DESIGN AND CONSTRUCTION OF

50 WATTS AUDIO AMPLIFIER

BY

JEREMIAH JOSHUA

98-7022EE

SEPTEMBER 2004

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A PROJECT SUBMITTED

TO

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IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING [B. ENG.] DEGREE IN ELECTRICAL ELECTRONICS AND COMPUTER ENGINEERING.

SEPTEMBER 2004

DEDICATION

is project work is dedicated sincerely and wholly to the Almighty God who is the

thor and finisher of everything.

DECLARATION

I hereby declare that this project was wholly designed and constructed be me under the supervision of ..Engr.....Romoke......, Department of Electrical Electronics and Computer Engineering, Federal University of Technology, Minna, Niger State.

....
Signature of Student

Jeremiah Joshua

98-7022EE

....

DATE

CERTIFICATION

This is to certify that this Project work titled "Design and Construction of A 50 Watts Amplifier was carried out by JEREMIAH JOSHUA with registration number 98-7022EE under the supervision of Engr. RUMALA and submitted to the Electrical Electronics and Computer Engineering Department, Federal University of Technology, Minna in partial fulfillment of the requirement for the award of Bachelor of Engineering (B. Engr.) Degree in Electrical Electronics and computer Engineering.

Engr. RUMALA
(Project Supervisor)

....
Signature and Date

Engr. M. A. Abdullahi
(Head of Department)

....
Signature and Date
20/04/2005

(External Examiner)

....
Signature and Date

ACKNOWLEDGEMENT

Praise and glory be to God for the great things He has done in my life in achieving numerous endeavours, a number of people, too many to mention in this brief acknowledgement have offered valuable supports and assistance.

I am greatly Indebted to my parents, Mr. and Mrs. Jeremiah Yissa Ndanaku, my elder brothers Mr. Isaac Jiyah, Mr. Yakubu Jeremiah, Mr. David Jeremiah and the rest of my family who have supported me right from child hood to this present time both spiritually, financially and morally in my endeavours.

I will like to express my sincere gratitude to Mr. and Mrs. Yakubu (Isreal) Ndagi. They have been a family to me for the few years that I stay with them in the school.

I have learnt a great deal from my colleagues who have studied with me and gratefully acknowledge my dept to them especially Afolabi Mupayi and others.

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ABSRACT

Communication is an important tool in information dissemination and it is always well appreciated when a means of communication is highly effective. This project focuses on the design and construction of a high quality audio amplifier which is to be used in the church, mosque and as a public address system in lecture theatres or halls in order to enable the effectiveness of communication by boosting up the audio capacity that a lecturer or other people in the church or mosque can discharge during the lecture and in there various meeting.

The design and construction procedures of a 50 Watts audio amplifier are highlighted here. The amplifier is designed to be used with an 8 Ohms loud speaker when powered with a 25V symmetrical supply. Necessary means of tone and volume control is incorporated, as well as filtering and decoupling networks. The amplifying stages was designed with discrete components while the incorporated networks are IC based. The amplifier has been tested and it delivers the expected output power. The output voltage is 0V as expected with the symmetrical supply.

CHAPTER ONE

GENERAL INTRODUCTION

0 BRIEF (INTRODUCTION)

n amplifier is a device for increasing the strength of a weak signal fed into it. This llows a small input signal to control a relatively large amount of power in the input rcuit.

mplifier are necessary in many application because the desired signal is usually too eak to be directly useful. Vacuum tube, transistors and magnetic amplifiers enlarge or nplify tiny electrical voltages to a level at which they can operate loud speakers, control ndustrial equipments, operate distant remote control defense centers, and perform housand of other essential task.

2 PROJECT MOTIVATION AND OBJECTIVES

is easily noticed in this academic system that studies are undergone under a very tensile mosphere as learning facilities are inadequate, ineffective and inefficient. Lecture heaters are often filled beyond their capacities and this has led to the use of part of the ining hall of the university's cafeteria for lectures.

he over-noisy condition of this hall and other lecture arenas, in no small measures npair with the effectiveness of communication between lecturers and students since here is a limitation to human audio capacity that a speaker can discharge.

Being part of these sufferings for years, the project is embarked upon since audio amplifier comes into place when voice augmentation is needed.

It is aimed that this amplifier will be of high quality to provide a measure of solution to these challenging situation. Its design will make it cost effective both in construction and running to enhance affordability, so that each lecture theatre / hall will be provided with one. The cost-effectiveness is not acquired by quality trade-off mean while.

1.3 METHODOLOGY

The modular approach is used in the design of this project, the design subdivides into different modules (asset of parts). Each are fitted together to achieve the objective of the project.

1.4 AN OVERVIEW OF AUDIO AMPLIFIER

An audio amplifier is a device for increasing the power associated with an electrical signal in audio frequency range. It is often employed for sound augmentation in a public address system. Since human voice falls within this frequency range.

To make a complete public address system, an input and an output transducers need be incorporated for the necessary energy conversion. The input signal, which is human voice, is converted from sound energy to electrical wave form of voltage variations by means of a micro phone which is the input transducer. After the signal is processed, the amplifier then delivers the amplified version of the signal to a loud speaker, which is the output transducer. This device functions to convert the input signal back into an audible sound wave.

1.5 PROJECT OUTLINE

The project has to do with the design and construction of 50 watts amplifier.

Chapter one deal with introduction, of the amplifier. The aims and objectives, literature review and as well as the project outline for carrying out this project work.

Chapter two contains the steps involved in the system's design. It includes the block diagram of the complete amplifier system as well as its operating principle. It shows the breakdown of each design steps of the decoupling network, speech filter / Pre-amplifier stages, the tone control as well as the Power amplifier stages. It also includes the design of the power supply unit.

In the third chapter, the construction and testing of the amplifier is discussed.

Chapter four contains the conclusion and recommendation for future upgrading of the project.

1.6 LITERATURE REVIEW

Every amplifying circuit increases the amplitude of a given input signal. A small A.C. signal of the same nature and level of amplification, and impedance matching requirements, there are different types of amplifiers.

These classification may base on;

1. Transistor configuration: Common Base, Common Emitter or Common Collector Amplifiers.
2. The Active Device: Junction Transistors (BJT) or Field Effect (FET) Transistors Amplifiers.
3. Operating Condition: Class A, Class B, Class C Amplifiers.

4. Number of Stages: Single stage or multistage Amplifiers.

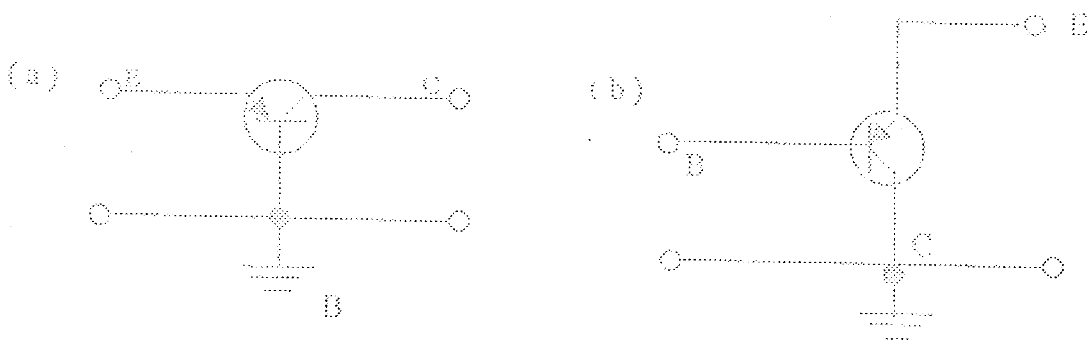
5. Frequency Response: Audio Frequency, Intermediate frequency or radio frequency Amplifiers.

The design of this project is an audio (power) amplifier using transistor and IC as components.

1.6.1 TRANSISTOR AMPLIFIER

The basic building block for an amplifier is transistor. Design of amplifying circuits has also been made easy with the advent of IC yet; transistors remain the main active components. These come in two families of Bipolar Junction Transistors (BJT) and Field Effect Transistors (FET). BJT is more common and it is a three terminal discrete device that comes in either NPN or PNP. The three terminals are the Emitter, the base and the collector.

When transistor is connected in any of the three basic configuration of common Base, Common Collector or Common Emitter, it becomes and amplifier. The connections are shown in fig 1.1.



(c)

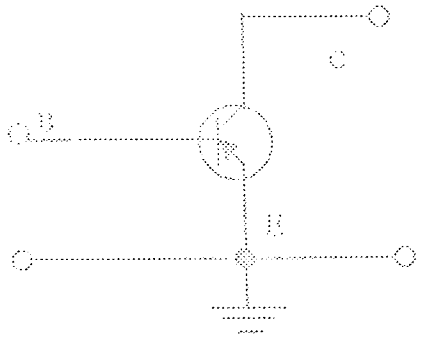


Fig. 1.1

COMMON BASE MODE: As shown in fig. 1.1(a) the base lead is common to both input and output.

COMMON COLLECTOR MODE: The Collector is common in this case as shown in fig. 1.1(b) above.

COMMON EMITTER MODE: In this mode, Emitter lead is common to both input and output. Fig. 1.1(c)

$V_{cc} = V_{be} + I_bR_b$

$I_b = (V_{cc} - V_{be}) / R_b$

$I_c = \beta I_b$

$V_{ce} = V_{cc} - I_cR_c$

The common Emitter configuration is often employed for amplification purposes because of its large current voltage, power gain and voltage shift of 180.

1.62 TRANSISTOR BIASING AND STABILIZATION

For proper operation of transistor, input signal is super imposed on D.C. signal so that both half cycles of the signal will be effective. The process of setting this operating point for a transistor is known as biasing current must be set at a value which allows equal changes in input current for equal positive and negative swing. The fundamental principle of biasing is that the Emitter Base (EB) junction is forward biased and collector Base (CB) junction is reverse-biased. This is achieved by the following methods.

FIXED BIAS: This is also called base biased as the bias current is supplied through a base resistor. It is given in fig. 1.2 (a)

Vcc = IbRb + Vbe + IeRe

Ib = I/B and Ie ~ Ic

Vcc IcRl + Vc

Vc = Vcc +Vc

FEEDBACK BIAS: When the stabilization is provided via collector voltage, this is known as feedback bias or collector bias Fig. 1.2 (b)

Vcc = Vc + [Ib + Ir] Rl

Vc = IbRb + Vbe

POTENTIAL DIVIDER BIAS: This is the most employed biasing. An emitter resistor is involved and so called emitter bias. Fig. 1.2 (c)

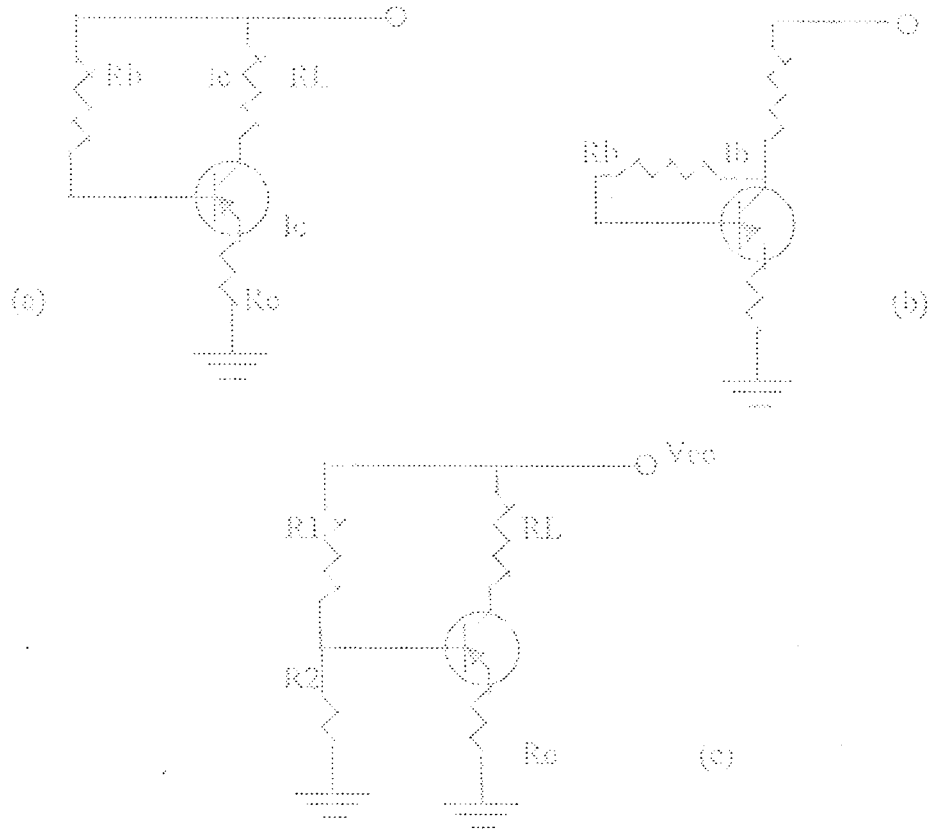
Vcc = Vce + IcRl + IeRe

Vce = Vc – Ve

Ve = V2 – Vbe

V2 = Vcc [R2/R1 + R2]

Vcc Ic Vcc



1.[illegible]3 AMPLIFIER CLASIFICATION

(According to B.L. Theraja and A.K. Theraja Page 1828). Output Power and efficiency are the main consideration in audio amplifier. For an appreciable output power, the large amplitude input signal is necessary in order to obtain large swing of output current and voltage. Transistors used in power amplifiers must be chosen and biased that maximum current, voltage and power rating are not exceeded.

Base on the amount of bias, amplitude of input signal as well as the cycle for which the transistors conducts, amplifiers are classified into classes; A, B, AB and C.

CLASS A AMPLIFIER

Class A amplifier is the one whose transistor is so biased that the current flows in the output during the whole period of input. It operates over a linear region. Such amplifier is characterized with low distortion low signal output and low efficiency of the order of 50%. The graphical representation is in fig. 1.3 below;

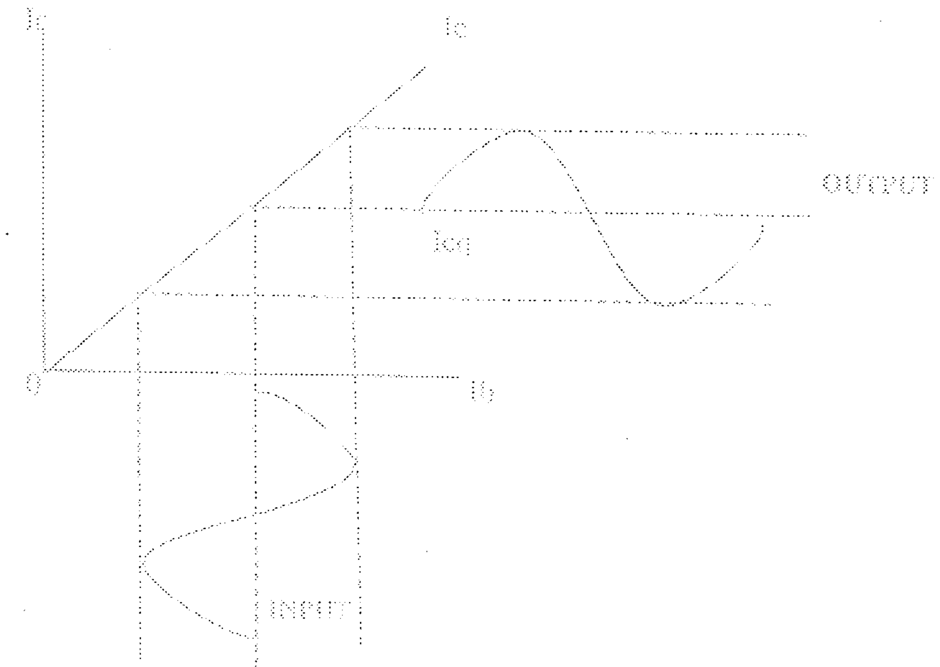
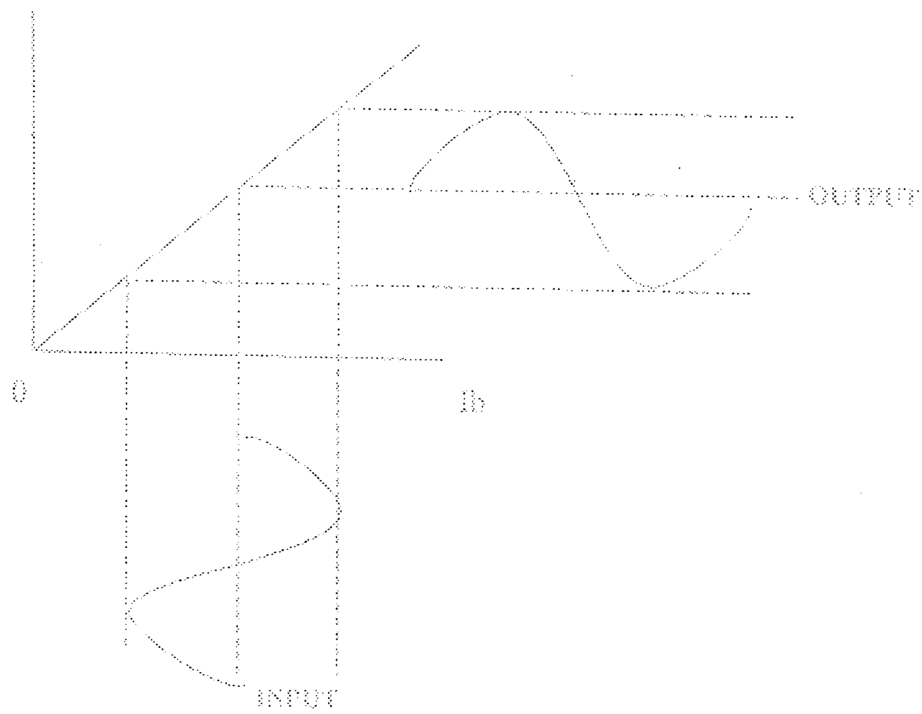


Fig. 1.3 Current in a Class A amplifier i.e. 360^0 conduction

CLASS B AMPLIFIER

The biasing of class B amplifier makes the operating point and the input signal to be such that the current flows in the output for half cycle of the input. This efficiency up to 78.5% in an ideal sense. The output is considerably distorted.

Ic



g. 1.4 Class B Amplifier i.e 180^0 Conduction.

LASS AB AMPLIFIER

class AB amplifier, output current flows for more than half cycle but less than a full cle of the input cycle. It therefore combine the characteristics of both class A and Class amplifier. It is a slight improvement on the class B amplifier, as cross-over distortion is minated in class AB the conduction is about 270^0.

ASS C AMPLIFIER

his class, the output current flows for less than one half cycle but more than 1 counter le, the typical conduction angle is 120^0 fig. 1.5 shows a load line for a class C rated device.

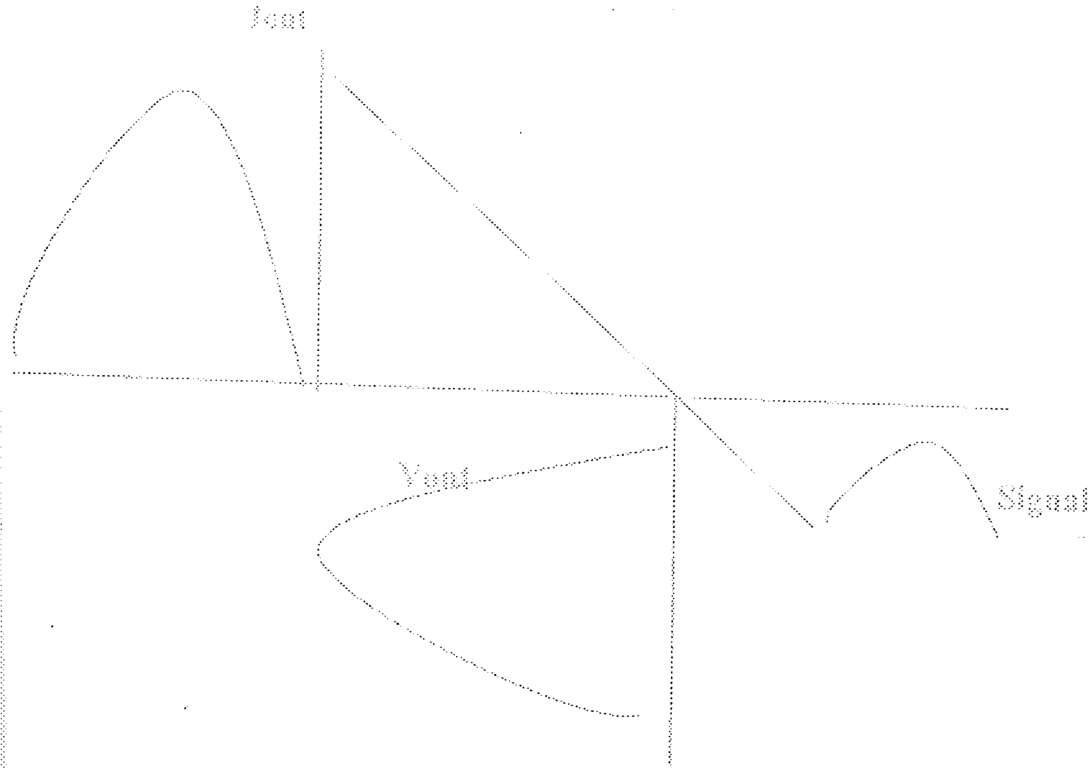


Fig.1.5 Class C amplifier

Class C has the highest efficiency among the classes. It is used in radio telephony and in many other communication circuit.

Highest in efficiency (η >85%).

CHAPTER TWO

2.1 SYSTEM DESIGN

The design approach that was adopted in this project work is the Top-Down design methodology. The design is broken into simpler modules and the stages are organized in a logical order for simplicity of analysis and synthesis. Fig. Below shows the block diagram of each stage of complete system.

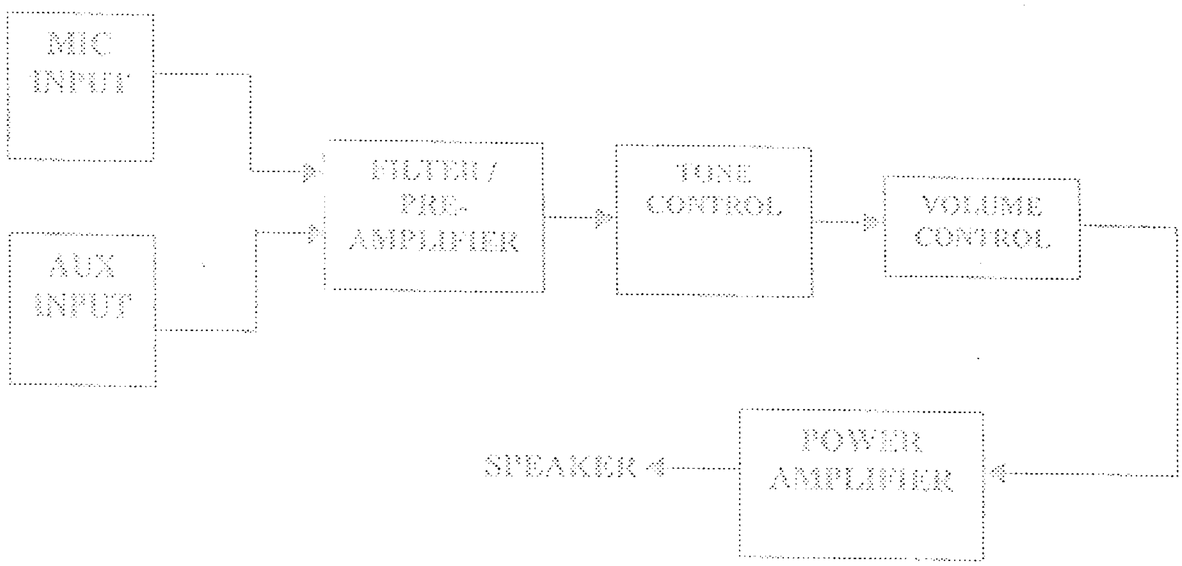


Fig. 2.1 Block Diagram of the Complete System.

2.2 OPERATING PRINCIPLE OF THE AMPLIFIER

The microphone converts the signal wave to electrical energy in the form of voltage at a very low level. The decoupling network serves to remove humming from the input signal while the next stage function as noise filter as well as Pre-Amplifier followed by tone control. This is basically a band-pass network.

For necessary volume variation, a volume control stage is incorporated and the next stage to that is the Power Amplifier stage. This stage provides the necessary signal Pre-amplification to raise the low level signal from the volume control to a higher level power, enough to drive the power stage. Differential amplifier is employed here because of its high throughput in terms of hum shielding. Feedback can also be easily effected with it.

2.3 POWER AMPLIFIER STAGE

This section consists of three stages, that is, the audio amplifier (Pre-amplifier), Driver and the Output which feeds a loudspeaker and they are connected together as shown in fig. 2.2

The (audio) signal is given to the following section through potentiometer R12 which is also used as a volume control.

The audio amplifier stage amplify the signal coming in through volume control and the output pin (6) is connected to pin 16 of the Driver stage (U10).

The driver stage further amplifies the (audio) signal obtained from the (U10) till it is large enough to drive the output stage.

Q1 (2N3055) and Q2 (2N3791), both transistors perform the work of the output stage and been taking from Pin II and 6 respectively.

The function of this stage is to amplify the (audio) signal received from the driver stage and hence provide sufficient power to drive the loudspeaker.

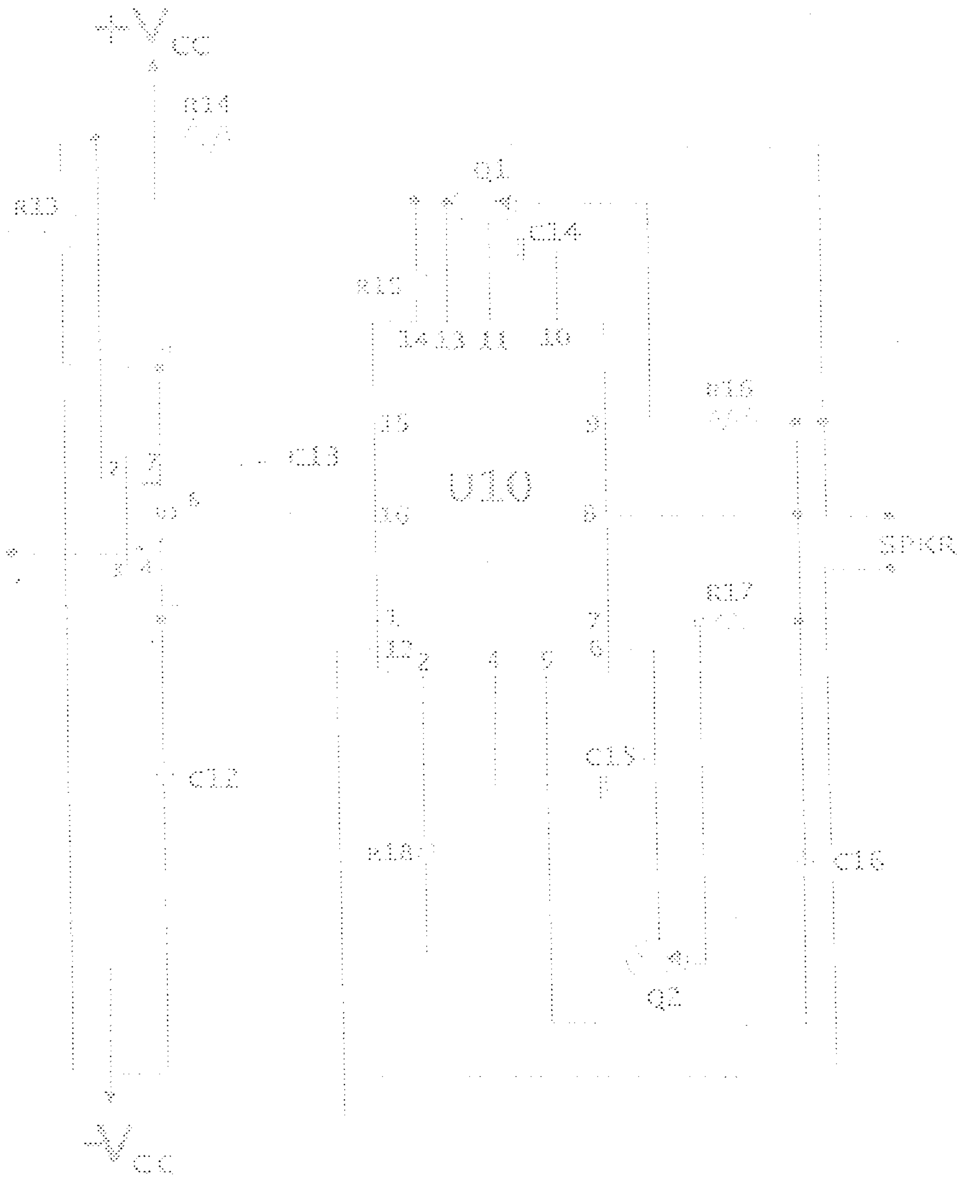


Fig. 2.2

2.2 : DESIGN OF THE POWER OUTPUT STAGE

In this power output, the complimentary symmetry Push-Pull Class-B amplifier is employed in this stage. As we know, a standard Class-B Push-Pull amplifier requires two Power transistors of the same type with closely-matched parameters. But the chief requirement of a complementary amplifier is a pair of closely-matched but oppositely-doped power transistor. The term "Complimentary" arises from the fact that one transistor is PnP type and the other is of npn type. They have symmetry i.e both are made with the same material and technology and have the same maximum rating.

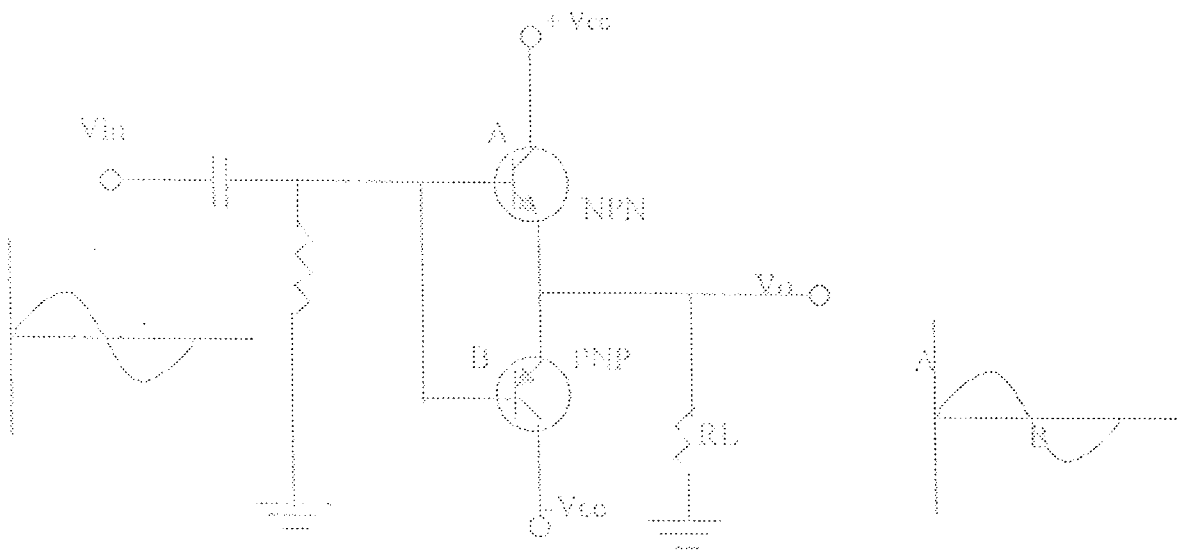


Fig. 2.3 (a)

The two transistors are complimentary to each other and operate as emitter-follower amplifiers. Emitter follower provide negative feedback, thus high stability is obtained. Good impedance matching is also obtained due to its low output.

From the above, fig. 2.3 (a) shows the output stage and the graphical representation.

To calculate the Input power, Output Power and the efficiency;

Input Power i.e. $P_{in} = V_{cc}.I_c/\pi$

And

$$I_c = V_{cc} / R_l$$

Ic = 25 / 8 = 3.125A

Therefore, Pin = 25 X 3.125 / 3.142

= <u>24.86W</u>

To calculate the output Power (Pout)

Pout = ½. Vcc . Ic / 2

= ½ (Vcc. Ic / 2)

= Vcc. Ic / 4

Pout = 25 X 3.125 / 4

= <u>19.53W</u>

To calculate the efficiency (ŋ)

ŋ = (Pout / Pin) X 100

= (19.53 / 24.86) X 100

= <u>78.5 %</u> this fall in Class B

The maximum power each transistor Q1 and q2 is to handle

Pq. Max = $Vcc^2 / \pi^2 RL$

= $25^2 / (3.142)^2$ X 8

= <u>7.916W</u>

The maximum Collector current for each transistor Q1 and Q2

Ic (max) = $(P2 (max) / RL)^{½}$

= $(50 / 8)^{½}$

= <u>2.5A</u> Per Transistor

The Direct current D.C coming into the transistor Q1 and Q2

$Idc = 2Vcc / \pi RL$

$= 50 / 3.142 \times 8$

$= \underline{1.988A}$

$= \underline{2.00A}$

Based on the above values, the transistors were chosen having power and current ratings for greater than the calculated values for safety of operations. Thus TIP 130 and TIP 135 were chosen using the reference data book.

For the base current of each transistor;

$Ic = hfe . Ib$

$Ib = Ic / hfe$

The hfe for both Q1 and Q2 is 0.4Ohms

$Ib1 = 2.5 / 0.5$

$= \underline{6.25A}$

$Ib1 = Ib2 = \underline{6.25A}$

Total biasing current for both transistors is:

$Ibt = Ib1 + Ib2$

$= 6.25 + 6.25$

$= \underline{12.5A}$

R_{23} and R_{24} was chosen to be 0.4Ohms as biasing resistor for both transistors.

$V_{R24} = I_{BT} \times R_{2}$

$= 12.5 \times 0.4$

= 5V   i.e   Voltage across resistor

Voltage across resistor 23 (R_{23})

$VR_{23} = Vcc - Vcc/2 - VR_{24} - 2V_{BE}$

$= 25 - 25/2 - 5 - 1.2$

$= 6.3V$

But, I_{EQ} flows through R_{23} also

Therefore,

$R_{23} = V24 / I_{EQ} = 5 / 12.5$

$= 0.4$ Ohm

R_{23}' = 0.4 Ohms which is the same with the given one i.e. R_{23}, R_{24} = 0.4 Ohms

2.5 THE VOLUME CONTROL

It is often necessary to provide a manual means for setting or adjusting the gain of an audio amplifier. A variable resistor serves as a good purpose in this respect. The main concern here is the placement of the variable resistance in a transistor circuit and the volume control was chosen to be 10K and placed between the tone control circuit and Power Amplifier circuit to prevent impedance Mis-matching.

2.6 THE TONE-CONTROL CIRCUIT

The tone control is basically a band pass filter. This circuit is incorporated to serve the purpose of tone controlling as well as noise filtering. As a tone control the frequency response of the amplifier is varied. This means that high-frequency (treble) or low-frequency (bass) are amplified to a higher or lesser degree.

As a noise filter, the circuit has a lower cut-off and higher cut-off frequencies. Any signal frequency e.g. noise that those not fall within this frequency band width is filtered away. The number of passive component is few, only capacitors C7 and C9 are needed for the frequency control. The schematic diagram of a tone-control circuit is given in Fig. 2.4

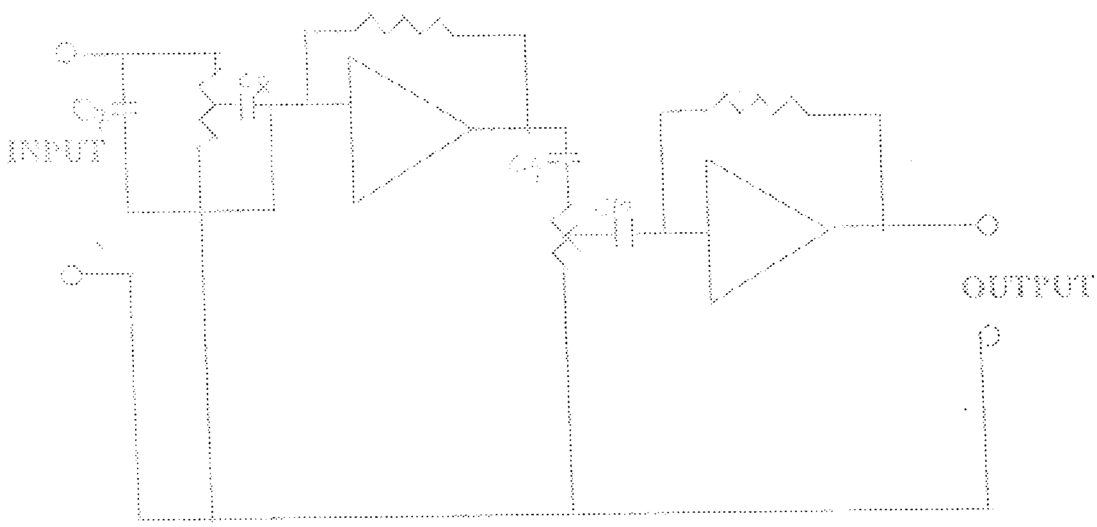


Fig. 2.4 THE TONE CONTROL

2.[illegible] FILTER- PREAMPLIFIER STAGE

This circuit is incorporated to serve the purpose of noise filtering as well as pre-amplifier. As a noise filter, the circuit has a lower cut-off and high cut-off frequency. Any signal frequency e.g. noise that does not fall within this frequency bandwidth is filtered away.

As a pre-amplifier is used to convert low level signal into higher level signals.

2.8 POWER SUPPLY UNIT

A symmetrical + or – 25V line powers this amplifier. The reason for this is that this enables the central (0V) potential to be earthed so that the amplifier can swing in either positive or negative direction.

And it provides a regulated output voltage of + or – 25V.

The circuit diagram of power supply unit in given fig. 2.5

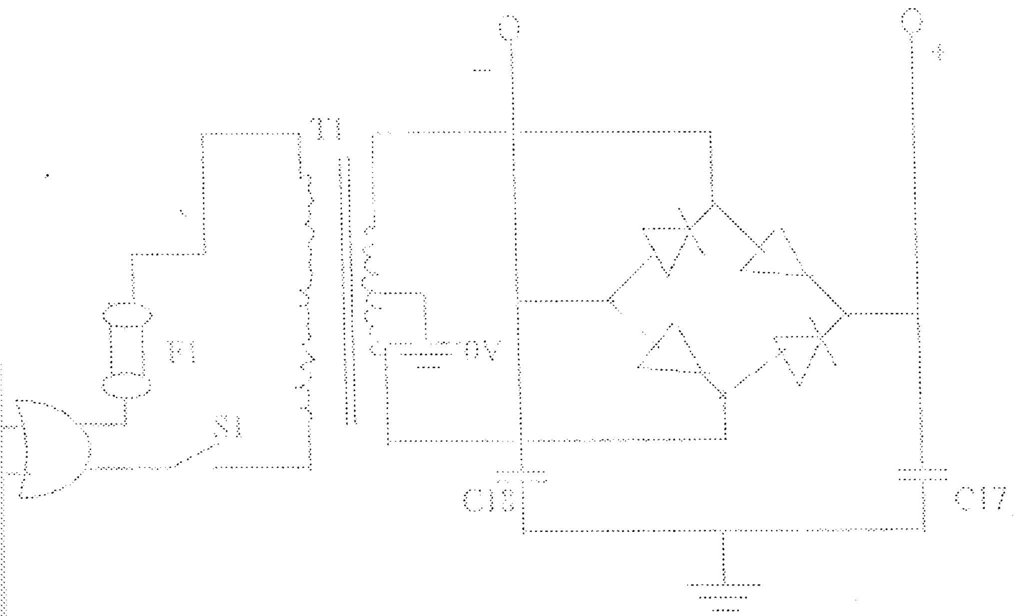


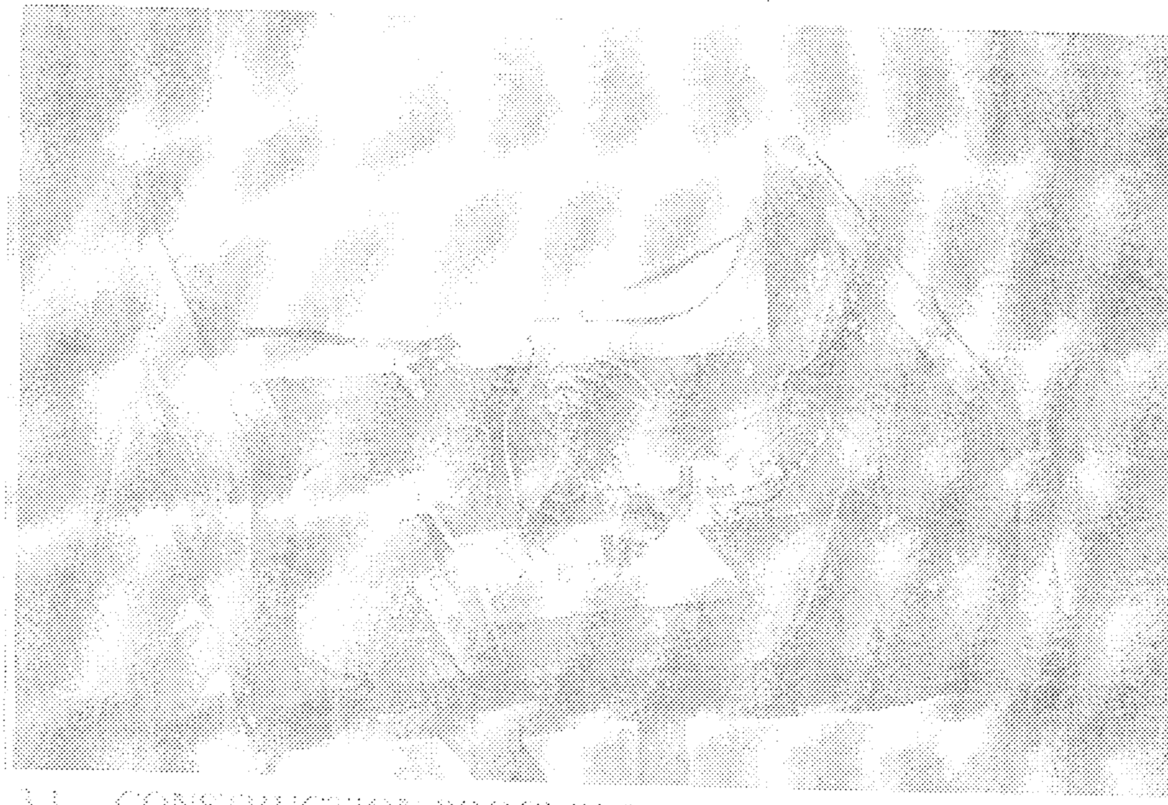
Fig. 2.5 POWER SUPPLY UNIT

The transformer employed is 240 / 2 X 25V Center tapped transformer is used for step down. The secondary voltage is rectified by a 250V 6A rated bridge rectifiers. rectifies the voltage and capacitors rated 10,000uF / 50V are used for smoothing.

CHAPTER THREE

3.0 CONSTRUCTION AND TESTING

Fig 3.1 Shows the proper inner view of the 50 Watts amplifier



3.1 CONSTRUCTION PROCEDURE

The construction of 50 Watts Audio Amplifier involved careful arrangement of the various components in each section as specified by design and inter connected for easy trouble shooting and maintenance as shown in Fig 3.1

3.2 TOOLS AND EQUIPMENT

a. Side Cutter,

b. Long Nose Pliers,

c. Soldering Iron,

d. Lead Sucker.

e. Digital Multi-meter,

f. Vero Board,

g. Connecting wires,

h. Metal Steel,

i. Signal Generator.

3.3 CONSTRUCTION DETAILS

A temporary work bench was setup and it had the following components and equipment listed above in section 3.2. For each stage of the construction, the components were carefully selected and collected together.

The components were first laid on the bread board to ensure its workability and then transferred to the Vero board. The components were assembled on the board and soldered according to the circuit diagram.

3.3.1 POWER AMPLIFIER STAGE

This stage (Transistor Driver and Power Transistors) were mounted directly on the Vero board, which serve as a link between the Vero board and the heat sink. The heat sink in turn was mounted directly on the back panel of the system.

The output of the audio power amplifier is connected to the positive side of the 8 ohms speaker while the negative of the speaker is connected to the ground.

3.3.2 PRE-AMPLIFIER STAGES

Each circuit that is, pre-amplifier (Microphone / Aux) Filter, Tone Control and Volume Control were mounted separately on the Vero board. Flexible wires were used to supply voltages to various points / units as demanded, also all other points / units were connected to another by using flexible wires. The capacitors being used through the connections is to reduce distortion for effective performance of the amplifier.

3.3.3 POWR SUPPLY UNIT

The power supply unit consists of center tapped transformer, rectifier, filter capacitors. all were constructed on Vero board except the transformer. And this stage is to converts the alternating current (AC) wave to direct current (DC).

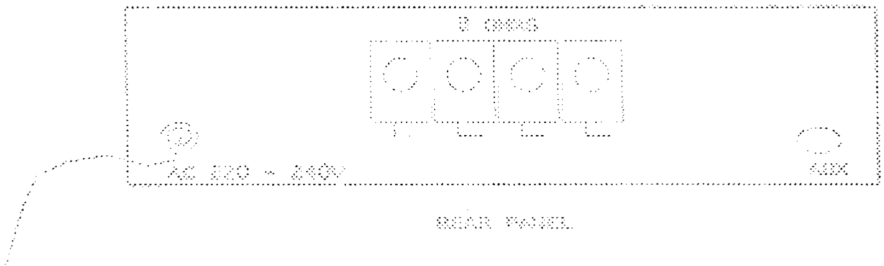
3.3.4 CONSTRUCTION OF THE CASING

The casing was constructed using metal sheet, on the front panel there are: ON / OFF Switch, Control Knobs (Volume, bass and treble) and jack input (Mics) and a jack input (aux) and jocket was mounted on the back of the amplifier case to provide connection of the speaker to the amplifier.

The front and rear view of the casing is shown below:

CASING DIAGRAM

FRONT PANEL



REAR PANEL

3.4 TESTING AND MEASUREMENT

A number of amplifier parameter can be measure using a signal generator and a cathode ray oscilloscope (C.R.O), but the more important ones as far as this project is concerned are the detection of distortion and the measurement of gain.

3.4.1 THE DETECTION OF DISTORTION:

The final stage in an amplifier handles the largest amplitude signal and it is therefore in this stage that signal distortion is most likely to occur. This is also possible in previous stage before the final voltage applied to the circuit is excessive; the output current and voltage swings will be large and will encroach into non-linear region of the output characteristics of the transistor. The effect of this to make the output signal waveform differs from the input waveform.

To determine the voltage which when applied to the input terminals of an amplifier, just causes distortion of the output waveform to become apparent, the circuit of the figure 3.4 should be used (Green, 1981).

The frequency of the generator should be set to the desired test value and the output voltage be steadily increased from zero until onset of distortion is noticed. The maximum input signal amplitude that the amplifier can handle without distortion is somewhat less than the value, which the distortion becomes evident.

3.4.2 THE MEASUREMENT OF AMPLIFIER GAIN.

The gain of an amplifier can be measured using the test circuit of the figure 3.4. The output voltage of the signal generator should be set to a value that will not produce distortion of the output signal waveform, and the generator frequency should be adjusted to the required test frequency. The gain of the amplifier is then the ratio output voltage/input voltage; these two voltages should preferably be measured with the same voltmeter since then the measurement will not be affected by meter accuracy. Feeding both voltage into a double beam oscilloscope and their magnitudes calculated from the oscilloscope can also carry this out.

3.4.3 GAIN/FREQUENCY CHARACTERISTICS

The gain/frequency characteristics of an audio frequency amplifier is known in the figure 3.3 and it is exactly that of the audio amplifier designed and constructed in this project since the shape corresponds to the readings obtained from the measurement made on the amplifier. It can be seen that the gain is constant hover the mid-frequency band and falls at both low and high frequencies as is expected. The bandwidth of an amplifier is the band of frequencies over which the gain is not more than 0.707 times the maximum gain.

3.4.4 RESULT:

From the measurement carried out to determine the gain of the amplifier and to determine the 0n-set of distortion, the following observations were made:

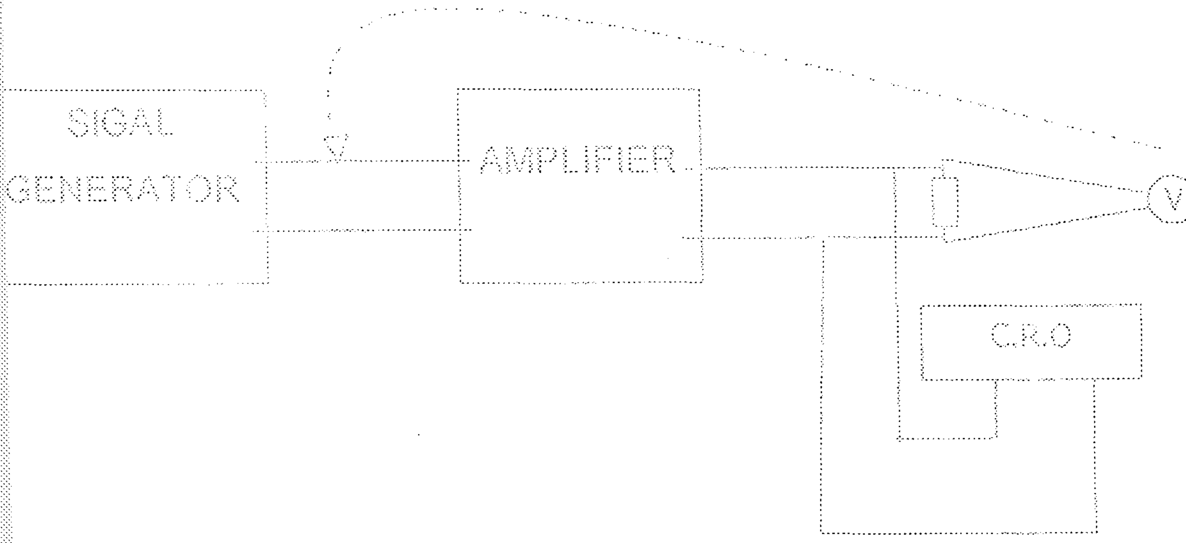
When signal were applied from a signal generator to the amplifier, there was no d stortion of any type until when the input signal was raised to 50 millvolts, at frequency of 100 Hz is 3.35V, giving a voltage gain of AV=65. The readings were taken by the calculation from the gain of the amplifier.

To measure the gain of the amplifier, it was observed that at 100Hz, when a signal of 25.0 milvolts was applied from a signal generation to the input terminals of the amplifier, the output signal was 5.25 volts. The amplifier – voltage gain (AV) from these readings is AV=210. The above voltage gain was obtained when negative feedback was not applied in the circuit and this brought about distortion. The output waveform was distorted and the need for negative feedback arises.

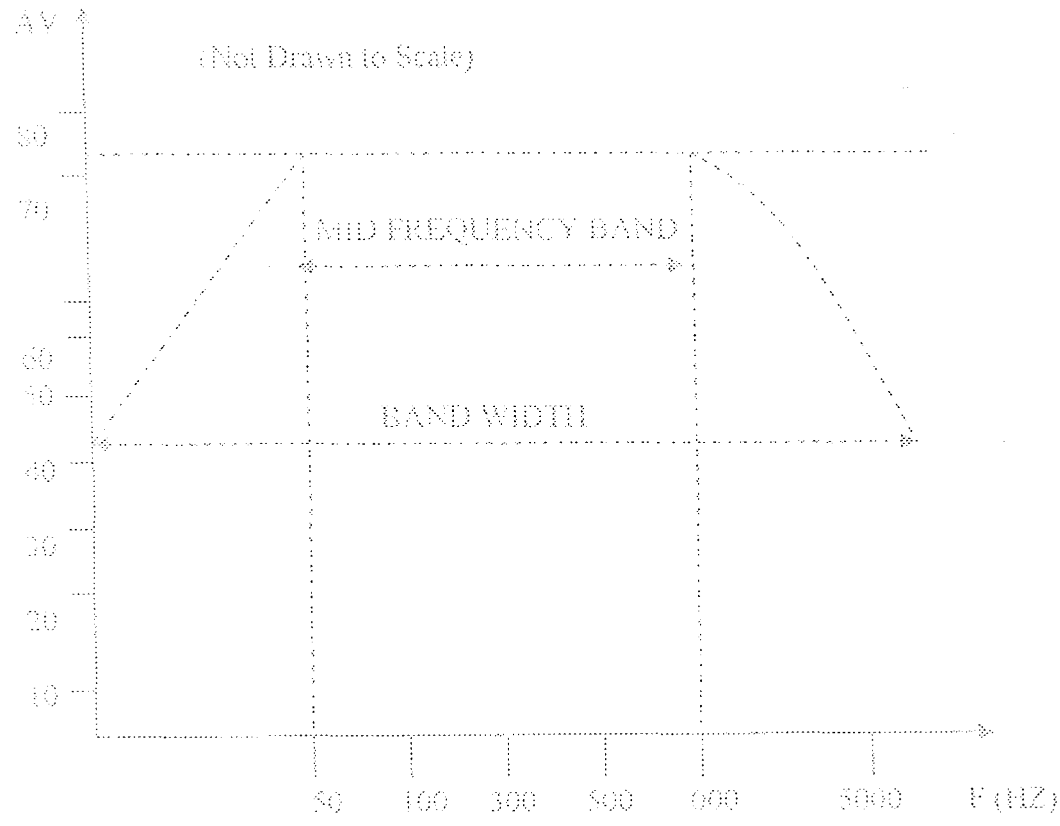
When negative feedback was applied, a signal input of 25.0 milvolts, at a frequency of 100Hertz, gave an output signal of 1.625 volts, giving a voltage gain of AV=65.

Several other readings were also observed at different frequencies and the results were as tabulated below. The results below were used to plot the gain/frequency characteristics graph of amplifier shown in the figure 3.5.

INPUT Signal (MV)	OUTPUT Signal (V)	FREQUENCY (HZ)	VOLTAGE Gain
25.0	0.791	25	32.0
25.0	1.030	50	41.2
25.0	1.377	75	55.1
25.0	1.625	100	65.0
25.0	1.852	200	74.1
25.0	1.900	300	76.0
25.0	1.926	500	77.0
25.0	1.936	700	77.4
25.0	1.941	900	77.6
25.0	1.943	1,100	77.0



3.4 THE CIRCUIT FOR MEASUREMENT OF AMPLIFIER GAIN/DISTORTION.



THE GAIN/FREQUENCY CHARATERISTIC OF THE AUDIO FREQUENCY AMPLIFIER

CHAPTER FOUR

4.0 CONCLUSION AND RECOMMENDATION

4.1 CONCLUSION

This Project "Design and Construction of a 50 Watt Audio Amplifier" achieved its objective within a reasonable degree of efficiency. The output is fairly constant within the frequency range of 64hz – 16Khz when tested with a signal from a signal generator. This agrees with the expectation. This project might be thought to be a simple task considering its commonness, but practically it is not so when the unavailability and market price of many components used had to be transported from far places and those that are readily available are too exorbitant in price

However, within the limit of available components used and experimental error, the aim of the project was reasonably achieved.

4.2 RECOMMENDATION

For future work on this project, a computer Aided Design may be employed, using packages like Tina, Electronic workbench or Spice for necessary simulation. Also an IC chip called TDA 2030 can also produce the needed 50 Watt Audio Amplifier.

This circuit can also be built as 50 Watts, 60 Watts, 80 Watts, 100 Watts Amplifiers. I appeal to the Federal Government to provide grant of substantial amount yearly for the technology students for the development and implementation of designed works.

4.3. References

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[3]. Thereja B.L; Theraja A.K. (Pp. 1828 – 1840).

[4]. Holt A. Charles (1978): Electronic Circuits: Digital and Analog. John Wiley and Sons, New York. Pp. 351 – 607.

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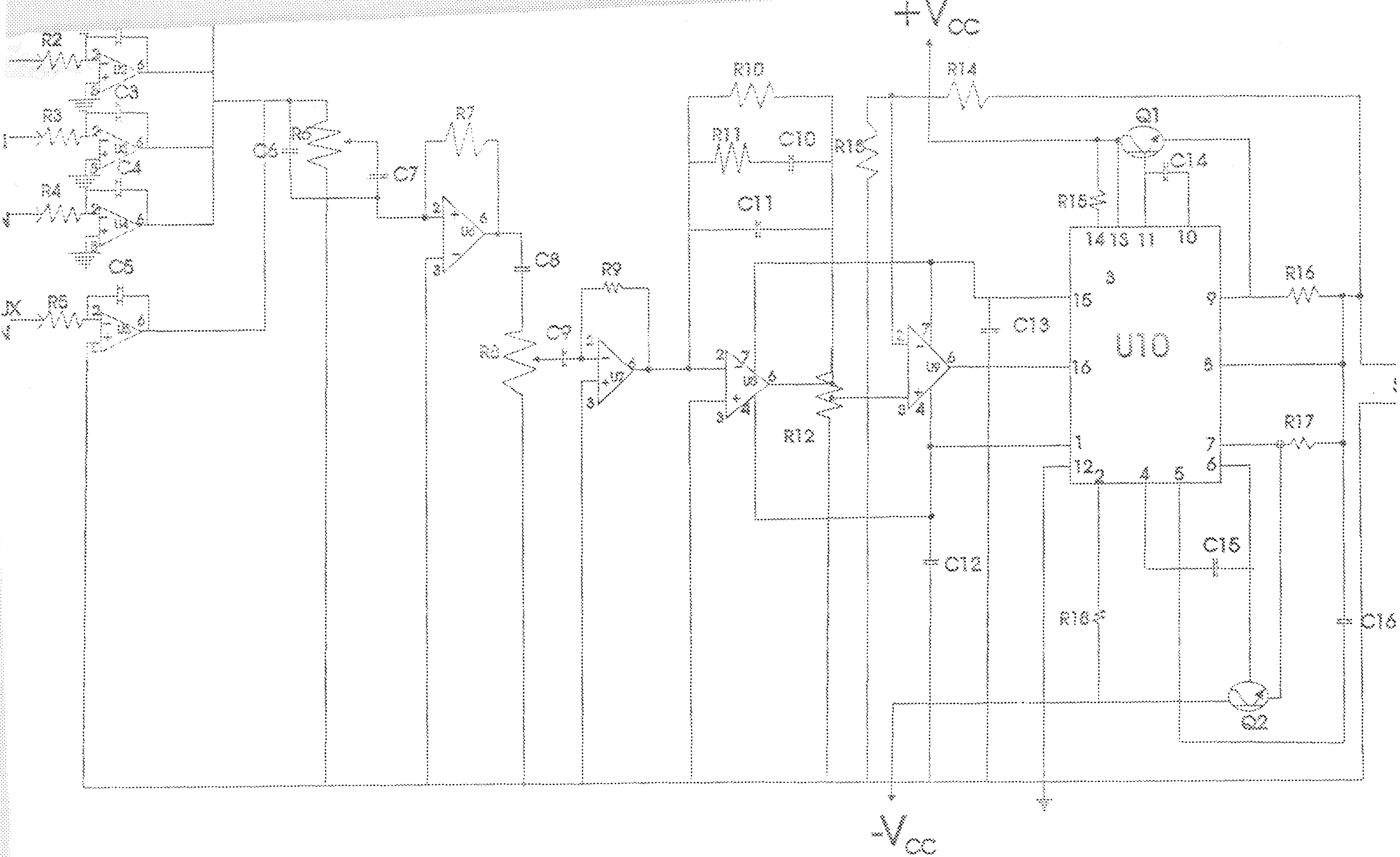
[6]. Watson J. (1996): Mastering Electronic, Fourth Edition, Macmillian Press Ltd, London.

TABLE OF THE COMPONENTS USED

COMPONENT	VALUE
R_1, R_2, R_3, R_4	51K ¼ W Resistor
R_5	47K ¼ W Resistor
R_6	10K pot,
R_7, R_9, R_{10}	200K Resistor
R_8	10K pot
R_{11}	30K ¼ W Resistor
R_{12}	10K pot
R_{13}	1K ¼ W Resistor
R_{14}	5K¼ W Resistor
R_{15} R_{18}	1Meg (5%) ½ W Resistor
R_{16}, R_{17}	0.4 ohm 5W Resistor
C_1, C_2, C_3, C_4, C_5.	0.3μF Capacitor
C_6	330nFCapacitor
C_7	10nF Capacitor
C_8	470μF Capacitor
C_9	1μF Capacitor
C_{10}	0.011μF Capacitor
C_{11}	3,750PF Capacitor
C_{12}, C_{14}, C_{15}	0.001μF Capacitor

C_{15}, C_{16}	1,000PF Capacitor
C_{17}, C_{18}	10,000µF 50volt Electrolitic Capacitor
U_1 U_2 U_3 U_4 U_5 U_6 U_7 U_8 U_9	741OP AMP
U_{10}	8,063AUDIO Amplifier Transister Driver
Q_1	2N3055NPN Power Transistor
Q_2	2N3791PNP Power Transistor
BRI	250v 6Amp Bridge, Rectifier
T_1	50v Center Tapped 5Amp Trans


+Vcc
-Vcc
R2
R3
R4
R5
C3
C4
C5
C6
R6
C7
R7
C8
R8
C9
R9
R10
R11
C10
C11
R12
R13
R14
C12
C13
U10
R15
Q1
C14
R16
R17
C15
R18
Q2
C16