DESIGN AND CONSTRUCTION OF FREQUENCY MODULATION RECEIVER WITH POWER PACK

BY

YISA FRANCIS BABA
99 / 9318EE

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA NIGER STATE.

A PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELOR OF ENGINERING DEGREE (B.ENG) IN ELETRICAL COMPUTER ENGINEERING.

NOVEMBER, 2005.

TABLE OF CONTENT

CONTENT PAGE

DECLARATION

I sincerly declare that, this project work was s completely carried out by me under the able supervision of **Dr. (Mrs.) E. N. ONWUKA** of the Electrica / computer l Engineering Department, Federal University of Technology Minna Niger State.

CERTIFICATION

This is to certify that this project titled **Design and Construction of Frequency Modulation Receiver (FM) with Power park** was carried out by **Yisa Francis Baba** under the supervision of **Dr. E. N. Onwuka** and submitted to Electrical and computer Engineering Department, Federal University of Technology Minna, in partial fulfilment of the requirements for the award of Bachelor of Engineering (B. ENG) Degree in Electrical and computer Engineering.

DR. E. N. Onwuka
Project supervisor

07/12/05
Sign/ Date

ENGR. M. D. Abdullahi
Head of Department

Sign/ Date

Exetrnal Examiner

Sign/ Date

DEDICATION

This Project is dedicated first to Almighy God, to my loverly mother Mrs. Grace L. Yisa who good take care of me and to my late friend Baba N. Ndagi who God call to glory early this year, your demised has left an indelible mark in my life which only God can fill; rest im perfect peace at the bosom of the LORD.

ABSTRACT

The main concept of this design is to incorporated a rechargeable battery into an FM Receiver circuit. This feature allow for long usage of the Receiver during power outage, for a Receiver design do not have such feature, even when its obvious that power supply in Nigeria is unstable.

The circuit is designed with the consideration of minimum component usage, the main integrated circuit is KA 2003, it is embodies everything necessary to Receive a FM signal except Audio Amplifier. Additional circuit is maintain for the automatic charger of the battery. It is simply designed to cut off the battery from excessive charging,

The main integrated circuit is designed to receiver a particular tuned RF signal, which mix it with much closer frequency from the FM oscillator. The result is a stronger frequency called Intermediate Frequency, which is tuned Amplified. The FM demodulator extracts the Audio signal from the carrier wave now the Intermediate Frequency. The Audio signal is amplified through the LM 386. Moreover, the transmitted Audio signal can be from he speaker. The Automatic charging part is designed to sample the voltage of the battery through a LM 399 (Comparator) and it switches off the charging when completed.

The FM Receiver design is very favorable for location with limited power supply duration, so that the charged battery can still provide ample time to enjoy news, sport and other entertainment from the Receiver set.

CHAPTER ONE

1.0 INTRODUCTION

This project is on design and construction of FM receiver with Power Park within a frequency range of 88MHz-108MHz.

A FM receiver selects and recovers the original message from the various radio frequency (RF) signals that was received by the receiving antenna. Preliminary processing in the receiver also includes raising the voltage level of the received weak signal. The recovery of the original message involves demodulation which is the opposite operation of the modulation.

What prompted to this project is the rapid growth of FM radio station in our country, compare to the olden days, and the incorporation of Power Park was due to frequent outage of power supply in our country, to allow long time usage during power outage.

One of the advantages of FM receiver is that it has high signal to noise ratio. FM receivers are fitted with amplitude limiters or filters which remove amplitude variation caused by noise.

The principle of operation of FM receiver is based on the conversion of all incoming Radio frequency to a single INTERMEDIATE FREQUENCY (IF), which is kept fixed as such the amplitude circuits operates with maximum stability, selectivity and sensitivity.

The Radio frequency RF amplifier selects and amplifies the required frequency band signal from the various signals intercepted by the antenna. The amplified radio frequency (RF) signal 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 radio frequency (RF) amplifier and the other is from the lo9cal oscillator signal of frequency F_{LO}.

The local oscillator is a radio frequency (RF) oscillator whose frequency of oscillation can be controlled by varying the capacitance of its capacitor.

Infact, the turning capacitor of the oscillator is ganged with the capacitor of the input circuit, so that the different in the frequency of the selected signal and oscillator frequency is always constant.

The output of the mixer is the sum and the difference signals of frequencies (F_{LO} - F_{RF}) and (F_{LO}+F_{RF}). The function of the INTERMEDIATE FREQUENCY (IF) amplifier is thus to select the difference frequency signal.

$$F_{IR} = F_{LO} - F_{RF}$$

Where, F_{LO} is local oscillator

F_{RF} is Radio frequency

F_{IR} is the Intermediate Frequency

It is also the function of the Intermediate frequency amplifier to further amplify the Intermediate frequency (IF) signal, the intermediate frequency is kept constant by ganged-turning the local oscillator and the radio frequency (RF) amplifier. The local oscillator frequency is preferably chosen to be greater than the radio frequency for the narrower relative turning. The function of the limiter or filter is to remove all amplitude variation caused by the noise from intermediate frequency (IF) signal, which might have crept into the FM signal.

The removal of amplitude variations is necessary, in order to avoid distortion during demodulation. The detector or demodulator carries out the conversion of the Intermediate frequency (IF) signal to audio frequency (AF) signal.

This Audio signal is amplified by the Audio Frequency (AF) amplifier whose output is fed into the loud-speaker which produces the original sound.

FM Receivers operates with a very high frequency (VHF) within the frequency range of 88MHz to 108MHz; it has an Intermediate Frequency of 10.7MHz with a bandpass of (2 x 75 KHz).

The block diagram of FM radio Receiver for radio broadcasting is shown in fig. 1.0

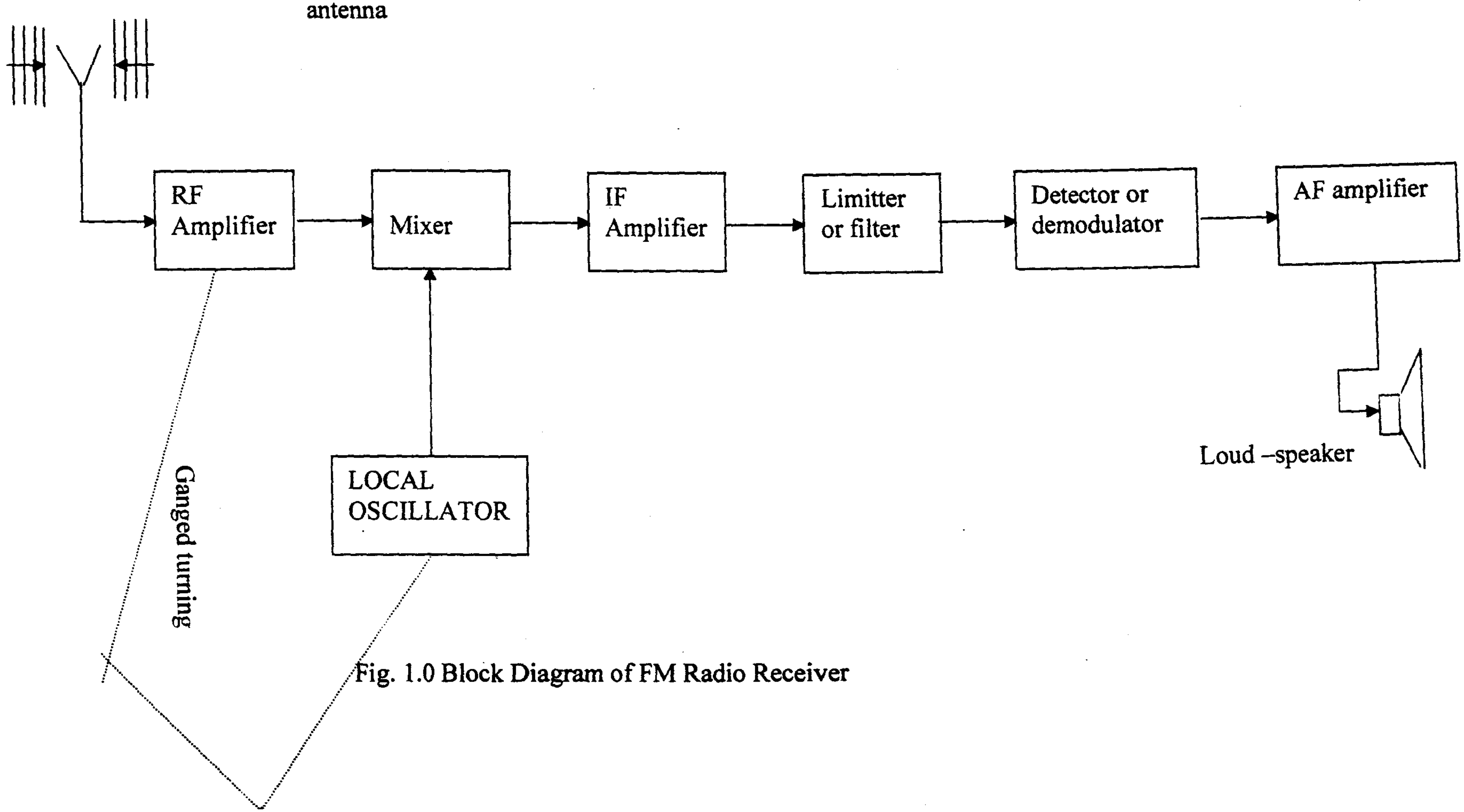


Fig. 1.0 Block Diagram of FM Radio Receiver

1.1 OBJECTIVES

The objective of this project was to design and construct a FM Receiver with Power Park within a frequency range of 88MHz to 108MHz, which is able to select the required Audio radio station (frequency band) out of the numerous modulated radio frequency (RF) signals into Audio frequency (AF) signal.

A good receiver should be able to select "WELL" the required signal and reject "WELL" any unwanted signal.

1.2 MERITS AND DEMRITS OF FM RECEIVER

1.2.0 MERITS

- All transmitted power in FM is useful whereas in AM most of it is in carrier which is not useful.
- It has high signal to noise ratio (S/N). It is due to reasons; firstly, less noise at very high frequency (VHF) band and secondly, FM receivers are fitted with limiters which remove amplitude variations caused by the noise.
- Due to guard band, there is hardly any adjacent channel interference.
- Since only transmitter frequency is modulated in FM only fraction of a Watt of Audio power is required to produce 100% modulation.

1.2.1 DEMERITS

- It requires much wider channel almost 7 to 15times as needed by Am.
- It requires complex and expensive transmitting and receiving equipment.
- Since FM station is limited to only line of sight, area of reception for FM is much smaller than for Am.

1.3 PARAMETER OF RADIO RECEIVER

For a good radio receiver station, certain parameters must be put into consideration, such as sensitivity, selectivity, output power, frequency range of operation and the quality of reproduction.

1.3.0 SENSITIVITY

This is the ability to pick up and reproduce a received weak signal; the sensitivity of a receiver is determined by the value of high frequency voltage fed into the input of the receiver circuit to secure normal output. The lower input voltage, the higher sensitivity.

1.3.1 SELECTIVITY

This is the ability of a radio receiver to pick up the required radio station and reject the unwanted adjacent station. This reduces the interference in the receiver.

1.3.2 WAVELENGHT RANGE

The wavelength range requirements of a radio receiver demand that receiver can be tuned to any radio station within that range.

1.3.3 OUTPUT POWER

This is determined by the level or amount of audio frequency power that the output stage of the receiver delivers to the loud-speaker.

1.3.4 QUALITY OF REPRODUCTION

This is determined by the level of distraction introduced by the radio receiver, the lower the distortion, and the higher quality of reproduction.

1.3.5 OUTPUT VOLTAGE

This is the level of output voltage developed across the loud-speaker.

1.4 CHOICE OF COMPONENT

The choice of the components as in many engineering designs is considered as one of the major factors in carrying out any engineering design. As a result of this, the choice of components for this project was based on many factors which includes;

- Availability of components
- Type of components needed
- Cost effectiveness and marketability
- complexity of the system design
- Reliability of the system design
- maintainability and availability of the system

1.5 PROJECT OUTLINE

This project consist of five chapter, chapter one contain introduction, objective, merits and demerits e.t.c.

Chapter two contains literature review, modern communication system and frequency modulation e.t.c.

Chapter three contains the block diagrams and detail operation of the circuit components. Chapter four contains construction, testing, result, tools used and precautions/problems encountered. Chapter five contains conclusion, recommendations and references.

CHAPTER TWO

2.0 LITERATURE REVIEW

The development of civilization as we know it to be today is largely due to man's ability to exchange information and ideas by the written word using some of accepted language or code. From the very beginning man has constantly searched for means of passing information beyond the normal range of human vision and hearing most people are familiar with such methods as India smoke signals, beacon fires and sewmophole flag signaling.

In Electrical Engineering terms, the term communication refers to sending, processing and reception of information using Electrical means (1). The information or message to be sent, processed and received may take different forms. It could be voice, picture, written message or Electrical signals e. t. c.

A communication system is therefore a technique or a equipment that is used to send, process and receive messages. This may take the form of telephone network, radio link, and optical fibre amongst other (1) (2).

At the end of the nineteeth century, the electron has been discovered and a great deal of experimental work was being done on electromagnetism. Sparks produced by discharges from a leyden jar through an induction coil of wire fitted with a spark gap were found to be reproduced on touching near by metal objects,. This was the first instance of energy transfer over a distance without wires.

Many theories were put forward for these phenomena, but James Clerk Maxwell (1831-1879) was the first to consider magnetic and electric fields together to be responsible and formulated his equations from which he predicted electromagnetic radiation on purely theoretical grounds in 1864. He predicted wave propagation with a finite velocity, which he showed to be the velocity of light (3, 4, 5, 7 and 6).

In 1877, a German Physicist Heinrich Hertz succeeded in producing electromagnetic wave. He also added a loop of wire and increased the distance over which sparks could be transmitted.

A spark detector was produced by a French Physicist called Branley, who noticed that the resistance of a glass tube filled with metal filling, normally high became low when an electric discharge occurred in the vicinity, which could be measured. It was now possible to transmit telegraphy by coding the sparks and using Branley's coherer to receive the sparks over a distance. It is interesting that Branley was the first to use the word "radio" in connection with his experiments.

Guglielmo Marconi was interested in Hertz's experiments and began experimenting in 1895 with a spark induction coil and Branley coherer, and succeeded in sending telegraph messages over a short distance. He traveled to Britain in 1896 to exploit his discoveries with W. H. Prece, Engineering chief of the government telegraph service, and Marconi demonstrated his apparatus to the post office officials over distance of 100metres.

Similar work was being done in Russia and A. S Popov gave a demonstration on 12th March 1896, but was not published until some thirty years later.

Marconi patented his invention in June 1896 and the first radiotelegraph wireless company was formed in 1897 to acquire Marconi's patents and set up manufacturing spark transmitters and Receivers Company. Other manufacturer's such as Siemens and Halske were by the late 1890's, also making radio equipment. By this time, aerials had become long wires raised as high as possible [3, 4, and 6].

Marconi continued to improve his equipment and succeeded in linking England with France by Radio in 1899, and later over longer distances. He also installed equipment on ships for communication between ship and shore. To explain why Radio communication was possible around the curvature of the earth, Heaviside in England and kenelly in America proposed an ionized layer in the upper atmosphere which reflected the waves. This was in 1901 and was know as the Heaviside/Kenelly layer.

Spark transmitters were almost universal for radio telegraph, but they were improved when rotary discharger sets were introduced fed from alternators to give more transmitter powers. Atmospherics were a great enemy. Larger and larger powers were introduced,such as at polhu in Cornwall, operating in 1911 and at the Clifedn in Ireland. In 1912, the sinking of the Titanic focused attention on radio telegraphy as, although over 1500 lives were lost, some 7000 were saved by ships summoned by wireless [3, 6].

The great war of 1914/1918 produced a major change in technology with the introduction of the three electrode tube in quantity, which ultimately resulted in the ending of the spark transmitter era. By 1919, high-power transmitter tubes were being made and the Marconi Company spanned the atlantic by telephony in daylight. The Superheterodyne receiver was in use and provided virtually constant gain and particularly constant selectivity over a wide tuning range. Attempts to make oscillators at much higher frequencies were made, such as the retarded field oscillator by Berkhausen and Kurtz in Germany in 1919 and the negative resistance oscillator by Gill and Morell in the United kingdom in 1902, crystal control of frequency was introduced and the screened grid tube and the pentode improved the performance of Radio receivers, which were made by home constructors in the 1920's.

Frequency standards were set up, first the quartz crystal itself, and then the atomic clock, using the spectral line of ammonia and finally the caesium and rubidium beam magnetic resonance method initially developed in 1939.

The advent of the 1939-1945 war introduced high-sensitivity

Communication receivers used for military purposes, such as the R1155 for the Airforce. The first production communication receiver in wide use was the National HRO of the late 1930's. Post war development benefited from the research which had been done on components and high quality FM Receivers and Hi-Fi amplifiers became available Radio astronomy discovered in 1933 aroused considerable interest and Jodrell Bank was operation in 1951 [6, 4].

The invention of transistor revolutionized radio techniques, with its low voltage and current requirements, leading to cheap and reliable battery power supplies for portable sets. In 1954, the regency transistor was introduced in America printed circuits were widely used with ferrite rod aerials in portable receivers. In 1957, the Russia sputnik satellite was launched and carried a 1-Watt transmitter becoming the fore runner of the modern satellite communication for low-noise amplification, MASERS, PARAMETRIC Amplifiers and cryogenic techniques were used, particularly in satellite signals receivers. Microwave systems were now developed from the earlier oscillators and the traveling wave tube was incorporated in high performance microwave sets. The United State of America launched EXPLORER 1 in 1958 which discovered the van Allen radiation belt. Also in 1958, the first communication satellite was launched in United State of America - the SCORE satellite which transmitted taped messages for 13 days. In 1960, ECHO – 1 was launched as a passive communication satellite, which relayed both voice and TV signal, and the first active repeater communication satellite COURIER – IB was also launched 1960, followed by TELSTAR – 1 in 1962. Since then a series of communication satellites has been launched by many countries, enabling world – wide coverage of radio and TV signals to be achieved.

Integrated circuits were now being used in radio receivers, commencing in the early 1960s, with circuit designs which often used transistors in place of many resistors and capacitors. Improvements in circuit techniques and in packing density and complexity have resulted in modern radio receivers of high performance and great reliability.Large Scale Integration (LSI), Very Large Scale Integration (VLSI), Microprocessor and uncommitted Logic Array (ULA) devices are now used in Radio systems [2, 4, 6].

Spread-Spectrum communication techniques are increasingly being used, particularly for satellite communication. A Spread-Spectrum is one in which the transmitted signal is spread over a wide frequency band. Various modulation techniques are used e. g. digital code sequences (DSK), frequency hopping (which can be also "time hopping or "time – frequency hopping") and chip or frequency sweeping. Because the system is based on coding, privacy is obtained by selective addressing and coding – division multiplexing. There is also freedom from interference.

High- speed converters are now being designed to translate analogue signals into digital data for microprocessor based control system such as high frequency video, radar signal processors e. t. c. The fastest method is know as parallel or flash encoding, where stray capacitances are reduced to a minimum by 1 micron lithography and other techniques [2, 3, 4].

The use of digital data systems in which machines communicate directly with other machines over radio path is increasing rapidly, often because of the improved bandwidth/information rate that can be achieved compared with human beings and the trade – off flexibility that can be achieved through bandwidth and data rate [2, 3, 4].

In the recent years FM Receivers station are popular and many in our society compare to other transmission stations as a result of clear reception it has, and ability to remove all amplitude variation that may be cause by noise, also the guard of channel prevents interference from adjacent channel make FM station more preferable in our country, because everybody likes and appreciate good product.

2.1 MODERN COMMUNICATION STYSTEM

The block diagram of the modern communication system can depicted as shown below.

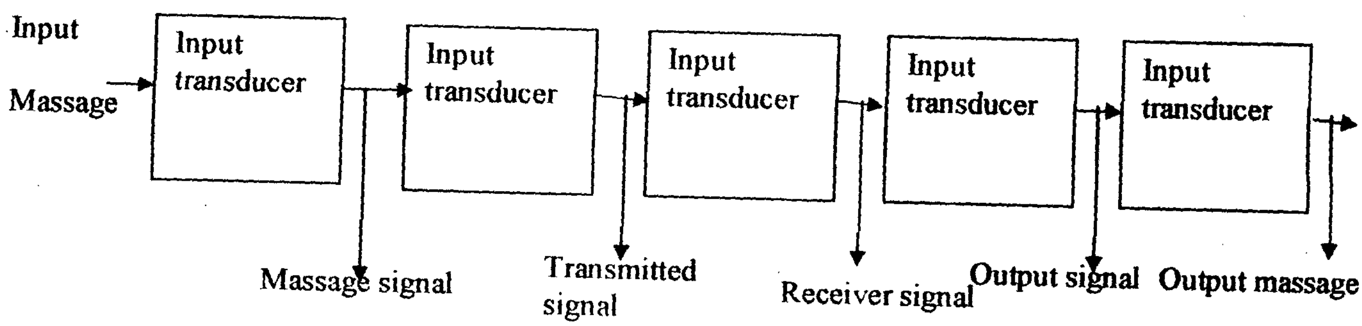


Fig. 1.1 modem communication system.

2.1.0 INPUT TRANSDUCER

The input message which may be analogue or digital must be converted from the original form into an electrical signal to enable it to be processed by the necessary electrical /electronic equipment.

2.2.1 TRANSMITTER

The transmitter, transmits the message through the channel, it is at the transmitter that, if necessary modulation of a carrier wave is carried out by the system. Modulation means modification of one of the parameters (amplitude, Frequency, Phase) of the carrier wave, usually of much higher frequency than that of the message signal. The parameter to be modified or modulated varies from one system to another depending on the system requirements.

2.2.2 CHANNEL

This is the medium through which the transmitted signal gets to the receiver. It may have many different forms, ranging from the ground, underground, overhead cables, sky and space. Therefore, the transmitter can either be wire or non- wire (wireless) to the receiver. A common characteristic of all channels is that the signal passing through them undergoes degradation due to noise, interference, distortion, multiple transmission paths filtering e. t. c.

2.2.3 RECEIVERS

A receiver in a communication system extracts and processed the desired signal from the various received signal at the channel output. The processing function includes conversion of the selected signal to a form suitable for the output transducer. This involves detection or demodulation, filtering and amplification of voltage and/or power, if the received signal level is low.

A good receiver should be able to select the desired signals and reject all unwanted signals.

2.2.4 OUTPUT TRANSDUCER

This is an element or device that converts the electrical output signal of the receiver into a form desired by the user. For example a loud speaker converts electrical signal to sound waves for the user to hear. Among other common transducer are cathode ray tube (CRT), Teletypewriters, meters (analogue or digital) and oscilloscopes.

2.2 FREQUENCY MODULATION

As the mane implies, in this modulation it is only the frequency of the carrier wave that is modified and not its amplitude or phase. The amount of modification in the frequency is determined by the amplitude of the modulating signal whereas rate of modification is determined by the frequency of the modulating signal. In an FM carrier, information is carried as variations in its frequency. Frequency of the modulated carrier increases as the signal amplitude increases, but decreases as the signal amplitude decreases. It is at this frequency signal amplitude has maximum negative value, when signal amplitude is zero; the carrier frequency is at its normal frequency F_O.

Two important points about the nature of frequency modulation are;

- The amount of frequency deviation, shift or variation depends on the amplitude (loudness) of the audio signal. The louder is the sound, the greater the frequency deviation and vice- versa. However, for the purposes of FM broadcasts, it has been internationally agreed to restrict maximum deviation to 75KHz on each side of the centre frequency for sounds of maximum loudness, sound of lesser loudness are permitted proportionally less frequency deviation.
- The rate of deviation depends on the signal frequency.

2.3 NEED FOR FREQUENCY CONVERSION

It is very difficult to design amplifier which give uniformly high gain over a wide range of radio frequencies used in commercial broadcasting stations. However, it is possible to design amplifiers that 0can provide high gain uniform amplification over a narrow band of comparatively lower frequencies called intermediate frequency (IF). Hence, it is necessary to convert the modulated radio frequency (RF) carriers into modulated (IF) carrier by using a frequency converter.

The principle of frequency conversion can be achieved by utilizing the heterodyne principle, for this purpose, the modulated radio frequency (RF) signal is mixed in a Mixer with an unmodulated radio frequency (RF) produced by local oscillator. The oscillator and the Mixer may be either two separate devices or may be combined into a single device called converter. The process of combining two ac signals of different frequencies in order to obtain signal of new frequency is called heterodyning action. During heterodyning two component of frequencies are produced which are the sum component and the difference component of frequencies. The sum is removed by bandpass filtering, whereas the difference frequency, which is called beat frequency, is retained and forms the intermediate frequency in FM Receiver.

2.4 APPLICATION OF FREQUENCY MODULATION

There are four major application of frequency modulation for FM transmission, which are as follows;

- It is used in FM broadcast band (88 -108MHz) with 20 KHz channels in which commercial FM stations broadcast there programmes to their listeners.
- It is used in armatuer band where only voice frequencies are transmitted.

- Frequency modulation is used in TV, though Video signal is amplitude modulated, sound is transmitted by a separate transmitter which is a frequency modulation.
- It is used in mobile or emergency services which transmit voice frequencies (20 – 4000Hz) only.

CHAPTER THREE

3.0 COMPONENTS DESINGN AND ANALYSIS

Just as it is been done in any design and construction layout project, the various component used for the project work has to be properly analyze to give the depth insight of the whole process. This gives better understanding of the project. Most of the components used in this project were according to the conventional value rating standard specification spelled out by the manufacturer from data sheet which does not need to be calculate.

3.1 THE VARIOUS COMPONT USED ARE;

- fm switch
- power indicator
- speaker (1 watt 8 ohms)
- resistors (1k, 210k, 50k and 220 all in ohms)
- crystals 10.7MH
- diodes
- integrated circuit (IC)
- KA 2297
- LM389
- LM 399
- Capacitors
- Rectifier
- Aerial
- Transformer

3.1.0 FM SWITCH

This switch, is used for the reception of fm. it is done by switching the fm mode ON or OFF. When it is OFF reception is deactivated.

3.1.1 POWER IDICATOR.

The power indicator is an LED (light emitting diode) it is connected in series with current limiting resistor. Light emitting diodes are designed for maximum voltage of about 2.3V excess voltage supply could damage the light emitting diode. The series resistor in the power indicator is usually in range of 470 to 1k ohms, if the light emitting diode potential be 2.3V and a supply voltage of 9V. Then, the voltage across the resistor is (9-2.3) =6.7V. The power indicator is shown below.

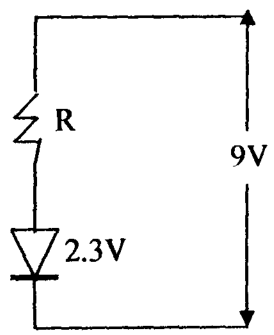


Fig. 2.4 Tuning circuit

From v= IR

R = V/I

Assuming 7mv (conventional rating) is applied to the circuit.

$R = 6/7x10^{-3} = 957$ ohms

957ohms gotten from calculation is within the specified range of 470 to1k ohms.

3.1.2 CRYTAL (10.7MHZ)

The crystal only permits signal at its resonance frequency pass through it to the integrated circuit (IC)

The LC circuit of FM Receiver is shown below.

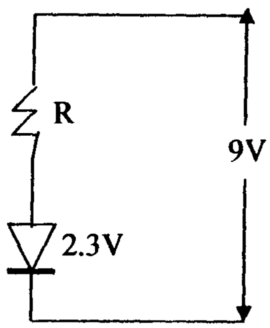


Fig. 2.4 Tuning circuit

The FM RF is a LC circuit. Therefore, any frequency in resonance in with LC tanks is tuned or selected. Only that frequency passes into the integrated circuit.

$F_O = 1/2$

L=2MH

While capacitor(C) is variable from 100uf-350uf

Varying the value of C makes the frequency vary from 88-108MHZ which is the conventional band of commercial FM Radio.

3.1.3 SPEAKER.

The Amplifier AF signal is fed into a loud- speaker which is an output transducer to convert the electrical signal or energy to sound wave. The loud- speaker used in the design is 1Watt, 8 ohms speaker. It employs a moving coil unit composed of the following parts. A con, a front suspension, Alloy mounting voice coil and permanent magnet.

3.1.4 RESISTOR

The resistor used provides a part for the capacitor to discharge when power supply is off. Without the resistor , t5he capacitor will retain its charge for quite along period of time even when the power supply is switch off. The resistor also improves the voltage regulation of the supply. The 10kohms is a current limiting resistor which values ranges from 1K to 100Kohms from specification. The volume control resistor in LM 386 is 50Kohms which is also the conventional value.

3.1.5 RECITIFIER

The rectifier used is the bridge rectifier which is most frequently used in circuit for electronic D.C power supply. It requires four diode but the transformer used is not centre tapped. The rectifier is designed to convert the incoming A.C potential from the transformer to equivalent D.C potential. The rectifier embodies four IN4001 rectifying diodes, one 1000uf 16V electrolyte capacitor. The ceramic capacitors ranging from 0.01uf to 0.47uf are usually used for filtering or smoothen electronic circuit, especially Radio related circuit. The output of the rectifier is usually connected in series with a power switch which is used to turn ON or OFF the device.

3.16 CAPACITOR.

A capacitor essentially consists of two conducting surfaces separated by a layer of an insulating medium called dielectric. The conducting surface may be in form of either circular plate, spherical or cylindrical shape. The purpose of capacitor is to store electrical energy by electrostatic force in the dielectric. The property of a capacitor to store electricity may be called its capacitance (C).

$$C=Q/V$$

Q is the change, while V is the potential difference; the unit of capacitance is coulomb/volt.

1 farad = 1 coulomb/volt.

Variable capacitors are widely used in radio work. Ceramic capacitors of 0.001micro farad to 0.047micro farad are usually used fore filtering or smoothing electronic circuit. Especially radio related circuit. The 0.01micro farad capacitor used is for coupling the output through the volume control resistor to the input of the audio amplifier.

3.1.7 AERIAL

An aerial or antenna is a structure that couples the input of a receiver to space. Either converts high frequency current into electromagnetic waves for radiation (transmitting antenna) or convert electromagnetic wave into high frequency current (receiving antenna). Antenna can be used for either transmission or reception of radio wave or even for both hence, antenna is reciprocal devices.

3.18 TRASFORMER.

A transformer is a static pieces of apparatus by means of which electric power in one circuit is transformed into electric power of the same frequency in another circuit. It can raise or

lower the voltage in a circuit but with a corresponding decrease or increase in current.

The simple element of a transformer consists of two coils having mutual inductance and terminating steel core. The two coils are insulated from each other and the steel core. In all type of transformers, the core is constructed of transformer sheet steel lamination assembled to provide continuous magnetic path with a minimum air gas included. Constructional the transformers are two general types, distinguished from each other by manner which the primary and secondary coils are place around the limited core, the two type are;

1. CORE TYPE.
2. SHELL TYPE.

Another recently development one is spiral core wound–core type voltage transformation ratio

$E_2/E_1 = N_2/N_1 = K$

K is called the voltage transformation

E_1 = Number of EMF in primary winding

E_2 Number of EMF in secondary winding

N_1 = Number of turns in primary

N_2 = Number of turns in secondary.

IF $N_1 > N_2$ i.e. > 1 the transformer is called step-up transformation if $N_1 > N_2$ i.e. k<1 the transformer is called step-down transformation.

For ideal transformer input VA= output VA.

From above deduction, hence the transformer of 220/9V is a step- down which was used for power supply.

3.2 DETAIL OPERATION OF KA2297

KA2297 Integrated circuit is the same as KA2003. KA is manufacture design by Samsung, and the two Integrated circuit serve the same purpose, and therefore due to the unavailability of the KA2003 Integrated circuit (IC), KA2297 was used to replace or served the same of KA2003 on the Vero board. Pin 1 and 2 connected to the antenna circuit for which the manufacturer specification range of 20 to 30pf capacitor is connected across the position and a coil of 3 turns are connected as a RF choke, therefore minimize the Radio frequency signal entering the power supply. Pin 3 is the FM Intermediate frequency (IF) output which was produce from the FM mixer. The mixer of the FM Receiver is designed to mix or beat the incoming from Radio frequency (RF) and the FM local oscillator. Normally the FM Radio frequency has much frequency in space. The oscillator is designed so that at any frequency, the Radio frequency (RF) of the oscillator is always 10.7MHz. When the mixer two frequencies or beat two frequencies together, two additional frequencies are produced which are the sum component and the difference component of the frequencies. The sum is removed by band pass filter, whereas the difference component which is called the beat frequency is retained and forms the Intermediate frequency (IF) in FM Receiver. A beat is attributed to the mixture of two close frequencies. Only 10.7MHz is required as the Intermediate frequency. Therefore, the signal is passed through a 10.7MHz crystal (X1) which filter out only 10.7MHz into Pin 8 which amplification is done on the Intermediate frequency, Pin is the output of the mixer. Pin 10 holds another 10.7MHz FM Intermediate frequency (IF) Crystal for internal amplification of the intermediate frequency.

Pin 15 holds the Radio frequency (RF) selected from the various Radio frequencies intercepted at the antenna which was fed into the mixer. Pin 13 holds the Radio Frequency from the local oscillator which can be varies by varying the capacitance of its capacitor. The turning capacitor of the oscillator is ganged with capacitor of the input Radio frequency circuit, so that the difference in the frequency of the selected signal and oscillator frequency is always constant.

Pin Demodulates the output and Pin 5 has 33uf 16V capacitor as specified by manufacturer to smoothen the internal operation of the Integrated circuit (KA2297). Pin 11 which holds Audio output is connected to a 10Kohms resistor and two capacitor value of 0.01uf. The 10Kohms is current limiting resistor which ranges from 1k to 100Kohms from the specification given by manufacturer. One of the 0.01uf is used for smoothen the Audio output and the other one is used for coupling the output through the volume control rectifier to the input of the Audio Amplifier. The Pin configuration of KA2297 is shown below.

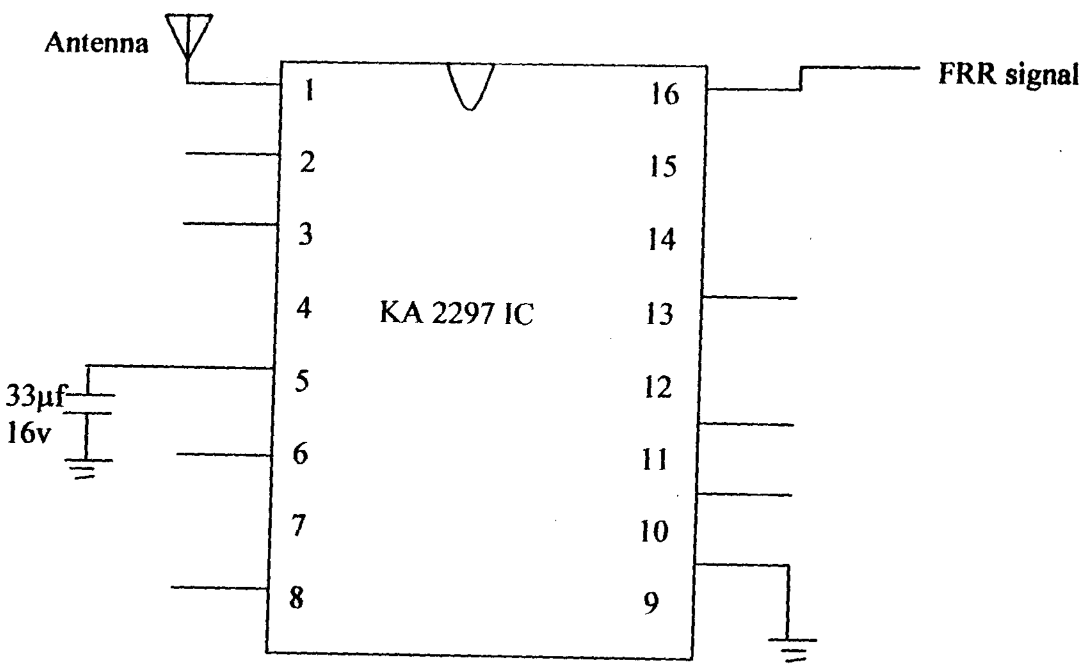


Fig. 2.5 KA 2297 diagram

3.3 DETAIL OPERATION OF LM 386 (IC)

LM 386 (IC) is Audio frequency amplifier which amplifies the Audio output signal coupled into it, through the volume control. The output of the amplifier is then, filter and coupled into loud- speaker.

3.4 CONNECTION OF KA2297 (IC)

The Radio frequency (RF) signal from the antenna circuit was connected to Pin 6, Pin 5 was ground. The output from Pin 5 was connected to the Intermediate frequency filtering circuit before it was connected to Pin 8. The Radio frequency coil is constructed carefully by winding a very thin wire round a ferrite rod while the ganged capacitor was mounted on the Vero board by drilling holes that connects the three legs of the gang capacitor and the nub for turning.

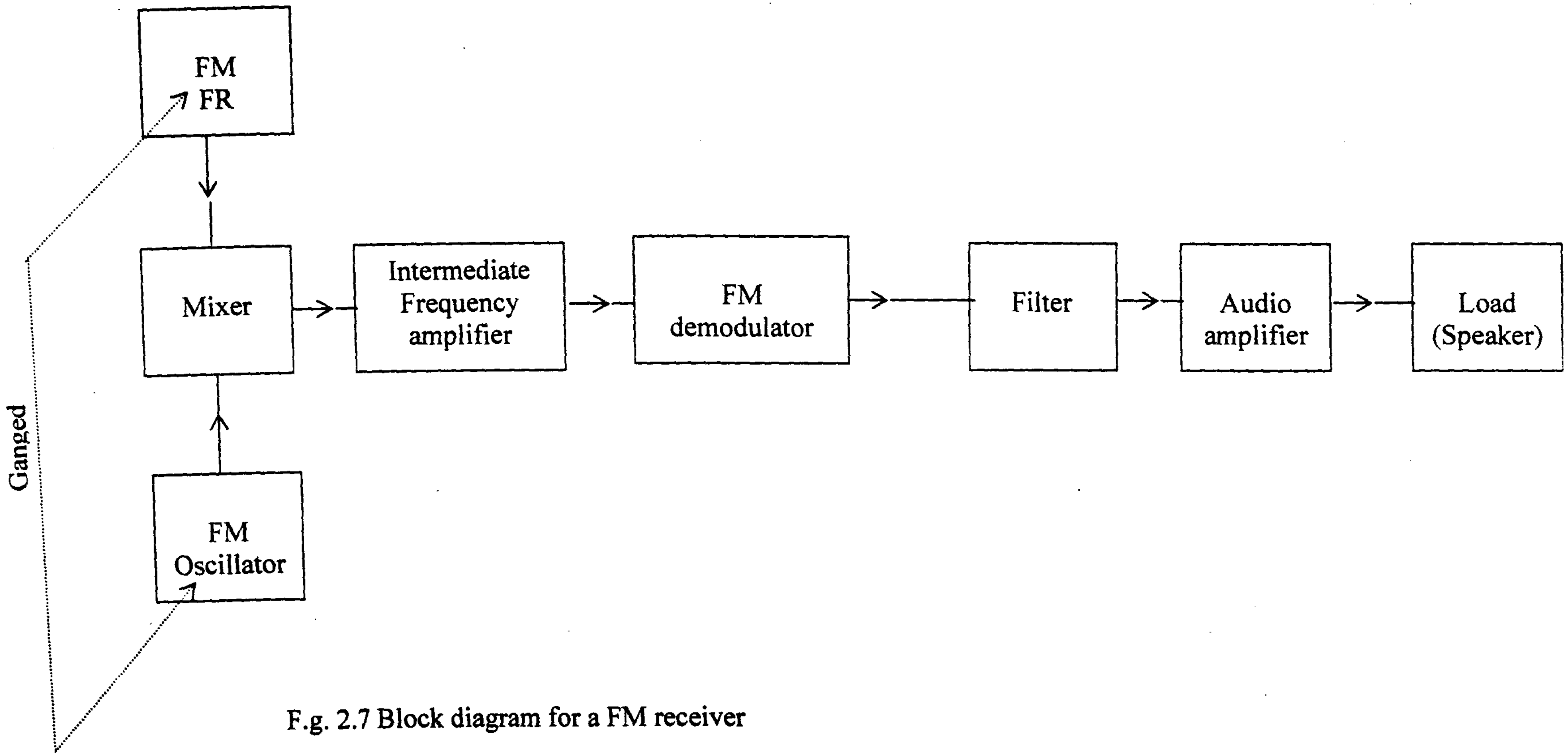
3.5 CONNECTION OF LM 386 (IC)

Pin 3 of the LM 386 (IC) was connected to the positive pole of the source while the Pin 2 was connected to the negative pole. Capacitor 47uf 16V was connected across Pin 1 and 8 to increase the gain of the amplifier. Pin 2, 4 and 7 were grounded while Pin 5 was connected to capacitor for filtering and coupling the output of the amplifier to the loud-speaker. Pin 6 was linked to the power supply which has smoothen capacitor value of 1000uf 16V for smoothen power supply to Audio Amplifier.

3.6 AUTOMATIC CHARGER OPERATION

The automatic charger is designed for regulating or controlling the charging current supply to the battery. It was designed to switch ON the Charging whenever power supply to the transformer rectifier circuit and to automatically switch OFF the charging effect whenever the charging is completed or battery fully charged. The main device used is the LM 399 Comparator. It is designed to compare the level of positive two inputs. They are the Non-Inverting positive (+) and Inverting negative (-) inputs. When the Non- Inverting positive (+) input is having a voltage supply higher than that of the Inverting negative (-) input, the output of the comparator is HIGH logical level, but LOW logical level whenever the situation at the input is reversed. Therefore, whenever the battery is weak the input of the comparator will be low. Because Non- Inverting positive (+) input is lower in voltage compare to the Inverting negative (-) input this is put to 0.7V by a 0.7V Zener diode connection. A suitable relatively low voltage is trapped from the positive terminal of the battery through 10Kohms variable resistor to grade the voltage level of the battery. When the battery is low the Non- Inverting positive (+) terminal is low in voltage compare to the other one. The 2SA733 transistor circuit is to switch required positive link for charging the battery, so that whenever the battery is fully charged the Non- Inverting positive (+) input will be higher than the Inverting negative (-) input. This resulted in the input of the comparator to be HIGH logical level and a relative HIGH voltage level at the base of the PNP Transistor through the base biasing resistor 10Kohms.

Switching OFF the transistor, the Transistor will be cut OFF and there would not be positive charging current to the battery which altered charging operation. The charging effect is restored back whenever the battery is low again. The D5 IN4001 diode is used for blocking current flowing from the transformer/rectifier circuit into battery, but the battery current flows through it.



F.g. 2.7 Block diagram for a FM receiver

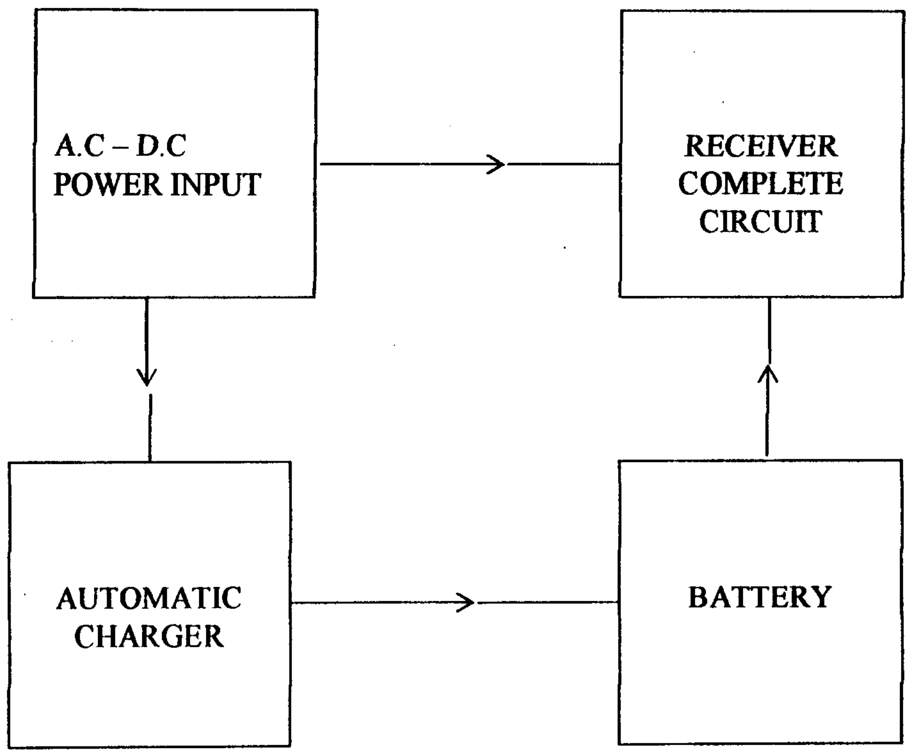


FIG. 2.8 Block Diagram of Power Supply

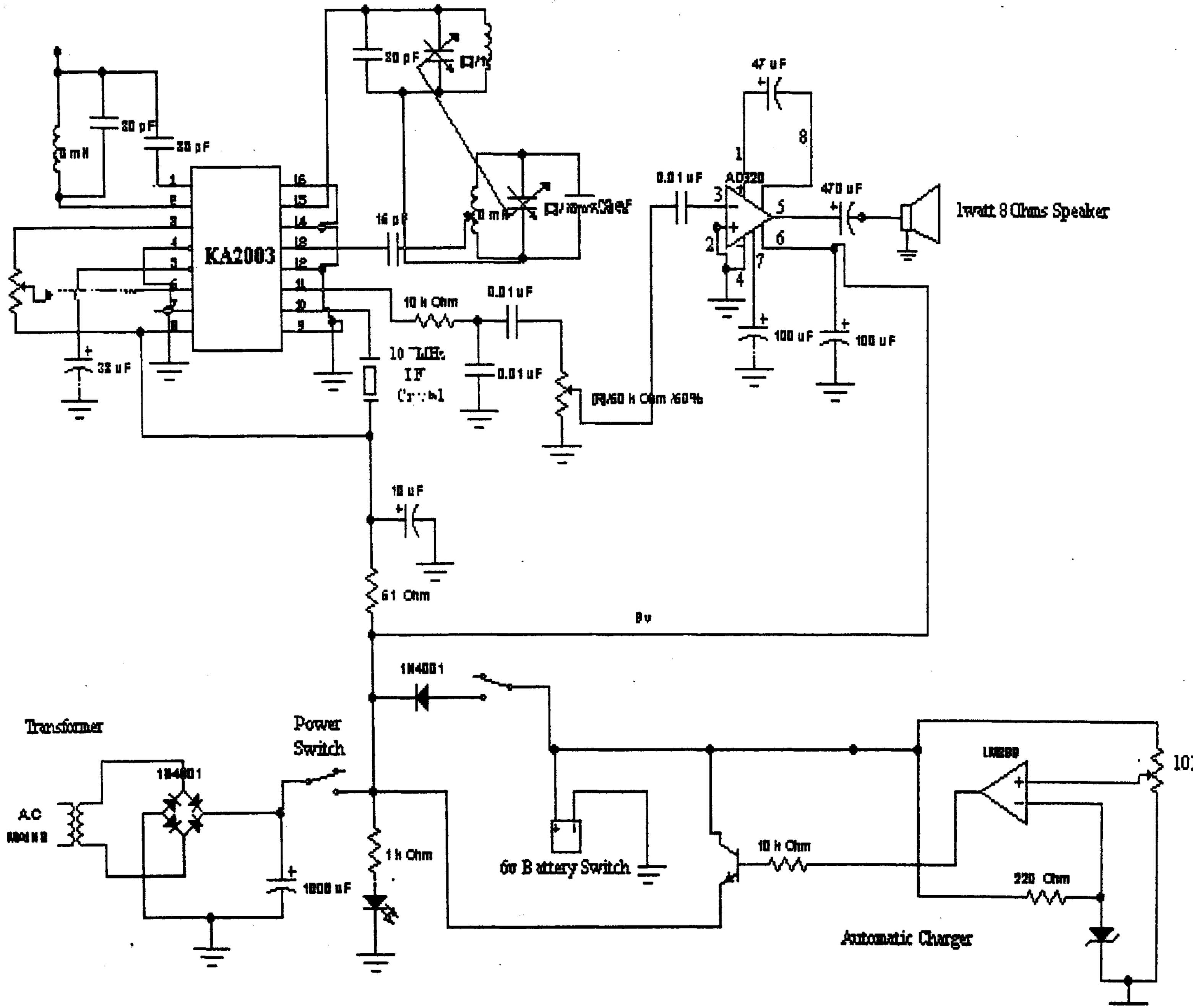


Fig. 2.9 CIRCUIT DIAGRAM

3.8 COMPONENT COSTING

S/No	Component	Quality	Unit price	Amount
1.	RA 2003 IC	1	₦150	₦ 150
2.	LM 399 IC	1	₦150	₦150
3.	LM 386 IC	1	₦150	₦150
4.	Crystal	2	₦150	₦300
5.	Speaker	1	₦100	₦100
6.	Diodes (IN4001)	5	₦5	₦25
7.	Transformer	1	₦120	₦120
8.	Battery (6v)	1	₦600	₦600
9.	1000µf, 16v capacitor	2	₦10	₦10
10.	30pf capacitor	2	₦10	₦20
11	Ganged	1	₦80	₦80
12	Volume control	1	₦100	₦100
13	Batter switch	1	₦50	₦50
14	Resistor	6	₦20	₦120
15	0.01µf capacitor	2	₦10	₦20
16	Zener diode	1	10	₦10
17	Power indicator	1	5	₦5
18	Vero board	1	80	₦80
19	Aerial	1	50	₦50
Total				₦1,840

CHAPTER FOUR

4 .0 CONSTRUCTION

The project construction is the practical aspect, which involves the assembly of components and testing. The project work consists of both the electrics and the casing parts The electronics part consists of audio amplifier, mixer and so on. All these were connected one after the other as designed and analyzed in the designed aspect of the project in chapter three

After all calculation, and the designed was completed, the components with the preferred values were bought, then the components were arranged circuit. While on the break board, the output of electronics part was tested with digital meter and oscilloscope. The oscilloscope displayed the waveform output of each stage.

The power unit was also tested to ensure that the require output voltage is 9v. after FM whole connection on the break board, the FM receiver was tested and it was functioning well then, the stages with the power unit were transferred and solder on the vero-board using soldering iron and soldering lead.

4.1 CONSTRUCTION TOOLS

During the construction of this project, some electronics tools were used. These tools are discussed below:

4.1.0 **Soldering Iron:-** A modular soldering iron with 40w heating element was used c for soldering the components together. A very voltage soldering iron will damage the electronic components

4.1.1 **Soldering Stand:-** This was used for keeping the soldering iron in a safe and upright position the stand is made up of metal and it is constructed so that the bit of soldering iron does not touch any metallic or plastic materials.

4.1.2 **Solder:** Flux-core colder type was used for the soldering of the electronic components.

4. 1.3 **Sponge:-** This was used for occasional clearing of the soldering bit when soldering. The sponge was always kept damp and used to wipe the soldering bit

4.1.4 **Lead-sucker:** This was used for sucking up molten solder. It also removes bad components out of the Vero board.

4.1.5 **Wire Cutters:-** Cutters were used to cut wires to require light and to tip off the excess leg of electronic components after soldering.

4.1.6 **Stripper:-** Wire striper were used to scrip off the insulation from solid or standard hook up wires.

4.1.7 **Digital Meter:-** This was used for quite a number of functions. It performs the following function during the construction of the project.

- It was used to test the continuity of each line on the Vero board.
- It was used to measure the secondary voltage of the 230v/9v transformer
- It was used to know the terminals of the transistor used
- It was used to know the voltage at each stage of the receiver
- It was used also to know value of the colure coded resistors, capacitors and inductors.

4.1.8 **CRT Oscilloscope:** - This was used to know the waveforms at each of the following stages.

- RF stage
- Detector stage
- Output of the audio amplifier stage
- Power supply stage

4.1.9 **Vero Board:-** This allows permanent prototyping of an electronic design. The vero board was pre-etched, therefore the various electronic components were simply soldered in place, using connecting lead and blade to make and break continuity between them, necessary. This is the board which the circuit diagram was built on. All the electronic components were soldered on it using soldering lead

4.2 TESTING

All design work, be it electrical, electronic or mechanical in nature require testing after construction before being commissioned into service, which is why this project work was firstly constructed on the break board for proper testing.

Various testing were performed during construction. T each stage, the project was tested to confirm if the waveform obtained conformed to the target

Also, at the end of construction, the project was tested and it is able to receiver Niger-FM radio with frequency 91.2kHz which is this area. the ability of the receiver to receiver signal from the nearest FM station shows that the receiver work as was planned.

4.3 RESULT

From the tests performed above, I was able to achieved the following results

- The noise was minimized
- The selectivity is high
- The output power the input of the loud-speaker
- The sensitivity is also high
- The level of distortion is low

4.4 PRECAUTION TAKEN DURING CONSTRUCTION

- The Breadboard was extensively used for testing before construction
- The vero board was carefully checked and tested for continuity
- Care was taken during soldering of the components to avoid overheating of the components
- Off-target solder splashes were carefully removed to avoid short circuiting
- Re-checks were made more often to ascertain the right position of components.
- The power supply unit was normally or removing components of discrete components such as transistor were ensured with multi-meter before they were finally soldered on the vero board
- Due to high frequency involved in the circuit the soldering was made very small to minimized interference

4.5 CASING

The casing of the radio receiver was based on the size of the fabrication components. The design was made to accommodate the speaker, length of the fabricated components, power supply unit and aerial.

4.6 PROBLEMS ENCOUNTERED

The following problem was encountered during construction of the project and it design.

1. In designing, the problem of getting the appropriate materials to study the behaviors of electronics components and how they can be connected manner was encountered.
2. The unfamiliarity with the electronic work bench made it difficult and took me a lot of time to design my circuit diagram
3. The materials used are quite scarce, it took me a lot of time to be able to get, and as a result of this, some components have to be replaced with it equivalent replacement specified in the data sheet.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The project thesis has explained in details the design and construction of FM Receiver with power park. The test and result of the receiver is very good and dependable

The project exposes me to design of electronic circuit and behaviour of electronic component used. The design and construction of this project did not exempt problem. Various problem were encountered in the course of design and most especially construction aspect of this project due to the fact that the practical experience I had about electronic is so little and their behaviour which encompasses my problem, but with constant research the problems handled accordingly.

5.2 RECOMMENDATION

1. The department should organize programmes that will expose student is practical experience
2. Student should be taught how to analyze circuit and how to solder and desolder on the vero board.
3. Electronic design textbook should be made available to students fore us during practical work and most especially project work.
4. Electronic tools and equipment should be made available in the department laboratory for students to use during project and practical work

Finally, I recommend this work that is very good, reliable for use and affordable.

REFERENCES

[1] Adediran Y. A (1997) "Telecommunication Principle and system" FINON ASSOCIATES MINNA

[2] THERAJA B. L. (1999) "Electrical technology" Nirja Construction and development Co-Ltd.

[3] Donald A. N (1996) "Electronics circuit Analysis and design" Mc Graw Hill, Boston.

[4] Harry K. (1979) " Electronics" John willey and sons, New yorks.

[5] GREEN D. C (1988) "Electronics (4th Edition)" ELBS KWALA Lumpus (Malaysia).

[6] G. W. A DUMMER, " Electronic Inventions and Discoveries, 3RD REVISED and Expanded Edition" (Electronics from its earliest beginning to the present day).

[7] YINUSA A. ADEDIRAN (PH. D) " Applied Electricity".