

# **DESIGN AND CONSTRUCTION OF A RADIO WAVE REMOTE CONTROL SWITCH**

**BY  
ABDULL-AZEEZ M. SHETTIMA**

**MAT.NO: 2000/11145EE**

**DEPARTMENT OF ELECTRICAL/COMPUTER ENGINEERING,  
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY**

**FEDERAL UNIVERSITY OF TECHNOLOGY  
MINNA,**

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT FOR THE  
REQUIREMENTS FOR THE AWARD OF BACHELOR DEGREE IN  
ENGINEERING (B.Eng) IN ELECTRICAL/COMPUTER  
ENGINEERING,**

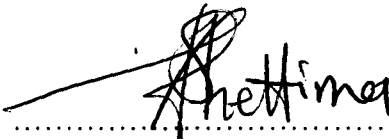
**FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.**

**NOVEMBER, 2005**

## DECLARATION

I hereby declare that this project work is an original work of mine and has never been presented in any form for the award of Bachelors degree or diploma certificate.


All information derived from published and unpublished works have been acknowledged.

  
.....  
ABDULL-AZEEZ M. SHETTIMA  
2000/11145EE

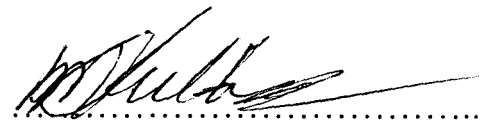
06/12/05  
.....  
DATE

# CERTIFICATION

This is to certify that this project work was carried out by ABDULL-AZEEZ M. SHETTIMA of the Department of Electrical /Computer Engineering of the Federal University of technology Minna under the supervision of Engr. Rumala.

  
Engr. S.N. Rumala  
(Project Supervisor)

12/12/05  
Date

  
Engr. M. D. Abdullahi  
(Head of Department)

16/02/06  
Date

.....  
External Examiner

.....  
Date

## DEDICATION

This project is heartily dedicated to Almighty (ALLAH) for his blessing, mercies and for sparing my life and also making it possible for me to complete the Degree programme.

## ACKNOWLEDGEMENT

My gratitude goes to ALMIGHTY (ALLAH) for His Mercy, Blessing, protection, guidance and since my day one on this earth to this time.

My unreserved gratitude goes to my project supervisor Engr. Rumala who has been generous in his assistance and guidance has checked the manuscript for accuracy despite his busy academic programme.

My appreciation to my mother (Hajiya Fatima) and my father (Alhaji Mohammed Shettima) for their maternal and paternal support and care.

I acknowledge the contribution and support of all my brothers and sister especially Suleman, Bagudu, and Adama, Shettima's.

## ABSTRACT

Over the years, the use of a remote to operate gates, garage doors, security alarm system and electronics devices has become widespread in industries and construction has increase in satisfaction and style.

This project work is base on the design and construction of a radio wave remote control switch. This was achieved by the design and construction of the transmitter and the decoder circuit which consist of multi-vibrator, power amplifier, modulator, transistor switch D type flip-flop etc.

## TABLE OF CONTENT

|                       |     |
|-----------------------|-----|
| TITLE PAGE.....       | i   |
| DECLARATION.....      | ii  |
| CERTIFICATION.....    | iii |
| DEDICATION.....       | iv  |
| ACKNOWLEDGEMENT.....  | v   |
| ABSTRACT.....         | vi  |
| TABLE OF CONTENT..... | vii |

### CHAPTER ONE

|  |   |
|--|---|
| 1.0 INTRODUCTION.....                  | 1 |
| 1.1 THE HISTORY OF REMOTE CONTROL..... | 2 |
| 1.2 OBJECTIVE AND MOTIVATION.....      | 3 |
| 1.3 PROJECT DESCRIPTION.....           | 3 |

### CHAPTER TWO

|   |   |
|---|---|
| 2.0 LITERATURE REVIEW.....                          | 5 |
| 2.1 FIRST TV REMOTE CONTROL.....                    | 5 |
| 2.2 DEVELOPMENT CHALLENGES.....                     | 6 |
| 2.3 THE BIRTH OF SPACE COMMAND.....                 | 6 |
| 2.4 QUARTER CENTURY OF ULTRASONIC REMOTES.....      | 7 |
| 2.5 TODAY'S INFRARED REMOTE CONTROLS.....           | 7 |
| 2.6 SOME ACHIVEMENTS IN REMOTE CONTROL SYSTEMS..... | 8 |

### CHAPTER THREE

|  |    |
|--|----|
| 3.0 DESIGN AND CONSTRUCTION OF RADIO WAVE REMOTE CONTROL SWITCH..... | 10 |
| 3.1 THE CIRCUIT OPERATION.....                                       | 10 |
| 3.2 DESIGNING OF THE TRANSMITTER SECTION.....                        | 11 |
| 3.3 DESIGNING OF TRANSMITTER.....                                    | 12 |
| 3.4 THE MULTI-VIBRATOR.....  | 13 |

|  |    |
|--|----|
| 3.5 CONSTRUCTION OF MULTI-VIBRATOR.....          | 14 |
| 3.6 DESIGNING OF THE TRANSMITTER.....            | 16 |
| 3.7 OSLILATION IN THE LC CIRCUIT.....            | 17 |
| 3.8 DESIGN AND ANALYSIS.....                     | 18 |
| 3.9 POWER AMPLIFIER.....                         | 19 |
| 3.10 DESIGN AND ANALYSIS OF POWER AMPLIFIER..... | 20 |
| 3.11 ANTENNA.....                                | 20 |
| 3.12 POWER SUPPLY.....                           | 21 |
| 3.13 THE DECODER SECTION.....                    | 22 |
| 3.14 THE POWER SUPPLY UNIT.....                  | 23 |
| 3.15 GENERAL DESCRIPTION OF THE DECODER.....     | 25 |
| 3.16 FEATURES OF LM 567.....                     | 26 |
| 3.17 DESIGNING OF THE DECODER.....               | 27 |

#### **CHAPTER FOUR**

|  |    |
|--|----|
| 4.0 CONCLUSION AND RECOMMENDATION..... | 30 |
| 4.1 CONCLUSION.....                    | 30 |
| 4.2 RECOMMENDATION.....                | 30 |
| 4.3 ACHIEVEMENT.....                   | 31 |
| 4.4 TESTING AND PROCEDURE.....         | 31 |
| 4.5 SUGGESTION.....                    | 31 |
| REFERENCE.....                         | 33 |



# CHAPTER ONE

## 1.0 INTRODUCTION

With the increase in development in science and technology, man in conscious effort to better our society began to evolve contrivance from relatively new discoveries. It is difficult to imagine what modern life would look like without an access to reliable, economical efficient means of communication.

Communication means converging or transmission of information from one place to another. In this design, emphasis would be on transmission and controlling Engineering.

Remote control is the ability to control an object or device without physically contacting the device. Remote control devices or systems enable an operator to handle, work or manipulate an object while being separated from it. This may be necessary because the object is out of reach, and in under water salvage work or as in space vehicles, or because it is dangerous to approach the material being handled, due to radioactivity or toxicity or because the objects may be suspected of containing explosives.

Remote devices are in recent times used simply for convenience as in the remote controls of mullet-purpose television and video sets. In certain cases this device serves to enhance security systems.

There are three essential components in a remote control system;

- A controlling quantity
- A transmission medium
- A controlled quantity

## 1.1 THE HISTORY OF REMOTE CONTROL

The earliest cases of remote control involved the handling and transfer of radio chemicals from one safe container to another-long reaches, which are just an extension of normal reach with tongs at the end could suffice, where partial shielding was employed to protect the operator from the chemical substance.

In the handling of radioactive substances however, where the work required full radiation shielding, it was usually to employ tool mounted on straight rods passing through ball and socket joints into the cell wall. The operator actuates the tool by a piston-grip handle, and by moving this; he can move and operate the tool at will, anywhere within the shielded area.

Where separation between the operator and work is greater, as in heavily shielded radioactive work, master-slave systems are used. These reproduce the movement of the operator hand via a slave tool head in the radiation area. Where distance between the operator and the work is very large, more advanced remote control systems are required. These use electronic or fluidic controls, and are being developed for a very large variety of applications.

For example, a space shuttle has a 50ft articulated arm with elbow and wrist movements for manipulation of payloads by the operator on the orbit flight deck. The need for the control of objects when separated by large distance from the operator brought about the means to achieve such control without making any physical contact with the object to be controlled. Today this technology has given rise to the remote control of gadgets such as Television sets video machines, cassette players etc.

## 1.2 OBJECTIVE AND MOTIVATION

The aim of this project is to design and construct a remote radio control switch in a building. This building could be residential, commercial or industrial. This remote control switch could serve as: -

- 1 Alleviate the inconvenience of walking to a switch wherever it is situated.
- 2 Enhance safety especially in industrial buildings
- 3 Enhance security: In market today are some intruder's alarms that go off once an intrusion is sensed.
- 4 Aid to individuals not tall enough to reach the location of a switch, the means to operate it.
- 5 Low cost, as this frequency is much less costly to generate than infrared rays.
- 6 The ability to use beyond the line of sight mode.

## 1.3 PROJECT DESCRIPTION

This project is design based on the principle of using F.M radio wave signal to control an electric switch. The circuit consist of one (1) tone decod, the transistor switch, the D- flip-flop, the relay, the radio receiver, the astable mutivibrator, the transmitter and the power source.

The power source: The transmitter is powered using D.C. power source for portability, the tone decodes, the transistor switches, the D- flip-flop, and the relay is powered by the PHCN power supplied.

The receiver is F.M superhedrodyne radio, through already constructed (not designed as part of the project work). The receiver is turned to the hand held transmitter oscillating frequency and it demodulates the carrier wave at it's demodulated output are the tune decoder to convert the audio tones to control the logic.

The tuned decoder IC that has high/low logic output. The output goes low when a sustained frequency that is at the same frequency as the on chip reference oscillator is present at the input, the logic output D FF- chip.

The transmitter is a low-power two transistor R.F oscillator with a modulating analogue audio signal applied into its base to modulate the collector-base capacitance to produce generated astable oscillator. of F.M R.F signal wave. The R.F transmitter is modulated by audio tones

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

The first machines to be operated by remote control were used mainly for military purposes. Radio-controlled motorboats, developed by the German navy, were used to ram enemy ships in WW I. Radio controlled bombs and other remote control weapons were used in WW II.

Once the wars were over, United States scientists experimented to find nonmilitary uses for the remote control. In the late 1940's automatic garage door openers were invented, and in the 1950's the first TV remote controls were used.

### 2.1 FIRST TV REMOTE CONTROL

The first TV remote control, called "Lazy Bones," was developed in 1950 by Zenith Electronics Corporation (then known as Zenith Radio Corporation). Lazy Bones used a cable that ran from the TV set to the viewer. A motor in the TV set operated the tuner through the remote control. Although customers liked having remote control of their television, they complained that people tripped over the unsightly cable that meandered across the living room floor.



#### Flashmatic: The First Wireless TV Remote

Zenith engineer Eugene Polley invented the "Flashmatic," which represented the

industry's first wireless TV remote. Introduced in 1955, Flashmatic operated by means of four photocells, one in each corner of the TV cabinet around the screen.

While it pioneered the concept of wireless TV remote control, the Flashmatic had some limitations. It was a simple device that had no protection circuits and, if the TV sat in an area in which the sun shone directly on it, the tuner might start rotating.

## **2.2 DEVELOPMENT CHALLENGES**

Zenith management loved the concepts proven by Polley's Flashmatic and directed his engineers to develop a better remote control. First thoughts pointed to radio. But, because they travel through walls, radio waves could inadvertently control a TV set in an adjacent apartment or room.

Using distinctive sound signals was discussed, but Zenith engineers believed people might not like hearing a certain sound that would become characteristic of operating the TV set through a remote control. It also would be difficult to find a sound that wouldn't accidentally be duplicated by either household noises or by the sound coming from TV programming.

## **2.3 THE BIRTH OF SPACE COMMAND**

Zenith's Dr. Robert Adler suggested using "ultrasonic," that is, high-frequency sound, beyond the range of human hearing. He was assigned to lead a team of engineers to work on the first use of ultrasonic technology in the home as a new approach for a remote control.

The transmitter used no batteries; it was built around aluminum rods that were light in weight and, when struck at one end, emitted distinctive high-frequency sounds. The first such remote control used four rods, each approximately 2-1/2 inches long: one

for channel up, one for channel down, one for sound on and off and one for power on and off.

They were very carefully cut to lengths that would generate four slightly different frequencies. They were excited by a trigger mechanism -- similar to the trigger of a gun -- which stretched a spring and then released it, so that a small hammer would strike the aluminum rod. The device was developed quickly, with the design phase beginning in 1955. Called "Zenith Space Command," the remote control went into production in the fall of 1956.

#### **2.4 QUARTER CENTURY OF ULTRASONIC REMOTES**

The original Space Command remote control was expensive because an elaborate receiver in the TV set, using six additional vacuum tubes, was needed to pick up and process the signals. Although adding the remote control system increased the price of the TV set by about 30 percent, it was a technical success and was adopted in later years by other manufacturers.

In the early 1960s, solid-state circuitry (i.e., transistors) began to replace vacuum tubes. Hand-held, battery-powered control units could now be designed to generate the inaudible sound electronically. In this modified form, Dr. Alder's ultrasonic remote control invention lasted through the early 1980s, a quarter century from its inception.

#### **2.5 TODAY'S INFRARED REMOTE CONTROLS**

By the early 1980s, the industry moved to infrared, or IR, remote technology. The IR remote works by using a low frequency light beam, so low that the human eye cannot see it, but which can be detected by a receiver in the TV. Zenith's development of cable-compatible tuning and teletext technologies in the 1980s greatly enhanced the capabilities and uses for infrared TV remotes.

Today, remote control is a standard feature on other consumer electronics products, including VCRs, cable and satellite boxes, digital videodisc players and home audio receivers. And the most sophisticated TV sets have remotes with as many as 50 buttons.

Zenith developed the world's first wireless trackball TV remote control, called Z-Trak. The remote works like a computer mouse - click the ball and a cursor appears on the TV screen. Roll the ball and the cursor activates control menus hidden in different corners of the screen. Then, activate something from those menus - bass, treble, contrast, color temperature, channel... whatever.

Manufacturers used to only make remote controls that operated one TV set. However, they are now making universal remote controls that can operate any TV set. Experts predict that someday remote control will control every device in the home.

## **2.6 SOME ACHIVEMENTS IN REMOTE CONTROL SYSTEMS**

- In 1999, more than 99 percent of all TV sets and 100 percent of all VCRs sold in the U.S. are equipped with remote control.
- More than 9 million ultrasonic remote control TVs were sold by the industry during the 25-year reign of Dr. Adler's invention.
- Zenith sales people were against using batteries in the remote control. In those days, batteries were used primarily in flashlights. If the battery went dead, the sales staff said, the customer might think something was wrong with the TV.
- Early remote controls were expensive because an elaborate receiver in the TV set, using six additional vacuum tubes, was needed to pick up and process the



signals. Adding a remote control system increased the price of the TV set by about 30 percent.

- Zenith's Dr. Rober Adler has more than 180 patents.

## CHAPTER THREE

### 3.0 DESIGN AND CONSTRUCTION OF RADIO WAVE REMOTE CONTROL SWITCH.

#### 3.1 THE CIRCUIT OPERATION

The circuit works on the basic principle of decoding an audio tones produced by an oscillator whose output (tones), modulate a short range F.M. R.F. oscillator.

For simplicity the project work was been broken down into three different sections:

- (1) Receiver
- (2) Transmitter
- (3) Decoder

**(1) THE RECEIVER:** of a F.M. superhetrodyne radio, though already constructed i.e, not design as part of the project work. The receiver is turned to the hand-held transmitter oscillating frequency and demodulate the wave, its demodulate output is the tone decoder to convent the audio tone to a control logic.

**(2) TRANSMITTER:** the transmitter is a low-power two transistor R.F. oscillator with a modulating analog audio signal applied into its base to modulate the collector-capacitance to produce in F.M. R.F. signal wave.

The R.F. transmitter is modulated by tone decoder (1 KHz) generated by an astable oscillation.

The tone is presented to the decoder connected to a radio receiver to translate the tone into command signal.

**(3) THE DECODER:** is an integrated circuit with a high\low logic output. Their output of the decoder goes low when a sustained frequency that is at the same frequency as the on chips reference oscillator is present at the output.

### 3.2 DESIGNING OF THE TRANSMITTER SECTION

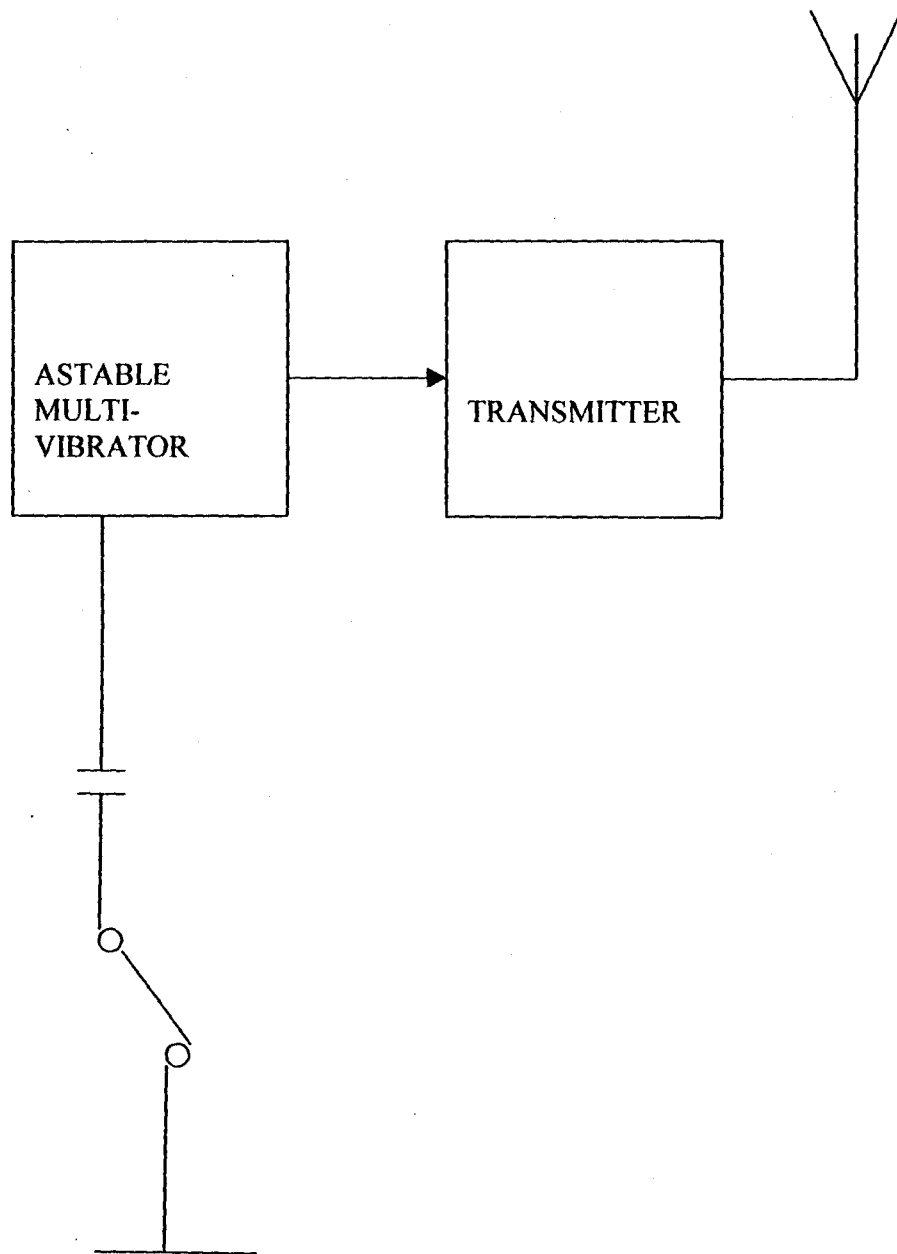
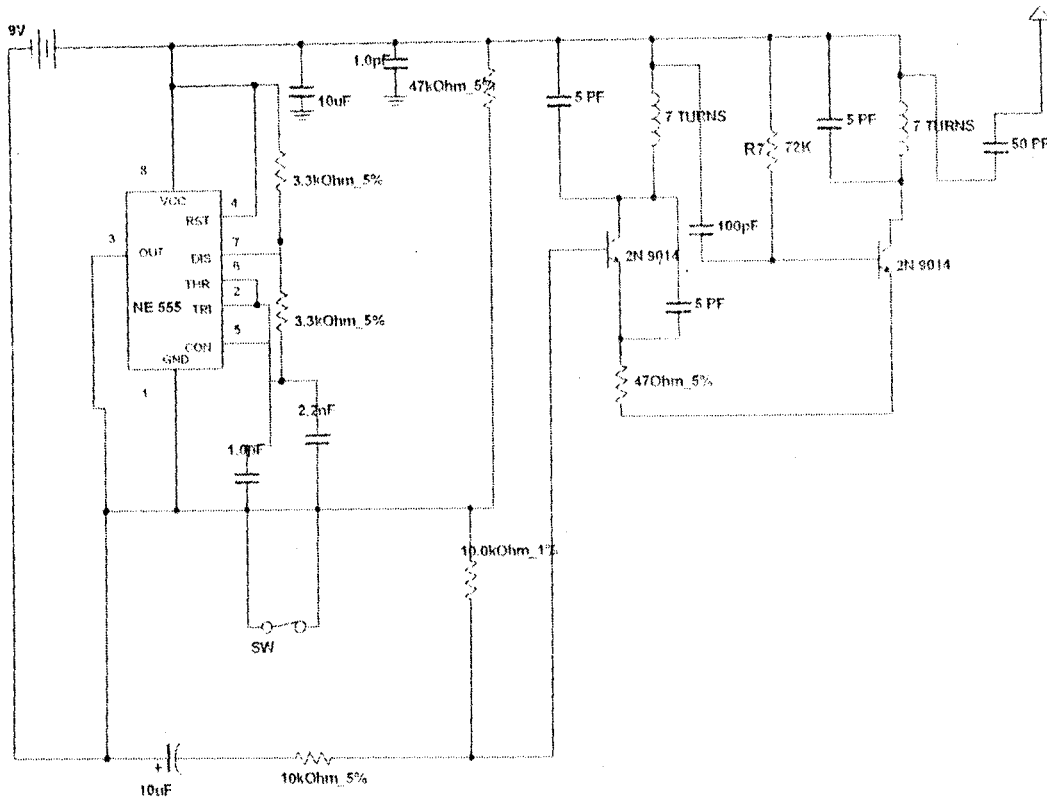


FIG 3.1 BLOCK DIAGRAM OF THE TRANSMITTER



**FIG.3.2 CIRCUIT DIAGRAM OF THE TRANSMITTER**

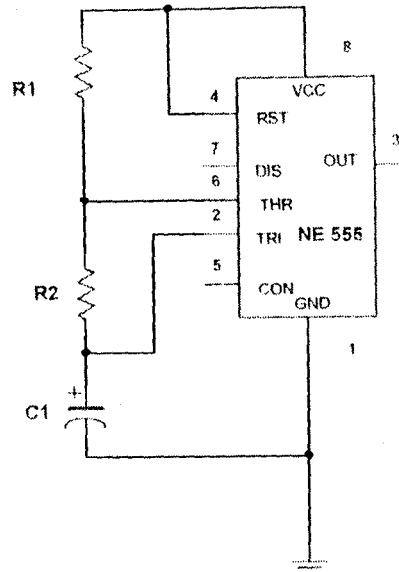
### 3.3 DESIGNING OF TRANSMITTER

The transmitter is a short range R.F oscillator with a set centre frequency determined by the values of the inductance and capacitance that form resonant tank circuit in the collector of a 2N 9014 high frequency oscillator

The transmitter section consists of the multi-vibrator, the modulator, the frequency power amplifier, and the antenna.

### 3.4 THE MULTI-VIBRATOR

The multi-vibrator use in this project is a NE 555 multi-vibrator connected in an astable mode as shown fig.3.3 shown below.

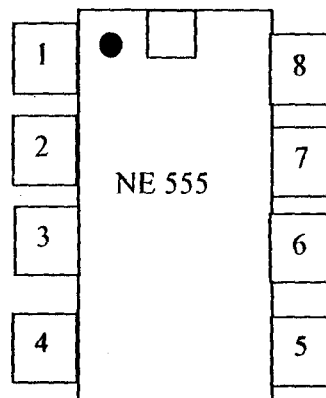


**FIG 3.3 NE555 CONNECTED IN ASTABLE MODE**

Here pin 2 and 6 are connected so that the circuit will trigger itself each timing cycle, thereby function as an oscillator.  $C_T$  charges through  $R_1$  and  $R_2$  but discharges from  $1/3 V_{cc}$ . The oscillation frequency is independent of  $V_{CC}$ .

| FUNTION   | 555PIN |
|-----------|--------|
| GROUND    | 1      |
| TRIGGER   | 2      |
| OUTPUT    | 3      |
| RESET     | 4      |
| CONTROL V | 5      |
| THRESHOLD | 6      |
| DISCHAGE  | 7      |
| Vcc       | 8      |

**(a) FUNCTION OF EACH PIN**



**FIG 3.4 (b) 555 PIN OUTLINE**

### 3.5 CONSTRUCTION OF MULTI-VIBRATOR

The circuit of the 555 astable oscillator is shown in fig.3.4 as shown below, with the relevant data related to its operation.

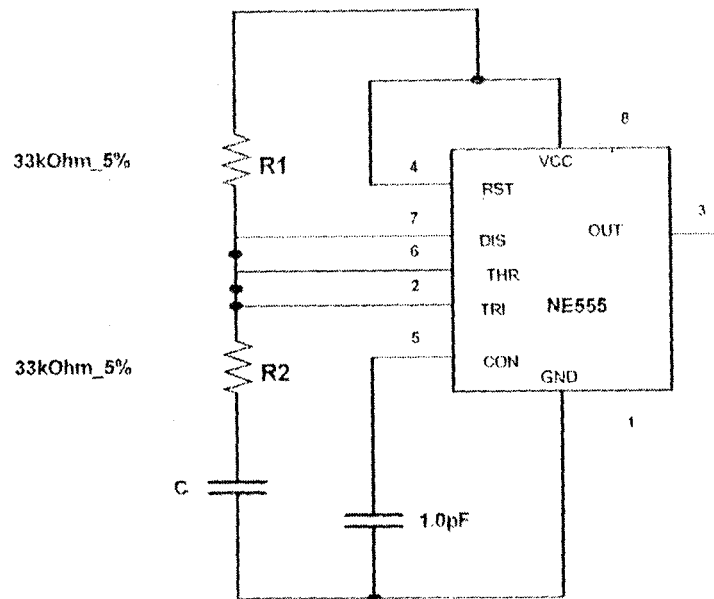


FIG 3.5 MULTI-VIBRATOR CONNECTED IN ASTABLE MODE.

The Frequency generated by the oscillator is ( $F_{OSC}$ ) set by:

$$F_{osc} = \frac{1.44}{0.693 (R_1 + 2R_2) \times C_T}$$

In the project work one audio tone 1kHz is chosen to provide the control signal.

Inserting the value of R1 AND R2 devised frequencies in the above expression yield

$$1000 = \frac{1.44}{0.693(99,000) \times C_T}$$

$$\therefore C = 21\text{nf}$$

The nearest standard value of 22nf was selected with adjustment to be made on the decoder circuitry.

Since only one tone can be generated by the oscillator at any time, determine by the value of the connected  $R_T / C$  a means of generating the required tone will be devised. The value of the capacitance is keyed into the circuit through one normally open and closed switch as in the fig 3.6 shown below.

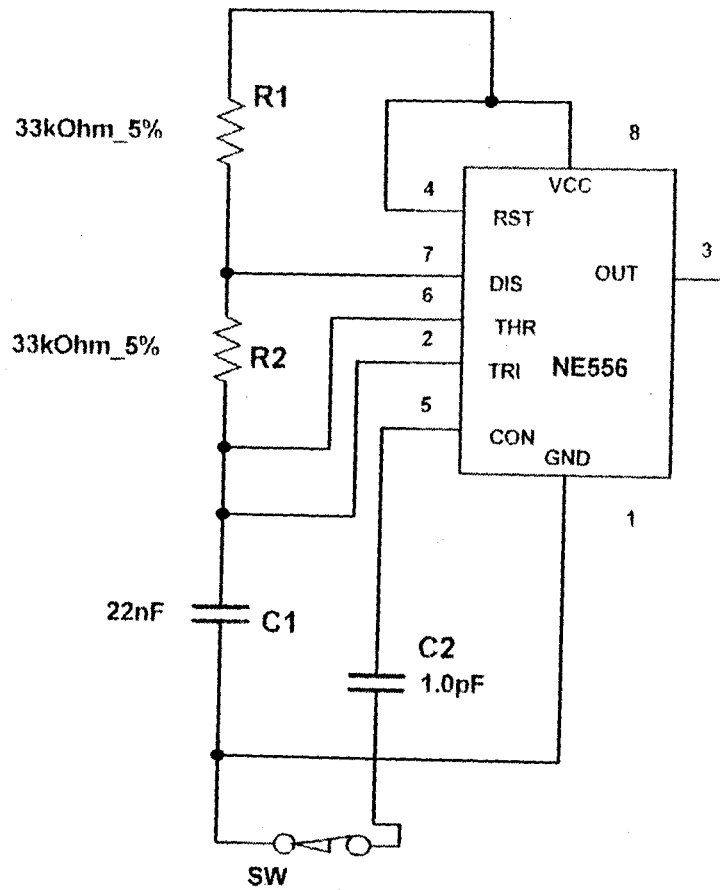


FIG. 3.6 555 MULTI-VIBRATOR SWITCH

The Capacitance is switched as shown above with the switch open, there is no capacitance connected in the circuit, and hence no oscillation and the output (pins 3) is in it's low state.

When the switch is depressed, the capacitance connected to the switch is taken to ground through the mechanical contact, and the tone incorporated in the astable circuit, the oscillator now oscillates at that very Frequency determined by the  $R_T / C$ .

The output of the astable is fed to into the base – emitter circuit of RF oscillator through in attenuator pad depicted in the fig.3.7 as shown below.

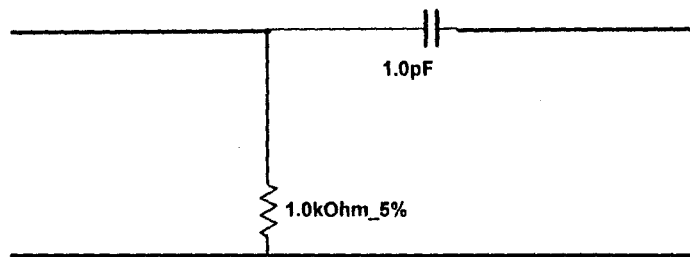


FIG .3.7 ATTENUATOR PAD

Attenuator is need to prevent overloading the transmitted, and since the tone decode is very sensitive, only little of tone energy is needed to active it.

### 3.6 DESIGNING OF THE TRANSMITTER

The main elements of the transmitter include the R.F oscillator the R.F power amplifier, and the antenna. The block diagram of the transmitter in fig.3.8 shown below



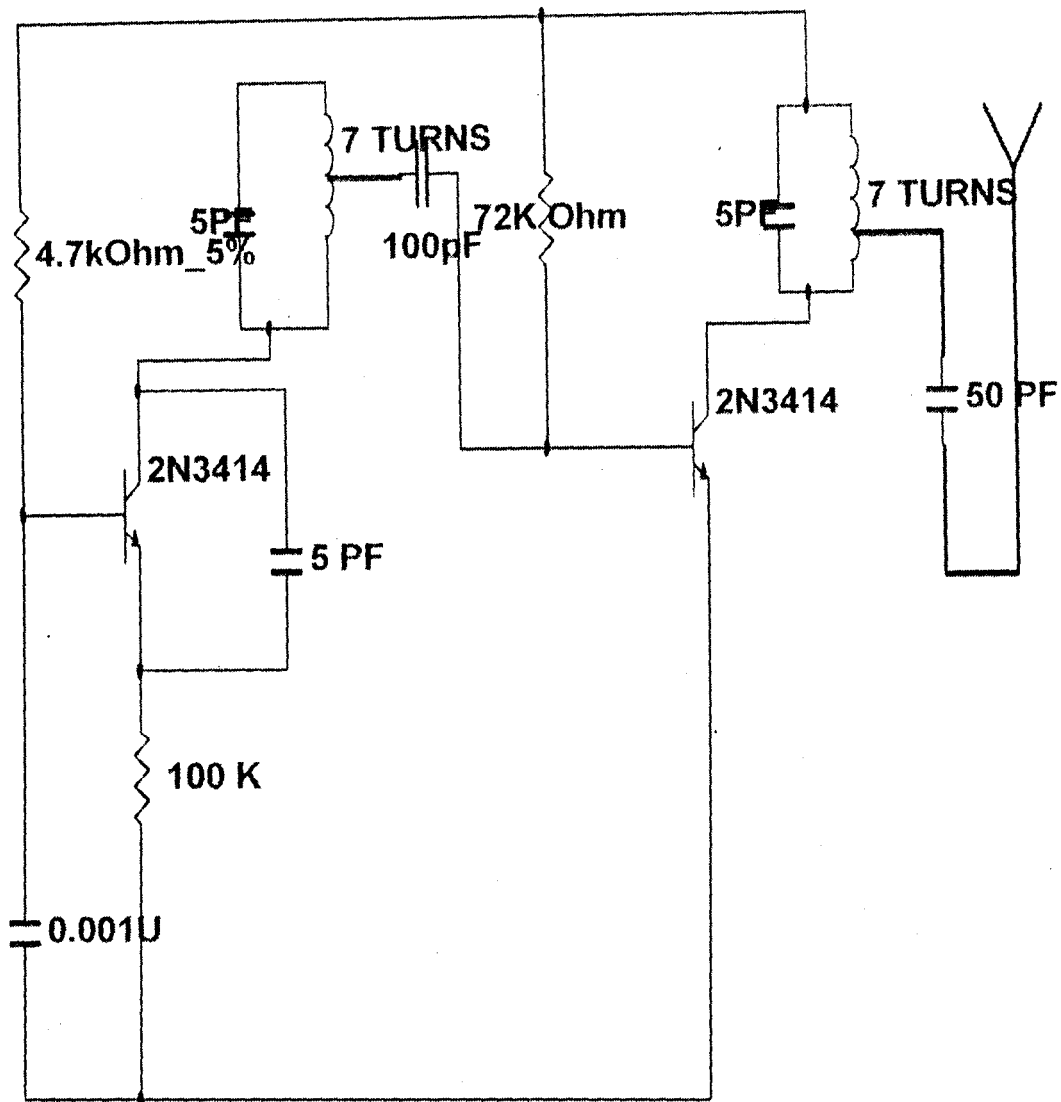


FIG 3.9 CIRCUIT DIAGRAM OF THE TRANSMITTER

### 3.7 OSLILATION IN THE LC CIRCUIT

When a charge is applied to the capacitor of the parallel L C circuits is shown below. A current flow round the circuit, but after some time of charge the current in reduce to zero, the current cannot immediately stop however, because of the collapsing

magnetic field, the result of the falling current induces an EM field across indicator such to maintain for the time being before the current reduces to zero.

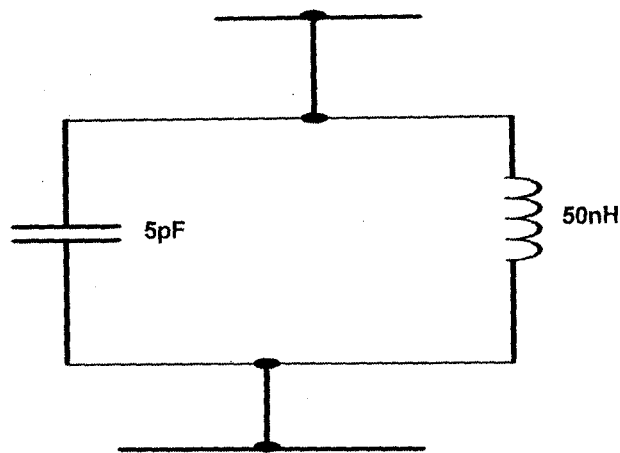


FIG 3.10 OSCILLATOR CIRCUIT

The capacitor charge has been built up nearly the same magnitude as that which was obtained original current now flow in the opposite direction and some sequence follow. Since the source of power. (A.C. source) enable oscillation to be maintained indefinitely, the D.C source must be so harnessed that the power is to the circuit at the correct time [Fitchen F. C.C (P, 985) ]

### 3.8 DESIGN AND ANALYSIS

$X_L$  = Inductive reactance

$X_C$  = Capacitance reactance

but  $X_L = \omega L$  and  $X_C = 1/\omega C$

$\omega$  = Angular Frequency

$$w = 2\pi F$$

And that  $X_L = X_C$

$$\therefore \frac{1}{2} \pi F L = 2\pi F C$$

$$\therefore L = (2\pi F)^2 \times C$$

$$\therefore L = 1/4 \pi^2 F^2 \times C$$

but operating Freq is 100 MHz

and capacitance  $C = 5\text{pf}$

$$\therefore L = 1/4 \pi^2 (100 \times 10^6)^2 (5 \times 10^{-9})$$

$$= 50.66 \text{ NH}$$

### 3.9 POWER AMPLIFIER

The purpose of a power amplifier is to obtain the maximum power while limiting distortion to a predetermined level. The aim of transmitted is to generate E.M. wave across the antenna, which receive the E.M wave signal.

The R.F power must be at low level to ensure complete stability. The application work in turn with inductance, but inductor was excluded. Therefore in other to radiator the greatest power for the limited input, the collector circuit efficiency of the amplifier (i.e. conversion of D.C. power to R.F power) must be as high as possible. This stage, provide best current and voltage gain is one of the basic thing R.F power amplifier needs. The resistor ( $R_a$ ) to provide appropriate d.c condition (bias) in terms of based current  $I_{BE}$ , collector current  $I_C$ , base emitter voltage  $V_{BE}$  and collector emitter voltage  $V_{CE}$ . This stage output is connected to the antenna transmit the E.M wave signal.

### 3.10 DESIGN AND ANALYSIS OF POWER AMPLIFIER

Let the Quiescent current be 0.25mA and  $V_{BE} = 0.7V$

And for npn silicon transistor we can write that since  $V_{CC} = 12V$  therefore,  $V_{CE} = 9V$

$$I_B R_B = 9 - 0.7 \\ = 8.3V$$

but  $I_B / I_C = h_{fe} = 0.25 / 50 = 0.005$

$$R_B = 8.3 / 0.005 = 1,060 \Omega$$

#### 3.10.1 COUPLING CAPACITOR

We know that  $X_L = 1/2\pi f L$

Assuming the satisfactory, coupling is achieved at  $X_L = R/10$

$$C = 1/2\pi f X_C = 1/2\pi f R/10$$

Let the operation frequency by 94MHz and  $R = 1,060 k$

$$C = \frac{1/2\pi (94 \times 10^6) (1,060 \times 10^3)}{10}$$

$$C = 1.597 \times 10^{-14} F$$

### 3.11 ANTENNA

An Antenna or aerial is a structure that couples the output of a transmitter or the input of the receiver to space, it either convert high frequency current into electromagnetic wave for radiation (transmitting antenna) or collects electromagnetic wave into high frequency current (receiving antenna).

As a result of the important role-played by an antenna in transmission. It has been employed in this project as a means of transmitting the radio frequency from the transmitter to the receiver.

### 3.11.1 ANTENNA DESIGN

Since we know the frequency at which the transmission is taken place i.e. 94MHz, the length of the antenna is given by this relation

$$\lambda = V/f$$

Where  $\lambda$  = wave length of the signal

V = velocity of the sound in air  $3 \times 10^8$  m/s

F = frequency at which signal is to be radiated (94MHz)

$$\lambda = \frac{3 \times 10^8}{94 \times 10^6} = 3.2 \text{ M}$$

But in order to enable the antenna radiate large fraction of power supply thereby achieving better efficiency, the length of the antenna needs to approach of the of the wavelength of the working frequency.

$$\frac{\lambda}{4} = \frac{3.2}{4} = 0.8 \text{ M}$$

In order to radiate a frequency of 94MHz, in aerial of length 0.8 in need. The antenna must be put above the ground for proper efficiency.

### 3.12 POWER SUPPLY

The source of power to the circuit is a portable 9V primary cell (Battery), due to the portability of the project that is why an adaptor was avoided

### 3.13 THE DECODER SECTION

The decoder section consists of the tone decode, the transistor switch, the D-type flip-flop, the relay and the power pack of the decoder. Its block diagram and the circuit diagram are shown fig.3.11 and fig 3.12 as shown bellow.

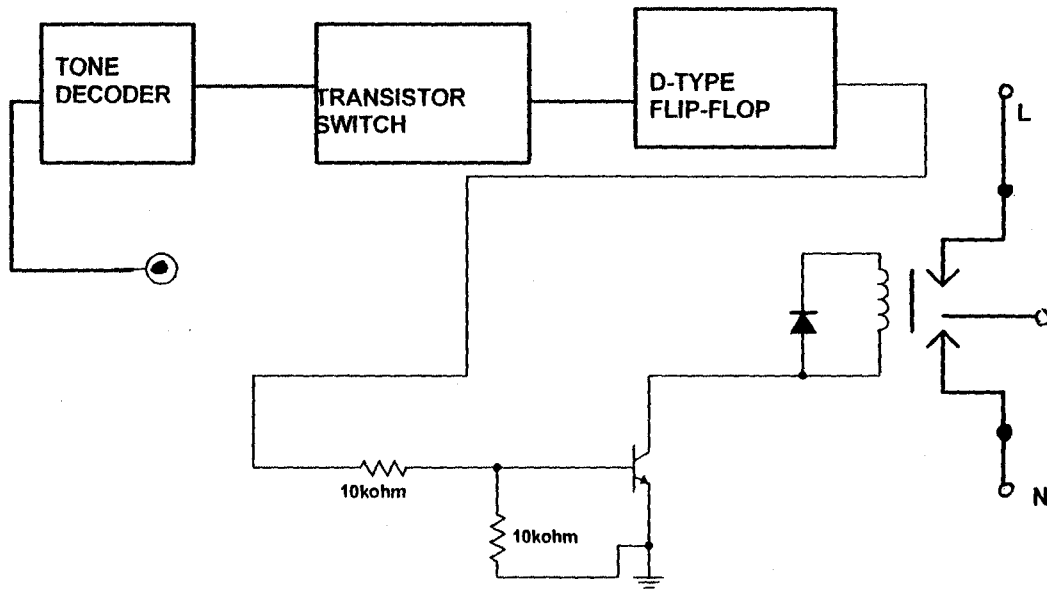
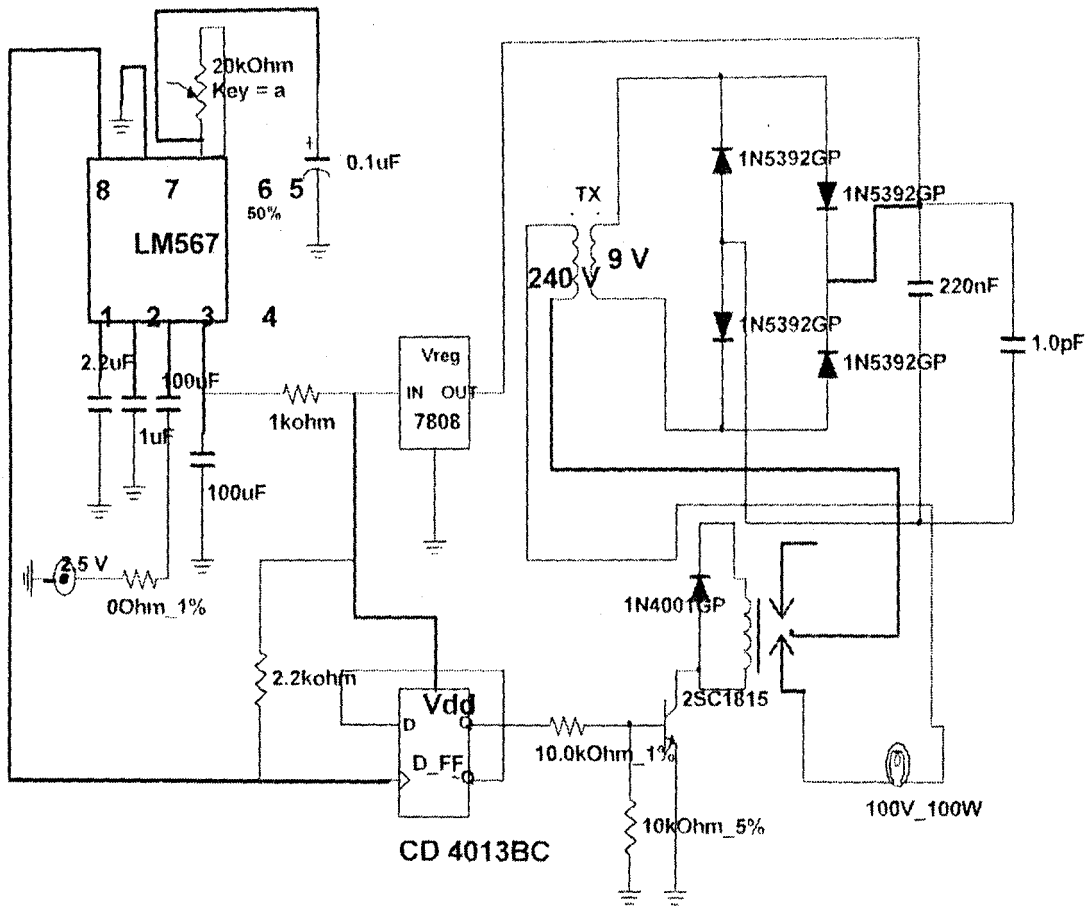


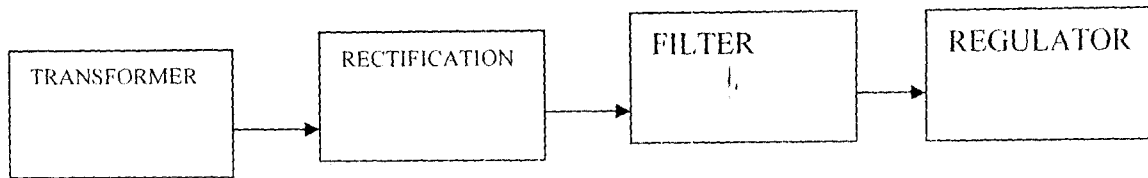
Fig 3.11 BLOCK DIAGRAM OF DECODER



### 3.12 CIRCUIT DIAGRAM OF THE DECODER SECTION

### 3.14 THE POWER SUPPLY UNIT

The power supply units of the decoder section consist of the transformer, the rectification, the filter section and the Regulator section as shown in the block diagram of fig 3.13 below.



**Fig 3.13 BLOCK DIAGRAM OF THE POWER-POWER SUPPLY UNIT**

Most electronic system usual requires cement (D.C) supply, and the supplies from the mains are usually about 120V, or 240V. There is need to design a power supply unit which get its supply (9V DC) and step it down to a required low voltage designed by the circuit in the question and then convert it form an A.C to d.c in a process noun as rectification. For the decoder, while the regulator is used to produced a constant d.c voltage of + 9V which is the required to power the I.C chips.

### **3.14. TRANSFORMER**

The transformer reduces the ingoing voltage to the required low voltage. For this project the incoming voltage is 240V in reduced to 12V by the center tap transformer

#### **3.14.2 FILTER**

Although the output of the AC to D.C converter is of a single paralytic, the changes in the level are still undesirable to operate electronics equipment, the dc most be constant level. This process of maintaining the level is called filtering.

A capacitor low filter is the most widely used. The changing and discharging of the capacitor in the filter designed so that is is capable of maintaining a relatively constant level as the input of the filter varies.



### 3.14.3 REGULATOR:

From the filter an operation step to take is to provide regulation. This maintains constant output under various load conditions. A special diode can be used for regulation. Voltage regulator IC are also used, which provide protection against over loading and of the circuit component.

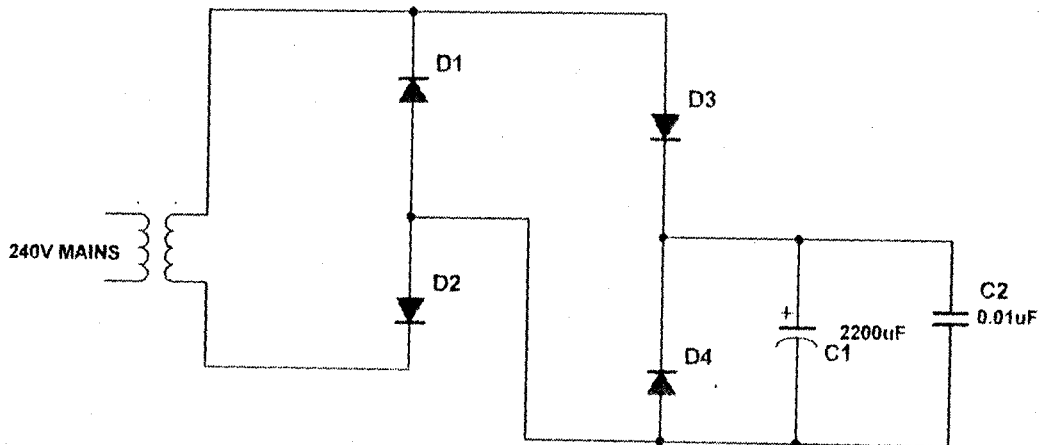


FIG 3.14 CIRCUIT DIAGRAM OF THE POWER SUPPLY UNIT

### 3.15 GENERAL DESCRIPTION OF THE DECODER

The decoder used in the project is LM 567 and is a general purpose tone decoder designed to provide a transistor switch to ground when an input signal is present within the passband. The circuit consists of an I and Q detector driven by a

voltage controlled oscillation which determines the center frequency of the decoder. External components are used to independently set frequency, bandwidth the and output delay.

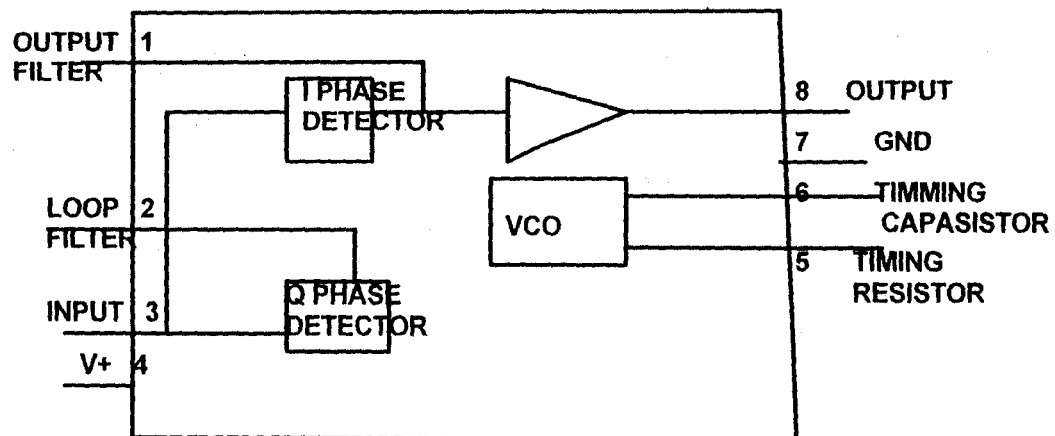


FIG 3.15 DUAL -IN- LINE SMALL OUTLINE PACKAGES

### 3.16 FEATURES OF LM 567

- 20 to 1 Frequency range with an external resistor
- Logic compatible output with 100mA circuit sinking capacity.
- Bandwidth adjustable from 0 to 14%
- High rejection of out of band signals and noise
- Immunity to false signal
- Center frequency adjustable from 0.01Hz to 500 KHz.

### 3.17 DESIGNING OF THE DECODER

The decoder is based on LM 567 tone decoder set up to respond to the audio tone transmitted by the hand-held transmitter. The tone decoder consists of a frequency voltage controlled oscillator (VCO), and quadrature dividers which establish the reference signals for phase and amplitude detectors. The phase detector and VCO form a phase-locked loop (PLL) which locks to an input signal frequency which is within the control range of the VCO. When the PLL is locked and the input signal amplitude exceeds an internally set threshold, a switch to ground is activated on the output pin (pin 8).

The reference oscillator is set up by external components to run at the input frequency and these also determine the phase and amplitude filter time constants.

The centre frequency of the tone decoder is equal to the free running frequency of the VCO, and this is given by

$$F_0 = \frac{1}{1.1RC}$$

The bandwidth of the filter is found from the approximation

$$\sqrt{\frac{V_i}{F_0 C}} \quad \text{in \% of } F_0$$

Where

$V_i$  = input voltage (Volts rms.),

$V_i = 200 \text{ mV}$

$C$  = capacitance at pin 2 ( $\mu\text{f}$ )

In this project work, R was chosen as an adjustable trimmer resistor so that all component variation can be accounted for, C was chosen as 0.1nF capacitance.

The input to the tone decoder is from 1 KHz FM R.F receiver turned to the centre frequency of the hand- held transmitter. The demodulated output is then fed into pin 3 of the tone decoder and the volume control adjusted to give voltage less than 200MV.

Outputs (pin 8) of the decoder is connected to the base terminal of the 2SA1015GR PnP transistor to provide switching when the output is activated. The transistor switch circuit connected to a CD 4013 BC D-type Flip – Flop

When the output of a tone decoder is activated i.e. taken low when an input tone within its passband is detected, the low voltage at the base of pnp transistor switches on, conducting current in the collector emitter junction, neglecting the 0.2V saturation voltage of the pnp transistor a voltage ( $V_{dd} - 0.2V$ ) appears at the collector of the conducting transistor.

This voltage is acknowledged as a logic 1 at the D or clock input of the CD4013BC bistable. The a output of the bistable goes high when clock input is high i.e. when 1KHz is transmitted by the oscillator and detected by the decoder the Q output is forced low when the voltage at 1KHz is not received at the decoder.

The Q output of the flip – flop is connected to a 25C1815 GR transistor that switches on and off a 12 V d.c relay whose content is capable of switching 10A. Once latched the bistable stays latched until transmitted change.

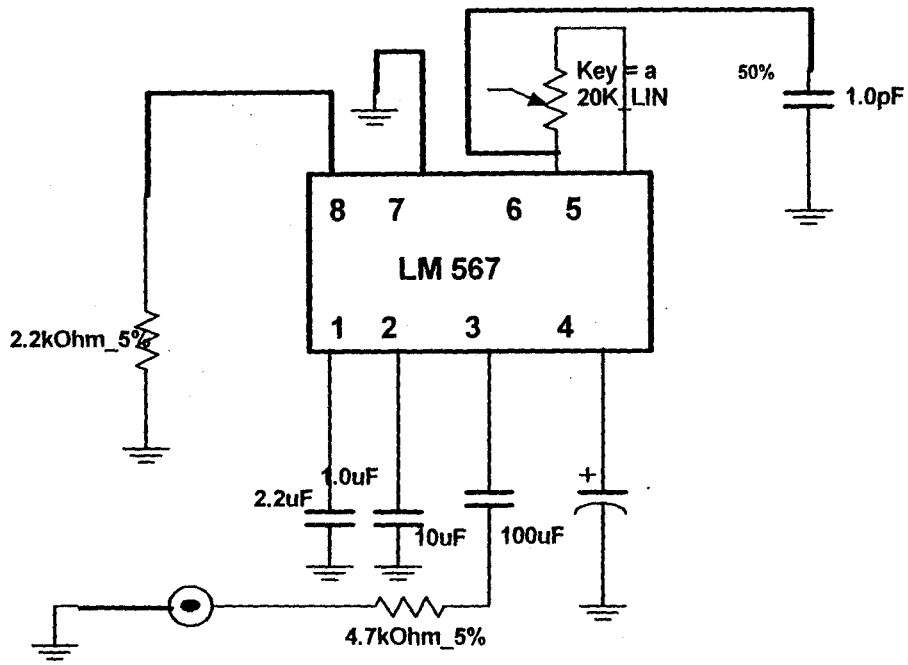


FIG 3.16 TRANSMITTER CONNECTION

## **CHAPTER FOUR**

### **4.0 CONCLUSION AND RECOMMENDATION**

#### **4.1 CONCLUSION**

This project was completed from development to fabrication within a time space of six months. The first four-month was used to understand and develop the design while the remaining two months was used to implement and test the design.

The radio wave remote control switch system was complete. It worth mentioning how fascinating it was when one design a system, constructs it and see it working satisfactory. This project has given a great experience especially in the designed construction of the system. It has also increased the knowledge and understanding of the use of different kinds of transmitter and receiver circuits. From the results, it showed the aim and the objective state in the chapter one was achieved since, the principle used in the system worked as expected.

#### **4.2 RECOMMENDATION**

For the improvement of this project it is recommended that some sort of the feedback should be incorporated in the system, which would notified the transmitter part if the intended controlled system has been controlled or not in order to increase the effectiveness and efficiency of the system.

It is recommended that the frequency modulation (F.M) receiver should be part of the project constructions and also increase the numbers of channels of control switches in other to control more then one device.

### **4.3 ACHIEVEMENT**

This system has been able to fulfil the basic requirement of the radio wave remote Controller.

The transmitter circuit has been able to transmit the required generated frequency modulations.

The power supply unit has been able to maintain constant power supply to the receiver, as there is power supply at the main.

The receiver has also been able to receive the transmitted signal and process it up to Schmidt trigger stage.

The receiver has also been able to receive the transmitted signal at quite a fair range of transmission.

### **4.4 TESTING AND PROCEDURE**

The following test was carried out during the construction of this project. Testing the output of each unit during construction process by the use of digital multi-meter

Physical connecting of wire between the receiver to confirm if both are working as expected.

Finally disconnecting of the connection between the transmitter and receiver to see if the wireless nature has been achieved.

### **4.5 SUGGESTION**

Due to difficulties, encountered during the cause of this project, some suggestions have been made for future improvement.

The Nation Institution of University Education should endeavor to wider the scope of the syllabus of the National Degree program course so that it will be theoretically and practically oriented.

Because the current syllabus in school lay more emphases on the theoretically aspect and neglect the practical aspect and thus make the student unexposed to practical aspect.

The government should make provision for libraries and research centers where student can go and do their project research and design.

It is indeed a good idea that engineering student's first-degree final year project be a practical one. However, the problem associate with construction with the regard to finance and component availability should not be overlooked.

Due to these two factors, student tent to shy away by drooping very challenging projects and go for "easy going" one. Proper attention given to student by their supervisors can also go a long way in motivating student to pick reasonable project titles. If the school will resolve to assisting students in their final year projects and reducing the number of courses offered by students in their final year, then we may eventually achieve the technological break-through we are pursuing.



## REFERENCE

- (1) B.L. Theraja and A.K. Theraja: A text book of electrical technology's Chand & Company Ram, New Delhi, pp.1951-1956
- (2) National Application Specific analogue products data book
- (3) Paul Horowitz and Winfield Hill: The art of electronics 2<sup>nd</sup> edition by Cambridge University **page** 175-231. 504-524.
- (4) Douglass V. Hall and McGraw Hill, page 1-58, 362-362-372.  
Morris Monu M.: Digital design page 158-160.