DESIGN, CONSTRUCTION AND TESTI
OF A REMOTE CONTROL LIGHTING SYSTEM

BY

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SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

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A PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMTN FOR THE AWARD OF BACHELOR OF ENGINEERING (B.Eng.) IN ELECTRICAL AND COMPUTER ENGINEERING.

NOVEMBER, 2004.

CERTIFICATION

This is to certify that this project titled "Design, Construction and Testing of a Remote Control Lighting System" was carried out by Aliyu Alhaji Ndakotsu for the award of Bachelor of Engineering (B.Eng) of the Department of Electrical and computer engineering of the federal university of technology Minna Niger state under the supervision of Mr. J. G. Kolo

Mr J. G. Kolo
Supervisor

15/12/07
Date

Engr. M.D ABDULLAHI
HEAD OF DEPARTMENT

16/12/2007
DATE

EXTERNAL EXAMINER

DATE

DECLARATION

I hereby declare that this project work titled "design, construction and testing of a remote control lighting system" has never been presented elsewhere for the award of any Diploma or Degree certificate. Information derived from published or unpublished work of others has been duly acknowledged in the text.

Aliyu Alhaji Ndakotsu	SIGNATURE	15/12/2004 DATE

DEDICATION

This project is dedicated to **Almighty ALLAH**, the supreme of all being, to my Parents: **ALH MUHAMMAD NDAKOTSU (LATE FATHER)**, may his gentle soul rest in perfect peace, Ameen, and **MALLAMA HAWAWU NDAKOTSU (MOTHER)**.

ACKNOLEDGEMENT

My first gratitude goes to Almighty **ALLAH.** Whom nobody can be likened to and who hears and sees, the protector and the best to help. I thank the almighty **ALLAH**, who has been supporting me through the thick and thin of this life and who has made this project possible at this appointed time.

I want to acknowledge and appreciate my parents; **Alh. Muhammad Ndakotsu** and **Mallama Hawawu Ndakotsu**. You both did everything possible to get me educated. Daddy, the cold hand of death caught you up and could not allow you to see this day. May your soul continue to rest in perfect peace, amen. Mum, **Mallama Hawawu Ndakotsu** you are a mother with examples worthy of emulation, you did everything possible to get me educated and saw me through in life. Thanks to **ALLAH** for your effort.

I am particularly indebted my indefatigable supervisor, Mr. J.G. Kolo and my H.O.D, Engr. M.D Abdullahi for all the assistance rendered towards the success of this project. My thanks also, are due to all the lecturers of Electrical and Computer Engineering Department.

I also acknowledge with thanks the role of my Uncle, **Ndagi Nusa (Baba), Yaman, Mal. Ibrahim B. Isah, Mall. Adamu Alh. Ndakotsu, Mall. Abubakar Yanda, Dr. Mohammed Ndakotsu, Mall. Mohammed Mayaki Vunchi** and their **families,** whom through their unrelantive efforts have contributed immensely towards the success of my academics pursuit.

I also thanks Alh. Isah Abdallahi Zhitu and his families: Isah (A Zhitu), Ndagiyaya (officer), Danladi, Dan Asebe, Alhaji for their support and courage.

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Aliyu Umar, Aliyu Ndanusa, Alh. Sogir, Ibrahim B. Kolo, Abdullahi Yahaya, Abubakar s. Aliyu, Mohammed Abubakar Baisa, Mohammed Alkali Baisa, Moh'd Elommi, Mahamud Mini, SGT Aliyu Baisa, Mohammed Ibn Mohammed , Aliyu Ibn Aliyu and others that are not mentioned here.

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I sincere appreciate the effort and patience of my roommates: Mi-iraji Abdulmummini, Ahmed Sodangi, Ibrahim Muktar, Danjuma, yahaya (YAHUS), Hamza and others.

I appreciated the role of my sisters and brothers: Aishetu Baba Isah (sister), Yakubu Ndakotsu, Suleiman Ndakotsu, Mohammed Ndahotsu, Suleiman Mohammed, Aishetu B. Isah, Halima B. Isah, Hauwa Isah Abdullahi.

I deeply appreciate the efforts of my ever cheerful and lovely ones. To **GOD** is the glory.

ABSTRACT

The title of this project is "Design, Construction and Testing of a Remote Control Lighting System" which can be achieved using the principle of transmission and reception of signals. The aimed is to design a transmitter as a remote control that can trigger ON or OFF a system connected to a receiver. It is called a remote control because of the ability of the transmitter (remote control) to control a device connected to the receiver unit.

The mode of transmission and reception used in this design is Radio frequency (fm). Radio frequencies are used where long range and high security are required. To prevent unauthorized code hacking, our RF security remote employ proprietary communication protocols, and are, therefore, only compatible with the receivers for which they are designed.

This design is applicable in control system such that a device to be controlled is connected to the receiver.

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CHAPTER FIVE

CHAPTER ONE

1.0 GENERAL INTRODUCTION

1.1 INTRODUCTION

The desire of mankind to control natural forces has been the catalyst for progress and development throughout human history. Our goal has always been to control those forces in order to perform physical tasks that are either beyond our own capabilities or simply to make our lives easier. Over the centuries, the control system engineers have transformed many of our hopes and dreams in to reality.

Wireless control systems as the name implied uses the principle of "wireless transmission" which can be described as a means of transmitting massages to control a system.

Wireless transmission, as the basic principle used in this project has made it so possible irrespective of the distance barriers to send information and this is what the project is all about. "DESIGN, CONSTRUCTION AND TESTING OF A REMOTE CONTROL LIGHTING SYSTEM"

In many situations it may be impractical to use direct manual switching, in order to switch on devices such as security lightings, security alarms system, electric motors responsible for opening of garage doors and gates. When switched are located in in-accessible places or where it is inconvenient to operate them.

A useful option for short range is the use of the remote control switching system. Most houses, offices, industries, banks etc have lighting systems, security alarm system in co-operated at various places. It is desired to easily control the ON or OFF states of lighting system by using a remote control from any part of the premises or room.

The purpose of a remote control serves as; -

i. **To alleviate inconveniences:** to alleviate inconvenience of trying to locate where the manual switches for switching on various appliances are placed. Sometimes manual switches are placed in an accessible place where it is inconvenient to operate them. In this case most remote control used for electronics devices, convenience and flexibility is the desired effect i.e. such device can be easily operated from quite a considerable range.

ii. **To enhance security:** most remote controls used today are also built for the purpose of security. In the case of an intruder trying to gain entry into a house, those residing in the house can easily switch on the security light or security alarm to warn to other people in the house of the impending danger and also wading off the intruder without going out to switch ON the security devices manually.

iii. **To ensure safety:** this is in the area of operating devices which can either be radioactive or toxic from a safe distance. There exists the need to keep searching for ways to provide a perfect and secured control system capable of stopping even the most determined intruder. It is hoped that this work will contribute to the further development of control system.

1.2 LITERATURE REVIEW

Due to the advancement in technology over the recent years the remote control used in switching on devices has now become very popular. Remote control is the ability to control a device without physically contacting the device. The remote control enables an operator to switch ON or OFF a device while being separated from it. This is necessary because the device being controlled is out of reach. Examples of such cases are in the case of space vehicle, under water salvage work e.t.c.

Sometimes a remote control is necessary because the device which is to be controlled is dangerous to approach such cases are in the case of a radioactive materials or toxic materials. Most remote control used today is for switching ON or OFF of devices such as television, video, security lighting system e.t.c. The aim is to reduce the inconveniences of switching ON or OFF such device manually.

The three basic components in a remote control system are: -

a. The controlling quantity

b. The transmission medium and

c. The controlled quantity

The various types of remote control system are:

1.2.1 REMOTE MANIPULATION

This is an electromechanically device used for handing radio-isotopes from a safe distance. The controlling quantity is the hand motion of the operator, the transmission medium is a mechanical linkage system and the controlled quantity is the position of the isotope containers.

In 1948, R.C Goertz developed a mechanical manipulator to aid radio active hot laboratory work. Today, hundreds of such mechanical manipulations are used in the nuclear industries.

1.2.2 ADVANCED SYSTEM

More advanced remote handling control system often using electronics or fluidic controls and with electromagnetic, hydraulic or pneumatic activators are being developed for a wide variety of applications for example such as in space activities, nuclear under sea activities. Although they are used for a wide variety

of applications they tend to be very expensive and they lack great value of simplicity.

1.2.3 TELEMENTARY SYSTEM

This is the transmission of a measured quantity over a distance to the receiving apparatus, which display or records it. Such measured quantity may be voltages, pressure or temperature. This system employs mechanical linkages electric acts or radio waves as the transmission medium; the quantity measured is displayed at the receiving point. One of the most important uses of telemetry system is the transmission of data covering a wide range of subjects. This data is transmitted from space over radio telemetry links to tracking stations on the signals into readable form of analysis.

It is based on this form of remote control that the present day domestic indoor remote control for controlling one quantity or the other is electric devices, such as television, video, radio cassette players, lighting systems etc.

The medium of control used to be through wire cables but today electromagnetic waves such as radio waves, infrared wave and ultra-sound waves are used to achieve the desired goal.

The modern period of system control which runs through to the present time is believed to have begun in 1948, when J. Von Weumann directed the construction of the IAS stored-program computer at Princeton.

The advent of computers, microcomputers, microprocessors, microcontrollers, transistors, transducers, etc have made it easier for more and more systems to be accurately and efficiently controlled.

1.3 AIMS AND MOTIVATIONS

I have been motivated to Design, Construction and Test a Remote Control Lighting system to control electrical point in order to avoid inconveniences, insecurity and to ensure safety in switching ON and OFF electrical point in our houses, offices, industries, banks etc.

The aims and objectives of this project are stated below: -

i. To minimise the bulkiness of cables used in any control system.

ii. To eliminate distance barriers that could make transmission of information almost impossible

iii. To make system easily controlled irrespective of the distance

iv. To design and construct a receiver unit that controls the switching (ON or OFF) of lighting systems.

v. To design and construct a transmitter device that switches the receiver unit.

CHAPTER TWO

2.0 COMPONENTS ANALYSIS

The design of this project basically employs generation of binary codes sequence (high or low), which is then used for transmission of signal from this transmitter (controlling quantity) to be received by the receiver.

In order to have a clear understanding of the project design, fundamentals of digital system briefly have to be taken into consideration. Electrical signal could either be discrete or continuous. A digital message or signal is a sequence selected from a finite or discrete element.

The graph below show the wave form of a digital signal.

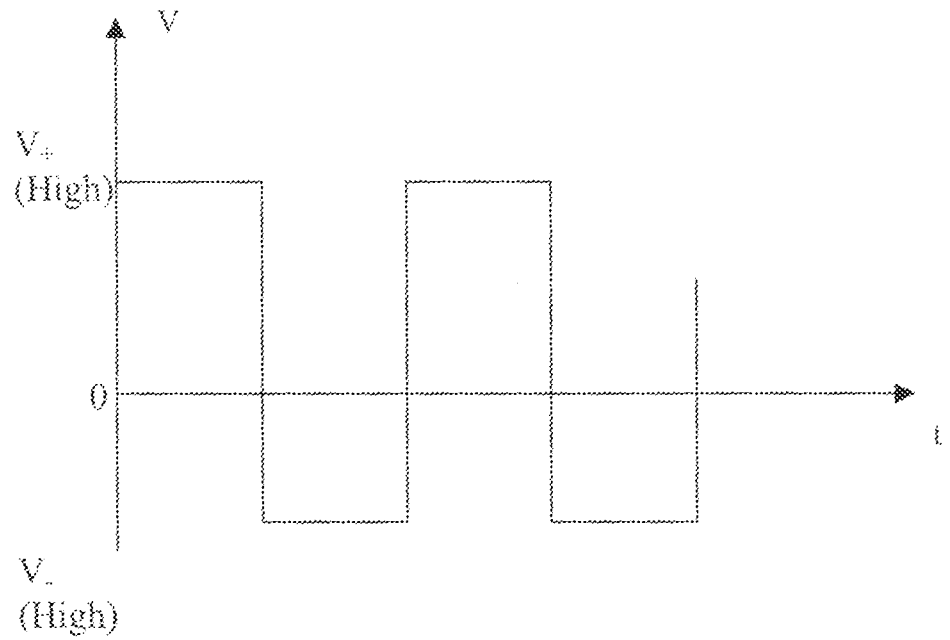


Fig 2.0 Digital representation of electrical signal

Shown in fig 2.0 is the electrical representation of digital signal. In fig. 2.0, V could take a value of V+ or V- (1 or 0) and that V+ is positive while V- is negative. V can also be represented as either "high" or "low" as indicated above.

However, in a particular digital system like this project, we may encounter binary variables which operate between two voltage levels or to 12V. In this project,

symbols 0 and 1 are represented as thus; the lamp or bulb will be off (logic 0) or (low), if the symbol 0 is transmitted. The lamp/bulb can only be on (logic 1) or 12V (high), if symbol 1 us transmitted from the transmitter to the receiver.

2.1 WHAT IS A CARRIER WAVE?

It is a high-frequency undamped radio wave produced by radio-frequency oscillator. As seen from fig 2.1, the output of these oscillators is first amplified and then passed on to an antenna. The antenna radiates out these high-frequency (electromagnetic) waves into space. These waves have constant amplitude and travels with the velocity of light. They are inaudible i.e. by themselves they cannot produce any sound in the receiver. As the name implied, their job is to CARRY THE SIGNAL (AUDIO) from transmitting station to the receiving station. The resultant wave is called modulated carrier wave. The diagram below shows the wave form of a carrier wave.

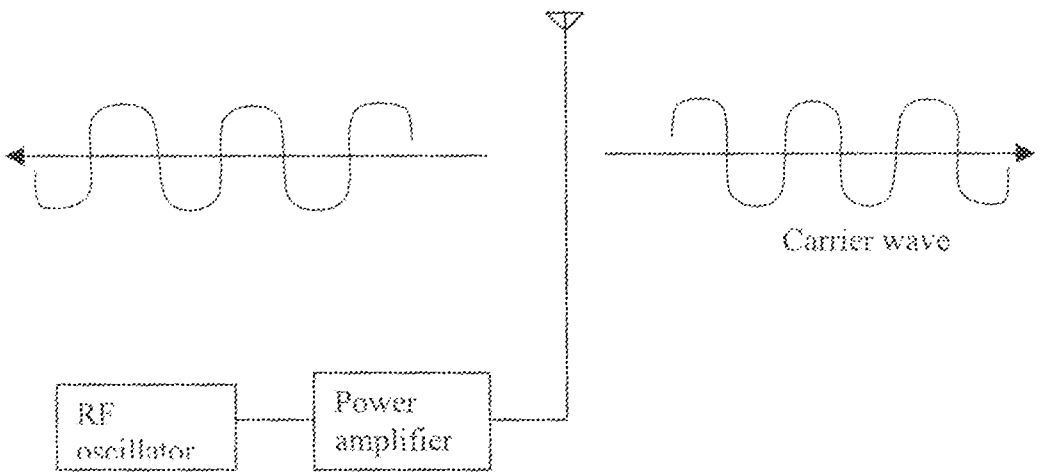


Fig 2.1 representation of carrier wave.

2.2 SWITCH

Switch is accessory, which is used to make or interrupt a circuit in order to turn alight or a piece of electrical equipment ON or OFF. Activation of the whole system starts from this unit and the unit is composed of push-down button and uses a 9V battery.

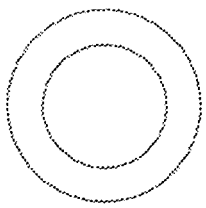


Fig 2.2 Representation of switch (push-button)

Fig 2.2 above shows the switching unit. A switch consists of three essential parts: the mechanism, the box and the front plate. The mechanism of operation of the switches may be of the dolly mechanism or may be rocker-operated type.

2.3 ASTABLE MULTIVIBRATOR

Multi-vibrator are devices useful in pulse generating, storing and counting circuits. The multi-vibrator used in this project is a stable multi-vibrator (AMV). It is also called free-running relaxation oscillator. The pulses generated by Astable multi-vibrator has no stable states but only two quasi state (half-stable) states between which it keeps oscillating continuously of its own accord without any excitation. The circuit diagram below show the Astable multi-vibrator.

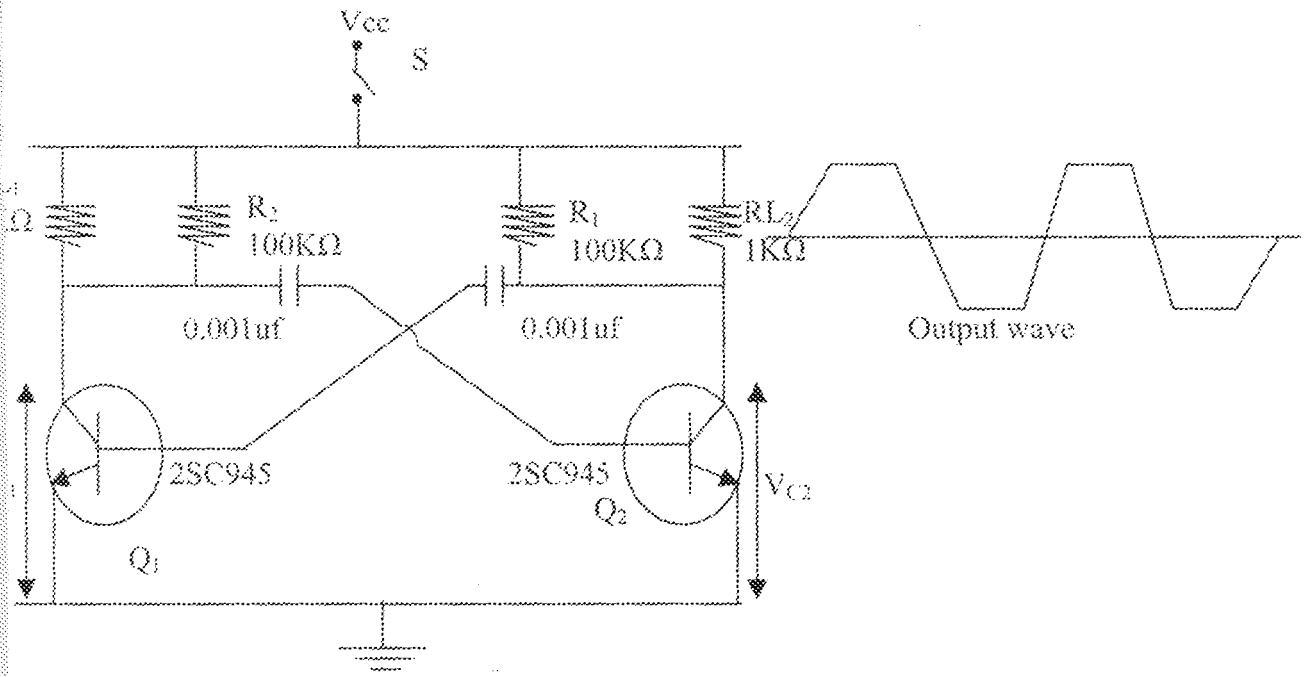


fig 2.3 representation of Astable multi-vibrator (AMV)

From the figure above, neither of the two transistors reaches a stable. When one is ON, the other is OFF and they continuously switch back and forth at a rate depending on the RC time constant in the circuit. Hence, it oscillates and produces pulses of certain mark-to-space ratio. It has two energy-storing elements i.e. capacitors C1 and C2 respectively.

2.3.1 CIRCUIT ANALYSIS

Fig 2.3 shows the circuit diagram of a symmetrical collector-coupled AMV using two similar transistor 25C945. it in fact, consist of two CE amplifier stages, each providing a feedback ratio is unity and positive because of 180^0 phase shift in each stage. Hence, the circuit oscillates. Because of the very strong feedback signal, the transistors are driven either io saturation or to cut-off. The transistor Q1 is forward-biased.

By Vcc and R1 whereas Q2 is forward-biased by Vac and R2. The collector-emitter voltages of Q1 and Q2 are determined respectively by R_L1 and R_L2 together with Vcc.

The output of Q1 is coupled to the input of Q2 by C2 whereas output Q2 is coupled to Q1 by C1. The output can be taken either from points A or B *though* these would be phase-reversed with respect to each as shown in fig 2.3.

2.3.2 CIRCUIT OPERATION

The circuit operation would by easy to understand if it remembered that due to feedback; when Q1 is ON, Q2 is OFF and when Q2 is ON, Q1 is OFF.

When the power is switched on by closing S, one of the transistors will start conducting before the other does (slightly faster than the other). It is because characteristics of no two seemingly similar transistors can be exactly alike. Suppose that Q1 starts conducting before Q2 does. The feedback system is such that Q1 will be very rapidly driven to saturation and Q2 to cut-off.

It is seen that the circuit alternates between a state in which Q1 is ON and Q2 is OFF and a state in which Q1 is OFF and Q2 is ON. The time in each state depends on RC values. Since each resistor is driven alternatively into saturation and cut-off the voltage waveform at either collector points A and B in fig 2.3) is essentially a square wave form with peak amplitude equal to Vcc (fig 2.4).

2.3.3 SWITCHING TIMES OF TRANSISTORS

It can be proved that off-time for Q1 isT1 = 0.69R1C1 and

hat for Q2 is T2 = 0.69R2C2. Hence, total time-period of the wave is:

T = T1 + T2

$$T = 0.69R1C1 + 0.69R2C2$$

$$T = 0.69 (R1C1 + R2C2)$$

If R1 = R2 = R and

C1 = C2 = C

i.e. the two stages are symmetrical, then

T = 1.38RC

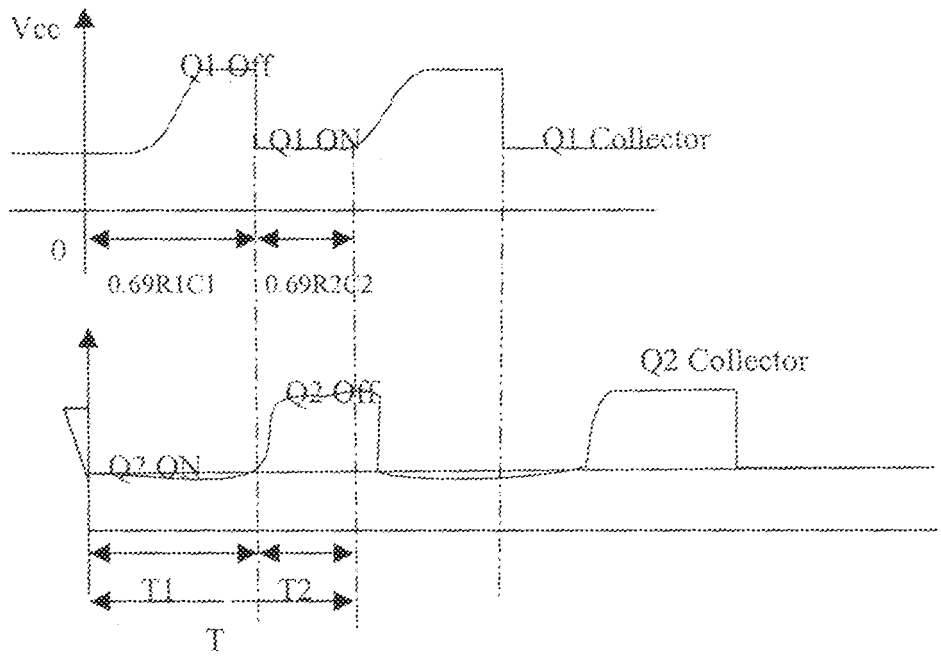


Fig 2.4 representative of switching times

2.3.4 FREQUENCY OF OSCILLATION

It is given by the reciprocal of time period

F = 1/T = 1/1.38RC

= 0.7/RC

For instance, in the AMV circuit of fig 2.3 R1 = R2 = 100K , C1 = C2 = 0.001μf and $R_L1 = R_L2 = 1K$. The frequency of circuit oscillation is:

Recall that T1 = T2 = 0.69RC

Then $T1 = 0.69 \times 10 \times 10^{3} \times 0.01 \times 10^{-6}$

T1 = 69μS

F0 = 1/T

$F0 = 1/138 \times 10^{-6}$

$F_O = 7.25$ KHz

2.4 TRANSMITTER (FM OSCILATOR)

The transmitter unit is basically the unit that generates the signal to be transmitted. Frequency-modulated (FM) transmitters are commonly used above the HF range, particularly for sound transmission e.g. the 88-108MHz band. The fm oscillator is operating at fm or very high frequency range e.g the frequency is from 60-70MHz. So not to cause interference with the normal fm band 60-70MHz range is preferable.

Because of such high-frequency involved, it is difficult to obtain crystals that will oscillate well. Other oscillator types are also found to be very unstable at high frequencies. One obvious method of circumventing this is to employ a low-frequency oscillator (e.g. crystal oscillator) and then multiply the output frequency as many times as to give the required high frequency. Such frequency multipliers may take the form of class C amplifiers tuned to the required frequency.

A better alternative is to make use of frequency synthesizers which provides better frequency ability than the crystal controlled oscillator. A frequency synthesizer basically accepts a single frequency of stability which is processed to provide full frequency coverage.

2.4.1 FREQUENCY REPONSE A TRANSMITTER

The transmitter unit of the design is a LC circuit. The frequency or transmitting frequency depends on the LC. Assumed $F_0 = 61$MHz.

Given that $F0 = 1/2\pi LC$

Where $F0 = 61$MHz

$C = 30$pf

L =? (Inductance value)

$\pi = 3.142$

$$FO = \frac{1}{2 \times 3.142 \times 30 \times 10^{-12} \times 6}$$

$$61 \times 10^{6} \times 2\ 3.142 \times 30 \times 10^{-12} \times L = 1$$

$$L = \frac{1}{61 \times 10^{6} \times 2 \times 3.142 \times 30 \times 10^{-12}}$$

$$L = \frac{10^{12}}{2 \times 3.142 \times 30 \times 61 \times 10^{6}}$$

$$L = \frac{10^{12}}{1.149972 \times 10^{10}}$$

L = 869.5863

L 870 H

2.5 ANTENNA

An antenna or aerial is a structure that couples the output of a transmitter, to the input of a receiver. This design make use of two antennas that is, the transmitting antenna i.e. To cause the generated signal from the transmitter to transmit to the receiver. It does this by radiating the signal generated from the transmitter unit into the atmosphere as electromagnetic wave that can be picked up by the receiving antenna. The receiving antenna receives or converts the electromagnetic waves radiated from the transmitting antenna. The transmitting antenna may transmit several kilowatt of power while the receiving antenna may receive a few kilowatt dissipated in it. The reason been that not all signal radiated from the transmitting antenna will be able to get to the receiving antenna.

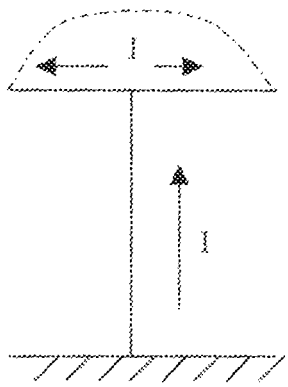


Fig 2.5 representation of antenna

2.6 SOUND RECEIVER

Basically, the sound receiver extract and process the desired signal from the various signals received at the channel output. The processing function includes conversion of the selected signal to form a suitable for the output transducer. These include detection or demodulation and amplification of the received signal. The selected modulated RF signal is also to be converted to AF signal. A good receiver should be able to select "well" the desired signal and reject "well" any unwanted signal. The circuit below shows the receiver unit of this project.

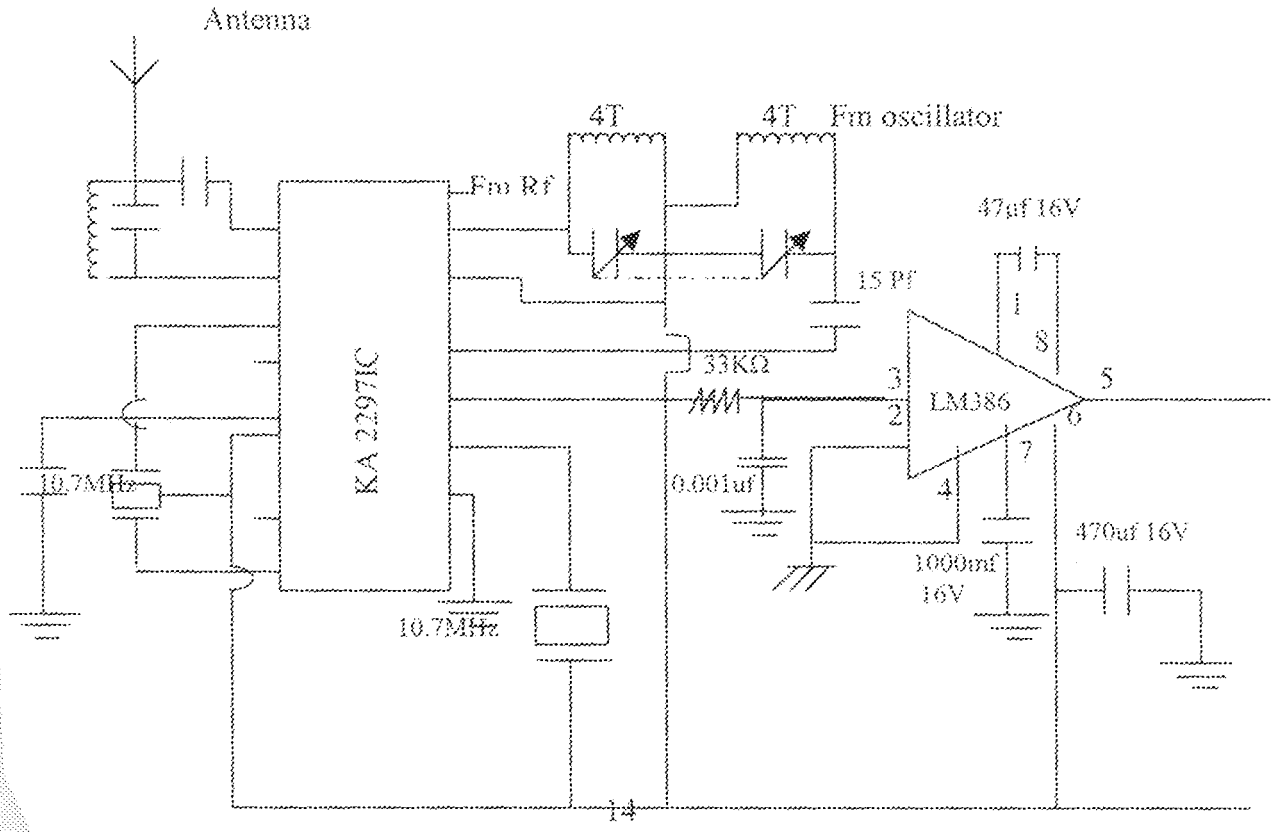


Fig 2.6 receiver unit

The Fm Rf is a LC circuit. Using the formula $F_0 = 1/2\pi\sqrt{LC}$

The resonant frequency depends on the values of the 3inductor and capacitor. Therefore the Rf is turned to the range 60-70MHz. if 61MHz is used. That is from the FM transmitter remote controller the 61 MHz (assumed) is fed into the mixer a very close frequency of about 70.7MHz.

We have,

F1 = 60.0MHz

F2 = 70.0MHz

F3 = F2 + F1 = 130.7MHz

F4 = F2 – F1 = 10.7MHz

F2 – F1 is 10.7MHz and also known as the intermediate frequency (I.F) for FM the I.F is 10.7MHz.

$F_0 = 1/2\pi\sqrt{LC}$

F0 = 61MHz

C = 15pf = 15×10^{-12}

$$61 \times 10^{6} = \frac{1}{2 \times 3.142 \times 15 \times 10^{-12} \times L}$$

$$L = \frac{1}{61 \times 106 \times 2 \times 3.142)^2 \times 15 \times 10^{-12}}$$

L = 4.5MHz

2.7 MIXER/DETECTOR

The amplified RF signal is coupled to the input of the mixer. The mixer beats together two frequency signals. KA2297IC is the IC that was used in this design and is a radio integrated circuit which requires external component by the manufacturer pin 1 and 2 are concerned with the antenna circuit.

Pin 3 and 8 deals with the intermediate frequency amplifier. The mixed frequencies come out from pin 3 and filled out to pin 8 pin 15 and 13 are concerned with radio frequency input and fm oscillator respectively pin 14 used to adjust the integrated circuit to frequency modulation mode (fm) pin 11 is the demodulated and audio signal output. Remember that pin 4, 5, 7,9,12 and 16 are un-used pins they are connected with the other part of the circuit.

Demodulation is the process of separating or recovering the signal from the modulated carrier wave. It is just the opposite of modulation and is performed at the receiving end. While modulation is the process of combining the low – frequency signal with a very high – frequency radio wave called carrier wave (CW). The resultant wave is called modulated carrier wave.

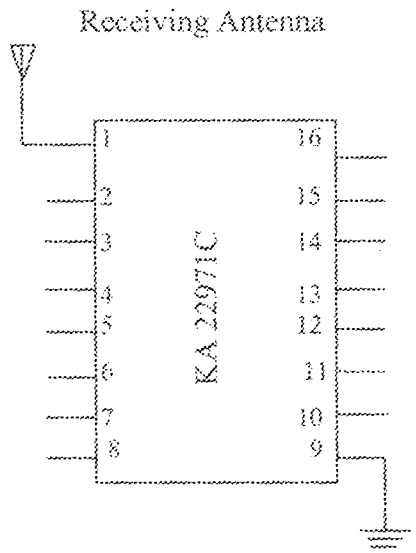


Fig 2.7 Show the pins configuration of a mixer (KA2297) IC

2.8 FILTERS

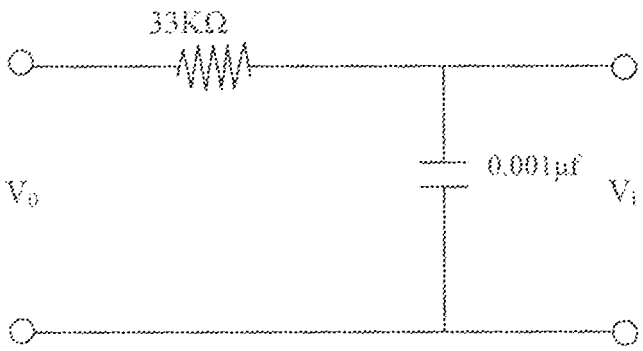
The term as used communication system is a frequency selective network designed to separate on an input signal to produce a desired output signal. That is, a filter passes signal of certain frequencies and blocks signals having a certain

range of frequencies, referred to as the alternation band or bands. The signals may be a continuous time entity that may be stated in time of frequency terms. Filters are classified as low pass, high pass band pass, based or phase characteristics.

2.8.1 FREQUENCY RESPONSE A FILTER

The frequency response of a filter is the maximum frequency which it allows to pass through, and its also called cutoff frequency Fc

Frequency response of a low-pass filter.



Fc = 1/2πRC

Given that R = 33KΩ

C = 0.001μF

Fc = ? (frequency response)

π = 3.142

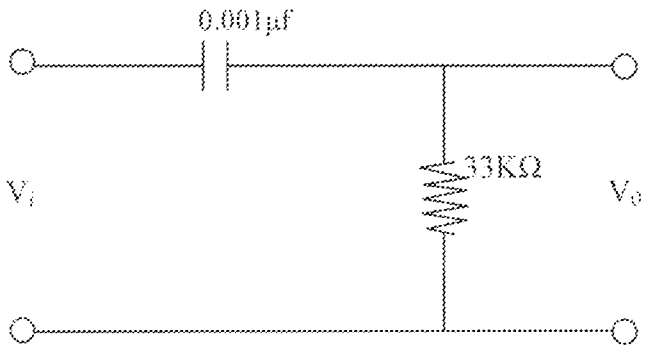
$$Fc = \frac{1}{2 \times 3.142 \times 33 \times 10^{3} \times 0.001 \times 10^{-6}}$$

$$Fc = \frac{1}{207.372 \times 10^{-6}}$$

Fc = 4822.25

Fc = 4.8KHz

requency response of a high-pass filter



$Fc = 1/2\pi RC$

Given that $R = 33K\Omega$

$C = 0.001\mu F$

Fc = ? (frequency reponse)

$\pi = 3.142$

$$Fc = \frac{1}{2 \times 3.142 \times 33 \times 10^{3} \times 0.001 \times 10^{-6}}$$

$$Fc = \frac{1}{2.07372 \times 10^{-3}}$$

$$Fc = \frac{10^{3}}{2.07372}$$

$Fc = 482.2252$

$Fc = 482.23Hz$

2.9 AUDIO FREQUENCY (AF) AMPLIFIER

The AF signal developed at the output of the mixer is next amplified in the audio frequency amplifier. This will increase the signal power and gain of the AF signal before it is finally fed to the next stage of the system (NPN transistor).

In this design LM386 IC is a power amplifier designed for use in low voltage consumer application. The gain is increase by the connection of a capacitor between pin 8. The connections are shown in the circuit diagram below.

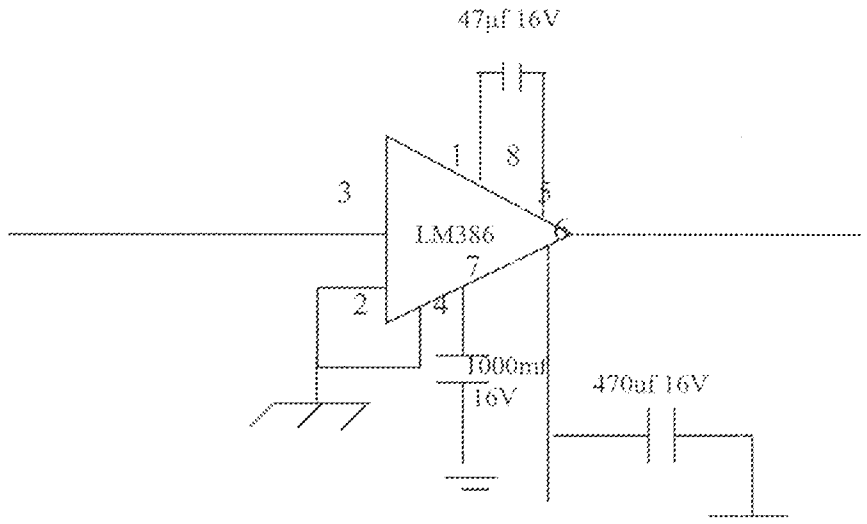
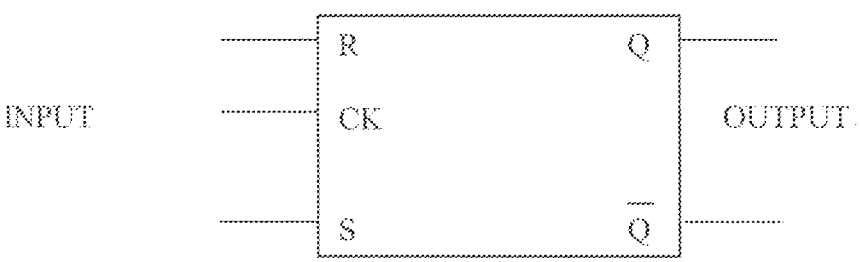


Fig 2.8 Illustrate the basic diagram of the LM386IC and how it was connected respectively.

2.11 RS FLIP-FLOP

A clocked reset set type of flip-flop called clocked R-S is perhaps the most basic flip – flop unit the operation of the basic flip – flop can be modified by providing an additional control input that determines when the state of the circuit is to be changed.

As the block and truth table of fig 2.9 show, no change occurs for both R and S inputs logical – 0 when the trigger pulse edge occurs, while S = 1 and R = 0 result in the flip – flops being set after the clock pulse, and S = 0, R = 1 result in the RESET state. To have both R and S inputs logical – 1 is not allowed, as this result is an indeterminate out put state.



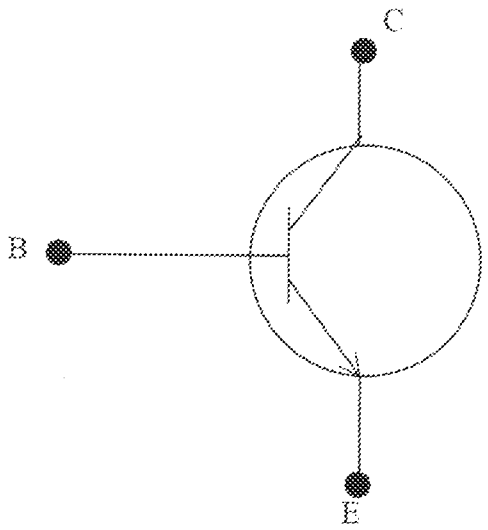
R	S	Q_{n+1}
0	0	- (NO CHANGE)
0	1	1 (SET)
1	0	0 (CLEAR OR RESET)
1	1	- (INDETERMINATE)

Fig 2.9 (a) and (b) shows the block diagram and truth table of R – S flip – flop. There are three RS flip – flops used in this design. These are 4027B1; 4060B and 4027B2. The combined effect of 4027BI and 4060B make 4027B2 to behave like a toggle flip-flop.

2.12 TRANSISTOR

Basically, it consists of two back-to-back P-N junctions manufactured in a single piece of a semiconductor crystal. These two junctions give rise to three regions called emitter, base and collector.

The transistor employed in this project is NPN transistor (25C945). An amplified signal is passed to the NPN of this transistor is such that it switches on whenever there is signal through its base and switches off when there is no signal. The output of a transistor is therefore a square waveform which is fed into the next unit of the system.



Where

B = Base

C = Connector

E = Emitter

Fig 2.10 circuit diagram of NPN transistor

2.13 RELAY

Relays are electromagnetically operated switches. The relay employed in this design is normally-closed type whose content are broken when the electromagnetically energized.

A relay basically consists of an electromagnet which operates a pair of electrical contacts. It requires just a small amount of current to energise the electromagnet which carries the movement of the armature, and hence, the closure of the contacts.

2.14 POWER SUPPLY UNIT

Power supply unit is an electrical circuit that supplies the device with an electrical energy. It can either be a battery or a rectified a.c as both used in this project. The power supply unit consists of rectifier circuit, and smoothing circuit for power regulation.

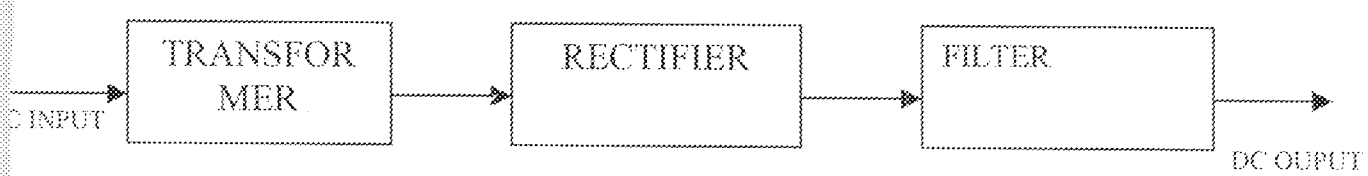


Fig 2.11 block diagram of power supply unit

2.14.1 TRANSFORMER

A transformer is an electrical a.c component or equipment, which consists of two or more coils that are linked together by mutual inductance. It used to transfer electrical power from one coil to another. It can be used to change voltage, current or impedance from one value to another.

A transformer can either be a step-up transformer. A step-down transformer was employed in this project to step-down the voltage from 220V to 12V.

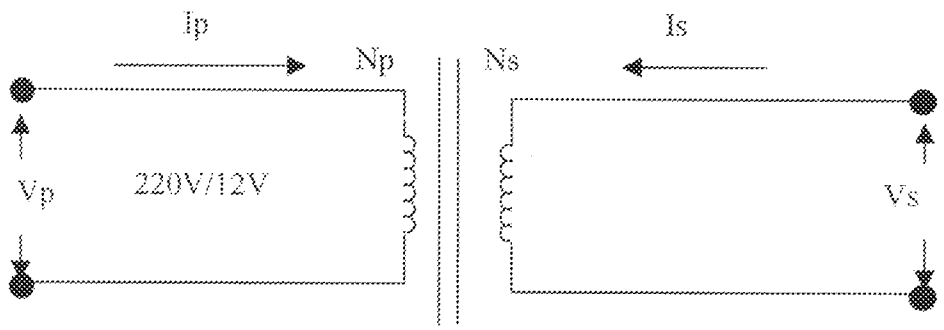


Fig a step-down transformer 220V/12V.

The primary voltage is V1 and the secondary voltage is V2. Np and Ns are the numbers of turns in the primary winding and secondary winding.

From the transformer data V1 = 220V, V2 = 12V, Is = 1000mA => 1A

The frequency fo the ac mains supply is 50Hz. The primary and secondary voltage of an ideal transformer are related as follows;

$$Vp/Vs = Np/Ns = 220/12 = 18.3$$

Hence, turns ration ratio Np:Ns = 18.3. In an ideal transformer, electromagnetic force (e.m.f) = NI

$$NpIp = NsIs$$

$$Np/Ns = Is/Ip$$

But, Is = 1000mA = 1A

$$Is/Ip = 18$$

Is = 18 Ip

Ip = Is/18 = 1/18

Ip = 0.0556 A 55.6mA.

In an ideal transformer input power (Pin) equals to the output power (Pout).

P1 = P2

IpVp = IsVs

55.6mA x 220 = 1000 x 10^{-3} x 12 = 12W

2.14.2 RECTIFIER CIRCUIT

It consists of step-down transformer to step down the a.c voltage and then convert it to a pulsating d.c signal. The type of rectifier used is a bridge rectifier and it consists of four IN4001 diodes in the arrangement shown in fig 13.0 below.

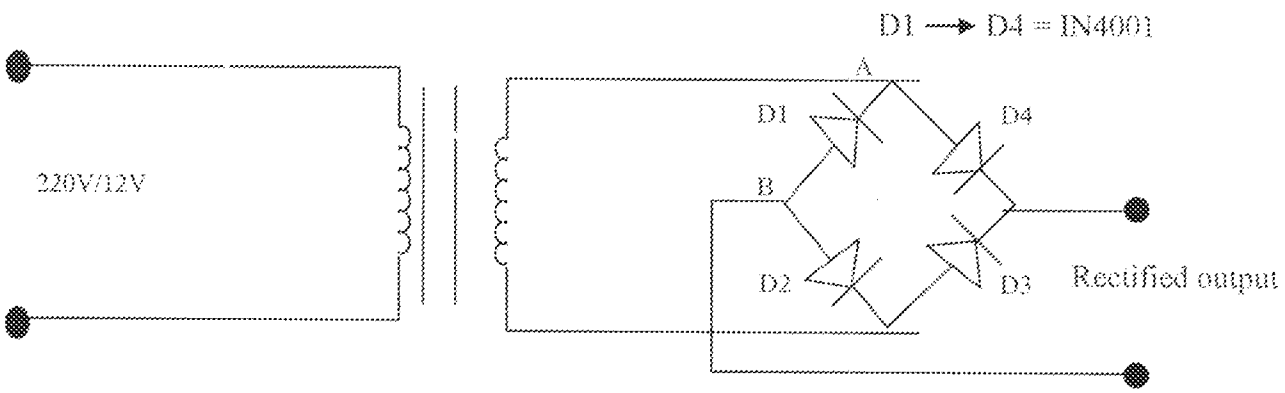


Fig 2.13 bridge rectifier

During the positive half-cycle of the ac input signal, diode D2 and D4 conduct while D1 and D3 did not conduct. Diodes D1 and D3 conduct during the negative cycle of the ac signal. The waveform obtained is of this form.

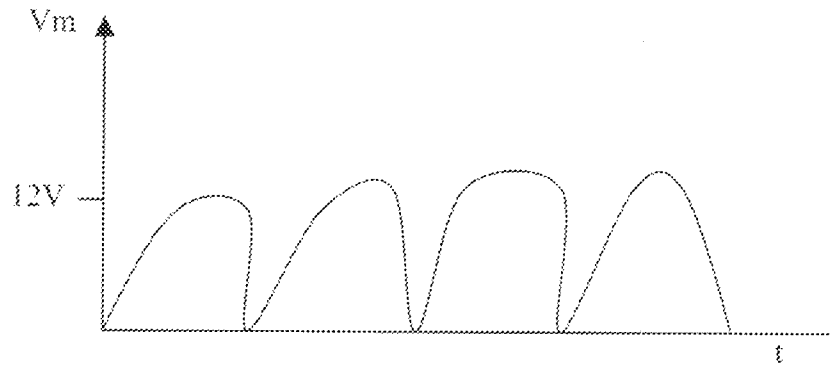


Fig 2.13 the wave form of the DC output voltage

Vs = output voltage of the transformer secondary winding = 12volts

Vs (peak) = Vs 2

Vs(peak) = 12 2 = 16.97 volts

The average dc voltage Vdc across AB

Vdc = 2/π Vs (peak) = 2/π (16.97)

Vdc = 0.636 Vs (peak)

Vdc = 0.63 (16.97)

Vdc = 10.79 volts

2.14.1 SMOOTHING CIRCUIT

The smoothing circuit is a filter network that reduces the ripples caused by the pulsation of the rectified signal. It is done by conducting a capacitor of 1000μf across output voltage Vout.

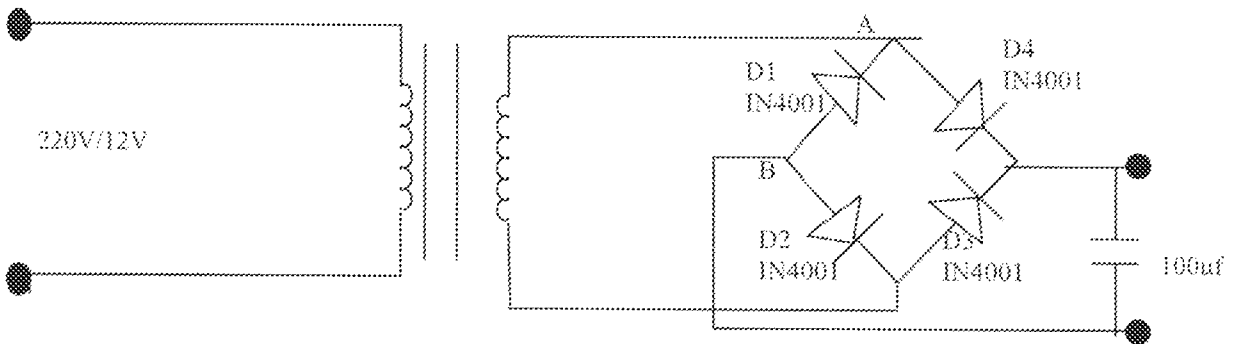


fig 2.14 smoothing circuit

When the output voltage is increased from 0volts to the conducting diodes passes current to the load to charge the capacitor. When the volt reaches its peak and begins to come down, the discharging time for capacitor is slow so that the waveform is of this form.

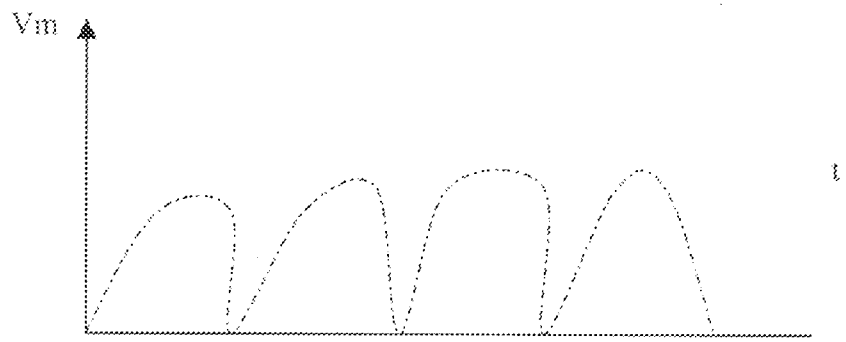


Fig 2.15 Waveform of the rectified DC voltage.

Its peak and begins to come down, the discharging time for capacitor is shown so that the wave form 16 of this form fig 2.14.

For an r.m.s (root mean square) voltage of 12 forms the transformer secondary.

Vs (peak) = 12 2 = r.m.s 2

Vs(peak) = 18.97V

Let the ripple voltage be 20% of this value,

dv = 20% of 16.97

dv = 3.39

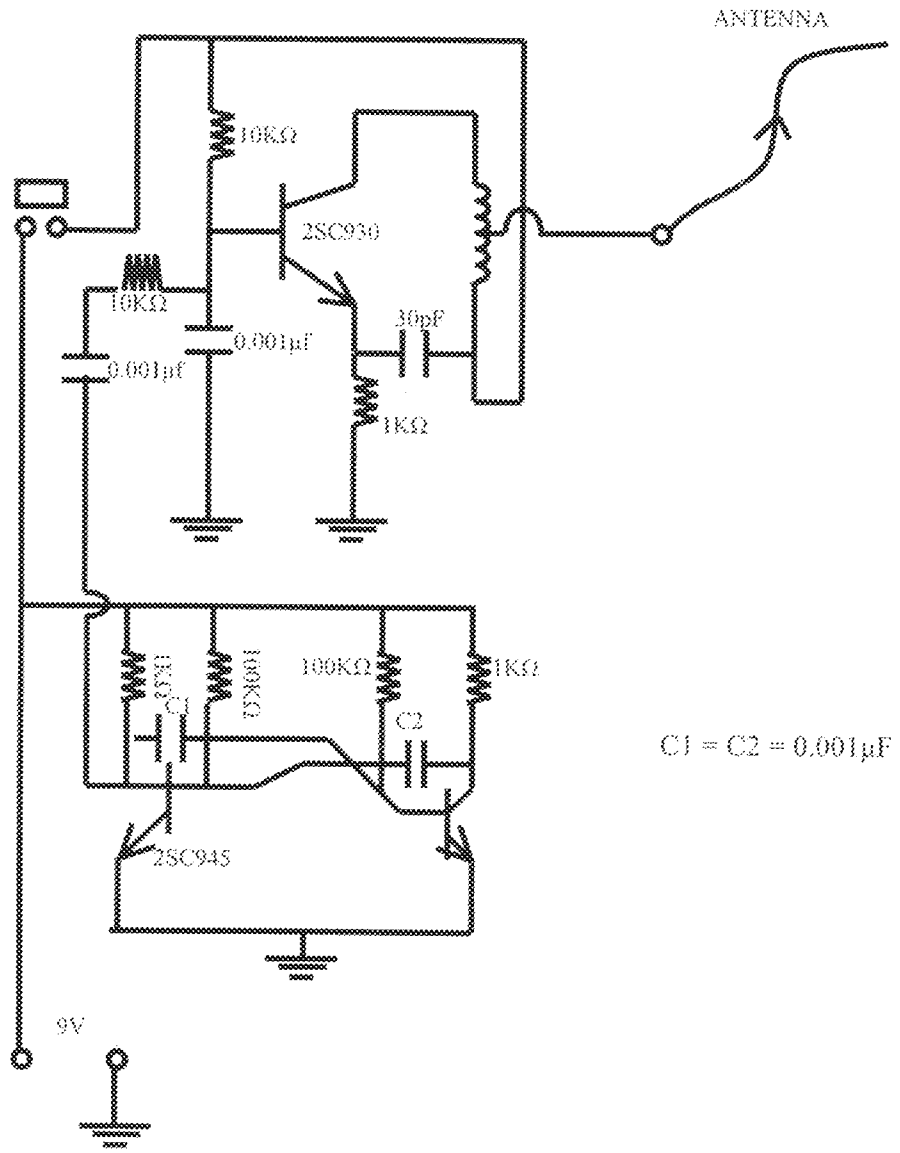
1/C = dv/dt

C = dt/dt = rms/3.39 (where dt = 3rms)

C = 0.0009

C = 900μf

A preferred valve (standard) of 1000μf/16V was used which to large enough for this purpose. The output volt with the presence of capacitor has with the ripples than without capacitor. The valve of capacitor the discharging rate is low.



TRANSMITTER unit

CHAPTER THREE

3.0 MODE OF OPERATION

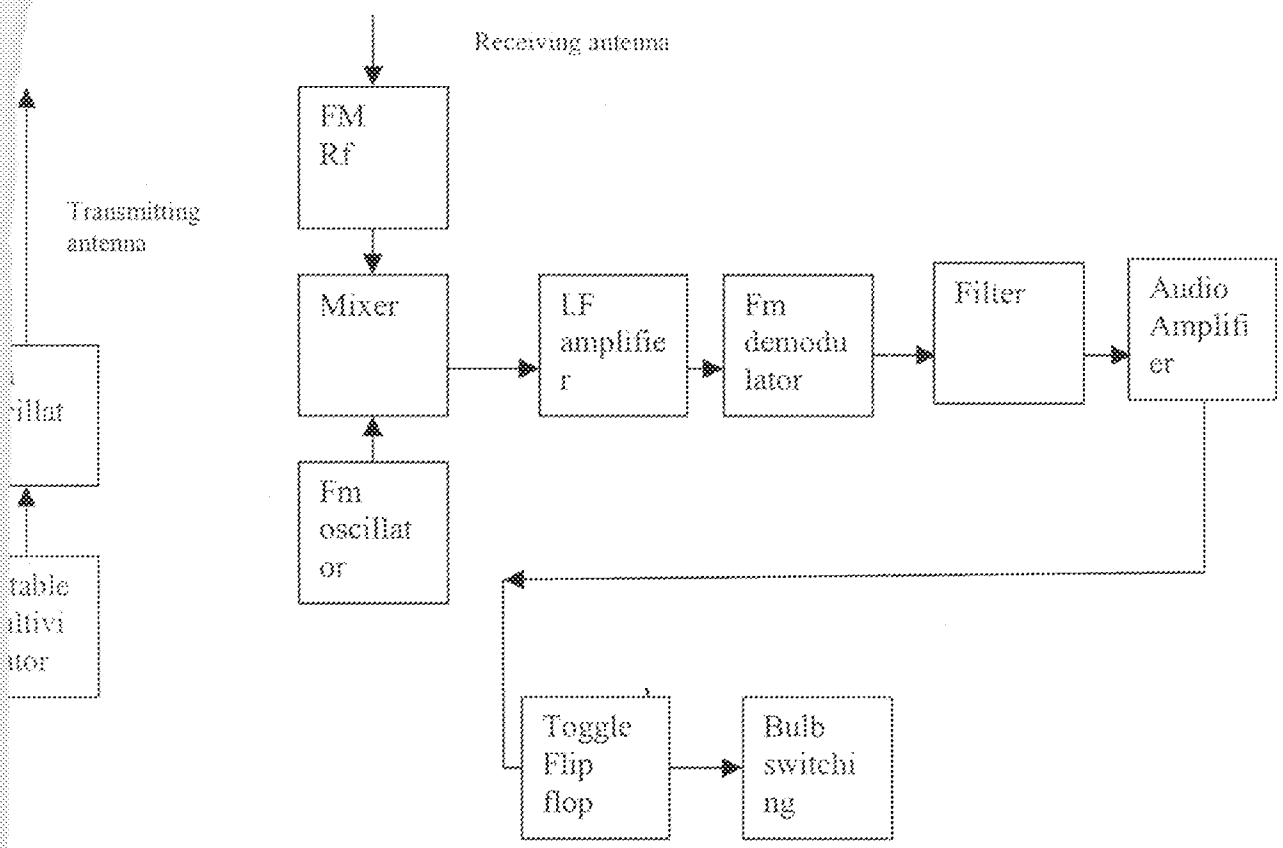
The basic working principle / operation of this design can be explained by using the block diagram shown in fig.3.1

The designs consist of two sections. The transmitting parts and receiving part. The receiving part is connected to a device to be controlled. For the transmitting past (hand heid device). The Astable multivibrator (AMV) generates pulses or is oscillating at audio frequency and is fed cr modulated into the FM oscillator so that the carrier wave carries the audio signal and the modulated carrier wave (FM) is transmitted through the transmitting antenna into the atmosphere as electromagnetic wave that can be picked up at the receiving end of the receiver. The receiver unit senses the waves radiated from the transmitting antenna through the receiving antenna. The transmitting antenna may transmit several kilowatt of power while (signals) while the receiving antenna may receive a few mill watts dissipated in it. The reason been that not all signal radiated form the transmitting antenna will be able to get to the receiving antenna.

The receiver unit is to remove any unwanted audio signal or noises by demodulating the received waves for logic control. The KA2297 is a radio integrated circuit which requires specified external components by the manufacturer. Pin 1 and 2 are concerned with the antenna circuit. The incoming signal enters the IC through this point. Pin3 and 5 deal with the intermediate frequency amplifier If. The mixer beats together two frequencies signal, the Rf and FM oscillator. The mixed frequency come out from pin3 and filtered out to pin 8. pin 13 and 15 are concern with radio frequency input and FM oscillator respectively. Pin14 is used to adjust the integrated circuit to frequency modulation

mode. Pin11 is the demodulated and audio signal output. Pins 4, 7, 9, 12, and 16 are unused. 33KΩ and 0.001uf is external filter for the out coming audio signal. LM386 is a audio amplifier. It is design to strengthen the out coming. This will increase the signal power and gain of the Af signal before it is finally fed to next stage of the system.

The output of the audio amplifier passes through 0.01uf and 33kΩ filter and then link with 4027B1 which is designed as a Rs flip flop. RS means (reset and set). When the signal arrives the Rs flip flop (4027B1) Q becomes logic one and Q becomes logic 0. Q 4027B1 enables, auto oscillator (4060B) which automatically reset Rs flip flop turning Q back to logic zero and Q to logic one and also disabling the 4060B. The combined effects of Rs flip flop and auto oscillator makes 4027B2 to behave like a toggle flip flop. A toggle flip flop behave in a mode of changing Q to either logic one or zero for every clock pulse. 4027B2 controls the npn transistor 2SC945 supplying it with positive and negative signals causing a ON or OFF effects on the relay. The npn transistor drives the relay by 12v. The diode (IN4001) is used to smoothing the operation and to remove the spark. The bulb is link or connected serially to the AC mains through the relay so that when the hand held device (transmitted unit or remote control) is pressed the bulb goes ON and a second press causes the bulb OFF. The operation controls the electric AC bulb (from 40 to 60watt)



NSMITTER UNIT
3.1

RECEIVING UNIT

CHAPTER FOUR

4.0 CONSTRUCTION, TESTING AND RESULTS

This chapter discusses the construction and testing of the project whose design has been analysed in chapter 3. It also list out the tools and components used in the project as shown below.

4.1 CONSTURCTION

The circuit construction started with metric layout of components on paper, which was checked and crossed-checked.

The construction of the project was carried out using the steps that have been designed. Construction took place by assemble the entire components one after the other on a breadboard. Following the assembly of components on the breadboard was testing. Immediately after testing, it was the lying and soldering of the components on the Vero board. During the soldering process, extra care was taken not to over heat the components because it could led to loss of rating or total damage to some of the components. After soldering, the digital circuits were tested again by powering the IC's by using multimeter to test the conditions of all the resistors and the capacitors.

CMOS IC was used for the construction of all the digital circuits. CMOSIC was chosen because of the fact that they have low power consumption. As such, the power supply to the transmitter system is a battery source (9V).

A wooden casing was also constructed in order to house the board containing the components.

4.2 TESTING

Series of testing that were carried out includes the test for output voltages at all the units by the uses of digital multimeter. Continuity test were also done to avoid short circuits the transmitting part and receiving part were tested by connecting the two parts together using a wire. This was done in order to be sure if there is transmission between the two parts.

Also, the transmitting part was separated and tested by the use of a radio receiver to sense the signal transmission of the transmitter.

4.3 RESULT

Various results were obtained for various testing. For instance, there was transmission between transmitter and the receiver when they were connected using wire.

Also, a radio receiver sensed the signal from the transmitter by making a noise when the transmitter and the receiver were separated a push-button precised from the transmitter triggered ON or OFF a light connected to the output of the receiver.

4.3.1 DISCUSSION OF RESULTS

From the design, results obtained at various stages shows that the expected results were satisfactory except for the fact that the distance between the two devices that is, transmitter and receiver was not much. This could be as a result of component malfunctioning between the transmitter and the receiver.

4.4 PRECAUTIONS TAKEN DURING THE CONSTRUCTION.

The precautions taken during the construction are as follows:

1. The bread board was extensively used for the test construction
2. The Vero board was carefully checked and tested for continuity.
3. Care was taken during soldering of the components to avoid over heating
4. Off – target solder splashes were carefully removed to avoid short – circuiting.
5. Re – checks were made more often to as certain the right position of components and jumper wires.
6. The power supply unit was normally put off from the circuit when mounting or removing component during the test construction and final constructions.
7. The polarities of capacitors (electrolytic) and the configuration of discrete components such as transistors, ICs were ensured with multimeter before; they were finally soldered on Vero board.

4.5 TOOLS AND COMPONENTS USED:

4.5.1 TOOLS:

The following tools and equipments were used during the construction: Bread board, Vero board, soldering iron, soldering stand, solder, sponge, digital multimeter, Hammer, cutter, drilling machines, nails, lead sucker and copper wires.

4.5.2 COMPONENTS

The components used during the construction include:

ICs:- KA2297, LM386, 4027B1, 4027B2 and 4060B.

CAPACITORS:- 0.001uF, 0.01uF, 33uF, 30pF, 15pF, 47uF, 470uF, 1000uF and Gang cap

TRANSISTORS:- Four NPN transistor 2 SC945.

Resistors:- 1KΩ, 100K Ω, 10K Ω, 33K Ω.

DIODES:- Five Diodes (IN4001)

SWITCH:- One push – button.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The design, construction and testing of a remote control lighting system was successful. From the design, the project was constructed and tested through which the aim of the project was achievable. That is, using the principle of wireless transmission, transmission between two systems (transmitter and receiver) was established and this can be used to control a device connected to the output of the receiver.

This project gave me an insight into quite a number of practical concepts in electronics and telecommunication engineering. It enhanced my skills in handling electronic tools and components.

The design and constructions of this project did not exempt problems, I encountered the following problems: -

a) In designing, the problem of getting appropriate materials to study the behaviour of electronics components and how they can be connected to each other to function in a required manner was encountered.

b) The unfamiliarity with the elecironic work bench made it difficult for me to design my circuit and stimulate and to easily analyse various of designs.

c) The problem of getting the required IC in the market. In this case, similar IC that does the same function were used.

5.2 RECOMMENDATION

Due to some difficulties encountered during the course of this project, I would like to recommend that:

i. Students should be allowed to choose or be given project topics proceeding on their six months industrial attachment (IT). For this will give more time in research making and thinking of improvement.

ii. The university should be properly equipped with adequate equipments so that students would be able to have enough equipment to work with during the course of carrying out their project.

iii. The practical orientation of the students should be taken more serious in order to eliminate poor design of student's final year projects.

iv. The use of electronic workbench (EWB) should be encouraged so that students will be familiar with designing and analyzing with EWB. I also recommend the latest version to be installed in the laboratory.

v. The government should be assisting students by providing research centres I also recommend that government should be involved in all engineering final year projects by awarding scholarship to lessen the financial burden to serve as impetus towards technological advancement.

REFERENCE

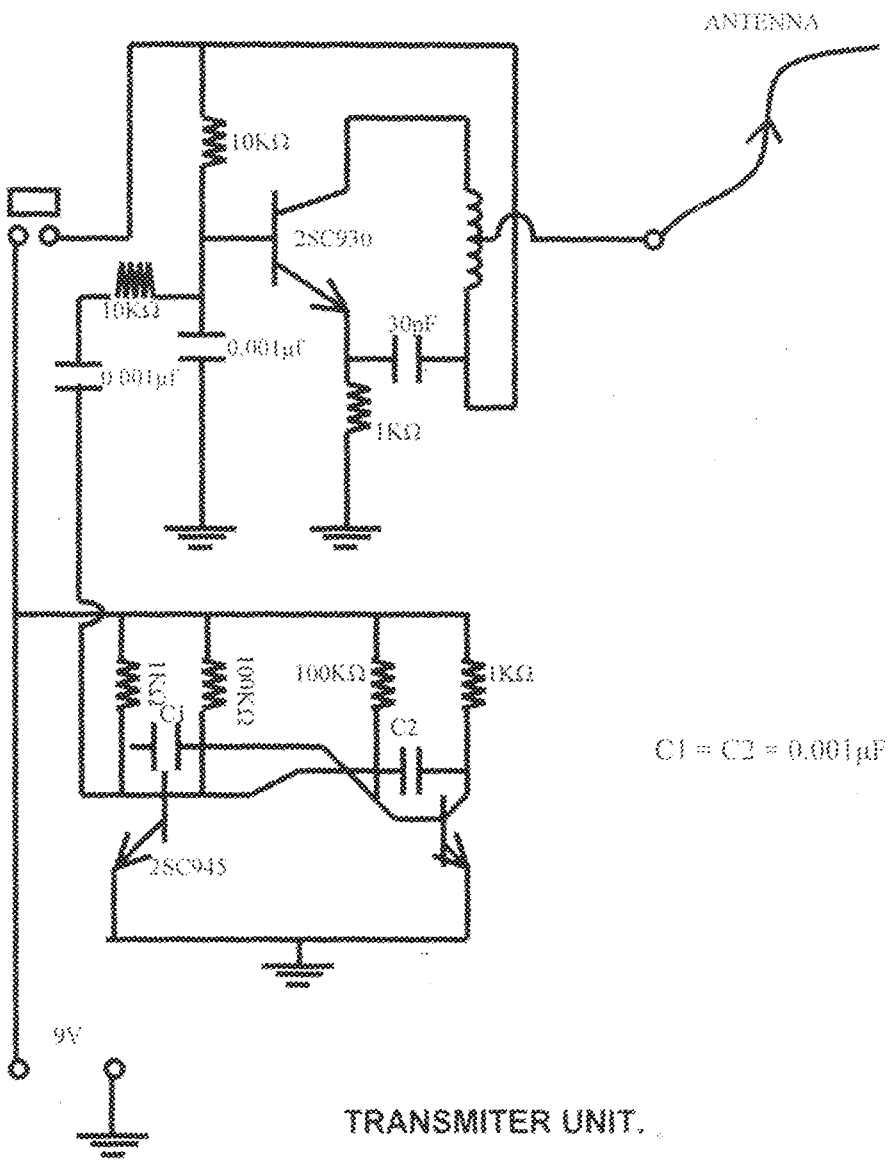
1. THERAJA B. L AND THERAJA A. K (1999) *A TEXTBOOK OF ELECTRICAL TECHNOLOGY*

2. Engr. Dr. ADEDIRAN Y.A (MAY 1997) *TELECOMMUNICATIONS PRINCIPLE AND SYSTEMS, FIRST EDITION.*

3. THOMAS L. FLODD (1994) *DIGITAL FUNDAMENTAL, 6TH EDITION*

4. FERREL C. S. (1982) *INTRODUCTION TO COMMUNICATIONS SYSTEMS, SECOND EDITION*, ADDITION WESLEY PUBLISHING COMPANY, INC

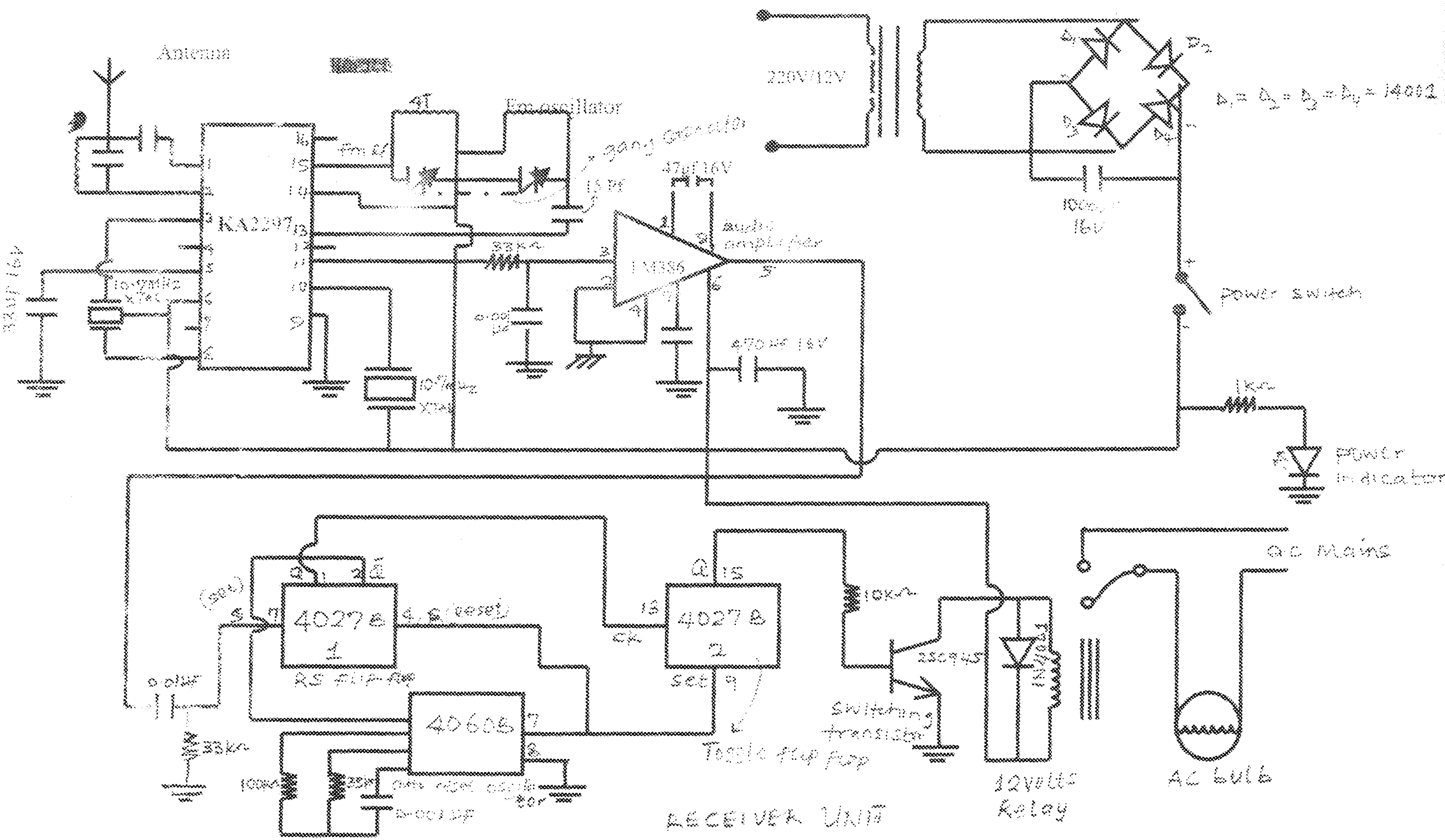
5. GAW – HILL M.C (1985) ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY (5TH EDITION) CAMBRIDGE UNIVERSITY PRESS



C1 = C2 = 0.001μF

TRANSMITER UNIT.

CIRCUIT DIAGRAM



RECEIVER UNIT