina Olugbenga E., Olayiwola Samuel O., Sadiq Mutiu O., Busari Abimbola A. (2017). Electrical Power Generation from Inverter for Domestic Usage in Nigeria: A Means of Youth Empowerment. Journal of Scientific and Engineering Research, Volume 4, No 5, 16-24.

APPENDICES

Appendix I

CIRCUIT DIAGRAM OF THE PROECT

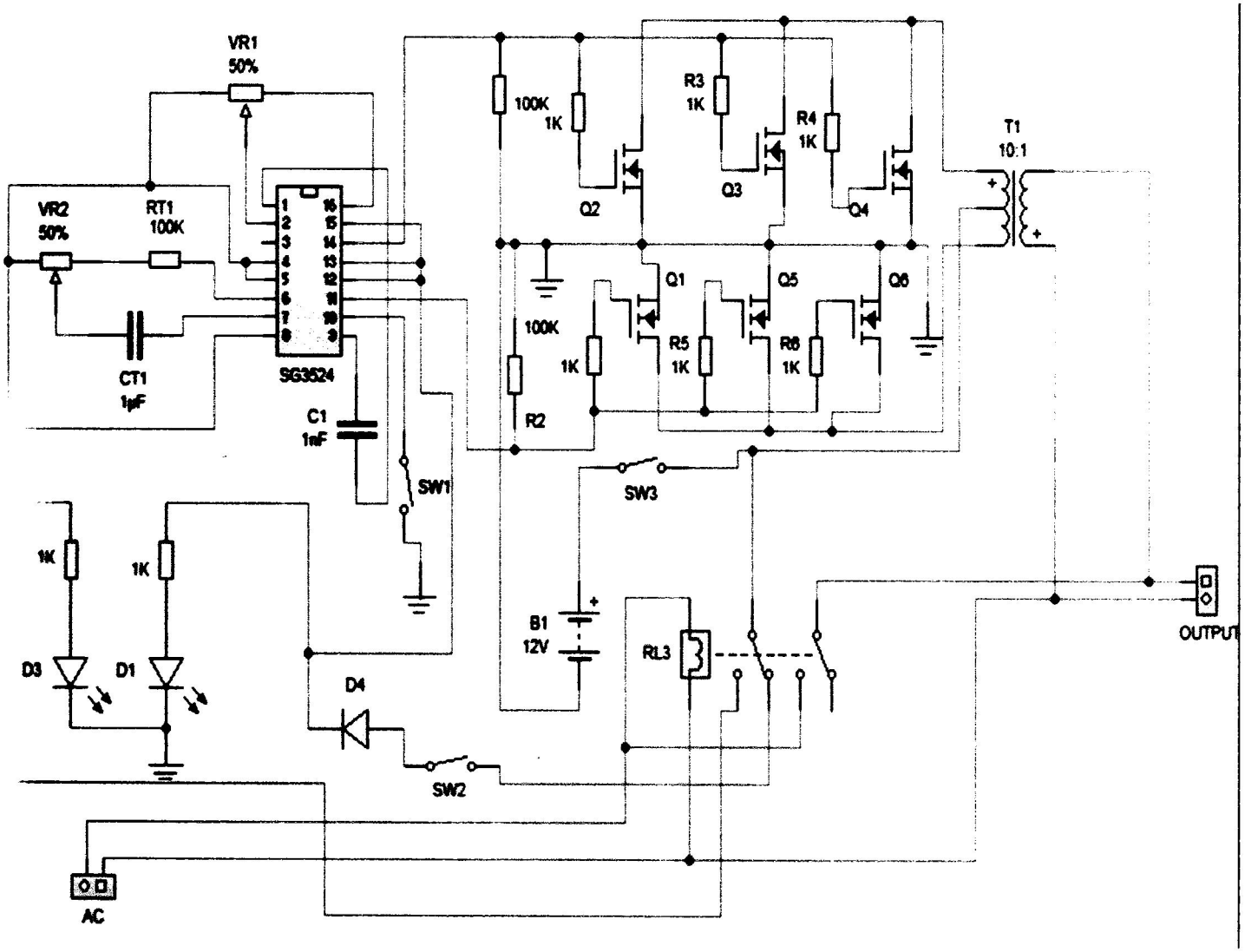
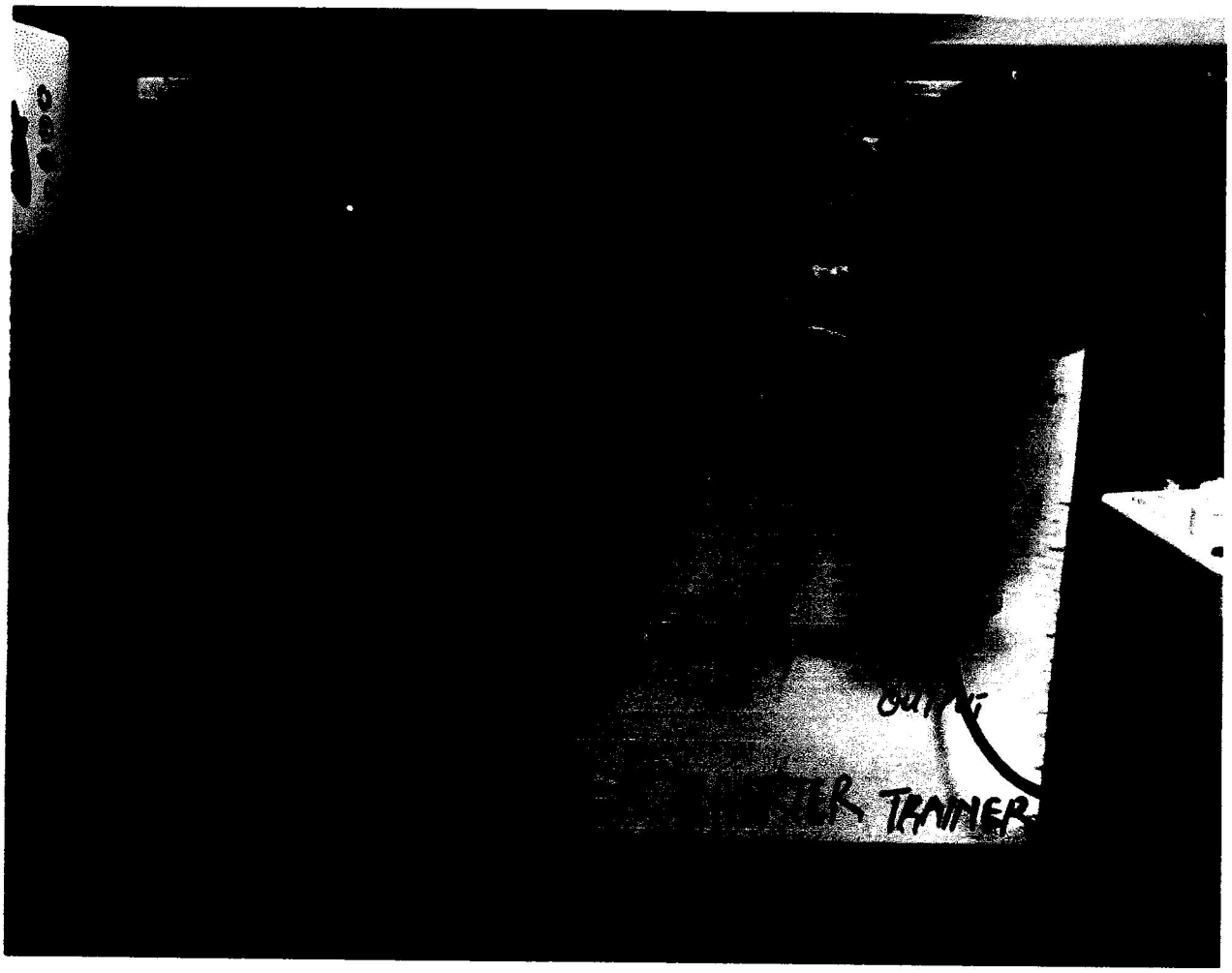


IMAGE OF THE PROJECT UNDER TESTING



Appendix III

BILL OF ENGINEERING MATERIAL AND EVALUATION

S/N	COMPONENT	COMPONENT DESCRIPTION	QUANTITY	UNIT AMOUNT (₦)	TOTAL AMOUNT (₦)
1	RESISTOR (OHMS)	1K	6	10.00	60.00
		100K	3	10.00	30.00
		50K (VARIABLE)	2	10.00	20.00
2	CAPACITOR(F)	1u	1	10.00	10.00

		1n	1	10.00	10.00
3	IC	SG3524	1	250.00	250.00
4	SOCKET	IC SOCKET	1	50.00	50.00
5	MOSFET	IRFP260N	6	500	3000
6	DIODE	LED	2	20.00	40.00
		IN4001	2	20.00	40.00
7	SWITCH	SPST	1	50.00	50.00
8	FAN		1	250.00	250.00
9	AC RELAY	DPCO	1	2500.0	2500.0
10	METER	DIGITAL AC METER	1	1500.0	1500.0
11	CABLE CLIP		16	5.00	80.00
12	CABLE LUG		2	20.00	40.00
13	TRANSFORMER	CENTER TAP	1	20,000	20,000
14	BOARD	PCB	1	250.00	250.00
15	CHARGE CONTROLLER		1	12,000	12,000
16	OUTLET	TWIN SOCKET	1	250.00	250.00
17	SOLAR PANEL	150 WATTS	1	3,5000	3,5000
18	CONNECTOR	TWO WAYS	1	30.00	30.00
19	BATTERY	12V, 100AH	1	3,5000	3,5000
	GRAND TOTAL				# 110460