DESIGN AND CONSTRUCTION OF AN HOME SECURITY MONITOR SYSTEM

BY

ADEBANJO OWOLABI SHAMUSIDEEN

[96/5052EE]

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

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DECLEARATION

It is hereby declared that this project was conducted by me under the supervision of Eng. Abdullahi M.D; Electrical/ Computer Engineering Department, Federal University of Technology, Minna.

Mr. Adebanjo Shamusideen

Student's Signature

Eng. Abdullahi M.D.

Supervisor's Signature

CERTIFICATION

This project has been supervised and deemed fit to fulfil one of the requirements for the award of Bachelor of Engineering degree in Electrical/Computer Engineering Department of the Federal University of Technology, Minna, Niger State, Nigeria.

PROJECT ADVISER/~~SUPERVISOR~~ 27/02/2002 DATE

EXTERNAL EXAMINER DATE

HEAD OF DEPARTMENT 24/3/02 DATE

ELECTRICAL/COMPUTER ENGINEERING

DEDICATION

This project is dedicated to God Almighty for taking care of my life.

And with love to the Adebanjo family.

ACKNOWLEDGEMENT

All books represent the handwork of many people aside from their authors. This study has stretched over years, and involved several distinct phases. Many people have made contributions to each of these phases and therefore there are a large number who must be acknowledged with my gratitude.

I would like to thank first and foremost the God Almighty who made everything worked in my favour.

I express my deep appreciation to my parents, Mr. Nosiru Ishola Adebanjo and Mrs. Phenomena Yetunde Adesanjo, also to my younger ones for their encouragement and support.

I am very grateful to my able supervisor, Engr. Abdullahi M.D. who has sacrificed much and given me enough guidance needed to make the project a success. Sir, your kindness and love are highly appreciated. May Allah reward you with abundant blessings and grant you all your wishes in life.

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ABSTRACT

The objective of the project is to design and construct a Home Security monitoring System that can be used where an intruder or a suspect can be monitored or detected. The design and construction was done in units (the power unit, switching unit, time - delay unit and alarm unit which consist of low frequency astable and high frequency astable) The units were coupled together.

The designed and constructed Home Security monitor System was tested and found capable of serving a home or a building for any security purpose. The system can be installed in a strategic places in the home so that the suspect or intruder will not know. It was able to sense or pick up a signal whenever the shadow of any intruder is cast on the monitor. The transducer is very sensitive to pick the signal for the 555 timer, and the relay to modify it into audible sound through a loudspeaker.

CHAPTER ONE

1.0 INTRODUCTION

Over considerable number of years, government, companies, parastatals, home and individuals have been deprived of their goods and happiness all of a sudden, some people even lost their lives accidentally to those oppressors who are behaved to be men of the under world. Disappearance of properties of values ranging from thousands to millions of Naira are being recorded in home and in different sectors of the economy in the society. Assets that took several years to acquire are carted away with little or no restriction to such devious, hazardous and foolish deed. Most of the victims were devastated in life. In other words died at thirties and buried at seventies. What a terrible and abnormal fear of an intruder, it disturbs individuals, in the day and haunts their night, it is a centre and source of complexes. It tangles the mind with obsession. It draws off energy, destroys inner peace, it reduces one to ineffectiveness and frustrate ambitions, oh! What a great loss to the global world as a whole.

Assasination, kidnapping, theft, embezzlement e.t.c. are a major concern in the society , with reference to all the stated factors, an affinity was developed toward over coming the deeds and fear of an intruder by designing and constructing a sound and solid security system known as HOME SECURITY MONITOR SYSTEM.

Although physical delay is provided by structural barriers such as fence, gates, wall roofs, floor door, windows or vaults and natural barriers such as rivers, lakes cliffs or any physical delay, unsophisticated or unconscious intruders whose mode of operation is limited to forcible entry though doors and windows, will probably be discouraged by the structural barriers secured with high security locks. A dedicated and skilled intruder will attack almost any barrier if he believes the rewards justify the effort and risk. However the degree of delay provided by the physical barrier is an important factor in either discouraging or impending the progress of intruder.

Above all this, what is important is a very effective home security monitor system that will combat any intruder weather sophisticated or otherwise. Consequent to the above limitation of physical barriers, here comes a security system. Electric Burglar alarm invented in the year 1853 Virtually the earliest commercial application of electricity. Actually there are various kinds of burglar alarm in existence designed by different engineers, they employ various approaches such as:

(a) Electric Burglar Alarm with flasher by Eng. A. Gilbert, which makes use of photo resistor as its sensor, thereby a specific source of light is required for it to work efficiently, unlike photo-voltaic cell which is used in this design, that can respond to any wave length of light.

(b) Infared proximity detected designed by Survitech Inc. as the name implies it simply means it can only detect proximity intruders and the sensor (Infra-red) can be compromised by generating some beam along the line of generator: but intruder monitoring system has enormous advantages of being able to protect anywhere an intruder is to be detected.

(c) Automobile/home burglar alarm by Eng. Charles G. Olives, which has a time lag of about ten seconds before the system will operate. The time lag is a disadvantage because, an intruder may want to steal an item from the car or home and not interested in carrying the car as a whole or stealing other things in the home hence the time lag is enough for them to carry out their operation. The lag was removed completely from a security monitor, which makes it to respond almost immediately as intruder is detected.

This design of Home Security Monitor System stands District by being better that the existing ones cum its ability to monitor and detect and intruder ranging from unskilled to skilled intruder. It's a design that encompasses 4 different effective stages namely, light stages, dark stage, touch stage and voice stage. Infact this device (HOME SECURITY MONITOR SYSTEM) has enormous power to affect the global world in many more ways.

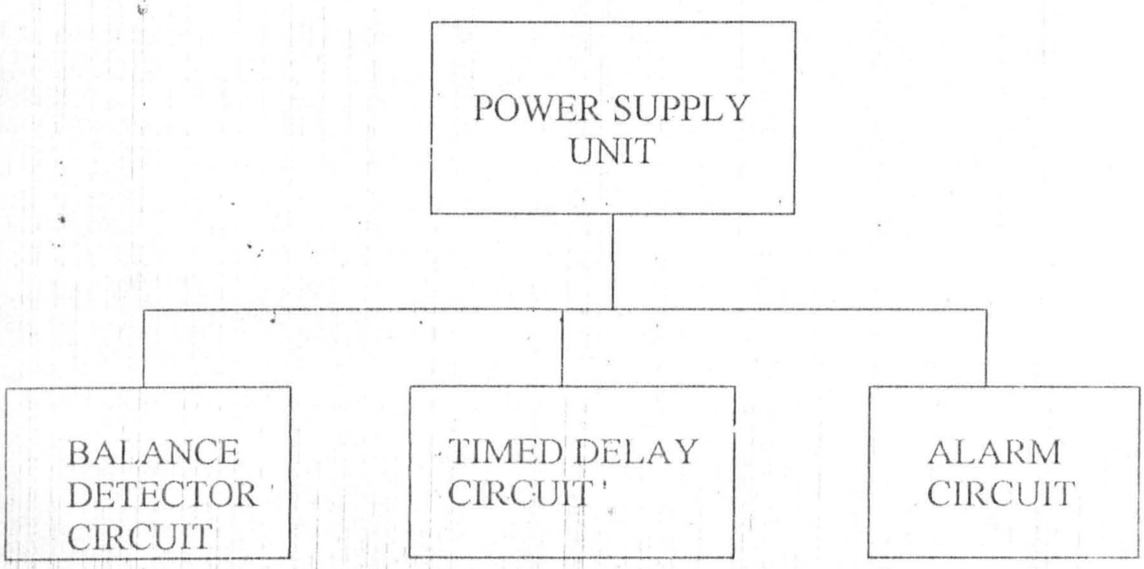


Fig. 1.0. Schematic Block Diagram of a Home Security Monitor System

1.1 LITERATURE REVIEW

Electric Burglar Alarm (Security Monitoring System)), invented in the year 1853 antedates the telephone 1876 and the electric light 1879. It was in fact, vertually the earliest commercial application of electricity except for telegraphy, first demonstrated in 1844.

Home security monitor systems are an asset to effective security because they can alert security guards and adequately to safe guard valuable asset against the sophistication of those adversaries who pose threats to the assets. Many different physical security devices and electronics surveillance systems are available that can be combined to form a security system. Physical protection is provided by locks, safes, vaults and structural barriers such as fences, wall and doors. Electronics surveillance is provided by interior and exterior security monitoring sensor; access controls, television. Cameras, detectors and alarm signal transmission monitoring systems. The key to having the "best" security systems is selecting the right adequate security devices and system is selecting the right security devices and systems and implementary adequate security control and operating procedures to ensure the safety of your asset.

1.1.2 COMPOSITION OF A PHYSICAL SECURITY SYSTEM

A physical security system consists of four equally important interacting functions namely delay, detect, Alert and Respond. The first function "Delay" is provided by the presence of physical barriers protecting the assets such safes, vaults, wall, ceiling door and fences. The second function "Detect" is accomplished by security monitor sensors that detects the presence of an intruder.

The third function "Alert" is provided by the alarm transmission and monitory system that annunciates and identifies the specific alarm location.

And the fourth function "Respond" is executed by the response force who respond to the intrusion alarm.

If this forth functions are not tightly integrated and established in the security system design the asset may not be adequately protected. For instants, the asset can be surrounded with the best intrusion/Security monitoring equipment available, but if no one hears and report the security monitoring alarms and especially if no one responds to the alarm, the security monitoring system is totally in adequate except perhaps as a psychological deterrent.

1.1.3 TYPES/STAGES OF HOME SECURITY MONITOR SYSTEM

1.1.3.1 LIGHT DETECTING MONITOR SYSTEM :- This stage depend intruder on rampages in home, building and some other building. This give way to low resistance, which means it's resistively value is very low.

1.1.3.2 DARK DETECTING MONITOR SYSTEM:- This stage depend on dark to trigger on an alarm which also signals a suspect breaking loose in home and other attractive buildings. This has a high resistance, which means its resistivity value is very high.

1.1.3.3 TOUCH DETECTING MONITOR SYSTEM:- This stage depend on when the suspect/intruder touch the strategic place where the device is installed. The transducer ·'se for this stage is different from the aforementioned stages.

1.1.3.4 VOICE DETECTING MONITOR SYSTEM:- This stage depend on when the suspect/intruder voice is heard. This is specially installed where humans are strictly out of bounds so, any human voice that is heard will trigger on the system which interprets danger in earnest and calls fort urgent attention.

1.1.4.0 HOME SECURITY MONITOR SYSTEM:-

Home security monitor system is gradually becoming a house hold name when we talk of security devices. It has been found worthy of holding or incapacitate any rampaging crooked minded person who might be trying dogged to burgle a house/home.

In recent years, lots of security devices were invented to combat intruder or monitor criminally minded individuals. But it has not been a security success until a more formidable and effective devices came into lime light and that device is home security monitor system. According to my own design the components and the values of the parameters used are only limited to my project design. And moreso, one has to take into consideration the financial implication of doing it. In essence, my project design and construction might not be that effective due to the high lighted factors.

Finally, home security monitor system has come to challenge the effectiveness of other security devices in the market.

CHAPTER TWO

2.0. COMPONENTS

2.1. TRANSDUCER

Transducers are elements or devices that convert one form of energy to another. A transducer is a device which responds to a signal in one form of energy and produces an output which is related to it, but in a different form of energy. The output of the monitor system is amplified and conditioned to suit the specifications of the consumer. An amplifier is connected to this monitor system which amplifies the weak or inaudible signals making it strong enough to drive a transducer, in this case a loudspeaker and LDR (Light Dependent Resistor).

2.1.1. LIGHT DEPENDENT RESISTOR

The electrical resistance of a dark photo resistor is ordinarily very high up to 1,000,000 ohms or more. The resistance may fall to as little as a few hundred ohms when the photo resistor is illuminated. The most common semiconductor used to make photo resistors is cadmium sulfide (cds). It is primarily sensitive to green light. Photo resistors exhibit a "memory effect" and that they may require a second or more to return to their high-resistance state after a light source is removed. Though this slows their response time they are very sensitive and easy to use. For better understanding they are also known as light dependent resistor (LDR).

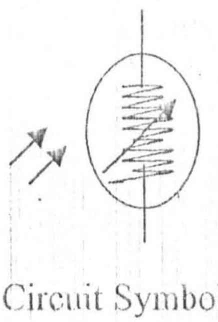


Fig. 2.0. Circuit Symbol for LDR

2.2.0 LOUD SPEAKERS

Aloud speaker converts frequency alternating current into sound wave energy (acoustic waves). A good loud speaker must not only be able to deliver high power audio output but must also faithfully reproduce sound of different frequencies. Most Modern loud speakers employ moving coil electromagnetic units. However, other types like ionic and piezoelectric units exist.

2.2.1 MOVING COIL LOUDSPEAKERS

Various forms and variations of moving coil loudspeaker units exist and they are used in more that 95% of modern loudspeakers. They are capable of reproducing high sound levels with a distortion level of less than 1% above 100Hz.

The audio signal is applied to the voice coil situation between magnetic pole pieces which produce a radial field. The interaction between the varying fields set up by the audio current in the voice coil and the static magnetic field makers the voice coil to oscillate along its own axis at the frequency of the applied audio signed. The oscillation of the coil radiates a sound from the diaphragm. The magnitude of the force on the coil is given by the expression.

$F = BLI$

Where B = Magnetic flux density within the air gap

L = The length of wire in the voice coil.

I = The audio current flowing in the coil

Voice coil is wound with a thin wire, with resistance of few ohms hence, they are usually connected to radio receivers through a step-down transformer.

2.3 INTEGRATED CIRCUITS (ICS)

Semi - conductor technology allows manufacturing of several components (resistors, transistor, some capacitor etc) even circuits on a single semi conductors chip. This allows micro-electronics to achieve incredible miniaturization of circuits. Ics have a lot of advantages of discreet circuit apart from space economy and cheap cost of production, the properties of components simultaneously manufactured on the same chip can be accurately matched and temperature compensated which is a great advantage in instrumentation amplifier and the ease of connecting complex circuit and automatic mass production of devices cannot be overemphasized.

Ics are found as gates, logic circuits, audio amplifiers microprocessors etc.

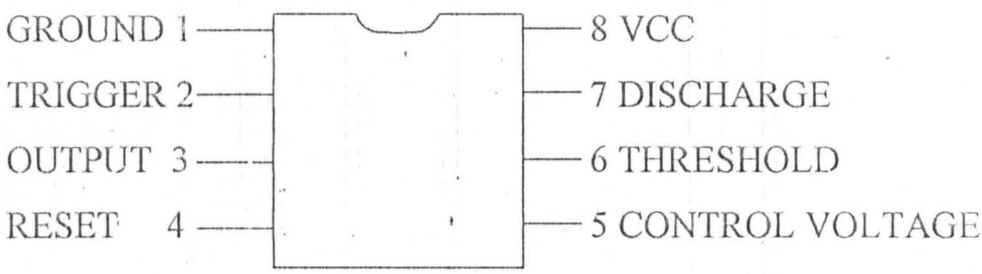


Fig. 2.1. Pin Diagram of 555 timer.

2.3.1 : PIN CONNECTION OF 555 TIMER

GROUND:- This is pin 1of the 555 timer. It should be connected to the negative side of the supply.

TRIGGER:- This is pin 2 of the 555 timer. It is being referred to as the trigger imput. A negative going voltage pulse applied to those pins trigger the device.

OUTPUT:- This is pin 3 of the 555 timer. It is capable of sinking or sourcing a load requiring up to 200mA.

RESET:- This is pin 4 of the 555 timer. Reset activated with a voltage level of between OV and 0.4V.

CONTROLVOLTAGE:- This is pin 5 of the 555 timer. A voltage applied to this pin allows device timer variations independently of the external tuning network. it should be by passed to ground using 0.01 micro farad capacitor if unused to maintain immunity from noise.

DISCHARGE:- This is pin 7 of the 555 timer. Usually, the external timer capacitor is connected between discharge ground. And this discharges when the transistor goes ON.

VCC:- This is pin 8 of the 555 timer. It is the power pin and is connected to the positive side of the supply.

2.4. TRANSFORMER:-

A transformer is a static (or Stationary) piece of apparatus by means of which electric power in one circuit is transformed) into electric power of the same frequency in another circuit. It can raise or lower the voltage in a circuit but with a corresponding decrease or increase in current. The physical basis of a transformer is mutual induction between two circuit linked by a common magnetic flux. In this project it is used to lower voltage in a circuit.

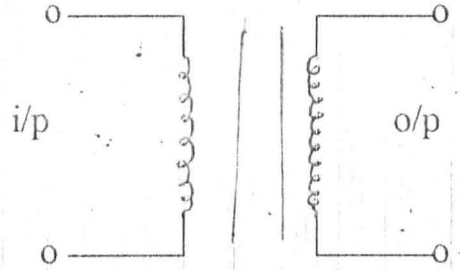


Fig. 2.2. Transformer circuit symbol

2.5. DIODES

It is a two-terminal device consisting of a P-N junction formed either in Ge or Si Crystal. This paid N type regions are referred to as Anode and Cathode respectively.

A P-N junction diode is one-way device offering low resistance when forward-biased and behaving almost as an insulator when reverse-biased. Hence, such diodes are mostly used as rectifiers i.e. for converting alternating current (a.c) into direct current (d.c).

In this project it is used as a rectifier and as a means of potential passage. The circuit symbol of a diode is shown below.

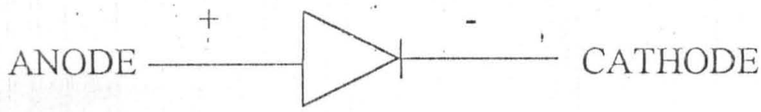


Fig. 2.3 Circuit symbol for diode

2.5.1 LIGHT EMITTING DIODE

The light emitting diode is a PN junction device which emits light when forward biased a phenomenon called electroluminescence. This light which issues from diode can be invisible, form infrared (IR) to ultraviolet (UV). The LED symbol is as drawn below.

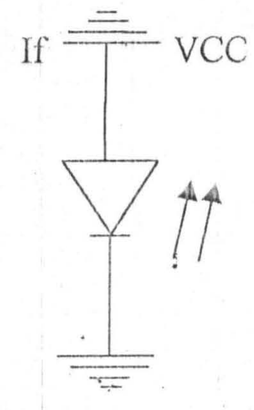


Fig. 2.4. Light Emitting Diode Symbol

2.6. CAPACITOR

A capacitor essentially consists of two conducting surfaces separated by a large of an insulating medium called dielectric. The surfaces are known as cathode and anode. If electrons are drawn from out of the plates and passed to the other, then a state of change will exist between them across the insulating medium i.e., a positive charge on the plate which has lost electron and a negative charges on the plate which has gained electrons.

There are so many types of capacitors ranging from electrolytic to non-electrolytic (Ceramic). The electrolytic type is also known as polarised capacitor, because it has both positive and negative terminals while the non-electrolytic are not polarised in this project, the capacitor's operation has to do with charging and discharging. The circuit symbol is as shown below.

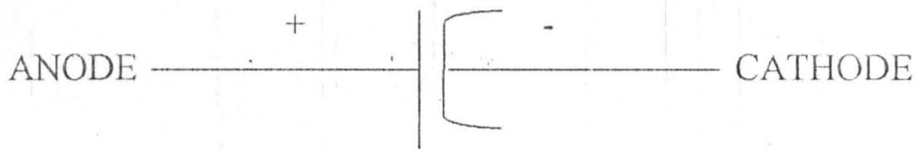


Fig. 2.5. Circuit symbol for capacitor

The property of a capacitor to store electricity may be called it's capacitance (c) and it is measured by the amount of a charge to one of the two plate of a capacitor and if a p.d of v volts is established between the two then it capacitance is

$$C = Q/V = \frac{\text{Charge}}{\text{Potential Difference}}$$

Hence, capacitance is the charge required per unit potential difference.

Charging of a capacitor always involves some expenditure of energy by the charging agency. This energy is stored up in the electro-static field set up in the dielectric medium.

On discharging the capacitor, the field collapse and the stored energy is released. The charging current is given by I(t) = dv/dt. If a capacitor charged to maximum voltage (v) is allowed to discharge through a resistor R, the shape of the discharge curve is as shown below.

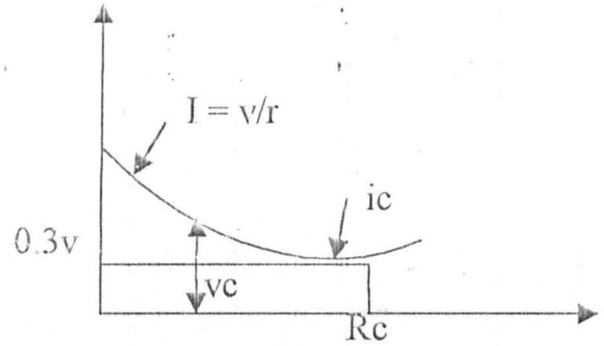


Fig. 2.6 Discharge voltage of a capacitor

The time constant of a charging capacitor is the time taken for the capacitor's voltage to grow to 63.7% (0.637) of it's steady state value and for discharging capacitor it is the time taken for the capacitor to fall to 37% (0.37) of its initial value.

The time constant is given by t = RXC

2.7. RESISTOR

Resistors resist the flow of electricity. They are very useful in supplying desire voltages to other electronic components thus, controlling the amount of current flowing in a particular part of a circuit. The resistance of a resistor is measured in ohms.

The circuit symbol of resistor is as shown below

Fig. 2.7. Circuit symbol of resistor.

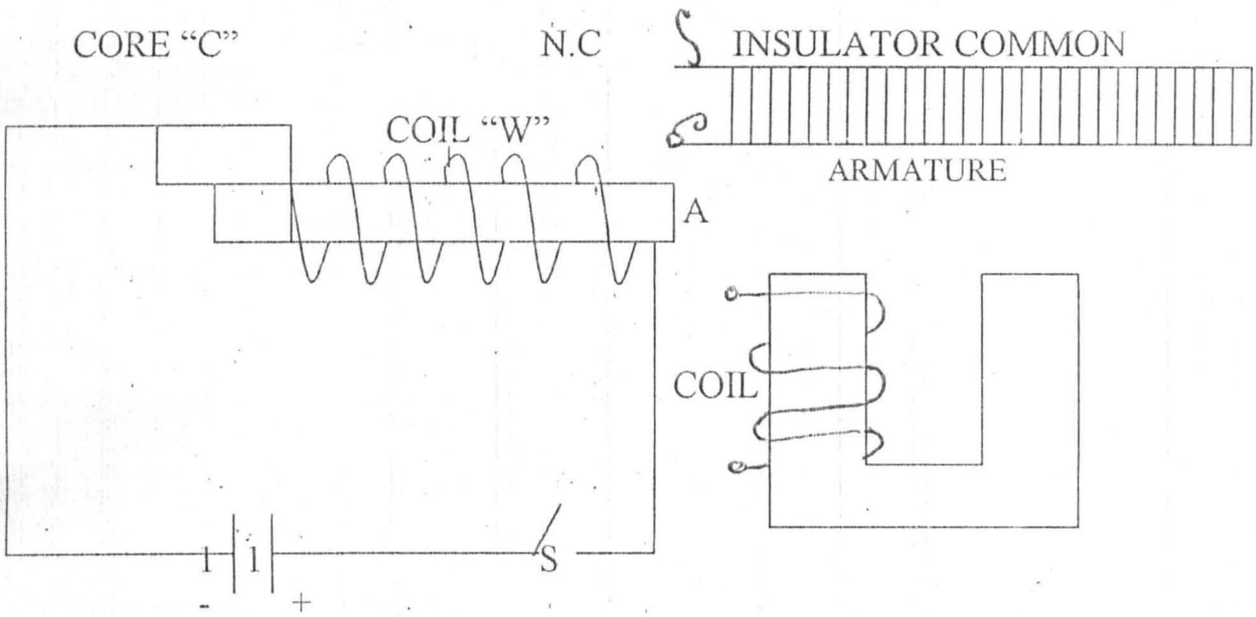
In this project resistor is use with capacitor to determine the entrance time delay and the time delay of the alarm. It is also used to determine the frequency of the tone generator.

2.8. RELAYS

Relays are electrically controlled switches. In the usual types a coil pull in an armature when sufficient coil current flows, many varieties are available including "latching" and "stepping" relays. Relays are available for dc excitation. A.d.c relay mainly consists of set (s) of contacts (normally open and normally closed). A coil

"W" wound on a soft iron care "C" as well as metallic mass "A". the core and the winding constitute the magnetic circuit of the relay.

The d-c relay is used as a switch, because of its ability to control large current through its contact. Voltages as low as 12 volts can operate its coil unlike electronic switches which must be operated by the rated voltage.



(a) A Basic Relay Circuit

(b) Internal Connection of a Relay

Fig. 2.8. (a) A Basic relay Circuit
(b) Internal connection of a relay

The three relays in my project are of the same values of JZC–20F (4088) 10A DC 12V which is a single pole relay.

ASTABLE OPERATION OF 555

The 555 can be used as an astable multivibrator by wiring it in the basic configuration shown below with trigger pin 2 shorted to the pin 6 threshold terminal and tuning resistor R_2 wired between pin 6 and discharge pin 7.

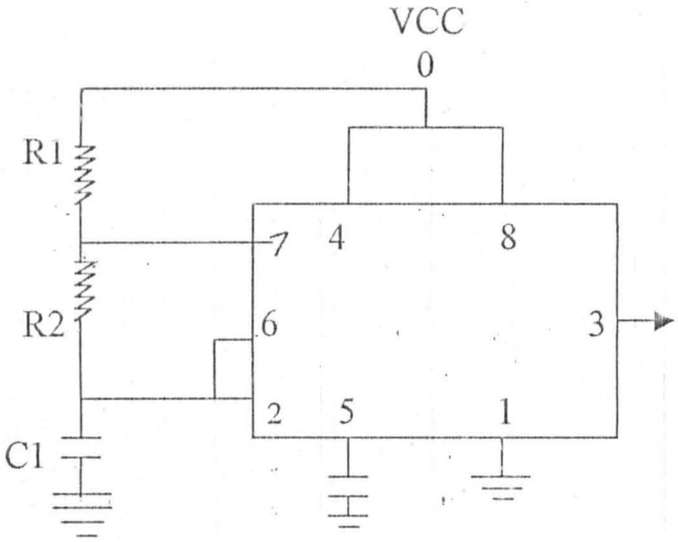


Fig. 2.9. ASTABLE MULTIVIBRATOR

When power is first applied to this circuit, C1 start to charge exponentially Via R1 – R2 until eventually the C1 voltage rises to 2/3 VCC, at which point discharge pin 7 switches low and stars to discharge C1 exponentially Via R2 until eventually the C1 voltage falls to 1/3VCC, and trigger pin 2 is activated, thus initiating a whole new timing sequences, which repeats continuously, with C1 alternately charging toward 2/3 VCC Via R1 – R2 and discharging towards 1/3 VCC Via R2 only.

If R2 is chosen very large relative to R1 the operating frequency is set by R2 and C1, and an almost symmetrical square wave output is developed on pin 3. ~~when power is first~~

if R_2 R_1

then t_1 $0.7R_2 C_1$

and t_2 $0.7R_2C_1$

where T $1.4R_2 C_1$

and f $\dfrac{0.72}{R_2 C_1}$

The astable multi vibration has no stable state. It requires state.

The astable multi vibrator is frequency dependent.

FLIP-FLOPS

Flip-flops are 1-bit memory element (or latch) having two outputs which take up complementary State i.e. O and I, when a signal is applied the input. The output condition would then be retained until another input signal combination causes the output state to charge. Some of the most widely used flip-flops are the SR, JK and D Flip-flops. The one used in the 555 timer is the SR flip-flop

SR FLIP-FLOP

A SR flip-flop is also called set-rest flip-flop inputs S and R are termed set and reset inputs (also known as preset and clear). If the sand R are both held at logic 1, the NAND gates simply function as inverters and the flip-flop holds its state indefinitely.

If now S falls to logic O whilst R remains at logic 1, output Q is forced to go to logic 1 because its NAND gate has an input at logic O. when both S and R return to logic 1, the flip-flop will remember indefinitely the fact that S fell to logic O. similarly, if R drops to logic O whilst S remains at 1 output Q bar is forced up to 1 and Q down to O. Once again this state will be held indefinitely as long as S and R remain at logic 1

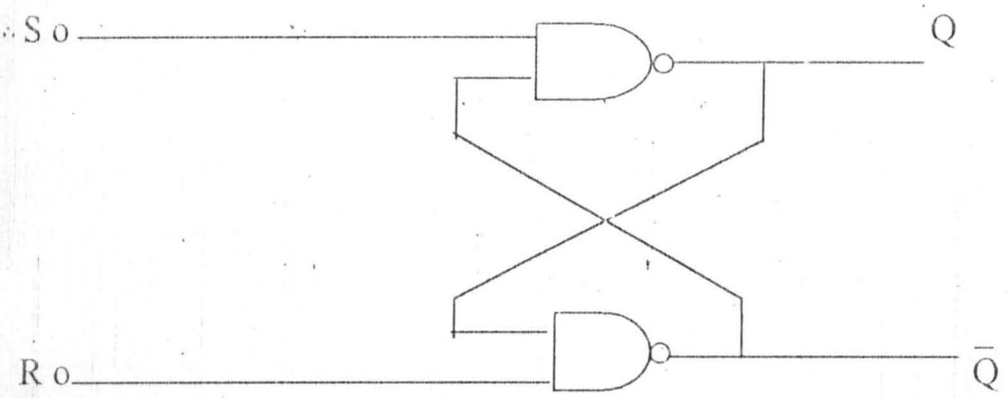


Fig. 2.10 Set-Reset (R-S) flip-flop

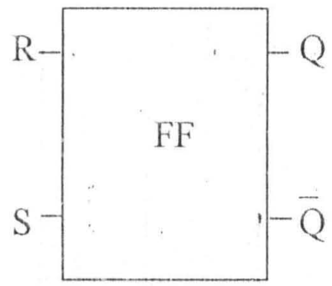


Fig. 2.11 R-S flip-flop symbol

Table 1.0

INPUT		OUTPUTS	
S	R	Q	$\bar{Q}$
0	0	INDETER MINATE	INDETERMINATE
0	1	0	1
1	0	1	0
1	1	Q STORED	$\bar{Q}$ STORED

Fig. 2.12 Truth table

2.9 POWER SUPPLY

BASIC PRINCIPLES OF D.C. POWER SUPPLIES

Practically, all electronic instruments require a source on d.c. Power before they will operate. Sometimes, the source is a battery, but more usually, the power is obtained from a unit that converts the normal single phase a.c supply (240v at 50Hz) to some different value of d.c voltage.

The function of the power supply is to provide the necessary d.c voltage and current, with low levels of a.c. ripple (mains hum) and with good stability and regulation. In other words, it must provide a stable d.c output voltage, irrespective of changes in the load current. A further important requirement of a modern power supply unit is that it should be able to limit the available output current in the event of an overload (limiting) and also limit the maximum output voltage.

Damage to sensitive components such as ic in the instruction can easily occur if excessive voltages appear on the power supply lines. There are various methods of achieving a stable d.c voltage from the a.c mains, but only two methods are commonly used. These are

(i) Using a linear stabilizer

(ii) Using a switching mode stabilizer

In my project switching mode stabilizer is used.

THE SWITCHING MODE POWER UNIT

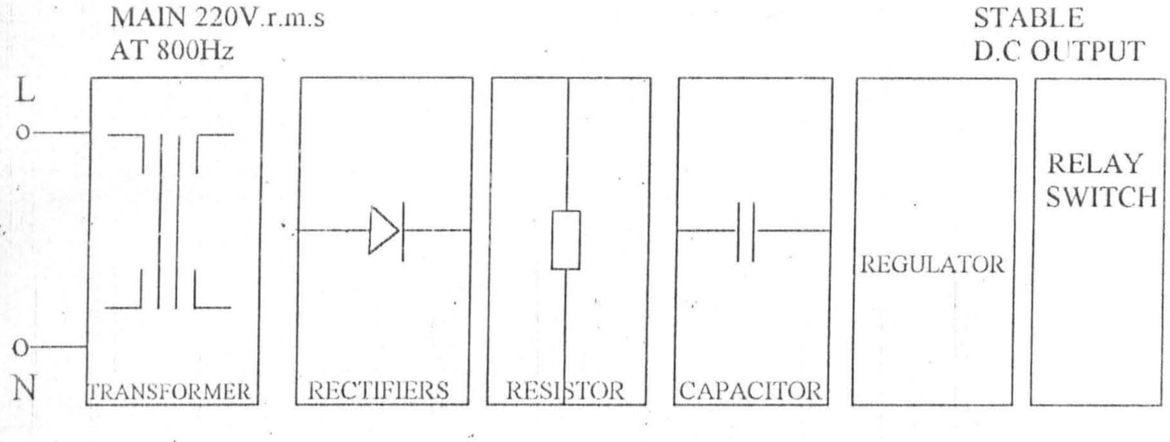


Fig. 2.13 BLOCK DIAGRAM OF CONVENTIONAL POWER UNIT

TRANSFORMER

It serves two main purposes; it isolates the equipment d.c power lines from the means supply, and it changes the level of the a.c mains voltage to some lower or higher value. The ratio of the secondary voltage to primary voltage is determined by the number of turns on each winding. The transformer used in this project work is a 220/12v step down transformer.

RECTIFIER

It converts the a.c voltage from the transformer, secondary winding into pulses of unidirectional current. Three types of rectifier circuit are used for single phase, the half wave, the full wave and the full wave bridge circuit.

FILTER

This help to smooth out the pulses recurr[illegible] from the rectifier. The circuit can have either a capacitive or an inductive input is used. Since on how power equipment a capacitive input filter is more typical. The input capacitor, called the reservoir, is used as a storage device for electric charge.

The function of this circuit element is to remove the fluctuations or pulsation (called ripples) present in the output voltage supplied by the rectifier used in this project work is a 2200 Micro farad (electrolytic).

VOLTAGE REGULATOR

The main function of the voltage regulator is to keep the terminal voltage of the d.c supply constant even when the a.c input voltage to the transformer varies (Deviations from 220v are common) or the load varies. In this project work.

TRANSISTOR

There are different types of transistors. We have them in different shapes and sizes. They are mainly use for driving current in a circuit. We also have n-p-n or p-n-p transistor

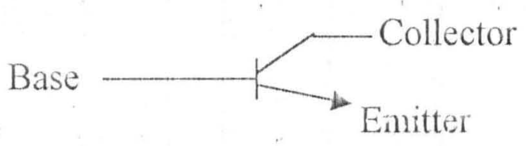


Fig. 2.14 Circuit symbol of a transistor

JUMPER WIRES:- These are used mainly for connecting external accessories to the board.

CHAPTER THREE

3.0. DESIGN AND CONTRUCTION

The design used in this project work make use of astable multi vibrator. Therefore, astable operations would be discussed first.

3.1 ASTABLE OPERATION

This 55 timer can be used as an abstable multivibrator by wiring it in the basic configuration with trigger pin 2 shorted to the pin 6 threshold terminal and timing resistor R_2 wired between pin 6 and discharge pin 7.

When power is first applied trio this circuit, C_1 starts to charges exponentially via R_1-R_2 until eventually the C_1 voltage rises to 2/3 V.c.c, at which point discharge pin 7 switches low and starts to discharges C_1 exponentially Via R_2 until eventually the C_1 voltage falls to 1/3 V.c.c, and trigger pin 2 is actuated, this initiating a whole new timing sequence, which repeats continuously, with C_1 alternately charging toward 2/3 V.c.c Via R_1-R_2 and discharging toward 1/3 V.c.c Via R_2 only.

If R_2 is chosen very large relative to R_1, the operating frequency is set by R_2 and C_1, and an almost symmetrical square-wave output is developed on pin 3 design calculation.

When the power supply V.c.c is connected, the external timing capacitor C charges toward V.c.c with a time constant ($R_1 + R_2$) C. During this time, output pin 3 is high (equals V.c.c) as Reset R= 0, set S = 1 and this combination makes Q = 0, which has unclamped the timing capacitor C.

The capacitor voltage for a low pass RC circuit subjected to a step input of V.c.c volt is given by.

$Vc. = V.c.c\ (1-e^{-t/Rc})$

The time ti taken by the circuit to charges from 0 to (2/3) V.c.c. is.

$(2/3)\ V.c.c = V.c.c\ (1-e^{-t/Rc})$

Assume $t = t_1$

$$2/3 = 1-e^{-t1/Rc}$$

$$e^{-t1/Rc} = 1 - 2/3$$

$$e^{-t1/Rc} = 1/3$$

Taking the natural logarithm of both sides.

$$\log_e (e^{-t/Rc}) = \log_e (1/3)$$

$$-t_1/Rc = -1.09$$

$$t_1 = 1.09RC$$

The time t_2 to charges from 0 to (1/3) V.c.c is.

$$(1/3)\ V.c.c = V.c.c\ (1-e^{-t2/Rc})$$

Assume $t = t_2$

$$1/3 = 1-e^{-t2/Rc}$$

$$e^{-t2/Rc} = 1-1/3$$

$$e^{-t2/Rc} = 2/3$$

Taking the natural logarithm of both sides.

$$\mathrm{Log}_e (e^{-t2/Rc}) = \log_e (2/3)$$

$$-t_2/Rc = -0.405$$

$$-t_2/Rc = -0.405\ RC$$

So the time to charge from (1/3) V.c.c to (2/3) V.c.c is.

$t_{HIGH} = t_1 - t_2$

$t_{HIGH} = 1.09Rc - 0.405\ RC = 0.69Rc$

So for the given circuit;

$t_{HIGH} = 0.69\ (R_1 + R_2)\ C$

The output is low while the capacitor d. .charges from (2/3) V.c.c to (1/3) V.c.c and the voltage across the capacitor is given by:

$(1/3)\ V.c.c = (2/3)\ V.c.c\ e^{-t/Rc}$

$1/3 = 2/3\ e^{-t/Rc}$

$1/3 * 3/2 = e^{-t/Rc}$

$1/2 = e^{-t/Rc}$

Taking the natural logarithm of both sides

$\log_e (1/2) = \log_e (e^{-t/Rc})$

$-0.69 = -t/Rc$

$t = 0.69\ Rc$

So for the given circuit

$T_{LOW} = 0.69R_2C$

Both R_1 and R_2 are in the discharge path, but only R_2 is in the discharge path. Therefore, total time.

$T = t_{HIGH} + t_{LOW}$

$T = 0.69\ (R_1 + R_2)\ c + 0.69\ R_2C$

$T = 0.69R_1\ C + 0.69\ R_2\ C + 0.69\ R_2C$

$$T = 0.69 (R_1 + 2R_2)C$$

And $f = 1/T$

$$= \frac{1}{0.69 (R_1 + 2R_2) C}$$

$$= \frac{1.45}{(R_1 + 2R_2)C}$$

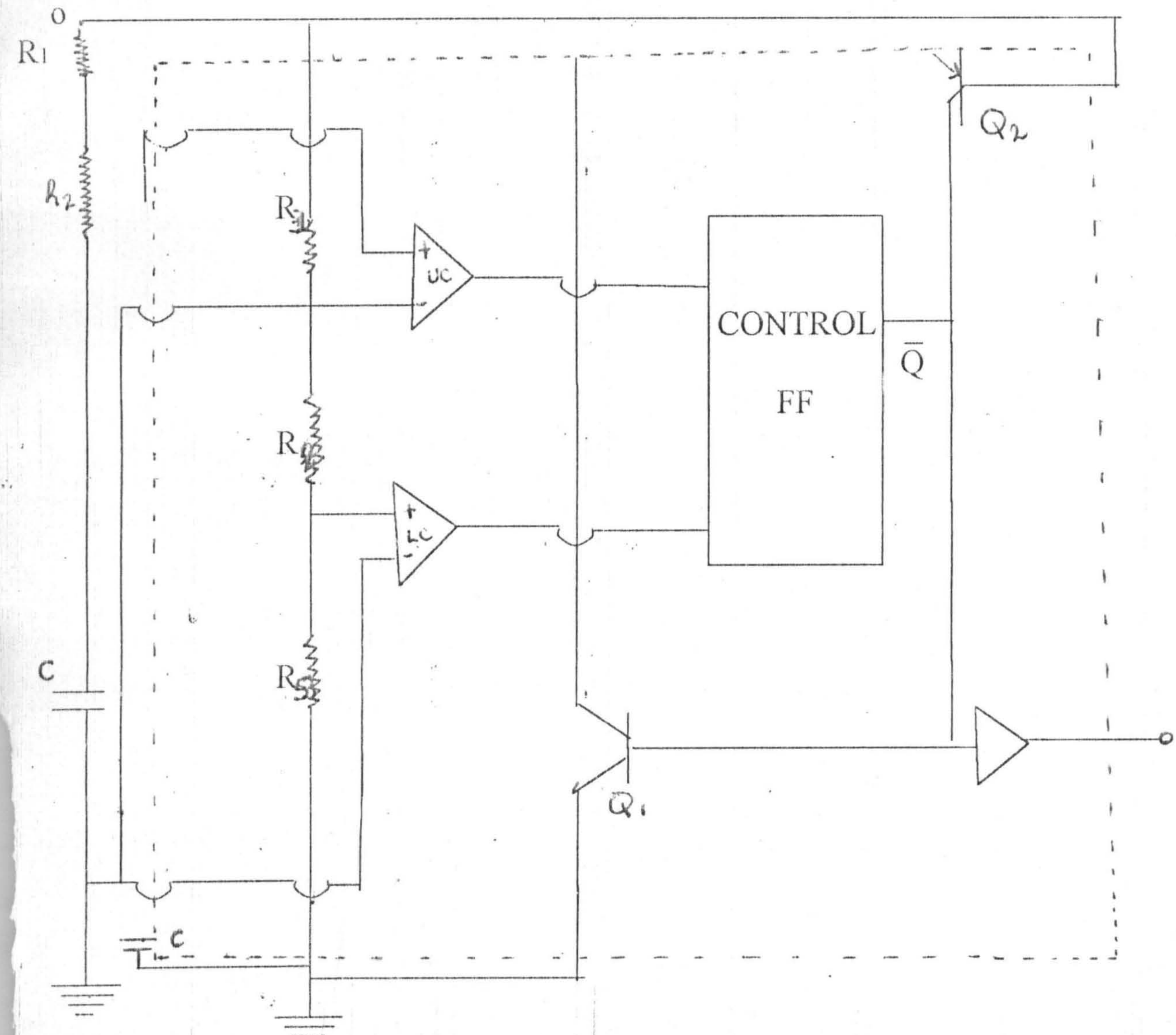


Fig. 3.1 Functional Diagram of astable multivibrator

3.2 TIMED DELAY CIRCUIT

This consist mainly of 555 timer configured as astable multivibrator. It can be subjected to frequency-sweep control to frequency modulation (fm), or to pulse-position modulation (ppm).

When the timed delay circuit is in it's quiescent state pin 2 is held Via R4, Q1 is saturated and forms a short across turning capacitor C_T, and pin 3 (output) is driven low. The monostable timer action initiated by feeding negative going pulse to pin 2 and this pulse falls below the interval 1/3 V.c.c. The output of the lower comparator changes state and switches the R-S flip-flop over, turning Q, off and driving the pin 3 output high. As Q, turns off, it removes the short from C_T, which starts to change exponentially Via RT until eventually its voltage rises to 2/3 Via, at which point the upper comparator changes state and switches the R-S flip-flop over again, turning Q, an and rapidly discharging C_T and simultaneously switching output pin 3 low again, this completing the operating sequence.

Note that, once triggered, this circuit cannot respond to additional triggering until the timing sequence is complete, but the sequence can be aborted at any time by feeding negative going pulse to RESET pin 4. The timing period, in which the pin 3 output is high is given by.

$$t = 1.1\, R_T\, C_T$$

The timing period can also be varied by applying a variable resistance or voltage between ground and the pin 5 control voltage terminal of the IC; this facility enables the periods to be externally modulated or compensated.

Let the timed – delay be 2 minutes (120 seconds) and the 2 minutes value is gotten from:

$$\text{Since } T = 1.1 * R*C$$

$$= 1.1.*100*10^{-6} * 10^{6}$$

$$= \frac{110 \text{ Sec}}{60} \approx 2 \text{ minutes}$$

For my design and R is chosen to be Imega ohm then from equation as above the value of C can then be obtained as.

$$C = T/I.IR = \frac{120 \text{ Sec}}{1.1 * 10^{6}} = \frac{120}{1.1} * 10^{-6} = 109 \text{ micro farad}$$

But C 100 micro farad is used

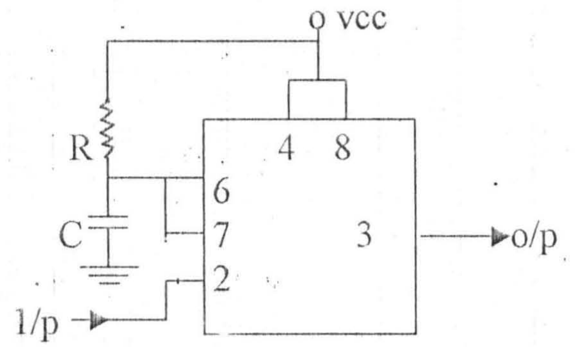


Fig 3.2 Circuit symbol of timed delay

Resistor R1 is used to reduce the chattering noise of the trigger signal

Capacitor C2 is used to by-pass the control Voltage pin to ground since it is not used in the circuit design to maintain immunity from noise.

3.3 ALARM CIRCUIT

555 Timer is used to realize this part of the project work. The astable is subjected to frequency modulation (fm) or to pulse-position modulation (ppm) by simply adding the modulation signal to the control voltage pin. These types of modulation are useful in special wave form generator applications as in various electronic siren and alarm-call generator.

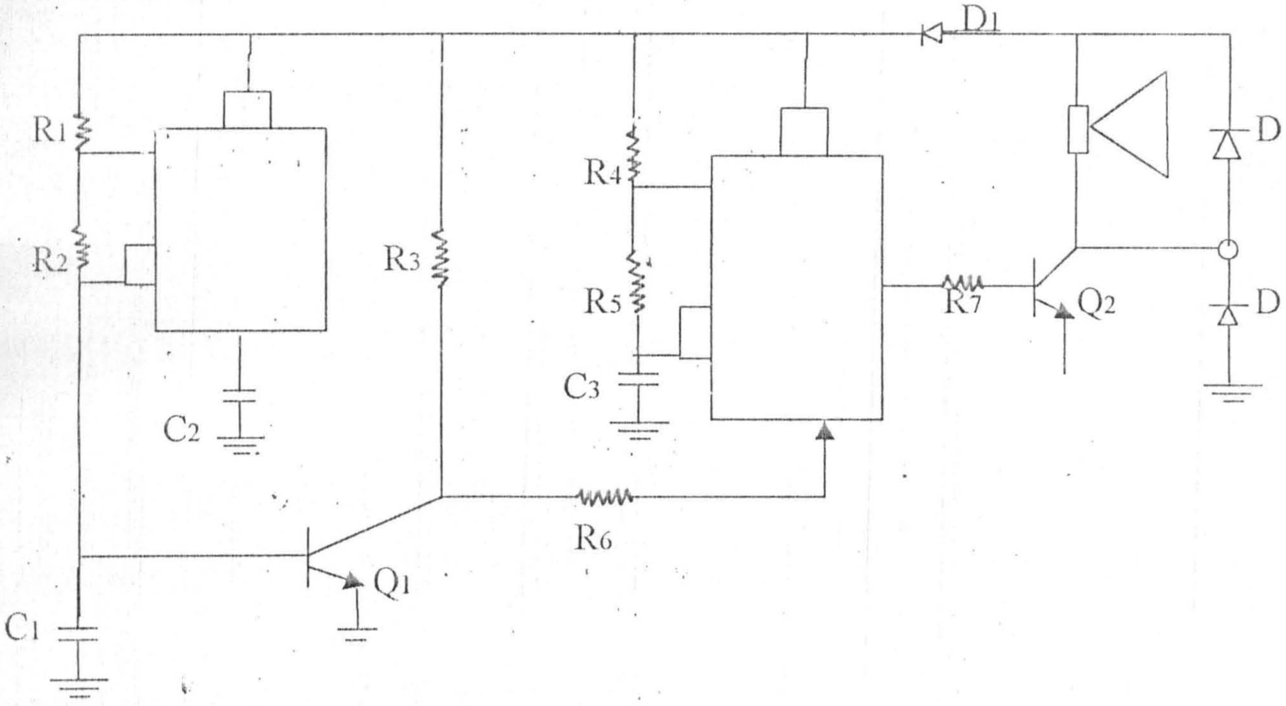


Fig. 3.3 Frequency modulated Alarm Circuit

Ic2 is a low frequency (t.sec) astable that generates a wave form that is buffered Via Q1 and used to frequency modulate a tone generator Ic1 Via R6. Ic frequency is chosen.

The modulation action is such that its output tone starts at a low frequency rises for t/2 see to a pack value, then falls back again for t/2 sec and so no continuously. Q2 is used in the circuit to prevent over driven of the current from the ic by the speaker.

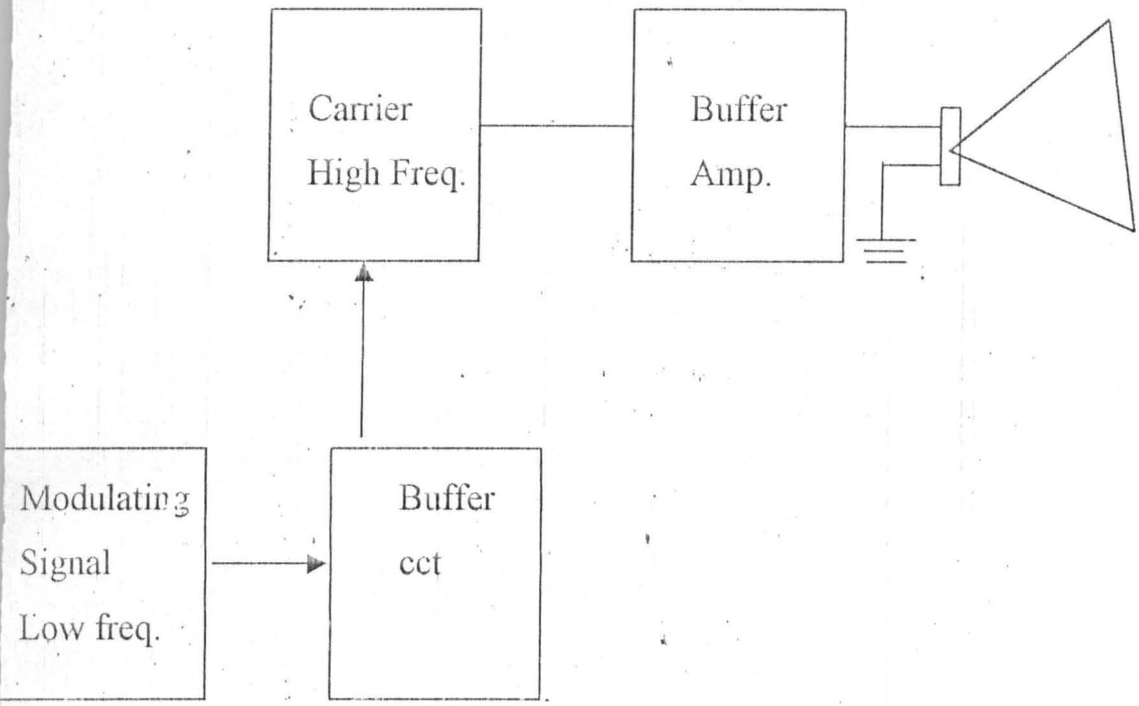


Fig. 3.4 Block diagram of an Alarm Circuit

For high frequency oscillator – 800Hz astable is used. For low frequency oscillator – 6 seconds astable is used.

but $R_2 \gg R_1$

since $R_2 = 10R_1$

then $R_1 = 4.7k$

3.3.1 LOW FREQUENCY

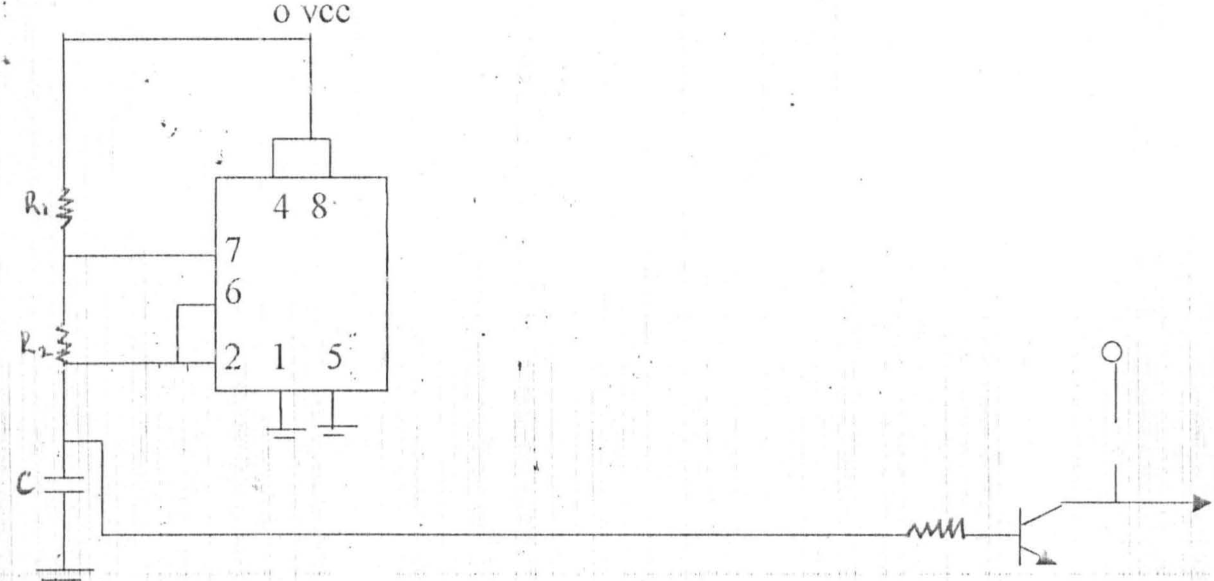


fig. 3.5 LOW frequency Circuit.

Low frequency (6 sec. astable)

Then from the frequency expression $f = 0.72 / R_2C$

and that $f = 1 / T \doteq 1/6$ Hz

from equation

$$C = \frac{0.72}{R2f} = \frac{0.72}{47 * 10^3 * 1/6} = \frac{0.72 * 6}{47 * 10^3}$$

$= 4.32/47 * 10^{-3} = 0.0919 * 10^{-3}$

$= 91.9 * 10^{-6}$ farad

C 100µF used for the design.

The total voltage for d.c supply is 124 but v c varies around 1/3Vcc: 1/3 * 12/1 = 4volts. This voltage equals.

$V_C = V_{RB} + V_{BE}$

$V_{RB} = 4 - 0.65$

$= \underline{3.35 \text{ vot}}$

for a minimum of 10MA current flowing in the timer IC.

$V_{RB} = I_{RB} * R_B$

$R_B = V_{RB}/I_{RB} = 3.35/10*10^3$

$= 3.35\ 8\ 10^3 /10$

$R_B = 335$ ohms

3.32 HIGH FREQUENCY ASTABLE

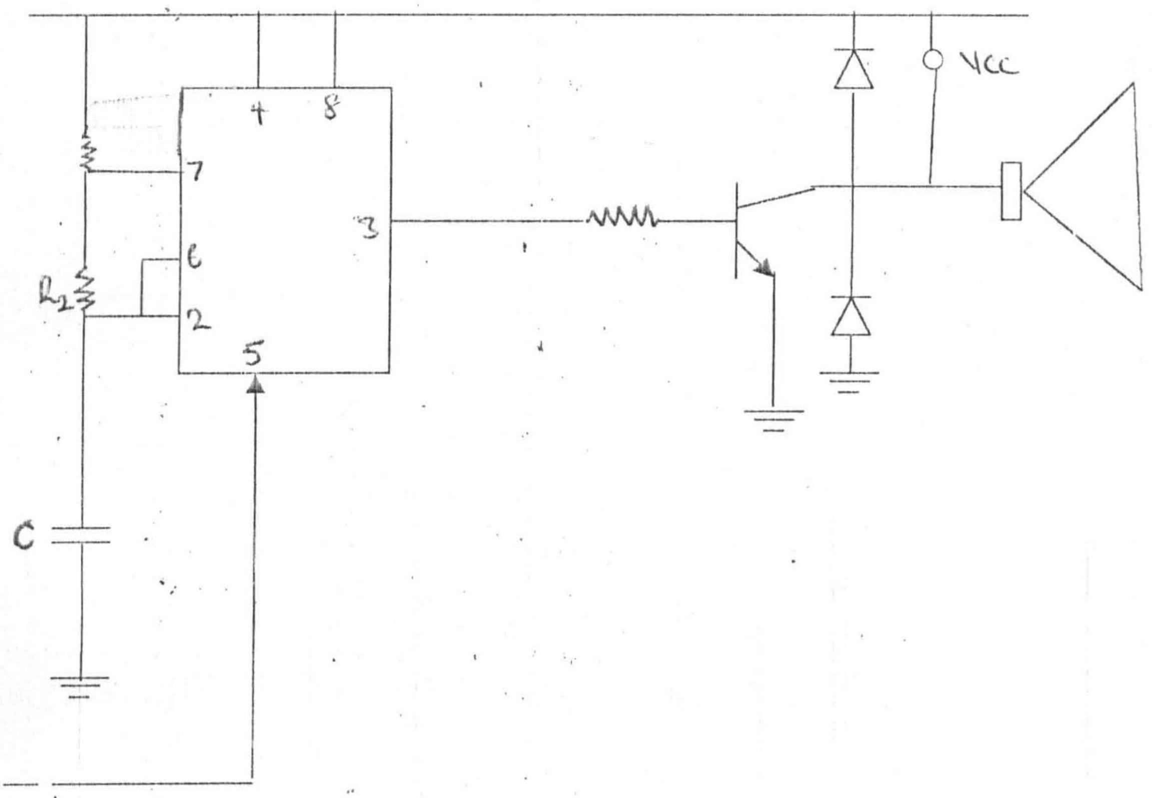


Fig 3.6 HIGH FREQUENCY CIRCUIT

F = 800Hz

Similarly assume $R_2 >> R_1$

And $R_2 = 10R_1$

Choose $R_1 = 10k$, $R_2 = 100k$

This from equation (2)

$F = 0.72/R_2C$

$C = 0.72/R2f = 0.72/10^5 * 800$

$= 0.72/80 * 10^{-6} = 0.009NF$

C= 9nf

But 10nf is used in this project.

3.4 SWITCHING CIRCUIT

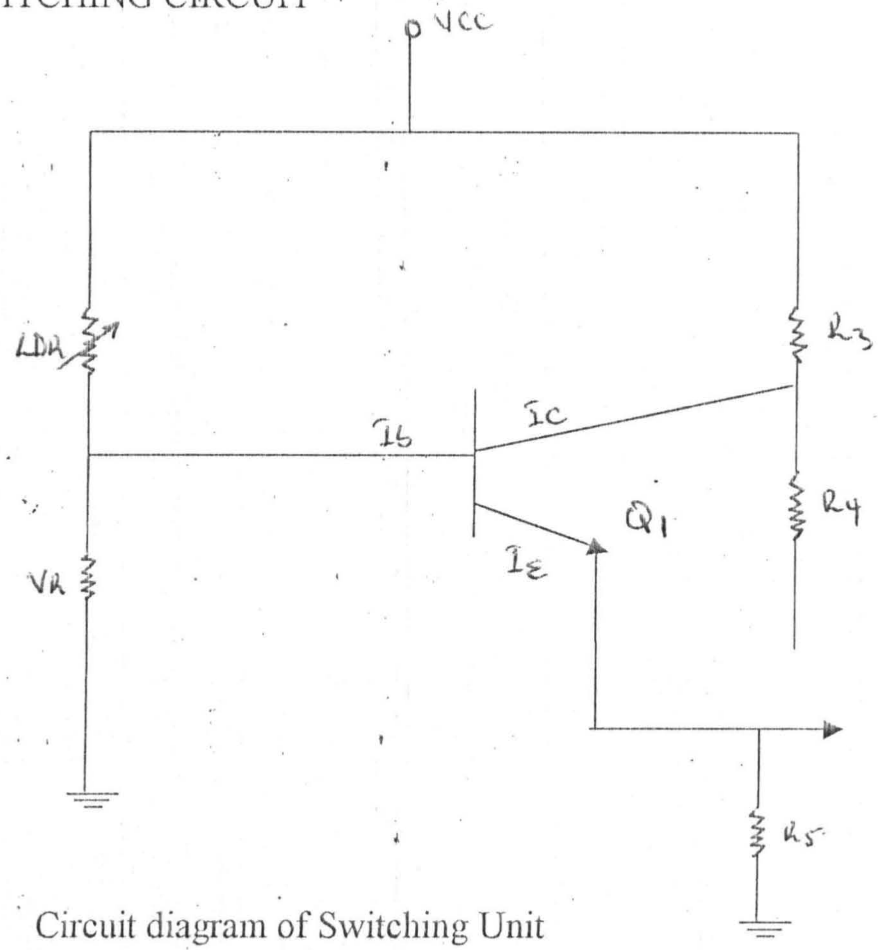


Fig. 3.7 Circuit diagram of Switching Unit

Q1 is a balance detector and R3 and R4 must be equal which LDR resistance vary in accordance with the preset value of VR for its operation as in wheatstone bridge

R_3 and R_4 are chosen to be 1k for my design and maximum value of VR equals the highest resistance of the LDR to be used for this design when the LDR is subjected to max darkness for this project LDR resistance under darkness is approx 50kohms hence VR = 50k is used in balance detected circuit.

VLDR = VVR = VBE + VR3 . ½ Vcc -------- must be satisfied for the balance detector Q1 to operate thereby making the preset input (pin4) of the astable switching circuit to have more than 1/3 vcc thereby turning on the astable switching circuit.

Switching cct determination of values for an astable $R_2 = 10R_1$ is considered.

F = 1Hz and for my design R_1 = 10k as chosen.

This, from previous equation.

$f = 0.72/R_2C$

from the above expression, the value of C is determined as

$C = 0.72/R_1f = 0.72/100k * 1$

$= 0.72/10^5 = 0.72 * 10^{-5}$

$C = 7.2 * 10^{-6}$ farad

$C \doteq$ 10NF is used

Because 7.2µF is used, then the actual value of R_2 to be use then is given as

$R_2 = 0.72/fc = 0.72/1*10*10^{-6}$

$R_2 \triangleq$ 75k.ohms is used

NB R_5 = 4.7k is used to prevent superior signal from falsely triggering the astable Q_1 is a general purpose PNP transistor silicon with UBE $\triangleq$ 0.65 volt.

The circuit is analogous to wheatstone bridge circuit such that R_3 & R_4 are known and are equal. 1k is only chosen for my design any other equal values can do in as much that half of vcc will be establish at the emitter of the balance detector --- Q_1 transistor used. This transistor acts more like galvanometer in the wheatstone bridge experiment. The position of the galvanometer is to detect the point of equilibrium in the wheatstone bridge experiment. But in this project the balance detector Q1 is also top detect that point where the equilibrium will exist while the unknown resistor (LDR) has it's value varying in accordance with the fixed resistor (V_R). The situation in this case is such that $V_B \triangleq V_E$ & this is the condition for the balance detector Q_1 to switch.

3.5 DETERMINING THE WATTAGE OF THE RL

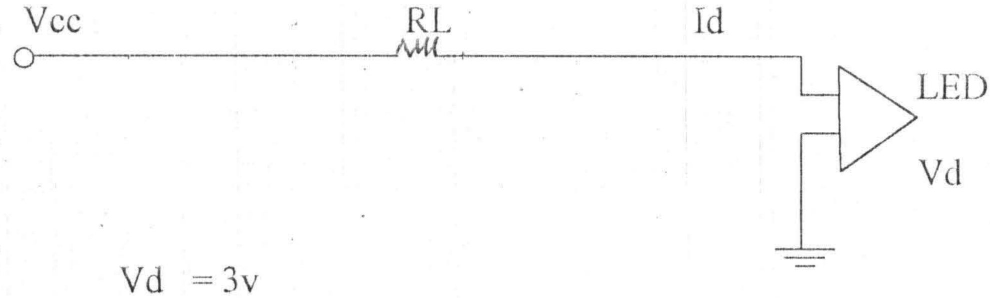


Fig. 3.8

$Vd = 3v$

$Id = 20mA$

$Vcc = 12v$

$Vcc = VRL + VD$

$VRL = 12 - 3 = 9$ volt

$VRL = IdRL$

hence $RL = VRL/Id = 9/20mA = 9/20 * 10^3$

$RL = 450$ohms

OR

Wattage of $RL = Id^2 \, RL$

$= (20 * 10^{-3})^2 * 450$

$= 400 * 10^{-6} * 450$

$= 0.4 * 0.45$

$= 0.18$watts

$RL = 450$ ohms

$= 0.45$ kilo-ohms

The amount of current that a LED can pass safety without overheating is given as

$$IF = \frac{VCC - VF}{R}$$

F = Maximum forward current

cc = Forward voltagedrop across the device

F = Supply d.c voltage

R = Limiting resistor value

3.6 DARK/LIGHT ACTIVATED RELAY SWITCHING CIRCUIT

The 55 is also use as a dark activated relay switch with high –dependence potential divider R_{V1}-LDR wired to its input terminal. The R_{V1} and LDR value are roughly equal at the median switching light level. This circuit acts as a fast comparator rather that as a true schmitt-trigger, since pin 6 is tied high Via R_1 and the light – sensing RV_1-LDR potential divide is applied to pin 2 only. The circuit can be made to act as a light activated relay switch by transposing RV_1 and LDR position.

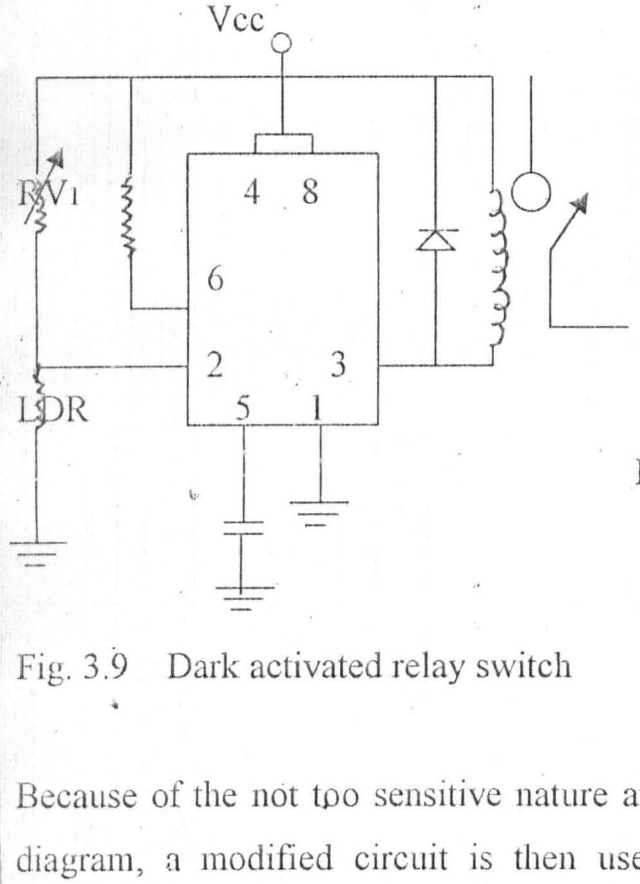


Fig. 3.9 Dark activated relay switch

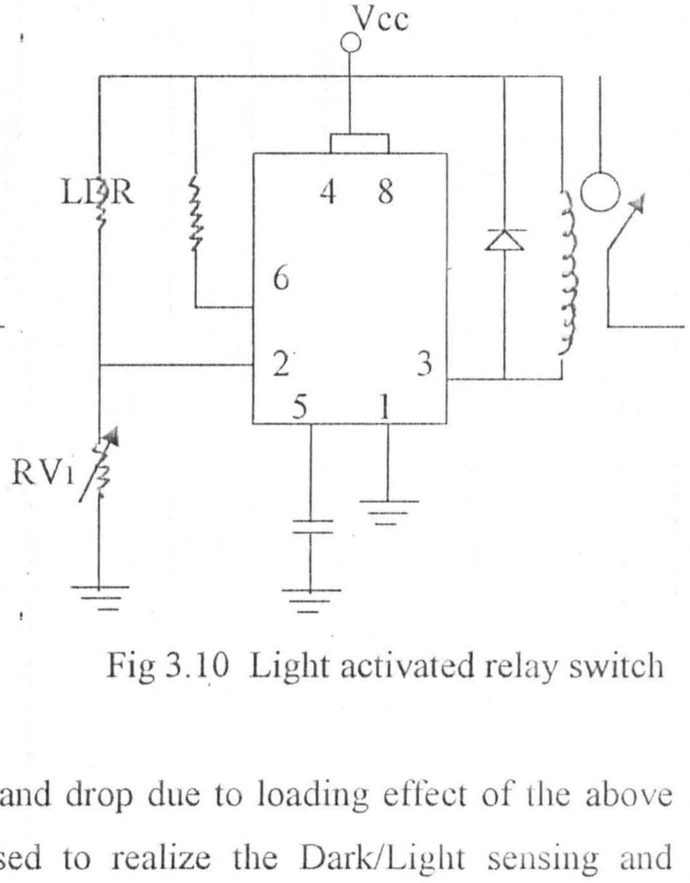


Fig 3.10 Light activated relay switch

Because of the not too sensitive nature and drop due to loading effect of the above diagram, a modified circuit is then used to realize the Dark/Light sensing and switching circuit.

R_4 – R_3 – LDR – RV_1 are used as a light sensitive wheatstone bridge that is used to activate the 555 astable Via balance – detector Q_1 and the pin 4 reset pin of the IC.

Under bright conditions the LDR has a low resistance, so the Q_1 base – emitter junction is reverse biased and less than 1/3 Vcc appear on pin 4, so the astable of off, but under dark conditions, the LDR resistance is high and Q_1 is biased on, generating more than 1/3 Vcc on pin 4 and thus turning the astable on.

The above technique gives precision gating and can be used to auto-activate variety of other 555 astable circuits.

3.7. CONSTRUCTION

For project models sake, it is mains powered and a permanent fixture.

Thus, the unit was constructed carefully and to a high quality to ensure long term safety for project model.

The components were first mounted on project board to effect all the necessary changes. Before it was soldered on a vero-board where continuity was not needed. Wires were used for connecting external accessories to the board.

The complete unit was loosed in a wooden case with the following dimensions. 35cm long, 22.6cm wide and 1.7cm thick.

3 VALUES OF 555 TIMER

The value of the 555 timer in the switching circuit and sensing circuit is :

CHN

NE555N

KOF 823

The value of the 555 timer in the timed delay circuit is

MAL

NE555N

90S82

The value of 555 timer in the alarm circuit are:

NE555N		NN555N
J57617E	*and*	J59536F
Jur 940 P		Jur 944 P
For low frequency		For high frequency

CHAPTER FOUR

4.0 TEST

After the soldering of the components on the vero-board, it is necessary to compare the practical output with the design work.

(a) Timed delay test

(b) Alarm circuit test

(c) Switching/sensing circuit test

(d) Determined the wattage of load resistor

(a) TIMED DELAY TEST :- The timed delay test was carried out by the triggering of the alarm switch. Which is used as the sensor for the alarm. When the switch was pressed, the alarm moves from its standby mode and enters into its entrance time delay mode.

This is known usually by the coming On of the Red Light emitting diode. The light emitting diode (L.E.D) was ON through out the time delay and it goes OFF immediately the alarm switches to its alarm section.

(b) ALARM CIRCUIT TEST:- This was carried out by determining the values involved in low and high frequencies astable. The 555 astable was used to carry this part of the project work. The astable is subjected to frequency modulation, (fm) or to pulse-position modulation (ppm) by simply adding the modulation signal to the central voltage pin. These type of modulation are useful in special wave form generator applications as in various electronic siren and alarm-call generator circuits.

(c) SWITCHING SENSING CIRCUIT TEST:- There is not much to be tested or carried – out in this part. This is ju ' a part to determine the varying resistance (ohm) in the circuit. Both the variable resistor and the balance detector are effectively alright when changing their variation. It could varies from 0 – 50k

(d) DETERMINING THE WATAGE OF LOAD RESISTOR:- Conventionally, the voltage of the light emitting diode is 3v while the current is 20mA. And the summation of variable load resistor with the voltage of the diode is the same as that of the voltage control.

Hence, the wattage of the R_L is 0.45kilo-ohms.

4.1 RELIABILITY

Reliability of a system or component is the probability that the system will function within. Specified limits for at least a specified period of time under specified environmental conditions. The reliability of this project work was calculated in order to know how safe and reliable it is.

TABLE 2.0 ASSUMED BASIC ASSESSED FAILURE RATES (%PER 1000hrs)

COMPONENTS	VALUES
CAPACITORS FIXED (CERAMICS)	0.01
CAPACITORS FIXED-ELECTROLYTIC (Aluminum Foil)	0.2
DIODES SILICON I WATT	0.005
SWITCHES, PUSH BUTTON (EACH CONTACT PAIRS	0.02
TRANSFORMER, A.F (EACH WINDING)	0.01
RELAY GENERAL SCALED (EACH OIL)	0.01
RESISTOR, FIXED CARBON FIRM (B.STAB)	0.05

Capacitors fixed (ceramics)

$= 0.01\%$ per 1000hr

$= 0.01 * 10^{-5}$ per hr

capacitors fixed electrolytic (Aluminum Foil)

$= 0.2\%$ per 1000 hr

$= 0.2 * 10^{-5}$ per hr.

Diodes silicon 1 watt

$= 0.005\%$ per 1000hr

$= 0.005 * 10^{-5}$ per hr

Switches, push button (each contact pair)

$= 0.02\%$ per 1000hr

$= 0.02 * 10^{-5}$ per hr

Transformer A.F (each winding)

$= 0.01\%$ per 1000hr

$= 0.01 * 10^{-5}$ per hr

Relay general sealed (each coil)

$= 0.01\%$ per 1000hr

$= 0.01 * 10^{-5}$ per hr

Resistor, fixed carbon film (B.Stab)

$= 0.05\%$ per 1000hr

$= 0.05 * 10^{-5}$ per hr

Assumed exponential model (for calculation)

$F(t) = 1 - R(t)$

$R(t) = e^{-\lambda t}$

Where $F(t)$ = failure probability of the system

$R(t)$ = Reliability of the system

λ = failure rate

t = Time in hours.

1 year = 365 ¼ days

24hours = 1 day

1 year = (365 * ¼) * 24/1

= 1461/4 * 24/1

= 1461 * 6

t = 8766hrs.

1a. Probability of failure of transformer (double winding)

$F_{TX}(t) = I\text{-}e^{-0.02*10E\text{-}5*(8766)}$

= 0.91408

b. Probability of failure of diode

$F_D(t) = I\text{-}e^{-0.02*10E\text{-}5*(8766)}$

= 0.91408

c. Probability of failure of capacitor (Electrolytic)

$F_{CE}(t) = I\text{-}e^{-0.2*10E\text{-}5*(8766)}$

= 0.92823

Probability of power supply unit failure

F_{PSU} =1 – (0.91408) * (0.91408) * (0.92823)

= 0.22443

2a. Probability of failure of 555 timer

$F_{IC}(t) = I\text{-}e^{-0.3*10E\text{-}5*(8766)}$

= 0.93506

b. Probability of failure of switch

$F_{SW}(t) = I\text{-}e^{-0.2*10\text{-}5*(8766)}$

= 0.91408

c. Probability of failure of resistor

$F_R(t) = 1 - e^{-0.15*10E-5*(8766)}$

$= 0.89815$

d. Probability of failure of capacity (ceramics)

$F_{CE}(t) = 1 - e^{-0.01*10E-5*(8766)}$

$= 0.91321$

e. Probability of failure of capacity (Electrolytic)

$F_{CE}(t) = 1 - e^{-0.2*10E-5*(8766)}$

$= 0.912823$

f. Probability of failure of Relay

$F_{REL}(t) = 1 - e^{-0.01*10E-5*(8766)}$

$= 0.91321$

Probability of timed delay unit failure

$F_{TD} = 1 - (0.93506)(0.91408)(0.89815)(0.91321)(0.92823)(0.91321)$

$= 0.40575$

3a. Probability of failure of speaker

Assumed probability of failure of speaker = 0.001

b. Probability of failure of 555 timer (ic)

$F_{IC}(t) = 1 - e^{-0.3*10E-5*(8766)}$

$= 0.93506$

c. Probability of failure of resistor

$F_{RF}(t) = 1 - e^{-0.3*10E-5*(8766)}$

$= 0.93506$

d. Probability of failure capacitor (ceramics)

$F_{CC}(t) = 1 - e^{-0.02*10E-5*(8766)}$

$= 0.91408$

e. Probability of failure of capacitor (electrolyte)

$F_{CE}(t) = I\text{-}e^{-0.2*10E-5*(8766)}$

$= 0.92823$

Probability of Alarm circuit failure

$F_{AC} = 1 - (0.9990)\ (0.93506)\ (0.93506)\ (0.91408)\ (0.92823)$

$= 0.25889$

Probability of total Home security monitor system failure:

$F_T = 1 - (1\text{-}0.22443)\ (1\text{-}0.40575)\ (1\text{-}0.25889)$

$= 1 - (0.77557)\ (0.59425)\ (0.74111)$

$= 1 - 0.34157$

$= 0.65844$

4.2 DISCUSSION OF RESULT

Since the total failure rate of this design more than 0.5. it is logical to say that the components used in this design are not that reliable (since it is use for project model) and the percentage reliability would be nothing less than 40%

The ranging values of the variable resistor does not make much change in this project because of the little difference it makes after switching it on.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The aim of the project was achieved as the system was tested and found to be working quite satisfactory.

This project has been logically designed to be able to reduce all possible approaches by home intruder and to give maximum protection to the owner, if he/she happens to be around during the operation.

5.2 RECOMMENDATION

There is need for improvement in all areas of work. Any subsequent designed should incorporate a remote control system, which may be either infra-red or transmitter/receiver operated. The control system should provide the alarm set and reset buttons.

The entrance timed delay should be made variable to allow the user to set it to the time that will be convenient for him/her.

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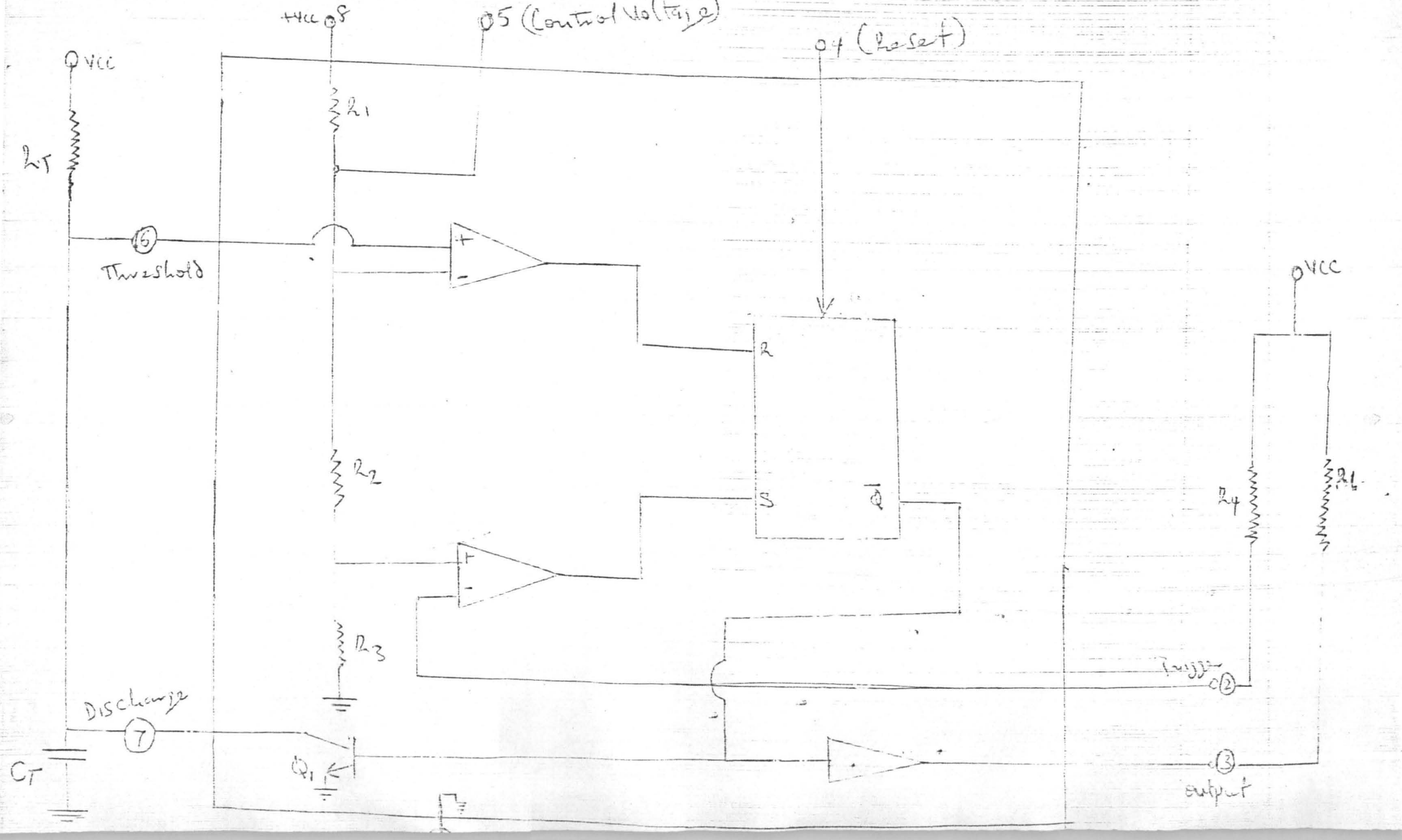
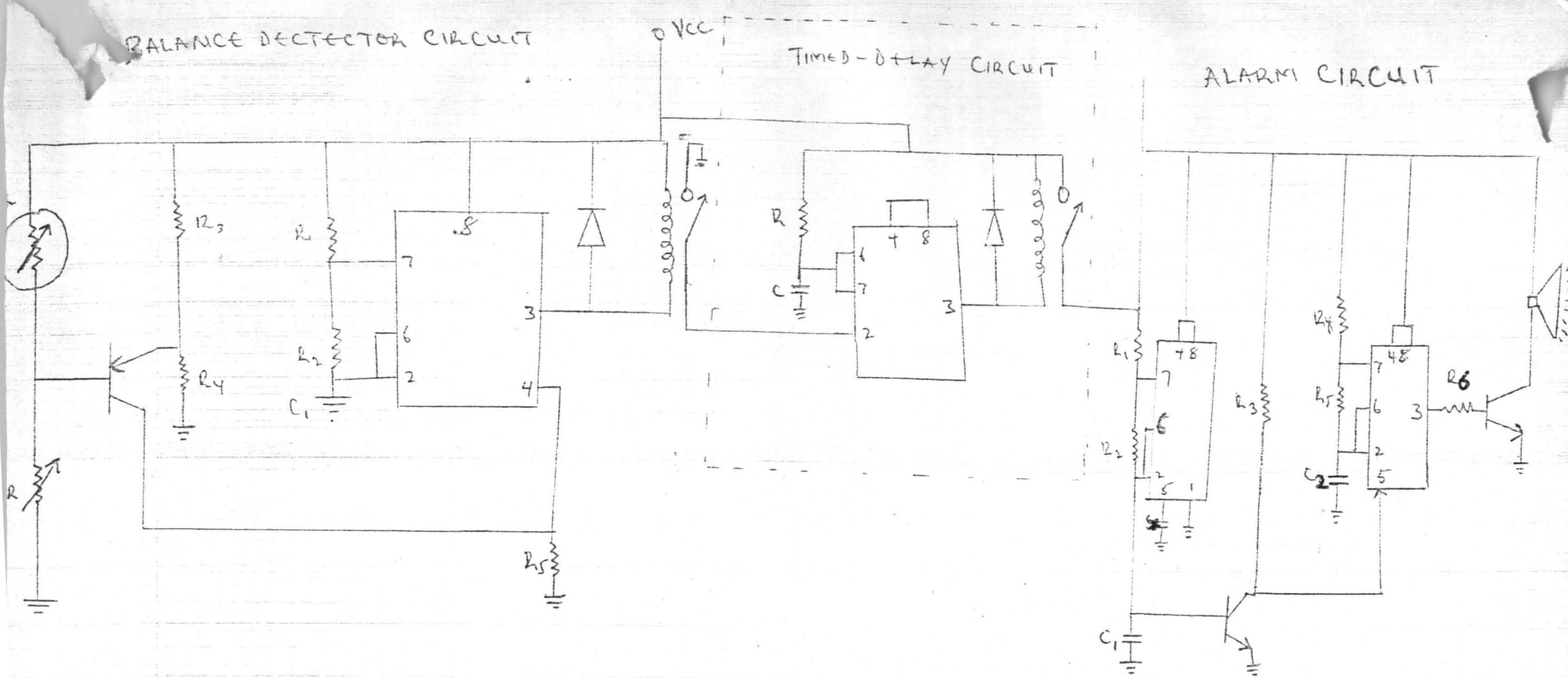
3. DAVID J. COMER (1990) "SOME DOCUMENTATION ON HOW INTEGRATED CIRCUITS WORKS AND ITS VARIOUS USES".MACMILLAN, ENGLAND.


+Vcc 8
5 (Control Voltage)
4 (Reset)
Vcc
R1
RT
6
Threshold
R
Vcc
R2
S
Q
R4
R3
Trigger
2
Discharge
7
CT
Q1
3
output



The Complete Circuit diagram of Home Security monitor System.

VALUES OF BALANCE DETECTOR CIRCUIT

LDR ≙ 50kΩ

VR ≙ 50kΩ

R_1 = 10kΩ

R_2 = 100kΩ

R_3 = 1kΩ

R_4 = 1kΩ

R_5 = 4.7kΩ

C = 10NF

VALUES OF TIMED-DECAY CIRCUIT

R = 100kΩ

C = 100NF

VALUES OF ALARM CIRCUIT

FOR LOW FREQUENCY

R_1 = 4.7kΩ

R_2 = 47kΩ, R_3 1kΩ

C_1 = 100NF

FOR HIGH FREQUENCY

R_4 = 10kΩ

R_5 = 100kΩ

C_2 = 10nf

R_6 ≙ 0.4kΩ