DESIGN AND CONSTRUCTION OF ELECTRONIC BUGGING SYSTEM

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DEDICATION

This project work is dedicate to God, the author and finisher of our work faith for given me the ennoblement to carry out this work, and to my parent Mr. Michael Nwosu, late Mrs. Felicia Nwosu, and also to my brother Chima Nwosu, my sisters Edith Nwosu, Edna Nwosu, Lillian Nwosu, Chaluka Nwosu, and to my friends Maiyaki Eshalomi, Ruben, Tola, Mosses, Harry and to the family of Onyeje and also to my aunty, Mrs. Stella Ejinkeonye for their moral and financial support.

DECLARATION

I Nwosu Henry Ifeanyi declare that this was done by me and has never been presented elsewhere for the award of Degree. I also hereby relinquish the copy right to the Federal University of Technology, Minna.

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ACKNOWLEDGMENTS

I hereby accord myself the immense opportunity to express my sincere gratitude to God Almighty for the knowledge, wisdom and protection given to me to perform this project I also greatly acknowledge the support of my sincere supervisor Engr. E. Eronu for all his advice, which contribute immensely in making this project a success.

My gratitude goes to my beloved mother late mrs Felicia Nwosu and my uncles Emeka oneyeje, Gideon oneyeje, Japhet nwosu, Ameze Nwosu and mostly my aunty Mrs. Stella Ejinkeonye Also to my friends simeon Nnadi, Samuel kine, saint obaje, uche M., Nkechi, may our lord grant each and every one of us our individual goals.

ABTRACT

Electronic Bugging System is a device used to intercept conversation between two or more people without the consent of any one of them.

The placement of electronic bugging devices in homes, offices, companies, battlefield has become a useful phenomenon in intelligence information gathering although it is legally prohibited in virtually all jurisdiction for commercial and private purposes.

The bugging system consist of two major components viz the transmitter circuit and the receiver (Detector) circuit. The receiver circuit is capable of selecting the wanted signals picked up by the aerial (Antenna) while rejecting all others, extracting the intelligence contained in the modulated signal and producing an audio frequency output of sufficient power to operate the loud speaker.

The project deals with the design and construction of an Electronic Bugging System, transmitting at a frequency of 4MHz and the receiving frequency of 97MHz, with a reception distance of about 10-15 meters.

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS

CHAPTER ONE

1.0 INTRODUCTION

Curiosity is the keystone of learning; the man who "wants to know" has a far better chance of digesting and retaining information than he who ploughs a set of subject simply because it has been put before him. Earlier before the invention of radio communication; drums, signal fires, smoke signals, even mirror reflection signals played a crucial role in communication.

With respect to electricity, communication can be defined as the sending, processing and receiving of information by electrical means.

Besides, radio communication or wireless communication is means of communication that relies on the use of electromagnetic waves propagated through the space at the speed of light.

Electronic bugging system can be defined as an electronic device used to intercept conversation (intelligence) without the consent of at least one of the participants.

In radio communication, two things are of paramount importance:

i. The sending of message or intelligence (signal)

ii. Reception of the message signal

In radio communication, the sending of message is done by the transmitter while the reception of be message signal sent is done by the radio receiver.

A simplified diagram of radio communication is shown in figure 1.0. We have the transmitter at the source and the receiver at the destination. [6]

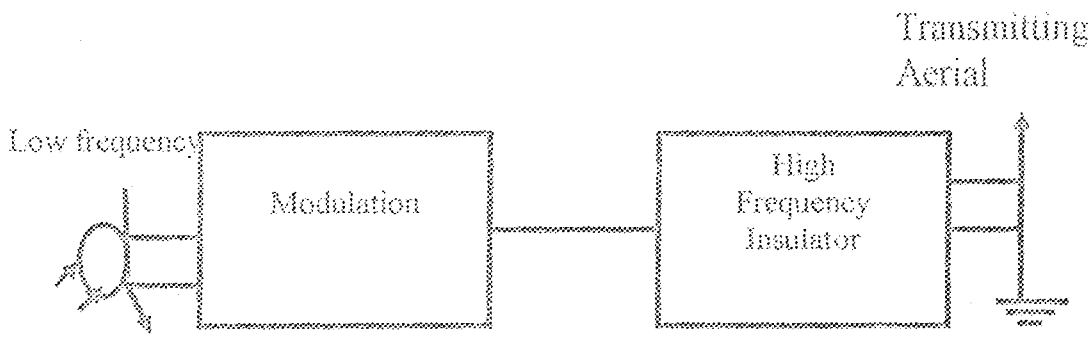


Fig 1.0 a Radio Transmitter

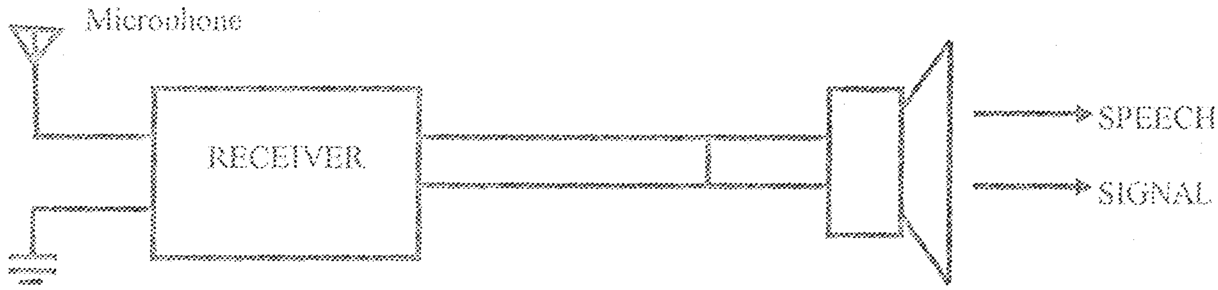


Fig 1.0 b Radio receiver

Fig 1.0 a simple diagram of a radio communication link

SPEAKER

Fig 1.1 Radio Receiver

A Simplified Diagram of A Radio Communication Link

1.1 AIM OF PROJECT

With respect to the principle of transmission and reception of message signal, it is necessary to appreciate the aim of this project titled "DESIGN AND CONSTRUCTION OF ELECTRONIC BUGGING SYSTEM".

Therefore, the objective is aimed at producing a simple radio transmitter with a high impute preamplifier stage and a radio receiver that are portable and capable of transmitting and receiving of intelligence on the commercial frequency modulation band of 88MHZ to 108MHZ. In accordar :e with the Broadcasting organization of Nigeria (BON) whose responsibility is to alloc :e usable frequencies to transmitting stations.

1.2 APPLICATION OF ELE(TRONIC BUGGING SYSTEM

The placement of electroni ugging system device in homes offices, companies, and battlefields has become a use l phenomenon throughout the passing years. Besides, the use of these devices is prohibited in virtually all jurisdictions for commercial and private purposes.

E.g In some countri like the United States of America, the use of bugging system devices was l gall- oroidden as way back as 1862. But today, electronic Bugging system, under the na ie ystem of Electronic surveillance is used for a variety of serous crimes subject to stri judicial control. This favours the police to use this method as an indispensable tool r ffective police work in many cases; particularly in the investigation and disposal of mes, sedition such as kidnapping. It also favours the military in checkmatin possibilities of coup plats an also used in the front line of battle areas [9]

1.3 TYPES / CLASSIFICATION OF ELECTRONIC BUGGING SYSTEM.

Some types of electronic bugging system devices in use are as follows

1.3.1 Audio Amplifier type

This type of Bugging system devices is normally use for short distances. This Bugging system consists of two (2) stages the input and the output stage. This device uses a microphone to convert sound energy being picked up into electrical pulses. The pulses are then passed on through a wire to another reproductive set where the pulses are then reconverted to sound. This type is used in TV, Radio stations etc.

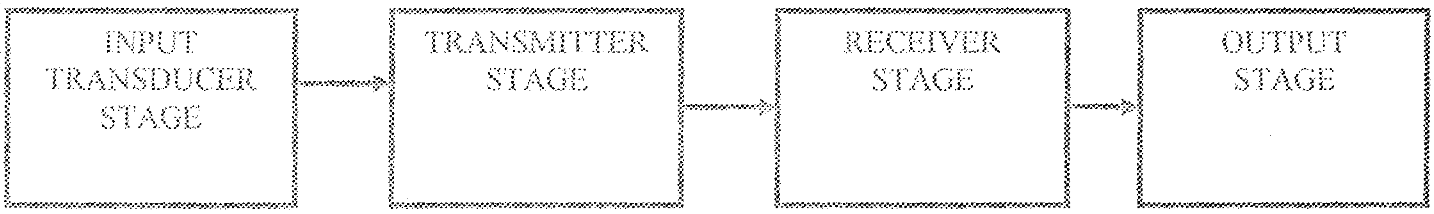


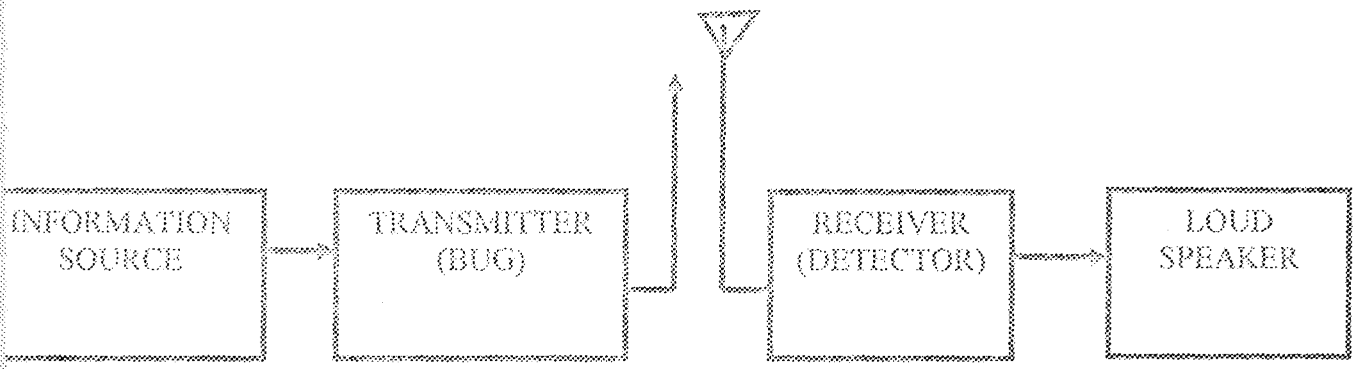
Fig 1.1 Block Diagram Of Audio Amplifier Bugging System

1.3.2 WIRELESS (FM) TRANSMITTER / RECEIVER TYPE

This type of Bugging system device is also known as Bugging device, which makes use of a transmitter circuit to pick- up conversation, which is then transmitted on to the receiver placed for distance away though the antenna They are secretly place in a room, office or any location that is to be monitored. In these types of Bugging system device, the information source (signal) is spoken into the microphone which serves as a transducer. The transducer then converts the analog signals into electrical pulses that can be resigned by the transmitter. In the transmitter. [9]

the modulated signal is amplified to a level suitable to drive an antenna. By the time the transmitted signal reaches its destination, the receiver demodulates and decodes the received waves, processes it and converts it to a form useful to a person.

Finally, electronic bugs take advantage of modern technology.



CIRCUIT DIAGRAM OF TRANSMITTER CIRCUIT DIAGRAM OF RECEIVER

Fig 1.2 Block diagram of wireless Bugging system.

1.3.3 THE RAY-GUN TYPE

A ray-gun device is an electronic Bugging system device that beams an object hundreds of meters away an can imperceptibly pick a conversation and return it to the man / person at the listening post. In modern technology, the conversation is ordinary carried by light beam or laser.

1.3.4 THE RADIO SIGNAL INTERCEPTOR

This type of Bugging system is used in battlefield as an electronics support measure (ESM)

The primary function of ESM is to search and monitor enemy radio signals. [9]

The ESM sets are mounted with scanners and direction finding antennas.

The antennas are meant to cope with wide range of frequencies from various enemy threats.

1.4 MODULATION

Modulation involves the process of placing or superimposing of information (intelligence) on a carrier wave at the transmitting signal end. The carrier wave by itself will not produce any intelligence at the laud speaker of the radio receiver.

The transmission of intelligence occurs when the modulating signal is superimposed on the carries wave.

Modulation can be defined as the process of combining the low frequency signal (voice, music etc) with a high frequency radio wave called the carrier wave together

The result of modulation process is a modulated carrier wave (signal) and a frequency shift.

Generally, a modulated sine wave signal may be represented by the equation.

$e = E \sin (wt + \Theta)$ ------------------(1.0)

Where e= the instantaneous value of the carrier modulated wave

E= Maximum Amplitude

wt = Angular velocity or angular frequency

Θ = Phase Shift

Finally, varying any of E, Ø, w of the carrier wave signal by the modulation of signal give rise to amplitude, frequency and pulse modulation respectively [8]

1.4.1 NEED FOR MODULATION

Modulation process is employed in communication systems for the following reasons:

i. For Channel Assignment

Each message signal is transmitted at unique frequency band to avoid mix up with other signals. This is why only one radio is received with in its coverage area without interference from another stations.

ii. To reduce noise and interference particularly at low frequency.

iii. For easy radiation and reception of signals by using practically realizable antenna size

Besides in order to radiate electromagnetic energy most efficiently,

The length of the transmitting antenna must be at least one quarter (1/4) of the signal wave length (λ).

iv. For multiplexing so that several message (signals) can be transmitted through the same signal channel.

v. To overcome equipment limitation e.g. size and weight

1.42 FORMS FOR MODULATION

There are two forms namely:

i. Analogue modulation

ii. Pulse or digital modulation

1.43 ANALOGUE MODULATION

Analogue modulation refers to a category of modulation techniques in which the carries signals are both analogue with respect to time.

1.4.4 DIGITAL OR PULSE MODULATION

In pulse modulation however, the carrier is a pulse whose amplitude phase (position or duration (width)) or frequency is proportionately varied with respect to the instantaneous value of the continuous-modulating signal. In order to achieve pulse modulation, it's necessary to sample the modulating signal so that the signal is used only during discrete time points. Two main advantage of pulse (digital) modulation over analogue modulation are as follows:

i. Transmission and processing of discrete signals are easier
ii. The system consumes less power since only a sample is sent instead of the whole signal

With respect to this project, frequency (FM) is of great importance.

1.5 FREQUENCY MODULATION (FM)

Frequency modulation is a modulation process in which the instantaneous frequency w (t) of the modulated wave is equal to the modulated carrier frequency w (c) plus a time-varying component that is directly proportional to the modulating signal Vm (t)

FM can be represented by the expression

$V_{fm}(t) = V_c \cos(W_c t + \beta \sin W_m t)$ ------------------------ 1.1

But

$\beta = \Delta F / F_m$ -- 1.2

$\Delta F = K[V_m/2\Pi]$ -- 1.3

Where Vfm (t) = FM modulated wave

Vc = Amplitude of the carrier (unmodulated)

Wc = Angular Velocity of the unmodulated carrier wave

β = modulation Index

Δf = Frequency deviation

Fm = Frequency of the modulating signal

KF = frequency sensitivity of the modulator circuit

Vm = amplitude of the modulated signal

Wm = angular velocity of the modulated signal e)

1.5.1 GENERATION OF FM WAVE

We have two methods of generating FM waves nam y

(i) INDIRECT METHOD

This method involves the process of connecting i quency multiplier circuit to the output of the Armstrong circuit (Narrow band FM g ator circuit). Figure 1..3 shows the block diagram of indirect method of generation FM e.

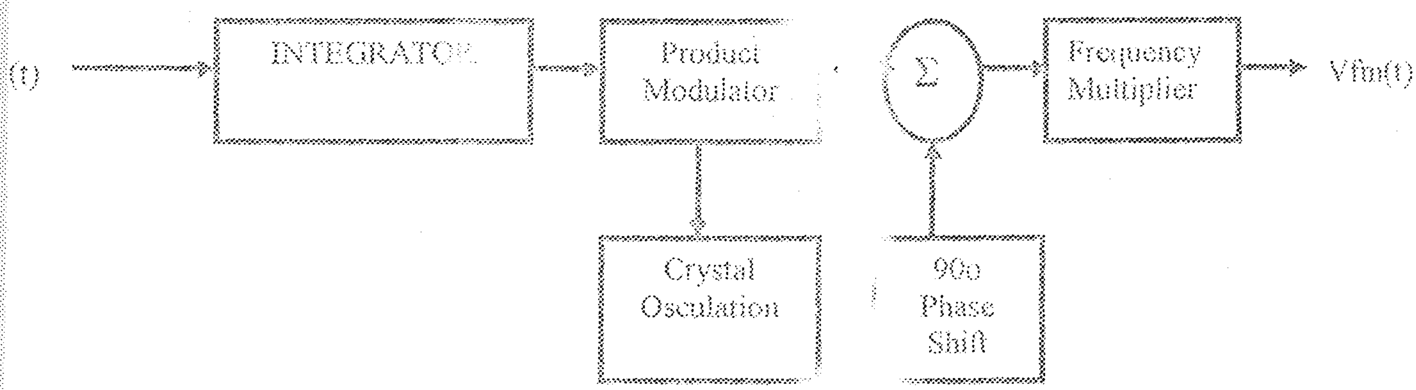


FIG. 1.3 GENERATION OF FM WAVE (I CT METHOD)

(ii). DIRECT METHOD

This method can be achieved by varying the frequency he voltage controlled oscillator (VCO) Figure 1.4 shows the block diagram of the metho above.

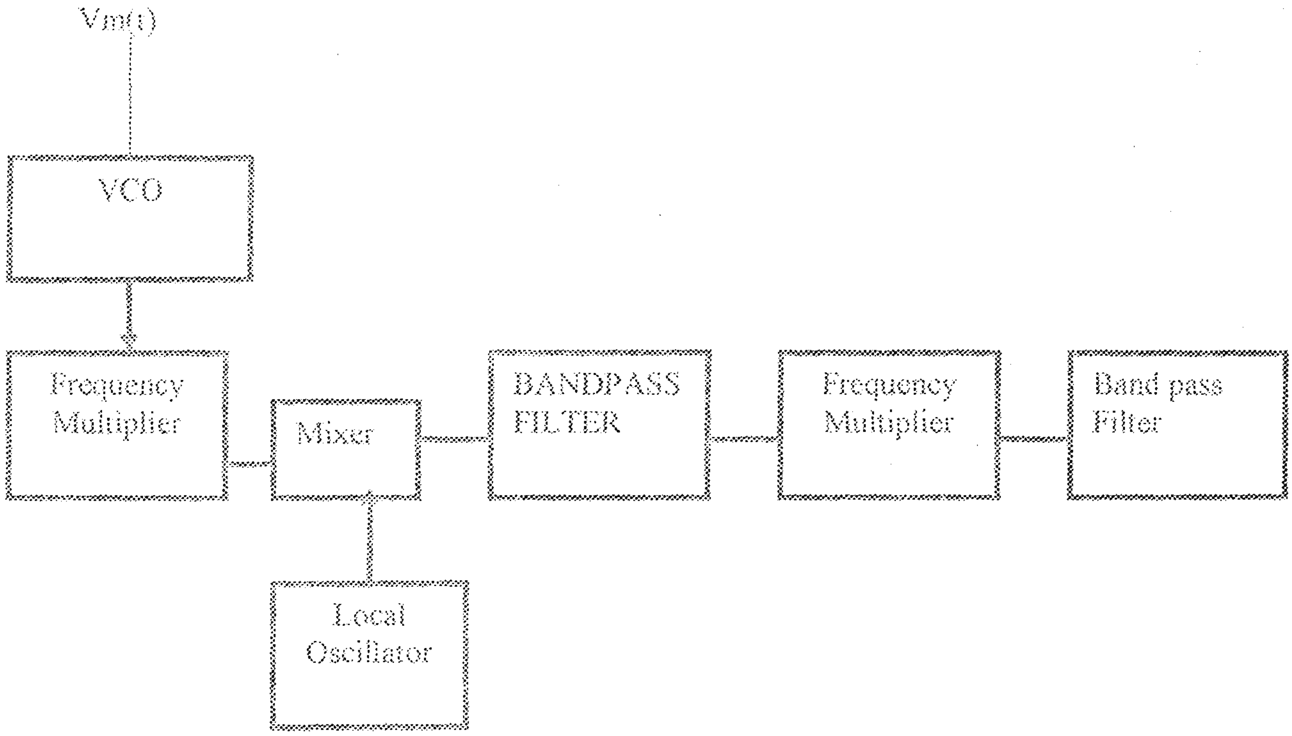


FIG 1.4 DIRECT METHOD OF GENERATING FM WAVE

1.5.2 DEMODULATION OF FM WAVE

Frequency demodulation is the process by which the original modulating wave is recovered from the FM wave. This process takes place at the receiving end.

Demodulation of FM wave can be achieved by using

i. Frequency discrimination circuit

ii. Radio detector circuit

iii. Phase locked loop (PLL) circuit

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Origin of Radio Communication

As far back as 1865, JC Maxwell predicted mathematically radio communication from the result of faraday's and Christian oersted-electrical magnetic experiment. The laws deduced from the experiment were proven right in 1885 by Heinrich hertz and by 1895 macron developed a practical radio transmitter. [4]

Edwin amstrong (major) a great scientist born in manhattan 1890 made and enormous contribution to the development of radio communication. In order to increase the sensitivity of the receiver, Armstrong hit on the idea of feeding the signal back to the gain. The primitive hard a very low gain at radio frequency, he called this idea "REGENERATION".

In 1914 precisely, major Edwin amstrong invented superheterodyne receiver. In the superheterodyne receiver each incoming frequency is tuned, amplified and the converted to an intermediate frequency (I.F) by mixing it with a signal from and oscillator. [9]

Finally: with the invention of superheterodyne receiver, turning has become easier because there are fewer variable tuned circuit feedback is less of a menace because the signal. (I.F) Is not at the same frequency with the input signal. It has also helped to reduce noise and interference [1]

2.2 RADIO TRANSMITTER AND FUNCTION

A radio transmitter is defined as an electrical device or system that uses electromagnetic energy for sending information

Through space. This information are sent as radio waves or electromagnetic waves. The transmitter actually modulates the information or message signal to be conveyed unto a carrier wave which is generated by the radio frequency oscillator and amplifies the wave form to the desired power level and deliver it to the transmitting aerial or antenna [4]

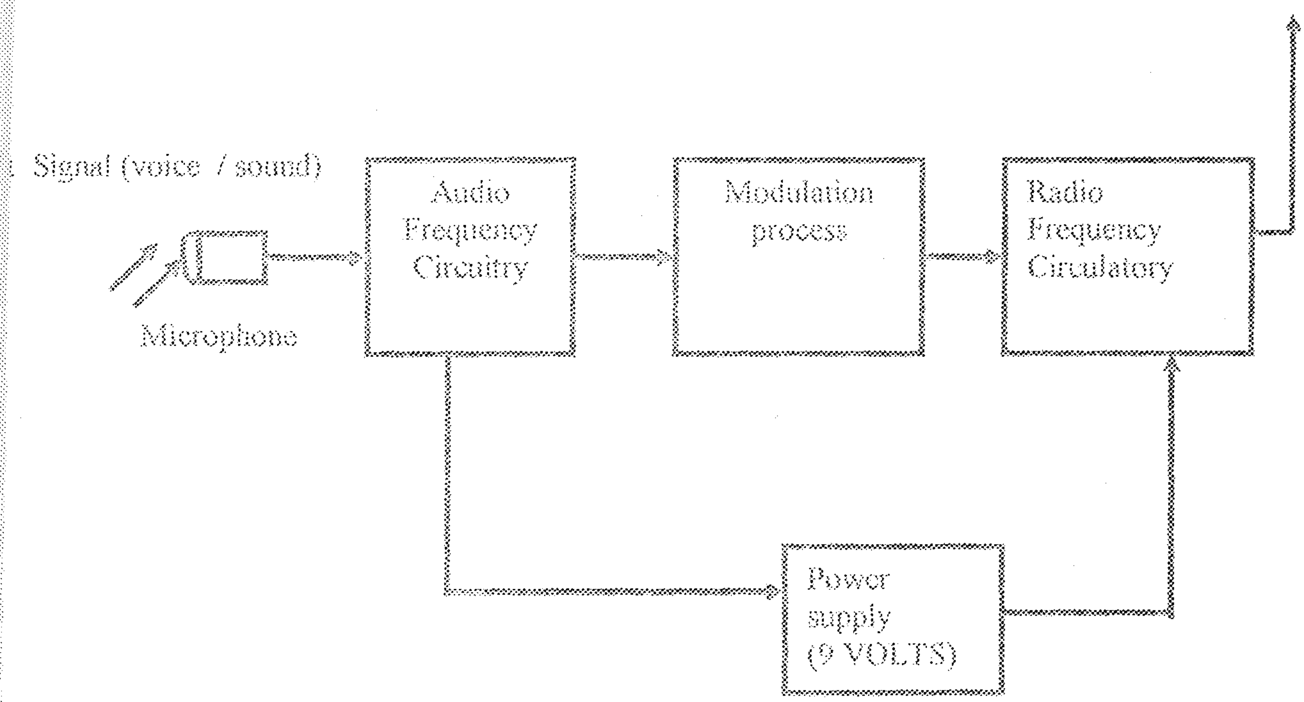


Fig. 2.0 BLOCK DIAGRAM OF A TRANSMITTER

2.2.1 TYPES OF TRANSMITTER: They Are Classified In Two

(i). **Wide Band Transmitter;**

This type of transmitter is used for long-range communication such as in military, marine aircraft and armature communication. They employ multimode modulation or function through single sided band modulation for transmission. [4]

ii. Narrow band transmitter

This type of transmitter employs frequency or pulse amplitude modulation for transmission. They are use for short distance communications.

2.2.2 USES OF RADIO TRANSMITTERS

i. Programme transmitter/ broad casting it's important to note that, the use of transmitting broadcasting of programmes affords entertainment in form of music, drama, sport event and information though newscast, interviews and public service announcement.

ii. Two way communication

iii. In the navigation of aircraft, ships and missiles to their target through the use of radar which is a specialized form of transmission

iv. In data transmission

2.3 RADIO RECEIVER AND FUNCITONS

A radio receiver is a device which picks up any desired radio frequency signal (i.e. modulated carries signal) and receiver form it the original modulating signal.

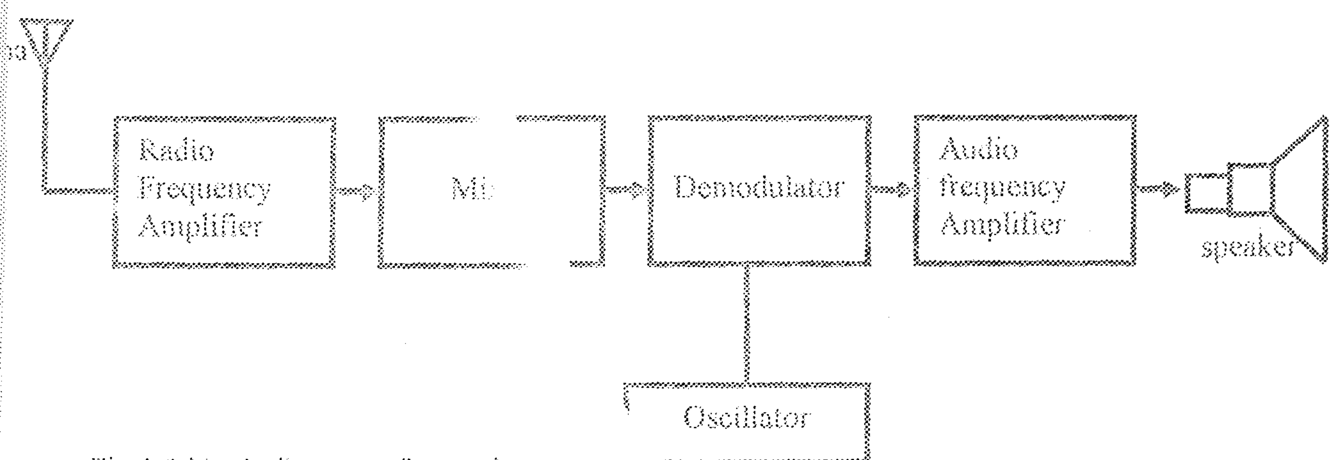


Fig 2.1 block diagram of a receiver.

From the figure above; the mixer converts the incoming signal to a predetermined fixed intermediate frequency usually lower than the signal frequency. The mixer is required to obtain a new frequency by combining the signal frequency with tat of the oscillator.

The demodulator demodulates the message being transmitted. (Demodulation can be also be explained as the process of separating the RF wave from the AF wave.

The AF amplifier helps in implying the weak electrical signal from the transmitter to a level capable of driving the loud speaker at the desired output sound level.

2.3.1 FUNCTION OF RADIO RECEVER

i. To select the wanted signal from all the signals picked up by the aerial while rejecting all others.

ii. To extract the intelligence contained in the modulated signal.

iii. To produce an audio frequency output of sufficient power is operate the loudspeaker or other receiving devices.

2.3.2 CLASSIFICATION OF RADIO RECEIVERS

Radio receiver may be classified according to the type of traffic they are designed to handle. Based on the operating techniques, radio receivers may be classified as:

i. Amplitude modulation (AM) broad cast receiver: - this type of receiver is meant for listening to broad cast of speech or music radiated from multitude broadcasting transmitters operating on a loug-wave medium wave or short wave band.

ii. Frequency modulate (FM) broad cast receiver they are use to receiving broad casting programmes from FM transmitters operating in the very high frequency (VHF) Range.

iii. TV Receivers

iv. Code receivers

v. Radar receive

vi. Communicati eceivers

Bases on the operating tech ques, radio ivers may be classified as

i. SIMPLE RADIO RECE ER

In this receiver types, tion is obtained by adjusting capacitor c1 (in figure 2.2) to give resonance at the wanted eq ncy. The diode D1, acts as a non- linear detector which helps in extracting the au gnal (plus a number of other component which is passed through the earphones for ersation into sound.

The loudspeaker cannot be used se there is insufficient power. The audio frequency output power of the simple re can be increased if an audio frequency amplifier is used.

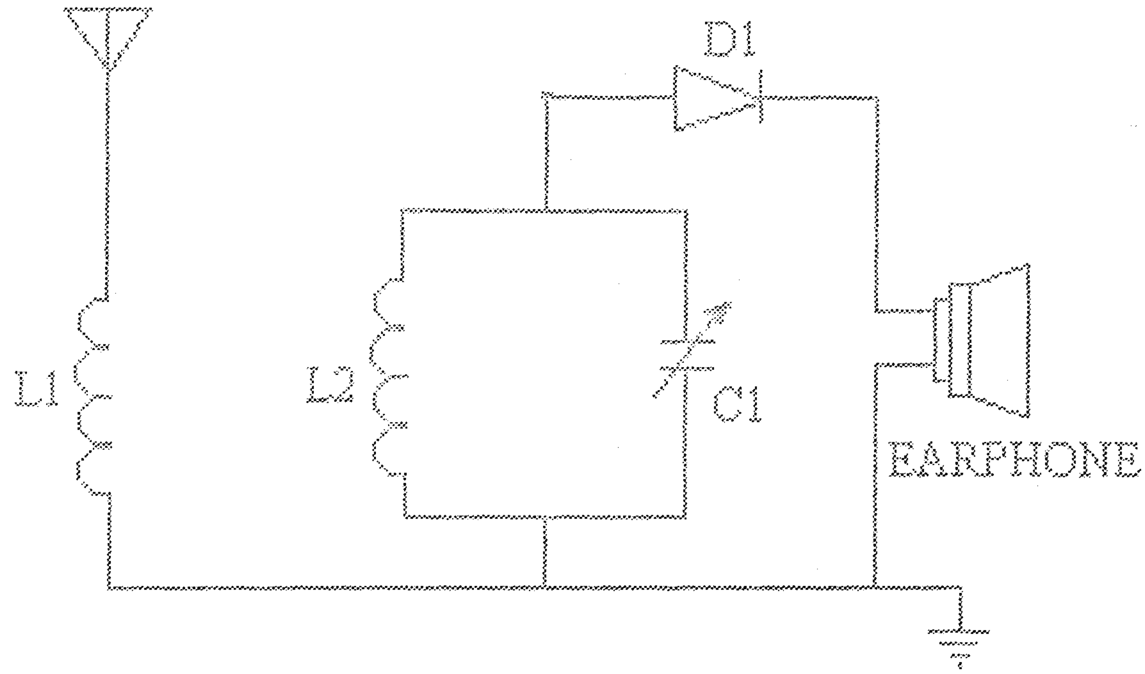
Finally simple radio receiv poor sensitivity and selectivity

II. TUNED RADIO FREQ CY (TRF) RADIO RECEIVER

In this type of receiver, am n is the radio frequency amplifier stages and in the tuned circuit improves its s y and sensitivity.

iii. SUPERHETERODY DIO RECEIVER

This is the commonly eceiver in these modern days. In a superheterodyne receiver, the wanted signal fr is converted into a constant frequency know as the Intermediate frequ) at which, most of the gain and the selectivity of the receiver is provided.



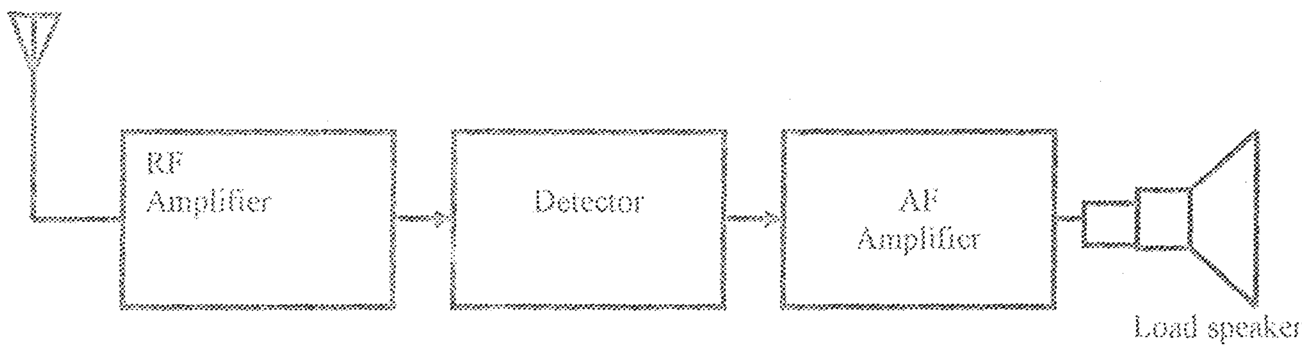


Fig 2.3 block diagram of tuned radio frequency receiver (TRF)

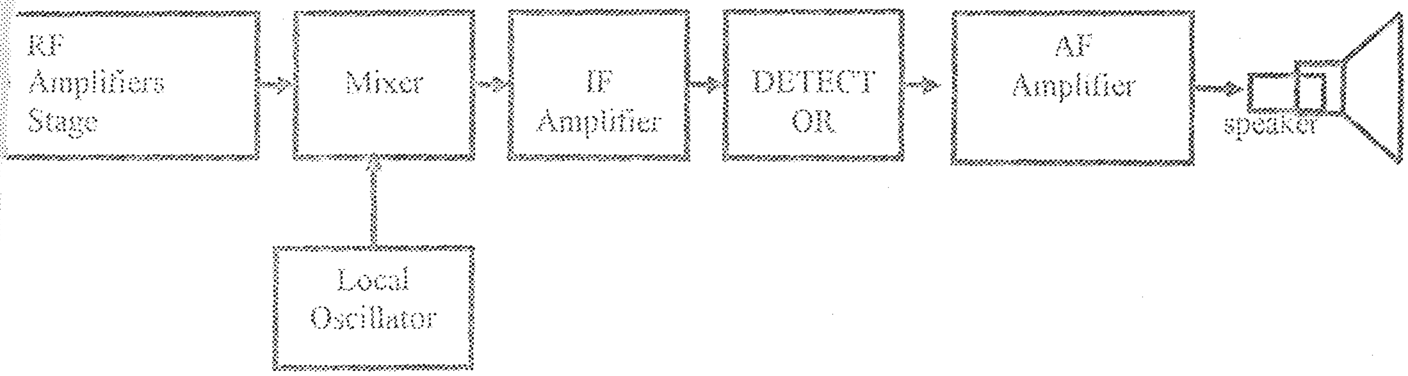


Fig. 2.4: block diagram of a supeheterodyne receiver

2.4 COMPARISM BETWEEN AM AND FM RECEIVERS

i. All transmitted power in fm receivers are useful whereas in Am, most of it is in the carrier wave from, which serves no useful purpose.

ii. It has a higher signal to noise (S/N) ratio then the Am receiver. This is because of VHF band, noise level is less and Fm receivers use amplitude limiters to remove amplitude variations caused by noise.

iii. In Fm receivers, there is hardly any adjacent interference due to "guard band) [8]

2.5 DISADVANTAGE OF THE FM RECEIVERS

i. It requires complex an expensive transmitting and receiving equipment.

ii. Since FM reception is limited to only line of sight, area of reception for FM is much small than for AM.

iii. It requires much wider channel (almost 7 to 15 times) as large as needed by AM receivers.

CHAPTER THREE

3.0 DESIGN ANALYSIS AND IMPLEMENTATION

3.1 Brief description of components

The component employed in the construction work comprises an input terminal for input device such as dynamic microphone through which the input signal (speech, sound and music etc) is fed into the system. Resistors foo biasing transistors, capacitors which serves as coupling capacitors for blocking the flow of DC components from one stage to another, transistor for the amplification of signal, an indicator in the tank circuit of the oscillator, and the antenna or the aerial which radiates or sends out the already modulated signal. Finally, variable capacitors is mainly used to very the carrier frequency of the transmitter.

3.2 Design Requirement

Since the electronic bugging system is used for clandestine operations, both its circuit and components have to be miniaturized (specially the transmitter) as much as possible.

Beside, for deception purposes, component or part should be properly concealed and camouflaged specially the transmitter circuit.

Finally, to prevent damage, the component had to be secured to the outer case properly.

The case of the device was design to eliminate heat produced when in operation.

3.3 CHOICE OF ELECTRONIC BUGGING SYSTEM

For this project, the electronic bugging system chosen is the wireless (FM) transmitter/receiver type because the transmitter circuit has an input audio frequency amplifier stage, which uses the microphone (dynamic) to pick up sound (signals).

Finally, its transmitting circuit takes advantage of modern technology.

3.4 CHOICE OF TRANSMITTER CIRCUIT

Since it illegal in most countries to operate a transmitter without license, special care must be given to the transmitter circuit design operation. For this project, the transmitter circuit type chosen is the NARROW BAND TRANSMITTER TYPE used for short distance communication.

3.5 Choice of Receivers Circuit

For this project, SUPER HETERODYNE receiver is the chosen type because it has high selectivity (i.e. the ability to discriminate the unwanted signal from all the other signals picked up by the aerial) and thus it has an easy sensitivity.

The receiver is capable of receiving intelligence within the range of 10-15 meters away from the transmitter circuit. [10]

3.6 Design Analysis

An electronic Bugging system as earlier discussed is made up of the transmitter circuit and the receiver circuit. Both the transmitter and the receiver circuit of this project are simple design.

3.7 The Transmitter Circuit

The transmitter circuits consist of

(i) The oscillator stage

(ii) The output (antenna) stage

(iii) The input audio frequency amplifier stage

(iv) The transistor audio Frequency amplifier stage (modulation stage)

3.7.1 THE INPUT AUDIO FREQUENCY AMPLIFIER STAGE.

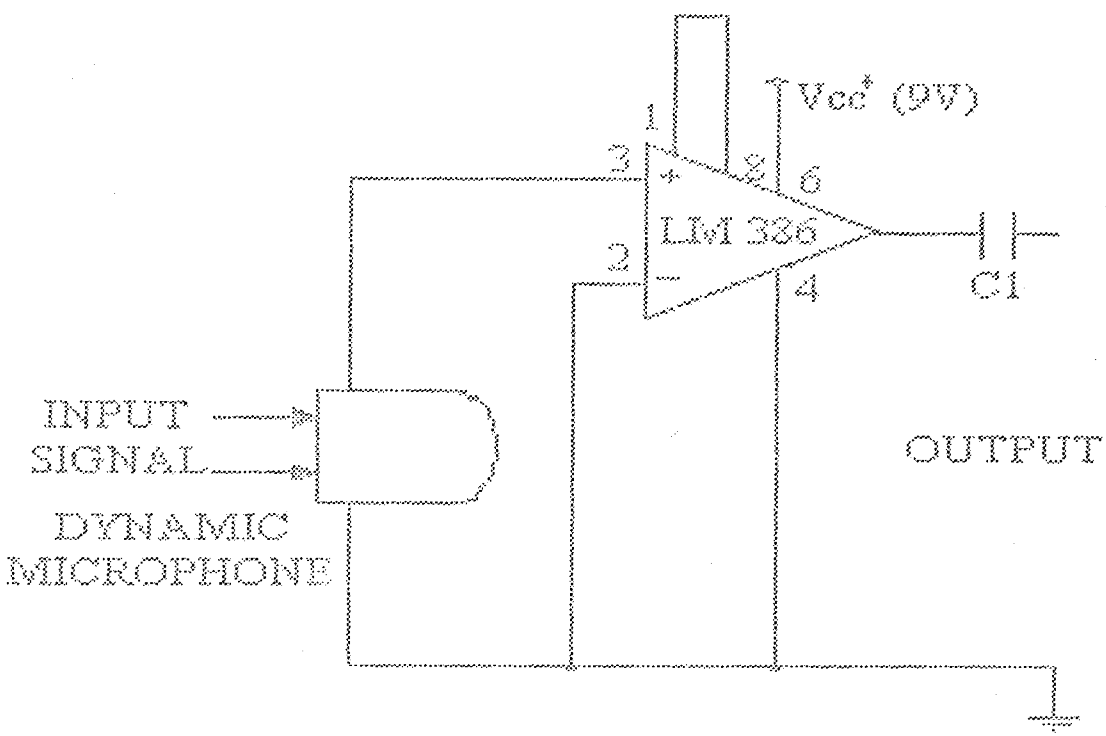


Fig 3.0 audio frequency amplifier circuit

The input audio Frequency amplifier stage consists of IC LM 386, capacitor CI (220μf). IC LM 386 is a dual-in –line integrated component that is design mainly for low voltage amplification that will drive directly an 8 speaker. IC LM 386 has a gain fixed at 20dB (manufacturers specification) but it can be increased to 200dB (X10) by short circuiting [7] plus 1 and 8 together as shown in figure 2.4 At gain 200dB, the receiver speaker will be audible and capacitor CI is also blocking all DC current/voltage from interfering with the transistor audio Frequency amplifier stage

CALCULATION

Gain (A) = Vout/Vin

Let input voltage (Vin) = 10mv

Gain = 200dB

Vout= AVin

$= 200 \times 10 \times 10^{-3}$

$= 2V$

The transistor Audio Frequency amplifier stage

3.7.2 the transistor audio frequency amplifier stage

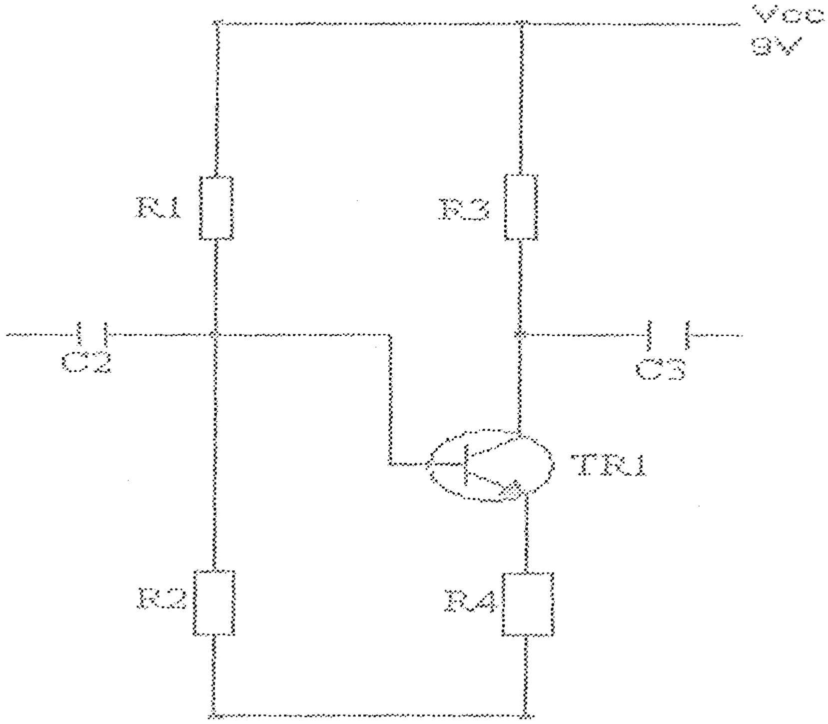


Fig 2.6 transistor Audio Frequency Amplifier Circuit

In figure 2.6 above, c_2 couples the output of the audio Frequency amplifier circuit to the base of the transistor 1(TRI). Its function is to block the flow of d.c. Current that would otherwise interfere with the bias conditions. R1, R2,R4 are the biasing. [4]

Table 3.0 the data sheet specification of BC107 NPN transistor

TYPE NO	Imax (MA)	V_{CEO}(MAX) (V)	P_{TOT} (mW)	hF_E	Fr (MHZ)	V_{BEO} (max) (V)
BC 107	100	45	360	110-450	250	0.7

Ic (max) = maximum collector current

V_{cEo} (max) = maximum collector- emitter voltage

V_{BEO} (max) = maximum base-emitter voltage

P_{TOT} = maximum total power rating (V_{CE}xI_c)

HF_E = dc current gain

FT= Frequency of transmission.

CALCULATIONS

From figure 2.6

$$V_B = (R_2/R_1+R_2)/(V_{cc})$$

$$V_B = (15k\times9)/(100+15)k$$

$$V_B = 1.174V$$

Where R_1 = 100k

R_2 = 15k

Vcc =9v

$R_B = R_1//R_2 = R_1R_2/R_1+R_2$

R_B = 100k x 15k/ (100+15)k

= 13043.48Ω

Voltage across the emitter resistor (V_E)

$V_E = V_B-V_{BE}$

But V_{BE}=0.7V

V_E=1.174-0.7

V_E= 0.474V

V_E=474$_M$V

$I_E=V_E/R_E$

But RE=R4+150

I_E=0.47/150 = 0.00316

I_E=3.16MA

Recall that Ic=I_E-I_B............(1)

Ic= B_{IB}........... (2)

Substituting 2 into 1 gives

BI_B= I_E-I_B

BI_B+I_B=I_E

I_B(B+1) =IE

I_B=I_E/(β+1)

But B for BC 107 = 175

I_B= 0.00316/17511

I_B= 0.000018A

I_B=0.018A

Ic=IE-IB= 3.16x10-3-0.018x10-3=3.142MA

Voltage at the collector (Vc)

Vc=IcRc where Rc=R3=Ik=R1

Vc= 3.142x10-3x1x103

Vc=3.142V

VcE= Vcc-Ic (R2+RE)

V_CE=Vcc-3.142x103(1000+150)

V_CE= 9-3.613

V_CE=5 387V

Power output=pout

$P_{out} = V_{CE} \times I_C$

$= 5.387 \times 3.142 \times 10^{-3} = 0.0169W$

$= 16.9mW$

Power input = Pin

$P_{in} = I_B^2 R_B$

$= (0.018 \times 10^{-3})^2 \times 13.043K$

$= 4.2 \times 10^{-6}W$

r_i= input resistance of the amplifier

$r_i = V_{BE}/I_B = 0.7/0.018 \times 10^{-3}$

$= 39K$

r_0=output resistance of the amplifier

$r_0 = V_{CE}/I_C$

$= 5.387/3.142 \times 10^{3}$

$= 1714.5\Omega$

3.7.3 The Oscillator Stage

An oscillator is basically an amplifier with an output but no external unit. The oscillator used in this FM transmitter is the COLPITTS oscillator operating in the common base mode, (i.e. no DC returning collector resistor is employed) and the junction between capacitor C6 and C7 in the tank circuit is not grounded. [4]

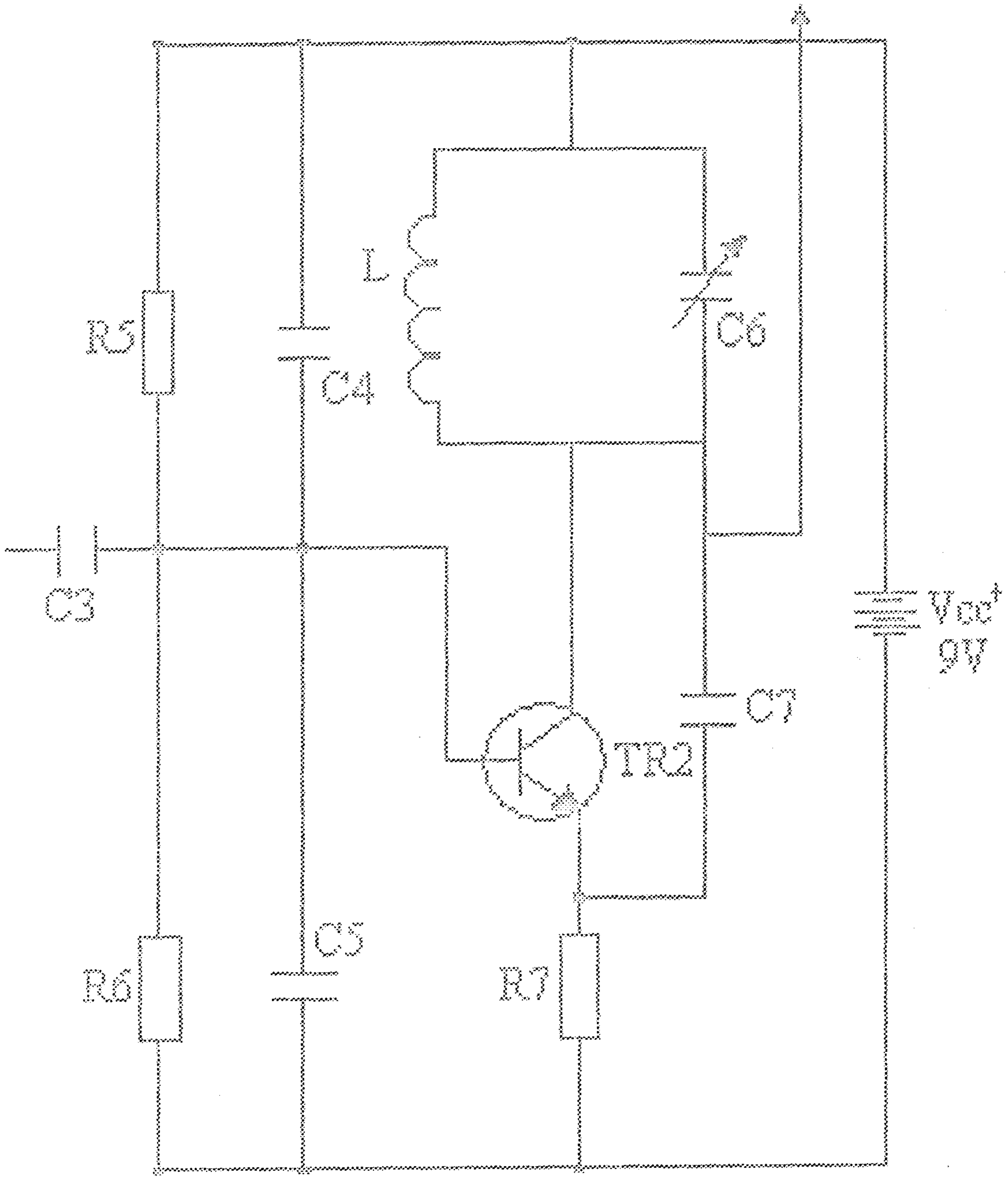


Fig 3.2 : circuit diagram of COLPITT Oscillator.

In figure 2.7, R5, R6, C4 and C5 are the FM carrier wave generator that Generate the high Frequency radio wave.

BC 140 (TR2), L, C6, R7 and C7 from the colpitt oscillator tank circuit responsible for the conversion of radio Frequency wave into electromagnetic wave. C7 is used for radio acting as a receiver. R7 is a swamping transistor that limits the flow of collector current. Finally, R5, R6, R7 serves as biasing resistors which stabilize the base voltage and they are used to aid the oscillator operations.

Table 3.1: Data sheet specification for transistor (TR2) BC140 NPN

TYPE NO	PTOT (w)	IC (max)	VCBO (V)	F_T(MHz)	HFE	VBED (V)	SF
IC 140	0.85	1	80	250	175	0.7	10

CALCULATIONS

Let open circuit voltage = V_{B2}

V_{B2} = (R6/R6+R5)) x V_{cc}

= 15Kx9/(15+10) K

V_{B2}= 5.4V

Voltage across R_7=VR_7

V_{R7}= V_{B2}-V_{BE}

= (5.4-0.7)

V_{R7}= 4.7

The resistance at the base of the transistor (TR2)= R_{B2}

R_{B2}= R_5//R_6

= $R_5R_6/(R_5+R_6)$

= 10Kx15K/(10+15) K

$= 6000\Omega$

$R_{B2}=6K\Omega$

SF=stability factor

$SF=R_{B2}/R_E=R_{B2}/R_7=6000/470=12.8$

$I_E=V_{B2}/R_E$

$= 5.4/470=0.01A$

The carrier oscillating Frequency = F

$F= 1/2\pi\sqrt{(LC_7)}$

Where C_7 = 10pF

F=carrier frequency

$F = 1/[(2x3.143)\sqrt{(0.2x10^{-6}x10x10^{-2})}]$

$F= 1/8.886918026x10^{-9}$

F=113MHz

But recall that $L=r^2n^2/(9r+10d)$

$n^2r^2 =L(9r+10d)$

$n=\sqrt{[L(9r+10d)/r^2]}$

$n=\sqrt{[((0.2)(9x0.5+10x1.3))/0.5^2]}$

n=3.74

n is approximately 4 turns

Where L= inductance of coil (μH)

r= radius of coil (cm)

d= length of coil (cm)

n= number of turns

Note (L=0.2μH, r=0.5cm, d=1.3cm)

3.7.4 The output State

The modulated signal going out of the transmitter is sent into the atmosphere as electromagnetic wave (radio wave) through the antenna.

3.8 The Receiver Circuit

The receiver used in this project is a single Ic (super heterodyne R-803). It consist of the following: the RF amplifier, mixer, local oscillator, IF amplifier, limiter, detector, de-emphasis network, AF amplifier and speaker [8]

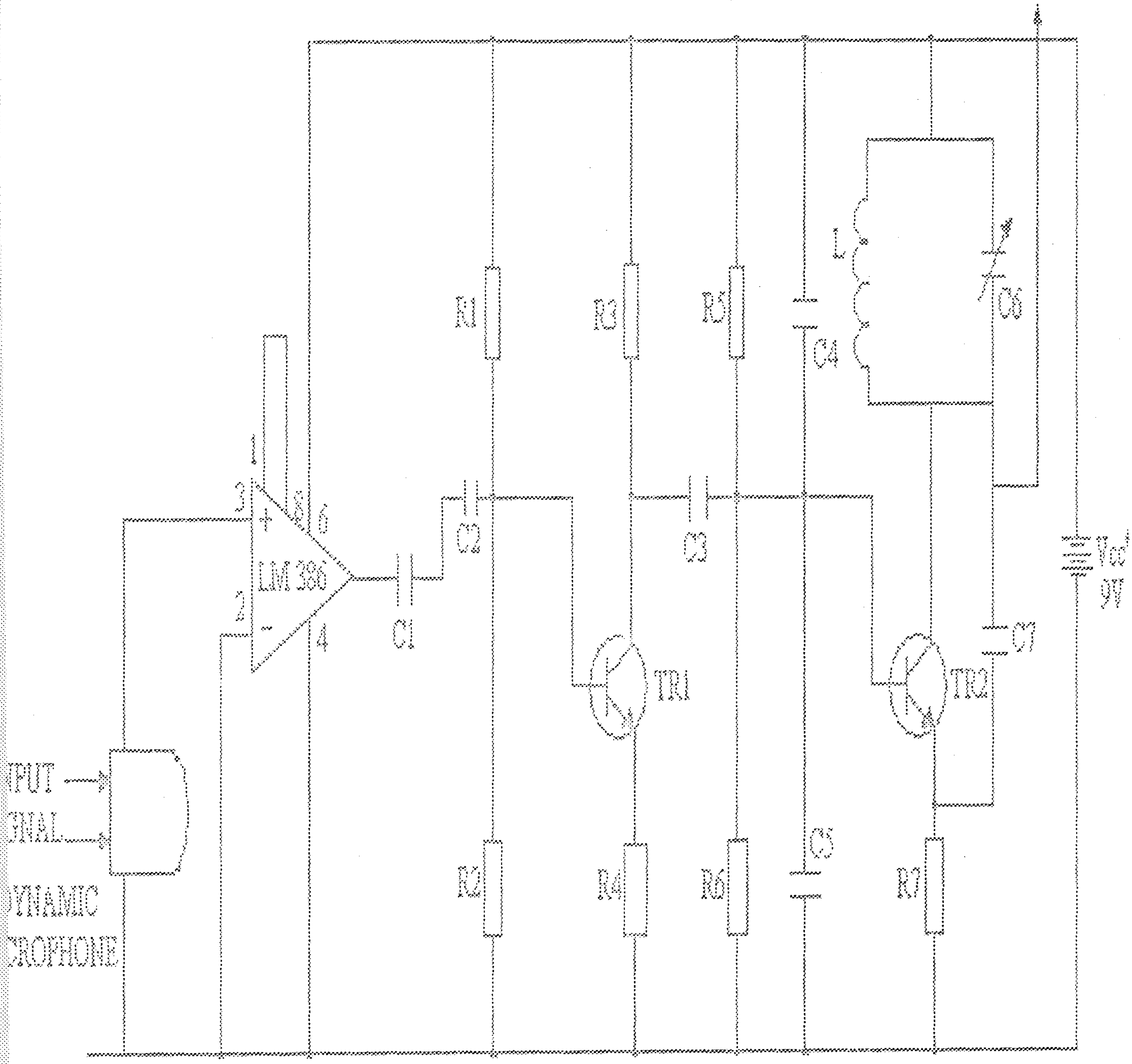
3.8.1 Operation of the receiver

First and foremost, the transmitter modulated signal (incoming signal) on reaching the receiver is first amplified by the RF amplifier, next it enters a mixer circuit which is so designed that it can conveniently combine two radio Frequency. One fed into it by the Rf oscillator whose frequency of oscillation can be controlled by varying the capacitance of its capacitor.

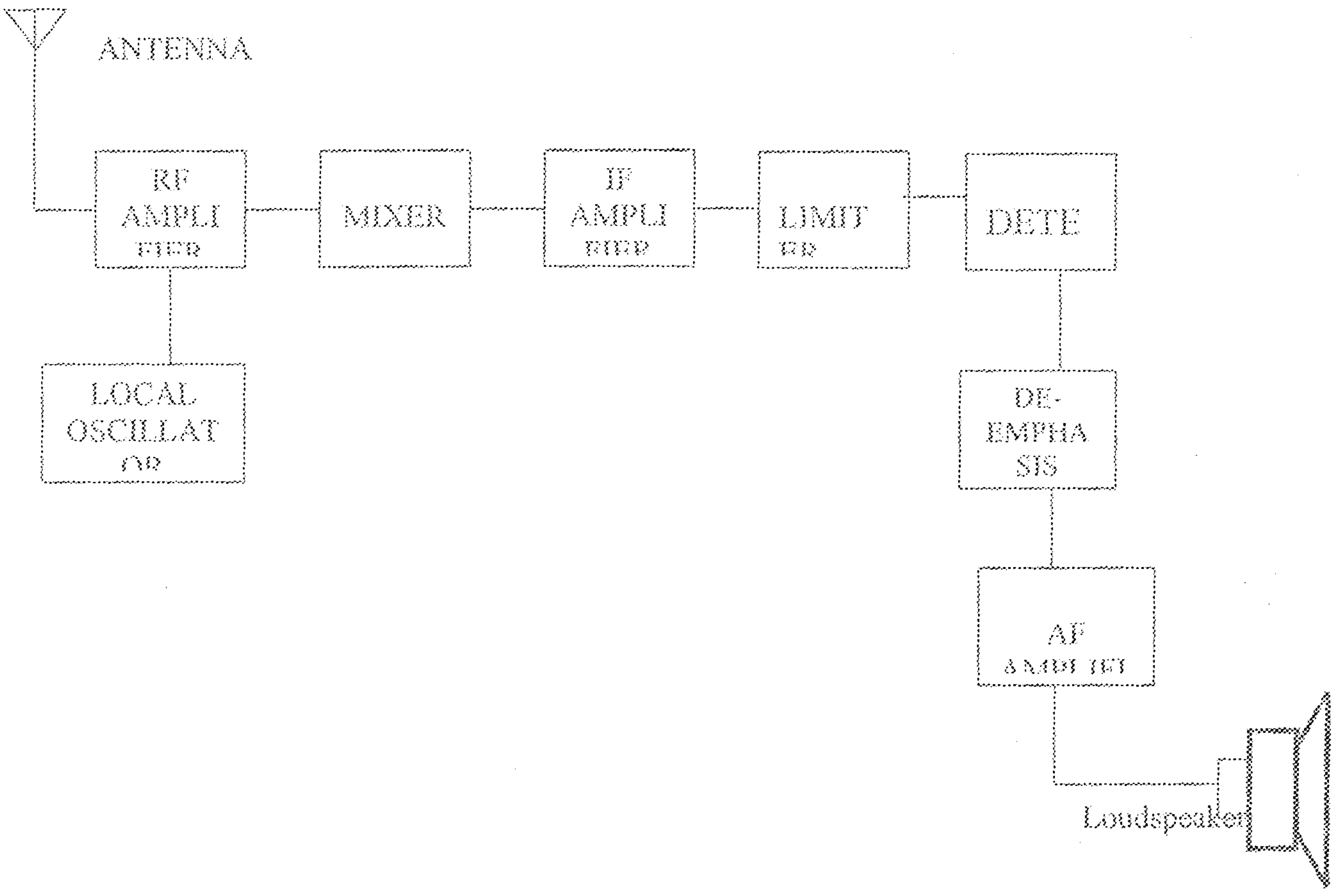
In fact, the local oscillator frequency is always higher than the frequency of the incoming signal. When two currents of these two different frequencies are combined in the mixer transistor, the phenomenon called BEAT or intermediate frequency (IF) is produced. BEAT or intermediate frequency is lower than the input signal frequency but it is still above the range of audio frequency. [8]

The output of the mixer circuit is fed into the IF amplifier circuit, thus, the output of the IF amplifier is fed into a limiter circuit. Its function is to remove all amplitude variation caused by noise from IF signal which might have crept into the FM signal. The limiter circuit is necessary for distortion-less demodulation. The limiter output is fed into detector circuit which provides the audio signal. The audio signal passes through the DE-EMPHASIS network. This network reduces the amplitude of high frequencies in the audio signals, which was earlier increased by the pre-emphasis, network in the transmitting station.

It is also used to re-establish the "TONAL BALANCE" of the speech or sound (music) lost in the pre-emphasis network. The output of the DE- EMPHASIS network is amplified by the AF amplifier whose output is fed to a loud speaker, which reproduces the original sound.



Complete Diagram of Fm Transmitter



Block Diagram of Super Heterodyne Radio Receiver

COMPONENT LIST

Resistors		Capacitors	
R1	100K	C1	2.2μF
R2	15k	C2	4.7Mf
R3	1k	C3	0.47Mf
R4	150K	C4	2nf
R5	10k	C5	2nF
R6	15K	C6	22pF
R7	470Ω	C7	10Pf

Inductor

L =0.2μH

Transistors

TR1 BC 107 NPN

TR2 BC 140 NPN

Microphone

Dynamic microphone

Antenna

Telescopic antenna (aerial)

Ics

LM386

R-803 (radio receiver

CHAPTER FOUR

4.0 TESTS, OBSERVATION AND RESULT

The construction of this project needs a lot of practical experience in handling components using soldering iron and lead, proper wiring of the circuit on the breadboard and vero board. Also knowing how to use the laboratory equipment like the oscilloscope [OSC], multimeter, frequency meter is very essential. First and foremost, after the construction of the FM transmitter (1 and 2), a super heterodyne radio receiver was tuned gently within the range of 88-108 MHz FM band until a humming sound was heard and then the receiver locks (i.e. no more sound is heard) indicating that the receiver does receive the transmitted sound. Besides, all these took place after the adjustment of the variable capacitor in the colpitts oscillator circuit has been done.

When the transmitter was powered with 9V d.c battery and music or sound was placed some distance away, the receiver received the transmitted modulated signal clearly at 97MHz FM band and the reception distance is 10-15meters away from the transmitter, while the transmitter and the receiver were still working, the carrier frequency of the transmitter was 4MHz. This value was measured through the frequency meter at the output of the colpitts tank circuit.

4.1 Discussion of Result

Distortion in the form of electrical noise and line effect of other broadcasting stations with high power transmitter cannot be totally eliminated. But the aim of this project was still achieved as the transmitter is capable of picking up small sound and still capable of transmitting picked up sound 10-25 meters away.

4.2 Precautions

During the process of constructions, the following precaution were taken to ensure good production.

(i) All components used were tested for fitness before being used in this project.

(ii) Continuity and voltage test were equally carried out using a digital multimeter to ensure that there was no short circuit or open circuit.

(iii) The use of a low voltage soldering iron to ensure that sensitive components were not damaged by heat.

4.3 Difficulties Encountered

The difficulties encountered during the construction of this project was adjusting of the variable capacitor in the transmitter circuit, and also knowing the exalt value of inductor that will fit into the culprit tank (oscillator) circuit.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The electronic bugging system was design and constructed to intercept conversation between two or more people without the consent of any of them with the use of superhetrodyne receiver, within the range of 10-15meters.

5.2 RECOMMENDATION

For this project to be improved upon in subsequent designs surface mounted device should be used so as to miniaturize the transmitter circuit and to enable the transmitter to transmit with a very high frequency and this will increase reception distance.

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