DESIGN AND CONSTRUCTION OF 500VA UN-INTERRUPTED POWER SUPPLY SYSTEM

PRESENTED BY:

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CERTIFICATION

This is to certify that my partner and I [Alexander Ofomata 98/7130EE] had successfully completed the project on design and construction of a 500VA UPS for the award of Bachelor of Engineering Degree, Department of Electrical and Computer Engineering, Federal University of Technology, Minna, Niger State, Nigeria.

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EXTERNAL MODERATOR

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DECLARATION

I hereby declare that this thesis is my original work and has never presented elsewhere for the award of any degree.

Information derived or published and unpublished work of others has been acknowledged in this text.

ALEXANDER OFOMATA	[signature]	24-11-04
STUDENT'S NAME	SIGNATURE	DATE

ACKNOWLEDGEMENT

Some years ago, a journey was embarked upon. By the special grace of God we have finally come to an end. Although, the journey was characterised by uneasiness along side; some injuries and bruises. However, the over the joy of a dream come true have been able to sweep this bitter days behind us.

As the saying goes, "No cross no crown" and also that "winners don't quit and quitters don't win". My topmost appreciation goes to God Almighty through His Son, Jesus Christ for his love and protection over me.

More so, I will also use this medium to extend my appreciation to my parents for their support, I never regret having them as parents.

My appreciation also goes to my project supervisor, Mr J. G. Kolo who has acted in the capacity of a father to me, his advice, care and co-ordination of the whole activity to ensure that this project comes out successfully and it's in this regard I regarded him as one of my heroes.

I wish to also recognise the supportive role of my friends and roommates Sabastine Onyekpe, Godfrey Anosike, Ogbonna, Christian Hill Ugwu, Kenny Obafaiye, Dan Ekpa Audu, Abubakar Daniya, and Musa C. Hassan.

ABSTRACT

The complete design procedure is illustrated by applying the derived analytical result to the practical design of an uninterrupted power supply (UPS).

The UPS system is designed in such a way that it utilises a 12volts D.C source accumulator battery cell to operate an inverter circuit whose frequency is set at 50Hz to operate an inverter circuit whose frequency is set at 50Hz to produce an alternating current.

However, the a.c circuit output from the inverter produces a square wave, which is further strengthened and fed into a 12/240volts transformer, which in turn stop up the voltage to the desired level of 240volts a.c.

In this light, a control circuit is incorporated to ensure the automation in changing from the public to that produced by the inversion of the direct current (d.c) into an a.c in the advent of power failure from the public supply and vice versa.

The control system set to operate a high speed for change over at an unnoticeable time. Monitoring circuit is employed in order to detect battery level and if low shuts down the system with time.

TABLE OF CONTENT

Shown below is the block diagram and flowchart of a typical ups system.

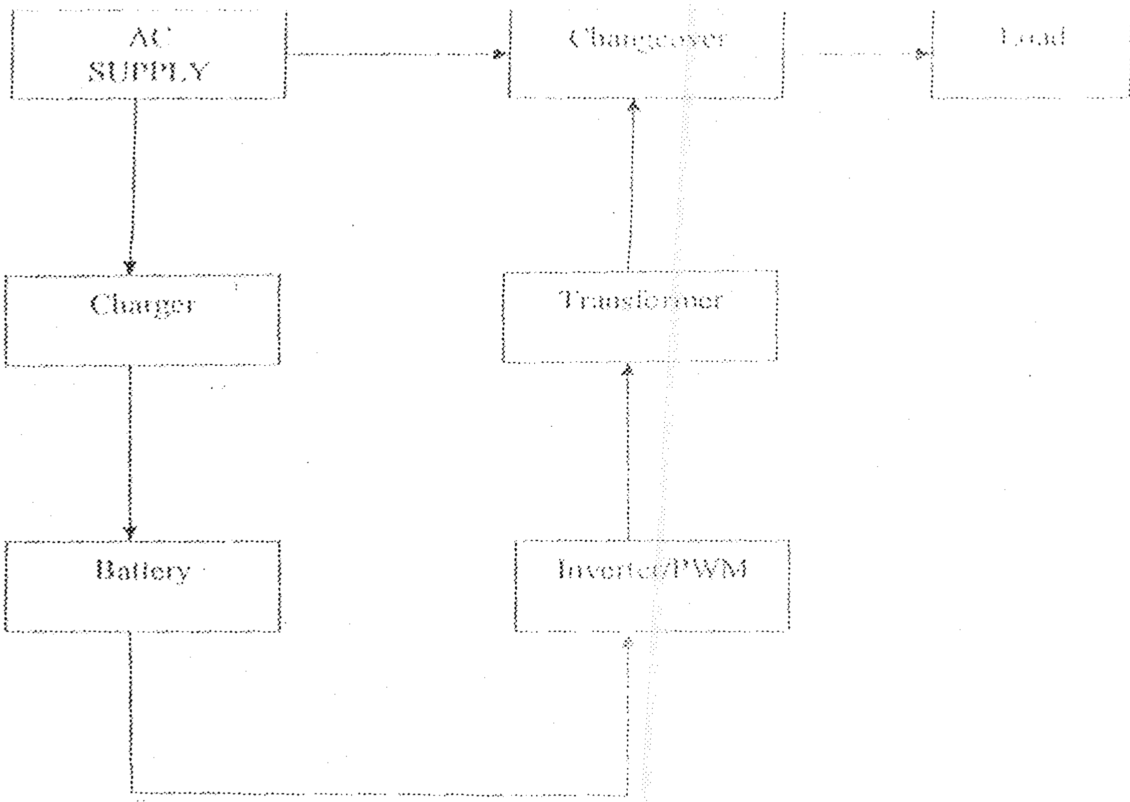


Fig. 1.1 Block diagram of an UPS

CHAPTER ONE

1.0 INTRODUCTION

In Nigeria today constant or regular failure of electricity is a common phenomenon. To this effect industrial and domestic consumers are said to be on the receiving end which has stood as a barrier between various business, organization and profit making which is basically for the economic growth of our country. Consumers are also faced with lot of difficulties along side schools, banks, hospitals, stores and so on. From this constant power failure syndrome.

To this effect an alternative source of electrical energy which is automatically applied to an electrical circuit in the case of failure of public supply of electricity by NEPA gave birth to the idea of an uninterrupted power supply (U.P.S).

This is noiseless and clean unlike generators which have high cost of running, maintenance and environmental pollution. U.P.S is an electronic device capable of generating alternating current (a.c) by it self when powered by a direct current (d.c) source of energy.

The general method is to have a storage battery which obtains sufficient charge from resource. Automatic return \to normal connection or return to power supply and automatic recharging of the battery are provided. We are in this project or U.P.S that provides a 500VA in the advent of power failure from NEPA. This system or device can be built as a small unit for easy movement, but a battery incorporated in the system is normally not handy

1.1BACKGROUND TO THE PROBLEM

The important of U.P.S could not be over emphasized because it is the life wire of a civilized country in terms of economy, social facilities etc. Some of the problem is highlighted bellow:

Increased death toll in the hospital and clinics due to power failure when ever surgical operation is taking place.

The stored information in the computer was lost immediately there is power failure.

Social amenities such as water supply could not be effective because of supply of electricity.

High running cost, regular service, maintenance and environmental pollution associated with running or use for fuel generator.

Many manufacturing companies have folded thereby causing the economy reduced job opportunities.

The sources of these problems include no other alternative means of power supply such as U.P.S.

1.2STATEMENT OF PROBLEM

This actually referred to the problem that brings about the design and construction of U.P.S.

the problem of inefficiency in the power supply system

The high cost of running generators, its maintenance and environmental pollution.

The reliability and maintainability of all the equipment in the generating, transmitting and distributing station is very low.

1.3OBJECTIVES OF THE PROJECT

To design an uninterrupted 0power supply, they will use the power stored in the charged battery as alternative source.

*to test the efficiency of the 500VA U.P.S

*To suggest ways of improving on the 500VA U.P.S

1.4 STANDBY SYSTEM

Load is fed from supply but when interrupted, battery output inverter (dc/ac) automatically switches to supply the load. When supply (NEPA) is cut off, it can only be seen as a drop less than 85% of nominal values. The standby system inverter need not be designed thermally to run continuously at full rating, and the rectifier is for battery charging.

CHAPTER TWO

2.0 LITERATURE REVIEW

Since the generating of electricity began, engineers and scientist have been exploring other way6s to meet up the demand for uninterrupted supply among the latest discovery is the U.P.S.

2.1INVERTER

The inverter is in synchronism with the supply, which means it runs continuously, this operation gives a faster and smooth change over from supply to battery and permit continuous fault sensing of the inverter during normal operation from the mains.

The inverter by virtue of its operation is simply defined as an electronic circuit which is used to convert a direct current (dc) into an alternating current (ac), they are mainly oscillators.

However, oscillators are classified under two categories which are characterized by their output wave form namely:

(i) A Sinusoidal Type Of Oscillator: This is concerned with the production of purely sine wave output

(ii) Non Sinusoidal Type Of Oscillator: This is concerned with the production of pulses of rectangular wave form as output. They are also known as multivibrators.

The non sinusoidal oscillator are of three main types which includes

(a) The bi-stable multivibrtors

(b) The monostable multivibrators

(c) The astable multivibrators

2.2 THE ASTABLE MULTIVIBRATOR

This is a simple relaxation oscillator that produces square wave signal from two identical amplifier circuits connected in a closed loop. Its configuration consists of two unstable and will change from one state to the other to generate a square wave output.

Moreover the astable multivibartor is employed in view of of advantage as a free running multivibrator.

2.2.1OPERATIONAL MODES OF ASTABLE MULTIVIBRATOR

T1 and Ta2 are transistors and it operates in such a way that when T1 is ON, the base of T2 is held at a low potential until capacitor C1 is fully charged. Thereafter the resistor R3 now turns T2 ON, and the voltage applied to T1 drops. Resistor R4 and capacitor C2 at the collector emitter junction of T2 charges the potential of the various points in the circuit when the capacitor charges and discharges thereby during T2 in either ON or OFF. When T1 turns OFF the circuit assumes a second stable until Capacitor C2 get charged p after which it changes state such that5 T1 goes On and T2 goes OFF> he whole process repeats itself allover as long as possible so long as it is with constant supply of power.

2.3AMPLIFIERS

An amplifier can be defined basically as an electronic circuit whose function is to increase the amplitude of the input signal connected to it. This implies

2.3.1CLASIFICATION OF AMPLIFIERS

Amplifiers can be grouped under different categories depending on various uses and modes of operation ect.

(i) They can be classified as direct current amplifiers, audio amplifiers, IF amplifiers, RF amplifiers etc depending on their operating frequencies.

(ii) They can be classified also into small signal, large signal or power amplifiers depending on the level of signals they are expected to handle and the output power.

(iii) Also they can be classified as class A, B or C depending on their mode of operation or their amount of base biasing current.

2.3.2POWEER AMPLIFIRS

Power amplifiers are amplifiers that are designed to provide high level of output power: hence they are required to deliver high output power.

This shows that this type of amplifier are also large signal amplifiers too if their operation level is anything to go by.

Some of the characteristics of the active devices for use at this stage considered critically include voltage and current handling capacity, power capacity etc.

2.4THE BATTERY

In the design of an uninterrupted power supply system, the battery is one of the components to be used. In order word it can be said or interpreted that the battery is the life wire of the project owing to the fact that it is the source of power to the circuit. And by virtue of this project the battery in used is a lead core accumulator battery of 12V. The U.P.S invariably can operate effectively between 6 hours and three days depending on the load it's carrying and also the strength and charged level of the battery.

However, there is a need to incorporate a charging circuit as used in the project which enables and ensures constant charging of the battery.

2.5RECTIFICATION CIRCUIT

RECTIFIER: A rectifier is a device that converts an ac voltage to pulsating dc voltages. Various types of diodes are used for rectification. The most common of all rectifying device (diodes) are the silicon and germanium diodes.

Rectification is achieved by the use of semiconductor, diodes or metallic rectifiers. The diodes is described as a semi conductor in that it offers a low resistance to current in one direction called forward resistance and very high resistance to current in the opposite direction called backward resistance.

2.5.1TYPES OF RECTIFICATION

There are three types of rectifiers they are:

(i) Half wave rectification

(ii) Full wave rectification

(iii)Full wave bridge rectification

2.5.2FULL WAVE RECTIFICATION

A full wave rectifier is a circuit that converts ac voltage into a pulsating dc voltages and thus allowing currents to flow in the same direction through the load for both halves of the ac voltage cycle.

There are two types of full wave rectifiers namely:

(i) The bi-phase rectifier

(ii) The bridge rectifier

2.5.3 BI PHASE RECTIFIRS

A bi phase rectifier is a type of rectifying circuit that requires two diodes and a centre tapped transformer in order to make a full wave rectification. During the first half cycle D1 conducts. And during the second half cycle D2 conducts. Currents therefore flow during both cycles thus giving rise to full wave rectification. However, the bi phase rectifiers give lower ripple voltage than the half wave rectifiers.

2.5.4 BRIDGE RECTIFIERS

A bridge rectifier requires four diodes in other to make a full wave rectification. In bridge rectifiers centre tapped transformers are not r4equired. The full input voltage is applied to the load. During the first half cycle D1 and D3 conduct an during the second half cycle D2 and D4 conducts. Hence current flows through out the cycle giving rise to a full wave rectification.

However, both bi phase and the bridge rectifiers have the same output waveform. in general full wave rectification contains less ripples and more efficient and thus having a wider area of application than half wave rectification.

2.6TRANSFORMER

A transformer is an electrical device which is used to step up or step down voltages or currents depending on the required operation.

In other words the transformer takes in ac voltage, increases or decreases it depending on the actual voltage needed. A transformer consists of two windings namely: Primary and secondary windings both working on the principle of electromagnetic inductions.

This flux is set up by the current in the primary windings which will cause or induce an electromotive force in the secondary by the process of mutual ind7ctance. The induced voltage into the secondary winding depends on the number of turns.

However, the total number of turns N_1N_2 in both the primary and secondary respectively can be determined by equating to the primary and secondary voltages V_1V_2 respectively. Thus the above assertion can be mathematically expressed by the following equations:

$V_1/V_2 = N_1/N_2 = I_2/I_1$ .... (1)

Therefore N_1 can be calculated for by a mere change in the subject of formula.

$V_1/V_2 = N_1/N_2$ ....(2)

$N_1V_2 = N_2V_1$ ....(3)

$N_1 = N_2V_1/V_2$ ....(4)

The same goes for N2 that is

$N_2V_1 = N_1V_2$ ....(5)

Thus $N_2 = N_1V_2/V_1$ ....(6)

To handle a MOSFET, care must be taken because the oxidation insulation film is thin: this film is easy to destroy in the high voltage of the static electricity.

2.7 REVIEW OF PREVIOUS WORKS

With reference to the design and construction of a 500VA Uninterruptible power supply by students before us, it was discovered that:

*The power rating of the unit was less than the acclaimed 500VA.

*The inverter section was designed with an astable multivibrator which the output voltage varies with load.

*The transformer used is stepping up the voltage has lots of disadvantage which includes power loss, noise etc.

* The solid state device used for switching was a bipolar junction transistor (BJT).

2.8 COMPARISON WITH PREVIOUS STUDIES

In this particular project a lot of research was made into the design using more recent technology in the inverter stage. The technology known as pulse width modulation PWM was employed as against the use of an astable multivibrator in similar projects at the department. Having made use of the more recent technology, the output of the U.P.S is being fed back to the PWM chips which help in maintaining the pulse width. Conversely, the previous project suffers difficulty in handling constant voltage as the load varies

CHAPTER THREE

3.1 DESIGN AND CONSTRUCTION

We laid emphasis on how we come about our parameters utilized in this project design. The design idea of this chapter can also be seen as a way of using different items and components to form what we want in order to perform a particular task.

3.2 OUTPUT TRANSFORMER

The inverter design type used in this project is the push-pull configuration. This configuration requires two input signals to the switching transistor at 180° out of phase, which is applied, to the two halves of a center-tapped transformer.

It is assumed that the output from the transformer flows continuously. With this assumption, when the 180° out of phase signal flows, switch T_1 closes and T_2 opens, current flows in the upper half of the primary winding and induces current in the secondary coil. In the second half cycle, T_2 closes and T_1 opens, current flows in the lower half of the primary winding coil and induces current in the secondary coil.

The diagram for this arrangement is as shown in fig. 2.7 below

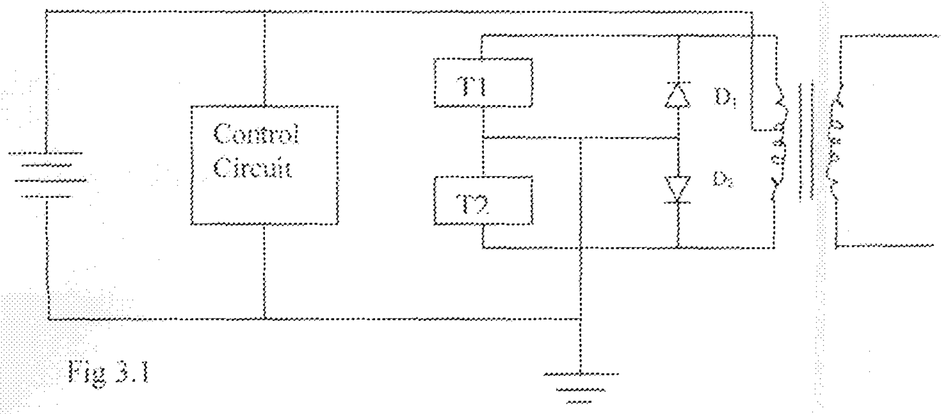


Fig 3.1

The reason for employing push-pull configuration is to minimize power loses. When a switching occurs at the primary of the transformer, the voltage shifts from one half of the primary winding to the other half. This therefore requires good magnetic coupling between the two half winding of the primary in order to reduce energy losses associated with leakage inductances of the primary winding. This issue was well taken care of in the design of the transformer. The diodes D_1 and D_2 across the switch in the push-pull configuration serves to return inductive energy back to the supply bus.

Therefore, regardless of the value of output current from the transformer, the output voltage is given by

$$V_o = \frac{M.V_d}{n}$$

Where:

n = the transformer turns ratio.

M_a = modulation factor or power of the input signal, which is one for a square

wave inverter ($M_a = 1$)

V_{dc} = 12V, battery.

For this inverter,

Power = 500W

Primary Voltage, V_p = 12V

Secondary Voltage, V_s = 240V

J = 200cm/A (j = operating current density); j ≤ 200cm/A from the manufacturer's data for wire size material.

K = 4.0 (for push-pull configuration)

Frequency = 50Hz

Primary current, $I_p = P/V_p = 500/12 = 41.67A$

Secondary Current $I_s = P/V_s = 500/240 = 2.08A$

Wire size for primary = $I_p \times J = 41.67 \times 200 = 8334cm$

From the wire specification chart, the gauge is AWG 10

Wire size for secondary = $I_s \times J = 2.08 \times 200 = 416cm$

From the wire specification chart, the wire gauge is AWG23.

Selection of core size:

$$\text{Core sile, } A_eA_c = \frac{(0.68P_o J)\times 10^3}{freq.\times B_{max.}}$$

Where: A_eA_c = core effective area in cm^4

$B_{max.}$ = Maximum flux density (given as 12000G at 240Vac)

Therefore:

$$A_eA_c = \frac{0.68\times 500\times 200\times 10^3}{50\times 12000} = 113.33cm^4$$

From the manufacturer's data sheet, a transformer core size is selected with A_e $=16cm^2$, $A_c = 10cm^2$.

Number of turns in primary

Assuming 4turns per volt, the primary winding Np which takes 12V, will have:

$N_P = 12\times 4 = 48$turns.

Since the primary is a centre-tapped, there will be a total of (2×48) 96turns in the primary with the centre-tapped at the middle of the coil.

To find the number of turns of the secondary,

$$\frac{N_P}{N_s} = \frac{V_P}{V_{P_s}}$$

where: N_p = number of turns of the primary winding = 48

N_s = number of turns of the secondary winding = ?

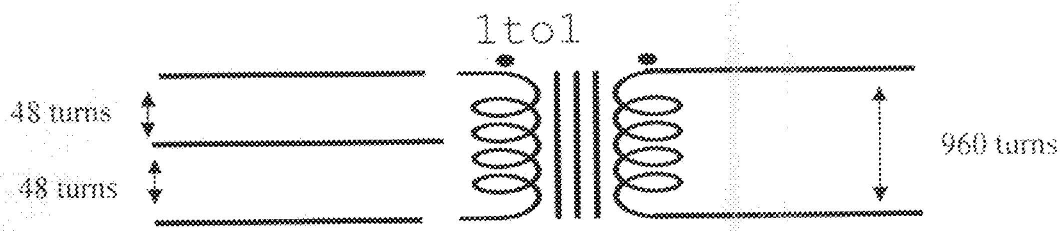
V_p = voltage at the primary = 12V

V_s = voltage at the secondary = 240

$\therefore N_s V_p = N_p V_s$

$$N_s = \frac{N_p V_s}{V_p} = \frac{48 \times 240}{12} = 960$$

$\therefore N_s = 960$turns.



3.3 INVERTER DSIGN

The Inverter consists of three subunits: the modulated signal generator, Pre-amplification/amplification and the Transformer. Fig. 3.2 shows the block diagram.

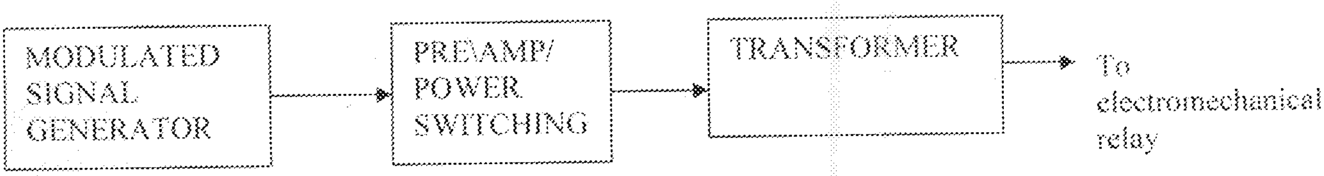
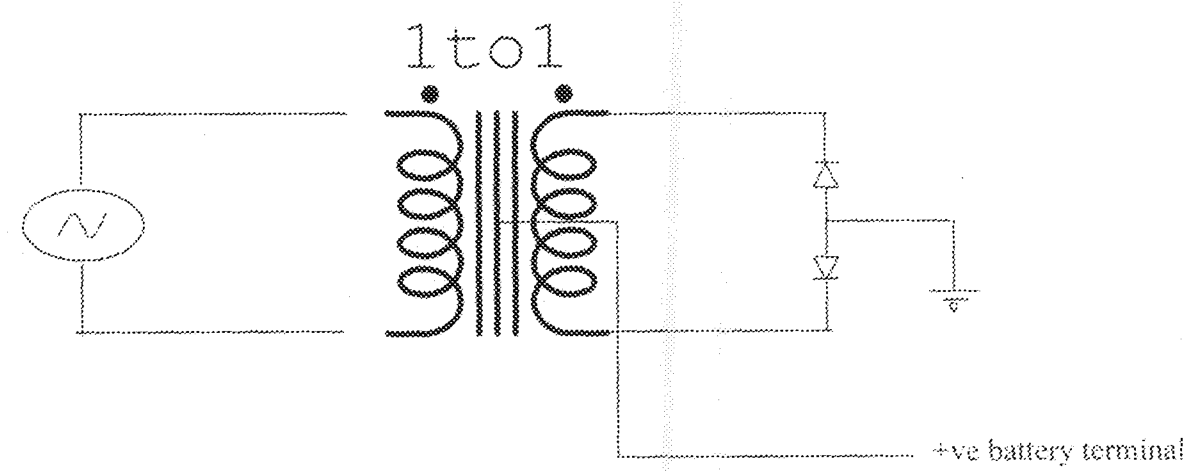


Fig. 3.2

3.4 THE CHARGER UNIT

To make the battery operative, it must be charged, i.e. an electric current must be passed through the battery. When a d.c current supplied by external power source flows through the battery, a chemical process takes place inside it as a result of which, the lead sulphate on the plate connected to the positive terminal of the power source changes to spongy lead gradually as the acid leaves the plate and returning to the electrolytes, thus increasing its density.

The charger circuit is a rectified power source, which supplies a dc voltage to the battery for charging. This consists of a step-down transformer and rectifier diodes. The circuit diagram is as shown below.



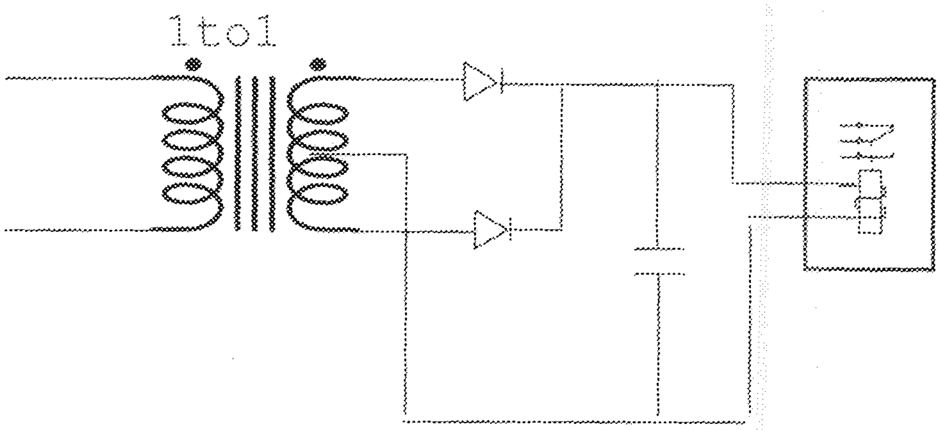
3.4.1 MODE OF CHARGING.

The mode of charging used is the constant voltage method; a constant voltage is applied to the battery terminals. Initially a heavy current will flow through the battery when charging an already discharged battery and gradually the current reduces as the battery is being completely charged.

3.5 CHANGE OVER CIRCUIT

The reliability of an inverter be it standby or online, is its ability to continue to supply power uninterruptedly when there is power outage from the mains. On this note, an electromechanical automatic relay switch is employed which performs the function of switching from mains supply to the inverter and vice versa. The switching operation is expected to be done substantially in less than 50 microseconds, without much transient noise during the switching.

The electromechanical relay switch is energized with a 12v dc. The 12v dc is received from the output voltage of a full wave rectifier. The circuit diagram is as shown below:



Three pieces of single pole/double strode cascaded in parallel are used for the switching process.

3.6 MODULATED SIGNAL GENERATOR

The modulated signal generator comprises of 555 Timer and 4027 CMOS dual JK Flip-Flop. The 555Timer is configured to operate in an astable mode for the generation of a non-sinusoidal wave of duty cycle greater than 50%.

INTERNAL STRUCTURE OF 555 TIMER AND ITS MODE OF OPERATION IN ASTABLE MODE

A 555Timer configured to operate as an astable multivibrator, which is a free running non-sinusoidal oscillator is shown in fig. 3.3a while the internal structure with the external component is shown in fig. 3.3b. The external components, R_1, R_2 and C_1 form the timing network that set the frequency of oscillation. The

0.01 μf capacitor C_2 connected to control (CONT.) input is strictly for decoupling and has no effect on the operation.

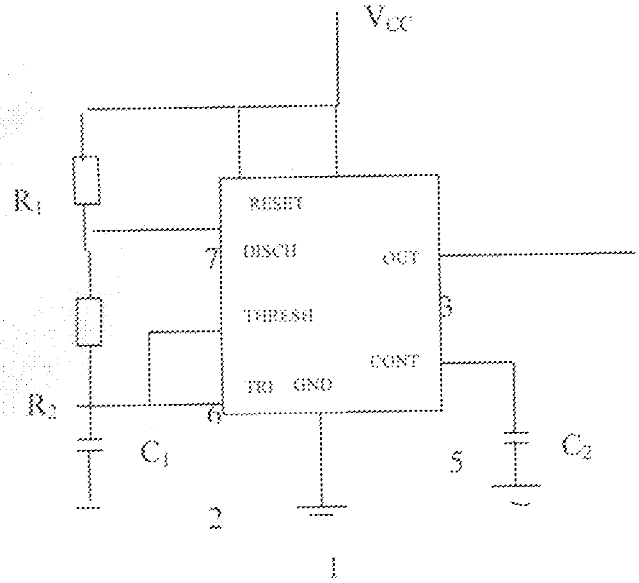


fig 3

Initially, when the power is turned ON, the capacitor C_1 is uncharged and thus the trigger voltage (pin 2) is at 0v. This causes the output of comparator B to be HIGH and the output of comparator A to be LOW forcing the output of the latch and thus the base of Q_1 LOW and keeping the transistor OFF. Now C_1 begins charging through R_1 and R_2. When the capacitor voltage reaches $\frac{1}{3}V_{CC}$, comparator B switches to its low output state and when the capacitor voltage reaches $\frac{2}{3}V_{CC}$, comparator A switches to its high output state. This RESETS the latch, causing the base of Q_1 to go high and turns ON the transistor. This sequence creates a discharge path for the capacitor through R_2 and the transistor. The capacitor now begins to discharge, causing comparator A to go LOW. At the point where the capacitor discharges down to $\frac{1}{3} V_{CC}$, comparator B switches HIGH, the SETS the latch, which makes the base of Q_1 LOW and turn OFF the transistor. Another charging cycle begins and the entire process repeats. The result is a rectangular wave output whose duty cycle depends on the value of R_1 and R_2.

The time that the output is HIGH (t_H) is how long it takes C_1 to charge from $\frac{1}{3} V_{CC}$ to $\frac{2}{3} V_{CC}$. It is expressed as

$t_H = 0.7(R_1 + R_2)C_1$

The period "T" of the output wave is the sum of t_H and t_L

$T = t_H + t_L$

$= 0.7(R_1 + R_2)C_1 + 0.7R_2C_1$

$= 0.7(R_1 + 2R_2)C_1$

Frequency of oscillation $f = 1/T = \dfrac{1}{0.7(R_1 + 2R_2)C_1}$

$= 1.44/(R_1 + 2R_2)$

In this project, the value of R_1, R_2 and C_1 are such that the frequency of oscillation is 200Hz

Let $R_1 = 18K$

$R_2 = 27K$

$C_1 = 100nF$

$F = \dfrac{1.44}{(R_1 + 2R_2)C_1}$

$= \dfrac{1.44}{(18+54)\times 10^3 \times 100 \times 10^{-9}}$

$= 200Hz$

The duty cycle of the signal generated by the 555 Timer is always greater than 50%

FUNCTION OF 4027 DUAL JK FLOP.

In this circuit, the J-K flip flop serves two purposes. viz

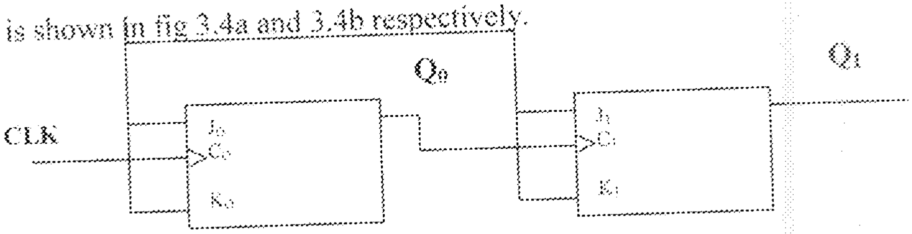
(i) Pulse width modulation.

(ii) Frequency division

The 4027IC is a J-K flip-flop that outputs a square wave of duty cycle 50 percent independent of the duty cycle of the input waveform. As in this design, the duty cycle of the waveform generated by 555 Timer IC is greater than 50 %. When this waveform is supplied to the 4027IC, it will then output a waveform with duty cycle 50 percent.

Another application of the J-K flip-flop that is utilized in this project is its ability of dividing (reducing) frequency. This IC (4027) is a dual (master- slave) flip-flop. Each of the flip-flop divides the frequency of its input by two. This with two of them cascade, the frequency of the input waveform will be divided by four.

The diagram of arrangement of the two flip-flops and the corresponding wave waveform is shown in fig 3.4a and 3.4b respectively.



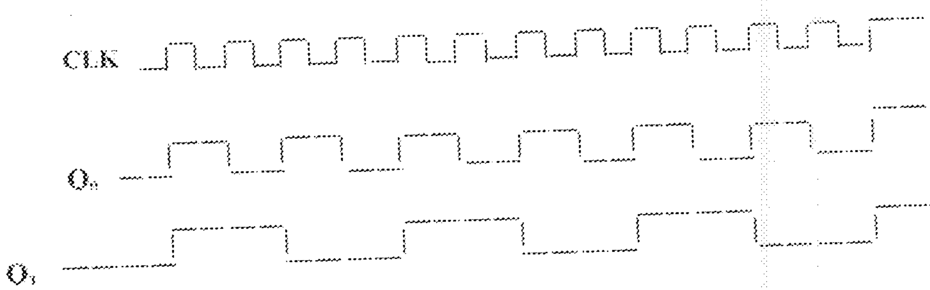


FIG 3.4b

As we can see in the above diagrams, the flip-flop change state on each triggering clock edge (positive edge-triggered in this case). Also from the waveform, the output frequency of the first flip-flop is half the frequency of the original clock Pulse. When the output of the first flip-flop is connected to the clock input of the second flip-flop, this then outputs a waveform of half the frequency of its input. thereby dividing the original clock frequency by four. The functional diagram and tables of the 4027 IC JK flip-flop are as shown in fig 3.5a and tables 3.la and table 3.1b respectively.

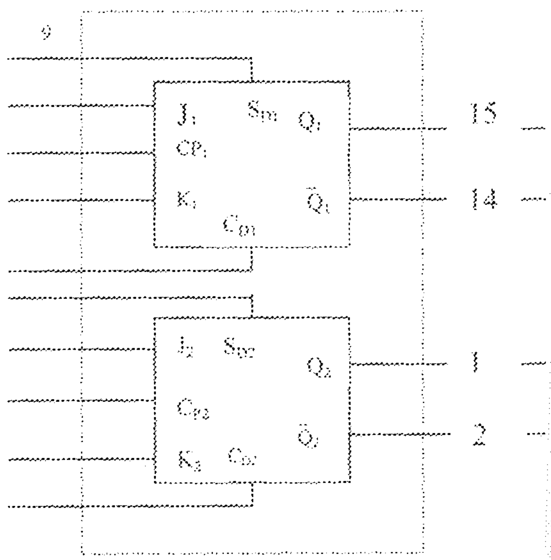


Fig. 3.5a

INPUTS					OUTPUTS	
S_D	C_D	C_P	J	K	Q	$\bar{Q}$

H	X	X	X	X	H	L
L	X	X	X	X	L	H
H	X	X	X	X	H	H

Table 3.1a

INPUTS					OUTPUTS	
S_D	C_D	C_P	J	K	Q_{n+1}	$\bar{Q}_{n+1}$
L	L	↑	L	L	No Change	
L	L	↑	H	L	H	L
L	L	↑	L	H	L	H
L	L	↑	H	H	$\bar{Q}_n$	Q_n

Table 3.1.b

Pinning

JK Synchronous Input

CP Clock Input (L to H edge triggered)

S_D Asynchronous set-direct Input (active High)

C_D Asynchronous clear-direct Input (active High)

Q True output

Q' Complementary output

3.7 BUFFER (PRE-AMPLIFIER)

The buffer circuit used in this project is the darlington transistor which is made up of two dissimilar transistors hooked together. For a darlington transistor, the combination tends to act like a rather slow transistor because Q_1 cannot turn off Q_2 quickly. This problem is taken care of by including a resistor from base to emitter of Q_2. Also a resistor is connected between the collector of Q_1 and of Q_2 to prevent leakage current throughQ_1 from biasing Q_2 into conduction.

The resultant diagram of the buffer circuit used in this project is as shown below.

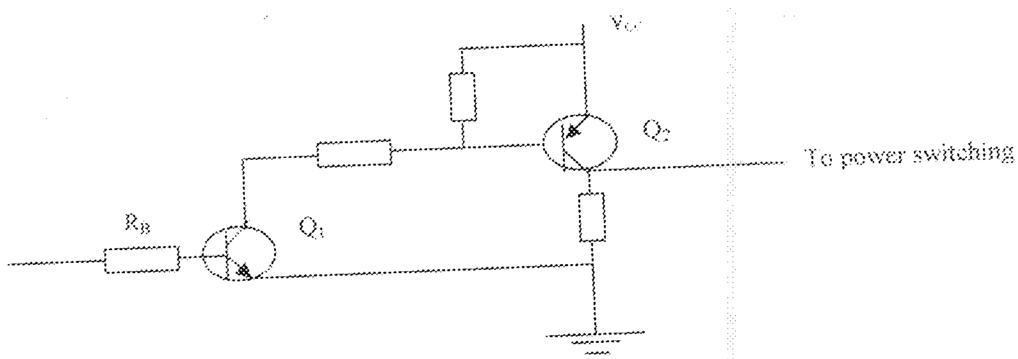


Fig 3.6

3.7.1 BUFFER (PRE-AMPLIFICATION) AND POWER SWITHING

To design the buffer and power switching circuit, it is more convenient to design from the power switching back to the buffer.

For a particular transistor to be used as a power-switching device, it has to posses some qualities that will make it suitable for the switching work. It must at least posses the following qualities:

1. It must be able to withstand certain amount of voltage
2. It must be able to carry a certain amount of current.
3. It must have a high switching speed.

Before choosing a transistor, we need to know the voltage and current that the transistor is supposed to carry.

Considering the output of the inverter in design with the output power and voltage of 500W and 240V respectively, we can determine the current and voltage that the transistor should be able to withstand as follows:

Power 'P' = 500W

Voltage 'V' = 240V

Output Current I_2 = P/V = 500/240 = 2.08A

Now, assuming that the efficiency of the transformer is 90%, then the input power to the transformer is given as;

P_{in} = 500×100/90

= 555.56W

Then $I_{in} = I_1 = P_{in}/V_{in}$

$= 555.56/12$

$= 46.296 = \underline{46.3A}$

On the primary side of the transformer, there are five transistors connected in parallel, therefore the current (collector current) that is to be carried by each of the transistor is given by

$I_C = I_1/5 = 46.3/5 = 9.26A$

Also each transistor must be able to withstand a collector voltage of twice the peak battery voltage

$V_C = 2\sqrt{2} \times 12 = 33.94V$

Now, the transistor to be used must be capable of carrying a collector current greater than 9.26A and collector voltage greater than 33.94V. Hence the transistor 2N3055, which has a maximum collector current of 15A and maximum collector to emitter voltage (V_{CE}) of 60V is suitable for the inverter power switching. Therefore 2N3055 transistor is chosen.

For a transistor to "ON" the relationship

$I_B > I_C/\beta$ must be satisfied.

From ECG book, h_{FE} (which is β) for the transistor is equal to 40

$I_C = 9.26A$

$\therefore I_B > I_C/\beta$

$> 9.26/40$

> 0.23

now let I_B 0.24A

but $I_{B1} = I_{B2} = I_{B3} = I_{B4} = I_{B5}$

$\therefore I_C^* = I_{B1} = 5 \times 0.24$

$= 1.2A$

The parallel connection of the five power transistors are as shown below

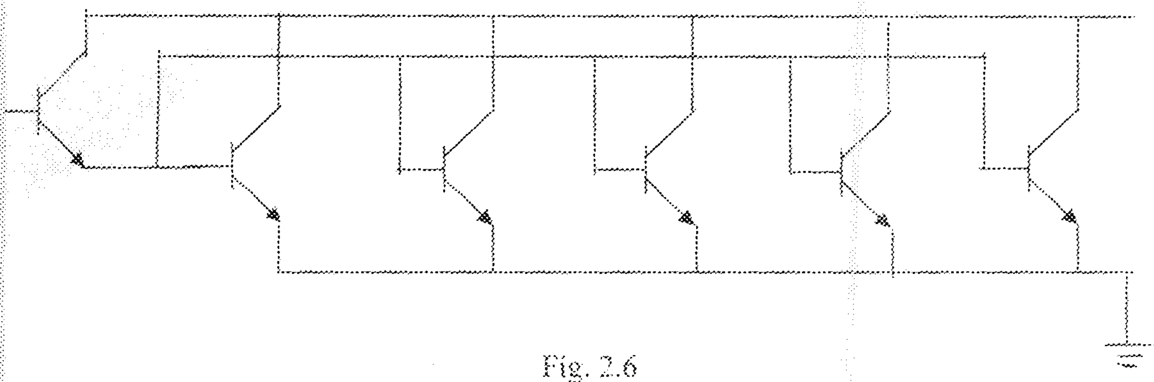


Fig. 2.6

For a push-pull inverter, it is made of two switches arranged adjacent to each other. These two switches do not switch "ON" at the same time rather they alternate. The other side of the switch is the same as the one above

SUMMARY

The modulated signal generator was made up of two ICs, the 555 Timer and 4027 dual J-K flip flop. The 555 Timer was configured to operate in an astable mode to generate a square wave. The output of the timer is then connected to the input of the 4027 dual J-K flip-flop.

The ICs were both first connected and arranged on the breadboard with their associated resistors and capacitors. The unit was then powered with 12V battery through 7805 regulator. This unit was then after powering, tested for its frequency with use of digital multimeter.

CHAPTER FOUR

CONCLUSION AND RECOMMENDATION

4.1 CONCLUSION

The inverter/charger is designed to be used as a dc inverter as well as battery charger. It is also designed to be used as a back up power supply to an equipment

The rectifier and charger unit, which converts the incoming ac mains into dc which is, used to charger the battery.

The battery unit, which is used to store energy in readiness for power failure. Invariably, the battery is used to power the inverter circuit. The larger the battery capacity, the more the equipment can stay on battery power before shutting down.

The Inverter unit, which converts the dc power of the battery into an ac power for the load. The inverter is switched on and draws power from the battery when the ac mains fail.

A static relay switch unit, which is responsible for switching the output from ac mains to inverter and vice-versa.

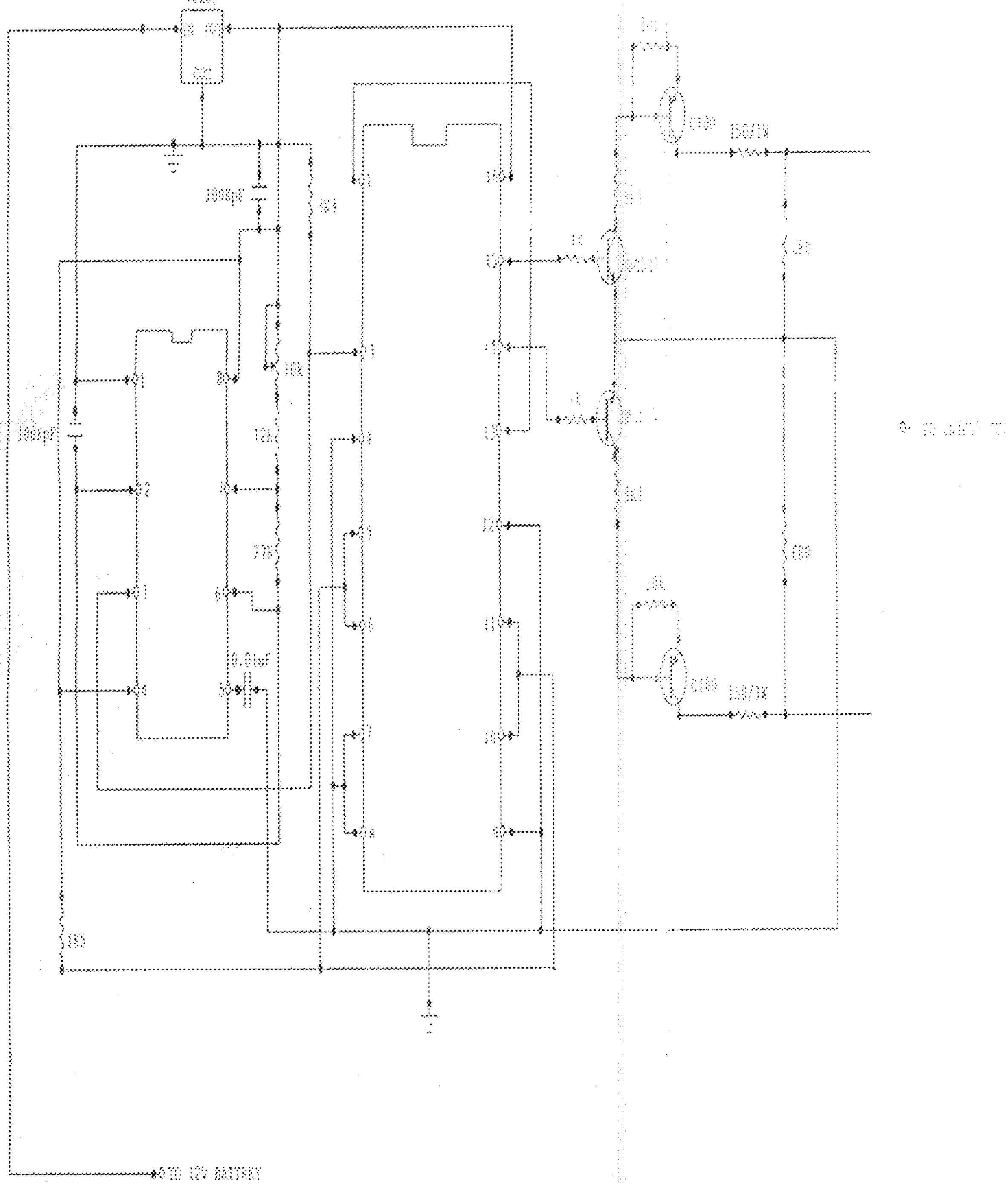
4.2 RECOMENDATION

Since the field of electronics remains ever dynamic, it is always very possible, with no limitation to modify the design and construction of any electronics devices for better performances. In view of the above statement, some recommendations are herby made;

Incorporation of an automatic voltage regulator (AVR) system in the project design which automatically adjust the mains input to correct under-voltage (and some times over-voltage) without having to draw on the precious battery reserves.

In the project design, a monitoring circuit could as well be incorporated which, constantly monitors the quality of the mains supply, ensuring virtually instantaneous correction in the event of any power deterioration.

More recent technology at the power switching stage, power switching MOSFET would have provided better performance.


1000pF
10K
12k
27K
1000pF
0.01uF
150/1W
150/1W
TO 12V BATTREY