DESIGN AND CONSTRUCTION OF TV (FM) SOUND RECEIVER

BY

EYIGEGE ADAMU ISA

2001/11900EE

A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

NOVEMBER, 2007.

DECLARATION

I Eyigege Adamu Isa hereby declare that this project is presented in partial fulfillment of the requirement for the award of Bachelor of Engineering (B.Eng) degree in Electrical and Computer Engineering. I hereby relinquish the copyright to Federal University of Technology, Minna.

Eyigege Adamu Isa	Mr. David Michael
(Name of student) 07/12/07.	(Name of supervisor)
-----------------------	-----------------------
(Signature and Date)	(Signature and Date)
Engr. M.D Abdullah	--------------------------------
(Name of HOD)	(Name of external supervisor)
-----------------------	-----------------------------
(Signature and Date)	(Signature and Date)

DEDICATION

This project work is dedicated to ALLAH (SAW) for His infinite mercy. And to the whole Eyigege's family.

Also I am dedicating this work to one big family (the entire TRUST HOUSE members).

ACKNOWLEDGEMENT

First and foremost, I have to give Glory and Adorations to ALLAH Almighty for His numerous mercy and favor. The entire EYIGEGE's family especially Sister Halima, Umar, Abubakar and lot of others.

Not forgetting Mr. Christopher for being there for me any time, Dr. E. N Onwuka, my honorable supervisor in person of Mr. Michael David.

The HOD in person of Engr. M.D Abdullah for his fatherly support, advise, encouragement and inspirations.

This is for you the TRUST members and to Muhammad Awal Wali. One love. May almighty ALLAH see us through our live endeavors. (Amin).

TABLE OF CONTENTS

ABSTRACT

The TV (FM) receiver was designed to receive a desired signal among many presences in space. The receiver selects and recovers the wanted signal from the various radio frequency signals arriving at the receiving antenna. Basically, the receiver extracts and process by amplifying weak but desired signal from the various signals available from where the signals will be converted to the form more suitable for the output transducer. These processes include demodulation and amplification (of voltage and or power). The receiver circuitry is made up of different types of filters and amplifiers as well as detector circuit that does the conversion from RF to AF signal.

CHAPTER ONE

1.1 INTRODUCTION

This invention relates to a TV (FM) sound receiver containing a radio frequency tuning circuit for selecting a signal from an antenna and a local oscillator tuning circuit tunable to an oscillating signal for converting the frequency of a receiving signal to an intermediate frequency.

In such a kind of super-heterodyne FM receiver, a desired broadcast signal received at an antenna is converted to a frequency called an intermediate frequency (IF), which is then detected and demodulated. For FM reception, 10.7 MHz is normally used as this intermediate frequency. A local oscillator circuit is oscillated at a frequency always apart from the frequency of a desired signal (that is, receiving frequency) by 10.7 MHz. A 10.7 MHz IF signal is generated as a beat component as a result of mixing the oscillating signal of this local oscillator circuit and the received signal so as to convert the received signal to the intermediate frequency. At this conversion, if the local oscillator circuit is oscillated at a frequency higher by 10.7 MHz than the receiving frequency, it is called the upper heterodyne method. On the other hand, if the local oscillator circuit is oscillated at a frequency lower by 10.7 MHz than the receiving frequency, it is called the lower heterodyne method. [1]

Whether an FM sound receiver is designed in the upper heterodyne method or lower heterodyne method is determined depending on the frequency allocation for FM radio broadcasting in each country and the presence of interference signals at image frequencies. In a super-heterodyne FM radio receiver, if an interference signal is located at the image frequency which is 10.7 MHz apart from a local oscillating frequency in the opposite direction to a receiving frequency, (i.e., 21.4 MHz apart from the receiving frequency,) image signals are mixed into the intermediate frequency signal resulting in interference.

An object of the present invention is to provide an FM radio receiver wherein both a circuit necessary for receiving FM radio broadcasting signals can be incorporated by means of a common front-end circuit without increasing the number of components, thereby preventing an increase of design work and a decline of productivity.

To achieve the above object, the present invention provides an FM radio receiver comprising a radio frequency tuning circuit for selecting a frequency modulated signal from an antenna and a local oscillator tuning circuit for tuning to an oscillating signal so as to convert the frequency of a receiving signal to an intermediate frequency. The radio frequency tuning circuit and the local oscillator tuning circuit each have variable capacitance diode elements. The variable capacitance diode elements of the radio frequency tuning circuit and variable capacitance diode element of the local oscillator tuning circuit are connected to a tuning control voltage source. The radio frequency tuning circuit has a capacitance variable ratio set so as to be capable of receiving continuously a first receiving band and a second receiving band. The local oscillator tuning circuit is so constructed that its inductance value and capacitance variable ratio can be switched according to the receiving band, so that the local oscillator circuit is set to lower heterodyne when the first receiving band is selected and to upper heterodyne when the second receiving band is selected. [1]

1.2 AIMS AND OBJECTIVES

This research project is aimed at design and construction of TV (FM) sound receiver with high sensitivity, selectivity and provision for stable oscillation.

1.3 THESIS OUTLINE

This thesis set out an orderly account of work done. It consists of five chapters.

i Chapter one gives an inside to the project from the introductory point of view and present the aim and objectives,

ii Chapter two gives historical review of the project and also expatiates on some of the fundamentals which are applied in carrying out the task.

iii Chapter three explains the theory of the elements that comprises the project and show how they function.

iv Chapter four shows all the steps carried out in setting up the circuit elements and reports on the construction and testing of the circuit.

v Chapter five reveals the level of accomplishment of task and seeking to suggest further work that could improve on the system characteristics and output.

CHAPTER TWO

LITERARURE REVIEW/THEORETICAL BACKGROND.

2.1 LITERATURE REVIEW.

In electronics, the super heterodyne receiver (also known by its full name, the supersonic heterodyne receiver, or by the abbreviated form super het) is a technique for selectively recovering the information from radios waves of a particular frequency. It is used in radio and television receivers and transmitters in order to tune them to a particular frequency. The super heterodyne principle was originally conceived in 1918 by Edwin Armstrong during World War I as a means of overcoming the deficiencies of early vacuum triodes used as high-frequency amplifiers in radio direction finding (RDF) equipment. In a triode RF amplifier, if both the plate and grid are connected to resonant circuits tuned to the same frequency, stray capacitive coupling between the grid and the plate will cause the amplifier to go into oscillation if the stage gain is much more than unity. In early designs dozens of low-gain triode stages sometimes had to be connected in cascade to make workable designs, which drew enormous amounts of power in operation. However the strategic value was so high that British Admiralty felt it was money well spent. Armstrong had realized that higher frequency equipment would allow them to detect enemy shipping much more effectively, but at the time no practical "short wave" (defined then as any frequency above 500 kHz) amplifier existed. [1]

It had been noticed some time before that if a regenerative receiver was allowed to go into oscillation, other receivers nearby would suddenly start picking up stations on frequencies different from those they were actually transmitted on. Armstrong (and others) soon realized that this was caused by a "supersonic" heterodyne (or beat) between the station's carrier frequency and the oscillator frequency. For example, if a station were transmitting on 300 kHz and the oscillator were set to 400 kHz, as well as the original 300 kHz, the same station would be also heard on 100 kHz and 700 kHz.

In a flash of insight, Armstrong suddenly realized that this was a potential solution to the "short wave" amplification problem. To monitor a frequency of 1500 kHz, he could set up an oscillator to, say, 1560 kHz, which would down-convert the signal to a 60 kHz carrier, which was far more amenable to high gain amplification using triodes.

The first super heterodyne circuits used the self-resonance of iron-cored interstage coupling transformers to filter the intermediate frequency, and this is why the Intermediate Frequency tuned circuits were still referred to as IF "transformers", long after they had been replaced by proper tunable coils. Early superhets used IFs as low as 20 kHz, which made them extremely susceptible to image frequency interference but at the time the main interest was sensitivity rather than selectivity. [1]

Armstrong was able to put his ideas into practice quite quickly, and the technique was rapidly adopted by the military; however, it was less popular when radio broadcasting began in the 1920s, due both to the need for an extra tube for the oscillator, and the amount of technical knowledge required to operate it. For domestic radios, an alternative approach to Short Wave "Tuned RF" ("TRF") amplification called the Neutrodyne became more popular for reasons of simplicity and economy.

However, by the 1930s, improvements in vacuum tube technology rapidly eroded these advantages. First, the development of practical indirectly-heated cathodes allowed the mixer and oscillator functions to be combined in a single Pentode tube, in the so-called Autodyne mixer. This was rapidly followed by the introduction of low-cost multi-element tubes specifically designed for super heterodyne operation and by the mid-30s the TRF technique was rendered obsolete. Just about all radio receivers, including the receiver sections of television sets, now use the super heterodyne principle. [1]

2.2 OVERVIEW.

The super heterodyne receiver principle overcomes certain limitations of previous receiver designs. Tuned radio frequency (TRF) receivers suffered from poor selectivity, since even filters with a high Q factor have a wide bandwidth at radio frequencies. Regenerative and super-regenerative receivers offer better sensitivity than a TRF receiver, but suffer from stability and selectivity problems.

In receivers using the super heterodyne principle, a signal at variable frequency f is converted to a fixed lower frequency, f_{IF}, before detection. Frequency f_{IF} is called the intermediate frequency, or "IF". In typical amplitude modulation (AM, e.g. as used on medium wave) home receivers, that frequency is usually 455 kHz; for FM VHF receivers, it is usually 10.7 MHz; for television, 45 MHz. [1]

Heterodyne receivers "mix" all of the incoming signals with an internally generated waveform called the local oscillator using a Frequency mixer. The user tunes the radio by adjusting the set's oscillator frequency, f_{LO}. In the mixer stage of a receiver, the local oscillator signal multiplies with the incoming signals, which shift them all down in frequency. The one that shifts to f_{IF} is passed on by tuned circuits, amplified, and then demodulated to recover the original audio signal. The oscillator also shifts a "copy" of each incoming signal up in frequency by amount f_{LO}. Those very high frequency "images" are all rejected by the tuned circuits in the IF stage. [1]

2.3 HIGH – SIDE AND LOW – SIDE INJECTION.

The amount that a signal is down-shifted by the local oscillator depends on whether its frequency f is higher or lower than f_{LO}. That is because its new frequency is $|f - f_{LO}|$ in either case. Therefore, there are potentially two signals that could both shift to the same f_{IF} one at $f = f_{LO} + f_{IF}$ and another at $f = f_{LO} - f_{IF}$. One or the other of those signals has to be filtered out prior to the mixer to avoid aliasing. When the upper one is filtered out, it is called high-side injection, because f_{LO} is above the frequency of the received signal. The other case is called low-side injection. High-side injection also reverses the order of a signal's frequency components. Whether or not that actually changes the signal depends on whether it has spectral symmetry or not. The reversal can be undone later in the receiver, if necessary.

2.4 DESIGN AND ITS EVOLUTION.

The diagram below shows the basic elements of a single conversion superhet receiver. In practice not every design will have all these elements, nor does this convey the complexity of other designs, but the essential elements of a local oscillator and a mixer followed by a filter and IF amplifier are common to all superhet circuits. Cost-optimized designs may use one active device for both local oscillator and mixer, this is sometimes called a "converter" stage. One such example is the pentagrid converter.

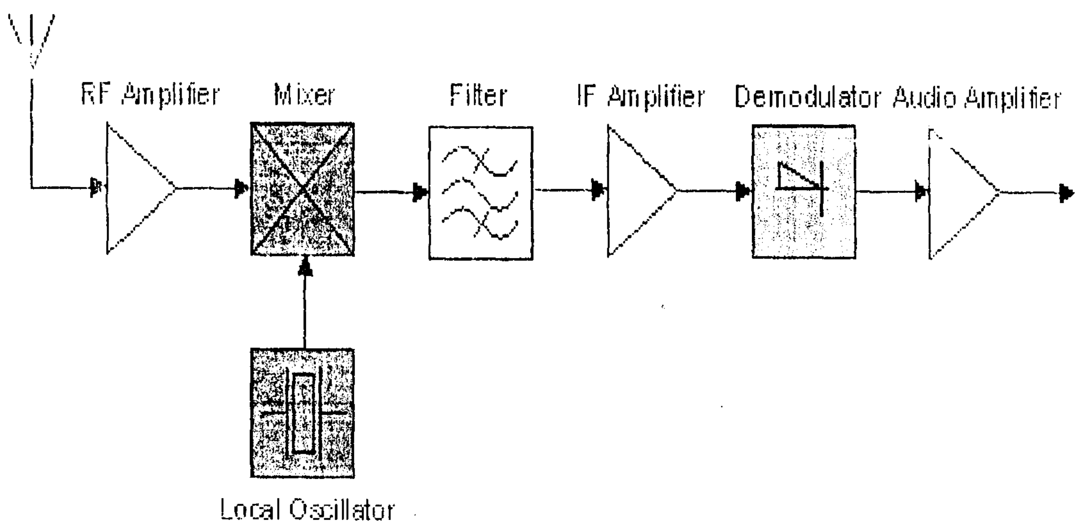

Fig 2.1 Block diagram of FM receiver

The advantage to this method is that most of the radio's signal path has to be sensitive to only a narrow range of frequencies. Only the front end (the part before the frequency converter stage) needs to be sensitive to a wide frequency range. For example, the front end might need to be sensitive to 1–30 MHz, while the rest of the radio might need to be sensitive only to 455 kHz, a typical IF. Only one or two tuned stages need to be adjusted to track over the tuning range of the receiver; all the intermediate-frequency stages operate at a fixed frequency which need not be adjusted. [2]

Sometimes, to overcome obstacles such as image response, more than one IF is used. In such a case, the front end might be sensitive to 1–30 MHz, the first half of the radio to 5 MHz, and the last half to 50 kHz. Two frequency converters would be used, and the radio would be a "Double Conversion Super Heterodyne"—a common example is a television receiver where the audio information is obtained from a second stage of intermediate frequency conversion. Occasionally special-purpose receivers will use an intermediate frequency much higher than the signal, in order to obtain very high image rejection.

Super heterodyne receivers have superior characteristics to simpler receiver types in frequency stability and selectivity. It is much easier to stabilize a tunable oscillator than a tunable filter, especially with modern frequency synthesizer technology. IF filters can give much narrower pass bands at the same Q factor than an equivalent RF filter. A fixed IF also allows the use of a crystal filter in very critical designs such as radiotelephone receivers which have exceptionally high selectivity. [1]

In the case of modern television receivers, no other technique was able to produce the precise band pass characteristic needed for vestigial sideband reception, first used with the original NTSC system introduced in 1941. This originally involved a complex collection of tunable inductors which needed careful adjustment, but since the early 1980s these have been replaced with precision electromechanical surface acoustic wave (SAW) filters. Fabricated by precision laser milling techniques, SAW filters are much cheaper to produce, can be made to extremely close tolerances, and are extremely stable in operation.

The next evolution of Super heterodyne receiver design is the software defined radio architecture, where the IF processing after the initial IF filter is implemented in software. This technique is already in use in the latest design analog television receivers and digital set top boxes, where there are no coils or other resonant circuits used at all. The antenna simply connects via a small capacitor to a pin on an integrated circuit and all the signal processing is carried out digitally. Similar techniques are used in the tiny FM radios incorporated into Mobile phones and MP3 players.

Radio transmitters may also use a mixer stage to produce an output frequency, working more or less as the reverse of a super heterodyne receiver.

Drawbacks to the super heterodyne receiver include the cost of the mixer and local oscillator stages. Receivers become vulnerable to interference from signals other than the desired signal. A strong signal at the intermediate frequency may overcome the desired signal; regulatory authorities will prevent licensed transmitters from operating on these frequencies. In urban environments with many strong signals, the signals from multiple. transmitters may combine in the mixer stage to interfere with the desired signal. A super heterodyne receiver may pick up a so-called "image frequency" signal that also produces a mixer output at the desired intermediate frequency; this phenomenon is sometimes used for scanner reception of transmissions outside of the receiver's official capabilities. [2]

Multi – Wire Aerial Cage;- Early antenna history of the station reveals an experimental multi – wire aerial cage was srung approximately 90 feet in air above the campus between chimneys of Havemeyer and Schermerhorn Halls, the cage being self – resonant between 200 and 300 meters and fed with single'wire feeder at the Havemeryer end. The Columbia University Experimental Wireless station (as inquiries reveals, the first of its kind at an

American University) was transmitting with this antenna in 1906. [3]

2.5 Intermediate Frequency (IF)

An intermediate frequency (IF) is a frequency to which a carrier frequency is shifted as an intermediate step in transmission or reception. It is the beat frequency between the signal and the local oscillator in a radio detection system. IF is also the name of a stage in a super heterodyne receiver. It is where an incoming signal is amplified before final detection is done. There may be several such stages in a super heterodyne radio receiver. [6]

2.6 Radio Frequency (RF)

A radio receiver comprised of several tuned radio-frequency amplifiers followed by circuits to detect and amplify the audio signal. Used in the early 20-th century, it is difficult to operate because each stage must be individually tuned to the station's frequency. It was replaced by the super heterodyne receiver invented by Edwin Armstrong.

The TRF receiver was patented in 1916 by Ernst Alexanderson. His concept was that each stage would amplify the desired signal while reducing the interfering ones. The final stage was often simply a grid-leak detector. [1]

A problem with the TRF receiver is that interelectrode capacitance causes oscillations and other modes in the tuned circuits. In 1922, Louis Alan Hazeltine invented the neutrodyne circuit, which - as its name implies - neutralizes these capacitances.

Antique TRF receivers can often be identified by their cabinets. They typically have a long, low appearance, with a flip-up lid for access to the vacuum tubes and tuned circuits. On their front panels there are typically two or three large dials, each controlling the tuning for one stage. Inside, along with several vacuum tubes, there will be a series of large coils. These will sometimes be tilted slightly to reduce interaction between their magnetic fields. [1]

2.7 Local Oscillator

A local oscillator is a device used to generate a signal which is beat against the signal of interest to mix it to a different frequency. The oscillator produces a signal which is injected into the mixer along with the signal from the antenna in order to effectively change the antenna signal by heterodyning with it to produce the sum and difference (with the utilization of trigonometric angle sum and difference identities) of that signal one of which will be at the intermediate frequency which can be handled by the IF amplifier. These are the beat frequencies. Normally the beat frequency is associated with the lower sideband, the difference between the two. [13]

Several local oscillators can be strung in series to form a local oscillator chain (LO chain). The most of principles listed below, were widely used in radio physics, for frequencies from kHz to MHz. After spreading of nonlinear optics, the same terms and principles apply also to the optical frequencies of order of 10^{15}Hz. [13]

2.8 THEORETICAL BACKGROUND

The application of general communication theory to acoustics leads to the separation of the sound carrier and its modulations. The way in which our sense of hearing performs this separation is illustrated, and its importance for the understanding of some acoustic phenomena is pointed out. The conditions for satisfactory sound reproduction are analyzed. [4]

A radio receiver must perform a number functions. First, the receiver must separate a wanted signal from all other radio signals that may be picked up by the antenna and reject the unwanted ones. Next, the receiver must amplify the desired signal to a usable level. Finally, the receiver must recover the information signal from the carrier and pass it on to the user.

2.9 Tuning Range:- Many TV sound (radio) receivers are fixed – tuned to a specific signal frequency, while others are designed to be continuously adjustable over a range (or band) of frequencies. Tuning of RF amplifiers and the oscillator is accomplished by varying the capacitance (or sometimes the inductance) in resonant circuit that act as band – pass filters. The tuning range is usually limited by the range over which the capacitance can vary. Typically, a maximum of 10:1. The resonant frequency of a high Q tuned circuit is given by $f_o = 1/2\pi(\sqrt{LC})$. [4]

The circuit frequency tuning range ratio R_f is defined as the ratio of its maximum frequency to its minimum frequency, and corresponding capacitance tuning range ratio R_c is the ratio of maximum capacity to minimum capacity. Applying these ratio to the resonant equation. [5]

$R_c = C_{max}/C_{min}$ ------------------------ (i)

$R_f = f_{max}/f_{min} = \sqrt{RC}$ ------------------- (ii)

If the oscillator frequency is chosen to be above the received signal frequency, then the tuning range of the oscillator tuned circuit will be smaller than that of the RF amplifier tuned circuits. If the oscillator frequency is below the signal, then its tuning range will be larger than that of RF circuits, and also its harmonics may fall within the signal range to cause interference. This is particularly true if the intermediate frequency IF is made much small than the signal frequency where the oscillator is located very near the signal frequency. [5]

2.10 Sensitivity and Gain

The sensitivity of a receiver is its ability to receive weak signals. This sensitivity may be defined in several ways. First, it may be stated in terms of the signal field strength of a signal that will produce a desired demodulated output level under a certain modulated level. The sensitivity is usually stated in terms of the voltage developed by the antenna across the receiver antenna terminals in micro volts. This level ranges from a few micro volts to a few hundred micro volts for typical receivers. [5]

Frequency modulated receivers are designed with a limiting amplifier stage just before the detector, which serves to keep any amplitude variations on the signal from reaching the detector. In this case, the sensitivity is stated as the input voltage level required to just bring the limiting amplifier to saturation level.

The gain required in the RF and IF amplifier chain of a receiver depends on the required input and output. The input is the minimum usable signal level at the antenna terminals. The output is the minimum signal level at the input of the detector required to make the detector perform satisfactorily. [4]

CHAPTER THREE

DESIGN AND IMPLEMENTATION

The design was carried out using the following modules;

3.1 Module one

Receiving Antenna or aerial.

An aerial is a structure that couples the input of a receiver to space. It converts electromagnetic waves into high frequency current. [10, 11]

3.2 Module two

Tuned Circuit.

The first stage in reception is to pick out the desired signal from one transmitter from which we wish to receive. This is done by passing the mixed signal to a resonant circuit known as tuned circuit. This circuit is usually a capacitor – inductor circuit. [11]

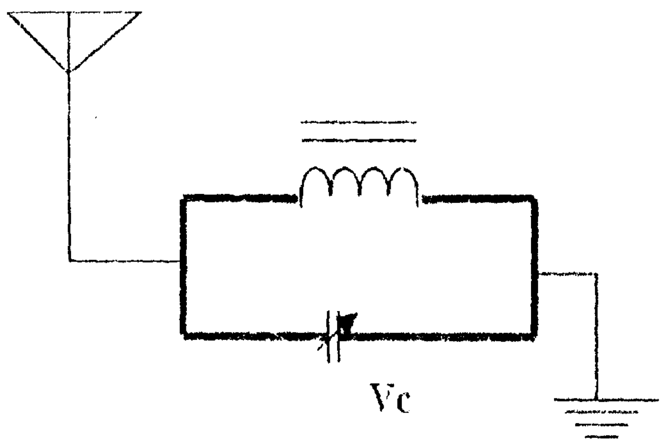

Fig 3.1 A Tuned circuit

3.3 Module three

KA2297 AM/FM IC

This is a 16 pin IC with the RF signal received from the transmission station passing through pin 1, and pins 3, 6, 8 and 10 connected to IF 10.7MHz crystal with pin 6 also acting as +Vcc input. Pin 11 is an audio output pin and 14 is AM/FM switch pin. [7]

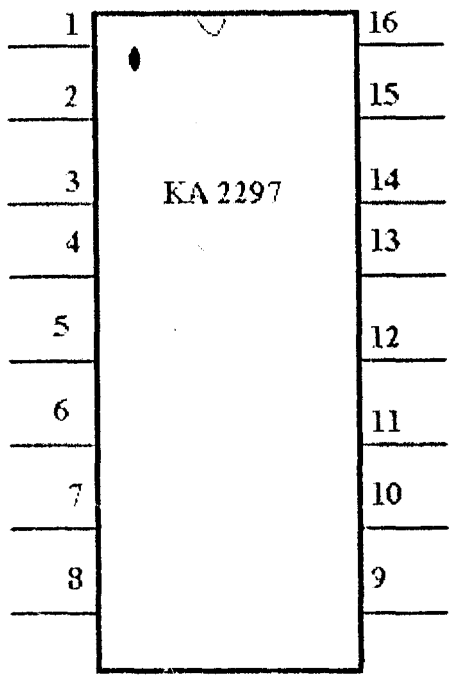

Fig 3.2 KA2297 AM/FM IC

3.4 Module Four

Audio Unit

The LM386 is a power amplifier designed for use in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value from 20 to 200. The inputs are ground referenced while the output automatically biases to one-half the supply voltage. The quiescent power drain is only 24 milliwatts when operating from a 9 volt supply, making the LM386 ideal for battery operation.[7]

It is an 8 pin audio amplifier. Pins 15 and 13 are connected through pin 14 of KA2297 to pin 6 the audio amplifier also pin 11 of FM IC is connected through a 50K potentiometer to pin 3 which is the positive input of LM386, this acts as the volume while pin 2 is the negative input and pin 5 as the output. [8]

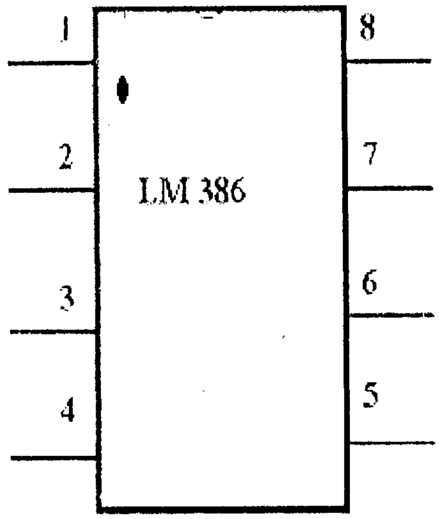

Fig 3.3 Audio amplifier (LM386)

3.5 Module Five

Speaker

A loudspeaker converts low alternating current energy into sound wave energy (acoustic wave). A good loudspeaker must not be able to deliver high power audio output but must also faithfully reproduce sounds of different frequencies. Most modern loudspeakers employ moving coil or electromagnetic units. However, other types like ionic and piezoelectric units also exist. [11]

The audio signal is given via 220uf capacitor to the loudspeaker which converts it into sound similar to the one at the transmission station [9].

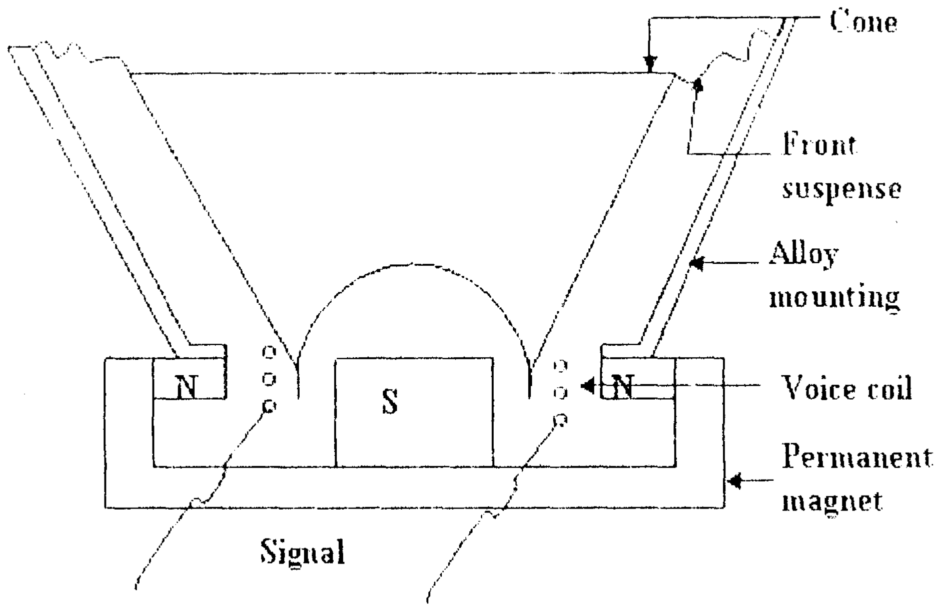

Fig 3.4 Moving - coil loud speaker. [11]

3.6 SUMMARY OF OPERATION OF FM RECEIVER.

The principle of operation of FM receiver is based on the conversion of all incoming radio frequency signal to an intermediate frequency. This is kept fixed. As such the amplifier circuits operate with maximum stability, selectivity and sensitivity.

The RF amplifier selects and amplifies the required frequency band signals from the various signals intercepted by the antenna. The amplified RF is coupled to the input of a mixer stage which beats together two frequency signals. A mixer circuit is so designed that it can conveniently combine two radio frequencies. One fed into it by the RF amplifier and the other by the local oscillator. The first input to the mixer is the amplified RF signal of frequency F_{RF}, which the input is from a local oscillator signal of frequency F_{LO}. [11]

The local oscillator is an RF oscillator whose frequency of oscillation can be controlled by the tuning capacitor of the oscillator is ganged with capacitor of the input circuit so that the difference in the frequency is always constant. [10]

The output of the sum and difference signal of the frequencies $F_{LO} \pm F_{RF}$. The function of the IF amplifier is, thus to select the different frequency signal. [11].

i.e. $F_{IF} = F_{LO} - F_{RF}$ .... (iii) IF

F_{IF} is known as the intermediate frequency IF. It is also the function of the IF amplifier to amplify the IF signal further. The IF is kept constant by gang – tuning the LO and the RF amplifier. The LO frequency is preferably chosen to be higher than the RF for narrower relative tuning [11]. The function of the limiter is to remove all amplitude variations (caused by noise) from IF signal which might have crept into the FM signal. This removal of amplitude variation is necessary for distortion less demodulation. The detector carries out the conversion of the IF signal to AF signal. This audio frequency amplifier output is fed to a loudspeaker to produce the original sound. [10]

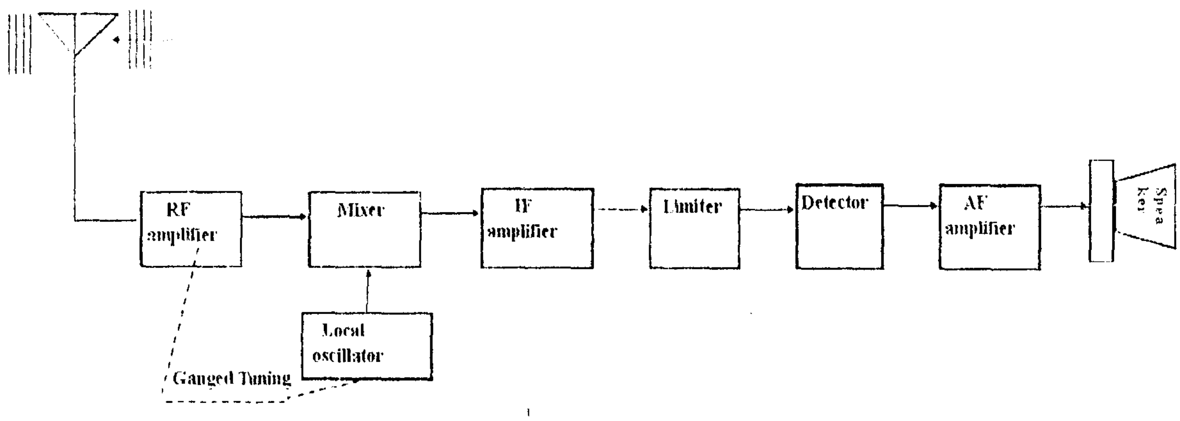

Fig 3.5 Block diagram of FM receiver

3.7 Summary of the Modules

It is important and necessary to put the modules into block format for easier trouble shooting. If the symptoms indicate the failure of one of the blocks, then the technician will devote special attention to that part of the circuit [10].

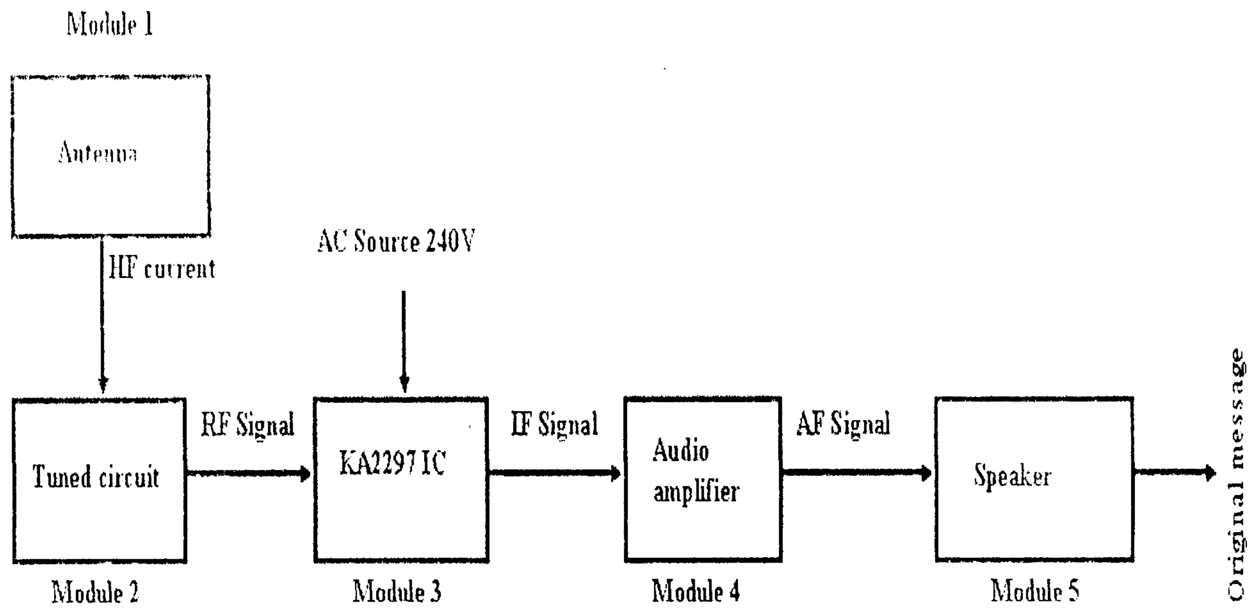

Fig 3.6 Summary modules.

3.7 Main Circuit Diagram

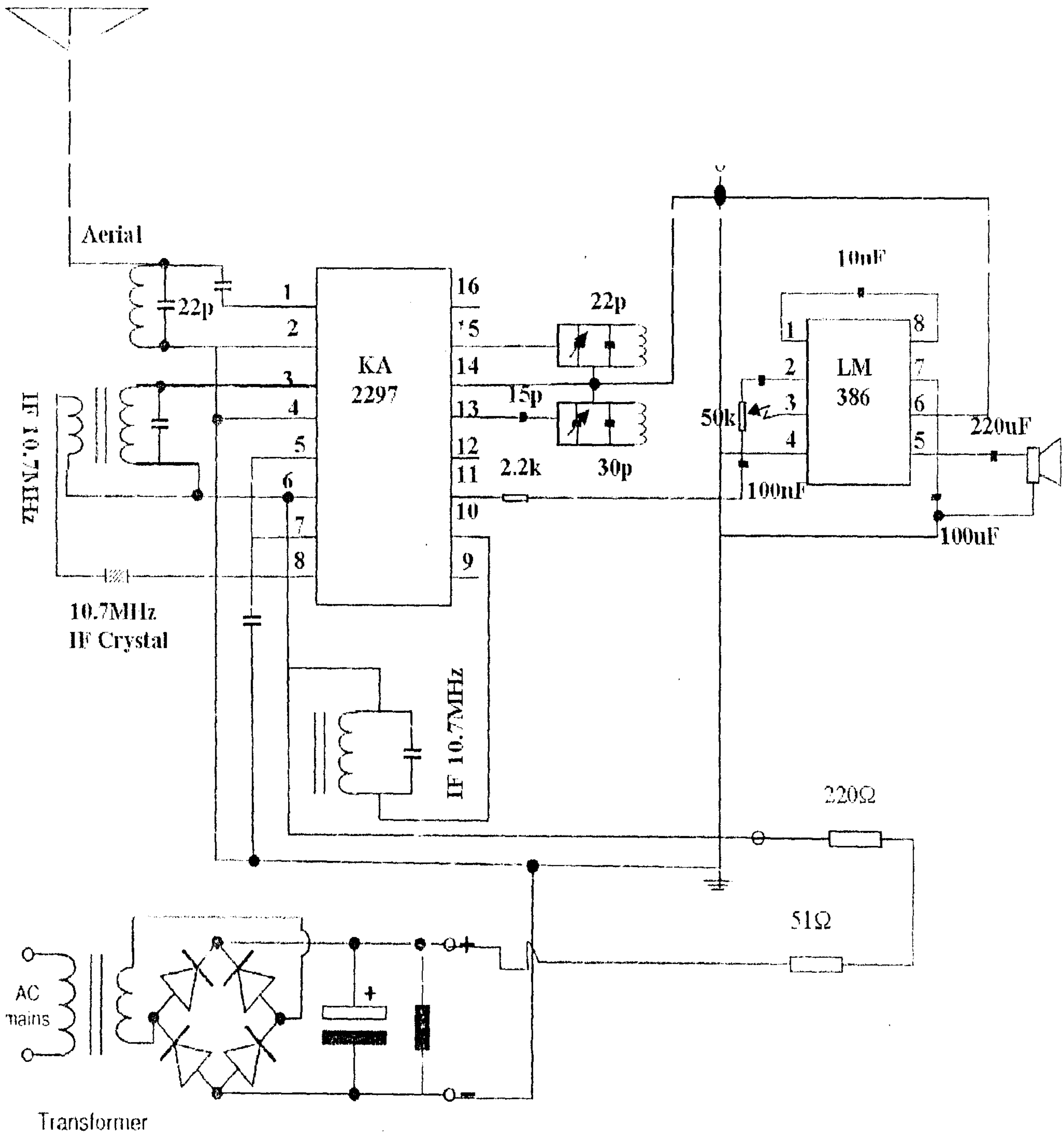

Fig 3.7 Main circuit diagram

CHAPTER FOUR

TESTS, RESULTS AND DISCUSSION

4.1 TESTING

For every design work, be it electronics, electrical, mechanical etc, to be satisfactorily commissioned into service, proper testing most be carried out, which is why this project work was first of all constructed or assembled on a bread board for proper testing.

Although this is an RF circuit which is difficult or practically impossible to bread board due to it nature of connection. This made it practically impossible for me to obtain satisfactory results.

The power unit was tested and 240V ac source was stepped down to 9V and rectified to dc.

The RF tuned oscillator circuit was tested and found to be receiving transmitted radio frequency signal.

The mixer (KA 2297) IC was tested and proper reception and amplification of signals was accorded.

Matching the output signal received from the KA 2297 IC to the audio amplifier, an output signal received after amplification shows that the audio amplifier IC (LM 386) was working the way it ought to.

4.2 RESULTS

After the construction and testing of the project work, the following results where obtained;-

i. High selectivity.

ii. Low noise.

iii. Low level of distortion.

iv. Output power matching the input of loudspeaker.

v. High sensitivity.

Using the frequency of NTA Minna station (that is 209.85 MHz) as a cast study and the capacitor across pin 1 and 8 (i.e 10uF), the value of our inductor can be obtained using this formula: $f = 1/2\pi\sqrt{LC}$.

That is: $209.85 * 10^6 = 1/2\pi\sqrt{(10 * 10^{-6} * L)}$

$L = 0.490mH$.

4.3 DISCUSSION.

For the signal received to be highly sensitive and with good selectivity, an appropriate aerial was used and the inductors used were coated to prevent any alteration of the preset frequency and to avoid or reduced distortion.

4.4 TROUBLE SHOOTING.

From the block diagram in fig 3.6, it will be easier to troubleshoot in case any fault.

If there is no sign of power in the system, the first place to check is module 1(i.e. the power supply unit). If the system is working but only noisy sound is being heard, modules 3 and or 4 should be check. Reasons being that when M3 is bad, the system will not be able to pick signal and when M4 is bad, the signal picked would not be able to be converted back to its original form as transmitted from the station.

In case of any problem, when these processes are followed properly, the fault would be detected and rectified.

CHAPTER FIVE

5.1 CONLUTION

This project is on the design and construction of TV (FM) sound receiver with the frequency range between 300 khz to 3MHz.

The function of this project work is to select the required TV station (carrier) out of the numerous modulated carriers reaching the receiving antenna and convert the selected modulated radio frequency RF signal into audio frequency AF signal.

The receiving circuitry is made up of different type of filters and amplifiers performing specific function as well as detecting circuit that does the conversion from RF to AF signal.

Preliminary process in the receiver also involves or includes raising the voltage level of the weak signal. The recovering of the original message involves demodulation which is an opposite operation to that at the transmitting end.

When dealing with RF circuitry, you have to work with inductors which are pretty difficult under experimental limitations to get them to resonant with the same frequency. Although KA2297 is a very good IC for AM/FM receiver, but sometimes it have problems of picking FM signals, due to this, it is advisable for any future work to go for BA4402 which is cheap but difficult to get within Minna.

5.2 RECOMMENDATION

It is recommended that KA2297 be replaced with BA4402 and also that DC source be incorporated into the design (that is batteries) due to incessant power failure in the country of continuous use.

REFERENCES

[1] www.wikipedia.org/wiki/superheterodyn FM receiver

[2] www.patent storm.com; Us patent issued on January 23, 2001.

[3] www.W2AEE antenna history.com

[4] Mayr, H; White, James; Acoustic communication theory, JAES volume 28 number 5, publication May (1980), pp. 331 – 339.

[5] Dennis Roddy; John Cooler; Electronics communications, 4th edition, pp. 224 – 232.

[6] www.wikipedia.org/wiki/intermediate frequency.

[7] www.national semiconductor corporats.com/datasheet

[8] www.Techlib.com/audio amplifier.

[9] B.L Theraja; A.K Theraja, A textbook of Electrical technology, 24th revised edition, S. Chand and company Ltd publication, 2006, pp. 2130, 2148, 2461 – 2467.

[10] Charles .A Schuler; Electronics principles and applications, Glencoe/McGraw – Hill publication, 5th edition, pp. 317 – 335.

[11] Dr Y.N Adediran; Telecommunication principle and system, 2nd edition, Finom Associates publication; January, 2005, pp. 48 – 49, 83 – 89.

[12] V.K Mehta; Rohit Mehta; Principles of Electronics, 9th edition, S. Chand and company Ltd publication, 2006, pp. 397, 425 – 430.

[13] www.wikipedia.org/wiki/local oscillator.