A PROJECT REPORT

ON

DESIGN, CONSTRUCTION AND TESTING OF A
DC – AC INVERTER (1000 VA)

BY

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CERTIFICATION

I certify that Mr. Shiawoya Job carried out this project work, and that he has met the minimum standard demand acceptable by the Department of Electrical and computer Engineering Federal University of Technology, Minna.

....

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SUPERVISOR

.... 14/1/07

DR. ADEDIRAN **DATE**

HEAD OF DEPARTMENT

.... 17/01/2007

EXTERNAL EXAMINER DATE

DECLARATION

This is to declare that I, Shiawoya Job of the Electrical and Computer Engineering Department of the Federal University of Technology, Minna, carried out this project. Under the supervision of Mr. Pinne K.

....

SIGNATURE OF STUDENT

DEDICATION

This thesis is dedicated to his Magnificent name, God the Father, the Son and the Holy Ghost who in his infinite mercy has seen me through, and to my caring and loving parents for their peerless understanding. You are wonderful.

ACKNOWLEDGEMENT

My immense appreciation goes to Dr. and Mrs. E.L Shiawoya and family who through their fervent prayer bequeathed a resounding legacy on me.

My sincere gratitude goes to my pragmatic supervisor Engr. Kenneth. P for his unequalled assistance and sacrifice during the tedious course of this project who is worthy of emulation

I also appreciate the efforts of other diligent staff of the department of Electrical and Computer Engineering and my project colleague Olajide K.O.

May the faithful Lord bless you all.

ABSTRACT

This project is embarked upon due to the recent erratic nature of Electricity supply in Nigeria and the experience of purchasing generating sets, which has necessitated alternative methods for supplying electricity for domestic utilization

The aim of this project, thus is to fabricate the d.c – a.c inverter/charger unit as an alternative to the use of generating sets due to its maintenance free nature coupled with its low cost

CHAPTER ONE

1.1 INTRODUCTION

Incessant power failure has become a disturbing and a common phenomenon today. Its occurrence has led to the damage and loss of so many domestic and industrial appliances and consequently also to the loss of both precious human lives and properties in places where constant power supply is inevitable. Such places include - hospitals, factories, libraries, theatre rooms, laboratories, hotels, banks and similar institutions just to mention a few.

As a result of this scourge, there is a vital need for an alternative source of power supply that will be more reliable and efficient for the provision of adequate electrical energy in the form of an alternating current, especially in times of failure from the public supply like NEPA.

This has actually lead to the research and discovery of the inverter, designed to handle electric power backing up problems, which ensures constant power supply to its consumers in case of power failure from the public ac utility.

Different countries or nations operate on various voltages and frequencies as their mains (utility). The major voltages used are: -

(1) 220 – 240v, 50HZ. E.g. Nigeria, Ghana Britain, Germany etc.

(2) 110 – 120V, 60Hz E.g. U.S.A, Japan, Korea e.t.c.

This device will serve as a secondary power supply in remote areas, where the facility of the utility is not available.

Secondly as a back up in places where the utility is present. It can also serve as a stand – by power supply when enough d.c is available (i.e. enough charged car batteries).

It has been designed to handle a number of appliances that may urgently require power, such as CPU, VDU, TV sets lightings, audio sets such as PAS (Public Address System), life support equipment's in the hospital etc.

To this end, 1000KVA output is the maximum it will be designed for, in order to handle just a few of the electronic devices simultaneously. It has self – defense / self – protection facilities e.g. over load protection and an under voltage input alarm

1.2 LITERATURE REVIEW

1.2.1 CHARGING UNIT

This is a very essential part of the DC –AC inverter due to the fact that it is the source of energy being stored in the battery, after the battery must have been discharged.

It consists of a rectifier, which can either be a half – wave or full – wave rectifier.

1.2.2 BATTERY

The battery is an electrochemical device that converts electrical energy to chemical energy (during charging) and then chemical energy back to electrical energy (during discharging).

1.2.3 LEAD ACID BATTERY

This comprises of two lead plates placed in a unit filled with an electrolyte in a solution of tetraoxosulphate (vi) acid and distilled water.

1.2.4 INVERTER CIRCUIT AND FREQUENCY GENERATOR

This is the heart of the Dc – Ac inverter and it is the sole determinant of the magnitude and frequency of the output and voltage. Frequency fluctuations or transients present on the utility power system are completely isolated from the critical load.

In the event of a power failure, the battery supplies sufficient power to the inverter to maintain its output for a specified time, usually from a few minutes to hours until the battery has discharged to a predetermined minimum voltage or it is turned off.

1.2.5 FILTER

The filter is necessary in order to get rid of high harmonic frequency which may be present in the output and thus the output voltage waveform closely approximates a sine wave.

1.2.6 SUMMARY

Chapter one is – Review of Literature, consisting of the introduction and structure of an inverter.

Chapter two entails the theory of operation of the basic inverter topology. Chapter three is the design of the inverter building blocks. Chapters four and five comprises of the construction and testing and recommendation as well as conclusion respectively.

CHAPTER TWO

2.1 SYSTEM DESIGN

To facilitate the construction of the inverter / charger system, it is necessary to split the complete system into simpler functional modules.

2.2 COMPONENT SELECTION

The major components employed in the design of the inverter/charger include the following: - Power mosfet, CMOS PLL 4046, voltage regulator IC, power transformer, counters and a number of resistors, capacitors as well as diodes.

2.2.1 VOLTAGE REGULATOR (78XX SERIES)

This series of three terminal regulator are available with several fixed output voltages making them useful within a wide range of appliances.

The voltages available allow these to be used in logic instrumentation. This series allows 1.5A load current to be supplied with adequate heat sinks provided. Current limiting is included to limit the peak output current to a safe value. Safe area protection is included to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinks provided, the thermal shutdown circuit takes over, preventing the IC from over heating.

Thus, the common output regulator voltages are 5, 6,12, 15 and 24 volts (for our use, 13.2 V is a good charging voltage)

2.2.2 POWER MOSFET

The inverter switching stage employs power mosfets for switching purposes. The MOSFET offers the designer: - high speed, high power device with high gain, almost no storage time, no thermal runaway and inhibited breakdown characteristic.

The MOSFET is a majority carrier voltage controlled device i.e. voltage of specified limit must be applied between the gate and source terminals in order to produce a current flow in the drain. Fig 2.11 shows the symbol of an N-channel enhancement MOSFET SWITHCH.

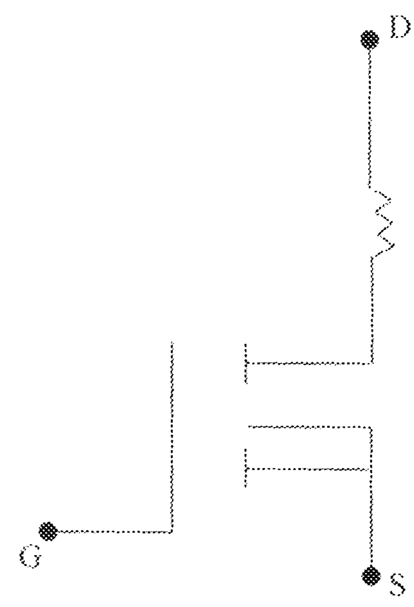
When the power MOSFET is used as a switch, the voltage drop between the drain and source terminal is proportional to the drain current i.e. the power mosfet is working in the constant resistance region and therefore it behaves essentially as a resistive element, consequently, the resistance of the power mosfet is an important feature.

In effect, current starts to flow after a threshold gate voltage has been applied. Beyond the threshold voltage, the relationship between the drain current and the gate voltage is approximately equal.

In order to turn a mosfet on; a gate source voltage is needed to deliver sufficient current to charge the input capacitor at the desired time. The input capacitor is the sum of capacitors formed by the metal oxide`s gate structure, from gate to drain (CGD) and gate to source (CGS)

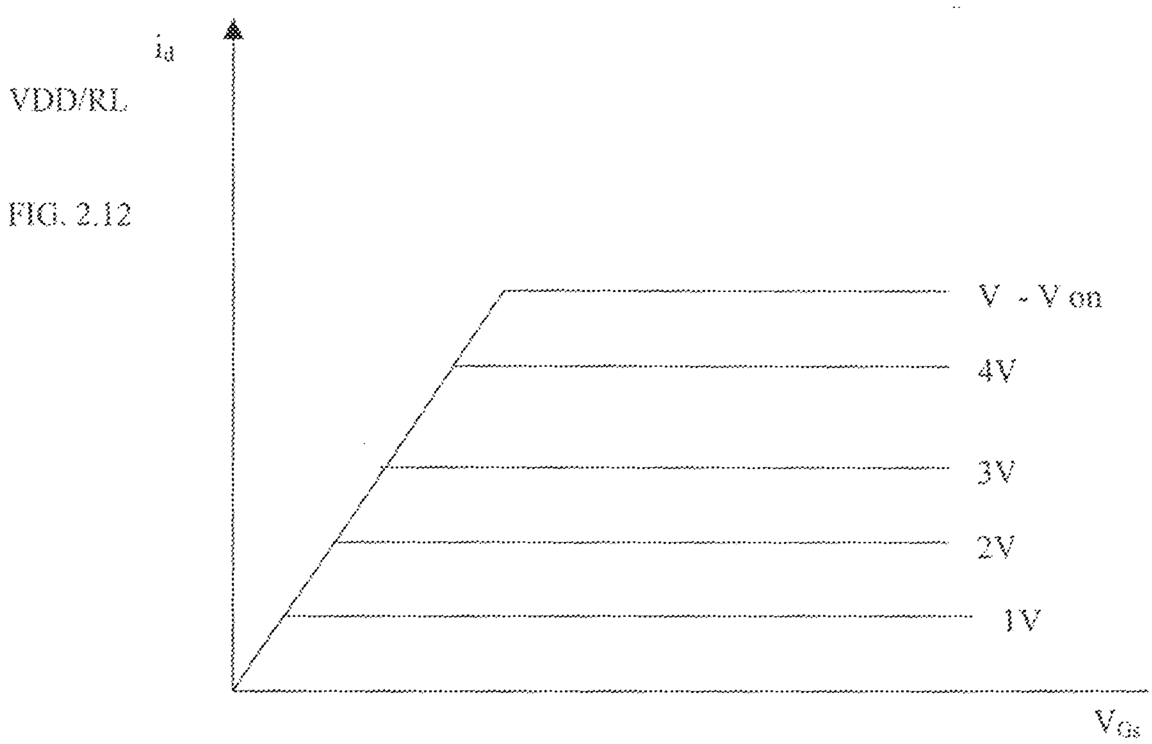
To turn off the mosfet: Since it is a majority carrier semiconductor device, it begins to turn off immediately upon the removal of conductance between drain and source, thus inhibiting current flow. Fig 2.12 shows the terminal characteristic and load time of the power mosfet.

FIG. 2.11



N – CHANNEL MODE MOSFET SWITCH

FIG. 2.12



2.2.3 DETAILED DESIGN PROCEDURE

The inverter/charger system comprises of two main parts:

(1) Battery charger module

(2) Inverter module

2.2.4 BATTERY CHARGER MODULE

The charger consists basically of a step down transformer whose output is rectified using a full wave bridge rectifier Fig 2.4 shows the circuit arrangement of a full wave bridge rectifier and its associated wave forms.

For a full wave rectifier

$$Vo = V_L = \frac{1}{\pi} \int^{\pi} V \sin wt \, d(dt)$$

$V_L = 2\,Vsm$

Where

V_L is the load voltage

Vsm is the maximum value of secondary volt.

$V_L = 16.5V$

$Vsm = V_L \sqrt{2}$

$Vsm = 16.5 \times \sqrt{2}$

$= 23.3V$

The output of the rectifier is filtered by 3300μF, 35V capacitor fed into a 12 volts regulator. This produced a constant output voltage of 12V. The 7812 IC was used as the fixed voltage regulator.

The 7812 has a maximum rating of 1.5A and it has to be mounted on heat sink to dissipate its maximum rated current. The output from the LM317 is also filtered with a 10μF capacitor.

A TIP41A transistor connected in the emitter follower mode is used to increase charging current by a voltage of 0.6V. which is dropped across the base and emitter junction of the transistor. A 20Ω 10W resistor was also used as a charging resistor. A power diode is used to block the reverse bias current.

A battery voltage indicator consisting of L.E.D. which operates with the principle of comparing the battery voltage with a reference voltage of 12V. 10.5V 9V, 8V.

The charging resistance is needed in order to: -

(1) Drop excess voltage between battery level and charger voltage.

(2) To protect charger semiconductors and battery itself

Choosing Assuming total reference resistance value = 10 K Ω Total output voltage of charger = 12.8V Scaling for 12V indicator

$$\frac{12}{12.8} \times 100 = 93.75\% \text{ of total resistance}$$

$$\frac{93.2}{100} \times 10k\Omega = 9.32k\Omega$$

$$= 10k\Omega - 9.32\ k\Omega = 0.68\ k\Omega$$

Scaling for 11v indicator

$$\frac{11}{12.8} \times 100 = 85.9\% \text{ of total resistance}$$

$$\frac{85.9}{100} \times 10k\Omega = 8.59k\Omega$$

$$= 10k\Omega - 8.59 = 1.41k\Omega$$

$$= 1.41 - 0.68k\Omega = 0.73k\Omega$$

Scaling for 10v indicator

$\frac{10}{12.8} \times 100$ = 78.1 % of total resistance

$\frac{78.1}{100} \times 10k\Omega$ = 10kΩ - 7.8 kΩ = 2.2 – 1.41 = 0.78kΩ

Scaling for 9v indicator

$\frac{9}{12.8} \times 100$ = 70.3% of total resistance

$\frac{70.3}{100} \times 10k\Omega$ = 10kΩ - 7.03kΩ = 2.97 – 2.2 = 0.77kΩ

Therefore, ground resistor = 10kΩ - (0.68 + 0.73 + 0.78 + 0.77) kΩ

10 – 2.96 = 7.04 kΩ

2.2.5 OPERATIONAL AMPLIFIER ASTABLE MULTIVIBRATOR

In its basic form this circuit requires only an op – amp, three resistors and a capacitor. However, the approach employed in this circuit is representatively oscillators utilizing the timing circuits and components that change state (for example, comparators) at certain critical levels.

Astable multivibrator has no stable states. Consequently, it continually changes back and forth between two states at a predictable rate the figure (fig. 2.13) below shows Astable Multivibrator implemented with an operational amplifier with biasing resistors.

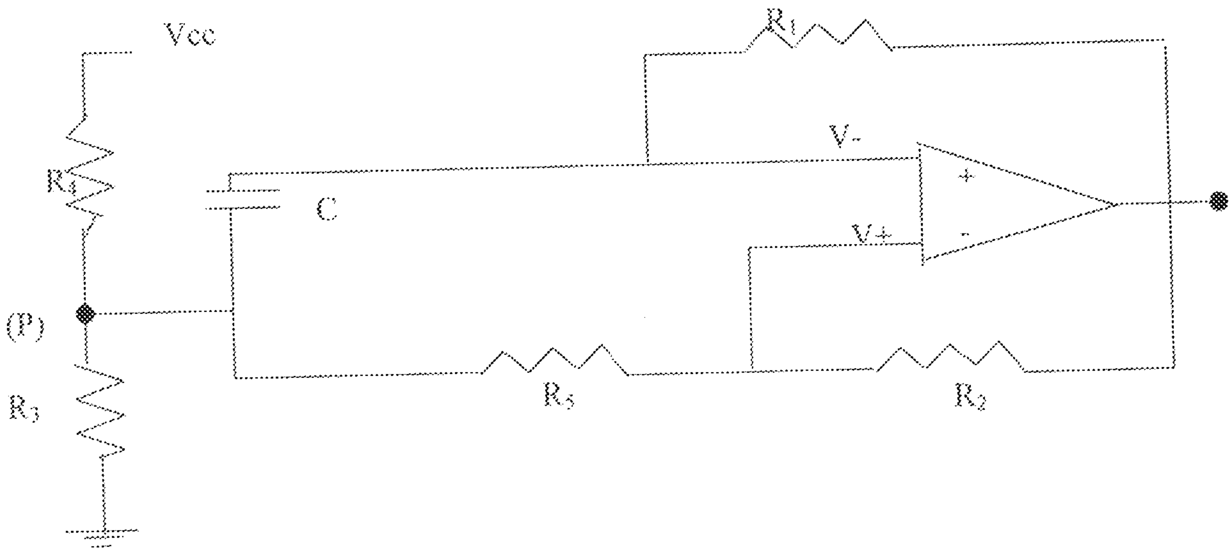


Fig 2.13

From the figure 2.13;

$V^{+} = V^{-}$ (1)

But

$$\frac{V_0 - V_1^{-}}{R_1} = \frac{V^{-} - (V_p)}{1/JWC}$$

$V(p) = 0$, $jwc = Sc$

$$\frac{V0 - V-}{R_1} = SCV^{-}$$

$V0 - V^{-} = ScV^{-}R_1$

$V0 = SCV^{-}R_1 + Vp$

$V_0^{-} = V^{-}(SCR_1 + 1)$

$$V- = \frac{V_0}{5CR_1 + 1} \quad ---- \quad ----- (2)$$

$\frac{V0 - V+}{R2}$ $\frac{V+ - V(p)}{R5}$ at the non inverting input

Since V (p) = 0

$\frac{V_0 - V^+}{R_2}$ $\frac{V^+}{R_5}$

$V+ R_2 = V0\ R_5 - VR_5$

$V+ (R_2 + R_5) = V_0R_5$

$V+ = \frac{V_0R_5}{R_2 + R_5}$ --- --- --(3)

Putting equation (2) and (3) in (1)

$\frac{V_0 R_5}{R_2 + R_5} = \frac{V_0}{SCR_1 + 1}$

$V_0R_5\ SCR_1 + V_0R_5 = V_0R_2 + V_0R_5$

$R_5\ SCR_1 + R_5 = R_2 + R_5$

$S = \frac{R_2}{R_1\ R_5} = JW$

$S = jw = 2\pi f = 1/R_1C$

For F = 50HZ

$jw = 2\ \pi\ 50 = 1/R_1C$

$= 100\pi = 1/R_1C$

Setting C =0.47μ f (polyester to charge in both direction)

$R_1 = \frac{1}{100\pi} \times 0.47 \times 10^{-6}$

$= 6.77k\Omega$

Sizing resistors thus approaching;

$R_1 = 6.8K + 470\Omega + 13\Omega$ (in series)

For 60 HZ

$$R_1 = \frac{1}{120\pi \times 0.47 \times 10^{-6}}$$

$= 5.643\ k\Omega$

$= 5.65k\Omega$

Approximating resistor size $=5.6k\Omega$

2.2.6 PHASE LOCKED LOOP

A phase locked loop is a closed loop feed back circuit in which a generated signal establishes a synchronization on "lock" with an input signal depending on the circuit configuration and the manner in which the input and output are connected.

Phase –locked loops may be used in FM detection frequency multiplication and division, tracking, establishing a noise free reference in the presence of noise.

It has a capture range which is the range of frequencies about the center frequency at which the PLL can initially establish synchronization and lock range which is the range or frequencies at which the PLL can hold the lock, once it is initially established. The phase lock loops includes: - voltage controlled oscillator (vco) phase detector and low pass filter. The architecture of a phase locked loop is shown below i.e. fig. 2.14

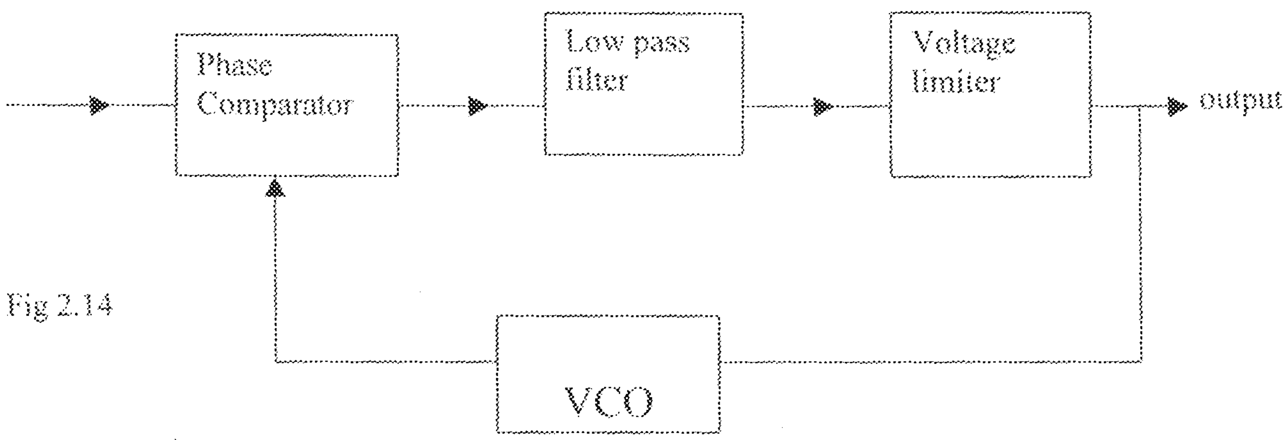


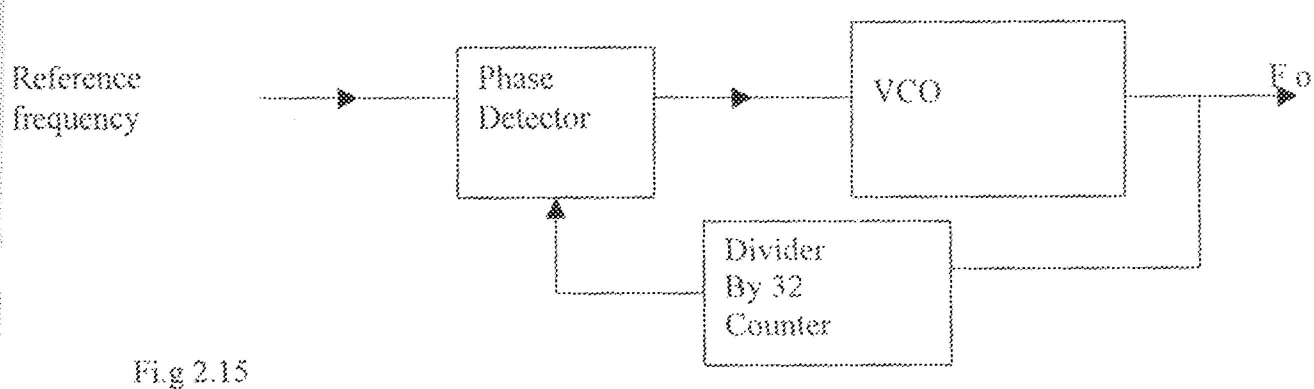
Fig 2.14

AN ARCHITECTURE OF PHASE LOCKED LOOP

2.2.7 PHASE – LOCKED LOOP AS A FREQUENCY MULTIPLIER

The operation of the PLL as a frequency multiplier is illustrated in fig 2.15. The circuit contains a divide by 32 counter in the feed back path within the loop. The output of the circuit is the VCO output, and no loop filter is assumed for the illustration.

It is assumed that all or a portion of the loop contains digital signal and components, since the frequency division circuit are most easily implemented.



Fi.g 2.15

Since reference frequency is 50HZ

Output frequency is: - 50 x 32 = 1600 = 1.6kHz.

A divide by 32 counter is used since: -

$\frac{\text{reference frequency is}}{\text{output frequency}}$ < 9 or >21

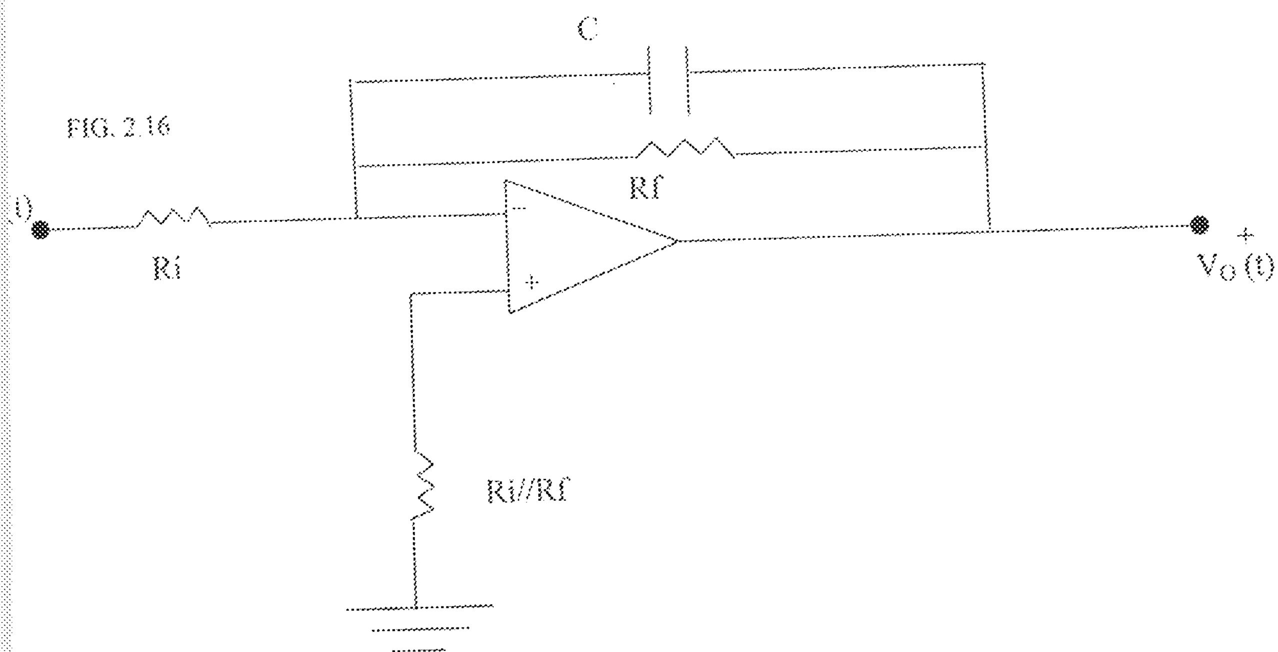
For pulse width modulation, the phase – locked loop employed in this project is the CMOS 4046

2.2.8 INTEGRATOR CIRCUIT

This circuit performs mathematical operations in various forms. These operations arise frequently in signal – processing functions. Both differentiation and integration change the shapes of waveforms i.e. (square wave to triangular, rectangular to saw tooth) depending on the mathematical operation performed.

The figure (fig. 2.16) below depicts an integrator circuit.

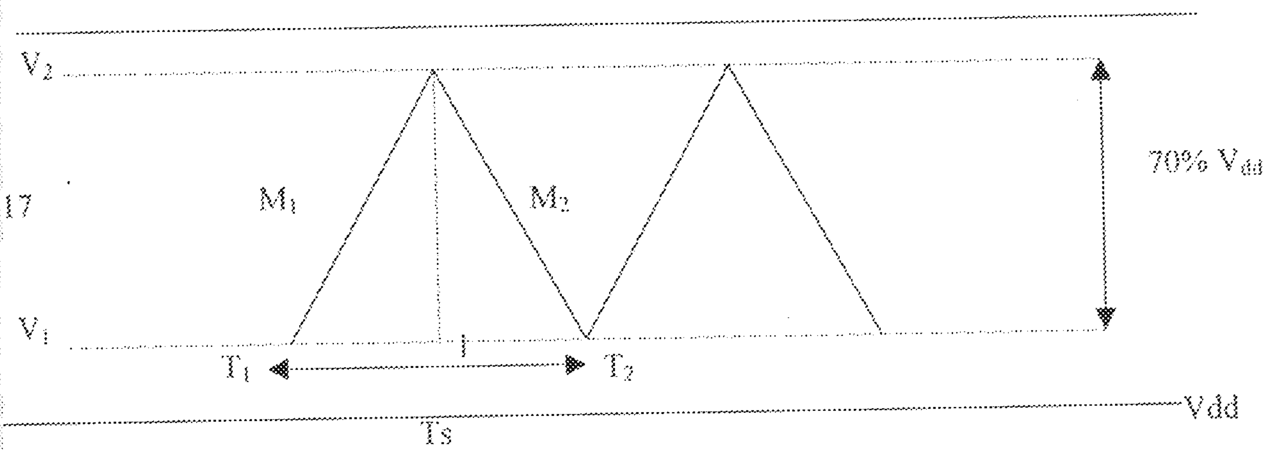
FIG. 2.16



Due to d.s voltage and bias current, which gives linear increase or decrease in lamp voltage and which affects the output of an integrator without resistor Rf i.e. (integrator) certainly moves towards[14] saturation, even with no signal present.

Thus, the introduction of Rf will drop the gain at DC, the input resistance is denoted as Ri. Since a capacitor is an open circuit at d.c, the circuit reduces to a simple inverting amplifier with gain – Rf /Ri at d.c. However, as the frequency increases, the magnitude of capacitive reactance decreases and more of the signal current is shunted through the capacitor.

For a triangle waveform as shown below i.e. fig 2.17

17 

Since

$$V0(t) = 1/RC \int Vi\, t + V0(t)$$

Therefore,

$$V0(t) = \frac{-Vi\, t}{R_T C_T} \times \frac{Vdd\, R_2}{(R_1 + R_2)\, R_T\, C_T} + k + \frac{Vdd\, R_2}{R_1 + R_2}$$

Gradient M_1 =

$$M_1 = \frac{-Vi}{R_T\, C_T} + \frac{Vdd\, R_2}{R_1 + R_2 R_T C_T} \quad \text{---------} (1)$$

But for M_1 to be positive

Vi = O for equation (1)

$$M = \frac{VddR_2}{(R_1 + R_2) R_T C_T} \quad \text{-- -- -- --} \quad (2)$$

But for M_2 to be negative

- Vi >o (ie Vdd)

$$M_2 = -\frac{Vdd}{R_T C_T} + \frac{VddR_2}{(R_1 + R_2) R_T C_T} \quad \text{......} (3)$$

Since $M_1 = -M_2$ from the wave form above

Equating (2) and (3) yields

$$\frac{R_2}{R_1 + R_2} = 1 - \frac{R_2}{R_1 + 2}$$

$$\frac{2R_2}{R_1 + R_2} = 1$$

$2R_2 = R_1 + R_2$

Therefore $R_1 = R_2 = 10k\ \Omega$ (each)

Thus, scaling R_1 and R_2 for l0kΩ each

R_1 and R_2 are biasing resistors

Solving for R_T and C_T

Since $M_F = 32$

Thus, If Fo = $50H_z$

Then fs = $1000H_z$

T = 6,25 x164 = 62.5msec.

T = T/2 = 312.25m sec.

For safety and to accommodate different battery voltages

$(V_2) - (V_1) < V_{dd}$ i.e (voltage supply)

Let

$(V_2) - (C_1) = 70\% V_{dd}$

$V_2 = V_{dd} - 15\% V_{dd}$

$V_1 = O + 15\% V_{dd}$

$V_2 = 10.2V$

$V_1 = 1.8V$

When $V_2 = 10.2V$ $t = 31.2m$ sec

When $V_1 = 1.8V$ $t = O$ sec.

$$\text{Gradient} = \frac{10.2 - 1.8}{31.2\text{x}10^{-3} - 0}$$

as $M_1 = M_2$

$M_1 = 269.23$ V/sec

$M_2 = 269.23$ m V/sec

From Equation (2)

$$M_1 = \frac{V_{dd}\, R_2}{(R_1 + R_2)\, R_1 C_T}$$

$$269.23 = \frac{12\, R_2}{(2R_2)\, R_T C_T}$$

From Equation (3)

$$M_2 = -\frac{V_{dd}}{R_T C_T} + \frac{V_{dd}\, R2}{(R_1 + R_2)\, R_T C_T}$$

$$-269.23 = \frac{-12}{R_T C_T} + \frac{12R_2}{(2R_2)\ R_T C_T}$$

From Equation (4)

$269.\ 23\ R_T C_T = 6$

$R_T = 0.\ 022 C_T$ ---------- (6)

From Equation (5)

$$-269.23 = -\frac{12}{R_T C_T} + \frac{6}{R_T C_T}$$

$$-269.23 = \frac{-6}{R_T C_T} \quad \text{---------- (7)}$$

Putting equation (6) in (7)

$$-\ 269.23 = \frac{-6}{0.022C^2_T}$$

$$-269.23 = -269.23\ C^2_T$$

$$C^2_T = \frac{(-269.23)}{(-269.23)}$$

$$= 1$$

$$C_T = \sqrt{1}$$

$$C_T = 1\ \mu F$$

$$R_T = 0.022\ C_T$$

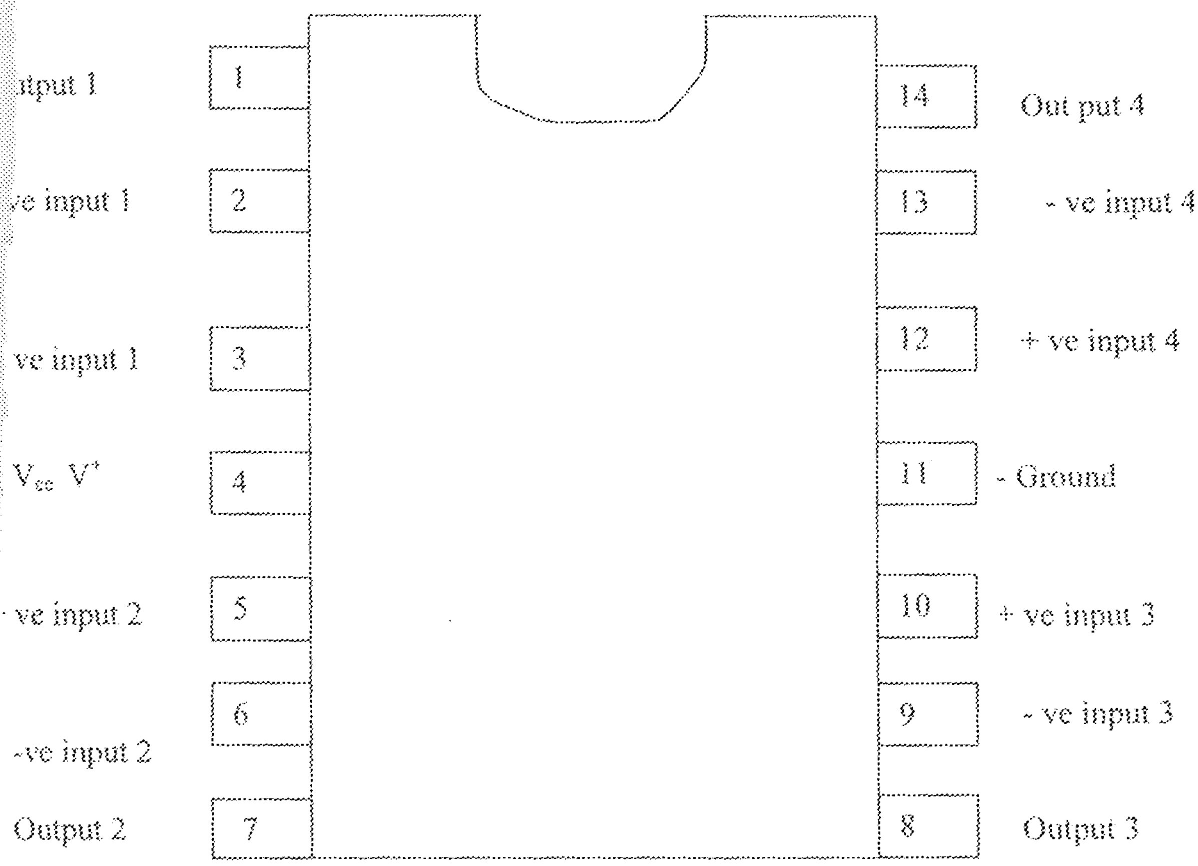
$$= 0.022 \times 1$$

$$= 22 \times 10^{-3}\ \Omega$$

$$R_T = 22\ m\Omega$$

2.2.9 COMPARATOR CIRCUIT

The Comparator circuit is achieved by means of the integrated circuit LM 334N known as a quad Op- Amp.



The LM 334N consist of four independent voltage comparators which operate from a single power supply over a wide range of voltages. The comparator circuit is designed to compare a voltage from the sensing circuit which is fed to the inverting input against a reference voltage, and then to the non-inverting input of the Comparator through a voltage divider network.

2.3 POWER TRANSFORMER

A transformer is a stationary or static piece of apparatus by means of which electric power in one circuit is transformed into electric power of the same frequency in another circuit. The voltage can be raised or lowered but with a considerable drop in current.

The transformer comprises of two windings i.e.

(1) The primary winding

(2) The secondary winding

Thus, the transformer used for the inverter/ charger is a step up transformer.

If Volt/turns ration = 0.284

Then $\frac{220}{Np} = 0.284$

Np = 774.6

Np $\simeq$ 775

X $\simeq$ 775

Thus feed back ratio taking 12V out of 220V loading

$\frac{N_f}{N_s} = \frac{12}{220} = 0.0545$

Number of turns for feed back

N_f = 0.0545 x 775 = 43 turns

For the secondary winding

$\frac{18 \times 775}{200}$

$\frac{Ns}{Np} = 70$

Where Ns = Number of turns in the secondary

Np = Number of turns in the primary

To calculate for area of core used

$\frac{\text{Volt/ turn}}{\sqrt{\text{KVA/phase}}} = \text{KCF Bm} \times 4$

Substituting in the values

Bm = maximum flux density in the core

KVA = 4.44

KVA /Phase = 1 KW

F = 50HZ

Volt /turns = 0.284

$$\text{Area} = \frac{0.284}{4.44 \times 1 \times \sqrt{1000} \times 50} = \frac{0.284}{7020.24}$$

Area of core is proportional to the square of stacking length. A core $= d^2$

C = core constant = 0.45

$$L = \frac{\sqrt{\text{Area}}}{\sqrt{C}}$$

$$L = \frac{\sqrt{0.001279}}{\sqrt{0.0533}}$$

Number Of Laminations Used

$$\frac{\text{Length}}{\text{Lamination thickness}}$$

$$= \frac{0.0533}{0.5 \times 10^{-3}}$$

= 106.6

Number of Laminations

$V_1 I_1 = V_2 I_2$

Let Vp Ip = VsIs If efficiency is 98%

Power out = 98%

Using P.F. $\cos \theta = 1$

$$V_s I_s = \frac{98}{100} V_p I_p \quad (1)$$

But VsIs = 1000

$1000 = 0.98 \times 24 \times Ip$

$Ip = \frac{1000}{0.98x24} = 42.5A$

$Is = \frac{1000}{220}$

= 4.545A

For the gauge of wire used: -

Output is 1000 watts; power factor (p.f) is unity at output

Choosing maximum current density (J) = 10A/mm^2

Cross sectional area of coil is mm^2

Maximum Area of copper required (mm)^2

$= \frac{Ip}{Jmax} = \frac{42.5}{10} = 4.25$ mm^2 (for the input)

Minimum Area of copper required

$= \frac{Is}{\sqrt{mas}} = \frac{4.85}{10} = 0.485mm^2$ (for the output)

From the conversion table

0.485 mm^2 is approximately SWG 25

where SWG is the Standing Wire Gauge

CHAPTER THREE

3.1 CONSTRUCTION AND TESTING

3.1.1 CONSTRUCTION PROCEDURE

The processes involved in construction include pre-construction; bread boarding and then transfer onto vero board after necessary modification is completed on the proto type.

According to the circuit diagram the battery charger module was first connected and the output voltage measured. The circuit was then transferred on to the vero board. The inverter module was also connected on the breadboard and the output waveform oscillator and frequency multiplier is observed on the oscilloscope before it is transferred on to the vero board perforations for the transformer, battery level LEDs and other components were made on the prefabricated casing. Thus, a strong casing is necessary for this because of the heavy component of the inverter/charger. The power mosfets were then mounted on an aluminiom heat sink and properly screwed. The wires were then connecied to their respective points as in the circuit diagram. The heat sink was vital because of the heat dissipated by the power switches. Hence, the components were finally assembled into the casing.

3.1.2 WINDING OF THE POWER TRANSFORMER

The shell type magnetic core was chosen. This core is made from steel laminations that have desirable properties such as low core loss, high flux density and permeability, low cost and its availability.

A concentric type of winding was used in which the conductor was first wound on, and insulation was being made after each layer till the desire number of turns were obtained.

Thus, the leads were then brought out after each wound have desired number of turns were reached. The secondary winding was wound on to of the primary core winding, and this was done according to the desired number of turns for each voltage.

Hence, the laminations were then arranged through the central hole using both the I and E parts until the construction was completed Again, the core was laminated to reduce vibration as well as excessive noise by using insulation varnish. This varnish also reinforces the insulation of the windings in order to prevent the contact of copper wires with the iron laminations and for the separation of various layers of copper winding as well as its joints.

3.2 TESTING

The necessary connections were carefully made. Hence, the inverter/charger was connected to two 12v, 60Ah car battery, both connected in series. An extra vero board was bought for the mosfets to sit on. The acquisition of heat sink was, by cutting aluminium frames to the required size and drilling the 4mm holes.

During testing, op-amp voltage swings were not symmetric. The positive Vmax was about 2.4 and – Vc max was 1.4. Soldering the inverter conductors was tedious due to use of large core cables to handle large currents.

Careful planning was done on the vero boarding of mosfets to cater for good electrical conductivity and avoid burns on the board due to hiding current.

CHAPTER FOUR

4.1 CONCLUSION

From the tests and results obtained, conclusions may be drawn consisting of the aims and objectives outlined in chapter one which have been realized over the frequency range established for the design.

Thus, the main aim of this project is to improvise a more reliable and efficient alternative source of electrical power owing to incessant power outage. The D.C–AC inverter/charger can power most household appliances for a period of time directly proportional to the amp hour rating of the batteries.

Hence, to increase the period for which the loads can be powered, implies increasing the batteries by means of enlarging the battery bank size.

4.2 RECOMMENDATIONS

I recommend that the D.C –AC inverter / charger could have features such as pulse width modulation as well as low battery shut down, which may be efficacious.

The design of the charger section must be able to deliver sufficient charging current in order to enhance quick charging of large battery banks.

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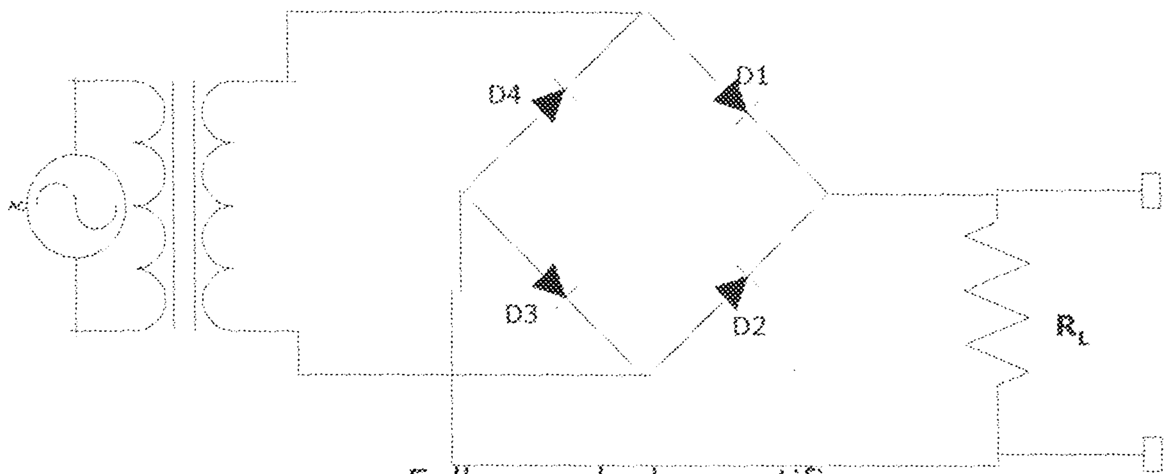
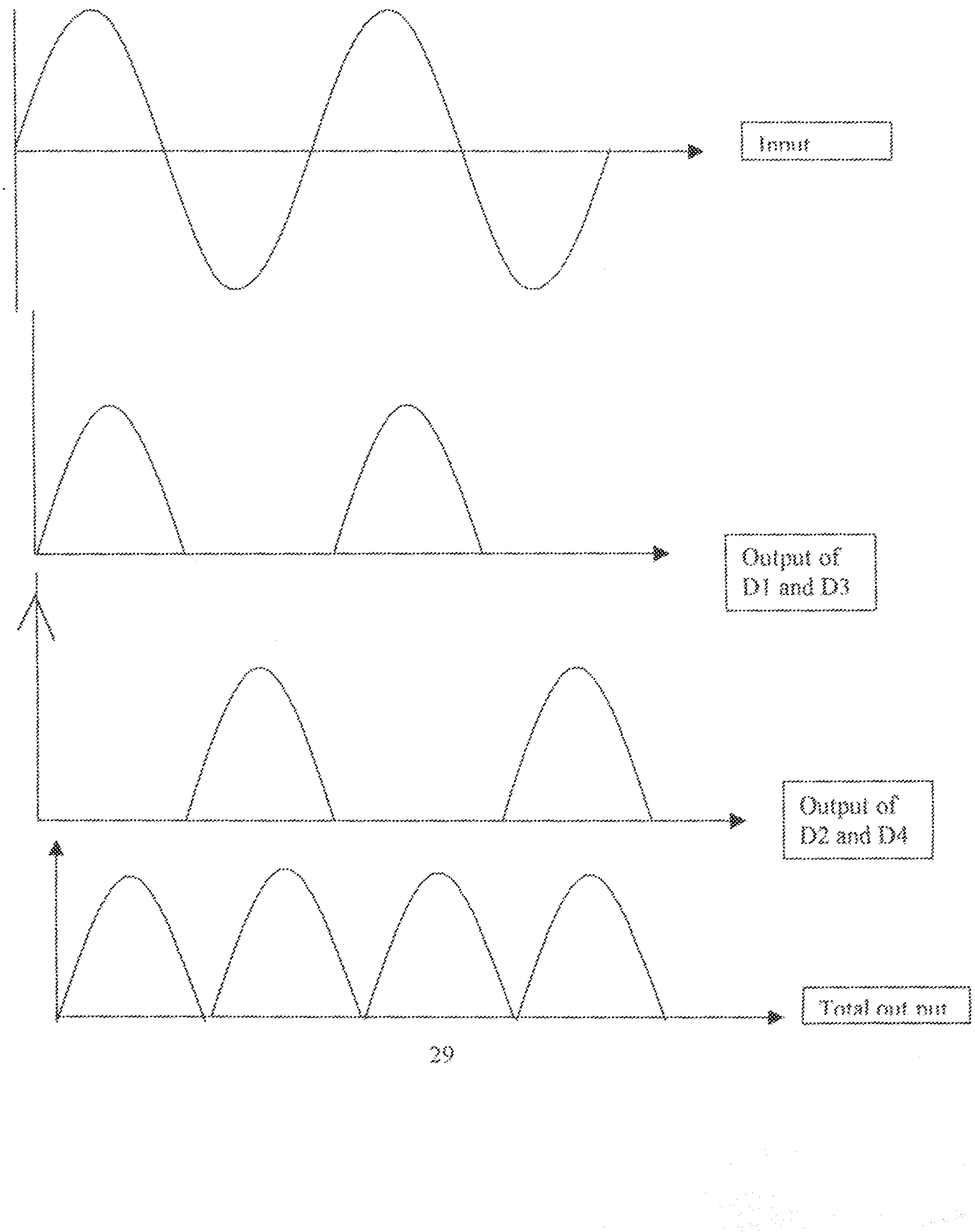
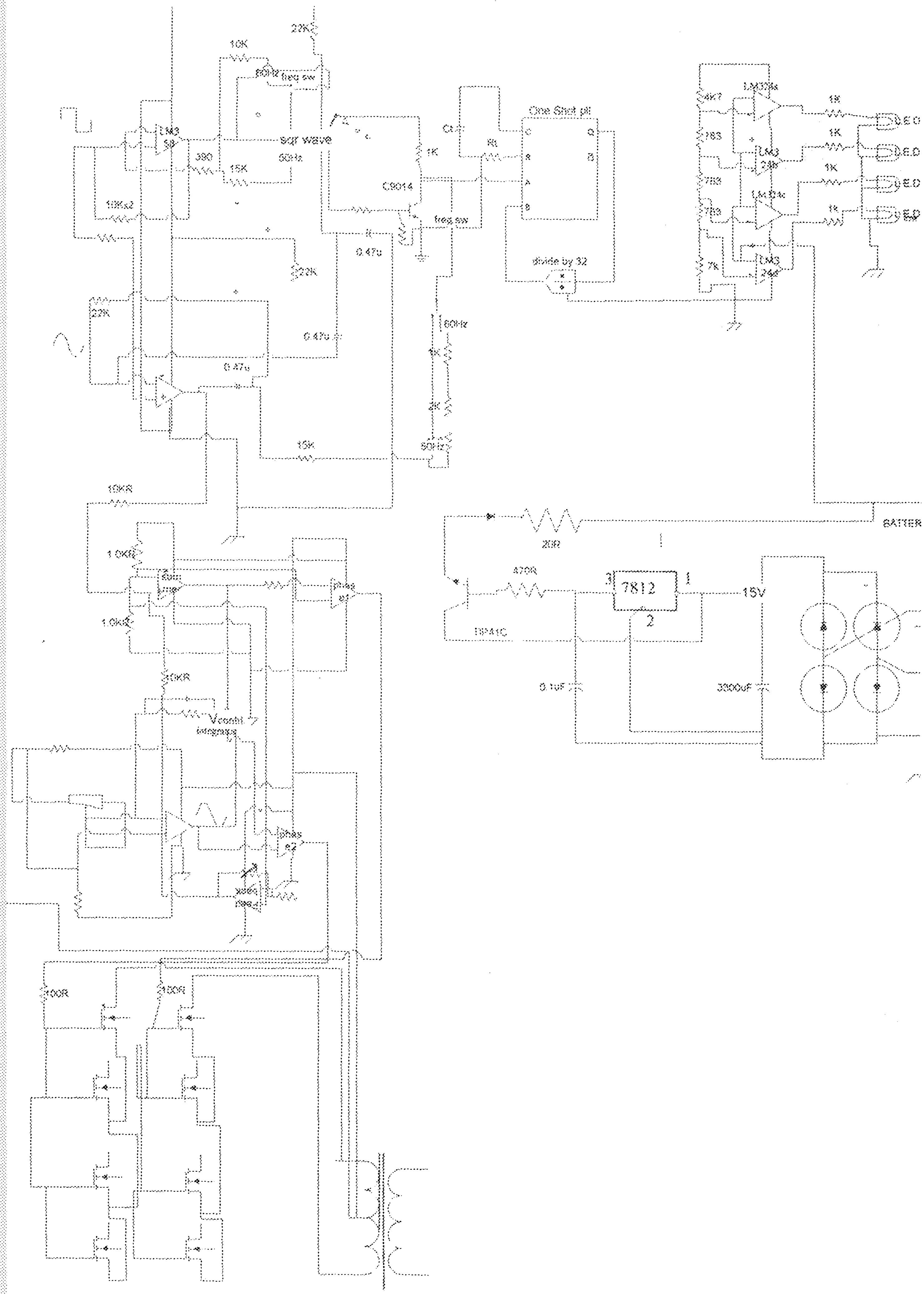


Full wave brdge rectifier




22K
10K
freq sw
sqr wave
390
15K
50Hz
10Kx2
22K
0.47u
0.47u
0.47u
One Shot pll
Ct
Rt
1K
C9014
freq sw
divide by 32
60Hz
1K
2K
50Hz
15K
10KR
1.0KR
1.0KR
10KR
100R
100R
4K7
7k
1K
1K
1K
20R
470R
7812
15V
TIP41C
0.1uF
3300uF