DESIGN AND CONSTRUCTION OF A FREQUENCY MODULATION (FM) TRANSMITTER AND RECEIVER

BY

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MAT. NO: 2004/20875EE

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELOR OF ENGINEERING DEGREE (B.ENG) IN THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

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CERTIFICATION

This is to certify that the project work title "Design and Construction of FM Transmitter and Receiver" was carried out by IDAMA OMOKARO under the supervision of MR P. O. ABRAHAM-ATTAH, and submitted to the department of Electrical and Computer Engineering for the award of Bachelor of Engineering degree (B.Eng) in Electrical and Computer Engineering of the Federal University of Technology, Minna.

MR P. O. ABRAHAM-ATTAH Project Supervisor	10/11/2008 Date
Dr. E.N Onwuka Project Co-ordinator	Date
Engr. Dr. Y. A. Adediran Head of Department	Date
External Examiner	Date

DECLARATION

I hereby declare that this is my original work and has never been printed else where for award of any degree. Information derived from published and unpublished work of other has been acknowledged in this project write up.

IDAMA, OMOKARO.

NOVEMBER, 2008.

DEDICATION

To the Rock of Ages Jesus Christ, the greatest influence upon me who has made living meaningful and rewarding. To you be all the praise forever, amen.

ACKNOWLEGMENT

I am eternally grateful to God Almighty, the author and the finisher of my faith for His mercy that endureth forever. Without any reservation, I give all the praise and honor to Him. He has been my closest companion through out my stay in the university and till now.

My special thanks go to my parents Mr. & Mrs. G.O Idama and Mr. & Mrs. J.O. Igbodo for their moral and financial support rendered to enhance my success in life.

My profound gratitude goes to my able, diligent and kind hearted Supervisor Mr P. Attah who offered suggestions and assistance when most needed.

My special gratitude goes to Prof. J.O Asalor of Mechanical Engineering Department, University of Benin and Prof. K.R Onifade of Chemical Engineering Department, Federal University of Technology, Minna for the indelible role they played to make my life a success.

Finally, my special appreciation is extended to my siblings and my numerous friends who stood by me and encouraged me through out my stay in the university. May they ever be rewarded in Jesus name.

ABSTRACT

This project report is on "Design and Construction of a Frequency Modulation (FM) Transmitter and Receiver".

The FM transmitter in view consist of tree stages namely the main stage, which consist of the oscillator and modulator and the RF amplification stage which is made up of two RF amplifier and an antenna.

The RF amplification stage produces power to be radiated through electromagnetic waves by an antenna. The antenna is necessary for transmission of signals from the transmitter to an FM receiver in the frequency range of 88MHZ-108MHZ. The radiated electromagnetic energy travels away from the antenna at the speed of light approximately 186,000 miles per seconds (300 million meters per second).

The receiving antenna picks up energy from the transmitter whose output passes through its intercept area. The receiver circuit consists of a regenerative amplifier, an oscillating circuit, filter circuit, audio amplifier and a power source.

CHAPTER ONE

1.1 INTRODUCTION

Communication in its widest sense entails the exchange or sending of information from one person to another.

A communication system is therefore, a technique or equipment that is used to send, process and receive messages. This may take the form of telephone network, radio links, satellite and optical fibers, amongst others. In communication system discussion, the word message is often used in place of information. Message is the information that is produced by a particular source which needs to be transmitted to a given destination. There are various types of information sources which generally include man and machines. Information is usually presented in two broad categories of message formats namely analog or digital. The form of message determines the nature of communication system for successful transmission [1].

An analog message is a physical quantity that varies with time, usually in a smooth and continuous fashion; examples include voice, video, temperature, pressure, e.t.c.

A digital message is an ordered sequence of symbols selected from a finite of discrete elements. Examples include text, numbers, e.t.c. [1, 8].

1.2 ELEMENTS OF A COMMUNICATION SYSTEM

A block diagram of the basic elements of a communication system is shown in fig 1.0. These include the transmitter, transmission channel, and the receiver plus disturbances and perturbations in the channel. The transmitter processes the input signal to produce the transmitted signal suitable for the characteristics of the transmission channel. Signal processing for transmission usually involves modulation and coding. The transmission channel is the electrical medium that bridges the distance from source to destination. It may be a pair of wires, a coaxial cable, or a radio wave or a laser beam. Every channel introduces some amount of transmission loss or attenuation, so the signal power progressively decreases with increasing distance. The receiver processes the output signal from the channel in order to recover from it as much of the transmitted signal as possible. Receiver operations include: amplification to compensate for transmission loss and demodulation and decoding to reverse the signal processing performed at the transmitter. The receiver also performs filtering due to signal contamination with noise.

Various unwanted and undesirable effects occur in the course of transmission such as attenuation, distortion, interference and worst of all noise. These act in various ways to alter the shape of the transmitted signal. It is usually assured that all these manner of contamination occur in the channel as shown in Fig 1.1

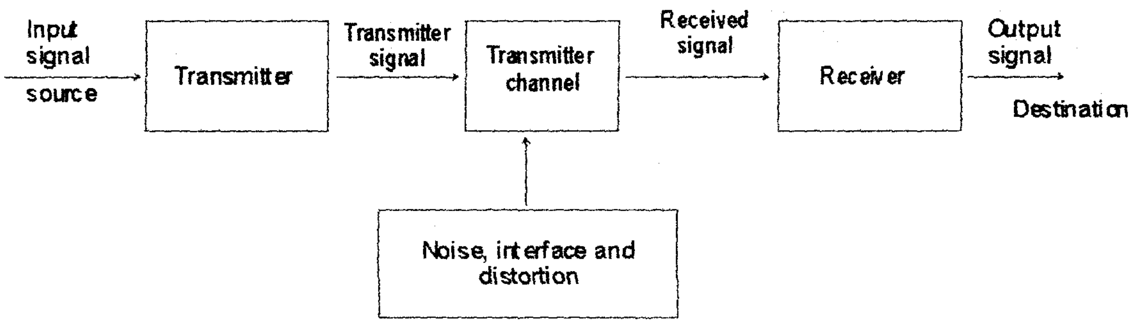


Fig 1.1 Elements of communication system

1.3 DISTORTION

Distortion is a wave form perturbation caused by imperfect response of the system to the desired signal. Unlike noise and interference, distortion disappears when the signal is turn off. If the channel has linear but distorting response, then distortion may be connected or at least reduced with the help of special filters called equalizers [1].

1.4 INTERFERENCE

Interference is contamination by extraneous signal from human sources e.g other transmitters, power lines and machines, switching circuits e.t.c. Interference occurs most often in radio systems whose receiving antennas usually intercept several signals at the same time. Radio frequency interference (RFI) also occurs in cable systems if the transmission wires or receivers circuiting pick up signals radiated from nearby sources. Appropriate filtering removes interference to the extent that the interfering signals occupy different frequency bands than the desired signal [11].

1.5 NOISE

Noise refers to the random and unpredictable electrical signal produced by natural processes both internal and external to the system. When such random signals are superimposed on information bearing -signal, the message may partially be corrupted or totally wiped out. Filtering reduces noise contamination, but there inevitably remains some amount of noise that cannot be eliminated. Noise constitutes one of the fundamental system limitations [1].

1.6 AIMS AND OBJECTIVES

The aim and objective of this project is to design and construct a frequency modulation (FM) transmitter and receiver. The transmitter will send audio signal while the receiver will receive the sent audio signal. This means the speech or message signal will be transferred from a source to a medium or channel to a known destination.

Radio receivers and transmitters are part of devices used in communication system. Notably, the main function of a transmitter in the radio communication and broadcasting is to deliver enough frequency (RF) power for radiation by the transmitting antenna to a receiver which selects and recovers the original message from the various RF signals that arrives at the receiving antenna.

CHAPTER TWO

2.1 LITERATURE REVIEW

The development of radio in the late 1800s revolutionized communication. At that time, people used other means of quick, long distance communication telegraph and telephone, but the signals sent by both devices had to travel through wires. As a result, telegraph and telephone communication was possible only between places that had been connected by wires.

Radio signals on the other hand passed through the air. Thus, radio enabled people to communicate quickly between any two points on land at sea and later in the sky, and even in space. Production of radio existence was made in 1864 by James Clerk Maxwell, the great English Mathematical Physicist. In 1873, J.C Maxwell now described the theoretical basis of the propagation of electromagnetic waves [3].

In 1878, David E. Hughes was first to transmit and receive radio waves when he noticed that his induction balance caused noise in the receiver of his home made telephone. He demonstrated his discovery to the royal society but was told merely induction.

It was Heinrich Rudolf Hertz, a German physicist who between 1886 and 1888 demonstrated that waves do actually exist and they travel through space.

In 1895, Guglielmo Marconi, an Italian inventor, combined earlier ideas and his own ideas and sent the first radio communication signal through the air. He used electromagnetic waves to send telegraph code signals a distance of more than 1 mile (1.6 kilometers) [4].

Reginald Fessenden, a Canadian physicist, in 1900 made a weak transmission on Christmas Eve in 1906, Fessenden transmitted the first radio broadcast in history from

Brant Rock, Massachusetts; ship at sea heard a broadcast that include Fessenden playing song "O Holy Night" on the violin.

The world's first news programme was broadcast August 31, 1920 by station 8mk in Detroit Michigan. The world's first regular wireless broadcast for entertainment commenced in 1922 from the Marconi Research Center at Writtle near Chelmsford, England. Early radios ran the entire power of the transmitter through a carbon microphone while some early radios used some type of amplification through electric current or battery, through the mid 1920s, the most common type of receiver was the crystal set. In the 1920s, amplifying vacuum tubes revolutionized both receivers and transmitters [3, 5].

Charles David's Herrold, an electronics instructor in San Jose California constructed the first broadcasting station. It was the spark gap technology but modulated the carrier frequency with human voice and later music. The station 'San Jose Calling' was first established in April 1909 and has continued an unbroken lineage to eventually become today's KCBS in San Francisco [7].

Herrold, the son of a Santa Clara valley farmer coined the terms "narrowcasting" to identify transmissions destined for a single receiver such that on board a ship and those transmission destined for a general audience [11].

The term "broadcasting" had been used in farming to define the tossing of seed in all directions.

Charles Herrold did claim to be the first to conduct "broadcasting" to facilitate the spreading of the radio signal in all direction; he designed omni directional antenna which he mounted on the roof tops of various building in San Jose.

Reginald Fessenden (1906) demonstrated the first double sided band amplitude modulated (AM) transmitter. These devices were noisy with poor frequency stability. The transmitter could not transmit speech. The invention of the vacuum tube diodes by J.A Fleming (1906) and the triode by Lee De Forest (1913) made possible development of powerful transmitter with improved frequency stability [4].

In 1912, Edwin Howard Armstrong, used the diode and triode to invent a regenerative circuit, the super heterodyne in 1918 and the super regenerative circuit in 1920, which aided high frequency generation.

This led to the first significant demonstration of speech transmission by J.R Carson, a AT and T (SBB communication) in1915.

The first transmitter to broadcast speech and music was later developed by the American Marconi company in 1916.

In 1925, E.H. Armstrong's work on the correction of the static communication, resulted in the achievement of frequency modulation (FM) that year Dr J.R Carson of AT and T development and research department was first to investigate FM transmission in 1927 [5].

Commercial operation of FM transmission started in 1940, after the improvement on the frequency capabilities of the vacuum tubes; tetrodes by Round (1962), pent rode by Tellogen and Holst (1928) and development of phase locked loop (PLL) FM generation technique by Foster and S.W Sweeley (1914) [7].

It is worth pointing out here that "tele" is derived from the ancient Greek word for "at a distance". Also, the word "phone" is derived from the Greek word meaning sound or speech, while “graphs” means writing or drawing. So the following well known terms have emerged.

a. telecommunication – Communication at a distance

b. Telephone – Speaking at a distance

c. Television – Seeing at a distance

d. Telegraph – Writing at a distance [11]

CHAPTER THREE

3.0 DESIGN AND ANALYSIS OF THE CIRCUIT

The design and construction of FM (**FREQUENCY MODULATION)** transmitter and receiver is based on six main stages, which are;

1. Power supply unit.
2. Transmitter Unit
3. Pre-Amplifier Unit.
4. Amplifier/Oscillator Unit.
5. Tank (FDN) Unit.
6. Receiver Unit.

3.1 THE POWER SUPPLY SYSTEM

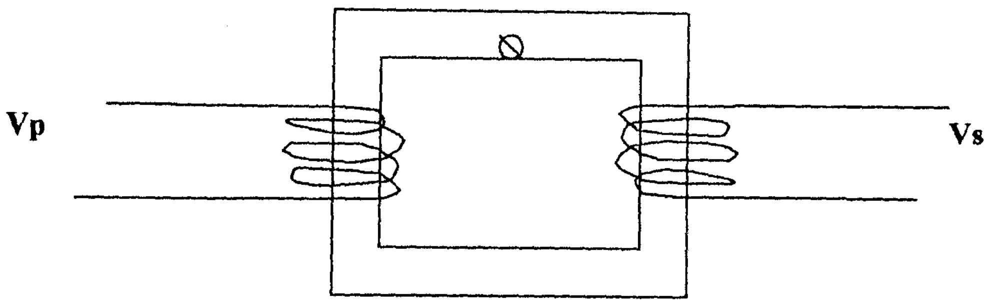
Electronic circuit needs energy to work. In most cases a circle called the power supply provides this energy. A power supply failure will affect all the other circuits. The supply is a key part of any electronic system. All electronic equipment requires a suitable power supply; most often they take the form of a rectifier and filter arrangement. Power supplies use rectifier diode to convert alternating current to direct current. The aim of conversion is achieved by the purpose of the power supply. The A.C supplies available at ordinary wall out let 230V, 50hertz.Electronic circuit often requires lower voltages. Transformers can be used to step down the voltage to the level needed.

The D.C. output of a power supply meets the following requirements detailed by the needs of the equipment served.

1. It must be of the proper voltage level and current capacity.

2. It must be adequately filtered and regulated.

3.1.1 IDEAL TRANSFORMER



Fig; 3.1 Ideal Transformer

Q is the flux in the core.

Vp is the primary voltage.

Vs is the secondary voltage.

Ep is the primary e.m.f. and

Es is the secondary e.m.f.

Let N1 and N2 represent the number of the turns of the primary coils and the secondary coils respectively.

Then $\frac{Vp}{Vs} = \frac{N1}{N2}$ ....equation 1

Thus $Vs = \frac{Vp \times N2}{N1}$ ....equation 2

In this project, a standard 15V transformer is used.

3.1.2 RECTIFICATION

Rectification is the conversion of alternating current to direct current i.e. D.C. In this project work, a full wave bridge system of rectification was adopted. With this method, there is no need for a center tapped power transformer. The output is twice that of center tap circuit for the same secondary voltage.

The arrangement is shown in fig 3.2 below .It contains two diode D1 and D2 connected to form bridge. During the positive input half cycle, terminal P of the secondary is positive and Q is negative. Diodes D1 become forward biased (i.e. ON) whereas D2 are reverse biased (OFF). During the negative input half-cycle, secondary terminal Q becomes positive and P negative.

The waveform of the secondary voltage to the bridge rectifier is A.C. input.

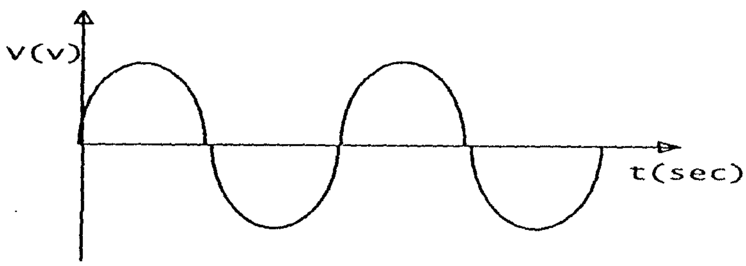


Fig. 3.2 Input waveform of AC supply

The output is a DC output. The waveform is as shown below in fig 3.3.

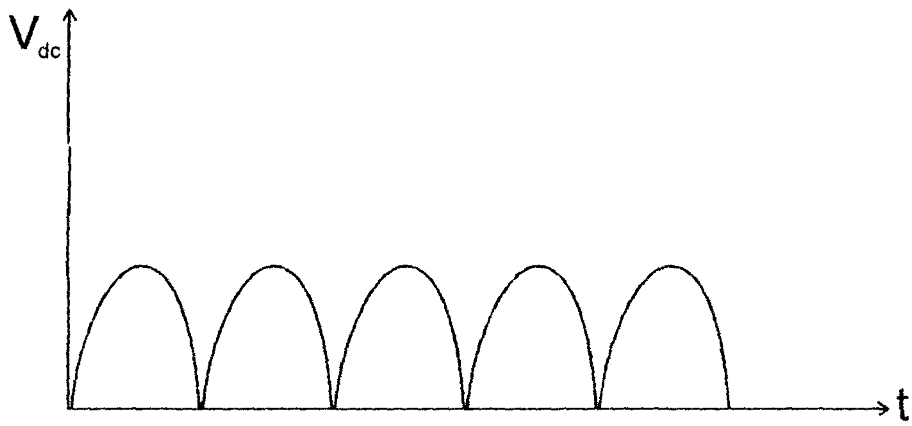


Fig 3.3 the rectifier output waveform

The full wave rectification efficiency can be calculated using

$$\eta = \frac{0.812\,R_l}{r_d + R_l}$$

Where R_l = load resistance and

r_d = diode resistance.

After full wave rectification, the relation below gives the D.C voltage with peak amplitude

$$Vdc = (Vrms\sqrt{2} - 1.4)$$

For 9V rms input, the peak D.C voltage is therefore. $Vdc = (9\sqrt{2} - 1.4) = 12.6V$.

3.1.3 FILTERING AND SMOOTHING

The output waveform of fig 3.2 comprises of both A.C components.

The A.C component in a D.C power supply, a ripple voltage, is removed through filtering or smothered project work; the D.C voltage was smothered by a 50V 1000UF capacitor and fed in to the charger circuit.

3.1.4 REGULATING CIRCUIT

The regulating circuit enables the power supply unit to supply constant output voltage under varying input voltage or varying load current condition. An IC voltage regulator was employed to provide the regulated power supply. Table output voltage of 9V was obtained using 7809 with permissible load current of 1A respectively.

Two microfarad, 160V capacitors were filtered at the output of the regulator to keep the circuit constant at high frequency. Finally, the circuit diagram of the power the supply is shown below.

3.1.5 POWER SUPPLY SECTION

One of the most important applications of diodes is the design of rectifier circuits. A diode rectifier forms an essential building blocks of the dc power supply required to power electronic equipment. A block diagram is shown below. The first block in a dc power supply is the power transformer. It consists of two separate coils wound around an iron core that magnetically couples the two winding. The primary winding having N1 turns is connected to the 220v ac supply and the secondary winding having N2 turns is connected to the circuit of the dc power supply. Thus an AC voltage

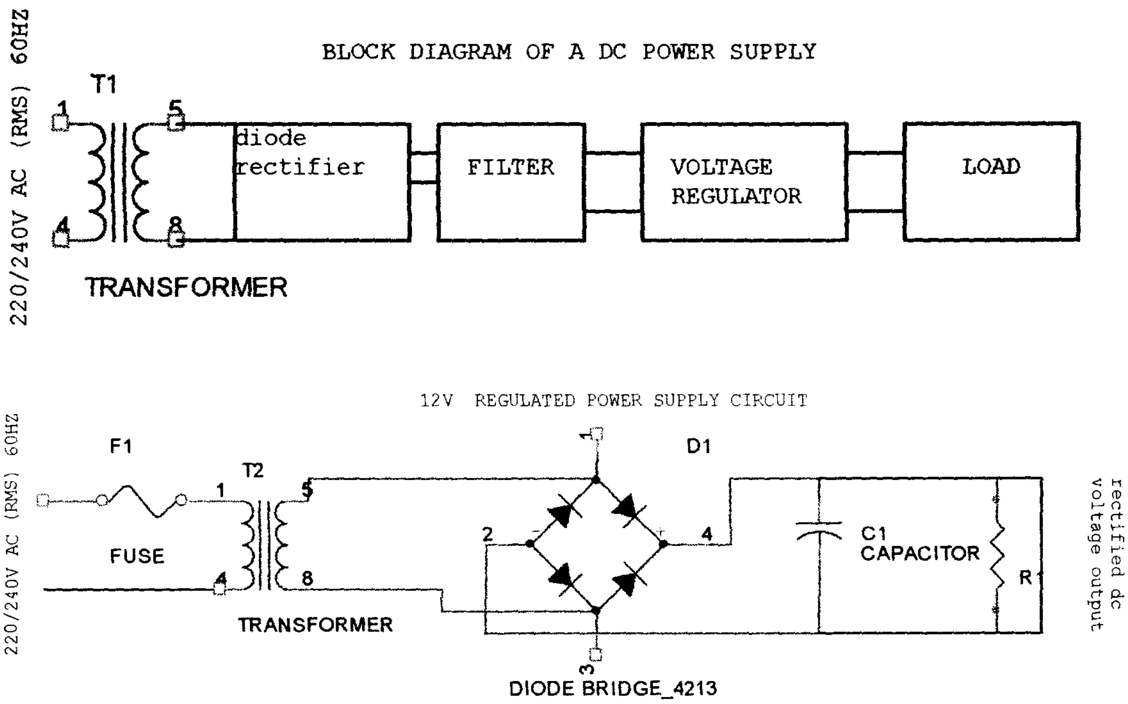


Fig 3.4 Power supply Circuit

3.2 FM TRANSMITTER

Any radio communication system needs a device that will transfer information from one point to another. This device is known as a transmitter. Thus, a transmitter is a 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 [2].

Radio signals are transmitted and received by means of an aerial, but since no kind of aerial can operate at such low frequencies, it is necessary to MODULATE-shift each signal to some higher frequency.

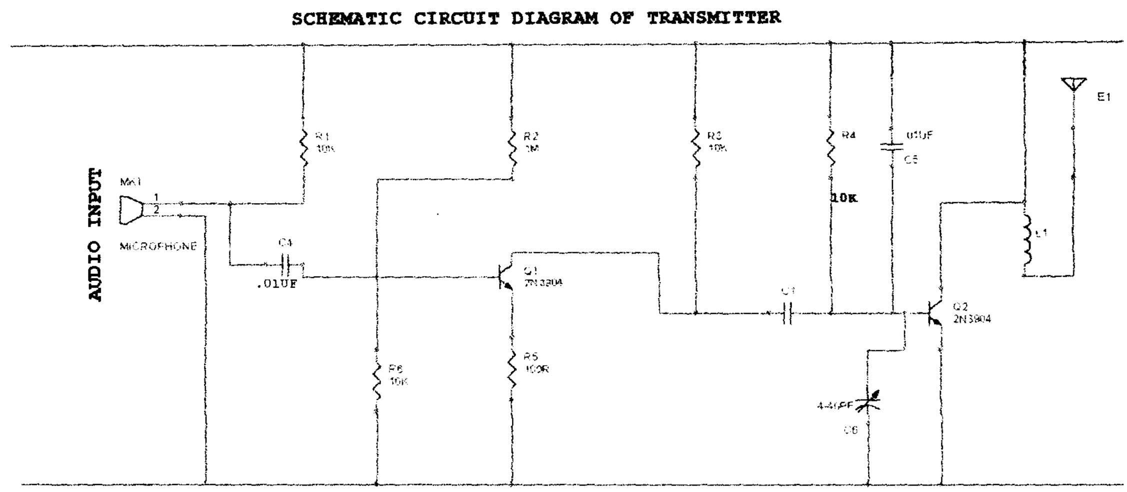


Figure 3.5 Circuit diagram for the Transmitter

3.2.1 MODULATION

Modulation is the process of super imposing a low frequency (containing information) into a high frequency (carrier) which does not contain information being sent over long distance as required. It is necessary to modulate because the low frequency, can not travel far but it carried the information while the carrier can travel very far and so carry the low frequency along. It is of course necessary to carefully choose the frequency bands to which the signals are moved in order to ensure that each service within a given geographical area operates at a different frequency. In practice, the frequency bands which are used for particular purpose are allocated in accordance with the recommendation of International Telecommunication Union (I.T.U). Two methods can be used in this regard. These are Amplitude Modulation (AM) and Frequency Modulation (FM). For this project work, we are interested in FM.

3.2.2 FREQUENCY MODULATION (FM)

Frequency modulation (FM) is the process by which we vary the frequency of the carrier wave with respect to the amplitude of the modulating frequency.

In FM, the amplitude of the carrier wave is kept constant during modulation, and so the power associated with an FM wave is constant.

When the modulated signal amplitude is zero, the modulated signal has the same frequency as the carrier wave.

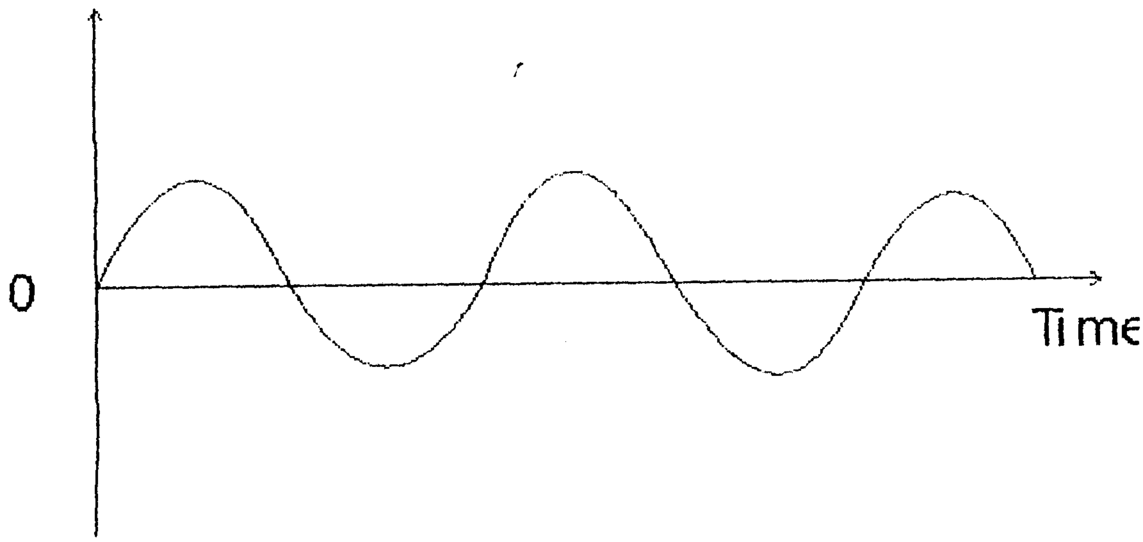
When the modulated signal voltage is positive, the frequency of the modulated signal is greater than the unmodulated carrier signal, and when the modulating signal is negative, the frequency of the modulated signal is less than that of the unmodulated carrier [11].

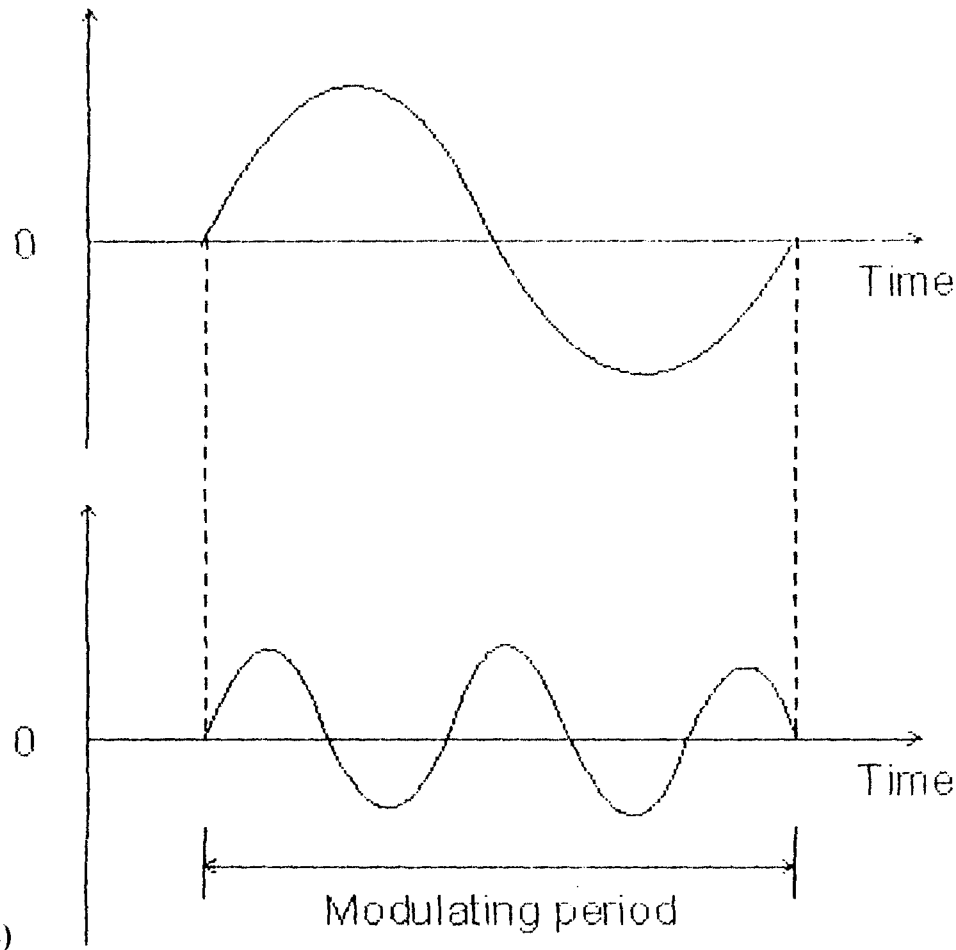
The maximum frequency of the modulated signal clearly occurs when the modulating signal is at its maximum positive value; the frequency of the modulated signal occurs when the modulating signal is at its maximum negative value.

Frequency modulation (FM) which is used for sound broadcasting occupies the 88 MHz band.

The wave forms are illustrated below.

(a)





(b and c)

Fig 3.1

(a) the carrier signal

(b) the modulating signal and

(c) Modulated signal

3.3 BLOCK DIAGRAM OF THE FM TRANSMITTER

The FM transmitter being constructed consists of a microphone, a main stage (which is made up of the oscillator and modulator), the last stage (which consists of the RF amplifier) and an antenna. A block diagram of the FM transmitter is shown below;

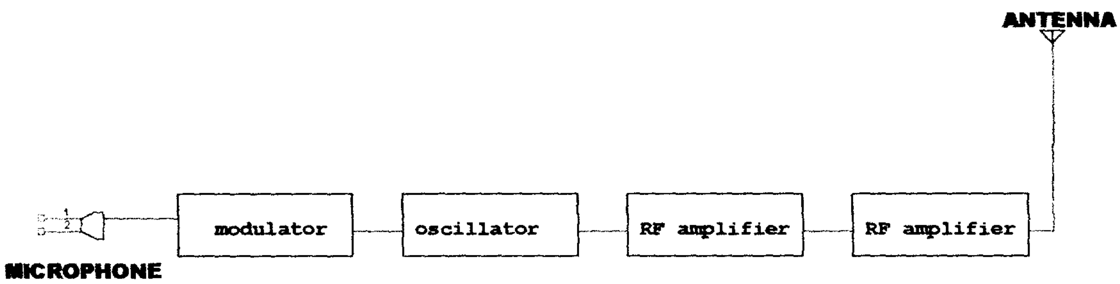


Fig 3.6 **BLOCK DIAGRAM OF THE FM TRANSMITTER**

3.4 MICROPHONE

The microphone serves as the audio input. It converts the voice of signal into an electrical signal [1]. Microphone is a device that converts the variation in air pressure by voice or musical instrument into electrical voltage or current of the same frequency and corresponding amplitude.

There are different types of microphone base on applications ranging from public address system, telephone handset, and transmitter, broadcasting to scientific measurement and recording microphones are related in terms of frequency response, directivity, impedance and sensitivity.

The next block stage consists of the modulator and oscillator. It receives the audio input. The oscillator is an electric circuit used to generate wave forms that occurs at some repetitive frequency [1]. Factors considered when choosing an oscillator include the stability, the allowable wave form distortion and the power output required [1]. The modulator frequency is changed in accordance with the variation in the instantaneous value of the message signal [3]. The modulator and oscillator generate a steady wave signal.

The RF amplifier is responsible for amplifying the signal, to a level high enough to be radiated by the antenna.

The antenna aids transmission of signals from the transmitter to a receiver. Every stage of the transmitter consists of an LC circuit, of the same frequency. Coupling is made possible by means of a coupling capacitor; the coupling capacitor also acts as a filter.

For this transmitter circuit, the resistance value of electric microphone was 100000 ohm and R1 was taken to be 10000 ohm (10k-ohm).

3.5 INPUT STAGE CALCULATION:

From the above,

Rmic = 100000 ohm

R1 = 10000 ohm

Vcc = 9v

Voltage drop across mic. is given as,

$$V_{mic} = \frac{V_{cc} * R_{mic}}{(R_{mic} + R1)} = \frac{100000 * 9}{(100000+10000)} = \frac{900000}{110000} = 8.1820V = \underline{8.18V}$$

Voltage drop = 9 - 8.18 = 0.8 V

3.6 PRE-AMPLIFICATION STAGE:

Signal collected through C1 is fed to the amplifier from it's base region. Q1 offers the first amplification to the weak signal. A linear amplification is necessary so as to prevent the distortion of the input signal. Distortion in amplifiers refers to as the differences between the output and input of an amplifier, due to unequal amplification of different frequencies present in the input signal.

3.7 AMPLIFIER/ OSCILLATOR CIRCUIT:

The modulating signal is coupled through C2 to the base of Q2. C1 and C2 are the same in value of 10uF, but C3 which 0.1uF bypasses the A.C signal at the emitter. The capacitor and resistor network at emitter region prevent degeneration of the vibrating frequency. For this stage, a frequency determination network, i.e. a low resistant coil with a variable capacitor are connect in parallel with each other at the collector region of the circuit which resonance at a frequency which is given by the formula,

$$f = \frac{1}{2 \times 3.142\ LC}$$

Where f = oscillating frequency (Hz)

L= self inductance (Henry)

C= tank capacitor (Farad)

3.8 SELF-INDUCTANCE:

The inductor used has a value determined by its radius (r), length (l), and number of turns (n).

$$L = \frac{n^2 \times r^2}{9r + 10x}$$

When,

n=5, r=0.13, x=0.25

Therefore,

$$L = \frac{(5)^2 \times (0.13)^2}{9(0.13) + 10(0.25)} \quad (\mu H)$$

L= 0.17μH or 0.00000017H

3.9 TANK (FDN) CIRCUIT CALCULATION

The tank circuit also known as the FDN which is the frequency determination network, have two elements which are connect in parallel with each other, i.e. the self-made inductor and a capacitor. The inductor having a reactance value of 2πLC, and the capacitor, having a reactance value of 1/2πfc operates in three basic modes, i.e

1. When the current across capacitor (C) is high, then that of L is Low.
2. When the current across inductor (L) is high, then that of C will be low.
3. Or, the current across C will be equal to that of L

From the above,

If V=I x R (according to ohms law)

Then $I = \frac{V}{R}$

Given that the reactance of Capacitor C = 1/2πfc (ohms)

And inductive reactance L= 2πfL (ohms)

If $I_C = I_L$

Then,

$$\frac{V_C}{} = \frac{Vl}{2\pi fL}$$

$$Vc = \frac{1}{2\pi fc}$$

$2\pi fL \times Vc = VL/2\pi fc$

$$4\pi^2 f^2 LC = \frac{V_L}{Vc}$$

$$F^2 = \frac{1}{4\pi^2 LC}$$

$$F = \frac{1}{\sqrt{4\pi^2 LC}}$$

$$F = \frac{1}{2\pi\sqrt{LC}}$$

Using the formula,

$$F = \frac{1}{2\pi\sqrt{LC}} \quad \text{or} \quad C = \frac{1}{4\pi^2 f^2 L}$$

Given that, L= 0.000000017H

And F= 93.2MHz

Then

$$C = \frac{1}{4(3.142)^2 \times (93.2 \times 10^6)^2 \times 0.000000017}$$

$C = 1.71 \times 10^{-11}$

C= 17.1 pF

3.10 RADIO FREQUENCY (RF) RECEIVER

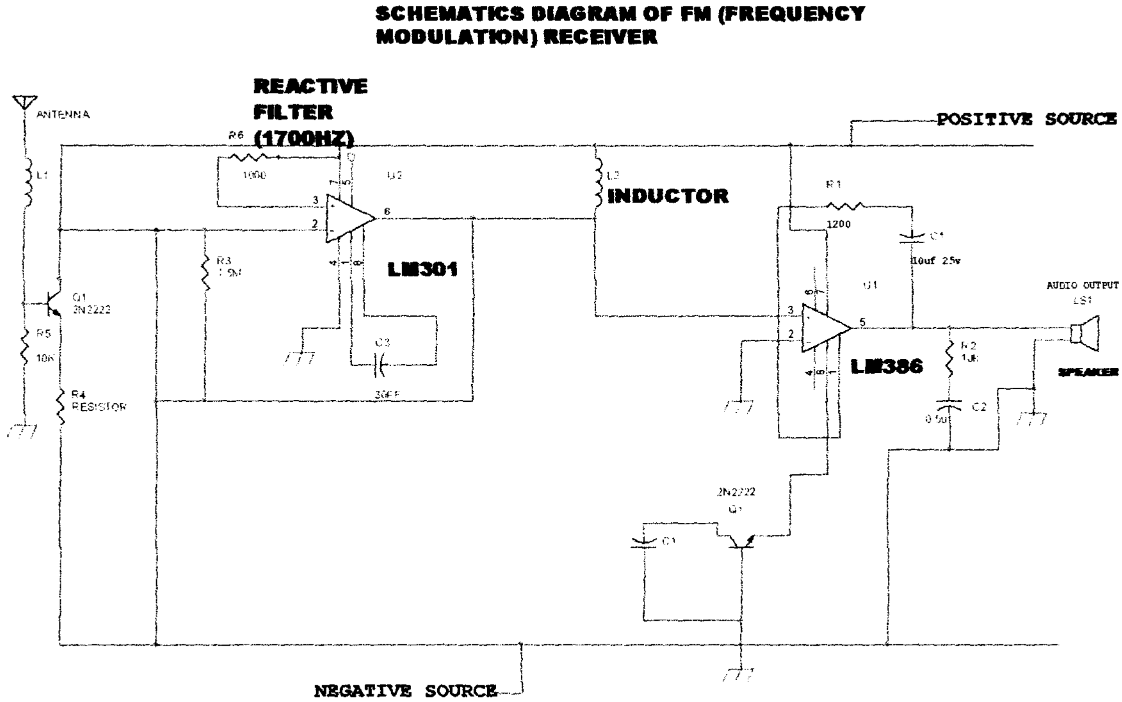


Fig 3.7 schematic diagram of rf receiver

LM386 is a voice/audio amplifier: It includes audio preamp, RC active filter, audio output stage. And voltage regulator, operating from 9v supply rated at 300mA or more. Developed as low distortion audio amplifier for communication receiver. With filter out changing input frequency from **300** to **3000Hz** has little effect on output. Switching in audio filter should attenuate all frequencies not in **700Hz** pass band gain is adjustable over wide range. Output will drive small loud speaker of 4-16 ohms or headphones of **4-2000 ohms**. Can also be used as test bench audio amplifier or with code practice oscillator.

LM301: Is an **RF (RADIO FREQUENCY)** receiver **ICs** used for RF, oscillator, mixer and IF stages of radio while **LM386** is an audio amplifier driving the loudspeaker.

Double turn circuit at output of the mixer provides selective total gain from base of input stage to diode selector is 95db

CHAPTER FOUR

4.0 CONSTRUCTION PROCEDURE

Construction simply means the practical aspect, which involves the assembly of the components and testing. The project work consists of both the electronics and the casing parts.

The electronics part consist of audio amplifier, modulator and the oscillator at the transmitter's section, and Radio frequency amplifier, mixer, oscillator, intermediate frequency, demodulator network, the audio frequency amplifier to the transducer at the receiver's section. All these were constructed one after the other as designed and analyzed in the design aspect of the project in chapter two.

After all the calculation and the design completed, the components with the preferred values were bought, then the components were arranged on a breadboard starting with the crystal microphone which is the first stage. Then up to the antenna stage, which launches the signal to space thereby, intercepted the receiver circuit whose stages of signal processes were constructed one after the other.

While on the breadboard, the output of the transmitter part was tested with digital multimeter and with conventionally general receivers in the market. The oscilloscope available in the school laboratory could not be use to display the output waveform because of high frequency response needed in the work.

Similarly, the receiver part was subjected to the same test with digital meter and we try to use it to receive any nearby transmitter and FM station example 91.2 crystals FM Minna.

After the whole connection on the breadboard, the system was tested and it function well, the stages in both transmitter and receiver were transferred and soldered on Vero-board using soldering iron and soldering lead.

4.1 COMPONENTS SELECTION (TRANSMITTER)

- Resistor, 100 k ohms
- Resistor, 10 k ohms
- Resistor, 1M ohms
- Resistor, 100 ohms
- Resistor, 1 k ohms
- Capacitor, 0.01 μF
- Capacitor, 0.1 μF
- Capacitor, 0.4 pF
- Capacitor, 200 μF 25V
- Capacitor, 0.01 μF
- Transistor, NPN (2N3904) – 2
- Induction coil – 2
- Vero board – 1
- Microphone (electric)
- Antenna
- Connecting wire (22 Gauge wire)
- Transformer (Step down) 230 / 24V

4.2 Components Selection (Receiver)

- Resistor, 10 k ohms (3)
- Resistor, 1.5 M ohms
- Resistor, 2.7 k ohms
- Resistor, 15 k ohms
- Resistor, 100 k ohms
- Resistor, 10 k ohms (variable)
- Resistor, 470 k ohms
- Capacitor, 0.001 μF
- Capacitor, 10 μF 15V (2)
- Capacitor, 10 μF 25V (2)
- Capacitor, 2 μF 15V (2)
- 9V Battery (2)
- Transistor, NPN (2N2222) – (2)
- LM 386 (IC)
- LM 301 (IC)
- Antenna
- 350 MW Audio output (Speaker)
- Induction coil (2)
- Battery cap (2)
- Connecting wires (22 gauge wire)

4.3 CASING OF THE NETWORK

After the construction was completed and tested, the transmitter and the receiver, were cased differently using hard but transparent plastic.

Portability and easy handling was considered during casing design. Hence, the hole for the elongation of the antenna was also drilled.

Testing in the box gave a satisfactory result.

4.4 PREVENTIVE MEASURES TAKEN

i. The entire individual components were independently tested before use, to ensure that they are all in good working order.

ii. Polarities of the components (where applicable) were considered before connecting them to prevent demand and ensure proper sequence of operation.

iii. Necessary portions of the electronic board (Vero board) were isolated to avoid continuity which may result in short circuit.

iv. Badly soldered joints were avoided by applying a little soldering lead into the joints.

v. Water and moisture were prevented from coming in contact with the circuit constructed.

4.5 RESULT AND DISCUSSION

The design and construction of an FM transmitter and receiver given to us was completed and the test result was fairly adequate.

Although the sound level of the loudspeaker was not all that high, this is traceable the fact that most of the components used were approximate. Hence, the distance covered by the transmitter is small.

4.6 TESTING

As a result of the problem of RADIO FREQUENCY circuit working effectively on the breadboard, this project was done directly on the veroboard to achieve the realisability

However, because of unavailability of a high range frequency oscilloscope, proper oscillation frequency for transmission could not be determined as a result, a little distance was covered. The transmitter could covered as far distance as 70 meters and the distance can be increased with little modification to the lc oscillator circuit. The frequency of both the transmitter and the receiver is 93.2 MHz.

CHAPTER FIVE

5.1 CONCLUSION

This project work was a complete success. Effective communication can be achieved while transmitting from the constructed transmitter to the receiver. However, this project work is simply a model. The FM transmitter constructed has a coverage area of 70m on a frequency of 93.2MHz. In the course of designing and construction, the best method of testing the transmitter and the receiver is by using a vero board and not a bread board. Using a bread board will only result in frustration and waste of time.

5.2 PROBLEMS ENCOUNTERED

1. Scarcity of the components used necessitated the traveling from one place to the other in search of those components.
2. Resistors: from the calculated valued or data and stated value of resistance obtained, the actual values were not available only but few.
3. Replacements of burnt components.
4. Unavailability of the required oscilloscope to determine the frequency signal.

5.3 RECOMMENDATIONS

1. The FM transmitter circuit can be modified by providing more amplifier stage at output, thereby making the output sound to be louder.
2. Application of this write up is highly recommended to any body who wishes to carry out test or repairs on both circuits (i.e. that of the transmitter and the receiver).
3. Another method suggested for an increase in the coverage area is by grounding the antenna point to a ground electrode, then using a stronger antenna.

4. A microphone jack may also be introduced so that a microphone can be attached and removed at will.

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