DESIGN AND CONSTRUCTION

OF AN

ELECTRONIC EAVESDROPPER

BY

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98/6906EE

A project report submitted to the Department of Electrical and Computer Engineering, School of Engineering and Engineering Technology, Federal University of Technology, Minna in partial fulfillment of the requirements for the award of Bachelor of Engineering degree (B. Eng) in Electrical and Computer Engineering.

NOVEMBER 2004

CERTIFICATION

This is certify that this project titled "Design and Construction of an Electronic Eavesdropper" was carried out by me, Babatunde Oluwafemi .A (98/6906EE), for the award of Bachelor of Engineering degree (B. Eng) in Electrical and Computer Engineering, Federal University of Technology Minna, Niger state.

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DECLARATION

I do hereby declare that this project report was wholly presented by me under the supervision of Engr. M. D. Abdullahi of the Electrical/Computer Engineering Department, Federal University of Technology Minna during the 2003/2004 academic session.

30/09/05

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DEDICATION

I dedicate this piece of work to Him who has made it possible for me to have come this far; Almighty GOD, the reason for my existence .I also dedicate it to my late dad, Mr. Babatunde Aderemi and my mum, Mrs. Babatunde Abiola and to my younger ones – Tunji, Bola, Toyin, Shola, Kike and Tayo.

ACKNOWLEDGEMENTS

I wish to acknowledge the Almighty God first and foremost for sparing my life up to this moment to be able to achieve this feat.

I wish to acknowledge the assistance of my initial supervisor, Engr. M.N. Nwohu for his tireless efforts to see that he left nothing undone even when he was supposed to be away on Study Fellowship.

Engr. M.D Abdullahi, has always been a source of inspiration to me as lecturer and now as Head of Department and supervisor. It has been wonderful working under your supervision. I am greatly indebted to you sir. Barrister Kamar Alimi, Mr. Wasiu Shittu, Ft.Lt. Olushola Bamidele and other uncles and aunties too numerous to mention, I am indeed grateful for your prayers, moral and financial support.

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Mark Enwongulu, Felix Ishaya, you guys have been wonderful roommates. I appreciate you for the times of laughter, illness, financial crackdowns and periods of chastisement.

Mohammed Abubakar, Kunle Adeyemo,Tokunbo Balogun, Nancy Nkoli, Vivian Obi, Maimuna Haliru, Thompson Awoyemi, Emmanuel and Charles Okponaviobo,Otejiro Ikie, Deji Balogun we shall meet at the top.

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CHAPTER ONE

1.0 INTRODUCTION

No doubt, the goal of every nation is to develop into a prosperous society where all the necessity for high standard of living is accessible to every citizen.

However, for such prosperous nation to realize its dream, its security must be of paramount interest to its government. hence, the use of electronic eavesdroppers by security agents.

An Electronic eavesdropper is an electronic device used to intercept conversational or communications without the knowledge or consent of at least one of the participants.

The electronic eavesdropper is divided into five sections of operation; the power supply module that delivers the deliver direct current voltage to the entire systems. On this module also is an anti-surge systems meant to disengage the entire system whenever surge occurs.

The second stage is a transducer on which audio signals is received and converted to voltage signal required to activate the switching module via the amplifier module via the amplifier module.

However, the switching module comprises a relay, transistor and parallel combination of Rin and Rg meant to protect the transistor base from thermal runaway, a phenomenon that leads to the sudden rise in base voltage or current that subsequently destroys the transistor.

Nevertheless, the output of the switching module, usually a voltage signal is thus fed to a transducer (speaker) that finally converts the voltage signal into an audio sound, as spoken by (crime) conspirator.

1.2 PROJECT AIMS AND OBJECTIVE

The aim of this project "Design and construction of an electronic eavesdropper" are:

i. To develop a simple low cost security device aimed at easing the financial difficulties faced by security agents in importing foreign ones.

ii. To stimulate the interest of students to take up research topic in the security industry, thereby helping our nation to develop the security sector.

iii. To demonstrate the relevance of electrical and computer technology to security.

1.3 PROJECT LAYOUT

Chapter one of this project introduces the major modules that make up this project work. It also describes the working principle of the electronic eavesdropper as well as its objectives.

Chapter two reviews some of the related work done by other people so as to ensure successful breakthrough in the research work.

Chapter three presents the detailed design/calculation of the electronic eavesdropper incorporating power supply with anti-surge protection. The section begins by discussing various modules that make up the project design.

The next chapter discusses the result obtained from simulation, how the various modules were constructed, the testing of the hardware and the results obtained.

Chapter five discusses the conclusion, recommendation and reference of books consulted during the course of work.

CHAPTER TWO

2.0 LITERATURE REVIEW

Historically, the most form of electronic eavesdropper is that used for wire-tapping, which monitor telephone and telegraphic messages. The use of this device is logically prohibited in virtually all jurisdictions for commercial and private purpose.

Wire tapping devices date back to the beginning of telegraphic communication. In some countries, like, United States of America for example, the use of such devices was legally forbidden as early as 1862.

During the late 16^{th} and 17^{th} century, electronic eavesdropper emerged as a distinct scientific discipline. Concerned with the electronically description of the electronic eavesdropper, it was based on direct observation and concluded with the rise of mechanistic rationalism.

The breakaway from the ancient theories can be found in the work of the American scientist Allen Frey of Random-line security Inc. He was interested more on how such system could be used in detecting criminal hideout by placing a transducer at a distance of few kilometers using a microwave of low intensity. Allen's work did not really come out because of the adverse effect of the microwave has on humans. In the context of controversy over reproductive hazards to video display terminal operators, Jose Delgado, a Bulgarian scientist, write of the alternation in brain function of animals exposed tot his microwaves during the course of its hypothetical stage. This he advocated was not a device fit for crime detection.

Similarly, Ross Aden, in support of Jose Delgado, rejected the profanation of Allen's invention and calls the CIA to take responsibility of crime as a matter of paramount importance, thus developing another device for crime detection that will not have adverse effects on the human generation.

Furthermore, a Russian security officer, Sam Kessler of the Defense Advance Research projects Agency, first prompted the US CIA with the prospect of an eavesdropper. He said the device was not meant to limit radiation just as the contentious microwave. However, owing to the inability of the system to detect any strange talk/noise at a distance say few kilometers, he proposed that scientists can be encouraged to improve on such system, thus without having any adverse effect on human.

Jan Swamerdam, in 1976, however came up with his security idea by the use of an electronic device with low microwave intensity so as to improve on Sam Koslov's proposal, this he called "Moscow signal" registered at the American Embassy in Moscow. Initially there was confusion over whether the signal was an attempt to activate the bugging device or some other purpose. There was suspicion that the low intensity microwave could still radiate and emit radiation even at a very low intensity.

However, Dr. Milton Zahra, in undertook to analyze soviet literature on microwave for the Criminal intelligence Agency (CIA), wrote for a nonthermal irradiation. They believe that the electromagnetic field induced by low intensity electronic eavesdropper using a microwave could have adverse effect on humans. However, according to Dr. Zahra, this adverse effect could only becomes noticeable with repeated or continuous exposure of a human being to such a device, which of course, when planted in an exposed environment would not achieve its desired aim.

Generally there are two kinds of electronic eavesdroppers. One takes advantage of equipment already present on the targets premises such as a telephone, radio, photograph, television set, public address loudspeakers, computers and or power supply.

The other does not use the above media but consist basically of a radio receiver capable of receiving radio signals over a wide band of wavelength.

In the former case, the targets equipment is said to have been compromised.

The compromise of the targets equipment takes advantage of the fact that any loudspeaker is capable of functioning first as well as a microphone, also the convenient source of direct current power are available within the equipment or that the equipment is connected to power or signal lines that can transmit the intercepted conversations to some place where recording can be done.

CHAPTER THREE

3.0 DESIGN ANALYSIS

INTRODUCTION

The advent of the modern day electronic eavesdropper has provided safety, security, time compression, cost reduction and technological advancement in the security industry.

This chapter gives a complete description of the various modules that make up the design and construction of the electronic eavesdropper. The theoretical background of each module is dealt with. The block diagram of the electronic eavesdropper is shown in fig below:

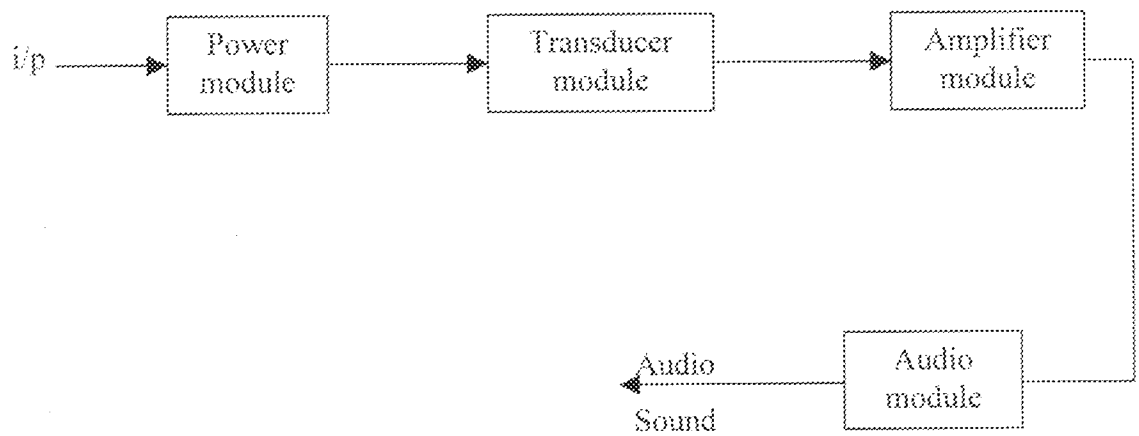


Fig. Shows The Block Diagram of The Electronic Eavesdropper

The four sub-systems that make up the electronic eavesdropper circuiting are; power supply module, transducer module, amplifier module, and the audio module as illustrated in the block diagram above. It shows the process leading to report of audio signal on the transducer (microphone) input.

The power supply module is the powerhouse of the entire system of the electronic eavesdropper. Its output voltage (usually after rectification) is fed into the electronic eavesdropper and subsequently converted into sound energy. This is achieved when an audio signal usually produced by human is incident on the transducer where it si then changed from sound into a voltage signal where it undergoes a series of amplification.

3.1 POWER SUPPLY MODULE

Majority of electronic system uses d.c supply for operation through the conversion of an a.c supply. This is achieved by the following laid down procedure.

The block diagram of the power supply module is illustrated in the figure 3.1 below.

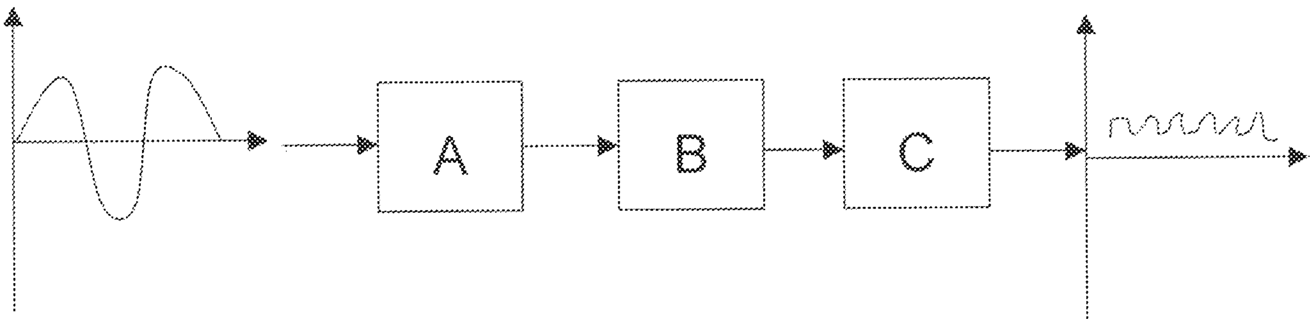


Fig 3.1 Show Block Diagram of The Power Supply Module of The Electronic Eavesdropper

A = transformer

B = rectifier (bridge rectifier)

C = filter

D = voltage regulator

3.1.1 TRANSFORMER

A 240 Vr.m.s step-down transformer is used to reduce 240 Vdc. From NEPA supply to 12 Vdc, which is rectified, to give a rectified d.c output voltage, 12 dc by the bridge rectifier.

3.1.2 RECTIFICATION

The term rectification is defined as the process of changing pulsating a.c voltage into a d.c voltage by eliminating the negative half-cycle of the alternating voltage. This project adopts the use of a full-wave bridge rectifier because of its ability to produce the approximate varying and reference voltage.

The maximum instantaneous voltage between terminals is: -

$$V_{max} = V_{r.m.s} * \sqrt{2}$$

The figure below illustrate bridge rectifier module of the electronic eavesdroppers power supply.

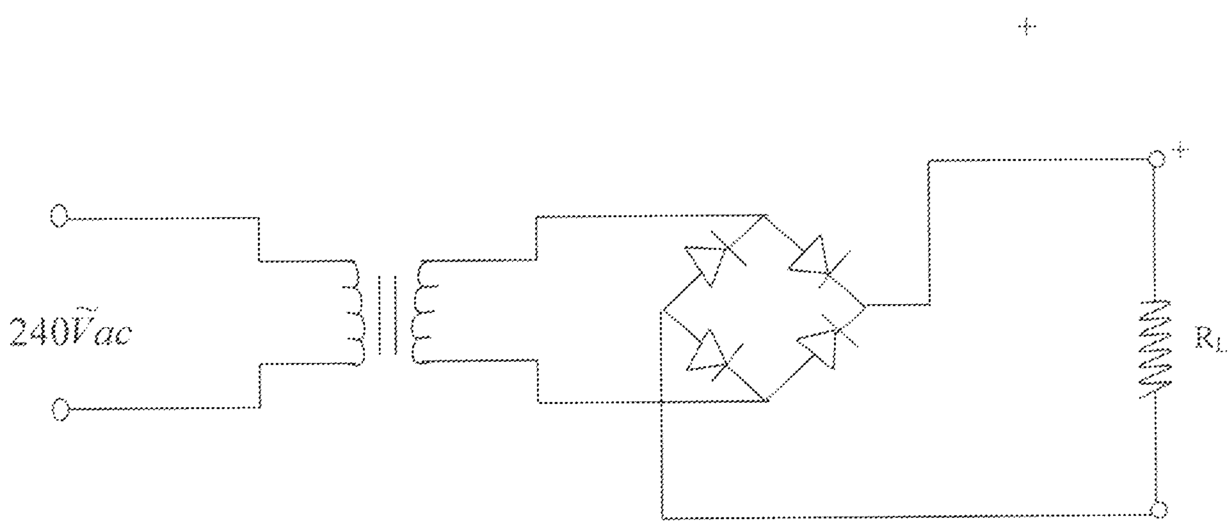


Fig 3.2 Bridge Rectifier Circuit

CALCULATION

The direct current voltage, V d.c is given by;

$$Vd.c = 2Vmax / \pi = 0.636\ Vmax \text{ ----------------------------- (i)}$$

It must be noted that the PIV (peak inverse voltage) be greater than Vmax.

Also note that Vr.m.s – 12V.

From the expression; $Vmax / \sqrt{2} = Vr.m.s$ -------------------------- (ii)

$$Vmax = Vr.m.s * \sqrt{2} \text{ ----------------------------- (iii)}$$

$$12V * \sqrt{2} = 16.968V \text{ -------------------------------- (IV)}$$

Allowing a safety margin of 1.5, hence, PIV = 1.5 * 16.986V = 25.5V

This value of the PIV (25.5V), prompted the need for selecting a 2Amp bridge rectifier with a maximum peak inverse voltage of 100V.

3.1.3 FILTERING CIRCUIT

The main function of a filter is to minimize the ripple content at the output of the bridge rectifier. The input and output waveform of the filter circuit is shown below:

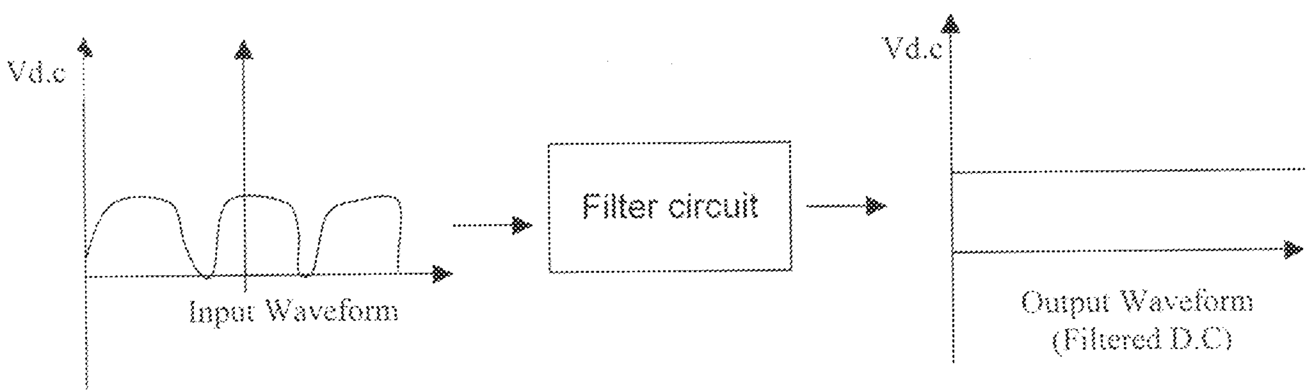


Fig 3.3 The Input and Output Waveform

The electrolytic capacitor depends on its operation; the property of the device (capacitor) to charge up (i.e. store energy) during the conducting half-cycle and discharge during the non-conducting half-cycle.

Below is the input and output waveforms of the shunt capacitor and the approximated ripple voltage.

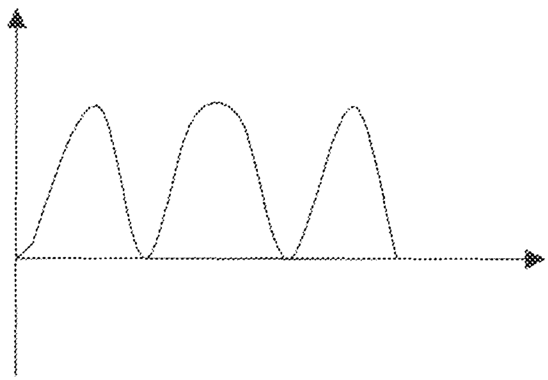


Fig 3.3 (a); Input to the Shunt Capacitor

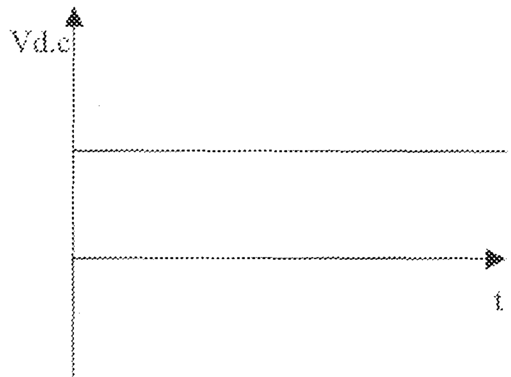


Fig 3.3 (b); Output of the Shunt Capacitor

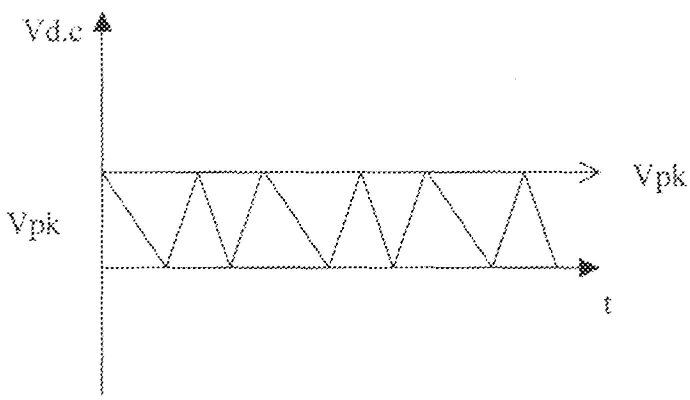


Fig 3.3 (c); Approximated Ripple Voltage.

The ripple voltage can be approximated by a triangular waveform that has a peak-to-peak ripple voltage, Vr (p) and a period of Tr as in fig 3.5 (c) above.

Considering the charges lost during the capacitor discharge as dq in time

T = Id.c * Tr

i.e dq = Id.c * Tr -- (v)

Dividing through by C, (the capacitance of the capacitor)

We have; dq/c = (Id.c * Tr) / C ------------------------------------ (vi)

But Vr(p-p) = dq/c = (Id.c * Tr) / C ------------------------------(vii)

Also; Id.c = Vd.c/RL and Tr = 1/Fr ---------------------------------(viii)

Where Fr is the ripple frequency, RL is the load resistance.

Substituting (viii) into (vii) we have;

Vr(p-p) = dq/c = (Vd.c/RL * 1/fr)/c --------------------------------(ix)

= Vd.c / RLfrC --(x)

But, Vr.m.s = Vr(p-p)/2√3 --(xi)

Therefore substituting equation (x) into equation (xi) we have

Thus Vr.m.s / Vd.c = 1/(2√3RLFrC) -------------------------------------- (xiii)

Taking the ratio of Vr.m.s/Vd.c as γ, we have

γ = 1/(2√3RLFrC) --- (xiv)

Substitute Fr = 2f into equation (xiv) we have

γ = 1/(2√3RL2FC) = 1/(4√3RLFC)

By design, γ is kept at a minimum value of 0.0386 where F = 50Hz,

C = ? µf, Vmax = 16.986V (from equation iv)

Vr.m.s = 12V, RL = 21Ω

But Vmax = Id.cRL

Therefore RL = Vmax / Id.c -- (xv)

Hence, $\gamma = 1 / (4\sqrt{3}FC \{Vmax / Id.c\}) = Id.c / (4\sqrt{3}FCVmax)$

But from equation (i), Vd.c = 0.636 Vmax

= 0.636 x 16.986V = 10.792V

Therefore Id.c = Vd.c / RL = 10.792V / 21Ω = 0.5A

Hence $\gamma = (4\sqrt{3}$ (50Hz) (C) (16.968V))

$0.0386 = 0.5A / (4\sqrt{3} \times 50 \times C \times 16.968)$

$C = 0.5A / (0.0386 \times 4\sqrt{3} \times 50 \times 16.968)$

C = 0.0022F

Converting the equivalent capacitance in µf we have;

$$\frac{0.0022F \times 1\mu F}{10^{-6}F}$$

= 0.0022 x 106 x 1µF

= 2.2 x 10-3 x 106 x 1µF

= 2.2 x 103 x 1µF

Therefore C = 2200µF, 16V, was used in designing the power supply module of the electronic eavesdropper.

3.1.4 VOLTAGE REGUALTOR

In order to obtain a regulated voltage of the desired voltage (Vd.c) a 7812A, (voltage regulator) IC is used in the design of the power supply. It has a 3-pin configuration.

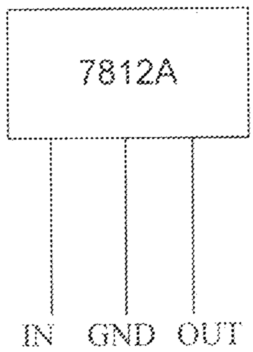


Fig 3.4; Voltage Regulator I.C

3.2 TRANSDUCER (SOUND SENSOR/MICROPHONE)

The term "transducer" has been applied to a variety of devices, including measuring instruments, acoustics-energy transmitters, signal converter and phonograph cartridges. With the recent vast increase in the development and use of electronic measuring systems, instrumentation engineers find it necessary for converting physical quantity into an electrical signal.

In accordance to these, the instrumentation society of America (ISA) published a standard definition in 1960 and defines transducer as a device which provides a useable output in response to a specified measurand.

Considering the function or the role of the microphone in this project, in relation to the above definition, its measurand is the surface incident audio sound induced into the microphone (transducer) at the input while its output is the electrical quantity (voltage signal) that enters the amplifier module. Below is the circuit radiogram of the transducer module of the electronic eavesdropper.

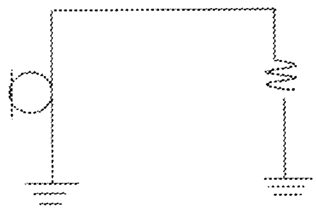


Fig 3.6 Shows The Transducer (Input) Module Of The Electronic Eavesdropper.

3.3 AMPLIFIER MODULE

An amplifier is that electronic circuit that increases the amplitude of a voltage signal. In this circuit, a small a.c signal from the transducer is applied to the input of the amplifier and a large a.c signal is obtained at the output usually at the same frequency. Amplifier is very important for security devices like electronic eavesdropper.

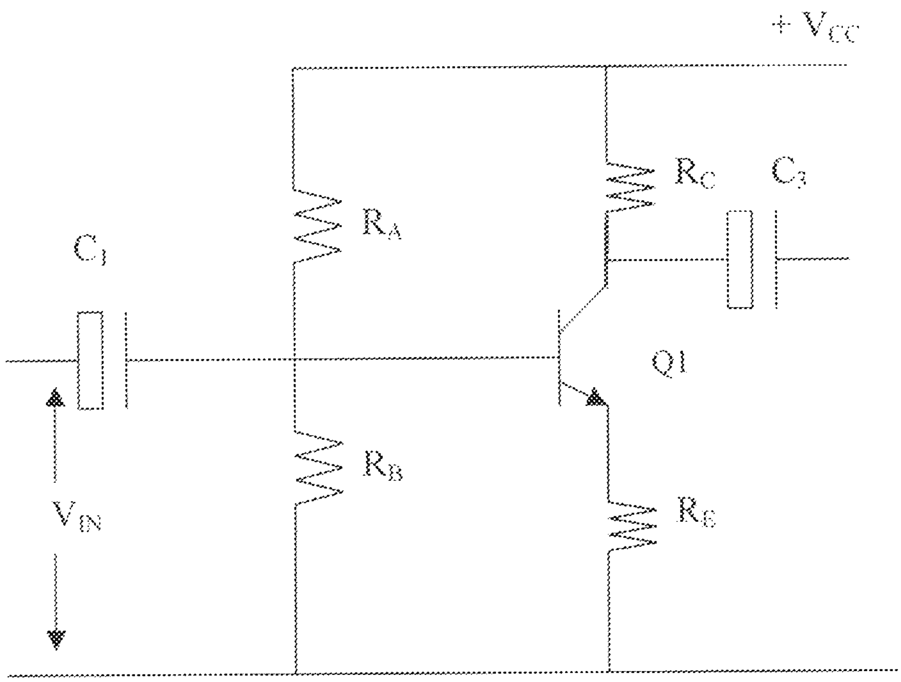


Fig 3.7 Shows the Amplifier Module of the Electronics Eavesdropper.

For the common-emitter amplifier circuit with transistor Q1, the first stage of the input amplifier, which amplifies the input audio signal.

DESIGN/CALCULATION

Ic = 0.50mA is set.

To centre Vout (Vc) for Ic=0.50Ma

$$Vcc = Vc - IcRc$$

$$Rc = \frac{Vcc - Vc}{Ic}, \quad Vcc = 0.5Vcc = 6V$$

$$Rc = (12\,v - 6\,v)\,/\,0.5\,mA = 12\,k\Omega$$

$R_E = 2k\Omega$ is chosen

$V_E=I_ER_E$

$= 2k\Omega * 0.5mA$
$= 1V$

$V_B=1V+0.6V=1.6V$

For the ratio R_A: R_B, put $V_B=1.6V$

$V_{CC}-V_B=12V-1.6V=10.4V$

$R_A/R_B=10.4V/1.6V=6.5V$

$R_A=6.5V*R_B$

$R_B=6.5V*15\,K\Omega$

$R_B=100\,K\Omega$

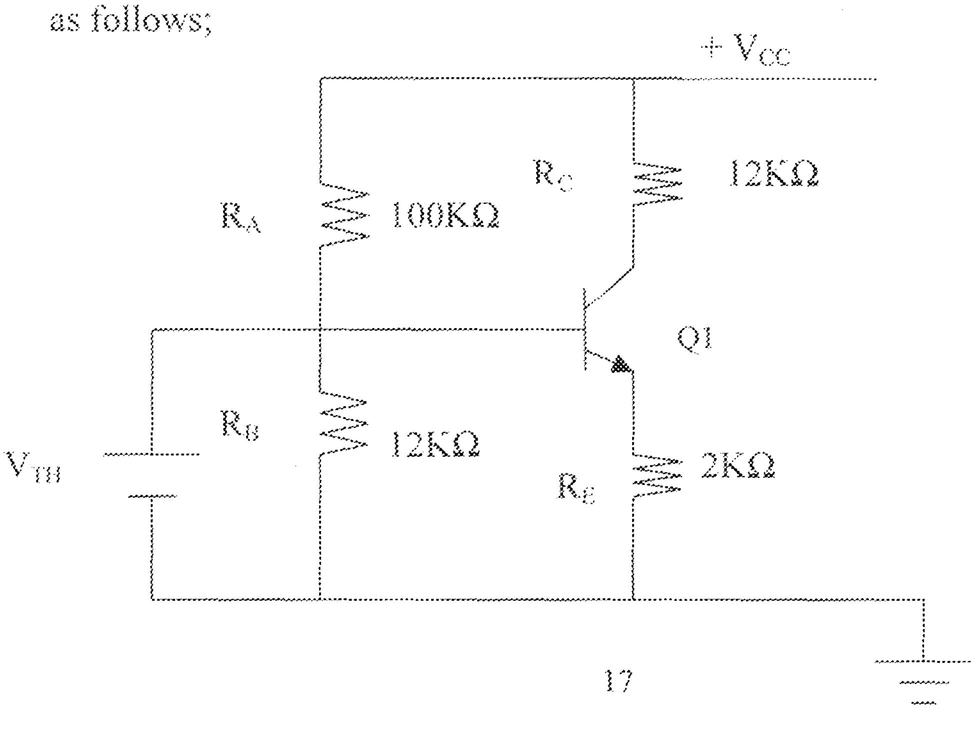
Now R_A, R_B, R_C and R_E apply in the same way to Q2.

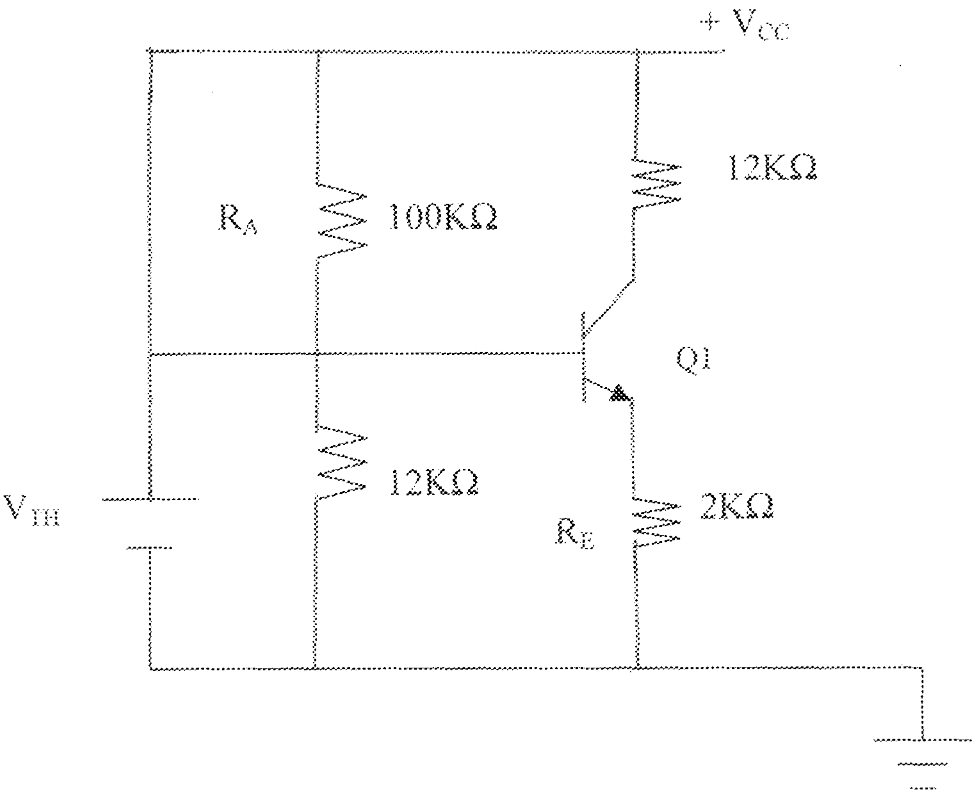
Towards analysis of the circuit presented, values for V_{TH}, V_{CE},

$I_{C(sat)}$.

In D.C analysis, all capacitors are open circuited hence, figure A is redrawn

as follows;





$V_{TH}=V_{CC}* R_B/R_A+R_B$

$(12V*15\,K\Omega)/(15\,K\Omega+100\,K\Omega)=1.56V$

$R_{base}=R_{BB}=R_A//R_B$

$=(100K\Omega*15K\Omega)/(100K\Omega+15K\Omega)$

$=1500\,M\Omega/115K\Omega$

$=13K\Omega$

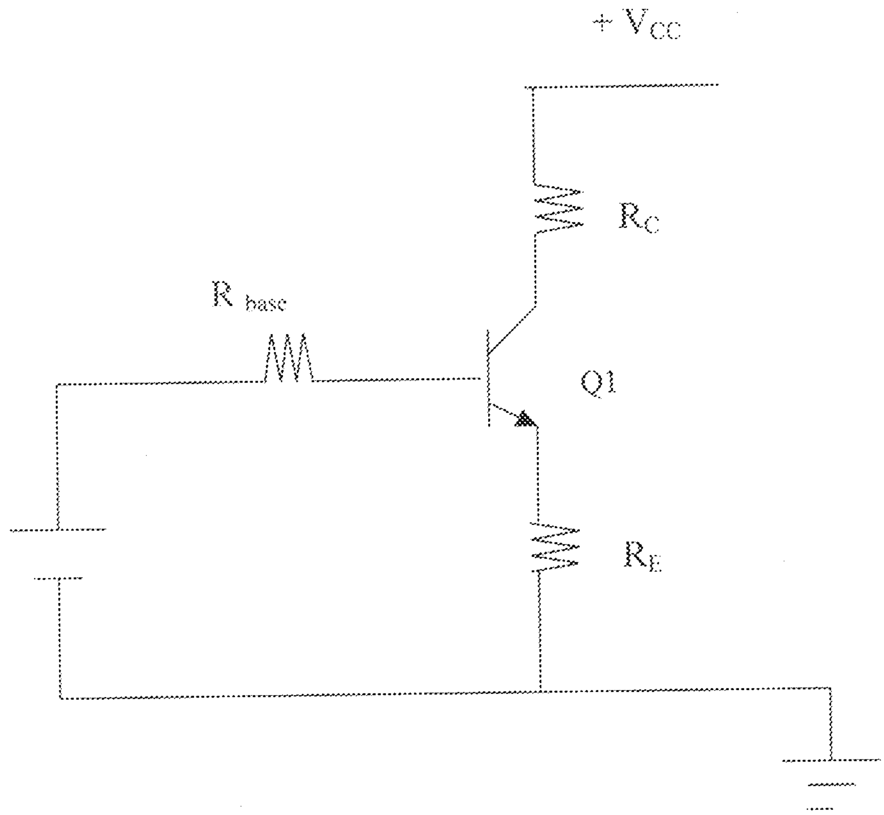
$I_{C(sat)}=(V_{CC}-V_{BE})/(R_C+R_E)$

$=\ (12V-0.6V)/(12K\Omega+2K\Omega)$

$=11.4V/14K\Omega$

$=0.81\,mA$

Note $Ic \approx I_E = 0.5mA$, also $V_E=1V$



From the collector-emitter loop;

$V_{CC} = I_C R_C + V_{CE} - I_E R_E$

$V_{CE} = V_{CC} - I_C R_C - I_E R_E$

But $I_C \approx I_E$

$V_{CE} = V_{CC} - I_C (R_C + R_E)$

$= 12V - 0.5mA(12K\Omega + 2K\Omega)$

$= 12V - 0.5mA(14K\Omega)$

$V_{CE} = 12V - 7V = 5V$

$V_{CE} = 5V$

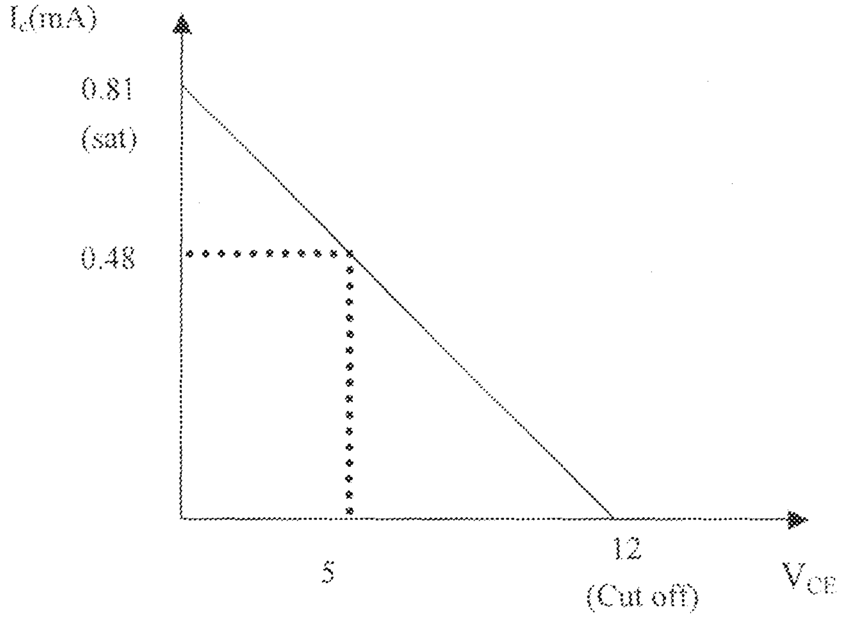
$I_C = (V_2 - V_{BE}) / R_E = (1.56V - 0.6V)/2K\Omega$

$= 0.96V/2K$

$= 0.48mA$.

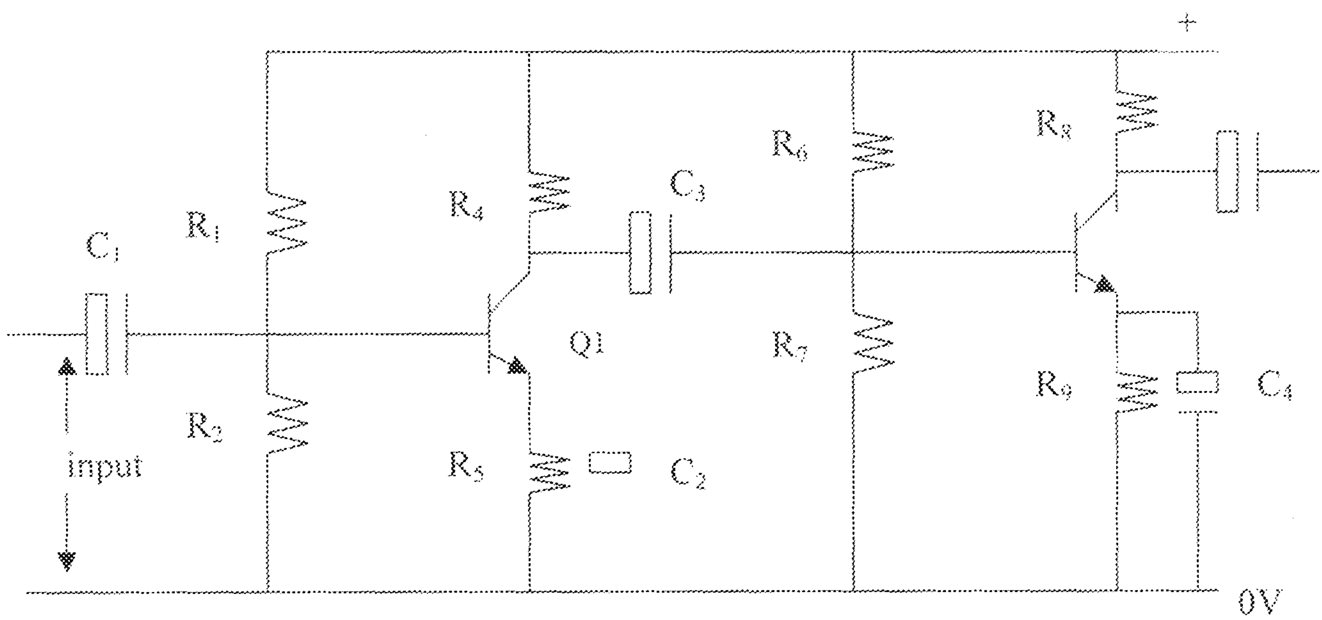
From the parameter, the d.c load-line can be drawn as shown below;

$V_{CC} = V_{CE(cut\text{-}off)} = 12V$, $I_{C(sat)} = 0.81mA$, $I_C = 0.48mA$, $V_{CE} = 5V$



From the d.c load-line, we deduce that the transistor can operate safely within the system since its Ic and V_{CE} are below the $Ic_{(sat)}$ and $V_{CE\ (OFF)}$.

3.4 MODE OF OPERATION



The transducer on receiving an audio signal converts it into electrical signal. The incoming signal is fed to the audio amplifier circuit through a logarithmic potentiometer, which is the volume control with impedance between $1K\Omega - 5K\Omega$. Because the incoming signal is very small, the transistors Q1 and Q2 form an audio pre-amplifier.

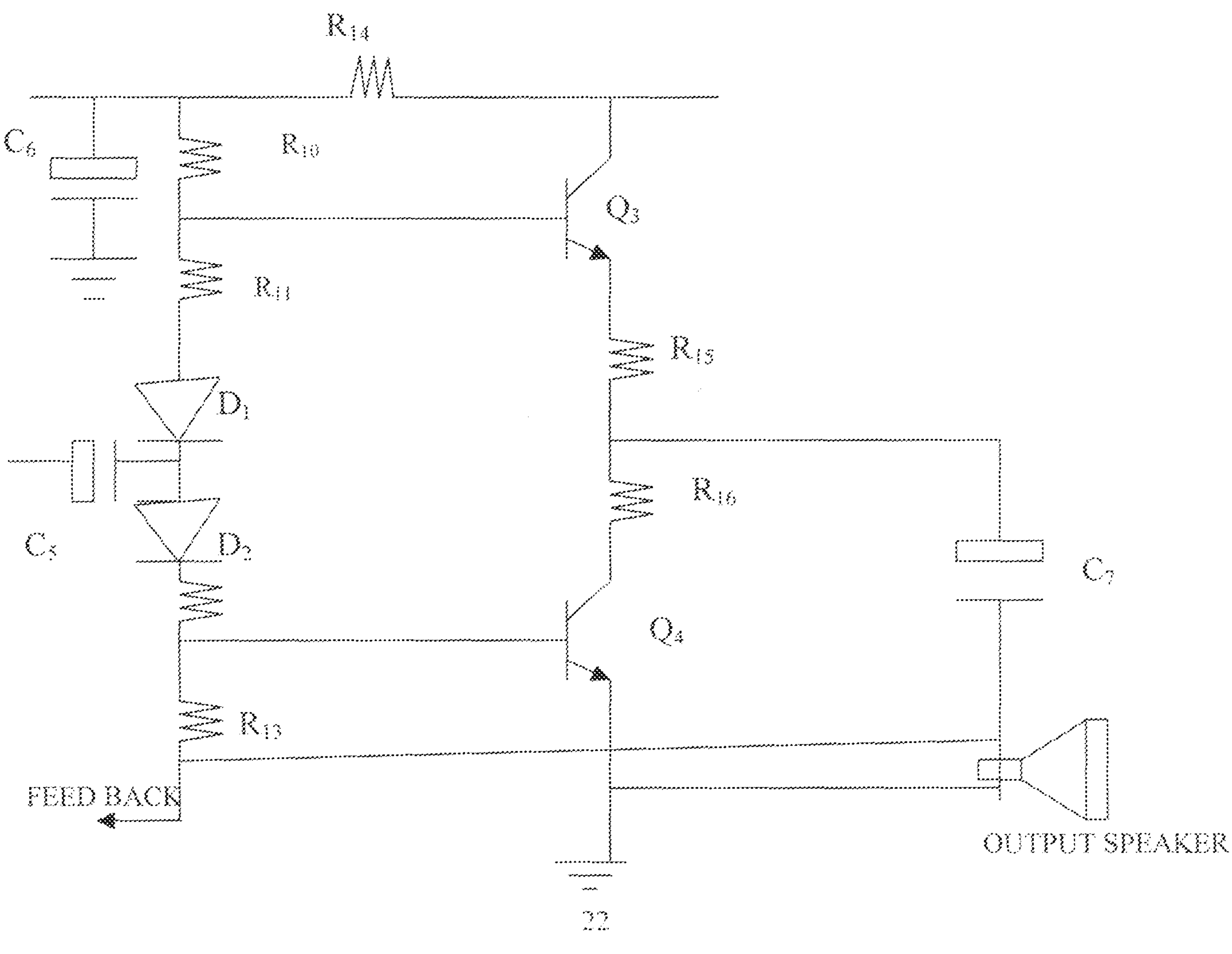
R_1 and R_2 provide proper d.c biasing for transistor Q1 while R_6 and R_7 bias the transistor Q2. The choice of BC109 for Q1 and BC107 for Q2 is based on the fact that BC109 is more sensitive to very small signals than BC107.The output of the preamplifier stage of transistor Q1 is coupled to the second stage of amplification through capacitor C_3. The last stage of amplification is a class B push-pull amplifier using complimentary transistors BC142 (Q3) and BC143(Q4) working in the common-emitter mode to give current and voltage gains Since Q3 and Q4 are ---- out-of-phase, they cancel out even order harmonics thereby giving a distortion-less output.

The d.c biasing and temperature stabilization of the transistors are provided in conjunction with diodes D_1 and D_2 supplemented by resistors R_{11} and R_{12} which has been adjusted to minimize cross-over distortion. The choice of common-collector is not suitable for the output because it gives only current gain which in turn means lesser power gain. Common-emitter is most suitable for current and voltage gain which also leads to high power gain. In common-collector the output is in phase with the input of the transistor, which leads to oscillation.

Whereas in common-emitter the output of a transistor is 180^0 out of phase with the input signal which gives stability.

The output transistors were provided with clip-on heat radiators to prevent their getting hot. The diodes are put in contact with the radiators to provide feedback and automatic stabilization of the bias conditions. The purpose of resistors R_{14} and capacitor C_6 is to decouple the power supply. This will prevent any sudden voltage drop due to large current intake by the output appearing at the input stage.

The capacitor C_6 is very large enough to prevent the impairment of the low frequency response of the amplifier. The output of the push-pull amplifier is a dynamic speaker that produces the amplified signal.



CHAPTER FOUR

4.0 CONSTRUCTION AND TESTING

In the hardware construction, the overall system was broken down into modules for easy construction, testing and trouble-shooting.

4.1 CONSTRUCTION

Construction of the electronic eavesdropper involved the bringing together of all the components as specified in the design. It also includes the encasement of the components to give the finish. During the construction, the following instruments/tools and materials were employed.

Bread board - This is the board on which the circuit was set up on a temporary basis to ascertain the workability before it was permanently transferred to a Vero-board

Vero-board - This is a plastic over laid with perforated strip of copper wire. After every adjustment to the design which was made on the breadboard, it was finally transferred to this board.

Soldering iron - This provided the needed heat to melt the lead which holds the components in place on the Vero-board when it solidifies.

Lead sucker - This was employed when there was need to de-solder a joint. It was the principle of suction pressure to remove pre-melted lead in a soldered joint.

Multi-meter - This is multi-function electronic measuring instrument employed in the measurement of voltage, current and checking for continuity.

4.1.1 CONSTRUCTION OF THE POWER SUPPLY MODULE

This module was built with the bridge rectifier incorporated into it. It also comprises of a filtering capacitor. The bridge rectifier terminals were denoted by the following symbols, +, ~ and -, such that the terminals was connected to the supply line, V_{CC} and the negative terminal to the zero voltage line while the a.c denoted symbol (~) terminal was connected to the transformer secondary, in this case 12Va.c. Similarly, because of filtering purpose, a 2200µf is connected across the rectifier output, with their corresponding positive terminals connected to the 12V line and their corresponding positive terminals connected to the 12V line and their negative terminals connected to the supply and zero (0V) volts lines respectively.

Owing to the need of a regulated voltage supply required by the system, a voltage regulator I.C, with its pin configuration identified, was connected across the filter output so as to produce a regulated output voltage usually a Vd.c as required by the system.

4.1.2 TRANSDUCER MODULES

This module was built into the circuiting of the electronic eavesdropper using a dynamic microphone that converts sound energy (audio sound) into a voltage signal at the input.

The output is also a transducer (a dynamic speaker) that converts the amplifier signal to sound energy that is a function of the input audio signal.

4.1.5 CONSTRUCTION PRECAUTIONS

1. Polarity of capacitors was properly observed before soldering.
2. Soldered points were tested to ensure continuity
3. The long leads or legs of the various components such as
4. Transistors, resistors, capacitors and diodes were reduced so as to prevent short circuit/bridging.
5. Each stage was tested during the designing to avoid multiple faults.

4.2 TESTING HARDWARE

After the completion of the hardware construction, a careful hardware test of the completed circuit was carried out as follows:

Step 1: Polarity of the power supply output was tested using a digital multi-meter to ensure adequate link to the entire circuitry as well as the identification of the reverse bias and forward bias of the diodes used in the construction of the electronic eavesdropper.

Step 2: The output voltage of the transformer (secondary output voltage) was observed and measured to be 12Vd.c as required.

Step 3: The potentiometer was set so the relay turn "OFF" and "ON", hence ensuring a good switching. This shows that the interfacing of the amplifier module to the sound module was achieved.

4.3 RESULTS

The power supply module gave a voltage output of 11.99V as against the expected 12V. This is within acceptable error range. The whole system operates based on audio-sensitive principle.

On receiving audio signal, usually the speech of an individual via the microphone, the system transduces it into electrical signal, energizes the switching circuit through the amplifier circuit contained in the system. The switching circuit in-turn energizes the output transducer (the dynamic speaker) with an audible output sound which is a function of the microphone input.

CHAPTER FIVE

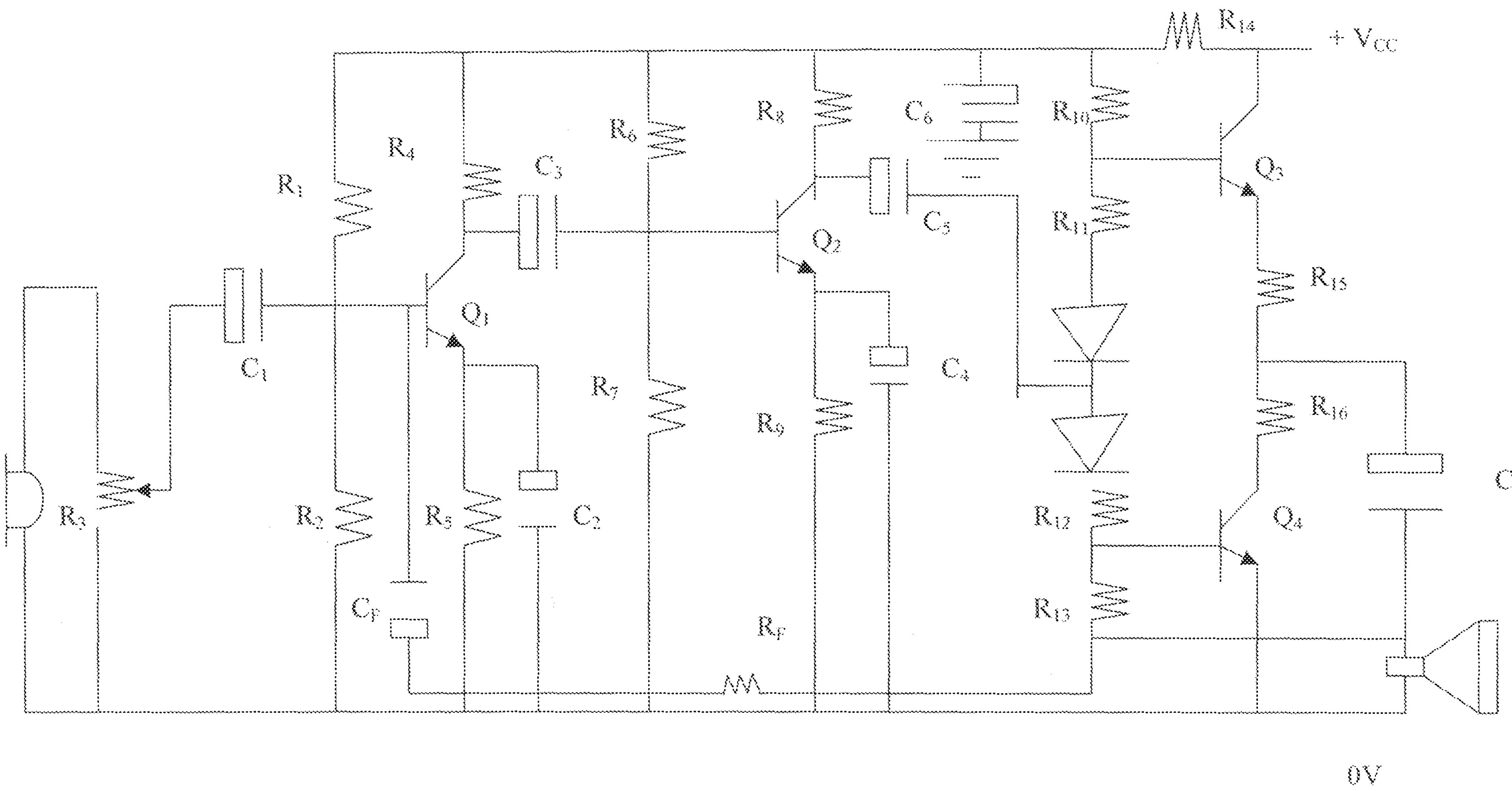
5.1 CONCLUSION

The motive and objective of the project was realized as observed during the hardware testing and operation thus proving that the eavesdropper can be constructed from the basic audio-sensitive principle by the use of microphone, amplifier module, switching module and the dynamic speaker. The low operating voltage, 12Vd.c and low power consumption of the system allows for the longer life-span, better performance, low overall cost of construction and operation thus resulting in high reliability of the system.

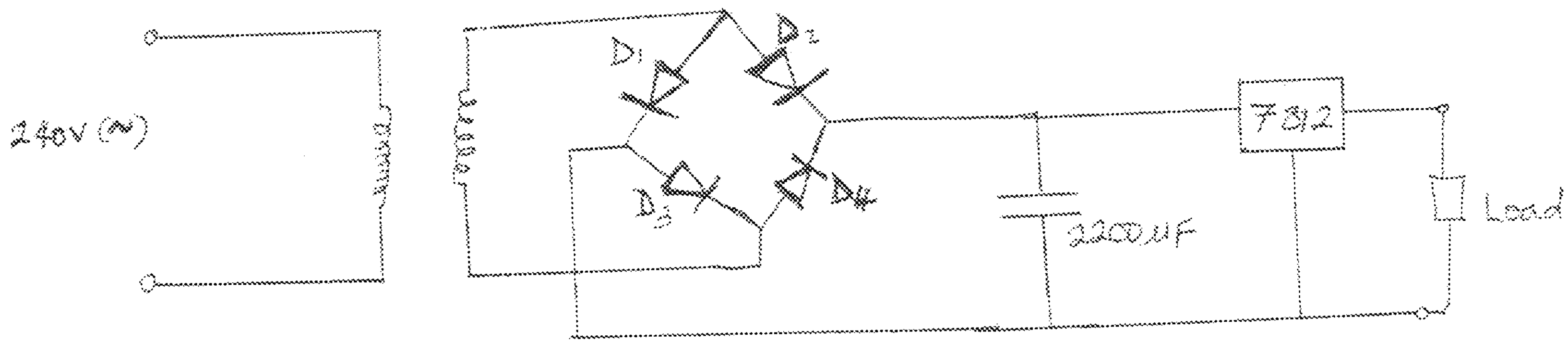
5.2 RECOMMENDATION

Technological advancement is at a rate beyond comprehension nowadays. Therefore, I encourage upcoming students to take up their research in security systems.

Furthermore, a highly sensitive multi-directional microphone should be incorporated so as to enhance the objective of the project i.e. to be sensitive to audio sounds made at an appreciable distance from the microphone.


R14
+ VCC
R8
C6
R10
R6
R4
C3
Q3
R1
R11
C5
Q2
Q1
R15
C1
C4
R7
R9
R16
C7
R3
R2
R5
C2
R12
Q4
CF
R13
RF
0V

POWER SUPPLY UNIT



D1 – D4 = IN4001

$R_1 = 100K\Omega$

$R_2 = 12K\Omega$

$R_3 = 1.0K\Omega - 5K\Omega$

$R_4 = 12K\Omega$

$R_5 = 2K\Omega$

$R_6 = 100K\Omega$

$R_7 = 12K\Omega$

$R_8 = 12K\Omega$

$R_9 = 2K\Omega$

$R_{10} = 3.3K\Omega$

$R_{11} = 33K\Omega$

$R_{12} = 33K\Omega$

$R_{13} = 3.3K\Omega$

$R_{14} = 1K\Omega$

$R_{15} = 2.7\Omega$

$R_{16} = 2.7\Omega$

$R_F = 100\Omega$

$C_1 = 10\mu F$

$C_2 = 4.7\mu F$

$C_3 = 47\mu F$

$C_4 = 47\mu F$

$C_5 = 47\mu F$

$C_6 = 1000\mu F$

$C_7 = 1000\mu F$

$C_F = 22nF$

Transistors

$Q_1 =$ BC 109

$Q_2 =$ BC 107

$Q_3 =$ BC 142

$Q_4 =$ BC 143

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