DESIGN AND CONSTRUCTION OF INFRA-RED ALARM SYSTEM

ISSA ASSANE ABDOULKADER
2001/13919EE

ELECTRICAL/COMPUTER ENGINEERING DEPARTMENT,
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

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A thesis submitted to the Department of Electrical and Computer Engineering, Federal University of Technology, Minna.

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Dedication

I dedicate this project to almighty God for being my shepherd throughout my research that finally culminated in this feasible work piece, may his grace continue to be my strength.(Amen)

Declaration

I, Issa Assane Abdoulkader, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

Issa Assane Abdoulkadir.....	Engr. J. G Kolo
(Name of student)	(Name of supervisor)
.... 10/10/06	.... 12/10/06 ....
(Signature and date)	(Signature and date)
.Engr. M.D. Abdullahi	....
(Name of H.O.D)	(Name of External Examiner)
....	....
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Abstract

This thesis work Design and Construction of Alarm System is a proposal made to uphold a multipurpose movement detector which be able to form the basis of all sorts of burglar alarms.

Infrared detection system is a detection system comprising of a source of infrared radiation used as transmitter and receiver consisting of a sensor sensitive to infrared, an amplifier, the tone decoder and the timing circuit. The infrared beam between the transmitter and the receiver is invisible, if the beam is interrupted an alarm signal is produced. The transmitter and the sensor are separated at reasonable distance where the presence of an intruder is to be detected.

The alarm sounder operates for the period determined by the timer and stops until another intruder passes in between the transmitter and the sensor.

② Acknowledgement

I wish to express my profound gratitude to my supervisor G.KOLO for his critical review, suggestions and comments that helped me immensely towards the successful completion of this thesis. I wish also to thank all my lectures of the Department of Electrical and Computer Engineering for their support and contributions towards the achievement of this work.

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CHAPTER ONE

INTRODUCTION

1.1 GENERAL INTRODUCTION

The topic of this project is the design and construction of infra-red alarm system. There are various forms of alarm system, in this particular case, the unique advantage is the use of an invisible infrared ray to detect intruders. The infrared source is a semiconductor diode made from gallium arsenide, which is a strong infrared transmitter in the 9,000 angstrom region.

The specific role the burglar must play is to learn the daily habits of any individual and wait until the ideal opportunity occurs. By taking the proper preventive method to reduce the chances of your property being burglarized, it is to install a good burglar alarm system and let it be known that such system exist. Some current application of infrared system:

MILITARY: Military fire control at might or during the day when vision diminished due to fog, smoke or haze. Detection and tracking of ships, aircraft, missiles, surface vehicles and personnel, submarine detection and range finding.

MEDICAL: Early detection and identification of cancer, obstacle detection for the blind, location of blockage in a vein and early diagnosis of incipient stroke.

SCIENTIFIC: satellite and space communication. Environmental survey and control, detection of life and vegetation on other planets and measurement of lunar and planetary temperature.

INDUSTRIAL: Aircraft Landing aid and traffic counting forest fine detection and natural resource detection.

1.2 AIMS AND OBJECTIVES

The aim of this project is to design and construct a multipurpose movement detector, which is able to form the basis of all sorts of burglar alarms and automatic controllers.

It will work either as a single interrupted beam alarm over substantial distance or will directly detect moving objects or persons by measuring chances in the level of reflected over shorter distances. It is intended that the project will be insensitive to ordinary visible light.

1.3 METHODOLOGY

Each of the stages was designed separately (i.e. Modular approach method). This project was built using integrated circuited (I.C) and discrete components. The design is composed of four basic sections, the infrared pulse generator, sensor, control unit, power supply and the alarm indicator.

The circuit diagram of the transmitter is a standard 555- astable circuit having the values of the timing components. (R_3, R_4, and C_3) chosen to give a suitable operating frequency. The output wave arm of the 555 astable was connected to the emitter diode between the output of the IC, and the negative supply rails. The next (fig. 1) is the circuit diagram of the receiver. The detector diode (D_5) is coupled to receive transmitted signal filtered by R3 and C5. At the receiver circuit is the amplifier, which is a simple three-stage common emitter type capacitive, coupled. The timer circuit employed is a 555 timer IC which has a monostable operation. The timing components are R16 and C12. The NE 567 (Tone decoder) is used to drive a load whenever a sustained frequency within its detection band is present at the selft-biased input.

1.4 SCOPE OF THE WORK

The design is such that objects are detected as they pass between the transmitter and sensor device (fig 1). They are placed in short distance a-part depending on the range are want to cover. The transmitted signal is the form of infrared pulses and the generator is an oscillator which pulses is infrared LED.

The sensor unit consists of infrared detector diode feeding a very high gain amplifier. The control unit read the condition of the sensor circuit and determine if current flowing or not. The control unit detects the loss of current flow and produces an alarm output.

A simple alternating current power supply is used to power the infrared alarm system. A 12V battery can still be used as a stand by supply.

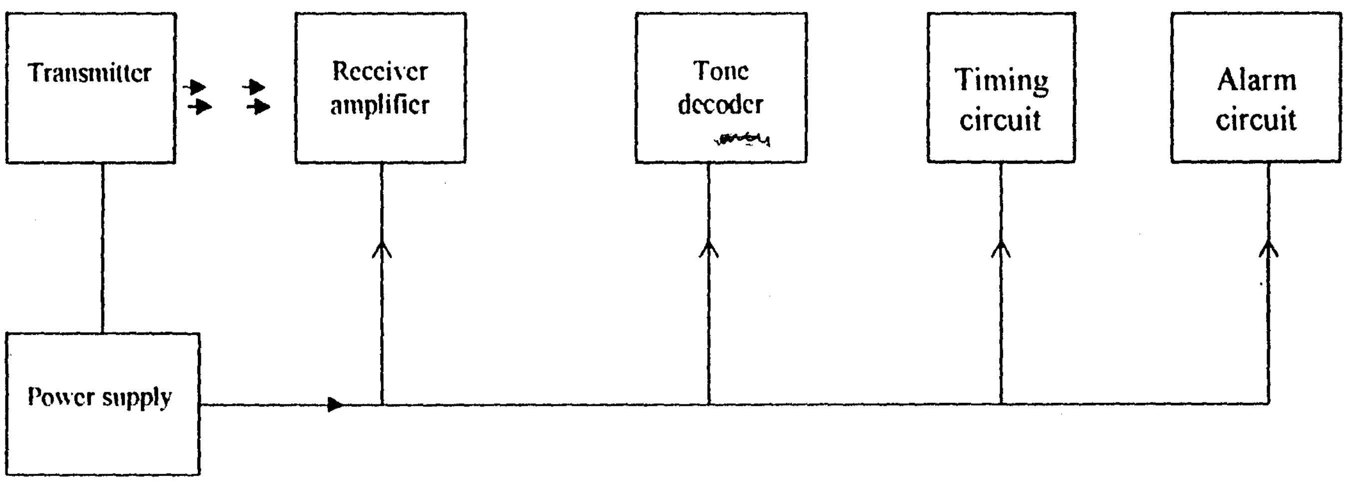


Fig. 1: Block Diagram of Infrared Alarm System

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Alarm is an electronic device that gives a warning signal of danger or state of instability in a system under a given condition. This chapter will enhance the understanding of the historical development of alarms, types and their operational usefulness in each case.

2.2 EVOLUTION OF ALARMS

According to Joe Maurath [1] the development of alarm started by the time man was created. Man being above all other animals, requires a way of giving information, which was in form of sign by exclamation. After some time this was replaced by clapping of hands. In most places of the word today this still exists. When a hand is clapped at a particular time and environment a sign has been initiated which is interpreted by another person. A serious decision will be taken to combat that situation. Sooner the military introduced the use of whispering to indicate action while laying ambush. This will give them all the information that is being carried out. All these method of giving warning or information about the state of nature were crude and unreliable. It is when technology evolved that the solution to the limitation encountered in the use of those methods was solved. It started with the building of an electronic alarm system. This is operated without human intervention. Once it gets information on the state of the system it will indicate.

The indication of the alarm depends on the configuration of the system.

Soon after the invention of the telegraph by Samuel FB More [2] in 1884, the concept of the utilizing the Boston alarm telegraph system of communication for reporting incident by means of alarm signal boxes, wired to the nearest station, was realized. Pioneer alarm telegraph system originated in the larger United States cities and had greatly spread in popularity in most other communities, especially in the east by 1900. Of interest is the Boston alarm system, since it was among the first and certainly utilized a great many glass insulations that are highly sought after today. The introduction of this system revolutionized communication by permitting messages to be transmitted instantly over long distances.

On May 30, Dr William .F. Channing of Boston and graduate of the university published an article in the Boston daily advertiser 3. He described in general terms how a practical alarm telegraph system in the city of Boston could be constructed. He convinced the Boston city government in 1857, when funds were appropriated for the construction of such a system based upon plans he devised with the associates. Moses .G. Farmer, a telegraphic engineer. This was to be the first alarm telegraph system of its type in the word.

This system embodied all of the principles of fire alarm telegraph in use today, namely, a closed electrically supervised assembly of circuit's street fire alarm boxes with code wheels and key breaks determining the number of current interruptions which produced coded signals on local instruments at central offices. The central office is where an operator-transmitted signal is received over separate alarm circuits to the appropriate firehouse. The system also featured telegraphic communication key and sounder between individual street boxes and the central offices. The completed system was placed in services at 12noon on April 28, 1852 with the first alarm offices located in the city building at Court Square and William court. Staff included a superintendent, fire alarm operators and repairmen. These were the first position of their type in the world the original system had 40 street boxes on 3 circuits and 19 alarm bells on the three circuits. The first alarm sent on the system took place on April 29, 1852 at 8.25pm. All of the boxes were of the manual crank type locked outside and the boxes were painted black. The sector type boxes started by simply pulling the hook were introduced experimentally in 1864. A new fire alarm office with improved equipment was placed in serve on December 26, 1564 in the top story of the New City Hall building at 45 School Street. Here, as was the case at the court square office, all the circuits entered the office over head, all outside wiring being of the aerial type. On December 11, 1868 the purchase and delivering of the sector type boxes was authorized and within a short time all of the original crank type units were replaced. To established communication between head quarters in the city, the central office and various district headquarters, so called dial telegraph instruments were introduced in 1874. To provide more rapid access to the boxes for the purpose of giving alarms the first keyless door was placed in service on box No. 42 at the intersection of Tremont and winter streets on April 16, 1881. On May 2, 1881 it was ordered that fire alarm boxes in the city were to be painted black. On February 28, 182 the fire alarm Division ordered the installation of telephones at the fire alarm central office, headquarters and most firehouses. However the system was not entirely completed until about 185. During late 1882 the first underground fire connections were to this cable on June 14, 1893. The first box to be connected to this underground service was box 54 on Beech Street. In 1894 a few boxes were equipped with red electric lamp indicators for the first time. On May 20, 1895 a new fire alarm office was placed into service and the new headquarters at 60 Bristol Street featured modern equipment. Here, for the first time, all fire alarm circuits entered the building through underground ducts. By October 29 1907 all fire alarm boxes in the city of Boston were equipped with keyless doors. Finally, other different alarms emerged as the technology advanced. These systems were built based on the function to be performed by each one. Today we have a large numbers of different types of alarm system you can ever think of.

2.3 TYPES OF ALARM SYSTEM

There are different types of alarm system, in existence today. The function of each alarm depends on the system configuration.

2.3.1 PROFESSIONAL BURGLAR ALARM

Joe Maurath said that using window foil "breaks" a circuit, as the glass is broken, could use the professional type burglar alarm to protect windows or glass. It is an alarm that is triggered when the protective glass is broken. It is an alarm that is an alarm is triggered when the protective circuit is opened. All protective door and window circuits must be normally closed series connected so that an opening of any protective device wills triggers the alarm. Once the alarm is triggered it can be turned off only be opening master switch. The recommended power supply is an AC powered 6VDC source or a lantern battery, standing current is about 100μf.

2.3.2 LATCHING BURGLAR ALARM

This makes use of relay latching circuit. The input terminals are connected to parallel wired normally Open (N.O) magnetic switches, or wire type security switches stretched across a window that closes a ball circuit when the wire is pushed or pulled.

When a security switch closes the series battery circuit the relay pulls in. One set of contents closes the alarm bell circuit. While the second set "latches" the battery circuit. Even if the security switches are opened the alarm remains on to disable the alarm or for reset, a concealed switch in series with one battery lead is installed.

2.3.3 OPEN CIRCUIT BURGLAR ALARM

These simple electronic latches up alarm circuit handles normally open protective devices such as conceal for mat switches. All protective devices are connected in parallel and the alarm is tripped as soon as any of the devices are closed. There is no stand by current and a battery power source will last its sheaf life. Either a line powered 6VDC supply or a 6v lantern battery is used. Once the alarm is tripped opening the master switch can only turn it off.

2.3.4 ANTI-THEFT CAR ALARM

Electronic magazine of March, 1983 affirmed that, the unit is mounted somewhere in the car where it will be difficult to find and removed. The switch is located under the dashboard where the driver can reach it but where a thief will not easily find it. When the ignition is turned on with the switch closed, whether by using the key or by "hot" wiring the circuit will be activated.

2.3.5 SPEED LIMIT ALARM

It is wireless portable unit adaptable with most internal combustion engine vehicles. This circuit has been designed to alert the vehicle driver that he has reached the maximum fixed speed limit (i.e. in a motor way). It eliminates the need to look at the tachometer and to be distracted from driving. There is a strict relation between engine RPM (revolution per minute) and vehicles speed. So this device controls RPM and start beeping and flashing a LED (light emitting diode), once per second when maximum fixed speed is reached. Its outstanding feature lies in the fact that no connection is required from circuit to engine.

2.3.6 INDUSTRIAL ALARMS

This alarm comes in three versions as stated in RS book of October 1992. The 12V dc GREY bell are affordable home security. Whenever any vehicle, this is ideal for use in security system and complies with the requirements of BS4737 intruder alarm system in buildings. The unit must be mounted within a bell enclosure when used in external environments of BS5839 fire detection and alarm systems in buildings. The 20Vac GREY bell is an extremely effective signaling unit for use in industrial environments.

The design avoids the need for mechanical contacts resulting in greater reliability effective and longer operating life. All units may be ceiling or wall mounted, with flush or surface wiring and requires no final setting up adjustment. A chip holds the movement to a tough polycarbonate base, and a twist lock mechanism holds the going in position.

2.3.7 INTRUSION DETECTION ALARM SYSTEM

The intrusion detection alarm system provides effective and affordable home security when ever any vehicle, intrusion detection as unexpected guest approaches your property. This perimeter intrusion detection system alerts you of arrival. It is simple to operate yet technically sophisticated and is completely wire-less. It is ideal for monitoring your drive way, yard, house, etc. The system, consist of two basic component; an infrared senor detects the presence of a vehicle or person through heat and motion, and then immediately transmits via a 300MHz radio signal to the receiver in the house which sounds the alarm. It has an exceptional range of up to 1500 feet. The sensor/transmitter is a special military version. Its military colour of green is to blend it directly in outdoor

Intrusion it mounts easily on a tree or fence in the garage at a pool entrance or anywhere security is desired. The sensor has an adjustable field or view with a 30 feet detection zone and is powered by a 9 volts battery. The battery can last over a year since the circuit draws just 0.05 milliamps. The receiver/alarm unit is plugged into a standard electrical outlet inside the house. Upon receipt of the alarm transmission signal from the sensor unit the receiver sounds its alarm and activates a LED light for five seconds and then reset itself. The receiver has a volume control for the alarm and terminal board for connection of an optional external siren.

2.3.8 REFRIGERATOR DOOR ALARM

This system is so designed to indicate the state of a refrigerator door. This alarm was designed based on the light sensitivity received when a refrigerator door is opened. Today many people are conscious of the havoc caused by lack of preservation of foods as in some cases the items get spoiled when the refrigerator door is left open for a long time. So this system will alert someone that the refrigerator door is not closed. It shows thus when it starts beeping after a preset time.

CHAPTER THREE

DESIGN ANALYSIS

3.1 INTRODUCTION

The system design of the infrared security involves different stages of operation. It includes the:

- The power supply
- The transmitter
- The receiver / IR amplifier
- The tone decoder
- The timing circuit
- The alarm circuit

3.2 POWER SUPPLY

The power circuit was designed with two sets of bridged rectifying diodes so as to totally shield the transmitter and receiver circuit. The input power to the system is 220v, which is stepped down 12v through a step down transformer. The down 12v is still a.c and need to be converted to d.c required by the system. To achieve this, the rectifier section is used which comprises of four diodes. Discrete diode can be used or IC diode of which the IC type is used in this design and it is IN4001. Output from the full wave rectifier diode contains ripples and needs to be smoothened further. The capacitor takes this voltage and charges during positive half [8] of signal and during negative half it discharges given continuous signal. Capacitors of higher values are used to give the required output. In this case 470µf, 25v and 100μ*f*, 16v are used. A 6v regulator is used to ensure constant output of 6v inrespective of any variation of output current.

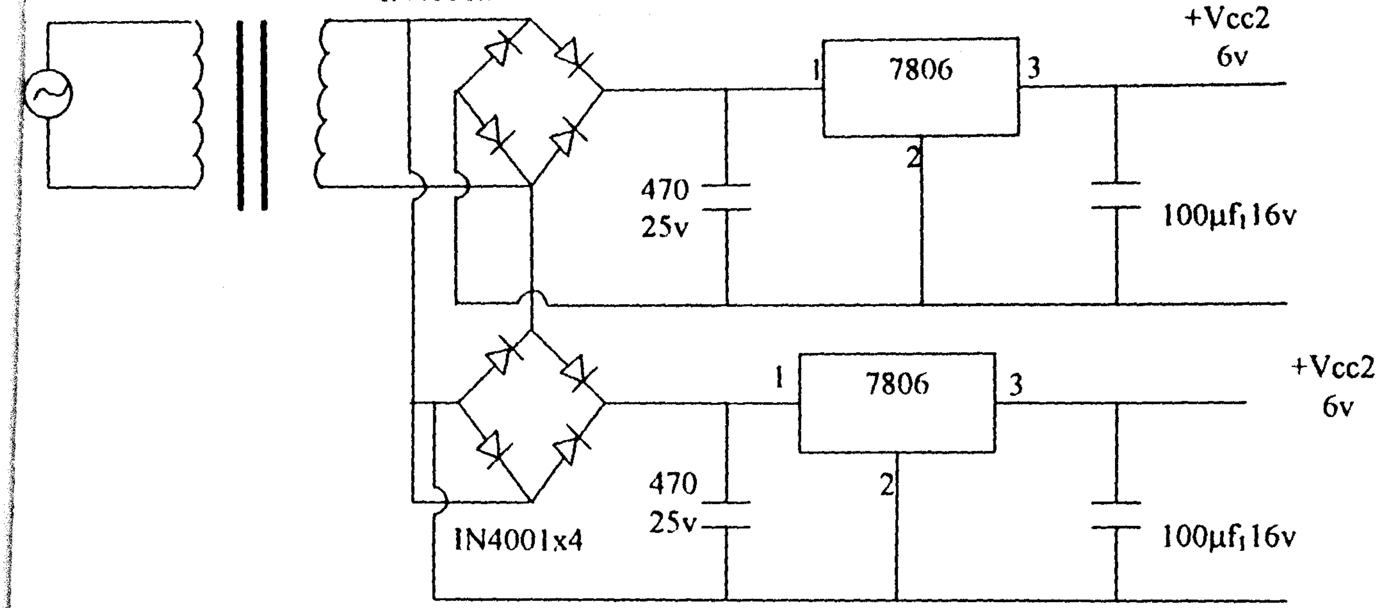
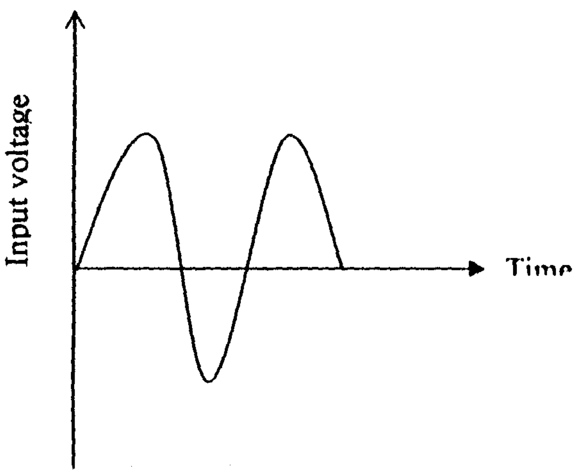
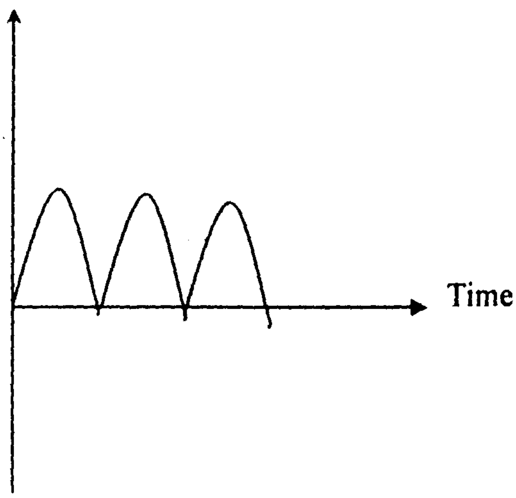


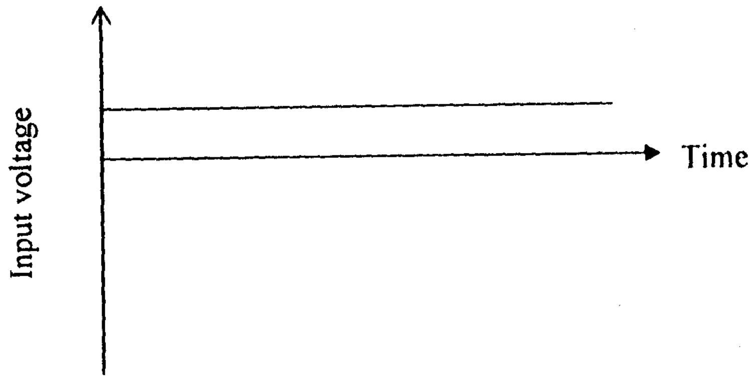
Fig 3.2a Block Diagram of the Power Unit



a) Full wave rectification



b) Fluctuating direct current



c) Steady direct

Fig 3.2b Signal Representation of the Output of the Power Unit.

3.2.1 TRANSFORMER

It is a device consisting of two closely coupled coils in which on a.c signal applied to the primary appears across the secondary with a voltage transformer and current multiplication is inversely proportional to the turn's ratio. A transformer could be a step up transformer in which the input voltage is stepped up (increased) at the output voltage is stepped down (decrease) at the output. In this design a step down transformer is used since the speaker needs 6V to operate.

The transformer used also a 220v/12 step down transformer where [5]:

$Vm = \sqrt{2} \times Vrms$

$= \sqrt{2} \times 12$

$= 16.97V$

$Vdc = \frac{2Vm}{\pi}$

$$= \frac{2 \times 16.97}{3.142}$$

$$= 10.08V$$

3.2.2 CAPACITOR SELECTION

Voltage rating [7]:

Capacitor voltage, Vc rating $> \sqrt{2}$ Vrms

$$\sqrt{2} \times 12 = 16.97V(\sqrt{2}Vrms)$$

$$VC \geq 16.97\ V$$

A capacitor of voltage rating of 25V was chosen.

$$\text{Therefore } C = \frac{Idc}{4\sqrt{3} \times f \times Vm}$$

Where Idc = 0.276A = 276ma

F = 50Hz

Vrm = 16.97V

If ripple = 0.1

$$C = \frac{0.276}{4\sqrt{3} \times 50 \times 0.1 \times 16.97}$$

$$= 469 \times 10^{-6}\ F$$

$$= 470\mu f$$

The point + Vcc_1 in fig 3.2a are to be, connected to the transmitter, circuit, while + Vcc_2 is to be connected to receiver, tone decoder, timing, circuit and the alarm circuit.

3.2.3 VOLTAGE REGULATOR

Line voltage at output at a power supply often fluctuates by as much as 10-20% causing the output voltage of the phase to vary [5], the current drawn by the supply load may have a wide range of values, and in addition the temperature may change this effect and tend to change the output voltage. A regulator is normally connected between the filter and the load designed to maintain a nearly constant output voltage for anticipated variation in input voltage load current and temperature.

There are several regulation circuits used for power supply design, the IC voltage regulator and the series voltage regulator.

An IC voltage regulator was used for this design, for a fixed 6v output, the CI voltage regulator 7806 was used to obtain this output. The circuit diagram of the voltage regulator is show in fig3.3.

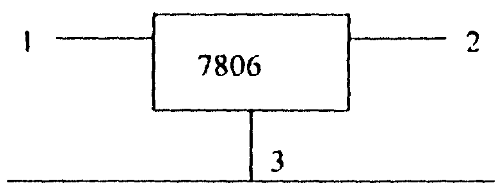


Fig 3.3 The Voltage Regulation Circuit.

For the 6v output, the IC voltage regulator 7806 was used to obtain this output. These include fairly simple, fixed voltage types of high quality precision regulators. These IC regulators have much improved performance as compared to those made from discrete components. The IC is a three terminal type; if excess current, or overheating should occur the IC would shut down to prevent any damage being caused.

Therefore, the power unit comprises of

1) Transformer used to step down the 220v to 12volt

2) Diodes used for rectification (IN4001)

3) Capacitors (electrolytic) used for smoothing the 12v ac to 12v dc 470μ*f* 25v 100μ*f* 16v.

4) Voltage regulator

3.3 THE TRANSMITTER

The transmitter circuit or pulse generator in fig3.4a is a standard 555 astable circuit with an infrared emitting diode at the output. The frequency, F, of the pulse produced by the astable is given by: F= 1.44 / (R1 + 2 R2) Hz [4]With the mark period three times longer than the space times so that the emitter diode is only pulsed on 25% of the time figure. This was done to keep the average current consumption of the circuit down to reasonable Level fig and by calculating the frequency of the astable multivibrator.

$$F = \frac{1.44}{c_1(R1 + 2R2)}$$

Where $C_1 = 0.1\mu$ f, R1 = 1kΩ R2 = 10kΩ

$$F= \frac{1.44}{0.1(1000 + 20000)x10^{-6}}$$

= 685, 7 Hz

The 390 Ω timing resistor was calculated thus:

$$R=\frac{Vcc - V1}{Id}$$

Where Vcc = 6V, V_1 = 2 V, ID = 10mA

$$R = \frac{6-2}{0.01}$$

$= 400\ \Omega$

390 Ω was used because of non-availability of 400 Ω. The 0.1μf at pin5 is to help the limit error in the frequency.

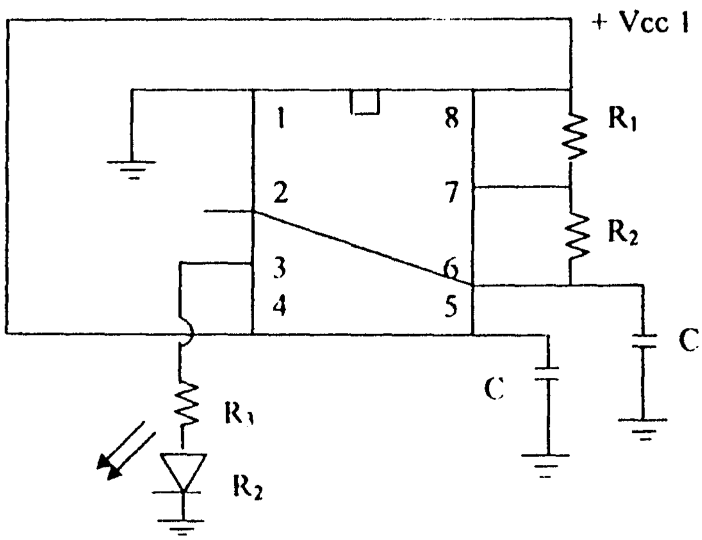


Fig 3.4a the Transmitter Circuit

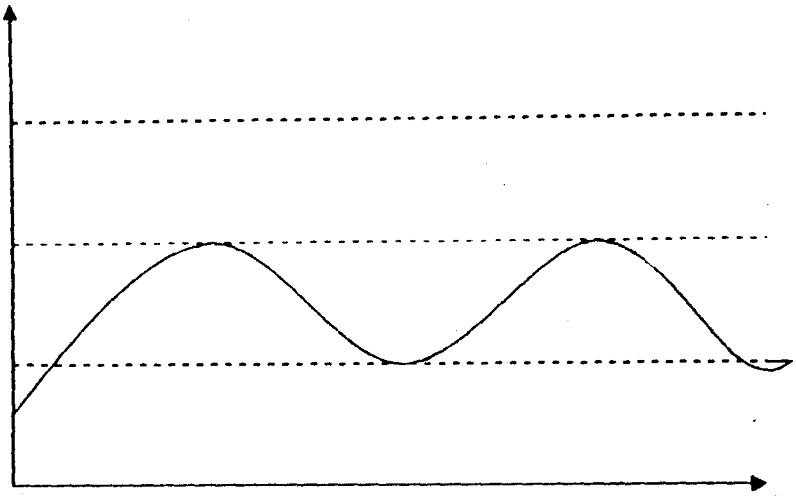


Fig 3.4b

3.4 THE RECEIVER / FR AMPLIFIER

For the transistor to be used as amplifier, the following were done:

- Bias at the mid-point of transistor operation
- Collector resistor, R_C and base resistor, R_B were included
- A transistor of high gain, hFE were chosen
- Base resistor value used was very high

Since high input resistance implies small base current and this together with high hFE increases the sensitivity of the transistor figure

Capacitor C was included to the block d.c (component of the signal into the transistor).

The loop equation gives:

$Vcc = Ic \times R_L + V_{BE}$

$Vcc - V_{CE} = I_C \times R_L$ -- (i)

V_{CE} $I_B \times R_B + V_{BE}$

$V_{CE} - V_{BE} = I_B \times R_B$ -- (ii)

Dividing equation (i) by (ii)

$$\frac{V_{CC} - V_{CE}}{V_{CE} - V_{BE}} = \frac{I_C R_L}{I_B R_B} \quad \text{------------------------------------ (iii)}$$

But hFE = I_C / I_B

Hence substitute hFE in equation (iii)

$$\frac{V_{CE} - V_{CE}}{V_{CE} - V_{BE}} = \text{hFE} \left(\frac{R_L}{R_B}\right)$$

$$\text{hFE} = \frac{R_B}{R_L} \left(\frac{V_{CC} - V_{CE}}{V_{CE} - V_{BE}}\right) \quad \text{------------------------------------ (iv)}$$

For the first amplifying stage the hFE can be calculated.

Where $R_B = 3.319\text{k}\ \Omega$ $V_{CC} = 5.9\text{v}$
$R_L = 4.7\text{k}\ \Omega$ $V_{CE} = 4.3\text{v}$
$V_{BE} = 0.56\text{v}$

By using equation (iv)

$$\text{hFE} = \frac{3300000}{4700} \left(\frac{5.9 - 4.3}{4.3 - 0.56}\right)$$

$$= 702 \left(\frac{1.6}{3.74}\right)$$

$$= 300$$

Hence hFE = 300

For the second amplifying stage the gain is:

Where $V_{CE} = 2.38\text{v}$, $V_{BE} = 0.53\text{v}$, $R_B =$ $R_L = 4.7\text{k}\ \Omega$

$$\text{hFE} = \frac{1000000}{4700} \left(\frac{5.9 - 2.38}{2.38 - 0.58}\right)$$

$$= 213 \left(\frac{3.52}{1.8}\right)$$

$$= 416$$

Hence hFE = 416

For the third amplifying stage the gain is:

$V_{CC} = I_B R_B + V_{BE}$

$V_{CC} - V_{BE} = I_B R_B$ -- (i)

$V_{CE} = F_C R_L + V_{BE}$

$V_{CE} - V_{BE} = I_C R_L$ -- (ii)

Dividing equation (ii) by (i)

$$\frac{V_{CC} - V_{CE}}{V_{CE} - V_{BE}} = \frac{I_C R_L}{I_B R_B} \text{ -- (iii)}$$

But hFE = I_C/I_B

By substituting hFE in equation (iii)

$$\frac{V_{CC} - V_{CE}}{V_{CE} - V_{BE}} = \text{hFE}\left(\frac{R_L}{R_B}\right)$$

$$\text{hFE} = \frac{R_B}{R_L}\left(\frac{V_{CC} - V_{CE}}{V_{CE} - V_{BE}}\right)$$

Where R_B = 470k Ω, R_L = 4.7k Ω, V_{CE} = 3.7v, V_{BE} = - 1.22v

$$\text{hFE} = \frac{470000}{4700}\left(\frac{5.9 - 3.70}{3.70 - 1.22}\right)$$

$$= 100\left(\frac{2.2}{4.92}\right)$$

$$= 44.7$$

For the total hFE:

hFE = 300 + 416 + 44.7

= 760.7

hFE = 760.7

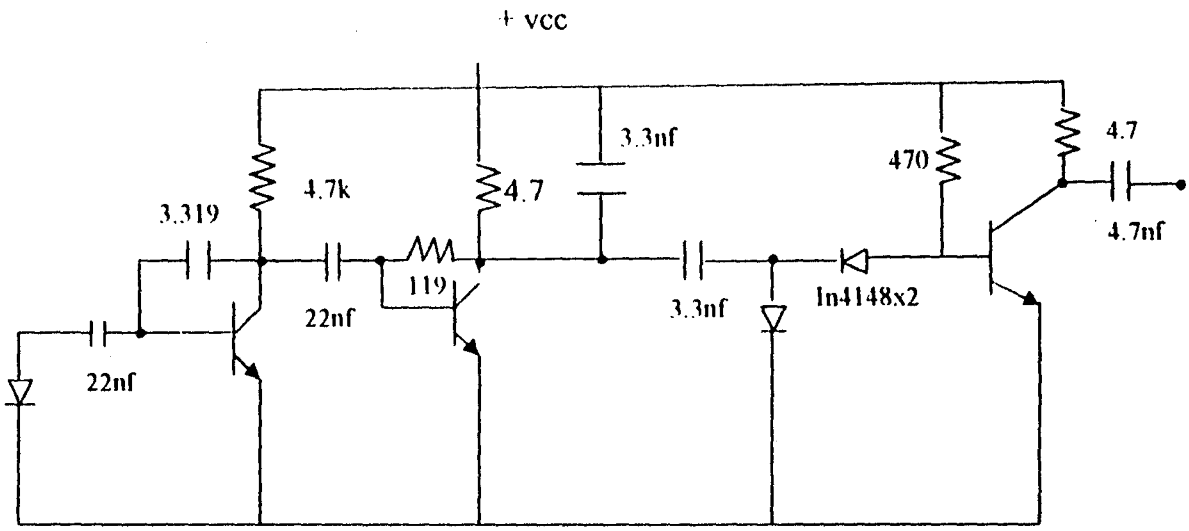


Fig 3.5: Receiver Circuit.

3.5 THE TONE DECODER

The NE567/SE567 tone [9] and frequency decoder is a highly stable phase-locked loop with synchronous AM lock detection and power output circuitry. Its primary function is to drive a load whenever a sustained frequency within its detection band is present at the self-biased input. The bandwidth center frequency and output delay are independently determine by means of four external components.

THE NE567 HAS THE FOLLOWING FEATURES:

- Wide frequency range (0.01 Hz to 500 kHz)
- High stability of center frequency
- Independently controllable bandwidth (up to 14%)

- High out-band signal and noise rejection
- Logic-compatible output with 100 mA current sinking capability
- Internal immunity to false signals
- Frequency adjustment over a 20-to-1 range with an external resistor

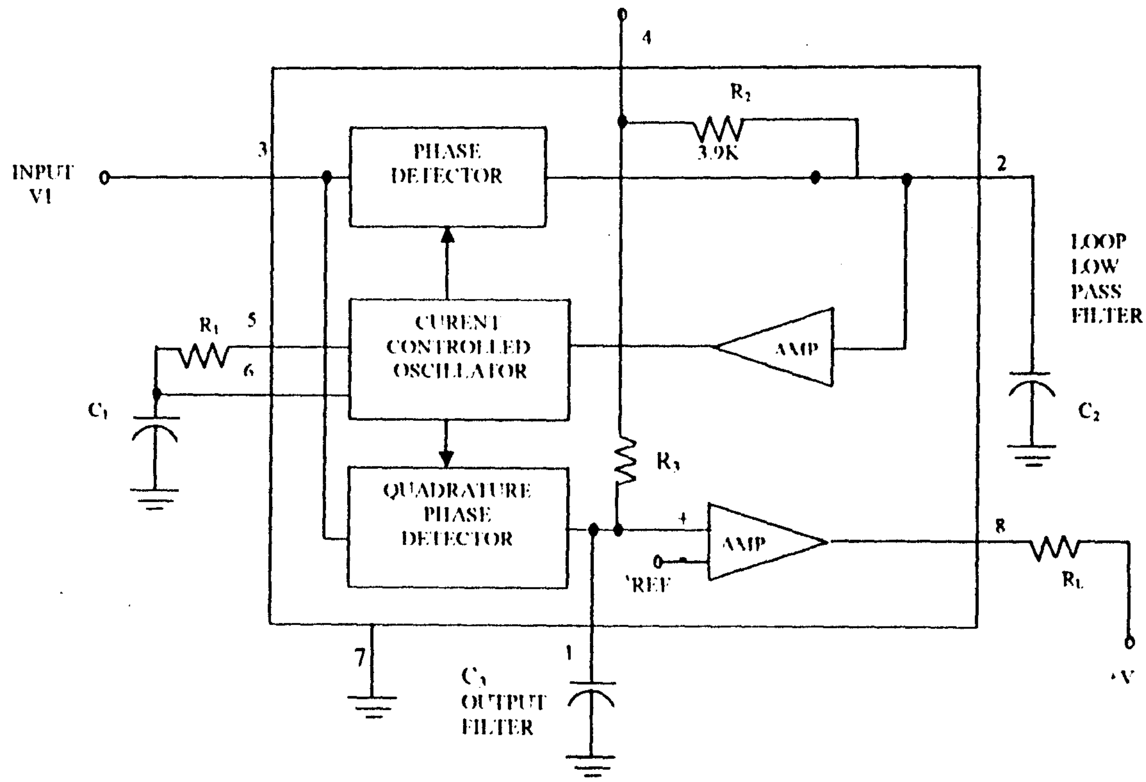


Fig 3.6a Block Diagram Circuit.

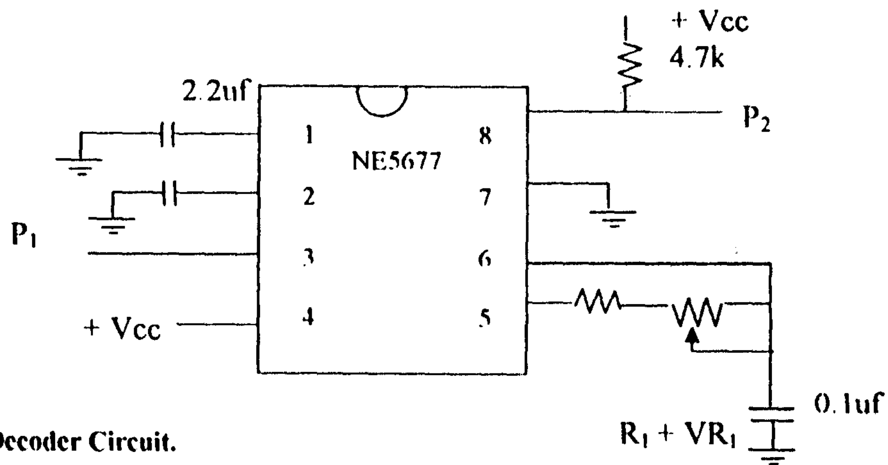


Fig 3.6b Tone Decoder Circuit.

The point P_2 is to be connected to P_1 of fig 3.6b. The frequency of oscillation of the toned decoder was calculated.

By using the design formulas:

$$F_0 = \frac{1}{1.1 R_1 C_1}$$

Where $R_1 = R + V_{R1}$, is a

$C_1 = 0.1\ \mu f$

F= 685.7Hz

$$R_1 + V_{R1} = \frac{1 \times 10^6}{1.1 \times 685.7 \times 0.1}$$

$R_1 = 13.258k\ \Omega$

V_{R1} was chosen to be 10k Ω and a fixed resistor (R) 10k Ω. The variable resistor was then adjusted until this frequency (i.e. 685.7Hz) was attained.

The bandwidth of the tone decoder was also calculated:

$$BW = 1070\sqrt{\frac{1.33}{f_0 C_2}}$$

Where V_1= input voltage (Vrms)

C_2= Low-pass filter capacitor (μf)

$$V_1 = {}^{1.88}\!/_{\sqrt{2}} = 1.33V$$

$V_1 = 1.33V$, $F_0 = 685.7Hz$, $C_2 = 1\mu f$

$$BW = 1070\sqrt{\frac{1.33}{(685.7 \times 1 \times 10^{-6})}}$$

$$= \frac{1070}{\sqrt{(1939.62)}}$$

$$= \frac{1070}{44}$$

$= \pm 24.318Hz$

3.6 THE TIMING CIRCUIT

The 555-timer monostable circuit is design to switch on a device for a pre-set period of time and then switch off.

The delay time, t is given by

$t = 1.1\ R_{15}\ C_{12}$

$t \propto R_{15}\ (1.1\ C_{12} = \text{constant})$

$R_{15} = 1MK\ \Omega$

$C_{12} = 1.1 \times 22010^{-6} \times 1 \times 10^{6}$

$= 242sec$

Point (P_1) is to be connected to P_2 fig 3.7a, such that on receiving a position signal from P_1 the trigger pin of the 555 timer is grounded via the transistor and then timing commences. The output pin (i.e. P_2) becomes high for the length of about 242 seconds. Then the switch connected to pin 4 of the 555 timer is the reset switch to stop the alarm. Sw1 is the deactivating switch. When depressed, the alarm system is deactivated and the beam can be broken without the alarm being activated.

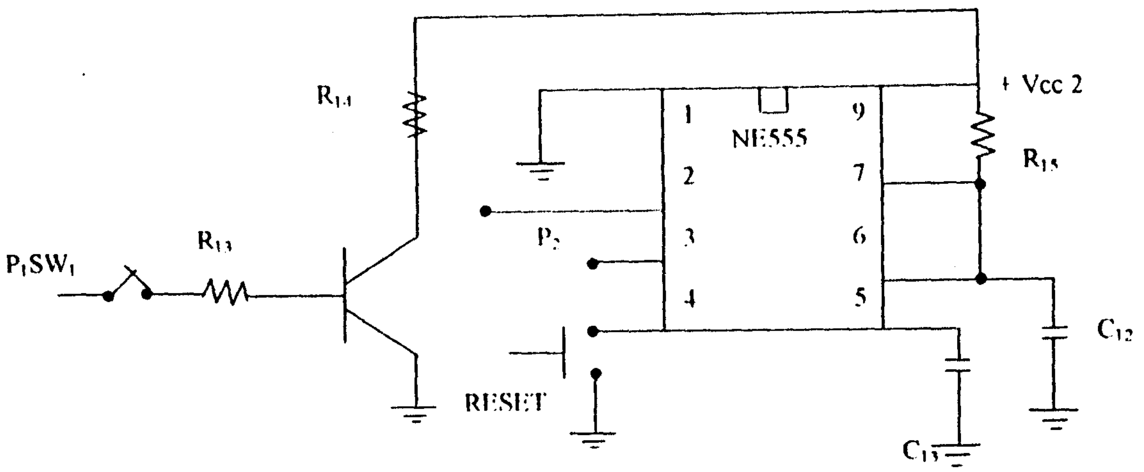


Fig 3.7a Timer Circuit

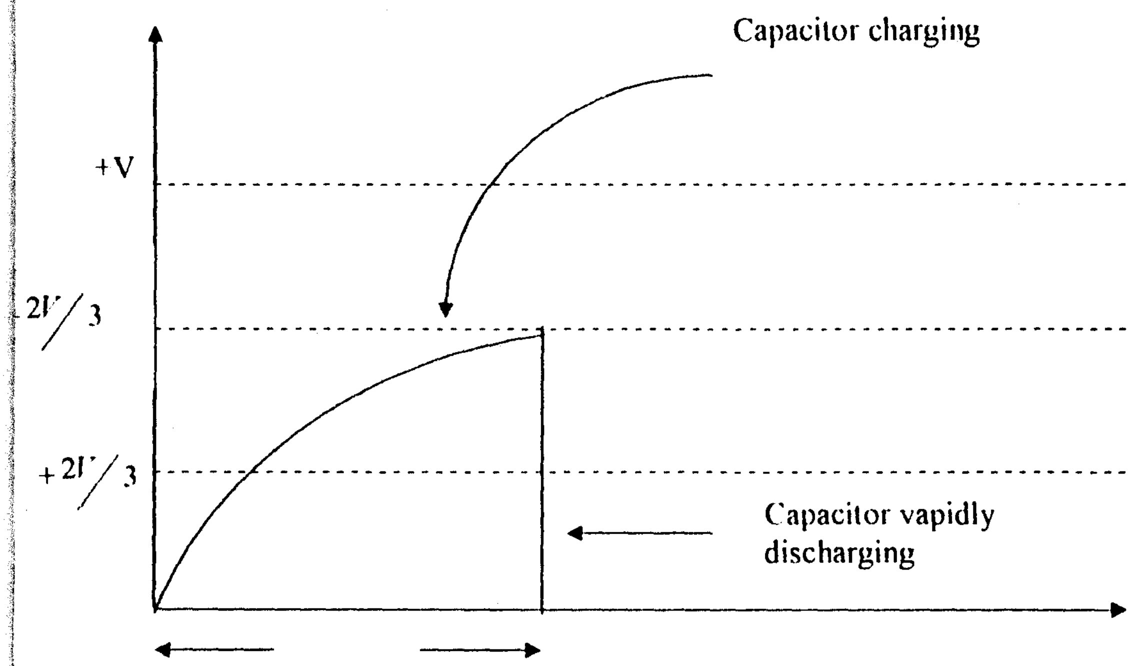


Fig 3.7b capacitor charge and discharge curve for 555-monostable function

3.7 THE ALARM CIRCUIT

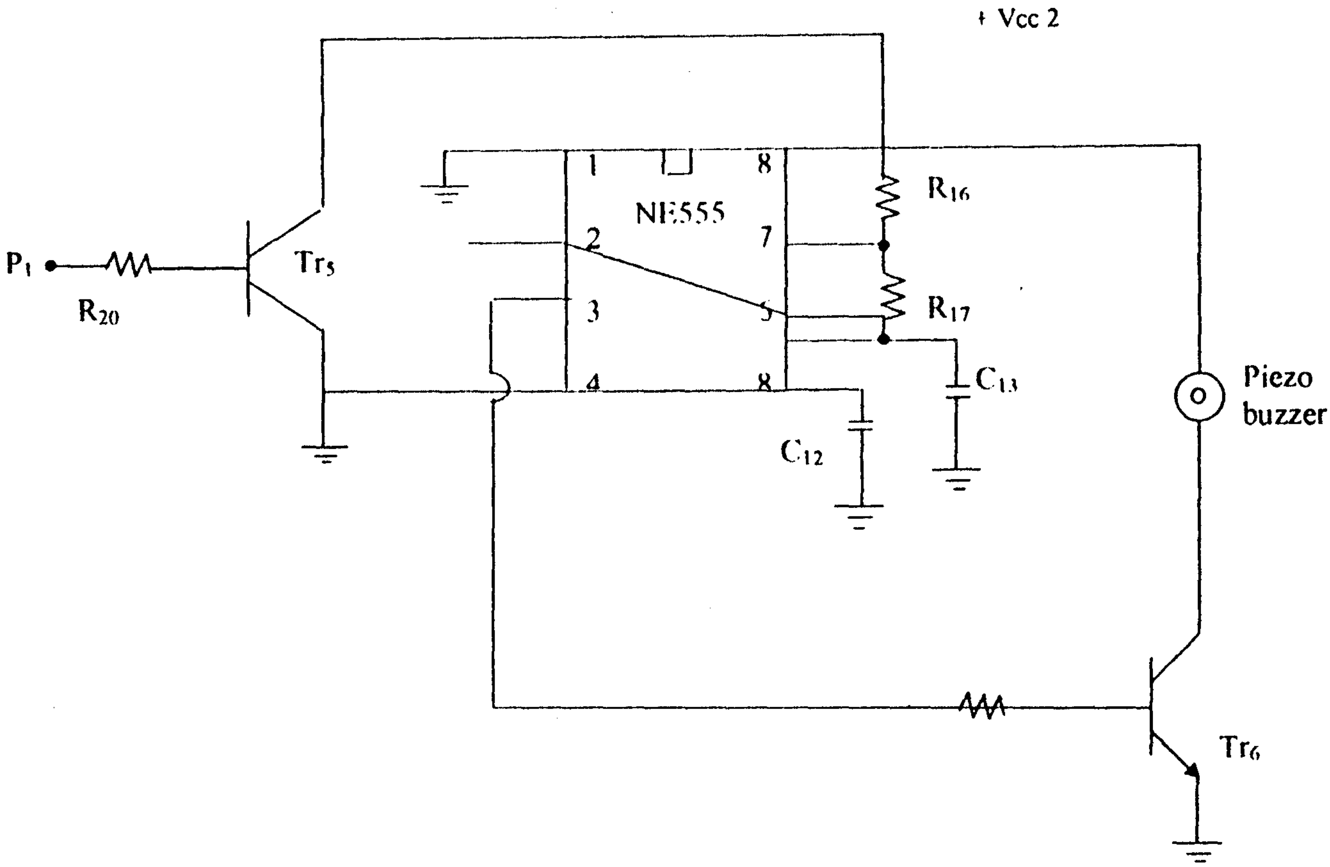


Fig 3.8 Alarm Circuit.

The alarm circuit was also designed using the NE555 timer.

P_1 is to be connected to P_2 of fig 3.7a. The frequency of oscillation of the alarm circuit was calculated.

$$F = \frac{1.44}{C_1(R_1 + 2R_1)}$$

Where $C_1 = 10\mu f$, $R_1 = 4{,}7k\ \Omega$, $R_2 = 82k\ \Omega$

$$F = \frac{1.44}{10 \times 10^{-6}(47000 + 82000)}$$

F=1.66Hz

From the result the oscillator on receiving – a positive Voltage from P2 of fig 3.7 a, -a positive voltage –appears at pin 4 of the time IC - and then oscillation – commence. The output of the oscillator thus clocks the NPN. Transistor (i.e. Tr6) – and the buzzer is switched on – and off at this frequency.

CHAPTER FOUR

CONSTRUCTION; TESTING AND RESULTS

4.1 CONSTRUCTIONS

The construction of the project was based on the design procedures. Each of the stages was first connected on a breadboard (project board) tested separately and transferred to the Vero-board and soldered permanently (with alloy lead). Screened cables were used in the connection to link some of the stages, which are not so close to one another.

The steps, the methods and the components as stated in the design, were followed. The transformer was mounted inside the cabinet some distance away brings damaged by the heat that may be generated form the power supply unit. The transmitter and the power supply was housed in a separate cabinet. The sensor (receiver) and the alarm sound were housed in the same cabinet.

4.2 TESTING OF TIMER CIRCUIT

Various values to time in second were obtained for corresponding values of the timing resistor with the value of capacitor fixed at $C = 220\mu f$

Table 1.2 of result for timer circuit

Timing Result (K)	Time of operation (seconds)
10	2.42
100	24.2
220	53.4
470	113.04
1	242
4.7	1.13
82	19.8

$t \alpha R$ (i.e. time of operation is directly proportional to the timing resistor) $t = CR$

4.3 TESTING OF THE INFRARED ALARM SYSTEM

The circuit was tested in broad daylight and the performance was satisfactory.

It was also discovered that total darkness does not favor the performance of the circuit

Table 1.3 **sensitivity of the infrared alarm system**

Nature of object	**range**
Large object	150-300mm
Small object	25mm
Very small object	not detected
Large and highly Reflective object	150 500mm

LIST OF COMPONENTS

RESISTOR

$R_1 = 1K\ \Omega$

$R_2 = 10K\ \Omega$

$R_3 = 330K\ \Omega$

$R_4 = 3.3K\ \Omega$

$R_5 = 4.7K\ \Omega$

$R_6 = 19K\ \Omega$

$R_7 = 4.7K\ \Omega$

$R_8 = 470K\ \Omega$

$R_9 = 4.7K\ \Omega$

$R_{10} = 4.7\ \Omega$

$R_{11} = 10K\ \Omega$

$R_{12} = 10K\ \Omega$ (variable resistor)

$R_{13} = 1k\pi\ \Omega$

$R_{14} = 4.7k\ \Omega$

$R_{15} = 4.7k\ \Omega$

$R_{16} = 1M\ \Omega$

$R_{18} = 4.7K\ \Omega$

$R_{19} = 82K\ \Omega$

$R_{20} = 1K\ \Omega$

$R_{21} = 1K\ \Omega$

CAPACITORS

$C_1 = 470\mu f$, 16v

$C_2 = 100\mu f$, 16v

$C_3 = 0.1\mu$

$C_4 = 22nf$

$C_5 = 22nf$

$C_6 = 33nf$

$C_7 = 4.7nf$

$C_8 = 2.2\mu f$

$C_9 = 1.\ \mu f$

$C_{10} = 0.1\mu f$

$C_{11} = 0.1\mu f$

$C_{12} = 0.1\mu f$

$C_{13} = 220\mu f$.16v

$C_{14} = 10\mu f$, 15v

$C_{15} = 470\mu f$, 25v

DIODES

D_1 = IN 4001X4

D_2 = TIL31

D_3 = TIL 100

D_4 = IN 4148

D_5 = IN 4148

TRANSISTORS

Tr_1 = BC109

Tr_2 = BC109

Tr_3 = BC109

Tr_4 = BC337

Tr_5 = BC337

Tr_6 = BC337

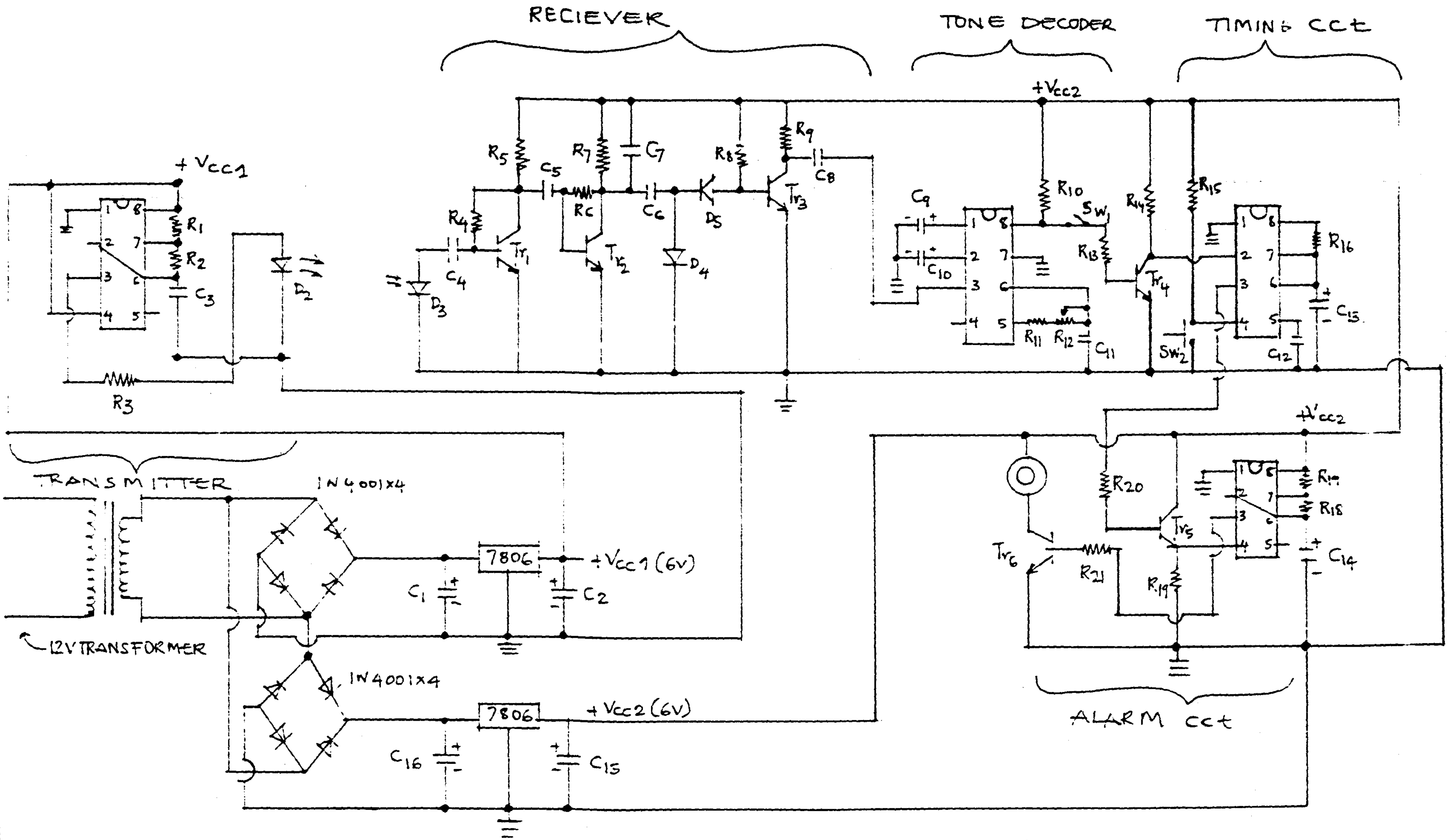
220,12V TRANSFORMER

SPK = PIEZO BUZZER

SW_1 = DEMOBILIZER SWITCH

V_2 = RESET SWITCH.

TAGE REGULATOR = 7806.



RECIEVER
TONE DECODER
TIMING CCt
+Vcc2
+Vcc1
R1
R2
C3
R3
D2
D3
C4
R4
R5
C5
Rc
Tr1
R7
Tr2
C7
C6
D4
D5
R8
R9
C8
Tr3
C9
C10
R10
SW1
R11
R12
C11
R13
Tr4
R14
R15
SW2
R16
C13
C12
TRANSMITTER
12V TRANSFORMER
IN4001x4
7806
+Vcc1 (6V)
C1
C2
IN4001x4
7806
+Vcc2 (6V)
C16
C15
+Vcc2
R20
Tr5
Tr6
R21
R19
R17
R18
C14
ALARM cct

CHAPTER FIVE

CONCLUSION AND RECOMMEDATION

5.1 CONCLUSION

From the table of result for alarm circuit, it could be seen that the frequency of operation of the alarm circuit, $f \alpha 1/.Rb$.

Also, from the table of the result for the timer circuit, timing operation, $t \alpha R$, where R is the value of timing resistor. This is the timer of operation is directly proportional to the timer resistor.

From the general outcome of the testing of the infrared alarm system, it could be seen that the amount of the infrared energy emitted depends on the nature of the body and the wavelength of the radiation. This agrees with Planck's law [6].

Planck's Law:

$W(\lambda) = Cl\, \lambda^{-5} C_1 \lambda^{-5} (e^{c2/\lambda T} - 1)^{-1} W/cm^2/\mu m$

$W(\lambda)$ = energy of radiation is show a that the Electron emerge with a kinetic energy increases directly with the frequency of the light

Where $Cl = 2\pi hc^2 = 3.7415 \times 10^4$ W. $(\mu m)^2$

$h = 6.6256 \times 10^{-34}$ W. S^2 is Planck's constant

$c = 3 \times 10^{10}$ cm/s is the velocity of light in vacuum

λ = Wavelength in micrometers

T = absolute temperature in degree Kelvin

Therefore, the objectives of the project were achieved

Appendix 1

List of abbreviation /symbols

Vrms/Irms= instantenous value of voltage/current

Vm/Im = maximum voltage/current

Vdc/Idc = dc output voltage/current

Vbe = base-emitter voltage

Vcc = Voltage supply

Vce = Collector-emitter voltage

Ic = Collector current

Rb= Base resistor

Ib = Base current

C = capacitor

F =Frequency

Hfe = dc current gain of the transistor

LED = Light emitting diode

Tr = Transistor