

**COMPUTER AIDED DESIGN OF A MULTI STAGE
AMPLIFIER**

BY

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APPROVAL PAGE

This project has been read and approved and accepted has meeting the requirement of Mathematics and Computer, Federal University of Technology Minna, for the award of Postgraduate Diploma in Computer Science.

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DEDICATION

Dedicated to glory of God and the honour of my parents Mr. & Mrs. F. O. Adeoti

ACKNOWLEDGEMENT

My special thanks goes to God for the privilege giving to me undergo and complete this program. My profound gratitude goes to Mallam Audu Isah, my project supervisor who despite his tight scheduled spare time for me to see that this project come to a reasonable conclusion. Also to my entire lecturer I say thank you

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Finally I appreciate and acknowledge all my well wishers for their co-operation, Love, and understanding. May all your good labour of Love be rewarded.

ABSTRACT

This project work, computer aided design, for a multi-stage Amplifier was designed to make the design process of an Amplifier simple, reliable and user friendly. The system was implemented using Visual Basic language the stages of the Amplification process was limited to two and the self. Bias and common Emitter Amplifier configuration mode was used.

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CHAPTER ONE

1.0 GENERAL INTRODUCTION

1.1 INTRODUCTION

Computer aided design (CAD) OF A multistage amplifier is an expert system (a system that has been programmed by human expert to behave in a pre-design way or like a human specialist in an are of discipline) that is aimed at simplifying the design process of a Multi-stage Amplifier. With this system the designer's role is reduced to that of supplying his or her input requirements to the system and it will provide all the components parameter and specifications needed for the construction.

1.2 STRUCTURE OF COMPUTER AIDED DESIGN PROCESS

It is possible to identify some basic features common to most accounts of design process and to pick out some activities that are common to designer's job in any industries. The first activity is usually that of specification. Here the designer's task is set out, and the criteria for the performance of the design are laid down. The designer will probably be involved here in collecting different kinds of information about existing product of similar type, the potential market, the manufacturing constraints, Legal requirements and standard.

The second phase is that of generation or synthesis of alternative designs. This is the very heart of the design process, where the designer's creativity and inventive power are brought into play. Often, a new design may be only a modification of an existing artifact .We might call this ' evolutionary design ' in which small incremental changes

are made in each new generation of a certainty of product, or a new design created by permuting and recombining components or elements in anew configuration. In the extreme case, the result may be sufficiently novel in quality as a powerful invention

The third activities, is that of evolution and analysis. Here the alternative designs that have been generated, are tested in turn and compared, to see if they meet the specification. The test would probably be theoretical in the first instance made in the designer's imagination or by means of calculations. Later on, there may be practical tests made using physical models or actual prototypes.

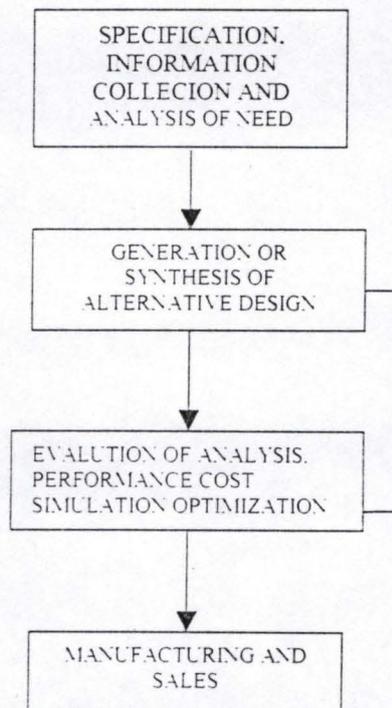


Fig 1.1 Schematic structure of Computer Aided Design Processes

1.3 THE CONCEPT OF AN AMPLIFIER

Amplifiers are electronic circuit which are designed to raise the current, voltage, or power level of the signal applied to their input. The input signal amplified may be direct or alternating. Basically, the essence of amplification is to make weak signal sufficiently strong to reach the range of human sensory organs or other monitoring mechanisms. Amplifiers are either connected in common emitter mode, common

collector mode or in the common base mode. but in each case the active device, for example transistor used must be properly biased in order to set them ready for operation.

Amplifiers can be classified in different ways depending on the main use to which it is put into. Thus an amplifier can be classified under

- Direct or Alternating signal Amplifier
- Voltage, current or power Amplifier
- Low or High frequency Amplifier
- Narrow or Wide band Amplifier.

The output and the input of an Amplifier are always related by a constant: that is, the gain of the Amplifier.

$$\text{Amplifier gain} = \frac{\text{Amplifier output}}{\text{Amplifier input}}$$

As the input increase the output also increase by a factor determined by the gain of the Amplifier.

1.4 MULTI-STAGE AMPLIFIER

When two or more Amplifiers are connected such that they have the same power supply and the output of one stage is connected to the input of the next stage. Such an arrangement is said to be in cascade. Amplifier can be cascaded in common emitter, common collector, and common base mode. When Amplifiers are cascaded the alternative name for such a circuit is termed **MULTI-STAGE AMPLIFIER**.

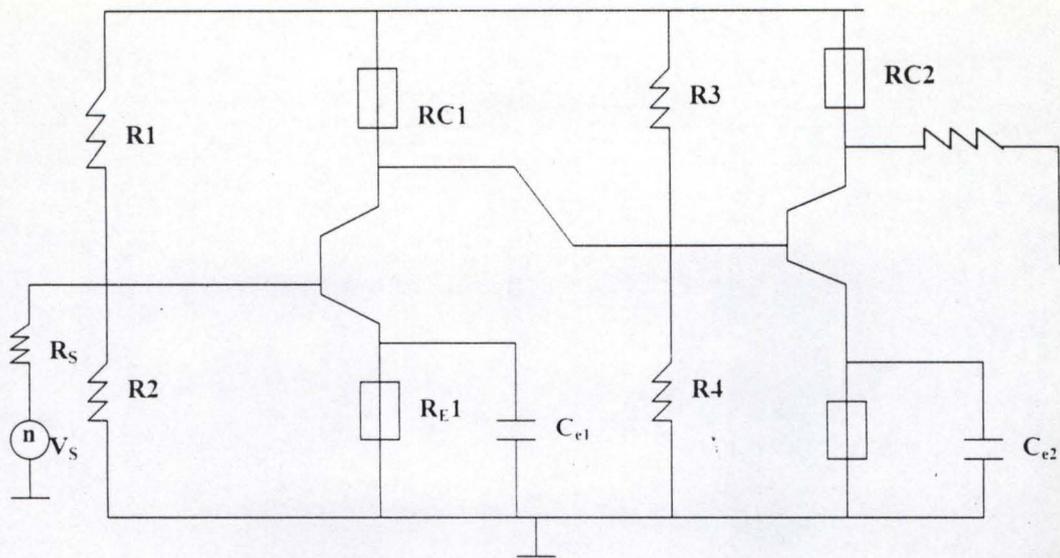


Fig 1.2 Schematic Diagram of a Multistage Amplifier

1.5 OBJECTIVE OF THE STUDY

The object of this project is to develop a computer Aided procedure for the design of a multistage Amplifier, which will be fast, efficient and easy to use without much knowledge of Electrical Engineering.

1.6 SCOPE OF THE PROJECT

Due to the constraints of time and resources, this project work will be limited to the use of transistor as the active device, the common emitter mode of configuration and two stages of amplification process

1.7 JUSTIFICATION FOR THE STUDY

Computer aided design involve any activity which make use of computer to develop, analyze or modify and simplify an engineering task. It helps to increase the productivity of the designer. This is accomplished by helping the designer to visualize the products and its component sub-assemblies and parts, and by reducing the time

design. These productivity improvements not only lower design cost but also shorter project completion time, and help to improve the quality of the design.

Computer aided design (CAD) system permits a more thorough Engineering analysis and a larger number of design alternatives can be investigated. Design error are also reduced through the greater accuracy provided by the system.

Finally computer Aided design also allows one to create a database for manufacturing parameters. In the process of creating the documentation for the project design, the required database to manufacture the project is also created.

1.8 METHODOLOGY

Computer Aided Design of an amplifier is a project that is aimed at simplifying the design process of a multi-stage amplifier with the aid of a computer system.

Manually, the designs of an amplifier have various Formular and steps that must be followed strictly.

However, for this work a program will be written using visual Basic Five

Programming language that will perform the design, do all necessary calculations and generate a report.

1.9 DEFINITION OF TERMS

- (1) **Configuration** – This is the method of arrangement of the transistor terminal with respect to the input signal to achieve either current voltage or power gain.
- (2) **Biasing** – This is the process of applying the appropriate direct current voltage to the terminals of the transistor.
- (3) **Terminals** – These are point of connection of a transistor. the terminals are collector, emitter and base terminals.

- (4) **Transistor** – This is an active electronic device, which can be used for amplification.
- (5) **Current** – this is the flow of electricity through or long a wire it could other be Direct (DC) or Alternating (AC).
- (6) **Base Emitter Voltage (VBE)**- This is the voltage across the Base and emitter terminals of the transistor.
- (7) **Collector Emitter Voltage (VCE)** – This is the voltage across the collector and he emitter terminals of the transistor.
- (8) **Quiescent point** – this is the point at which maximum Amplification output is obtained.
- (9) **Base Current (IB)** – this current flowing through the base terminal of the transistor.
- (10) **Collector Current (IC)** – this current flowing through the collector terminal of the transistor.
- (11) **Emitter Current (IE)** – this current flowing through the emitter terminal of the transistor.
- (12) **Bias Resistors (R1,R2,R3,R4)** - these are the resistors that supply the require bias voltages to the transistor terminal
- (13) **Collector Voltage (VC)** – this is the voltage across the collector terminal of the transistor.
- (14) **Emitter Voltage (VE)** - this is the voltage across the emitter terminal of the transistor.
- (15) **Base Voltage (VB)** - this is the voltage across the base terminal of the transistor.
- (16) **Quiescent Base Current (IBQ)** this is the current flowing through base terminal of the transistor at quiescent point
- (17) **Quiescent Collector Current (ICQ)** - this is the current flowing through collector terminal of the transistor at quiescent point
- (18) **Quiescent Emitter Current (IEQ)** - this is the current flowing through emitter terminal of the transistor at quiescent point

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 FUNDAMENTAL OF COMPUTER AIDED DESIGN [CAD]

Computer aided design [CAD] involve any type of design activities which make use of computer of develop, analyses or modify an engineering procedure. Modern CAD system also know as CAD/CAM system are base on interactive computer graphics [ICG]. Interactive computer graphics denotes a user-oriented system in which the computer is employed to create, transform and display data in the form of pictures or symbols. The user in the computer graphic design system is the designer, who communicates data and commands to the computer through any of several input devices. The computer communicates with the users via a monitor.

The typical ICG system is a combination of hardware and software, the hardware includes a central processing unit (CPU), One or more workstation and peripheral devices such as printers plotters and drafting equipment. The software consists of the computer program needed to implement graphics and data processing on the system. The software would also typically include additional specialized application program to accomplish the particular engineering functions required by the User Company. It is important to note the fact that the interactive computer graphics system (ICG) is one component of computer aided design [CAD], the other major component is the human designer.

2.2 HISTORICAL PERCEPTIVE OF COMPUTER AIDED DESIGN (CAD)

The evolution of computer-aided design has been largely related to development in computer graphics. However, interactive computer graphics [ICG] forms the essential technological foundation for CAD. One of the significant initial projects in the area of computer graphics was the development of APT Language, an acronym for automatically programmed tools. Although the development of APT was an important milestone in the field of computer graphics the earlier use of it was not accomplished interactively.

Another concept that took form during the early 1950's was 'Light pen', which was used to identify a particular sector of the cathode ray tube [CRT] screen. Despite all these advancement one cannot directly linked the development of computer aided design any of them. But however, if a single historical point of origin of CAD were to be located, then it would surely have to be the revolutionary SKETCHPAD SYSTEM development by Ivon Sutherland at the Massachusetts institute of Technology [MIT] in 1965.

Computer have been used before then for making analytical calculations in Engineering design, what was new in SKETCHPAD was that the designer could for the first time interact with the computer graphically, via the medium of display screen and Light pen. Sutherland first version of SKETCHPAD was limited to drawing in two dimensions. A later version of the system by T.E. Johnson in 1963 allows for the object to be module in the three dimensions. So that perspective view could be display of the design from different viewpoint.

During the 1980's CAD spread widely into the various application areas such as, graphics and textile design, television and film animation, typography and Engineering. It uses software such as SPICE-CHEMICAD, MATHCAD, ELECTCAD, AutoCAD and most of the programming Languages available today like visual Basic, Fortran and Pascal e.t.c. which are very common among industrial design engineers and experts.

2.3 AMPLIFIER CONFIGURATION

Amplifier circuit using junction transistors can be categorized [configured] depending on which terminal is common to both the input and output. The configuration, are

1. Common base
2. Common collector
3. Common emitter.

In the common base configuration, the base terminal of the transistor is common to both the input and the output. While in the common collector configuration, the collector is common to both the input and the output. In the common emitter configuration the emitter terminal is common to both the input and the output.

2.4 DIRECT CURRENT BIASING

Active devices like transistors must be properly biased in order to set them ready for operation, such as amplification of signals. The result of biasing is that a certain

condition of DC current and voltage is achieved. This gives the operating point (Q-POINT).

There are different types of direct current biasing circuit, among of which are the fixed biasing, voltage feedback biasing and self biasing circuits.

2.4.1 FIXED BIASING METHOD

The circuit diagram of a fixed bias method as shown in fig 1.3. Consist of a large base resistor R_B which fixes the quiescent collect-emitter voltage, V_{CEQ} and the power supply voltage V_{CC} which supplies the necessary biasing voltage. The input section consists of R_B , V_{CC} and the internal base emitter voltage V_{BE} . Thus, the Kirchhoffs voltage law for this section is

$$V_{CC} - I_B * R_B - V_{BE} = 0$$

from the above equation

$$I_{BQ} = \frac{V_{CC} - V_{BE}}{R_B}$$

I_{BQ} is the base current flowing at the quiescent point [Q-point] of the transistor. Once R_B is known then I_{BQ} is also known as fixed.

The output section of the circuit comprises of the collector resistor R_C , the supply voltage V_{CC} , and the collector emitter voltage V_{CE} . The Kirchhoffs voltage law for this section is

$$V_{CC} - I_C * R_C - V_{CE} = 0$$

Thus at Q-point, the collector-emitter voltage V_{CE} . Equals

$$V_{CEQ} = V_{CC} - I_{CQ} * R_C$$

The quiescent collector current, I_{CQ} can be obtain from the relationship

$I_{CQ} = B \cdot I_B$, where B is the current gain of the amplifier.

The operating point Q of the transistor for the fixed bias method has been determined as

$$V_B = \frac{R_2}{R_1 + R_2} \cdot V_{CC}$$

$$V_E = V_B - V_{BE}$$

$$I_{EQ} = \frac{V_E}{R_E}$$

$$I_{CQ} = \alpha \cdot I_{EQ} = \frac{\beta}{\beta + 1} \cdot I_{EQ}$$

$$I_{BQ} = I_{EQ} - I_{CQ}$$

$$V_{CEQ} = V_{CC} - I_{CQ} \cdot R_C - I_{EQ} \cdot R_E$$

$$Q(I_{BQ}, I_{CQ}, V_{CEQ})$$

The fixed biasing method is very simple and makes use of minimal number of components. In addition, the operating point is independent of V_{BE} . However, the thermally generated leakage current I_{CBO} is not controlled; hence the operation of the circuit can lead to thermal runaway. Also the current gain B increases with temperature and with collector current I_C (Beta Spread) thus leading to instability at the quiescent point (Q-point).

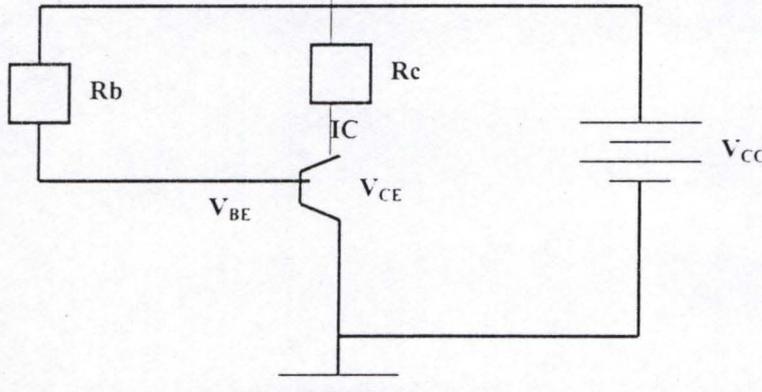


Fig 1.3 Schematic Diagram of a fixed bias method

2. 4.2 VOLTAGE – FEEDBACK BIASING METHOD

In the voltage feedback biasing, part of the collector voltage (Output voltage), VCE is fed back to the base as base current IB through a large resistor RB, hence a negative feedback is employed. This circuit provides a better Q – point stability than the fixed

bias circuit. This is because the collector current, I_C increases with the ambient temperature, thereby reducing the base current and the reduction in the base current, which will finally reduce the collector current. Therefore, the effect of thermal runaway is eliminated.

The quiescent current [I_{CQ} , I_{BQ}] and voltage [V_{CEQ}] values can be calculated from the following expressions

$$I_{BQ} = \frac{V_{CC} - V_{BE}}{R_B + R_C}$$

$$V_{CEQ} = V_{CC} - I_{CQ} * R_C$$

$$I_{CQ} = \beta * I_{BQ}$$

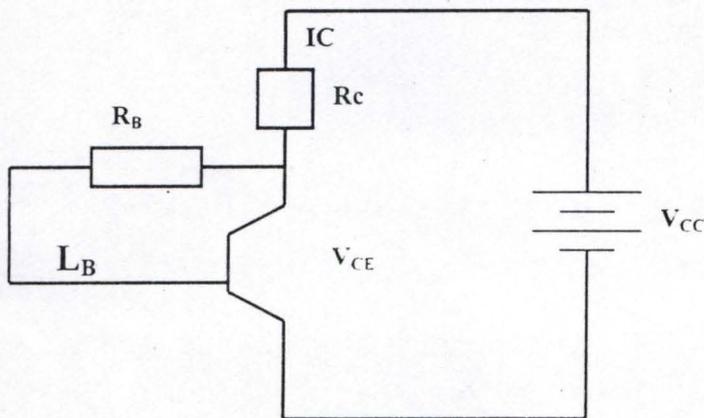


Fig 1.4 Schematic Diagram of a voltage feedback bias method

2.4.3 THE SELF BIAS METHOD

The self bias method as illustrated in fig 1.5 employ two Base resistors R_1 and R_2 which fix the value of the quiescent base voltage V_{BQ} . As a result, the emitter current I_E increases, while the base emitter voltage V_{BE} and the base current I_B reduces. Hence, the variation of the collector current with changes in temperature is reduced.

The self-biasing circuit offers better Q- point stability than both the fixed-bias and the voltage- feed back bias circuits since the quiescent currents and voltages are

independent of β . The stability is attributed to the emitter resistor, R_E , which serves as a negative feedback network. It, however, reduces the alternating current [AC] gain of the circuit.

This is why large BY-PASS CAPACITOR, C_E , is normally connected across R_E . The capacitor, therefore, maintains direct current D.C. stability without reducing the AC gain of the circuit.

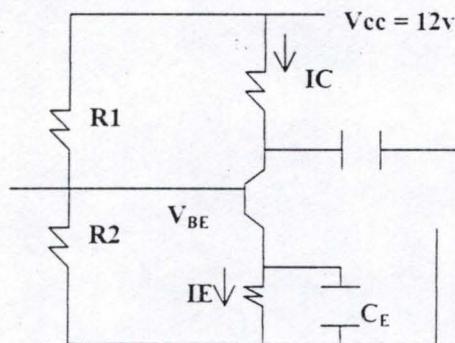


Fig 1.5. Schematic Diagram of a self bias method

CHAPTER THREE

3.0 SYSTEM ANALYSIS

3.1 INTRODUCTION

This chapter covers the system design analysis and it is necessary to define the term.

System analysis is the practice of evaluating an existing system, [design procedure] to see how it works and how it meets users need. The system is analyzed with the aim of Looking at the lapses and suggesting a better alternative for achieving the goal.

For this design (Multi Stage Amplifier) the self bias mode configuration will be analyze

3.2 INPUT REQUIREMENT

This are the known parameters the designer needs to work on to get the required specification rating for the amplifier. These are usually influenced by the output requirement. The input requirements are

- Supply voltage: V_{cc}
- Input signal: V_s
- Collector current: I_c
- Base emitter voltage: V_{BE}
- Amplifier gain [un-bypass]: A_V
- Source resistance: R_s
- Load resistance: R_L
- Audio frequency: f_L

3.3 OUTPUT REQUIREMENT

The output requirements are what the designer is expecting at the end of the design work. It is necessary to consider what is required from the system before deciding on how to go about it. For this design the output requirements are

- Emitter resistances; R_{E1}, R_{E2}
- Collector Resistances; R_{C1}, R_{C2}
- Biased resistances; R_1, R_2, R_3, R_4
- Bypass capacitor; C_{E1}, C_{E2}

3.4 PROCEDURE

These are steps, which unify the whole design process. It links every process together to produce the desired result.

Considering the circuit in fig 1.2 when RE is unbypass

$$\frac{R_C}{R_E} = A_R \dots\dots\dots 1$$

$$R_C = A_V * R_C \dots\dots\dots 2$$

Considering the KVL for the output Loop

$$V_{CC} = I_C * R_C + V_{CE} + I_E * R_E \dots\dots 3$$

Assume $I_E \approx I_C$ Then

$$V_{CC} = I_C * (R_C + R_E) + V_{CE} \dots\dots 5$$

For maximum output $V_{CE} = \frac{1}{2} V_{CC}$

Equation 5 becomes

$$R_C + R_E = \frac{V_{CC}}{2 * I_C} \dots\dots\dots 6$$

Since $R_c = A_V * R_E$ Equation 6 becomes

$$A_V R_E + R_E = \frac{V_{CC}}{2I_C} \dots\dots\dots 7$$

$$R_E = \frac{V_{CC}}{2I_C * (A_V - 1)} \dots\dots 8$$

$$V_E = I_E * R_E = I_C * R_E \dots\dots\dots 9$$

$$V_2 = V_E - V_{BE} \dots\dots\dots 10$$

Using voltage divider rule at the base loop

$$V_2 = \frac{R_2 * V_{CC}}{R_1 + R_2} \dots\dots\dots 11$$

$$R_2 = \frac{V_2 * R_1}{R_1 + R_2} \dots\dots\dots 12$$

$$\text{For better stability } R_2 = 5R_E \dots\dots 13$$

$$R_1 = \frac{R_2 * (V_{CC} - V_2)}{V_2} \dots\dots 14$$

Considering the base Loop

$$V_{CC} = V_1 - V_2 \dots\dots\dots 15$$

$$V_1 = V_{CC} - V_2 \dots\dots\dots 16$$

$$I_R * R_1 = V_{CC} - V_2$$

$$I_{R_1} = \frac{V_{CC} - V_2}{R_1} \dots\dots\dots 17$$

$$I_{R_2} = \frac{V_2}{R_2} \dots\dots\dots 18$$

$$I_{B_1} = I_{R_1} - I_{R_2} \dots\dots\dots 19$$

$$B_1 = \frac{I_C}{I_B} \dots\dots\dots 20$$

$$h_{ie} = B * \frac{V_S}{I_E} \dots\dots\dots 21$$

$$R_{in} = R_1 // R_2 // h_{ie} \approx h_{ie} \dots\dots 22$$

$$\text{Voltage gain} = \frac{B \cdot R_L}{h_{ie}} \dots\dots 23$$

$$CE = \frac{10}{2\pi \cdot FL \cdot RE} \dots\dots 24$$

3.41 MANUAL CALCULATION

Given that $I_C \approx I_E$, $V_{cc} = 12V$, $I_C = 2 \cdot 10^{-3}$, $A_v = 8$ and that the two transistors are identical

Considering The Kirchhoffs voltage law (KVL) for the output Loop

$$V_{cc} = I_C \cdot R_C + V_{ce} + V_{EE}$$

$$\text{But } V_{CE} = \frac{1}{2} V_{CC}$$

$$R_C + R_E = \frac{V_{cc}}{2 \cdot I_C}$$

$$R_C + R_E = \frac{12V}{2 \cdot 2 \cdot 10^{-3}} = 3000 \Omega \dots\dots\dots 1$$

When the emitter R_E is unbypassed

$$\frac{R_C}{R_E} = \text{Voltage gain } A_V$$

$$\frac{R_C}{R_E} = 8$$

$$R_C = 8 \cdot R_E \dots\dots\dots 2$$

By substituting R_C in equation 1 gives

$$8R_E + R_E = 3000$$

$$9R_E = 3000$$

$$R_E = 333 \Omega$$

$$R_E = 333 \Omega \dots\dots\dots 3$$

Since

$$R_C = 8R_E \text{ then}$$

$$R_C = 8 \times 333 = 2664 \Omega$$

$$RC \approx 2.664KM$$

The voltage across RE = VRE

$$VRE = IE \times RE = 2 \times 10^{-3} \times 333 = 0.666V$$

Let the voltage across R2 be V2

$$V2 = VE - VBE$$

When VBE = 0.6V

$$V2 = 0.6 - 666$$

$$V2 = 1.266V \dots\dots\dots 4$$

Using potential divider rule

$$V2 = \frac{R2}{R1 + R2} \times Vcc \dots\dots\dots 5$$

$$1.266 = \frac{R2 \times 12}{R1 + R2} \dots\dots\dots 6$$

$$\frac{R2}{R1 + R2} = 0.1055$$

$$R2 = 0.1055 (R1 + R2)$$

$$R1 = 0.8945 * R2 \dots\dots\dots 7$$

For better stability R2 ≈ 5RE 8

Since RE = 333

$$R2 = 5 * 333 = 1665 \Omega$$

From equation 7

$$R1 = 0.8945 * 1665 = 1489.$$

$$CE = \frac{10}{2\pi \times FL \times RE} = \frac{10}{2 \times 3.142 \times 16 \times 333} = 0.0002987 \text{ Farad.}$$

Since the two transistor are identical

$$R1 = R3 = 1489.3 \Omega$$

$$R2 = R4 = 1665\Omega$$

$$R_{E1} = R_{E2} = 33\Omega$$

$$R_{C1} = R_{C2} = 2664\Omega$$

$$C_{E1} = C_{E2} = 0.0002987 \text{ Farad.}$$

Summary of the Result for the Manual calculation

Input parameter

Gain	Supply voltage	Emitter voltage	Input signal	Audio frequency	Load resistance	Collector current
8	12	0.6	0.02	16	1kn	2mA

Calculated parameter (Output)

$$R_1 = R_3 = 1489.3\Omega$$

$$R_2 = R_4 = 16653\Omega$$

$$R_{E1} = R_{E2} = 333\Omega$$

$$R_{C1} = R_{C2} = 2664\Omega$$

$$C_{E1} = C_{E2} = 0.0002987 \text{ Farad.}$$

CHAPTER FOUR

4.0 SYSTEM DESIGN AN IMPLEMENTATION

4.1 INTRODUCTION

System design and implementation is the process of converting the requirement specifications into the system requirement, coding, testing and documenting programs in the system. Its involves the development of quality assurance procedures, including data security, backup, and system controls. This also involves testing the programs with both artificial and life data, training users and operating personnel.

4.2 PROGRAMMERS DOCUMENTATION

This explains the details of the programs (Package) for any programmer who may wish to make future modification. The programmer documentation provided for these packages are:

- (1) Program operation flowchart
- (2) Source code

The above documents provide the programmers with the detailed description of how the package is designed and implemented. The flowchart for the system is in appendix A while the source code is in appendix B.

4.3 CHOICE OF PROGRAMMING LANGUAGE

Visual Basic V is used for this project work. This is chosen because of its object oriented programming nature. Just as the nature suggest a big part or portion of the programming is done visually. This means that during design time you are able to see

how your program will look during the run time. This is a great advantage over other programming languages, because you are able to change and experiment with your design until you are satisfied with the colours, size and images that are included in the program. Visual basic becomes the choice of many because it is a language programmed in windows environment and makes available to user all the benefits imbedded in windows operating system.

Writing programs in visual basic involve two steps

- (1) The Visual programming step
- (2) The code programming step.

To do the visual programming, you don't have to do any code writing. All you have to know is how to operate and use the software tool. While, in the code-programming step you write programs using text editor. Writing code with visual basic is similar to writing code for other programming languages. However, writing code with visual basic is easier.

4.4 SYSTEM DESCRIPTION

This system(Computer Aided Design for a Multi-Stage Amplifier) is made up of three basic units, namely:

- (i) The Input Unit
- (ii) The Output Unit
- (iii) The Control Unit

The input unit consists of a number of text and combo boxes where the input parameters are to be specified, while the output unit is where the calculated

parameters will be displayed. The control unit is made up of a number of control keys that control the design operation. These control keys are:

- ◆ Design: use for designing
- ◆ Save: for saving the design parameters
- ◆ Clear input: for deleting the text and combo boxes.
- ◆ Edit: for editing the input parameters.
- ◆ Browse: for previewing previous design parameter
- ◆ Back: to return back to the opening screen
- ◆ Print: for printing the design parameter
- ◆ Cancel: for removing the design parameter completely from the database.

However, it must be noted that without activating in Add control key the text and combo boxes will not be activated. Once the program is loaded the splash screen will be displayed. On the screen is two control keys: namely: the open and the close button. To use the program you click the open button using the mouse, this will take you to the design screen where the design is carried out. To exit the program finally you click on the command.

4.5 HOW TO USE THE PACKAGE

Before the package is used the following directory should be created:

compusofttech/wole/design, then the following sequence should be followed for an effective and optimum operation.

Load the program

Run it

- (a) Click on open button
- (b) Click on the Add button
- (c) Input the BathNO and click OK
- (d) Input the input parameter
- (e) Click on the design button to calculate the output parameter.
- (f) Click on the button save the design parameter or on cancel to delete it.
- (g) Click on Browse to view the design parameter
- (h) To edit or change any of the input parameter you click on the edit key.
- (i) Click on the exit button to end the design work.

4.6 HARDWARE AND SOFTWARE REQUIREMENTS

For efficient and effective operation of this system, the following hardware's and software are needed.

- a) Pentium 233MH above microprocessor computer with about 32MB RAM. 4.3GB Hard disk. 3.5 inches disk drive and a super Video graphic adapter (SVGA) monitor.
- b) Windows operating system (pre-installed in the above computer) version 95 and above.
- c) Suitable and good anti-Virus program software package e.g. Dr Solomon's anti-Virus toolkit version 7.5(Latest Edition)
- d) Visual Basic V and Microsoft access 97 for database storage packages.(Because of Its large storage ability)
- e) DeskJet or Laser jet printer HP series.

- f) Un interruptible powers supply (UPS) system connected to the computer system to safe guard against sudden power failure from the main power source.

4.7 SAMPLE DATA AND EXPECTED RESULT

INPUT REQUIREMENT	SAMPLE DATA		
NAME	ONE	TWO	THREE
Supply voltage V_{cc}	13v	12v	10v
Input signal V_s	0.01v	0.02v	0.04v
Unbypass gain1 AV_1	8	8	10
Unbypass gain2 AV_2	9	8	12
Collected current1 IC_1	2mA	4mA	3mA
Collected current1 IC_2	2mA	4mA	5mA
Source Resistance R_s	1kn	1kn	2kn
Load Resistance R_L	1kn	1kn	1kn
Audio frequency F_L	20Hz	20Hz	18Hz
Basic emitter voltage1 V_{BE_1}	0.6v	0.6v	0.6v
Base emitter voltage 2 V_{BE_2}	0.6v	0.6v	0.2v

OUTPUT REQUIREMENT	EXPECTED DATA		
NAME	ONE	TWO	THREE
Emitter – Resistance 1 RE_1	0.36kn	0.17kn	0.15kn
Emitter- Resistance 2 RE_1	0.33kn	0.17kn	0.08kn
Collector- Resistance1 RC_1	2.88kn	1.36kn	1.50kn
Collector- Resistance2 RC_2	2.99kn	1.36kn	0.96kn
Biased- Resistance 1 R_1	15.97kn	7.12kn	6.39kn
Biased- Resistance 2 R_2	1.80kn	0.85kn	0.75kn
Biased- Resistance 3 R_3	15.37kn	7.12kn	6.27kn
Biased – Resistance 4 R_4	1.65kn	0.85kn	0.40kn
Bypass capacitor 1 CE_1	0.22mf	0.58mf	0.59mf
Bypass capacitor 2 CE_2	0.24mf	0.58mf	1.1

CHAPTER FIVE

5.0 EVALUATION AND SUGGESTION FOR FURTHER STUDIES

5.1 EVALUATION OF THE NEW SYSTEM

This refers to the review of the system for the reasons:

1. To ensure that the outlined goals and objectives for which the new system is developed are adequately met
2. To ensure an adequate optimization and utilization of the new system .
3. To arrest unforeseen problems that may arise while the new system is in operation.

The evaluation of this computer aided design for a multi-stage amplifier is done in two ways:

- (a) Workability of the new system
- (b) Limitation of the new system

5.1.1 WORKABILITY OF THE NEW SYSTEM

For the new system to be workable, the manual system has to be replaced by installing the new system. However, the problem arises as to how the changeover is to be effected such that there's minimum interruption in the normal running of the former system. Even though the new system has been properly tested at the development stage, one cannot be too sure that every thing will work fine when it is finally installed because a system might fail for one reason or another at any time. Methods that can be employed to change over from the present system to the new system are:

(a) Dual system method: this requires that the existing system be gradually phased out as the new system is gradually phased in.

(b) Direct method: this requires a complete, one-time changeover from the existing system to the new system.

(c) Parallel systems method: requires the simultaneous operation of both the new and the existing system until such a time that the new system is adjusted to work effectively.

(d) The pilot system: requires that a small portion of the new system be implemented and evaluated (by parallel, dual or even inventory method) while the major portion of the work load continues to be processed via the succeeds, the entire existing system can be converted to the new system.

Another factor that is necessary for the workability of the new system is to train the users how to operate the new system properly.

5.1.2 LIMITATION OF THE NEW SYSTEM

- 1.) Although the new system (computer aided design for a multi-stage amplifier) is fast and efficient, it's efficiency still depend on the initial design, that is the requirement specification. If this is faulty the new system too will be faulty.
- 2.) The new system is developed to operate only in one-way; calculating the output parameters from the input parameters and not vice-versa.
- 3.) The new system is developed using self-biasing mode configuration only.

5.2 SUGGESTION FOR FURTHER STUDY

- 1) The amplification for this project work is limited to two. For further work more stages should be incorporated.
- 2) For this project work the self-bias mode is used. For further study other bias mode should be used along side with it to be able to compare their effectiveness.
- 3) The design procedure should be in both ways that is from input to output and from output to input.

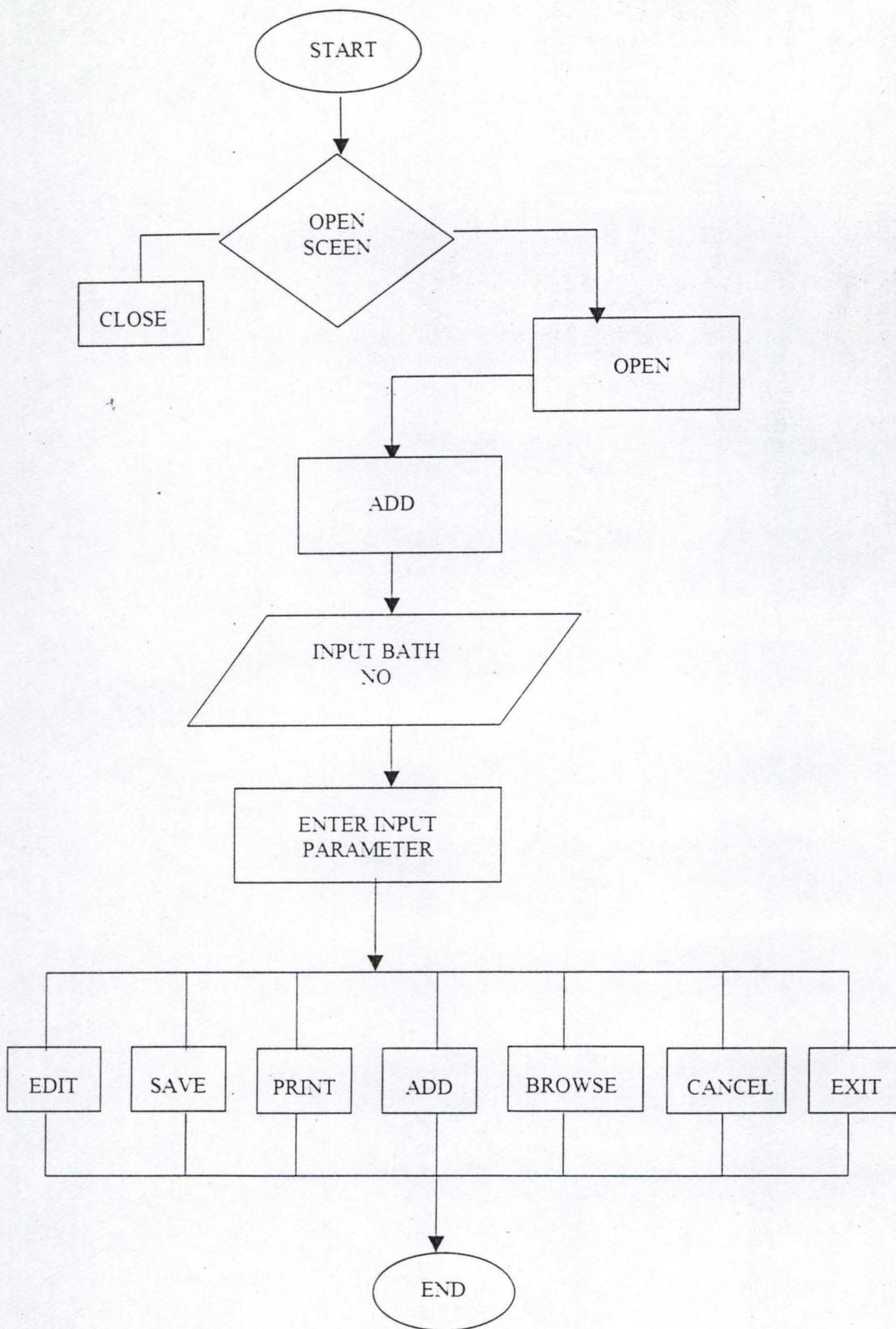
5.3 CONCLUSION

In this project work, an executable computer Aided Design software system for the design of a multi-stage Amplifier has been developed to serve as a model for the development of a complete system that will solve the problems and constraints of the manual system. Also, this software is expected to serve as the basis for the computerization of the entire procedure of designing amplifiers, with the view to improving the overall efficiency.

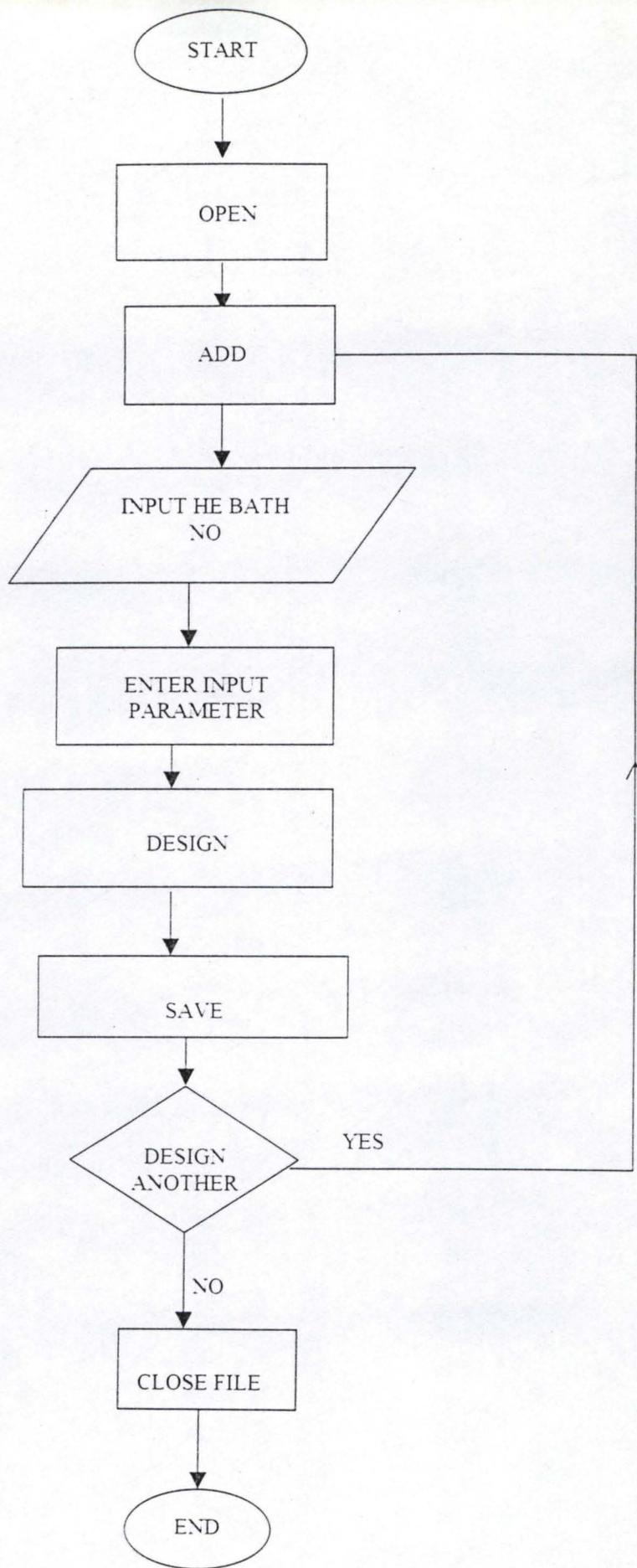
REFERENCE

1. Johnson, T.E (1963) Computer Aided Design Journal.
2. Mikelli, P.G (1974) Computer Aided Design and Manufacturing.
3. Musa, Y (1993) EEC 234 Handbook, Federal Polytechnic Idah.
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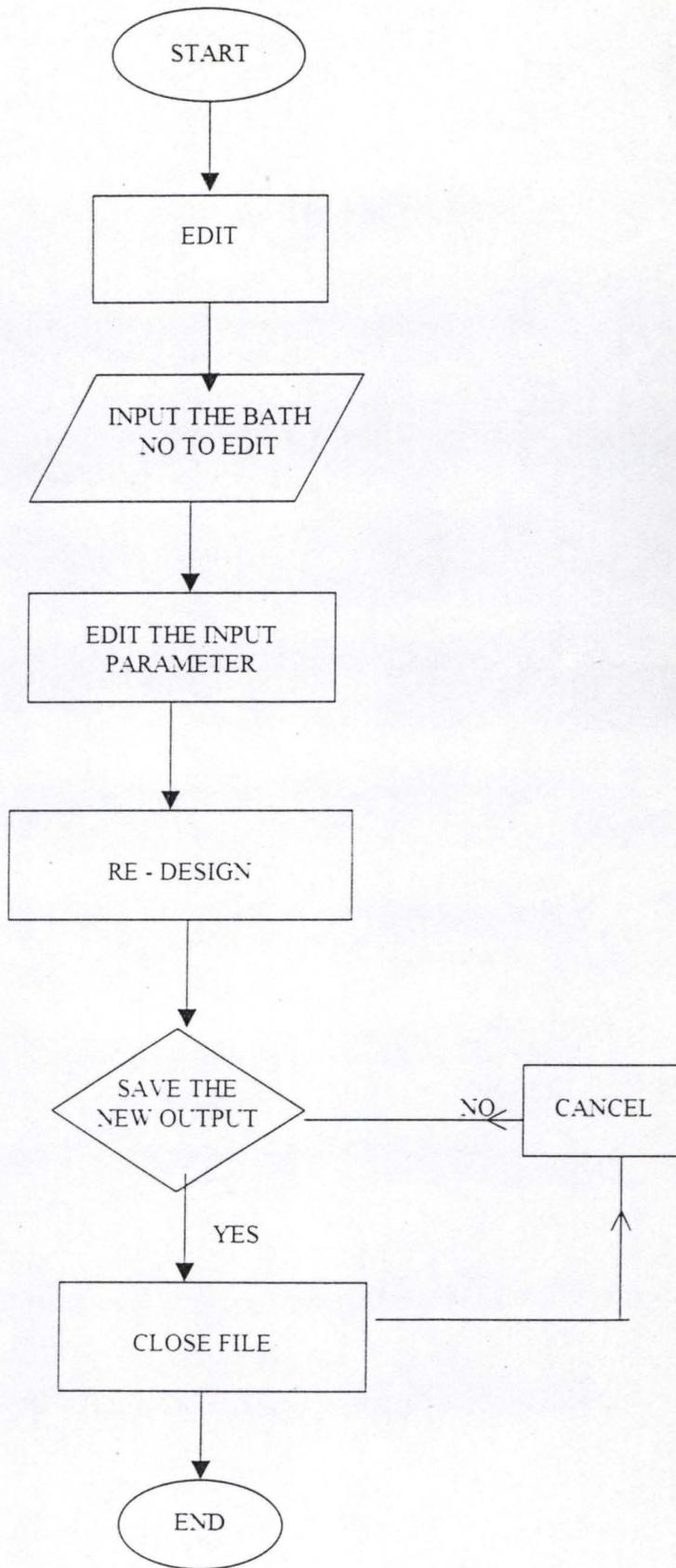
APPENDIX A. FLOWCHARTS



FLOWCHART ILLUSTRATING THE OPERATION OF CAD FOR A MUTI-STAGE AMPLIFIER



FLOWCHART ILLUSTRATING DESIGNING PROCESS



FLOWCHART ILLUSTRATING EDITING PROCESS

APPENDIX B. PROGRAM SOURCE CODE

Option Explicit

```
Private Sub cmdadd_Click()  
unlockdesign  
Dim dbsDatabase As Database, rectable As Recordset, del As Variant  
Dim X, i As Integer  
For i = 0 To 21  
    design(i) = ""  
Next i  
For X = 0 To 1  
    cbdesign(X) = ""  
Next X  
del = InputBox("INPUT BATH-NUMBER", "SEARCHING FOR EXISTING  
BATH.NO")  
  
design(21) = UCase(del)  
If del = "" Then  
    MsgBox "ERROR! No Bath.NO SPECIFIED", 48  
Exit Sub  
End If  
cmddesign(1).Enabled = True  
cmdadd.Enabled = False  
Dim dbsdatabse As Database, response  
Set dbsDatabase = _  
    OpenDatabase("C:\Compusofttech Wole Amplifier")  
Set rectable = _  
    dbsDatabase.OpenRecordset("SELECT * FROM " & _  
    " amp WHERE bath.No = " & design(21) & """, dbOpenDynaset)  
If Not rectable.EOF Then  
    response = MsgBox("The Batch No: " & design(21) & _  
    " Already Exists" & vbCr & "Please Enter " & _  
    "Another Batch No", vbOKOnly - vbInformation, "REPETITION " & _  
    "OF TASK")  
    design(21) = ""  
    lockdesign  
    cmdadd.Enabled = True  
Exit Sub  
End If  
design(0).SetFocus  
End Sub  
  
Private Sub cmdback_Click(Index As Integer)  
Unload Me  
End Sub
```

```
Private Sub cmdbrowse_Click()  
Form2.Show  
End Sub
```

```
Private Sub cmdcancel_Click(Index As Integer)
```

```
Dim i, X As Integer  
For i = 0 To 21  
    design(i) = " "  
Next i  
For X = 0 To 1  
    cbodesign(X) = " "  
Next X
```

```
End Sub
```

```
Private Sub cmddesign_Click(Index As Integer)
```

```
Dim response, i  
For i = 0 To 8  
    design(i) = Val(design(i))  
Next i  
For i = 0 To 8  
If Not IsNumeric(design(i)) Then  
    response = MsgBox("A number Must Be Entered Here". vbInformation, "INVALID  
ENTRY")  
    design(i).SetFocus  
Exit Sub  
End If  
Next i  
For i = 0 To 1  
If Not IsNumeric(cbodesign(i)) Then  
    response = MsgBox("A number Must Be Entered Here". vbInformation, "INVALID  
ENTRY")  
    cbodesign(i).SetFocus  
Exit Sub  
End If  
Next i
```

```
'All Criteria Satisfied
```

```
design(10) = Format(design(0) / _  
    (2 * design(4) * (design(2) - 1)), _  
    "##0.00")  
design(14) = Format(design(0) / _  
    (2 * design(5) * (design(3) - 1)), _  
    "##0.00")  
design(11) = Format(design(2) * design(10), _  
    "##0.00")  
design(13) = Format(5 * design(10), _
```

```

"##0.00")
design(15) = Format(design(3) * design(14). _
"##0.00")
design(17) = Format(5 * design(14). _
"##0.00")
Dim VE1. VE2. V2. V4
VE1 = design(4) * design(10)
VE2 = design(5) * design(14)
V2 = VE1 - cbodesign(0)
V4 = VE2 - cbodesign(1)
design(12) = Format(design(13) * (design(0) - V2) / _
(V2). _
"##0.00")
Dim u: u = design(12)
design(16) = Format(design(17) * (design(0) - V4) / _
(V4). _
"##0.00")
design(18) = Format(10 / _
(2 * (22 / 7) * design(8) * design(10)). _
"##0.00")
design(9) = Format(10 / _
(2 * (22 / 7) * design(8) * design(14)). _
"##0.00")
Dim IR2. IR4. IB1. IB2. B1. B2. IR1. IR3. A. c1
c1 = 0.000001
IR1 = (design(0) - V2) / design(12)
IR2 = (V2 / design(13))
IR3 = (design(0) - V4) / design(16)
IR4 = (V4 / design(17))
IB1 = IR1 - IR2
If IB1 = 0 Then
IB1 = c1
End If
B1 = design(4) / IB1

A = IR3 - IR4
If A = 0 Then
A = c1
End If
B2 = design(5) / A
Dim AV1. AV2
Dim u1. u2. u3
u1 = design(12) * design(13)
u2 = Val(design(12) - design(13))
u3 = u1 / u2
AV1 = B1 * u3 / design(6)
AV2 = B2 * design(7) / u3
design(20) = Format(AV1 * AV2 / 1000. "###.###.##0.00")
design(19) = Format(design(20) * design(1) / 1000. "###.###.##0.00")

```

```
cmdsave(2).Enabled = True
```

```
cmdcancel(3).Enabled = True
```

```
cmdadd.Enabled = True
```

```
End Sub
```

```
Private Sub cmdedit_Click()
```

```
Dim dbsDatabase As Database, rectable As Recordset, del As Variant
```

```
del = InputBox("INPUT BATH-NUMBER", "SEARCHING FOR EXISTING  
BATH.NO")
```

```
design(21) = UCase(del)
```

```
If del = "" Then
```

```
MsgBox "ERROR! No Bath.NO SPECIFIED", 48
```

```
Exit Sub
```

```
End If
```

```
Set dbsDatabase =
```

```
OpenDatabase("C:\Compusofttech Wole Amplifier")
```

```
Set rectable =
```

```
dbsDatabase.OpenRecordset("SELECT * FROM " & _  
" amp WHERE bathNo = " & design(21) & """, dbOpenDynaset)
```

```
With rectable
```

```
.FindFirst " BathNo = " & design(21) & "" "
```

```
If .NoMatch Then
```

```
design(21) = " "
```

```
Exit Sub
```

```
Else
```

```
design(0) = !supplyvoltage
```

```
design(1) = !inputsignal
```

```
design(2) = !unbupassgain1
```

```
design(3) = !unbupassgain2
```

```
design(4) = !CollectorCurrent1
```

```
design(5) = !CollectorCurrent2
```

```
design(6) = !sourceresistance
```

```
design(7) = !loadresistance
```

```
design(8) = !audiofrequency
```

```
design(9) = !BypassCapacitor2
```

```
design(10) = !EmitterResistance1
```

```
design(11) = !CollectoreResistance1
```

```
design(12) = !BiasResistance1
```

```
design(13) = !BiasResistance2
```

```
design(14) = !EmitterREsistance2
```

```
design(15) = !CollectorResistance2
```

```
design(16) = !BiasResistance3
```

```
design(17) = !BiasResistance4
```

```
design(18) = !BypassCapacitor1
```

```
design(19) = !OutputVoltage
```

```
design(20) = !TotaltGain
design(21) = !BathNo
cbodesign(0) = !BaseEmitterVoltage1
cbodesign(1) = !BaseEmitterVoltage2
End If
End With
```

```
unlockdesign
design(0).SetFocus
cmdsava(2).Enabled = True
```

```
cmdcancel(3).Enabled = True
cmddesign(1).Enabled = True
End Sub
```

```
Private Sub cmdexit_Click(Index As Integer)
Dim DialogType As Integer
Dim DialogTitle As String
Dim DialogMsg As String
Dim response As Integer
DialogType = vbYesNo + vbCritical
DialogMsg = "ARE YOU SURE YOU WANT TO EXIT?"
response = MsgBox(DialogMsg, DialogType, DialogTitle)
If response = vbYes Then
Unload Me
End If
```

```
End Sub
```

```
Private Sub cmdremove_Click(Index As Integer)
Dim response
response = MsgBox("Are you sure you want to remove it from the database", _
vbYesNo + vbCritical, _
"Hey")
If response = vbYes Then
Dim dbsDatabase As Database, rectable As Recordset
Set dbsDatabase = _
OpenDatabase("C: Compusofttech Wole Amplifier")
Set rectable = _
dbsDatabase.OpenRecordset("amp", dbOpenDynaset)
With rectable
.FindFirst " BathNo = " & design(21) & " "
.Delete
End With
Call cmdcancel_Click(3)
lockdesign
End If
End Sub
```

```
Private Sub cmdReport_Click()
```

```
CrystalReport1.Action = 1
```

```
End Sub
```

```
Private Sub cmdsave_Click(Index As Integer)
```

```
Dim dbsDatabase As Database, rectable As Recordset
```

```
Set dbsDatabase = _
```

```
OpenDatabase("C:\Compusofttech Wole Amplifier")
```

```
Set rectable = _
```

```
dbsDatabase.OpenRecordset("amp", dbOpenDynaset)
```

```
With rectable
```

```
.FindFirst " BathNo = " & design(21) & " "
```

```
If .NoMatch Then
```

```
.AddNew
```

```
!supplyvoltage = design(0)
```

```
!inputsignal = design(1)
```

```
!unbupassgain1 = design(2)
```

```
!unbupassgain2 = design(3)
```

```
!CollectorCurrent1 = design(4)
```

```
!CollectorCurrent2 = design(5)
```

```
!sourceresistance = design(6)
```

```
!loadresistance = design(7)
```

```
!audiofrequency = design(8)
```

```
!BypassCapacitor2 = Val(design(9))
```

```
!EmitterResistance1 = design(10)
```

```
!CollectoreResistance1 = design(11)
```

```
!BiasResistance1 = design(12)
```

```
!BiasResistance2 = design(13)
```

```
!EmitterREsistance2 = design(14)
```

```
!CollectorResistance2 = design(15)
```

```
!BiasResistance3 = design(16)
```

```
!BiasResistance4 = design(17)
```

```
!BypassCapacitor1 = design(18)
```

```
!OutputVoltage = design(19)
```

```
!TotaltGain = design(20)
```

```
!BathNo = design(21)
```

```
!BaseEmitterVoltage1 = cbodesign(0)
```

```
!BaseEmitterVoltage2 = cbodesign(1)
```

```
.Update
```

```
Else
```

```
.Edit
```

```
!supplyvoltage = design(0)
```

```
!inputsignal = design(1)
```

```
!unbupassgain1 = design(2)
```

```
!unbupassgain2 = design(3)
```

```
!CollectorCurrent1 = design(4)
```

```

!CollectorCurrent2 = design(5)
!sourceresistance = design(6)
!loadresistance = design(7)
!audiofrequency = design(8)
!BypassCapacitor2 = Val(design(9))
!EmitterResistance1 = design(10)
!CollectoreResistance1 = design(11)
!BiasResistance1 = design(12)
!BiasResistance2 = design(13)
!EmitterREsistance2 = design(14)
!CollectorResistance2 = design(15)
!BiasResistance3 = design(16)
!BiasResistance4 = design(17)
!BypassCapacitor1 = design(18)
!OutputVoltage = design(19)
!TotaltGain = design(20)
!BathNo = design(21)
!BaseEmitterVoltage1 = cbodesign(0)
!BaseEmitterVoltage2 = cbodesign(1)
.Update
End If
End With
Call cmdcancel_Click(3)
cmdsave(2).Enabled = False
cmdcancel(3).Enabled = False
cmddesign(1).Enabled = False
End Sub

Private Sub Command1_Click()

End Sub

Private Sub Edit_Click()
Dim dbsDatabase As Database, rectable As Recordset, del As Variant
Set dbsDatabase = _
    OpenDatabase("C: Compusofittech Wole Amplifier")
Set rectable = _
    dbsDatabase.OpenRecordset("SELECT * FROM " & _
    " amp WHERE bathNo = " & design(21) & " ". dbOpenDynaset)
With rectable
.Edit
!supplyvoltage = design(0)
!inputsignal = design(1)
!unbupassgain1 = design(2)
!unbupassgain2 = design(3)
!CollectorCurrent1 = design(4)
!CollectorCurrent2 = design(5)
!sourceresistance = design(6)
!loadresistance = design(7)

```