DESIGN AND CONSTRUCTION OF A

WIRELESS PUBLIC ADDRESS SYSTEM

BY

MOLAGUN ADELE SAMUEL

99/8250 EE

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING.

FEDERAL UNIVERSITY OF TECHNOLOGY
MINNA, NIGER STATE.

November 2005.

DESIGN AND CONSTRUCTION OF A

WIRELESS PUBLIC ADDRESS SYSTEM

BY

MOLAGUN ADELE SAMUEL

99/8250 EE

IN PARTIAL FULFILMENT OF THE REQUIREMENT
FOR THE AWARD OF BACHELOR OF
ENGINEERING (B. ENG).

DEPARTMENT OF ELECTRICAL & COMPUTER
ENGINEERING.

FEDERAL UNIVERSITY OF TECHNOLOGY

MINNA, NIGER STATE.

November 2005.

DEDICATION.

I dedicate my project to the Almighty God, the creator of all things for sparing my life to witness this moment of my life and for His protection over me throughout my years of study. Also, to my parents, Engr and Mrs. Molagun who have been wonderful parents desired by many.

DECLARATION

The under design certify that this project has been carried out by MOLAGUN ADELE SAMUEL under the supervision of Mr. Ozomata David Ahmed and submitted to the Electrical and Computer Engineering Department, Federal University of Technology Minna in partial fulfillment of the requirement for the Award of Bachelor of Engineering Degree (B. Eng) in Electrical and Computer Engineering.

Molagun Adele. S.	12/12/05 ……………………
Student	Signature & Date
Mr. Ozomata David Ahmed	12/12/05 ……………………
Project Supervisor	Signature & Date
Engr. M. Abdullahi	16/02/06 ……………………
Head of Department	Signature & Date
……………………	……………………
External Supervisor	Signature & Date

ACKNOWLEDGMENT

Passing through this programme and the project topic as made possible through my Lord and savior JESUS CHRIST; The maker of all things and easier with the help of my parents; Engr. and Mrs. Molagun, the humble support of my brother Tobi Molagun and sisters; Busayo and Gbenuola Molagun.

A lot of people have also contributed immensely to the success of this project offering their assistance in the ways they deem fit to do. First, my project Supervisor, Mr. Ozomata David Ahmed for imparting so much into my life in terms of diligence and being of help towards the successful pursuit and accomplishment of this project; thank you so much sir. My Uncles, Aunties and family friends for their immense support and encouragement during my period of study.

Furthermore, I wish to thank my friends: Omotosho Olayemi, Adeleye Tobi, Asuquo Okon, Mohammed Sanni, Tainimu Dodo, Ayoola Sunday, Adenrele Bamgboye and immensely Abu Margret. Just to mention a few for their love and support.

My utmost gratitude goes to all the lecturers of Electrical/Computer Engineering for their co-operation and support for my success in the school. God bless.

ABSTRACT

The principle behind public system and a wireless microphone is assessed in this write up. The Audio amplifier performs an essential role in communication process, in view of this it becomes imperative that the behaviour of transistors and integrated circuits have been studied, analyzed in terms of their characteristic functionality.

In the design and construction of the audio amplifier and wireless microphones, the receiver and other devices such as the ICs and capacitor become veritable components.

Graphical simulations, sketches and mathematical expressions are provided where necessary for the purpose of clarity, objectivity and understanding. Also, Computer Aided simulations have been carried out on the design to verify the correctness and proper functioning of the system design.

This write up cannot present an exhaustive analysis of transistors rather, the aim is to give a basic understanding of how such a device in addition to transistors; capacitors operate and to illustrate some ways in which they are designed and constructed.

TABLE OF CONTENT

CHAPTER FOUR: TESTING AND CONSTRUCTION

CHAPTER FIVE: CONCLUSION AND RECCOMENDATIONS

CHAPTER ONE

GENERAL INTRODUCTION

1.1 BRIEF HISTORY OF COMMUNICATION

Communication in its broad view entails the exchange or sending of information from one person to another. This chapter is the successful accomplishment of the design, construction and testing of a wireless public Address system which is capable of delivering a stable distortion less sound of about 1 Watt Audio output.

Communications by human beings has existed since the beginning of time. However, communication by electronic and electrical means has been possible only in the past century.

1.2 SCOPE OF THE PROJECT

The construction of this design was characterized by flat frequency response, high stability and low distortion and sufficient to operate the loud speaker. Any communication process must have an information source. This is the origin of the information to be communicated.

Next, the information to be communicated must be encoded or converted to an electrical signal. The second stage is often referred to as the transmitter stage from the encoder stage or transmitter; the communicated message is fed through same channel.

This can be electromagnetic waves, wires, air or some other median. After the message is fed through the particular channel, it is to be decoded.

At this stage is where the transmitted message is picked up and converted to some intelligent form in sound or picture as the case may be. Many atimes, the decoder stage is called the "receiver".

Lastly, the information goes to the destination to which it's intended to go to. A public Address System is an Electronic communication system which enables a speaker to be heard at a distance.

1.3 METHODOLOGY ADOPTED IN CARRYING OUT THE PROJECT

As quoted earlier, the construction of this design was characterized by flat frequency response and high stability.

The higher output obtained was as a result of the above-mentioned operational characteristics and as a result of the method used for the circuitry of each stage and as a result of the well designed filter circuit to block noise and interference.

Anything that brings unpleasantness to communication is called noise and the most common part where noise enters a communication process is the message channel; however it can enter any stage.

Apart from the above mentioned reasons, the choice of operational amplifier for the design of the pre amplifier stage and input stage of the power output section was because of the following advantages; flat frequency response, high voltage gain, low distortion when negative feed back was employed. Also, the type of coupling employed in the output stage was also put into consideration and the direct coupling method was used because it has a better frequency response.

The main elements of the public Address System are: microphone (transmitter), the receiver unit, the audio amplifier and the loud speaker.

CHAPTER TWO

LITERATURE REVIEW

2.1 REVIEW

Electricity and electronics perform a very important part in our modern communications system. A wide variety of both visual and auditory means of electronics communications systems have been developed such as telegraph, telephone, radio, public Address systems, disk recorders, tape recorders, television, motion picture, radar, sonar and telemetry.

2.2 Public Address Systems: Since pre-historic time, Man in common with his association with his environment and nature has relied on his five senses to keep informed about his surrounding to move around safely to seek out food and shelter and warn him of danger. Of the five senses, hearing was a relatively late in arrival in the evolutionary process, but has perhaps become the busiest. Our sense of hearing seems always to be at work and has certainly evolved as a uniquely complex and finally tuned mechanisms, which are only now beginning to understand properly.

It is therefore hardly surprising that sense of hearing and the nature of the sounds that surrounds us have interested scientists since the earliest times, as sounds come to be used for communication speeches and promoting pleasure (music), the nature of sound and hearing became a necessary study.

A very essential part of Public Address System is the loud speaker. Although the function of a commercial Public Address Loud speaker will be of a different kind cause it will be constructed to withstand and continue to operate in case of temperature changes in environment, humidity, dust e.t.c. Whereas a hi-fi loudspeaker is designed to produce sound as accurately as possible or perhaps be engineered to sound good on typical programme material, its commercial counterpart will be designed for robustness, longevity, ease of maintenance and servicing and ease of installation – not to mention the price.

The loudspeaker drive unit may be in the form of traditional cone unit mounted in a black box or alternatively the assembly may be installed directly into a ceiling without an enclosure. Compression drivers mounted to exponential, multicellular or more commonly these days, constant directivity, horn flares are frequently used in large sound system installation.

Another very major part of Public Address System is the microphone. The word microphone first appeared in 1827 in wheatstone description of an acoustic device and was later used by Berhliner in 1877 and Hughes in 1888 for their " loose contact", transducer later called carbon microphone. The microphone acts as the first link in the chain of equipment used to transmit sound over long distances as in broadcasting and telephony.

They are used for short distance communication in Public Address, sound reinforcement and intercom applications and they supply the signals which are used to cross the barrier time as well as distance in the field of sound recording.

Basically, a microphone is a device which converts acoustic energy received as vibratory motion of air particles into electrical energy sent along the microphone cable as vibratory motion of elementary electrical particles called electrons. All devices, which convert one form of energy into another, are called transducers, the last link in any audio transmission or play back system.

Amplification is the process where the power of a signal is increased without altering its basic information carrying characteristics. Amplification in communications has found itself in virtually all-human endeavors. From vacuum tubes to transistors and magnet amplifier, amplify tiny electrical voltage to a level at which they can operate loudspeakers. There is no doubt that without amplification, communication engineering would have been impossible. The earlier pioneers could never have envisaged the ways in which their technology could expand and diversify to cover first every field of human interest.

In the Public Address System is another very important part which is the Audio Amplifier. The microphone acts as the input transducer while the loudspeaker serves as the output transducer. The input transducer converts the sound energy into electrical signal. The output transducer converts the electrical signal to sound.

2.3 Radio: Radio is that means of communication that depend only on the use of electromagnetic wave propagation, which is being propagated through the space at the speed of light. In 1886, I.C. Maxwell formulated the Electromagnetic theory of light and predicted the existence of radio waves; Hertz established this in 1887.

2.4 Telegraph: A completely revolutionary means of real time long distance communication perfected by Samuel Moorse in 1837; transmitted by Electric Telegraph for the first time in 1844. Various refinements of telegraphy appeared in later decades. For example in 1874, Thomas Edison developed quadruplex telegraphy by which two messages could be transmitted simultaneously in two directions.

2.5 Telephony: Conceived in 1874 by Alexandra Graham Bell. The first version of Telephone was crude and weak, enabling people to talk over short distance only. The quality and range of the telephone was greatly enhanced by the inventions and developments of the carbon microphone and the induction coil between 1877 and 1880.

CHAPTER THREE

COMPONENT/ FUNCTIONAL DESCRIPTION.

3.1 TRANSMITTER (MICROPHONE): Microphones are devices used in the transfer of audio sound signal from one point to another and are termed " transmitters". Any radio communication system needs a device that will transfer information from one point to another. Thus a transmitter is the device used for sending of intelligence by means of radio waves from one point to another.

The transmission of intelligence involves the modulation of an audio signal by impressing on it a suitable carrier frequency so as to allocate to it a frequency spectrum and then amplified to the necessary power level. Microphones are rated in terms of frequency response, directivity, impedance, sensitivity and self-noise. When choosing a microphone for any particular application, some or all of the above mentioned characteristics needs to be considered.

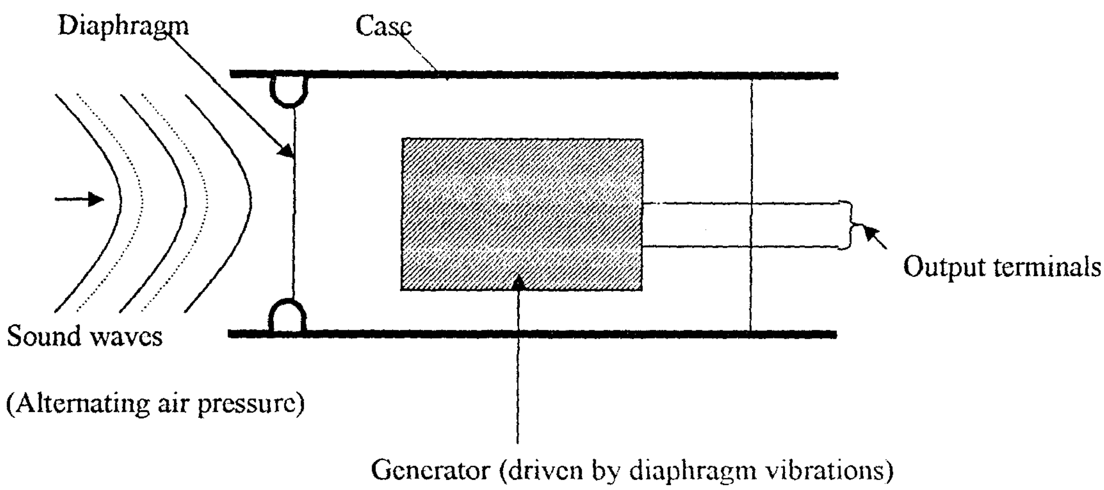


Figure 1: A microphone converts acoustical energy into electrical energy.

3.2 TRANSFORMER: A transformer is a passive device that has voltage gain but no power gain. It basically consists of two windings; the primary and secondary windings. Windings are basically of two types; shell and core types. The input electrical power (signal) is fed into the primary side while electrical power (signal) is drawn from the secondary side. When the output voltage is greater than the input voltage and the output current is less than the input current, it is known as a step – up transformer other wise, a stop down transformer. If implies that the number of turns of the secondary is higher than that of the primary. In this way the power is conserved and the transformation occurs at the same frequency.

This relationship can be expressed mathematically as: -

$E_s/E_p = N_s/N_p = K$

Where E_s = Secondary Voltage

E_p = Primary Voltage

N_s = Number of turns of the Secondary side

N_p = Number of turns of the Primary side.

Transformers serve two main purposes:

1. They isolate the electronic devices from the mains since the 2 windings are electrically insulated from each other and thereby provide a means of protection.

2. provide useful voltages (usually lower) for devices.

Power transformers come in variety of output voltages and currents. There are power sections nowadays that eliminate transformers but such could be lethal.

Transformers that are used for other applications also exist like those for audio and radio frequencies, which are made of special core material and construction to minimize core losses at high frequencies.

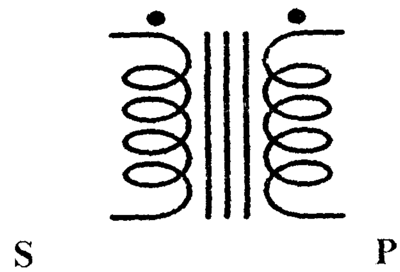


Figure 2: Transformer with primary and secondary windings.

3.3 DIODE

Diodes are passive non-linear circuit element. They are two terminal devices consisting of a p-n junction made of either Germanium or Silicon crystals. when forward biased, that is the p-side connected to a positive battery lead, forward current flow from the p-side to the n-side after the barrier potential has been overcome.

When reverse biased, only leakage current flow and reaches its limit until when additional reverse biased is added and the leakage current rises enormously. In the forward region, there is no current until the informal barrier voltage is overcome which is about 0.6V for silicon diodes and 0.3V for Germanium diodes.

After, there is an exponential rise in current which if not controlled could destroy the diode. In the reverse region, the leakage current quickly reaches its maximum and stays there until the reverse breakdown voltage is reached thereby causing the reverse current to increase rapidly.

Due to conduction in one direction, the diode has found application in rectification of a.c voltage into d.c. The a.c signal is usually from a transformer (step-down) and based on different configurations, you could get a full wave or half wave rectification. Half wave and full wave rectifications implies that half and complete input voltages are rectified respectively.

Figure 3: A diode Symbol

3.4 CAPACITORS:

Capacitors are also passive devices that are extremely important in circuits that involve changing voltages and currents. When a layer of an insulating medium known as a dielectric separates two conducting surfaces, they form a capacitor. The conducting surfaces may take various forms; spherical or cylindrical, circular or rectangular.

The capacitor cannot dissipate power because the voltage and current are 90 degrees out of phase. It has found application in waveform generation, filtering, blocking and passing. It is also used in integrators and differentiators and with a combination of inductors, can be used to make sharp filters. The ceramics and Mylar types are used where greater capacitances are required and the electrolytic types are used for power filtering.

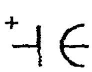


Figure 4: Capacitor Symbol (Polar cap)

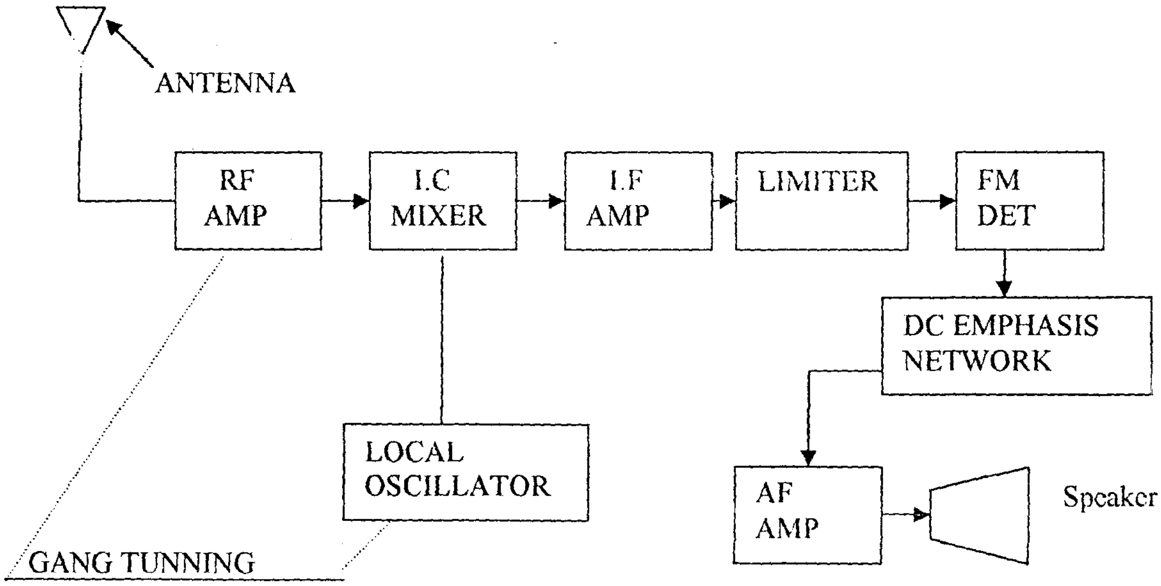


Fig 5: Block diagram of an FM receiver

An Oscillator is an amplifier that provides its own input signal, which is derived from the output signal.

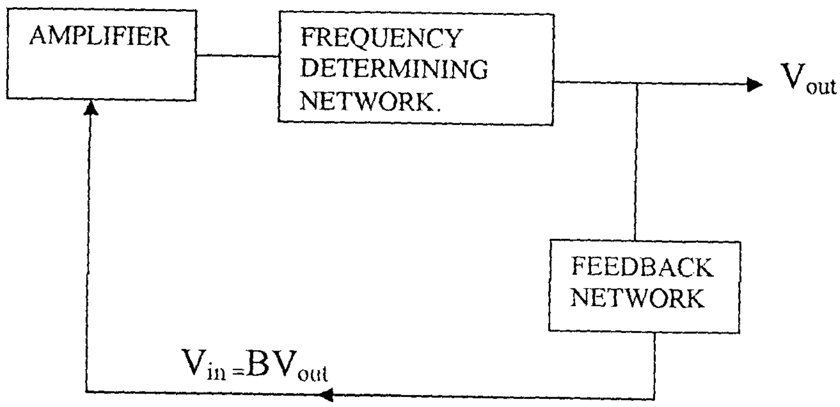


Figure 6: Principle of an Oscillator

From the diagram, a fraction of B of the output voltage is fed to the input. If the gain of the amplifier is AV, the output voltage exists and therefore;

(1- BAV) must be zero or 1.

BVA=1

In general, both the gain AV and the feedback ratio B are complex and hence, B< ϕ, AV<

θ = 1<0

So that $BA_V < \phi + \theta = 1 < 0$

This equation states the necessary requirements that must be satisfied before a circuit will oscillate. Firstly, the loop gain BA_V must be unity and secondly, the loop phase shift 1+θ must be equal to zero.

3.5 FUNCTIONAL DESCRIPTION

The KA 2297 I.C is a monolithic integrated circuit of an FM/FE + AM Intermediate frequency and DET amp. The KA 2297 I.C is a no adjustment AM/FM intermediate frequency DET coil.

The main circuit works along side with an LM 386 audio amplifier. The other integrated circuit serves to strengthen the audio output of the complete device. Although, the integrated circuit has both AM and FM features, only the FM mode is incorporated into the design. The pins that are not in use serves as the AM mode.

Pins 1 and 2 are designed for the antenna circuit; the input signal is fed into the device through these terminals. The two 30pF and a three turns coil on a 10mm diameter (air core) are used for the circuit.

The radio frequency signals from transmitting stations enter the circuit and they are directed to the RF circuit (pin 15) of the I.C. The FM RF is designed to select a particular signal from as many signals received by the antenna. Therefore a tuned LC circuit is in use.

The LC circuit helps to select a particular signal from the many received signals. The technique allows a specific signal to be picked up and listened to by the receiver. The selection is done by the resonance frequency formula of the circuit. Resonance Frequency Formula = $1/2\pi\sqrt{LC}$.

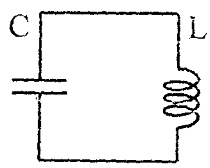


Figure 7: An L.C circuit representation

3.6 BIASING CALCULATION

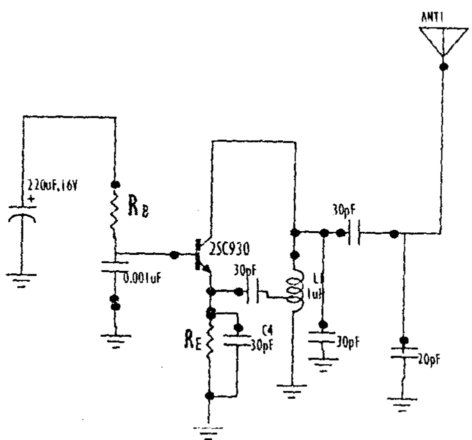


Fig. 8 FM Oscillator Stage.

From the diagram,

$I.c = 4.5$ mA

$Hfe=120$

$Vcc= 9V$

$Vce= \frac{1}{2} Vcc$

$= \frac{1}{2} \times 9$

$=4.5$ V

$R_1 I_c = Vce$

$$R_1= \frac{Vce}{I_c} = \frac{4.5}{4.5 \times 10^{-3}}$$

$R_1=1000\Omega$

$$Hfe = \frac{I_c}{I_B}$$

$$I_B = \frac{I_c}{Hfe} = 4.5 \times 10^{-3} = 37.5\mu A$$

For Silicon transistor, $V_{BE} = 0.7V$

$V_{R2}= V_{CE} - V_{BE}$

$= 4.5-0.7$

$= 3.8V$

$R_2 I_B= V_{R2}$

$$R_2 = \frac{V_{R2}}{I_B} = \frac{3.8}{37.5\times 10^{-6}}$$

$R_2 = 101k\Omega$

Frequency (F)= 20kHz for speech frequency

$$C_2 = \frac{1}{2\pi f}$$

$$C_2 = \frac{1}{2x\ 3.142\ 20x\ 10^3}$$

$C_2 = 8 \times 10^{-6}$ F

$$C_1 = \frac{1}{2\pi R_2 f}$$

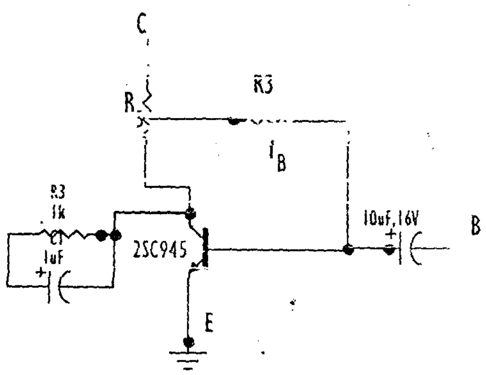
$$= \frac{1}{2x\ 3.142 \times 101x\ 10^3 x20\ x10^3}$$

$C_1 = 79x\ 10^{-12}$ F

$C_1 = 100x\ 10^{-12}$ F.

3.7 FM Modulator stage

This is a circuit employed so as to impose a low frequency voice information component on a high frequency carrier signal which is granted by the oscillator.



FM modulator stage

CALCULATIONS:

Hfe = 120

$I_c = 96mA$

$$I_B = \frac{96x\ 10^3}{120}$$

$I_B = 800 \times 10^{-6}$ A

$$R_3 = \frac{V_{r3}}{I_B} = \frac{4.5}{800 \times 10^{-6}\ A}$$

$R_3 = 5.625$ K

$R_3 = 5.6$K

$$C_3 = \frac{1}{2\pi_{R3}f}$$

$$C_3 = \frac{1}{2x\ 3.142x\ 5.6\ 10^3 x\ 20x\ 10^3}$$

$C_3 = 1.42x\ 10^{-9}$ F

Then $V_{R5} = V_{CC} - V_{CE}$

$= 9 - 0.9$

$= 8.1$ V

$$R_5 = \frac{V_{R5S}}{I_c} = \frac{8.5}{96 \times 10^{-3}}$$

$R_5 = 89\Omega$

$R_5 = 100\Omega$

Applying the approximation (junction resistance),

$$R'e = \frac{26mV}{I_E}$$

And $I_E = I_C$

The input resistance to the transistor in the Common- Emitter configuration is:

$$hfe = \frac{120\,(26 \times 10^{-3})}{96 \times 10^{-3}}$$

$hfe = 32.5\ \Omega$

For dynamic values of input and load resistance $V_{in} = hfe \,//\, R_3$

$$R_{in} = \frac{32.5 \times 5.6\ 10^3}{32.5 + 5.6\ 10^3}$$

$R_{in} = 32.3\ \Omega$

The Dynamic base amplifier and dynamic signal condition

$V_{EE} = I_E R_7 + V_{EB}$

$V_{EB} = 0.7$ Silicon transistor

$I_c = I_E = 8x\ 10^{-3}$ A

$$R_7 = \frac{V_{EE} - V_{EB}}{I_E}$$

$$= \frac{9 - 0.9}{8 \times 10^{-3}} = \frac{8.1}{8 \times 10^{-3}}$$

$= 1038\ \Omega$

$R_7 = 1\ K\ \Omega$

Determining the Value of R_L which is inductive,

$V_{CB} = 1/3 V_{CO}$

$= 1/3 \times 9$

$= 3V$

$V_{CE} = V_{CB} + V_{RL}$

$V_{RL} = 9 - 3 = 6$ V

Since $I_C = I_E$

$I_C R_L = V_{RL}$

$8 \times 10^{-3} R_L = 6$

Therefore, $R_L = \dfrac{6}{8 \times 10^{-3}}$

$= 750\Omega$

After having calculated the values of R7 and R_L necessary to establish proper d.c conditions, amplification can now take place.

3.8 DYNAMIC SIGNAL CONDITIONS

To now find the input signal current, we first determine that value by the signal source. Applying the approximation (junction resistance)

$$r'j = \frac{26mV}{I_{d.c}}$$

Becomes $r'e = \dfrac{26\ mV}{8 \times 10^{-3}}$

$$r'e = 3.25\Omega$$

To the signal source, r'e and R_7 appear to be in parallel

Then $R_{in} = r'e \,//\, R_7$

$$R_{in} = \frac{3.25 \times 1038}{3.25 + 1038}$$

$$R_{in} = 3.2\Omega$$

$$I_{in} = \frac{V_{in}}{R_{in}}$$

$$= \frac{3.5mV}{3.2}$$

$$I_{in} = 1 \times 10^{-3}$$

Since the signal is applied to the emitter, we can say that $I_{in} = I_E = I_C$ x 1mA

But the dynamic load R_i // R

Where R is the resistance of the antenna (R= 75Ω)

$$rl = 750 \,//\, 75$$

$$= \frac{750 \times 75}{750 + 75}$$

$$rl = 68\ \Omega$$

Finding output signal voltage.

$$V_{OUT} = I_c\, rl$$

$$= 1 \times 10^{-3} \times 68$$

$$V_{OUT} = 68 \times 10^{-3}\ V$$

$$\text{Voltage gain} = \frac{V_o}{V_i} = \frac{0.0068}{3.5 \times 10^{-2}}$$

$$= 19$$

$$\text{Current gain} = \frac{I_{OUT}}{I_{IN}} = \frac{i_{OUT}}{i_{IN}}$$

Power gain = Current gain x Voltage gain

$$= 1 \times 19 = 19$$

The total capacitance of the Oscillation,

$$C_t = C_5 + C_8 + C_9$$

$C_t = 7 \times 10^{-12} + 5 \times 10^{-12} + 2 \times 10^{-12}$

$= 14 \times 10^{-12}$ F

To calculate the value of inductor used in the Oscillating tank,

$F = 103.7$ MHz

$F = 1 / 2\pi LC_t$

$L = (1/2\pi F)^2 I/C_t$

$$L = \frac{1}{2 \times 3.142 \times 103.7\ 10^6 \times 14 \times 10^{-12}}$$

, $L = 168 \times 10^{-9}$.

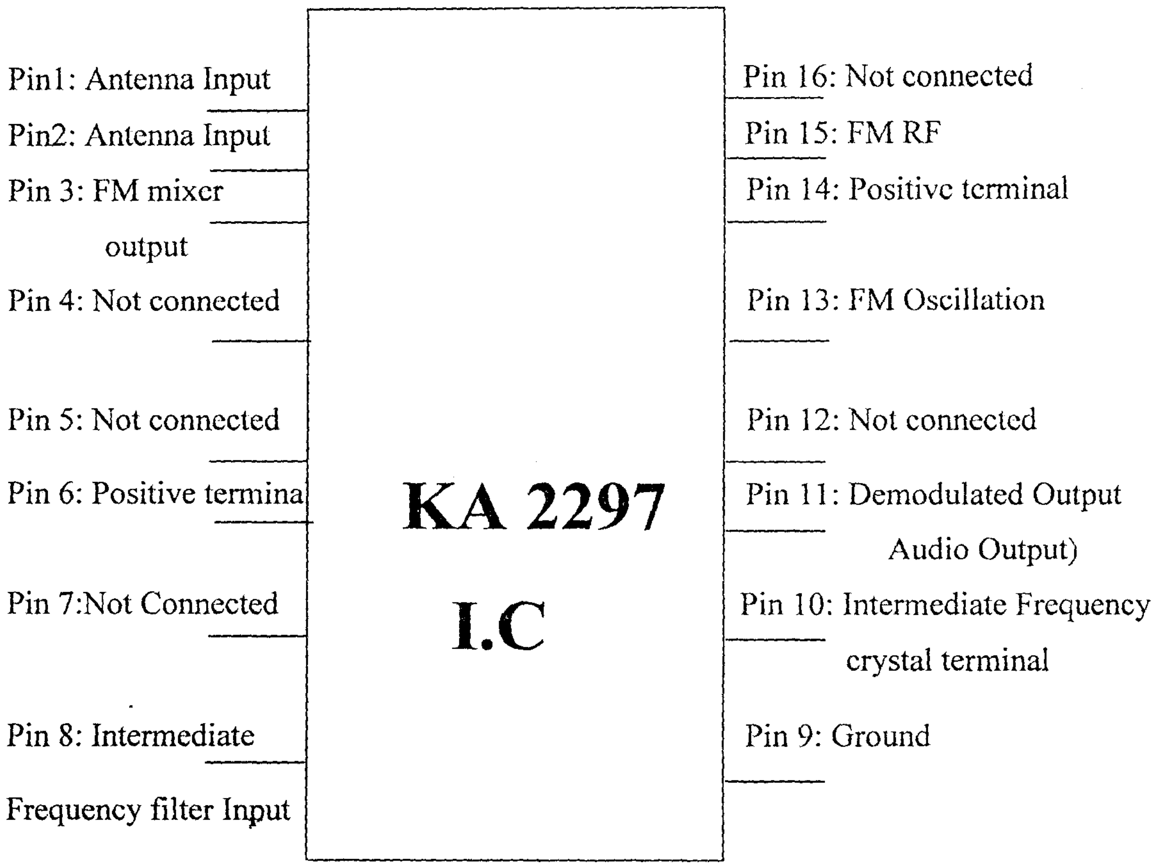


Figure 9:The KA 2297 I.C Pin Assignment.

CHAPTER FOUR

TESTING AND CONSTRUCTION

4.1 CONSTRUCTION AND TESTING

In constructing this project, a larger part was tested and placed on the breadboard except for the power circuit. Each component and module of the design was tested before soldering on to the Vero board.

4.2 CIRCUIT CONSTRUCTION, TESTING / RESULT

The Power section was constructed with the bridge rectification properly put into place and filtered with a 16V/ 1000μF capacitor. The step down transformer used is rated12V, 500mA. Output was finally obtained after series of checking and filtering to ensure correct connection of all components.

Supplying the output to the receiver section however followed this and a 9V regulator to the circuit supplied this. The output signal to the receiver was filtered and equally amplified passing through an LM386 amplifier.

The components were carefully soldered on to the Vero board used. The resonance frequency shows that a specific frequency can be associated with the LC circuit. That frequency is received and fed into the pin 15 of the KA2297 I.C.

In order to achieve easily, an amplification of selected frequency, I connected a local Oscillator into the circuit. The Oscillator is assigned a frequency which is very close to that of the radio frequency (RF).

This frequency is associated with terminal 13 of the I.C. The RF and local Oscillator frequencies were the internally mixed inside the KA2287 I.C. The results were four different frequencies, which include the two initial frequencies:

F_1------------- RF_1

F_2-------------Local Oscillator frequency

$F_1 + F_2$ ----------(RF + Local Oscillator frequency)

$F_1 - F_2$ ----------(Difference normally about 10.7MHz and called Intermediate frequency).

The four frequencies come out of terminal 3 of the KA2297 I.C. The desired frequency of the four frequencies is the intermediate frequency (i.e. $F_1 - F_2$) and since it was my desire to filter out that frequency, an intermediate frequency crystal of value 10.7MHz was used. Two of such crystals were used in the circuit; One at pin 3-6-8 and the other at pin 10.

Further amplification was done to increase the strength of the leading frequency. Then the frequency is demodulated, which was formerly done externally.

This demodulation removes the audio content of the frequency to pin 11. At this terminal, additional external components such as a 10K Ω resistor, 0.001 μF capacitors are connected to smoothen the quality of the signal.

A variable resistor was also added to function as a volume control. The variable resistor was connected to the audio amplifier through a 1 μF 16V coupling capacitor. The audio strength of the signal and the final output was through a 1 Watt 8Ω rating loud speaker. Moreover, pin 5 of the KA2297 I.C function as an Automatic gain Control terminal (AGS).

CHAPTER FIVE

5.1 CONCLUSION

From the designing and construction processes involved in this project, it can be concluded that there is an achieved goal in the aspect of incorporating project work in the university syllabus since one has been able to facilitate the aspect of the profession i.e. practical knowledge has been acquired to compliment almost all the theoretical aspects that have been imparted to us in our lecture classes.

It could also be deduced that the aim and objective stated in chapter one were achieved. The principle used for the system worked as required therefore, it could be used to compliment already existing means of communication and can be used as a better means of communication which brings solution to the setback(s) in a communication system.

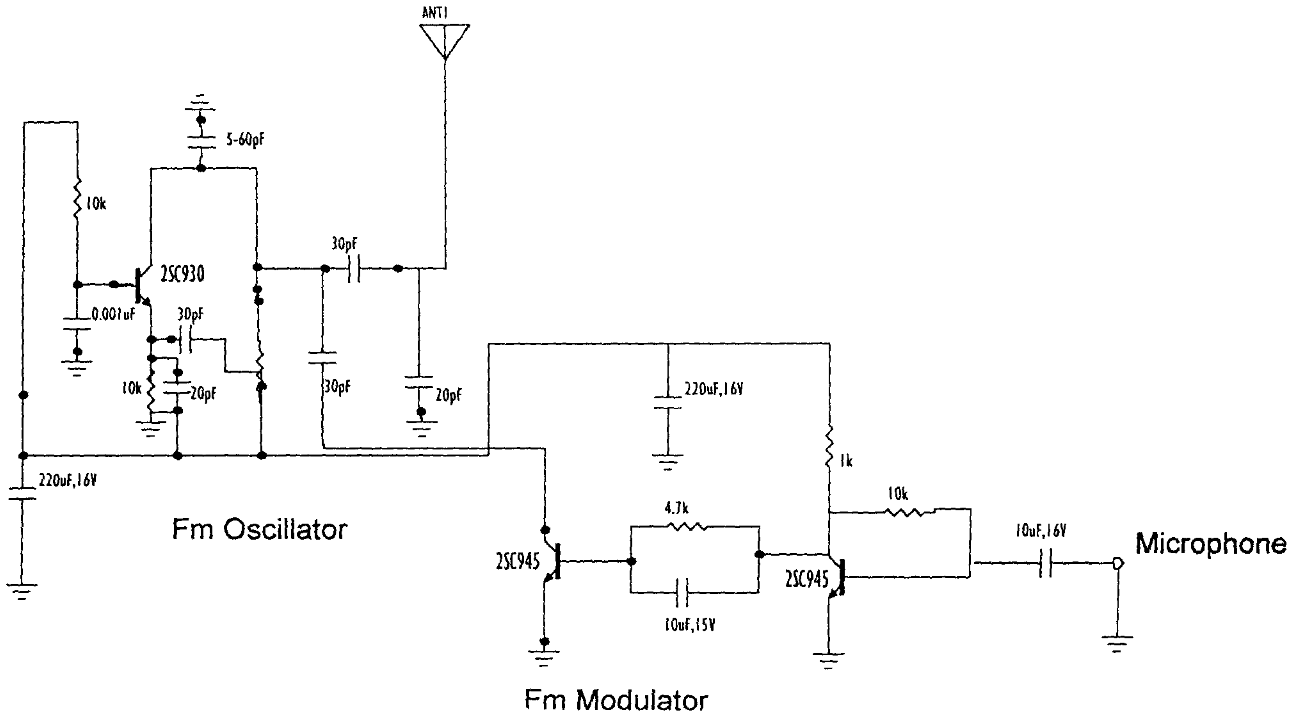
5.2 RECOMMENDATIONS

1. There should be upgrading of the equipment that are being used in the school laboratory so that students will be able to get the appropriate tools at the appropriate periods.

2. The University system should operate in a way that plans for project schedule would start from early stages of the syllabus in order for students to be more practical oriented before their final year.

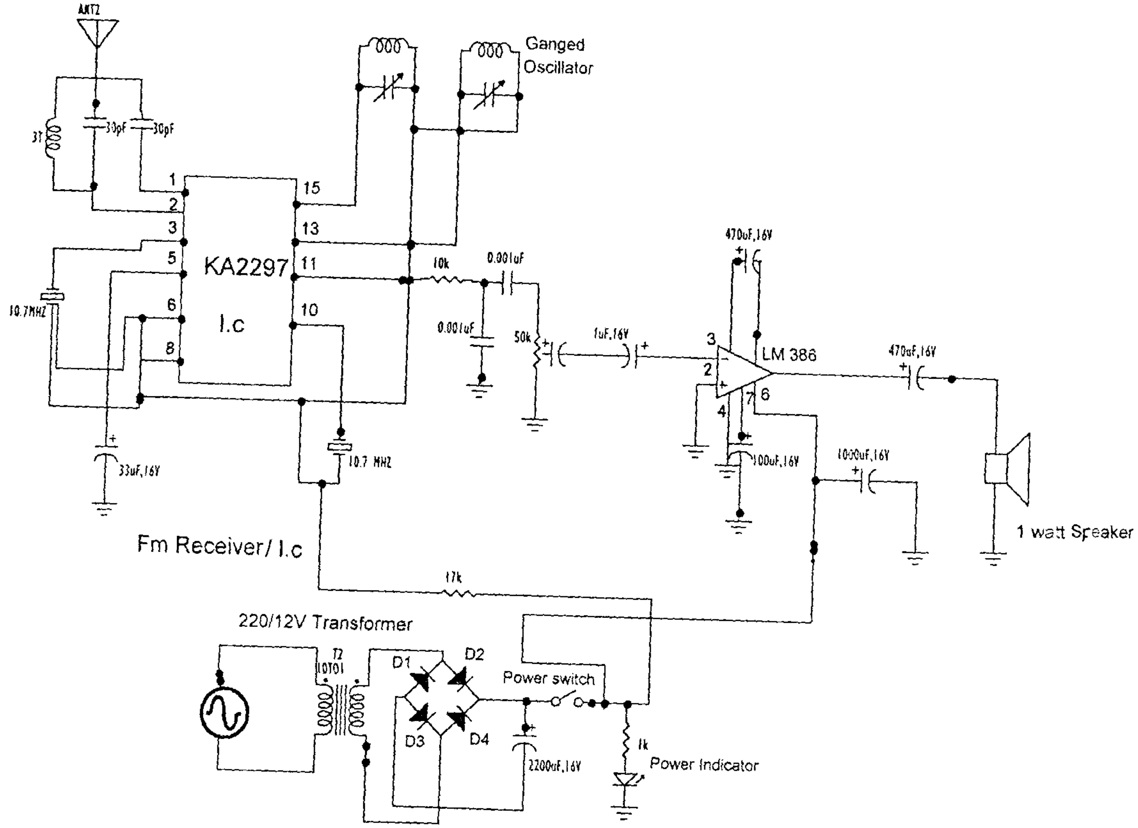
3. The Government should make provision for standard libraries and research centers where students can go and carry out their research.

Appendix 1



Fm transmitter operating at 60-70 MHz Fm range

Appendix 2



The Circuit diagram of a
mini Public Adress system.

BILL OF MATERIALS
(QUANTITY FOR THIS PROJECT)

S/N	Description of Component.	Qty	RATE (₦)	TOTAL AMOUNT (₦)
1	Capacitor	21	10	210
2	Resistor	7	5	35
3	Diode	4	5	20
4	LED	1	5	5
5	Transistor	3	15	45
6	Switch	1	50	50
7	Transformer	1	100	100
8	RF Ic	1	200	200
9	Amplifier	1	100	100
10	Crystal Oscillator	2	50	100
11	9V battery	1	50	50
12	Variable Resistor	2	15	30
13	1 Watt Speaker	1	80	80
14	Gang Capacitor	2	80	160
15	Antenna	2	100	200
	TOTAL			1385

REFERENCES.

1. http://www.suremicrophones.com / wireless mics
2. http://www.peaveyinstruments.com/ public address systems
3. Audio and Hi-fi handbook Second Edition, Edited by Ian Sinclair, 1997 Reprint.

   Chapter 18; Public Address & Sound reinforcement, Chapter 2; Microphones.
4. Electronic Components and System W.H DENNIS
5. Basic electronics System and Technology by DUGGAR PATRICK, SUESS ZIEGLER.
6. Design and Construction of Wireless VHF Public Address System by Gana. D Haruna, Federal University of Tech, Minna. September 2003.
7. http://www.ieee.com/components