Palestine Polytechnic University

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Graduation Project
Intelligent Security System

Project Team

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Abstract

In this project we well advance the alarm system into trap, so it won't only alert that there is unwanted or dangerous movement in the protected place, but also to participate in catching the person who try to enter this place and help security and police to arrest him.

The circuit contains of four stages every stage have exact job to do starting by alarm circuit then Dial up a Telephone number then AM transmitter and Receiver then finally shock circuit.

في هذا المشروع سنقوم بتحويل نظام الإنذار العادي المتعارف عليه من إنذار فقط إلى نظام يعمل كمصيدة حيث إن هذا النظام مصمم ليساعد في القبض على الشخص الذي يحاول اختراق المكان المحمي بواسطة صعقة بجهد كهربائي يعمل على إفقاده الوعي وأيضا فإن هذا النظام لا يقوم بالإنذار فقط بواسطة الصوت ولكن أيضا بالاتصال برقم تلفون وأيضا بواسطة أجهزة استقبال محمولة.

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Chapter One

Introduction

As science and technology are advanced, as world enters nuclear energy century and space war, and as humanity gets a high level of science, civilization and increase of natural use, still, bad things exist there. One of this is stealing.

Stealing, trying to steal and killing, this happens daily and illegally. And as we always hear about homes and banks robberies. To prevent such acts obviously security systems inside homes and rooms are needed.

1.1 Objectives

This project aim is to present an electronic system acts as home guard to sense any home entrance and make an alarm, and try to stop the stealer and catch him by shock, in addition to send alarming call to a specific phone number, this makes the room more secure against robbers and protect valuable items.

This project process one of the very important subject, it is home security system. And study the way of alarming, and sending the alarm in different ways by serine, telephone and AM transmitter.

1.2 Project limiting

The project concentrate on the way of alarming more than the way of sensing, we use alarm by sound, by telephone and AM Transmitter, and we use a protect unit (shock circuit) and this make our project unique.

There is a relation between the uses of protecting unit (shock circuit) and make stealing operation failed and catch the stealer.

1.3 Project contains

This project contains three chapters in addition to this chapter, Chapter two that gives a preview for previous home alarm system studies, Chapter three which emphasis on project details and its construction and circuits, and finally Chapter four which contains circuits design implementation and results.

1.4 Project scope

At the beginning of the semester, the time was divided to accomplish the work with no slag or delay. So, this section shows time division, which shown in the table 1.1 and table 1.2.

Table(1.1) : First semester Time Plan

Task \ Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Data Gathering & Analyzing	■	■	■	■	■											
System requirement specifications				■	■											
Study Previous Alarm Systems					■	■	■	■								
Conclusion And Results							■	■	■	■						
Project Design									■	■	■	■	■			
Documentation	■	■	■	■	■	■	■	■	■	■	■	■	■	■		

Table (1.2): Second Semester Time Plan

Task \ Week	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Implementation	■	■	■	■	■	■	■									
System Testing				■	■	■	■	■	■	■	■	■	■			
Documentation					■	■	■	■	■	■	■	■	■	■		

1.5 Total Cost

The total costs of the project are preliminarily estimated, and were put in table2 below. This cost is nominated to rise as a result of the need of supplementary parts to be added when finalizing the design of this project in the final paper.

Table (1.3): cost by part and totaal cost

Part	Quantity	Price {NIS}	Total price {NIS}
Transmitter	1	160	160
Receiver	1	180	180
Schmitt trigger	2		24
Capacitors	11	4	44
Diodes	15	5	75
Switch	3	6	18
Breadboard	4	20	80
Timer	4	12	48
Relay	5	30	150
Résistance	11	6	66
Optocoupler	5	12	60
Additional	-	200	200
Total cost	--	--	Around 1000 NIS

1.6 System General Block Diagram

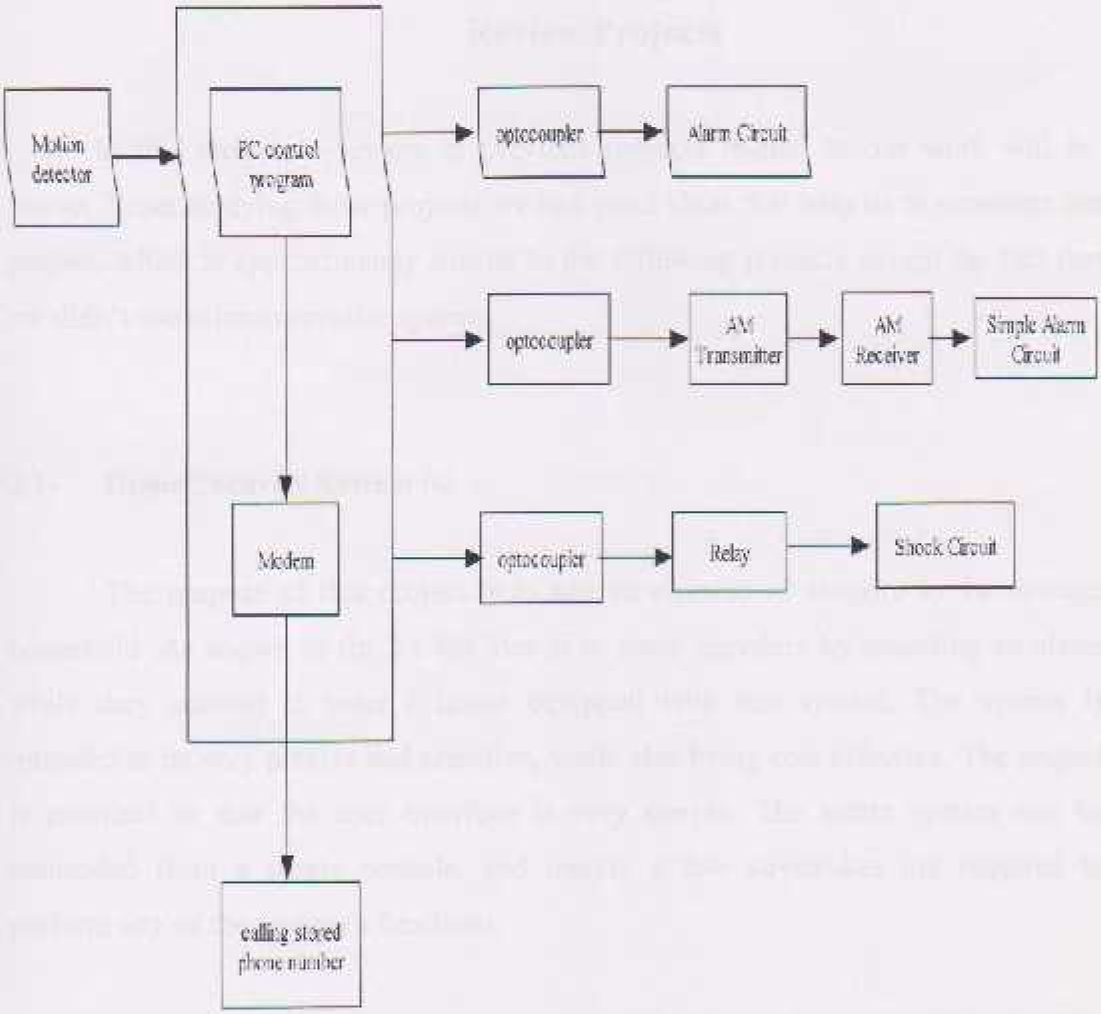


Figure (1.1) : General Block Diagram

Chapter Two

Review Projects

In this chapter a review of previous projects related to our work will be shown. From studying these projects we had good ideas that help us to construct our project, which is approximately similar to the following projects except the fact that we didn't use microcontroller system.

2.1- **Home Security System** [6]

The purpose of this project is to add an element of security to the average household .As shown in fig 2.1 the idea is to scare intruders by sounding an alarm while they attempt to enter a house equipped with this system. The system is intended to be very precise and sensitive, while also being cost effective. The project is practical in that the user interface is very simple. The entire system can be controlled from a single console, and merely a few keystrokes are required to perform any of the system's functions.

Using this pass-code, the user can arm and disarm the system. The user can also change the pass-code. The state of the system will be displayed using LEDs. It will display red for the arm state, green for the disarm state, and yellow for the pass-code changing state. While the system is in the arm state, the system alarm will sound if any of the break-beam sensors are tripped. The alarm can only be disabled by entering the correct user pass-code. The system will also automatically clear an incorrect pass-code once it is fully entered.

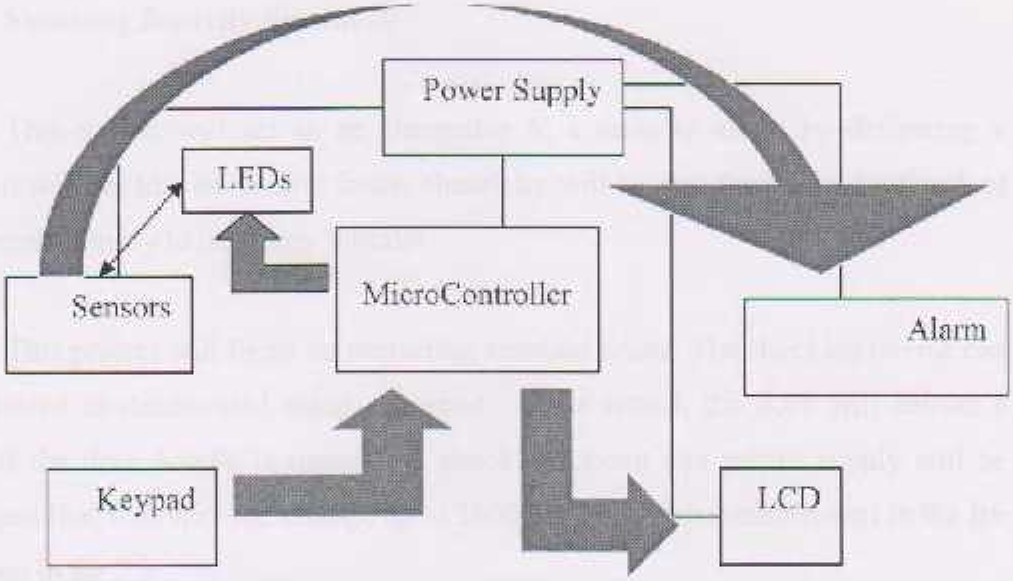


Figure (2.1) : Home Security System

2.2- **Shocking Security System** [7]

This device will act as an alternative to a security alarm by delivering a shock. It will act like an electric fence, electricity will be sent through a doorknob or other point of entry to deter any intruder.

This project will focus on protecting standard doors. The shocking device can be activated or deactivated using a keypad. Once armed, the door will deliver a shock if the door handle is turned. A shocking circuit and power supply will be developed that will vary the voltage up to 1000VDC for easy measurement in the lab as shown in fig 2.2.

The locking mechanism for the door will be accomplished through the use of a pull type solenoid. The HC12 microcontroller will be used to control the project by taking the keypad inputs, and outputting the correct control signals. Proper amounts of electricity will be researched as to not cause serious harm to an intruder.

- Programmable password for increased security
- Deter unauthorized entry into building or room
- Warning LED's for door states: Armed/Disarmed, Locked/Unlocked, and Shocking
- Variable shock voltage
- Will not shock intruder until doorknob is turned (2)

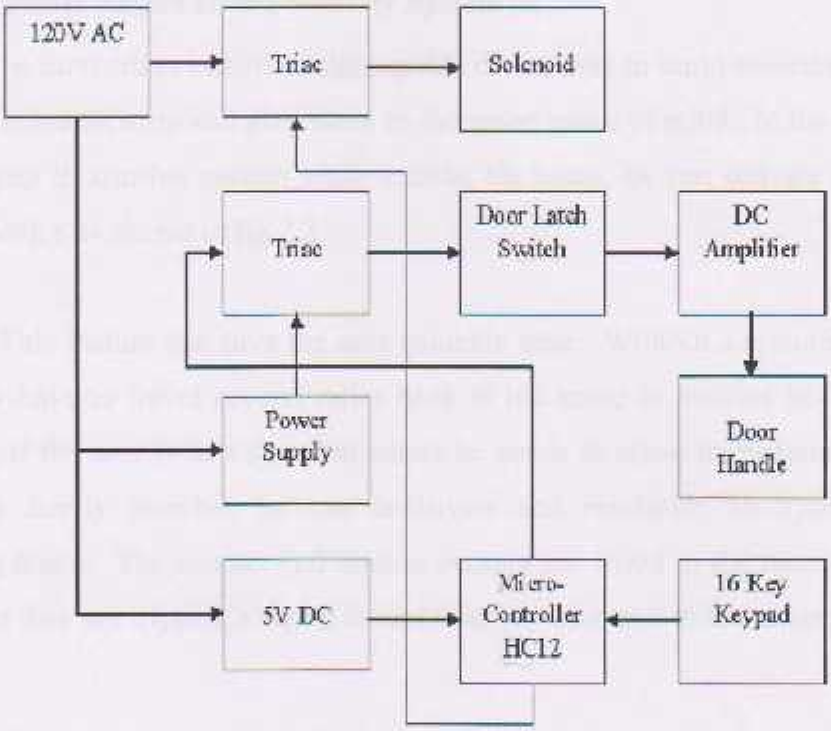


Figure (2.2): shocking security system

2.3- Remote Access Home Security System [9]

The motivation behind designing this device was to build something that will improve home security and give users an increased peace of mind. In the event that a user forgets to arm his system while exiting his home, he can activate it using the remote device as shown in fig 2.3.

This feature can save the user valuable time. Without a remote device, the user may have to travel several miles back to his home to activate his system. In addition, if the user is in a situation where he needs to allow immediate access to a friend or family member, he can deactivate and reactivate his system without returning home. The contact and motion sensors are wired to the base unit. In the event that they are tripped, a signal is sent from the base unit to the remote device.

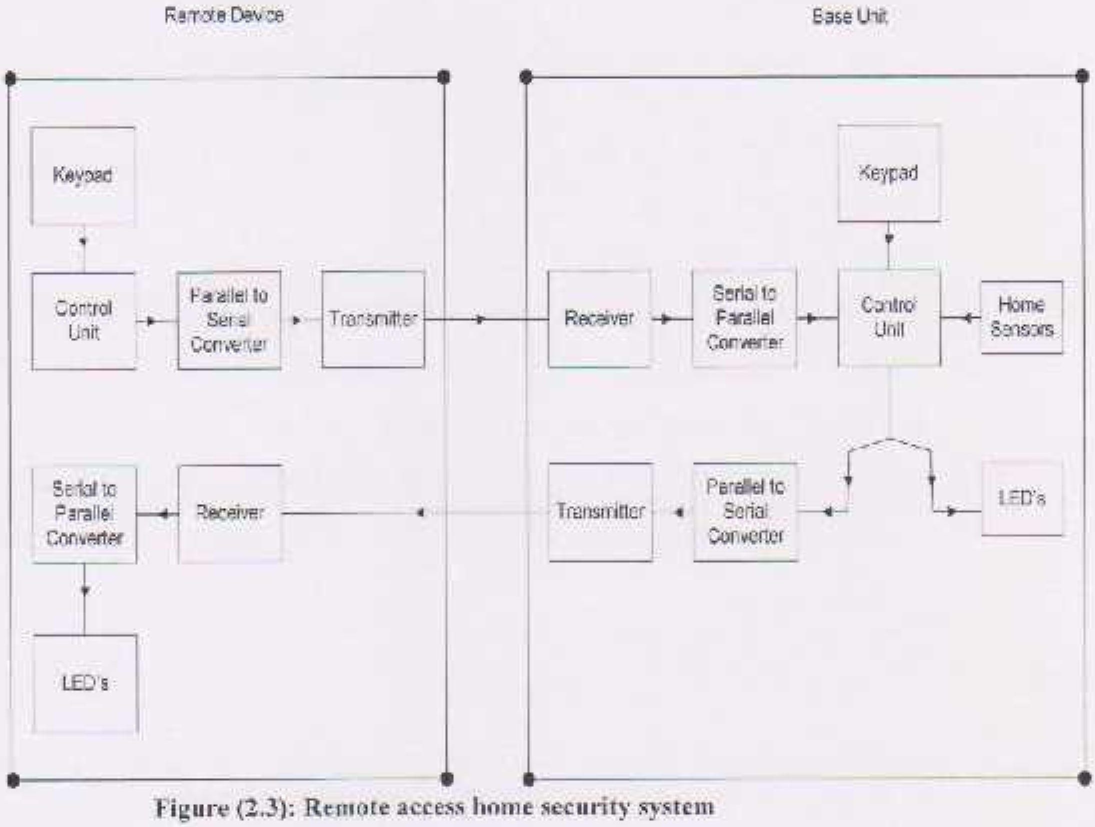


Figure (2.3): Remote access home security system

2.4- Phone Operated Home Control System [8]

This project, once installed in a home, will give the owner the capability to remotely control four independent lighting circuits, the alarm system, and the heating and cooling system from any touch tone phone through the PSTN (public switched telephone network).

Access to the system is controlled with a PIN that must be entered when the system answers a call. The caller selects commands though a tone driven menu and the system responds to the caller with short beeps produced by the DSP as shown in fig 2.4.

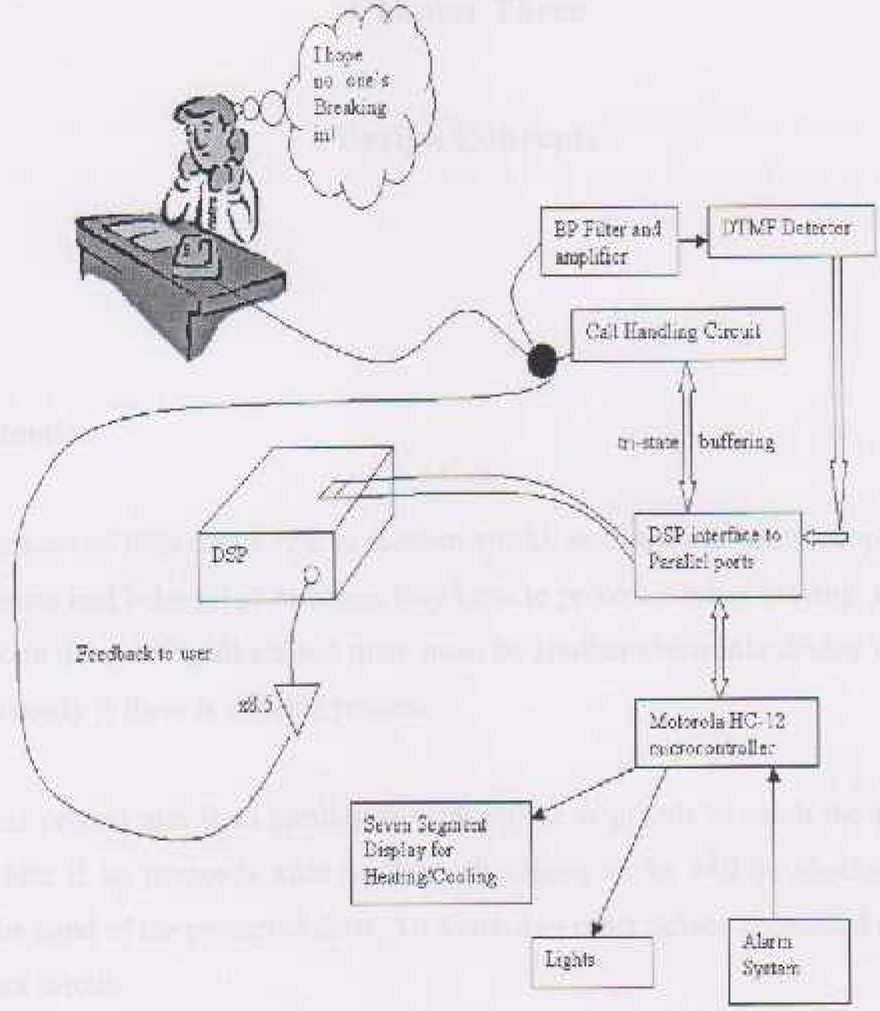


Figure (2.4) : Phone operated security system

The project is divided into many subprojects as you can see from the block diagram. The three main areas are the DSP and its interface, the HC12 and it's interface with the house, and the PSTN interface. The PSTN interface consists of the call handling circuit, the filter and amplifier and the DTMF detector.

Chapter Three

Design Concepts

3.1 Introduction

Because of high crime rate in modern world, and because many people keep valuable items and belongings at home, they have to protect it when leaving, and this can't be done using the padlock but there must be another electronic device work as guard and notify if there is stealing process.

This project aim is to participate with police or guards to catch the thief by shocking him if he proceeds after he hears the alarm so he will be shocked if he touched the hand of the protected door . Or touch any other device connected directly to the shock circuit.

Our design is very simple and easy to use and it is connected with a PC to implement trigger to the components of the system with suitable delay and suitable arrangement can be done using the control program.

3.2 Power Supply

In this project we will design a power supply which provides the circuit with 12 VDC and then we will use methods of voltage dividing to supply every circuit of this project with its required amount of voltage

3.3 Motion Detector

This part of circuit is works here as switch which generates the trigger to the whole parts of the system, it contain A circuit with relay which work on the Infrared Waves comes out the human body when moves .

3.4 Alarm Circuit

This circuit as shown in figure (3.1) is the first defense line in our project, it well turn on as soon as the Motion Detector Works, This circuit is simple works with two 555 timers to generate two sounds with two different frequencies and the reason to generate two sequential sounds is hearing it will be better from one single sound.

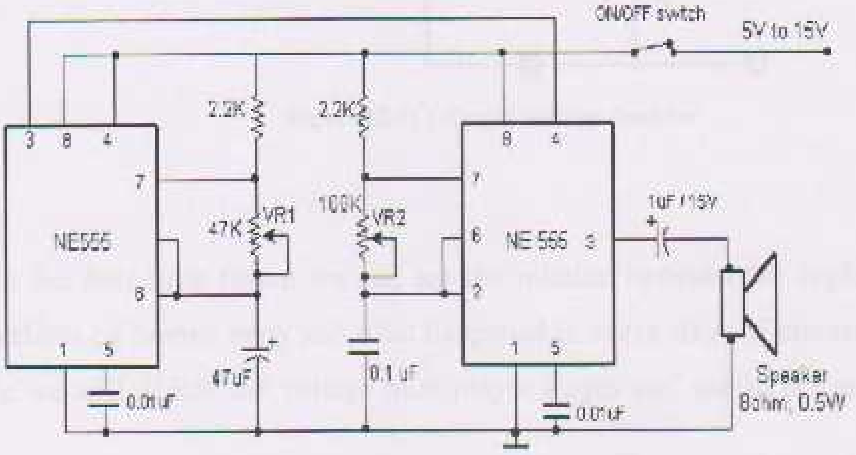


Figure (3.1) : Alarm circuit

3.5 AM Transmitter And Receiver

This part Transmits AM signal from the IC (RT4-433) to AM signal Receivers (RR3-433) and this signal which received will be Able to trigger A small alarm circuit connected to it so that in this combination we can see that we can Virtually move the alarm to a another place away from the main alarm buzzer.

3.6 Shocking Circuit

This is the last line and it's the most important and danger part because it is danger and supply very big amount of Voltage which will shock the thief who tries to open the protected door. To generate electrical shock we will use voltage multiplayer techniques and fig 3.2 samples a simple voltage multiplayer.

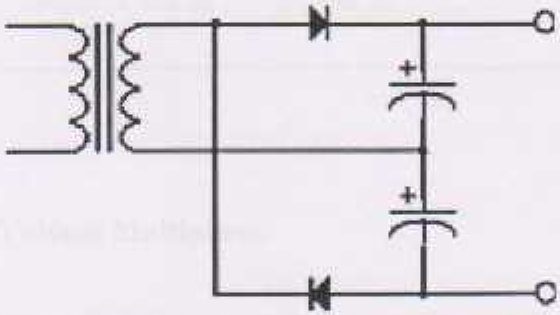


Figure (3.2) : simple voltage doubler

In the following figure we can see the relation between the applied current and the effects on human body and what happened in every stage of current and from this table we will decide the voltage multiplayer stages we" use to perform a shock circuit.

Table (3.1): Relation between Current And The Human Effects

BODILY EFFECT	DIRECT CURRENT (DC)	60 Hz AC	10 kHz AC
Slight sensation felt at hand(s)	Men = 1.0 mA Women = 0.6 mA	0.4 mA 0.3 mA	7 mA 5 mA
Threshold of perception	Men = 5.2 mA Women = 3.5 mA	1.1 mA 0.7 mA	12 mA 8 mA
Painful, but voluntary muscle control maintained	Men = 62 mA Women = 41 mA	9 mA 6 mA	55 mA 37 mA
Painful, unable to let go of wires	Men = 76 mA Women = 51 mA	16 mA 10.5 mA	75 mA 50 mA
Severe pain, difficulty breathing	Men = 90 mA Women = 60 mA	23 mA 15 mA	94 mA 63 mA
Possible heart fibrillation after 3 seconds	Men = 500 mA Women = 500 mA	100 mA 100 mA	

3.6.1 Cockroft Walton Voltage Multipliers

The classic multistage diode/capacitor voltage multiplier as shown in fig 3.3, popularized by Cockroft and Walton, is probably the most popular means of generating high voltages at low currents at low cost. It is used in virtually every television set made to generate the 20-30 kV second anode accelerating voltage from a transformer putting out 10-15 kV pulses. It has the advantage of requiring relatively low cost components and being easy to insulate.

It also inherently produces a series of stepped voltages which is useful in some forms of particle accelerators, and for biasing photomultiplier tube dynodes.

The CW multiplier has the disadvantage of having very poor voltage regulation, that is, the voltage drops rapidly as a function the output current. In some applications, this is an advantage. The output V/I characteristic are roughly hyperbolic, so it serves well for charging capacitor banks to high voltages at roughly constant charging power. Furthermore, the ripple on the output, particularly at high loads, is quite high.

It is quite popular for relatively low powered particle accelerators for injecting into another accelerator, particularly for heavy ions. The high ripple means that there is a significant energy spread in the ion beam, though, and for applications where low ripple is important at megavolt potentials, electrostatic systems like Van de Graff and Pelletron machines are preferred.

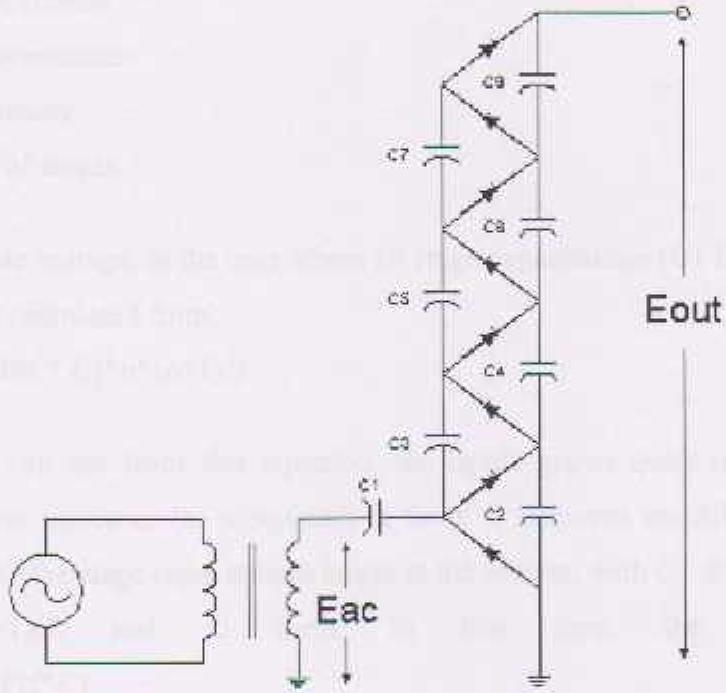


Figure (3.3) AC to DC Voltage multiplayer

The output voltage (E out) is nominally the twice the peak input voltage (E ac) multiplied by the number of stages, 4 in the above diagram. That is, the circuit above is a voltage octupler, E out = 8 * 1.4 * E rms In practice, the output is significantly lower, particularly with a large number of stages.

Regulation and ripple calculations

The voltage drop under load can be calculated as:

E drop = II/ (f*C) * (2 /3*n^3 + n^2/2- n/6) ------------------------------ (3.1)

where:

I load is the load current
C is the stage capacitance
f is the AC frequency
n is the number of stages.

The ripple voltage, in the case where all stage capacitances (C1 through C(2*n)) may be calculated from:
E ripple = I load/(f * C)*n*(n+1)/2

As you can see from this equation, the ripple grows quite rapidly as the number of stages increases (as n squared, in fact). A common modification to the design is to make the stage capacitances larger at the bottom, with C1 & C2 = nC, C3 & C4= (n-1)C, and so forth. In this case, the ripple is:
E ripple = I load/(f*C)

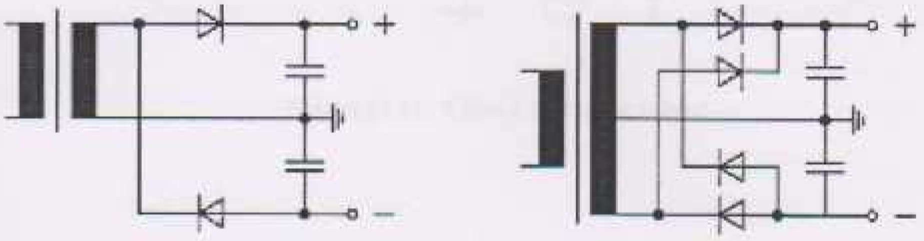
For large values of n (>= 5), the $n^2/2$ and n/6 terms in the voltage drop equation become small compared to the $2/3n^3$. Differentiating the drop equation with respect to the number of stages gives an equation for the optimum number of stages (for the equal valued capacitor design:

Noptimum = SQRT(V max * f * C/I load)

Increasing the frequency can dramatically reduce the ripple, and the voltage drop under load, which accounts for the popularity driving a multiplier stack with a switching power supply.

3.6.2 Basic multiplier circuits (rephrase)

Greinacher voltage doubler circuit. (a) simple version for grounded input voltage, (b) double version for symmetric input voltage. Diodes must be dimensioned for 2x input peak voltage Up, caps only for 1x Up.



(a) (b)

Figure (3.4) : Greinacher voltage doublers

The Grenache doubler circuit (a) transforms a grounded AC voltage (peak voltage Up) into symmetrical DC voltages of 1x Up each, thus producing 2x Up between outputs. If the input voltage is already symmetrical (e.g. as in an Obit), the Greinacher circuit may be doubled according to (b). This does not change the output voltages but increases the possible output current by a factor of two.

Villard voltage doubler circuit for positive polarity towards ground. For negative polarity reverse all diodes. Diodes and caps must be dimensioned for 2x Up. For sinusoidal input voltage 1x Up is sufficient for C1.

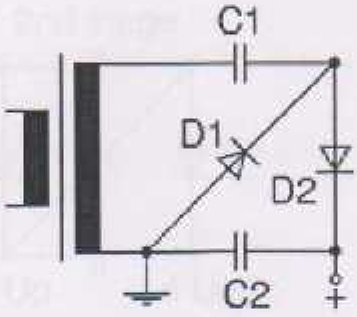


Figure (3.5) : Villard voltage doubler

In contrast to the Greinacher circuit, the Villard doubler circuit produces 2x Up towards ground at a single output. Besides this, the advantage of the Villard circuit is that it may be cascaded to form a voltage multiplier with (in principle) arbitrary output voltage. The way this works is that after C1 and C2 are fully charged to 1x and 2x Up respectively, there is a pulsating DC voltage oscillating between 0 and 2x Up across D2, which is converted to AC by the subsequent cap and thus acts as input AC of the next stage, and so forth.

Cascaded Villard doubler circuits. All diodes and caps must be dimensioned for 2x Up. For sinusoidal input voltage, C1 of the first stage may be reduced to 1x Up.

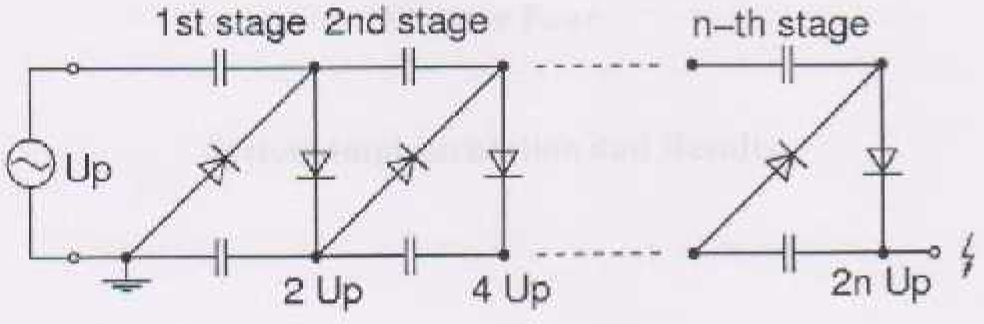


Figure (3.6) : Villard cascade

An n-stage cascade produces 2n x Up output voltage. By choosing an appropriate number of stages, any voltage can be reached. However, this is only valid for negligible current draw. As soon as there is output current, there is also an AC current through the caps, resulting in a voltage drop and a lower input voltage for subsequent stages. In fact, numbers much higher than, say, 10 or 20, are not sensible in practice. More specifically, the formula for the voltage drop is

$$\Delta U = \frac{I}{fC}\left(\frac{2}{3}n^3 + \frac{1}{2}n^2 - \frac{1}{6}n\right) \quad \text{where}$$

ΔU : voltage drop
I : output current
f : input frequency
C : capacity of caps
n : # of stages

This means, the voltage drop is the higher, the higher the output current I, the lower the frequency f and the lower the capacity C. The voltage drop also increases with the number of stages cubed, which means for 10 stages it is already 1000x as large as for a single stage.

Chapter Four

System Implementation and Results

4.1 System's Operation

The whole system operations are working on the following sequence, and can be shown in the flow chart of fig 4.1 .

A- The first circuit to work is the shock circuit which we design to implement (350 – 400) VDC with current value Of (0.5) A and these previous values of current and voltage can implement the shock we want to deliver to the intruder and don't kill him unless he has problem in his heart and this is unexpected.

B- The second circuit to work is the AM transmitter and receiver circuit which will deliver the alarm signal in place away from the intruder place by 70 m , the receiver is not heave and small and can alarm the house owner if he in the range or also can alarm a guard.

C- The third part to operate is the dial up modem which will be activate by a VB code and once it activates it will directly call a phone number stored in it, it could be the police number or the owner personal telephone.

D- The final stage is the alarm circuit, will be triggered throw the PC pulse and the aim from making it the final circuit to work is that we are designing here A trap system more than ordinary alarm system.

4.1.1- System Flow Chart

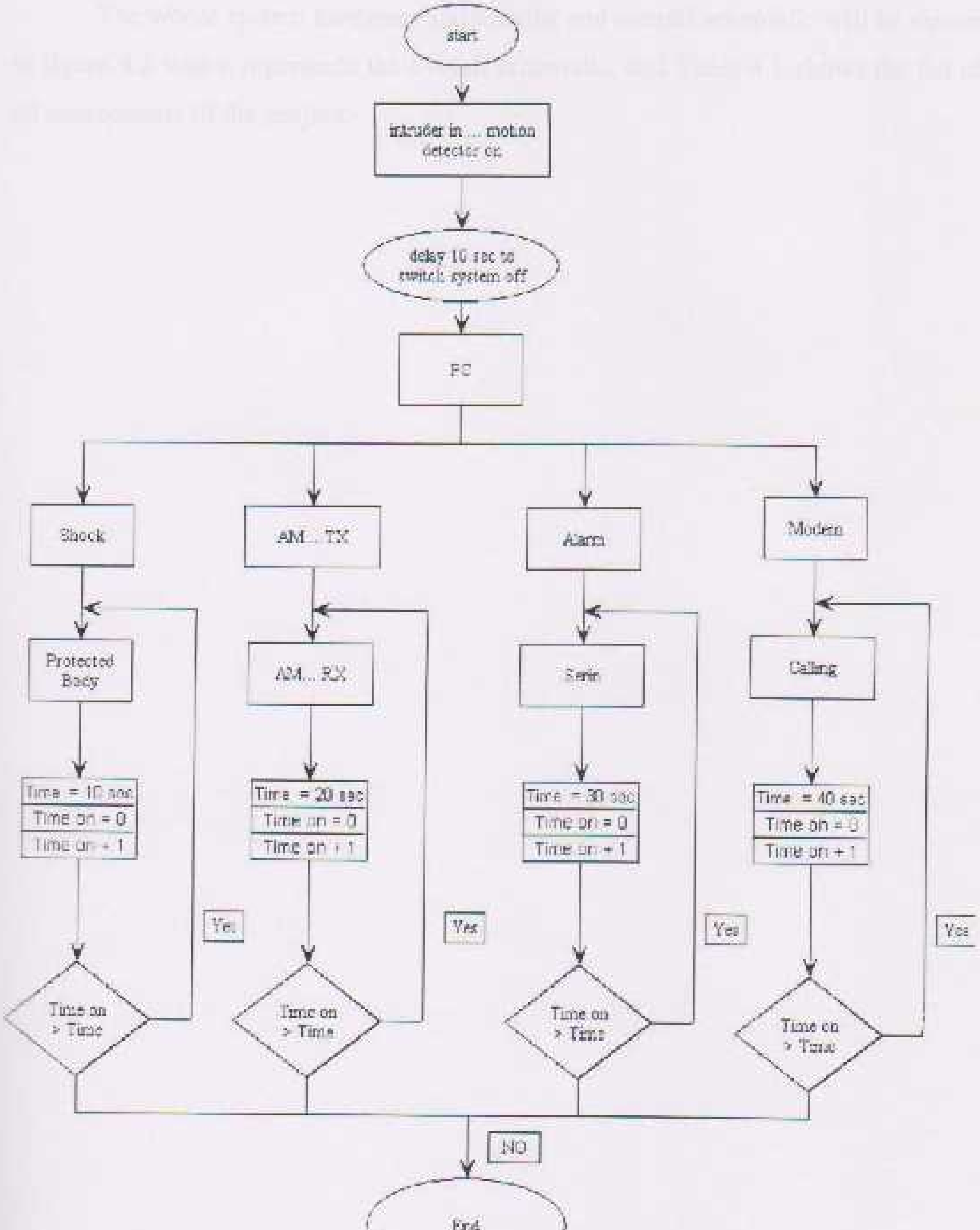


Figure (4.1): System Flow Chart

4.2 System's Hardware

The whole system hardware and circuits and overall schematic will be shown in figure 4.2 which represents the overall schematic, and Table 4.1 shows the list of all components of the project.

Table (4:1): list of system components

Component	Value
VCC	9 V
U1	4N25 Optocoupler
R1	10 k
R2	5.7 K
C1	0.1 uF
C2	0.01 uF
U4	555 Timer
U5	RT4-433 AM Transmitter
A1	Antenna 1
U2	4N25 Optocoupler
U7	555 Timer
R3	2.2 K
RV1	47 k
R4	2.2 K
RV2	100 K
C3	0.01 uF
C4	47 uF
C5	0.1 uF
C6	0.01 uF
C7	1 uF/ 15 V
LS1	Speaker 0.5W / 8 ohm
U6	555 Timer
U3	4N25 Optocoupler
U8	Relay
VAC	220 VAC
T1	Transformer 220 / 12 VAC
C8	10 uF / 400 V
C9	10 uF / 400 V
C10	10 uF / 400 V
C11	10 uF / 400 V
C12	10 uF / 400 V

C13	10 uF / 400 V
C14	10 uF / 400 V
C15	10 uF / 400 V
D1	Diode / 400 V
D2	Diode / 400 V
D3	Diode / 400 V
D4	Diode / 400 V
D5	Diode / 400 V
D6	Diode / 400 V
D7	Diode / 400 V
D8	Diode / 400 V
A2	Antenna 2
U9	RR3-433 AM Receiver
Zener Regulator	5.1 V
U1A	7414 Schmitt trigger
R5	57 K
R6	10 K
C16	0.01 uF
C17	4.7 uF
C18	15 uF / 15 V
LS2	Speaker 0.5 W / 8 ohm
U10	555 Timer

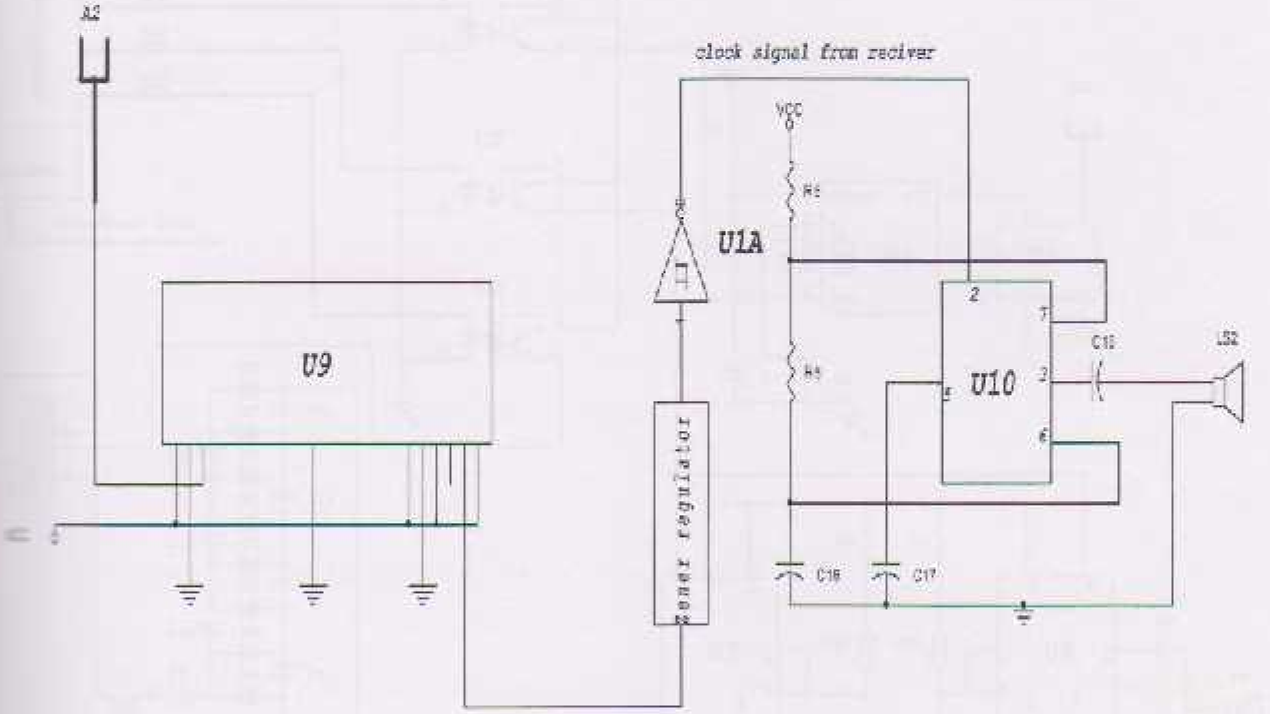


Figure (4.3) : Schematic For Receiver

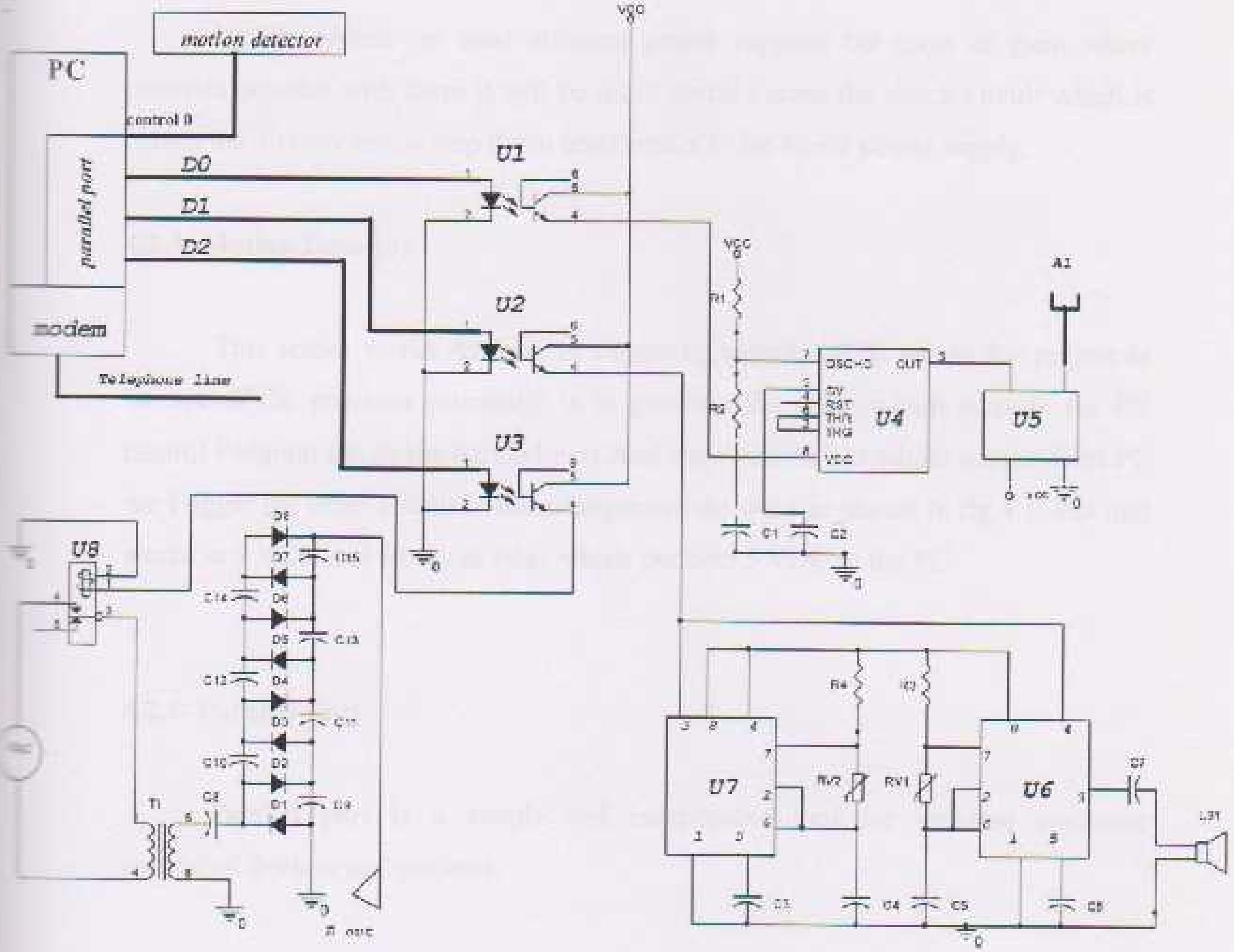


Figure (4.4) : Schematic For Transmitter And Other Circuits

4.2.2- Power Supply

In this system we used different power supplies but most of them where batteries because with them it will be more useful except the shock circuit which is connected directly throw step down transformer to the home power supply.

4.2.3- Motion Detector

This sensor works As relay or triggering circuit and its job in this project as we see in the previous schematic is to generate the pulse which activate the PC control Program throw the Parallel port And throw the Pulses which we got from PC we Trigger the other circuit in the arrangement we want as shown in fig 4.1, this unit works in 9 VDC and works as relay which perform 5 VDC to the PC.

4.2.4- Parallel Port

Parallel port is a simple and inexpensive tool for building computer controlled devices and projects.

.The simplicity and ease of programming makes
.The parallel port is often used in Computer controlled robots, Atmel/PIC
.programmers, home automation

In this design we used the port control 0 to the motion detector, and we use the ports D0, D1, and D2 to connect them with the alarm, transmitter, and the shock circuit and we use the port Status7 as ground for the parallel port.

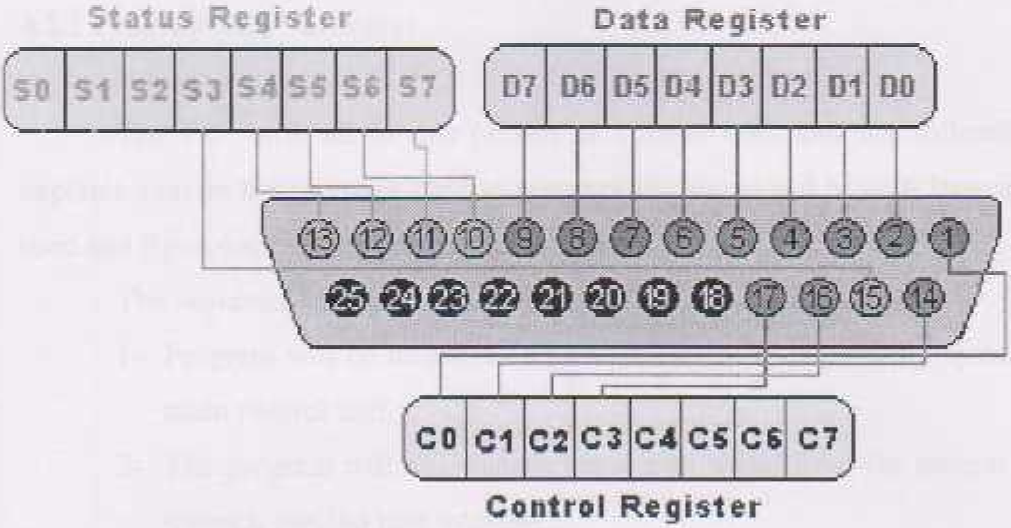


Figure (4.5) : Parallel port pins

4.3 Software Components

4.3.1 Program and Software:

The PC will act in this project as control unit, and the following point explains exactly the program used to accomplish this, visual basic 6 language were used and fig. 4.4 shows the program flow chart.

The sequence of operation is explained in the following steps

1- Program will be installed on pc which used in the security system as the main control unit.
2- The program will run when it has a high signal from the motion detector through parallel port interface.
3- As program runs it will run three different codes.
4- Every code will give a 5v signal through the parallel port to the optocoupler connected to the system different circuits
5- The fourth code is the dial up modem code which will run the modem to call specified number stored previously in the modem code as shown in fig 4.5.

program code is attached in the appendices and also the user manual, as you will see later in this project paper, will also explain more how this program and parallel port are connected .

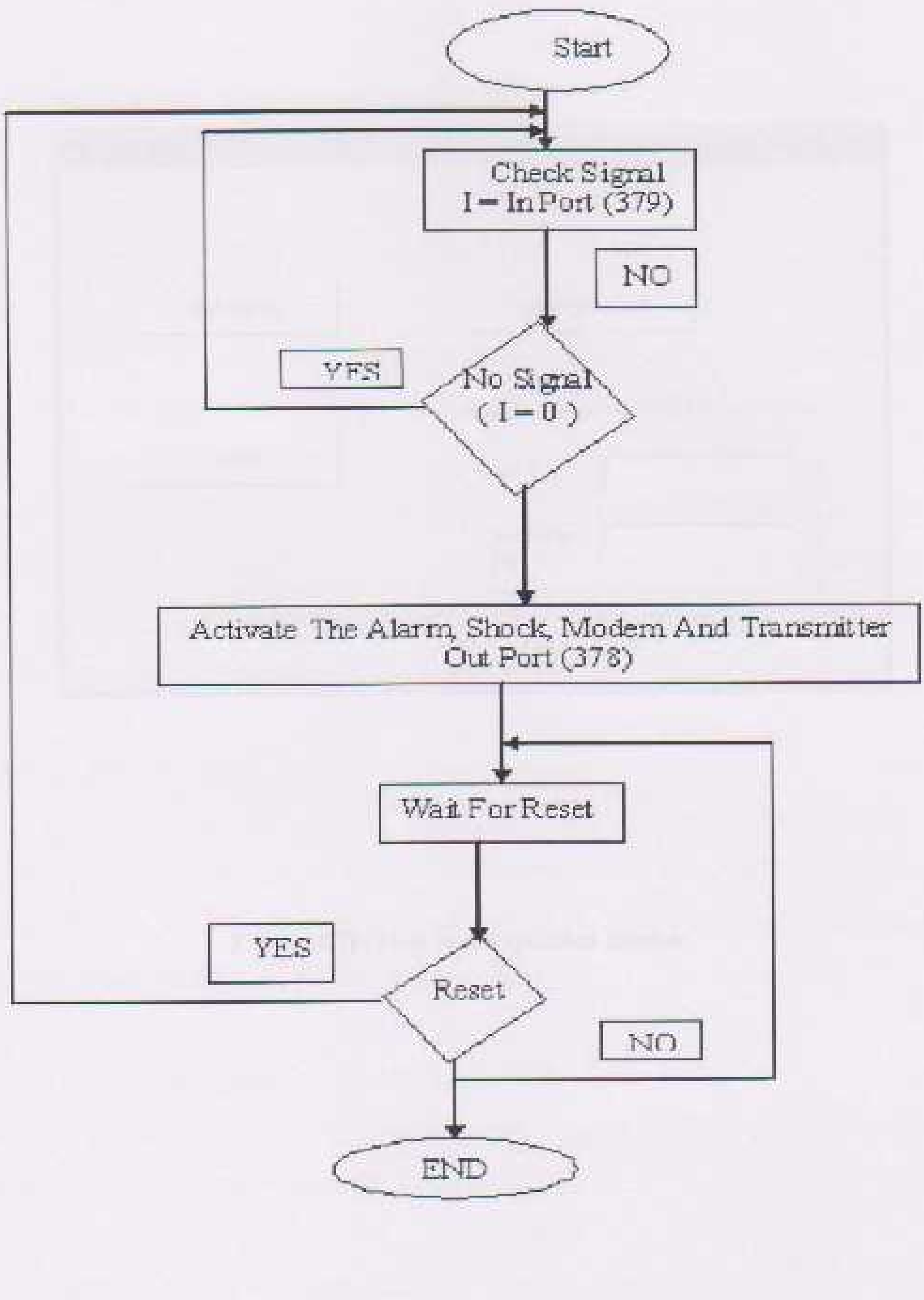


Figure (4.6): Program flow chart

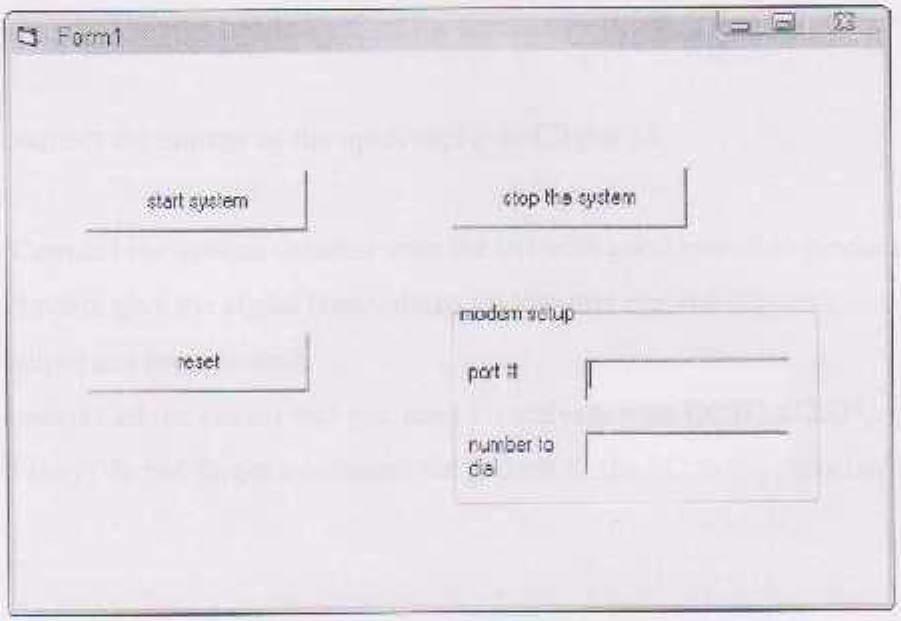


Figure (4.7) : How to call specified number

4.4 User Manual

1-connect the output of data port D7 pin9 with the optocoupler in inverse mode (the D7 will be the VCC of the transistor).

2-connect the emitter of the optocoupler to C0 pin 16.

3- Connect the motion detector with the led with good circuit to produce 2 volt when give the signal (use voltage divider and current limiters).

4-output not need ground.

5-connect all the circuit that you need t o activate with D0,D1,D2,D3.. pin 2-8 (any) do not forget to connect the ground of the PC to the optocoupler.

4.5 Output Results

1- The alarm circuit output is a sound wave which can be adjusted with the two potentiometers so we can get alternative sound, and this circuit designed to generate two different frequencies (9-15)KHz

2- The shock circuit output is a DC voltage with the following value
E out = E in * 2 * n: n is the number of stages, and the exact value we got from the voltage multiplayer is approximately (277 VDC)

3- The receiver output a single tune voice which heard by the person hold the receiver, and this voice practical frequency is (8)KHz.

4- The modem calls the number you add it in the program. And the calling takes approximately (60 sec) to reach the target number.

4.6 Conclusion

From the previous show we can say that our design had met our previous objectives in sensing, alarming, and transmit alarm through AM transmitter and dialing a specific telephone number, also it can participate in catching the intruder if he proceed after hearing the alarm by shock him with a value of dc voltage.

First, it is very simple to use i.e., you only need to run the program by pressing the start signal, which, in turn, makes the whole system work . Secondly, this project comparatively with other projects doesn't cost too much. The pc, which is available in every house, can replace the microcontroller which is very expensive. Thirdly, this system can easily be built up and checked. Simple and cheap parts are used to form this system. These parts are also available in the Palestinian market and they are known to every one who works in the electronics field, so it will be easy for him to check and fix them if any error appears.

4.7 Future Work

After working in this project we suggest and recommend the following points to future studies:

1- Use More Than One motion detector so we can protect more than one place.

2- Use more than one shock circuit And Receiver circuit so we can protect and generate alarm to different places.

3- Increase the stages of the shock circuit for getting more voltage drop output so you can get high shock.

4- Use Better Antennas to increase the distance of the receiver circuit.

References

(1) www.fairchildsemi.com/ds/MM/MM74C922.pdf

(2) Amplifying Circuit/Fly back Diagrams

(4) www.discovercircuits.com

(5) www.jlnlabs.org

(6) Melanie Gayagoy and others, **Home Security System**, Senior design project, fall, 2003 .

(7) Gato Yang, **Shocking Security System**, Senior design project, Spring, 2003 .

(8) Neal Graig, **Phone Operated Security System**, senior design project, march,

2002.

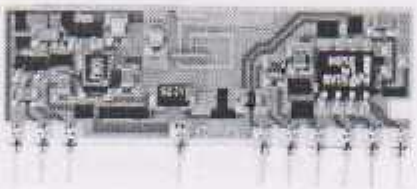
(9) Nisarg R. Shain, **Remote Access Home Security System**, senior design project, June, 2004.

Appendices

telecontrolli

RR3-XXX

Super Regenerative Radio Receiver With Laser Trimmed Inductor



General description

The RR3-XXX is a super regenerative data receiver.

Sensitivity typically exceedes -100dBm (2.2uVrms) when matched to 50 ohm.

It shows high frequency stability also in presence of mechanical vibrations, manual handling and in a wide range of temperature.

The frequency accuracy is very high thanks to laser trimming process. PATENTED.

I-ETS 300-220 Compliance (RR3-418, RR3-433.92)
FCC 15/C Compliance (RR3-315)

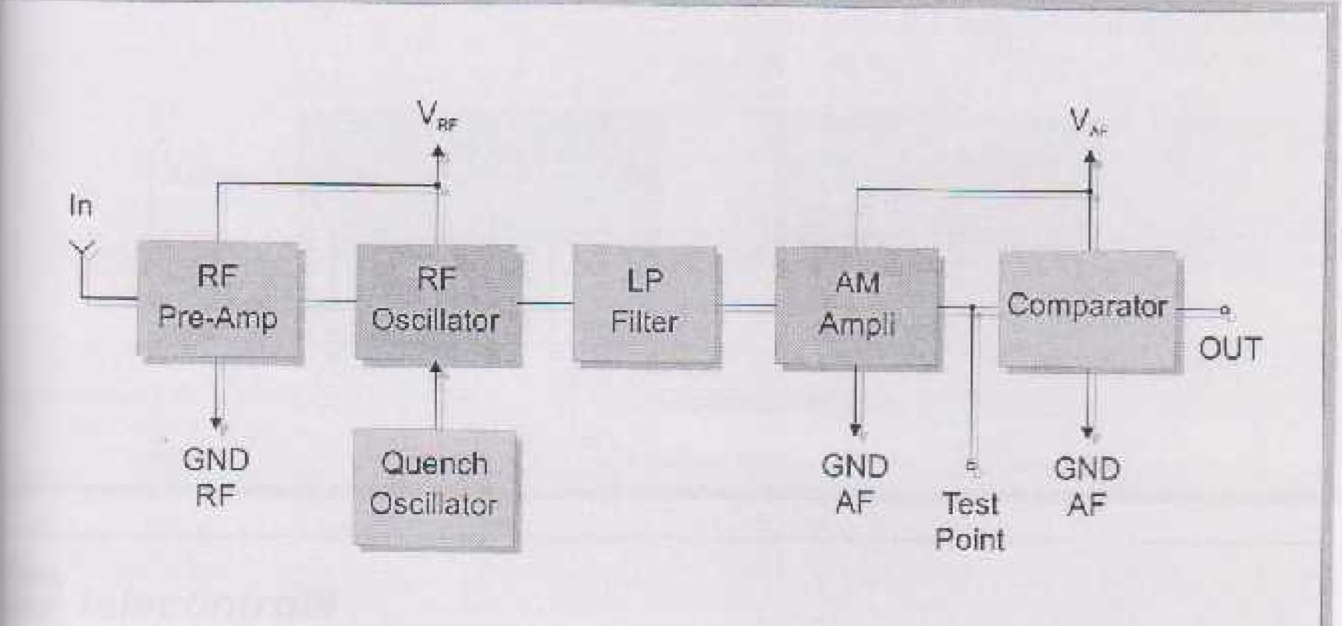
XXX: custom-specified working frequency (200 ÷ 450 MHz)

ndard European and U.S. frequencies (315MHz, MHz, 433.92MHz) are readly available from ck.

Applications

- Home security systems
- Car Alarm systems
- Remote gate controls
- Sensor reporting

BLOCK DIAGRAM



Electrical Characteristics

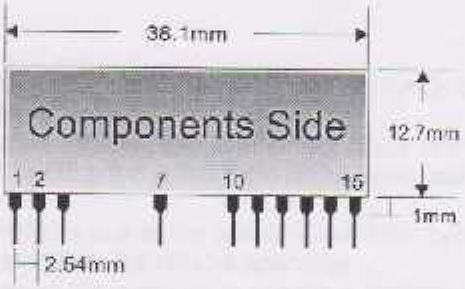
Ta = 25°C unless otherwise specified

	CHARACTERISTICS	MIN	TYP	MAX	UNIT
V_{cc}	RF Supply Voltage	4.5	5	5.5	VDC
V_{cc}	AF Supply Voltage	4.5	5	5.5	VDC
I_s	Supply Current		2.5	3	mA
F_w	Working Frequency	200		450	MHz
	Tuning Tolerance		±0.2	±0.5	MHz
B_w	-3dB Bandwidth		±2	±3	MHz
	Max Data Rate			2	KHz
	RF Sensitivity (100% AM)	-100	-105		dBm
	Level of Emitted Spectrum		-65	-60	dBm
V_{ol}	Low-Level Output Voltage			0.6	V
V_{oh}	High-Level Output Voltage	3.6			V
T_{op}	Operating Temperature Range	-25		+80	°C

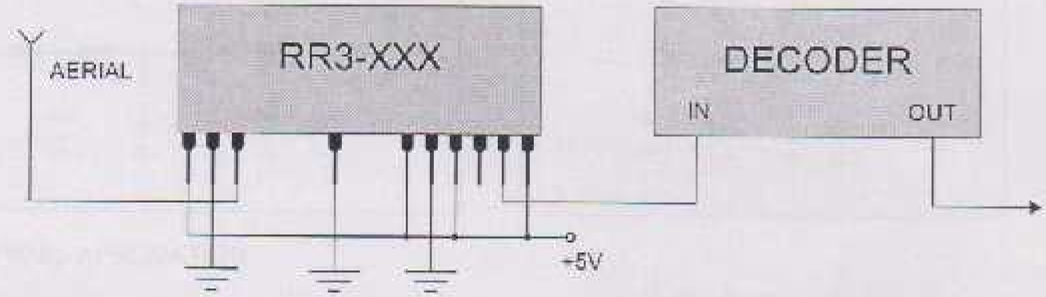
Pin Description

1	RF $+V_{cc}$	9	NC
2	RF GND	10	AF $+V_{cc}$
3	IN	11	AF GND
4	NC	12	AF $+V_{cc}$
5	NC	13	Test Point
6	NC	14	OUT
7	RF GND	15	AF $+V_{cc}$
8	NC		

Mechanical Dimensions



TYPICAL APPLICATION

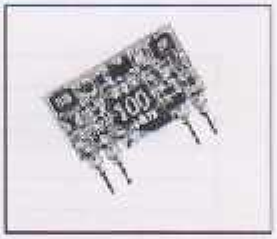


AM Hybrid Transmitter

AM-RTn-XXX

FEATURES

- COMPLETE RF TRANSMITTER
- TRANSMIT RANGE UP TO 70m
- CMOS/TTL INPUT
- AVAILABLE IN DIL OR SIL PACKAGE
- NO ADJUSTABLE COMPONENTS
- VERY STABLE OPERATING FREQUENCY
- LOW CURRENT CONSUMPTION (TYP 4mA)
- LOW SPURIOUS EMISSIONS (-35dBc)
- WIDE OPERATING VOLTAGE (2-14V)
- AVAILABLE AS 315, 418 OR 433 MHz
- COMPATIBLE WITH RF SOLUTIONS RECEIVERS



APPLICATIONS

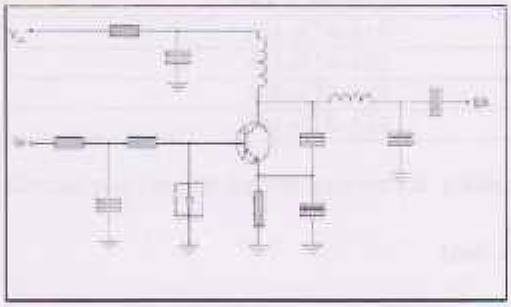
- WIRELESS SECURITY SYSTEMS
- CAR ALARMS
- REMOTE GATE CONTROLS
- REMOTE SENSING
- DATA CAPTURE
- SENSOR REPORTING

DESCRIPTION

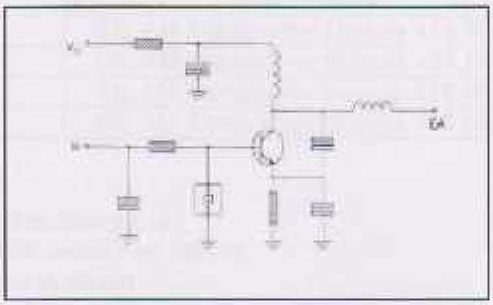
The R F Solutions Ltd. AM hybrid transmitter module provides a complete RF transmitter which can be used to transmit data at up to 4 kHz from any standard CMOS/TTL source.
The module is very simple to operate and offers low current consumption (typ. 4 mA). Data can be supplied directly from a microprocessor or encoding device, thus keeping the component count down and ensuring a low hardware cost.
The module exhibits extremely stable electronic characteristics due to the use of 'Thick-Film' hybrid technology, which uses no adjustable components and ensures very reliable operation.
The modules are compatible with R F solutions Ltd. range of AM receivers to provide a complete solution.

CIRCUIT SCHEMATICS

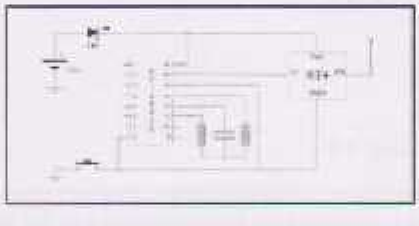
RT4



RT5

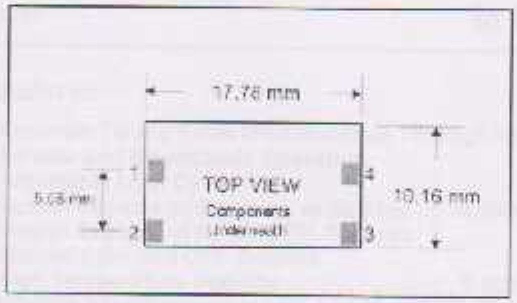


TYPICAL APPLICATION

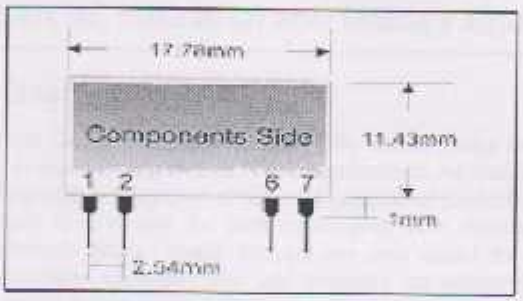


MECHANICAL DIMENSIONS

RT4



RT5



PIN DESCRIPTIONS

RT4 Pin	RT5 Pin	Name	Description
1	7	Vcc	Supply Voltage
2	6	GND	Ground, Connect to RF earth return path
3	2	IN	Data input
4	1	EA	External Antenna

ELECTRICAL CHARACTERISTICS

Ambient temp = 25°C unless otherwise stated.

Characteristic	Min.	Typ.	Max.	Dimensions
Supply Voltage	2		14	Vdc
Supply Current (Vcc=5V IN=1kHz)		4		mA
Supply Current (Vcc=5V IN=DC)		50		nA
Working Frequency	303.8		433.92	MHz
RF Output Power into 50Ω (Vcc=5V)		0		-dBm
Harmonic Spurious Emissions		-30		-dBc
Input Voltage High	2		Vcc	V
Time from Power on to data transmission		10		µSec
Data Rate	50		4000	Hz
Operating Temperature	-25		+80	°C

PART NUMBERING

PART Number	Description
AM-RT4-418	DIL AM Transmitter Module 418 MHz
AM-RT4-433	DIL AM Transmitter Module 433 MHz
AM-RT5-418	SIL AM Transmitter Module 418 MHz
AM-RT5-433	SIL AM Transmitter Module 433 MHz

Should you require further assistance, please call;

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Tel +44 (0)1273 898 000. Fax +44 (0)1273 480 661.

Email sales@rfsolutions.co.uk

http://www.rfsolutions.co.uk

R F Solutions Ltd is a member of the Low Power radio Association

HARRIS SEMICONDUCTOR

CA555, CA555C, LM555, LM555C, NE555

Timers for Timing Delays and Oscillator Application in Commercial, Industrial and Military Equipment

May 1997

Features

- Accurate Timing From Microseconds Through Hours
- Astable and Monostable Operation
- Adjustable Duty Cycle
- Output Capable of Sourcing or Sinking up to 200mA
- Output Capable of Driving TTL Devices
- Normally ON and OFF Outputs
- High Temperature Stability . . . . 0.005%/°C
- Directly Interchangeable with SE555, NE555, MC1555, and MC1455

Applications

- Precision Timing
- Sequential Timing
- Time Delay Generation
- Pulse Generation
- Pulse Detector
- Pulse Width and Position Modulation

Ordering Information

PART NUMBER (BRAND)	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CA0555E	-55 to 125	8 Ld PDIP	E8.3
CA0555M (555)	-55 to 125	8 Ld SOIC	M8.15
CA0555M96 (555)	-55 to 125	8 Ld SOIC †	M8.15
CA0555T	-55 to 125	8 Pin Metal Can	T8.C
CA0555CE	0 to 70	8 Ld PDIP	E8.3
CA0555CM (555C)	0 to 70	8 Ld SOIC	M8.15
CA0555CM96 (555C)	0 to 70	8 Ld SOIC †	M8.15
CA0555CT	0 to 70	8 Pin Metal Can	T8.C
LM555N	-55 to 125	8 Ld PDIP	E8.3
LM555CN	0 to 70	8 Ld PDIP	E8.3
NE555N	0 to 70	8 Ld PDIP	E8.3

NOTE: † Denotes Tape and Reel

Description

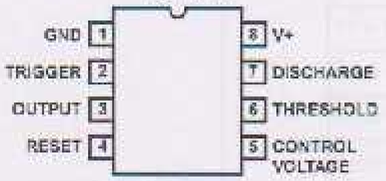
The CA555 and CA555C are highly stable timers for use in precision timing and oscillator applications. As timers, these monolithic integrated circuits are capable of producing accurate time delays for periods ranging from microseconds through hours. These devices are also useful for astable oscillator operation and can maintain an accurately controlled free running frequency and duty cycle with only two external resistors and one capacitor.

The circuits of the CA555 and CA555C may be triggered by the falling edge of the waveform signal, and the output of these circuits can source or sink up to a 200mA current or drive TTL circuits.

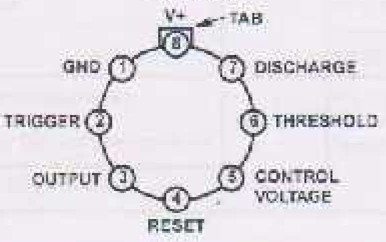
These types are direct replacements for industry types in packages with similar terminal arrangements e.g. SE555 and NE555, MC1555 and MC1455, respectively. The CA555 type circuits are intended for applications requiring premium electrical performance. The CA555C type circuits are intended for applications requiring less stringent electrical characteristics.

Pinouts

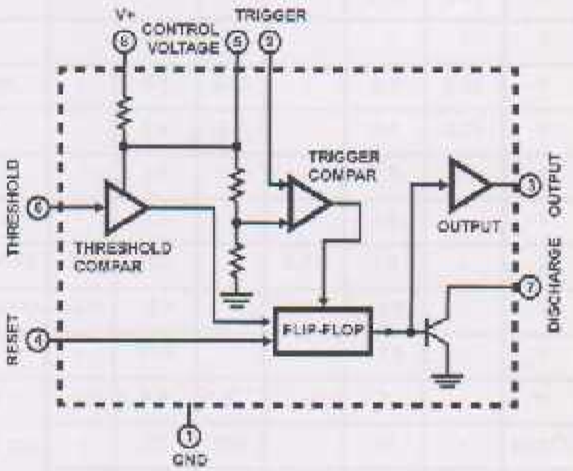
CA555, CA555C (PDIP, SOIC)
LM555, LM555C, NE555 (PDIP)
TOP VIEW



CA555, CA555C (METAL CAN)
TOP VIEW



Functional Block Diagram



File Number 834.4

Absolute Maximum Ratings

DC Supply Voltage 18V

Operating Conditions

Temperature Range

CA555, LM555 .... -55°C to 125°C

CA555C, LM555C, NE555 .... 0°C to 70°C

Thermal Information

Thermal Resistance (Typical, Note 1)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
Metal Can Package	170	85
PDIP Package	100	N/A
SOIC Package	160	N/A

Maximum Junction Temperature (Hermetic Package) .... 175°C

Maximum Junction Temperature (Plastic Package) .... 150°C

Maximum Storage Temperature Range .... -65°C to 150°C

Maximum Lead Temperature (Soldering 10s) .... 300°C

(SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

1. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications

T_A = 25°C, V+ = 5V to 15V Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	CA555, LM555 MIN	CA555, LM555 TYP	CA555, LM555 MAX	CA555C, LM555C, NE555 MIN	CA555C, LM555C, NE555 TYP	CA555C, LM555C, NE555 MAX	UNITS
DC Supply Voltage	V+		4.5	-	18	4.5	-	16	V
DC Supply Current (Low State), (Note 2)	I+	V+ = 5V, $R_L = \infty$	-	3	6	-	3	6	mA
		V+ = 15V, $R_L = \infty$	-	10	12	-	10	15	mA
Threshold Voltage	V_{TH}		-	(2/3)V+	-	-	(2/3)V+	-	V
Trigger Voltage		V+ = 5V	1.45	1.67	1.9	-	1.67	-	V
		V+ = 15V	4.8	5	5.2	-	5	-	V
Trigger Current			-	0.5	-	-	0.5	-	μA
Threshold Current (Note 3)	I_{TH}		-	0.1	0.25	-	0.1	0.25	μA
Reset Voltage			0.4	0.7	1.0	0.4	0.7	1.0	V
Reset Current			-	0.1	-	-	0.1	-	mA
Control Voltage Level		V+ = 5V	2.9	3.33	3.8	2.6	3.33	4	V
		V+ = 15V	9.6	10	10.4	9	10	11	V
Output Voltage Low State	V_{OL}	V+ = 5V, I_{SINK} = 5mA	-	-	-	-	0.25	0.35	V
		I_{SINK} = 8mA	-	0.1	0.25	-	-	-	V
		V+ = 15V, I_{SINK} = 10mA	-	0.1	0.15	-	0.1	0.25	V
		I_{SINK} = 50mA	-	0.4	0.5	-	0.4	0.75	V
		I_{SINK} = 100mA	-	2.0	2.2	-	2.0	2.5	V
		I_{SINK} = 200mA	-	2.5	-	-	2.5	-	V
Output Voltage High State	V_{OH}	V+ = 5V, I_{SOURCE} = 100mA	3.0	3.3	-	2.75	3.3	-	V
		V+ = 15V, I_{SOURCE} = 100mA	13.0	13.3	-	12.75	13.3	-	V
		I_{SOURCE} = 200mA	-	12.5	-	-	12.5	-	V
Timing Error (Monostable)		R_1, R_2 = 1kΩ to 100kΩ, C = 0.1μF	-	0.5	2	-	1	-	%
Frequency Drift with Temperature		Tested at V+ = 5V, V+ = 15V	-	30	100	-	50	-	ppm/°C
Drift with Supply Voltage			-	0.05	0.2	-	0.1	-	%/V

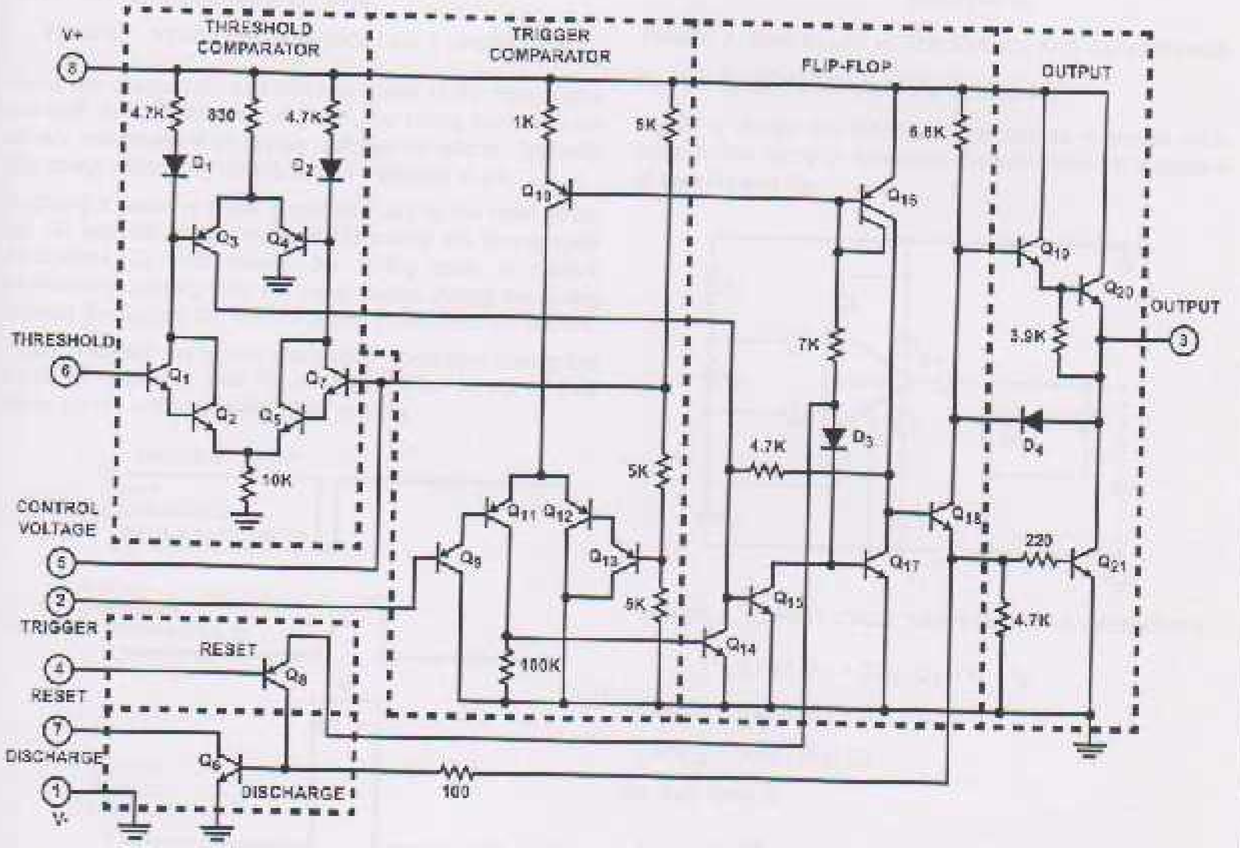
Electrical Specifications $T_A = 25^oC$, V+ = 5V to 15V Unless Otherwise Specified **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	CA555, LM555			CA555C, LM555C, NE555			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Output Rise Time	t_R		-	100	-	-	100	-	ns
Output Fall Time	t_F		-	100	-	-	100	-	ns

NOTES:

2. When the output is in a high state, the DC supply current is typically 1mA less than the low state value.
3. The threshold current will determine the sum of the values of R_1 and R_2 to be used in Figure 4 (astable operation); the maximum total $R_1 + R_2 = 20M\Omega$.

Schematic Diagram

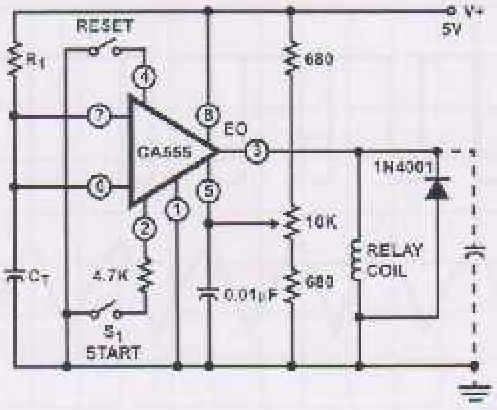


NOTE: Resistance values are in ohms.

Typical Applications

Reset Timer (Monostable Operation)

Figure 1 shows the CA555 connected as a reset timer. In this mode of operation capacitor C_T is initially held discharged by a transistor on the integrated circuit. Upon closing the "start" switch, or applying a negative trigger pulse to terminal 2, the integral timer flip-flop is "set" and releases the short circuit across C_T which drives the output voltage "high" (relay energized). The action allows the voltage across the capacitor to increase exponentially with the constant $t = R_1C_T$. When the voltage across the capacitor equals 2/3 V+, the comparator resets the flip-flop which in turn discharges the capacitor rapidly and drives the output to its low state.



NOTE: All resistance values are in ohms.

FIGURE 1. RESET TIMER (MONOSTABLE OPERATION)

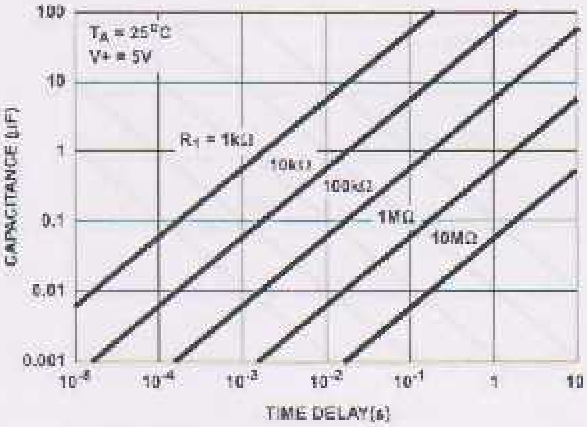


FIGURE 3. TIME DELAY vs RESISTANCE AND CAPACITANCE

Since the charge rate and threshold level of the comparator are both directly proportional to V+, the timing interval is relatively independent of supply voltage variations. Typically, the timing varies only 0.05% for a 1V change in V+.

Applying a negative pulse simultaneously to the reset terminal (4) and the trigger terminal (2) during the timing cycle discharges C_T and causes the timing cycle to restart. Momentarily closing only the reset switch during the timing interval discharges C_T, but the timing cycle does not restart.

Figure 2 shows the typical waveforms generated during this mode of operation, and Figure 3 gives the family of time delay curves with variations in R_1 and C_T.

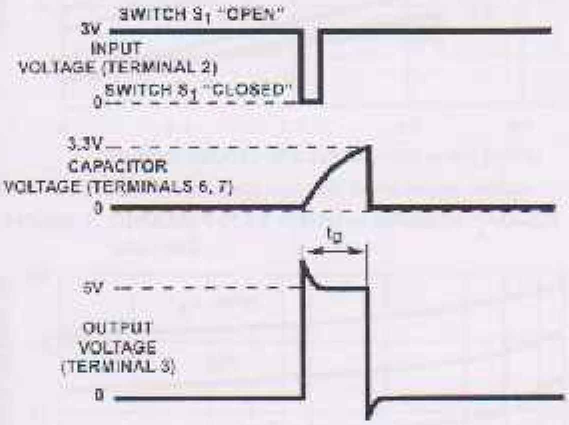


FIGURE 2. TYPICAL WAVEFORMS FOR RESET TIMER

Repeat Cycle Timer (Astable Operation)

Figure 4 shows the CA555 connected as a repeat cycle timer. In this mode of operation, the total period is a function of both R_1 and R_2.

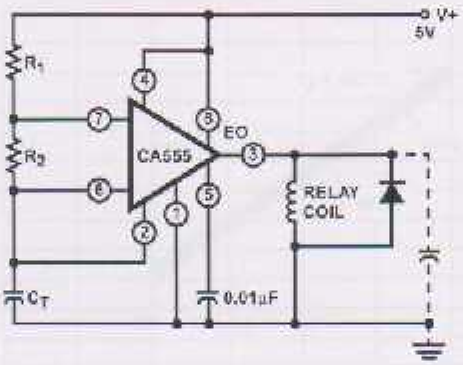


FIGURE 4. REPEAT CYCLE TIMER (ASTABLE OPERATION)

$$T = 0.693\,(R_1 + 2R_2)\,C_T = t_1 + t_2$$

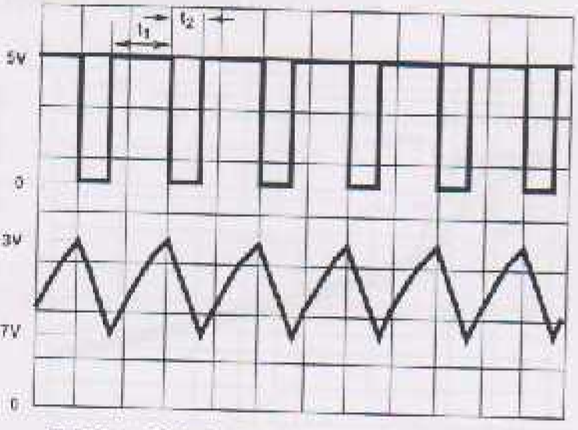
where $t_1 = 0.693\,(R_1 + R_2)\,C_T$

and $t_2 = 0.693\,(R_2)\,C_T$

the duty cycle is:

$$\frac{t_1}{t_1 + t_2} = \frac{R_1 + R_2}{R_1 + 2R_2}$$

Typical waveforms generated during this mode of operation are shown in Figure 5. Figure 6 gives the family of curves of free running frequency with variations in the value of $(R_1 + 2R_2)$ and C_T.



Top Trace: Output voltage (2V/Div. and 0.5ms/Div.)
Bottom Trace: Capacitor voltage (1V/Div. and 0.5ms/Div.)

FIGURE 5. TYPICAL WAVEFORMS FOR REPEAT CYCLE TIMER

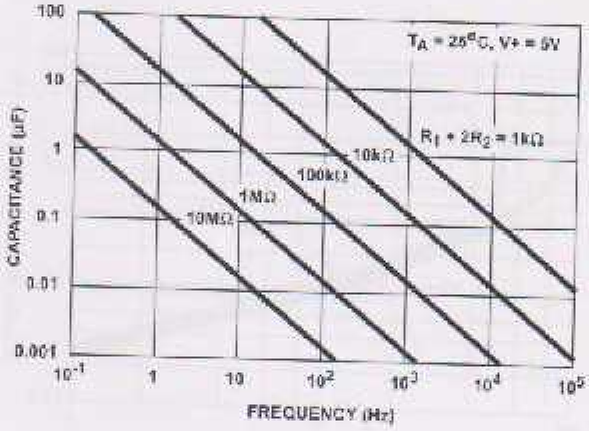
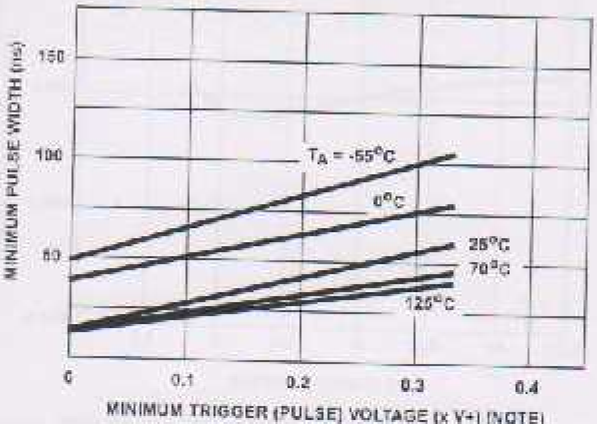


FIGURE 6. FREE RUNNING FREQUENCY OF REPEAT CYCLE TIMER WITH VARIATION IN CAPACITANCE AND RESISTANCE

Typical Performance Curves



NOTE: Where x is the decimal multiplier of the supply voltage.

FIGURE 7. MINIMUM PULSE WIDTH vs MINIMUM TRIGGER VOLTAGE

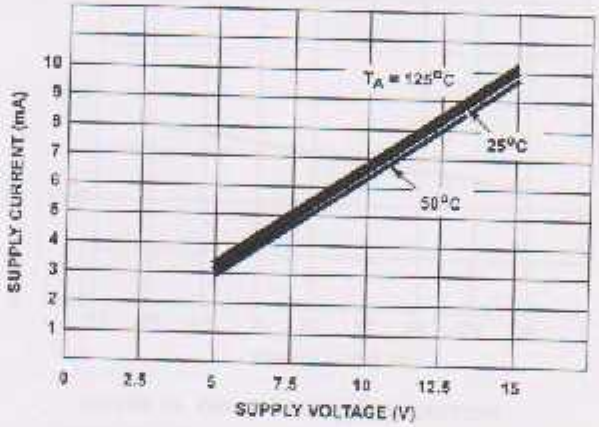


FIGURE 8. SUPPLY CURRENT vs SUPPLY VOLTAGE

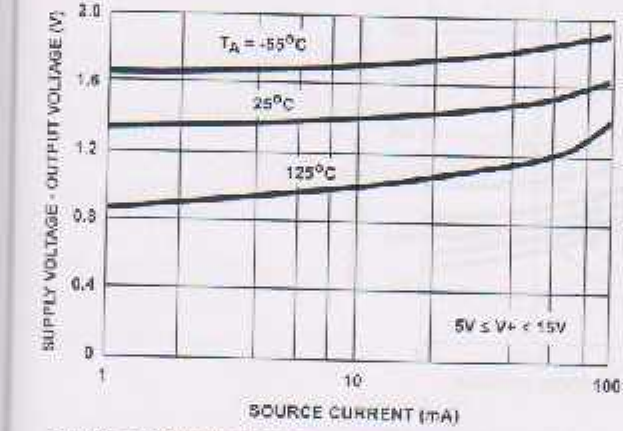


FIGURE 9. OUTPUT VOLTAGE DROP (HIGH STATE) vs SOURCE CURRENT

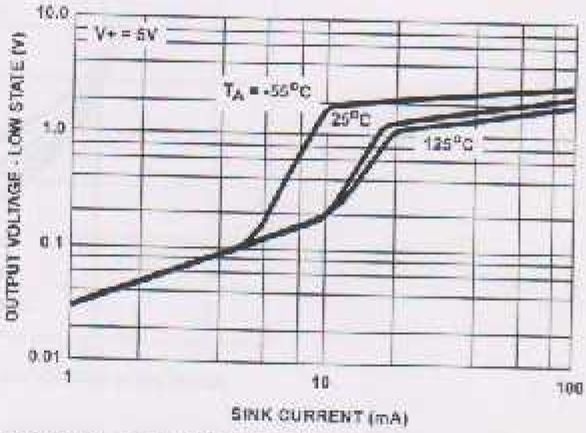


FIGURE 10. OUTPUT VOLTAGE LOW STATE vs SINK CURRENT

Typical Performance Curves (Continued)

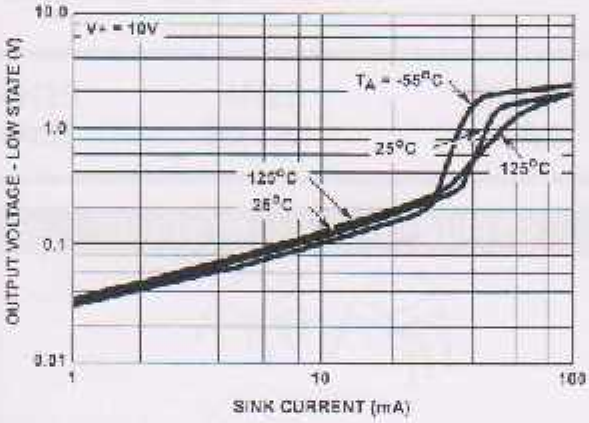


FIGURE 11. OUTPUT VOLTAGE LOW STATE vs SINK CURRENT

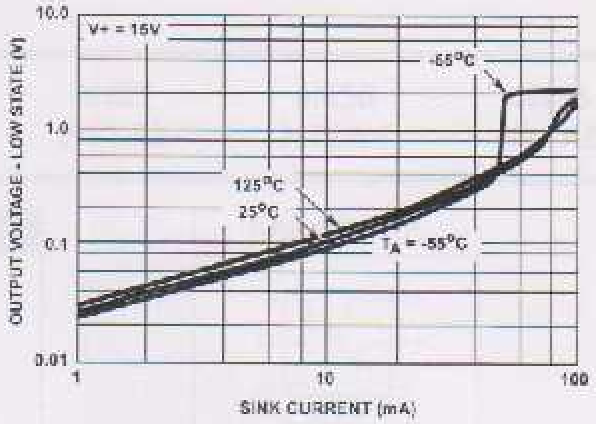


FIGURE 12. OUTPUT VOLTAGE LOW STATE vs SINK CURRENT

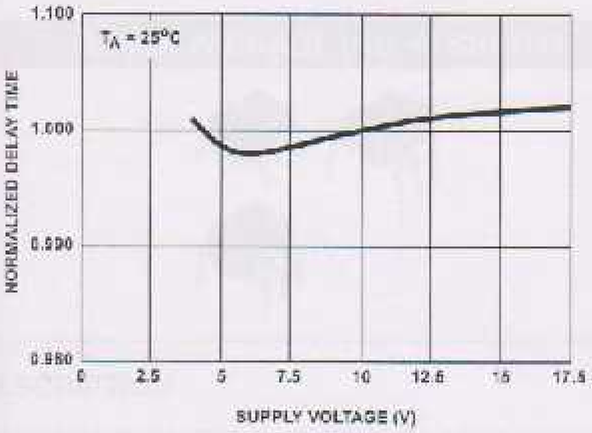


FIGURE 13. DELAY TIME vs SUPPLY VOLTAGE

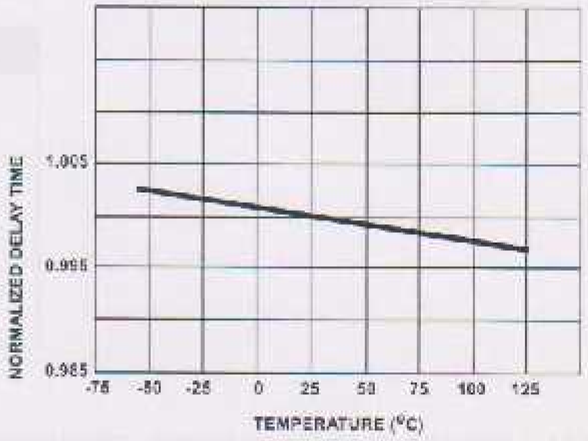
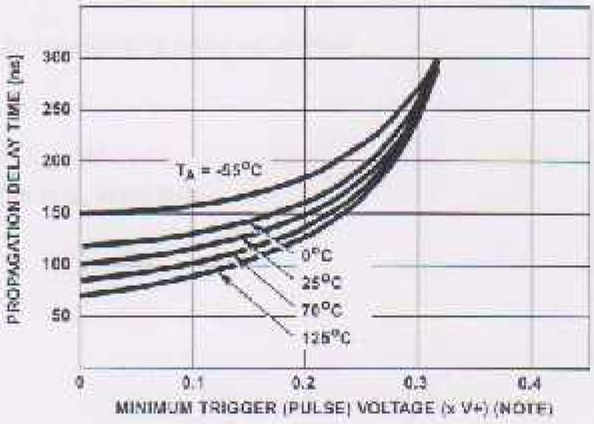


FIGURE 14. DELAY TIME vs TEMPERATURE



NOTE: Where x is the decimal multiplier of the supply voltage.

FIGURE 15. PROPAGATION DELAY TIME vs TRIGGER VOLTAGE

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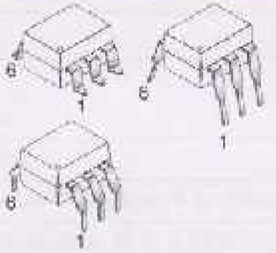
GENERAL PURPOSE 6-PIN PHOTOTRANSISTOR OPTOCOUPLERS

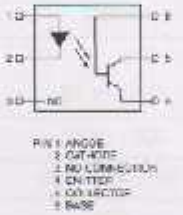
4N25	4N26	4N27	4N28	4N35	4N36
4N37	H11A1	H11A2	H11A3	H11A4	H11A5

WHITE PACKAGE (-M SUFFIX)



BLACK PACKAGE (NO -M SUFFIX)

SCHEMATIC



DESCRIPTION

The general purpose optocouplers consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a 6-pin dual in-line package.

FEATURES

- Also available in white package by specifying -M suffix, eg. 4N25-M
- UL recognized (File # E90700)
- VDE recognized (File # 94766)
  - Add option V for white package (e.g., 4N25V-M)
  - Add option 300 for black package (e.g., 4N25.300)

APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise specified)

Parameter	Symbol	Value	Units
TOTAL DEVICE			
Storage Temperature	T_{STG}	-55 to +150	°C
Operating Temperature	T_{OPR}	-55 to +100	°C
Wave solder temperature (see page 14 for reflow solder profiles)	T_{SOL}	260 for 10 sec	°C
Total Device Power Dissipation @ T_A = 25°C	P_D	250	mW
Derate above 25°C		3.3 (non-M), 2.94 (-M)	
EMITTER			
DC/Average Forward Input Current	I_F	100 (non-M), 60 (-M)	mA
Reverse Input Voltage	V_R	6	V
Forward Current - Peak (300µs, 2% Duty Cycle)	$I_F(pk)$	3	A
LED Power Dissipation @ T_A = 25°C	P_D	150 (non-M), 120 (-M)	mW
Derate above 25°C		2.0 (non-M), 1.41 (-M)	mW/°C
DETECTOR			
Collector-Emitter Voltage	V_{CEO}	30	V
Collector-Base Voltage	V_{CBO}	70	V
Emitter-Collector Voltage	V_{ECO}	7	V
Detector Power Dissipation @ T_A = 25°C	P_D	150	mW
Derate above 25°C		2.0 (non-M), 1.76 (-M)	mW/°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

Parameter	Test Conditions	Symbol	Min	Typ*	Max	Unit
EMITTER						
Input Forward Voltage	(I_F = 10 mA)	V_F		1.18	1.50	V
Reverse Leakage Current	(V_R = 6.0 V)	I_R		0.001	10	µA
DETECTOR						
Collector-Emitter Breakdown Voltage	(I_C = 1.0 mA, I_F = 0)	BV_{CEO}	30	100		V
Collector-Base Breakdown Voltage	(I_C = 100 µA, I_F = 0)	BV_{CBO}	70	120		V
Emitter-Collector Breakdown Voltage	(I_E = 100 µA, I_F = 0)	BV_{ECO}	7	10		V
Collector-Emitter Dark Current	(V_{CE} = 10 V, I_F = 0)	I_{CEO}		1	50	nA
Collector-Base Dark Current	(V_{CB} = 10 V)	I_{CBO}			20	nA
Capacitance	(V_{CE} = 0 V, f = 1 MHz)	C_{CE}		8		pF

ISOLATION CHARACTERISTICS

Characteristic	Test Conditions	Symbol	Min	Typ*	Max	Units
Input-Output Isolation Voltage	(Non '-M', Black Package) (f = 60 Hz, t = 1 min)	V_{ISO}	5300			Vac(rms)
	('-M', White Package) (f = 60 Hz, t = 1 sec)		7500			Vac(pk)
Isolation Resistance	(V_{I-O} = 500 VDC)	R_{ISO}	10^{11}			Ω
Isolation Capacitance	(V_{I-O} = &, f = 1 MHz)	C_{ISO}		0.5		pF
	('-M' White Package)			0.2	2	pF

Note
* Typical values at T_A = 25°C

TRANSFER CHARACTERISTICS (T_A = 25°C Unless otherwise specified.)

DC Characteristic	Test Conditions	Symbol	Device	Min	Typ*	Max	Unit
Current Transfer Ratio, Collector to Emitter	(I_F = 10 mA, V_{CE} = 10 V)	CTR	4N35 4N36 4N37	100			%
			H11A1	50			
			H11A5	30			
			4N25 4N26 H11A2 H11A3	20			
			4N27 4N28 H11A4	10			
	(I_F = 10 mA, V_{CE} = 10 V, T_A = -55°C)		4N35 4N36 4N37	40			
	(I_F = 10 mA, V_{CE} = 10 V, T_A = +100°C)		4N35 4N36 4N37	40			
Collector-Emitter Saturation Voltage	(I_C = 2 mA, I_F = 50 mA)	$V_{CE (SAT)}$	4N25 4N26 4N27 4N28			0.5	V
	(I_C = 0.5 mA, I_F = 10 mA)		4N35 4N36 4N37			0.3	
			H11A1 H11A2 H11A3 H11A4 H11A5			0.4	
AC Characteristic Non-Saturated Turn-on Time	(I_F = 10 mA, V_{CC} = 10 V, R_L = 100Ω) (Fig.20)	T_{ON}	4N25 4N26 4N27 4N28 H11A1 H11A2 H11A3 H11A4 H11A5		2		μs
Non Saturated Turn-on Time	(I_C = 2 mA, V_{CC} = 10 V, R_L = 100Ω) (Fig.20)	T_{ON}	4N35 4N36 4N37		2	10	μs

TRANSFER CHARACTERISTICS (T_A = 25°C Unless otherwise specified.) (Continued)

AC Characteristic	Test Conditions	Symbol	Device	Min	Typ*	Max	Unit
Turn-off Time	(I_F = 10 mA, V_{CC} = 10 V, R_L = 100Ω) (Fig.20)	T_{OFF}	4N25 4N26 4N27 4N28 H11A1 H11A2 H11A3 H11A4 H11A5		2		µs
	(I_C = 2 mA, V_{CC} = 10 V, R_L = 100Ω) (Fig.20)		4N35 4N36 4N37		2	10	

* Typical values at T_A = 25°C

Fig. 7 CTR vs. RBE (Unsaturated) (Black Package)

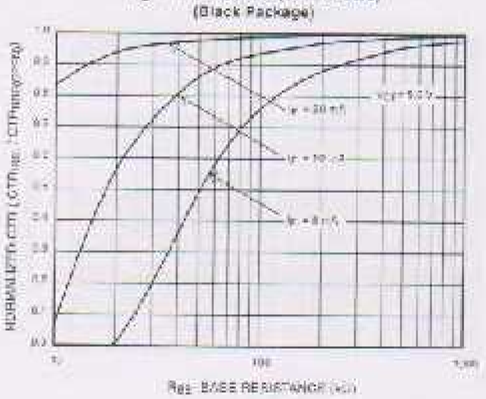


Fig. 8 CTR vs. RBE (Unsaturated) (White Package)

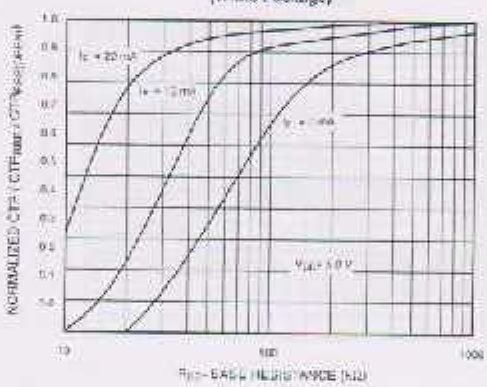


Fig. 9 CTR vs. RBE (Saturated) (Black Package)

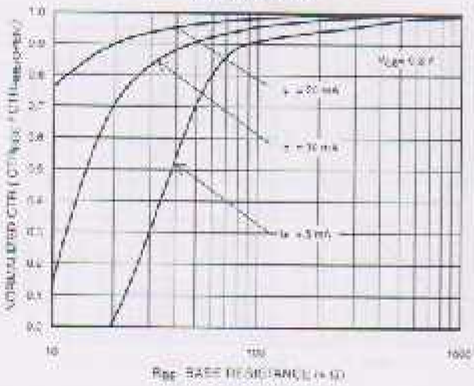


Fig. 10 CTR vs. RBE (Saturated) (White Package)

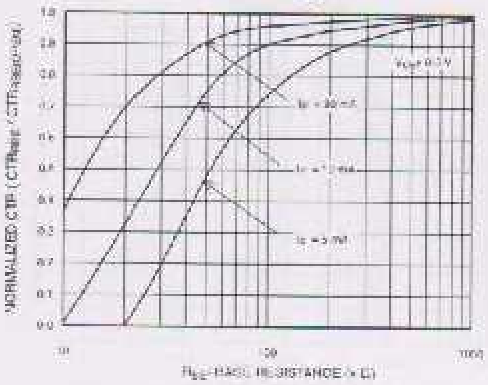


Fig. 11 Collector-Emitter Saturation Voltage vs Collector Current (Black Package)

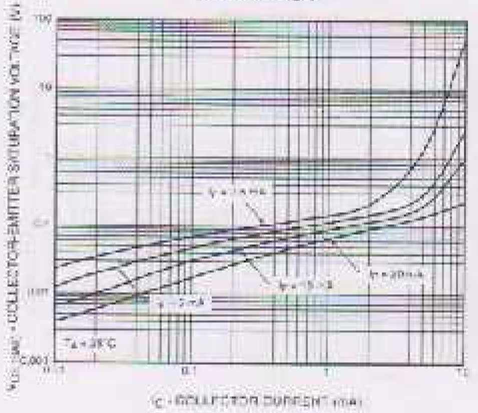


Fig. 12 Collector-Emitter Saturation Voltage vs Collector Current (White Package)

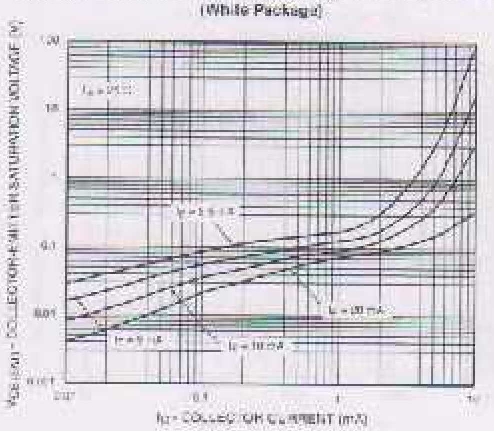


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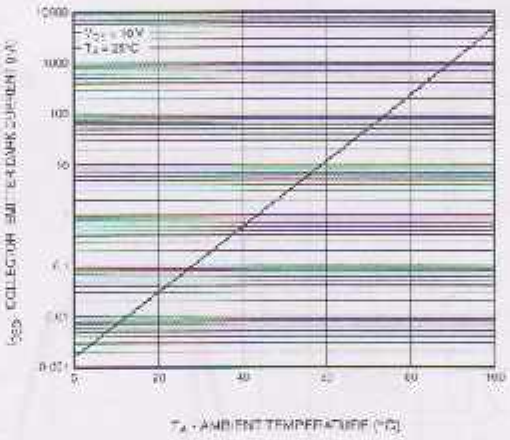
Fig. 19 Dark Current vs. Ambient Temperature



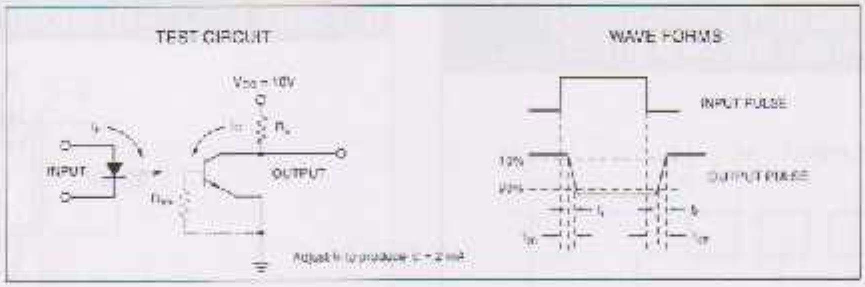


Figure 20. Switching Time Test Circuit and Waveforms

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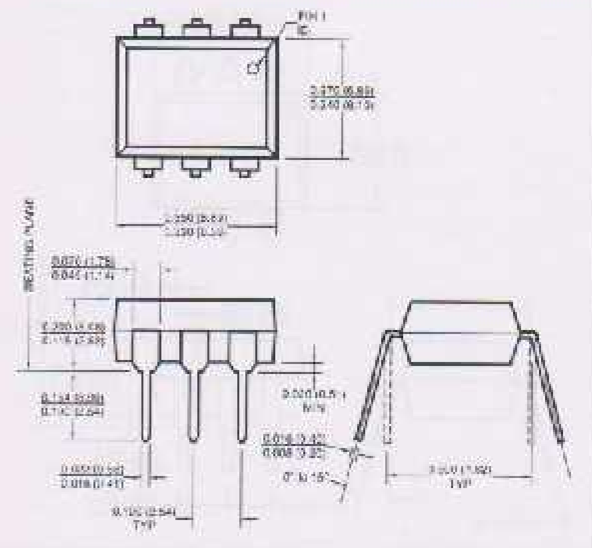
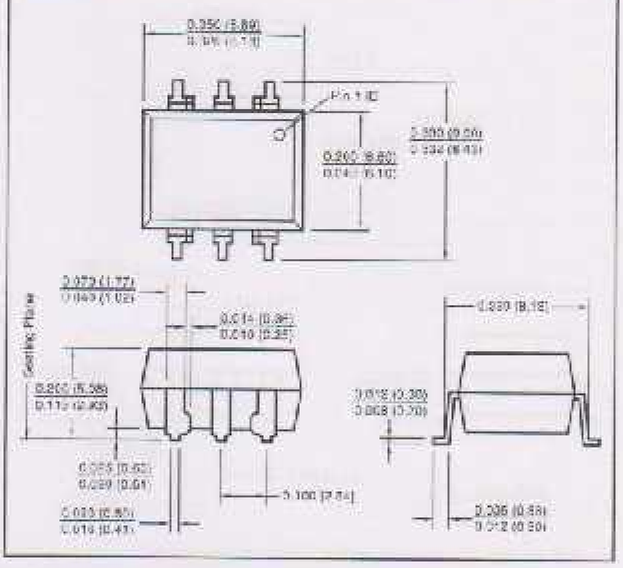
4N25 4N37	4N26 H11A1	4N27 H11A2	4N28 H11A3	4N35 H11A4	4N36 H11A5

Black Package (No -M Suffix)

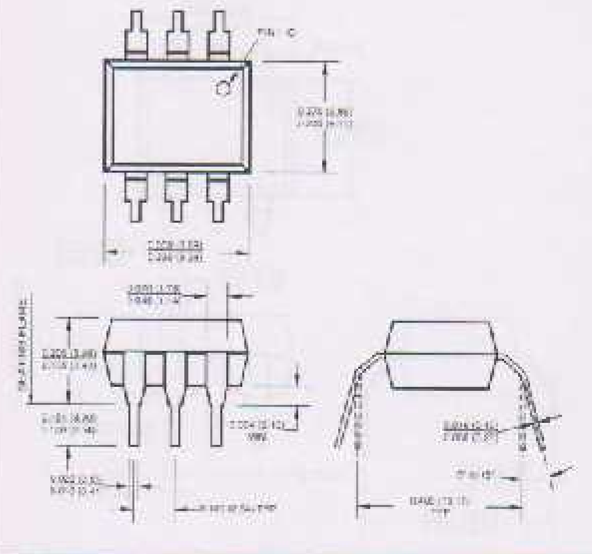
Package Dimensions (Through Hole)



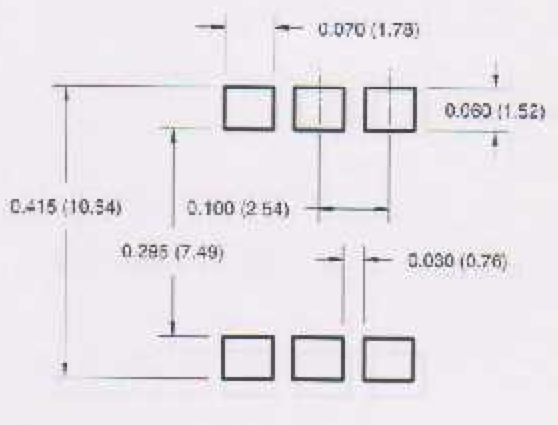
Package Dimensions (Surface Mount)



Package Dimensions (0.4" Lead Spacing)



Recommended Pad Layout for Surface Mount Leadform



NOTE
All dimensions are in inches (millimeters)

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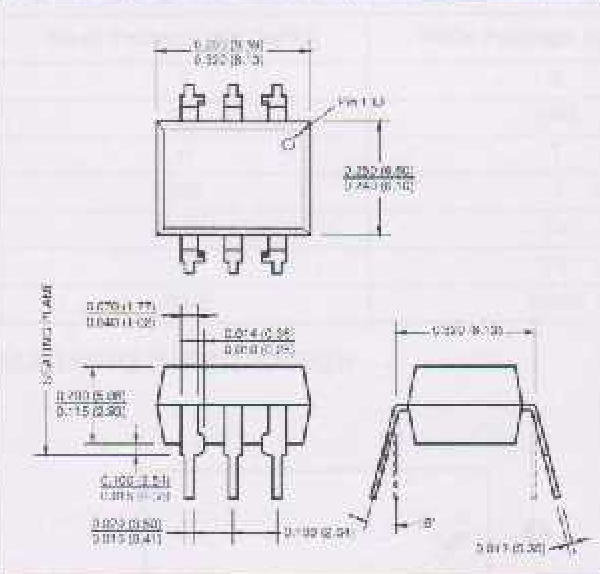
GENERAL PURPOSE 6-PIN PHOTOTRANSISTOR OPTOCOUPLERS

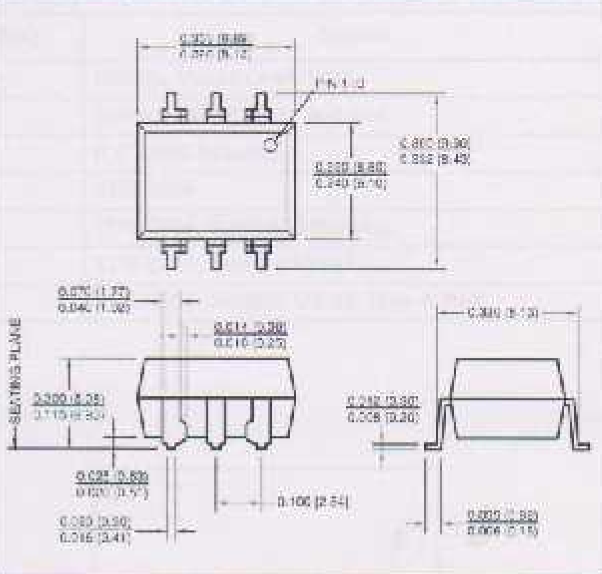
4N25	4N26	4N27	4N28	4N35	4N36
4N37	H11A1	H11A2	H11A3	H11A4	H11A5

White Package (-M Suffix)

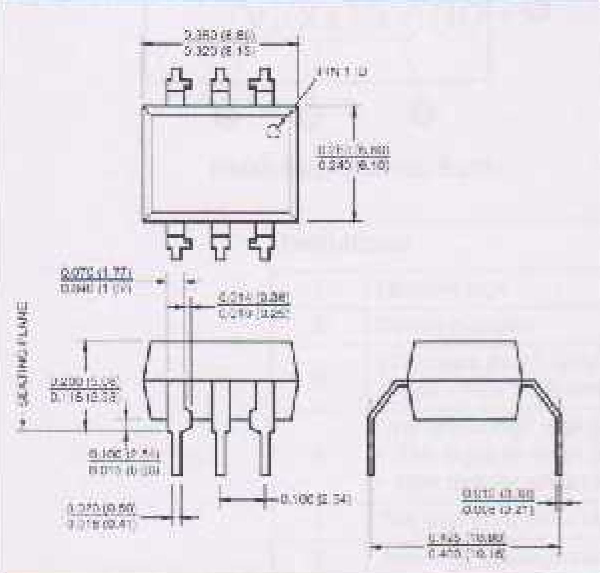
Package Dimensions (Through Hole)



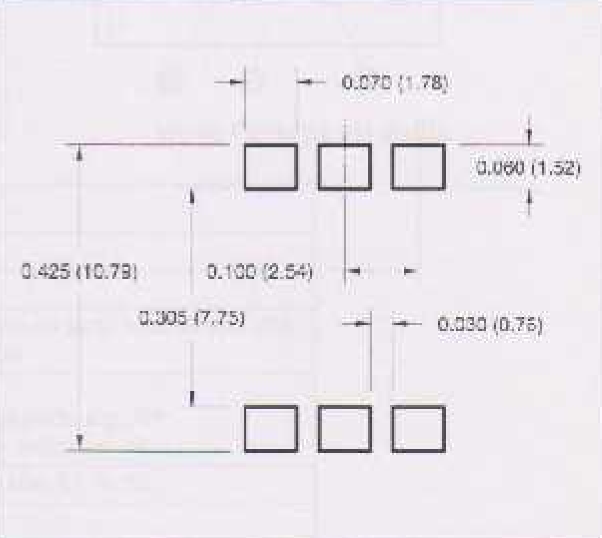
Package Dimensions (Surface Mount)



Package Dimensions (0.4" Lead Spacing)



Recommended Pad Layout for Surface Mount Leadform



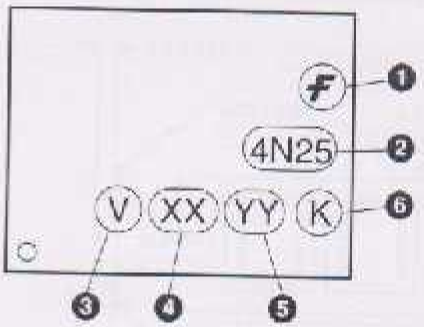
NOTE
All dimensions are in inches (millimeters)

ORDERING INFORMATION

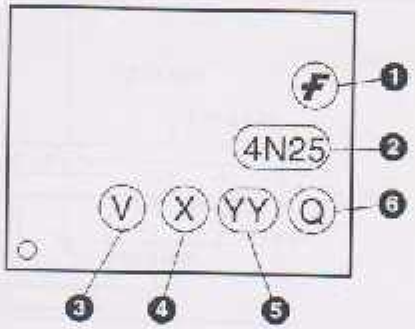
Order Entry Identifier

Black Package (No Suffix)	White Package (-M Suffix)	Option
.S	S	Surface Mount Lead Bend
.SD	SR2	Surface Mount; Tape and reel
.W	T	0.4" Lead Spacing
.300	V	VDE 0884
.300W	TV	VDE 0884, 0.4" Lead Spacing
.3S	SV	VDE 0884, Surface Mount
.3SD	SR2V	VDE 0884, Surface Mount, Tape & Reel

MARKING INFORMATION



Black Package, No Suffix

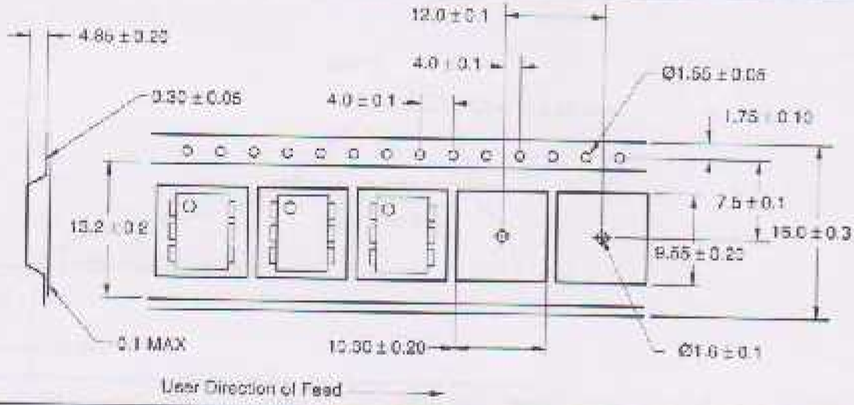


White Package, -M Suffix

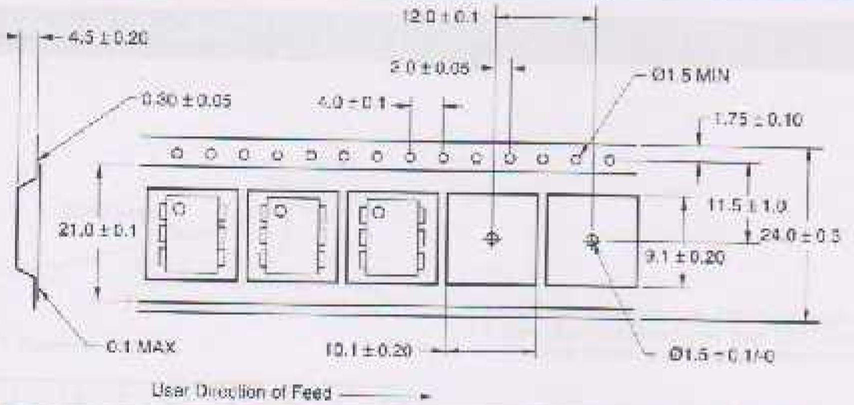
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One or two digit year code • Two digits for black package parts, e.g., '03' • One digit for white package parts, e.g., '3'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

*Note – Parts built in the white package (M suffix) that do not have the 'V' option (see definition 3 above) that are marked with date code '325' or earlier are marked in the portrait format.

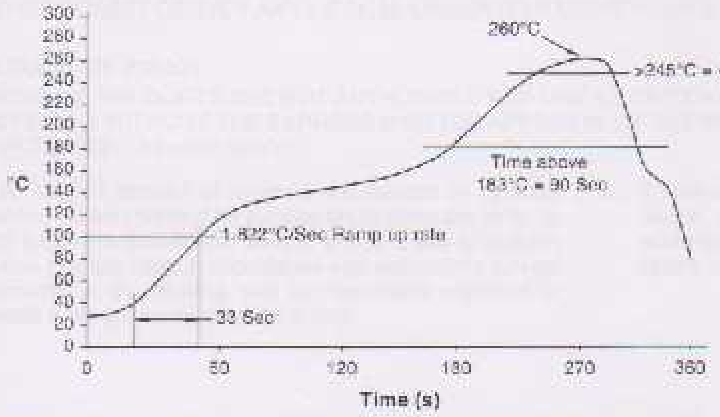
QT Carrier Tape Specifications (Black Package, No Suffix)



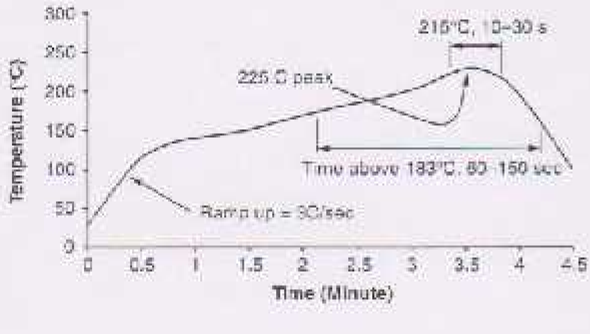
QT Carrier Tape Specifications (White Package, -M Suffix)



Reflow Profile (White Package, -M Suffix)



Reflow Profile (Black Package, No Suffix)



- Peak reflow temperature: 225°C (package surface temperature)
- Time of temperature higher than 183°C for 60–150 seconds
- One time soldering reflow is recommended

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4N25	4N26	4N27	4N28	4N35	4N36
4N37	H11A1	H11A2	H11A3	H11A4	H11A5

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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SEMICONDUCTOR™

March 1998

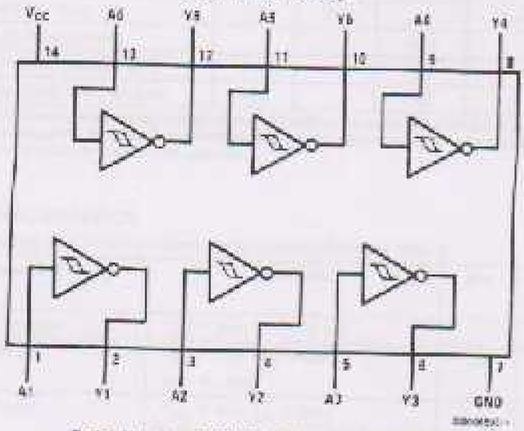
DM7414
Hex Inverter with Schmitt Trigger Inputs

General Description

This device contains six independent gates each of which performs the logic INVERT function. Each input has hysteresis which increases the noise immunity and transforms a slowly changing input signal to a fast changing, jitter free output.

Connection Diagram

Dual-In-Line Package



Order Number DM5414J, DM5414W or DM7414N
See Package Number J14A, N14A or W14B

Function Table

$Y = \overline{A}$

Input	Output
A	Y
L	H
H	L

H = High Logic Level
L = Low Logic Level

 DS006503

Absolute Maximum Ratings (Note 1)

Supply Voltage	7V	DM54	−55°C to +125°C
Input Voltage	5.5V	DM74	0°C to +70°C
Operating Free Air Temperature Range		Storage Temperature Range	−65°C to +150°C

Recommended Operating Conditions

Symbol	Parameter	DM5414			DM7414			Units
		Min	Nom	Max	Min	Nom	Max	
V_{CC}	Supply Voltage	4.5	5	5.5	4.75	5	5.25	V
V_{T+}	Positive-Going Input Threshold Voltage (Note 2)	1.5	1.7	2	1.5	1.7	2	V
V_{T-}	Negative-Going Input Threshold Voltage (Note 2)	0.6	0.9	1.1	0.6	0.9	1.1	V
HYS	Input Hysteresis (Note 2)	0.4	0.8		0.4	0.8		V
I_{OH}	High Level Output Current			−0.8			−0.8	mA
I_{OL}	Low Level Output Current			16			16	mA
T_A	Free Air Operating Temperature	−55		125	0		70	°C

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ (Note 3)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −12 mA				−1.5	V
V_{OH}	High Level Output Voltage	V_{CC} = Min, I_{OH} = Max, V_I = V_{T-}Min		2.4	3.4		V
V_{OL}	Low Level Output Voltage	V_{CC} = Min, I_{OL} = Max, V_I = V_{T+}Max			0.2	0.4	V
I_{T+}	Input Current at Positive-Going Threshold	V_{CC} = 5V, V_I = V_{T+}			−0.43		mA
I_{T-}	Input Current at Negative-Going Threshold	V_{CC} = 5V, V_I = V_{T-}			−0.56		mA
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 5.5V				1	mA
I_{IH}	High Level Input Current	V_{CC} = Max, V_I = 2.4V				40	µA
I_{IL}	Low Level Input Current	V_{CC} = Max, V_I = 0.4V				−1.2	mA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 4)	DM54	−18		−55	mA
			DM74	−18		−55	
I_{CCH}	Supply Current with Outputs High	V_{CC} = Max			22	36	mA
I_{CCL}	Supply Current with Outputs Low	V_{CC} = Max			39	60	mA

Note 2: V_{CC} = 5V

Note 3: All typicals are at V_{CC} = 5V, T_A = 25°C.

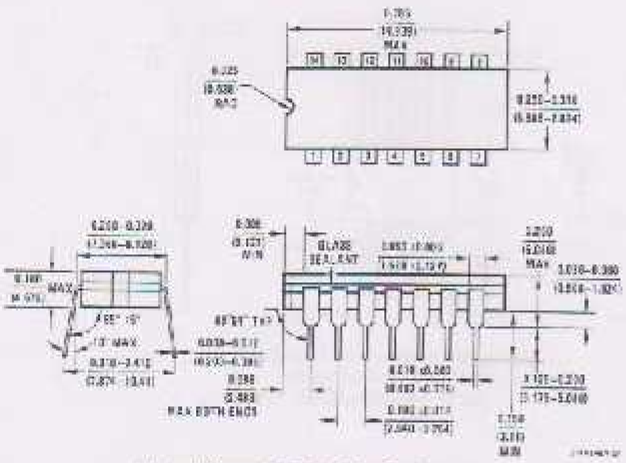
Note 4: Not more than one output should be shorted at a time.

Switching Characteristics

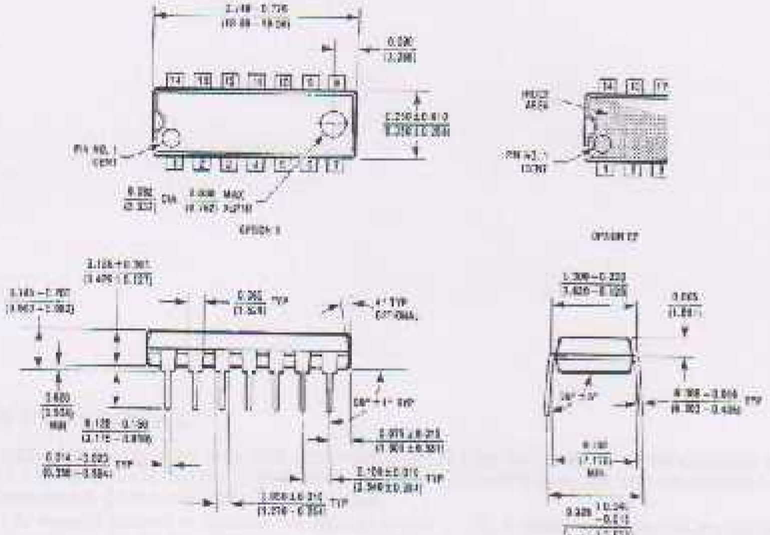
at V_{DD} = 5V and T_A = 25°C (for Test Waveforms and Output Load)

Symbol	Parameter	Conditions	Min	Max	Units
t_{PLH}	Propagation Delay Time Low to High Level Output	C_L = 15 pF, R_L = 400Ω		22	ns
t_{PHL}	Propagation Delay Time High to Low Level Output			22	ns

Physical Dimensions inches (millimeters) unless otherwise noted

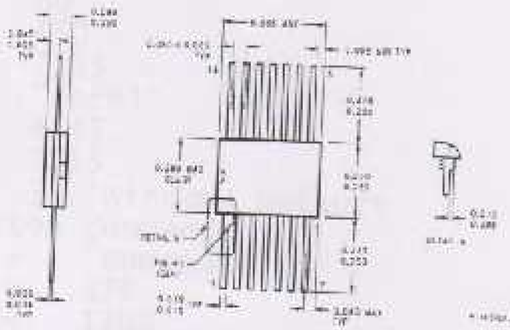


14-Lead Ceramic Dual-In-Line Package (J)
Order Number DM5414J
Package Number J14A



14-Lead Molded Dual-In-Line Package (N)
Order Number DM7414N
Package Number N14A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



14-Lead Ceramic Flat Package (W)
Order Number DM5414W
Package Number W14B

Fairchild Semiconductor Corporation
Americas
Customer Response Center
Tel: 1-888-522-5372

Fairchild Semiconductor Europe
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English Tel: +44 (0) 1 793-85-68-56
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National Semiconductor Japan Ltd.
Tel: 81-3-5620-6175
Fax: 81-3-5620-6179

www.fairchildsemi.com

Software programe

```
VERSION 5.00
Begin VB.Form Form1
   Caption         =   "Form1"
   ClientHeight    =   4545
   ClientLeft      =   60
   ClientTop       =   450
   ClientWidth     =   7155
   LinkTopic       =   "Form1"
   ScaleHeight     =   4545
   ScaleWidth      =   7155
   StartUpPosition =   3  'Windows Default
   Begin VB.CommandButton Command4
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      Left            =   1200
      TabIndex        =   9
      Top             =   360
      Width           =   855
   End
   Begin VB.Frame Frame1
      Caption         =   "modem setup"
      Height          =   1695
      Left            =   3600
      TabIndex        =   3
      Top             =   2040
      Width           =   3015
      Begin VB.TextBox Text2
         Height          =   375
         Left            =   1080
         TabIndex        =   5
         Text            =   "0599820457"
         Top             =   1080
         Width           =   1695
      End
      Begin VB.TextBox Text1
         Height          =   375
         Left            =   1080
         TabIndex        =   4
         Text            =   "2"
         Top             =   480
         Width           =   1695
      End
      Begin VB.Label Label3
         Caption         =   "number to dial"
         Height          =   495
         Left            =   120
         TabIndex        =   8
         Top             =   1080
         Width           =   735
      End
      Begin VB.Label Label1
         Caption         =   "port #"
         Height          =   255
```

```
                              Form1
            Left                =   120
            TabIndex            =   6
            Top                 =   480
            Width               =   615
         End
      End
      Begin VB.CommandButton Command3
         Caption             =   "reset"
         Height              =   495
         Left                =   600
         TabIndex            =   2
         Top                 =   2280
         Width               =   1815
      End
      Begin VB.CommandButton Command2
         Caption             =   "stop the system"
         Height              =   495
         Left                =   3600
         TabIndex            =   1
         Top                 =   960
         Width               =   1935
      End
      Begin VB.CommandButton Command1
         Caption             =   "start system"
         Height              =   495
         Left                =   600
         TabIndex            =   0
         Top                 =   960
         Width               =   1815
      End
      Begin VB.Label Label2
         Caption             =   "Label1"
         Height              =   255
         Left                =   3720
         TabIndex            =   7
         Top                 =   3240
         Width               =   615
      End
End
Attribute VB_Name = "Form1"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
Dim r As Boolean
Dim s As Boolean

Private Sub Command1_Click()
Dim a As Integer
Out Val("&H378"), 0
While r = False
a = Inp(Val("&H379"))
''a = a And 1
If a = 120 Then
s = True
```

```
Out Val("$H378"), 255
''modem
Dim f As New frmTapi
f.Show
Me.Hide
End If
Wend

End Sub

Private Sub Command2_Click()
s = True
End Sub

Private Sub Command3_Click()
Out Val("&H378"), 128
End Sub

Private Sub Command4_Click()
Dim f As New frmTapi
f.Show
Me.Hide
End Sub

Private Sub Form_Load()
r = False
End Sub
Sub modem()
If Text2.Text = "" Then
MsgBox "Error!!!"
Exit Sub
End If
Com1.CommPort = Val(Text1.Text)
Com1.Settings = "9600,N,8,1"
Com1.PortOpen = True
Com1.Output = "ATDT" & Text2.Text & vbCr
MsgBox "Dialing " & Tel.Text & vbCrLf & "Pick up the phone...",
vbOKOnly, "Dial-A-Phone"
Com1.PortOpen = False
End Sub
```

4.2.1 Overall system schematic

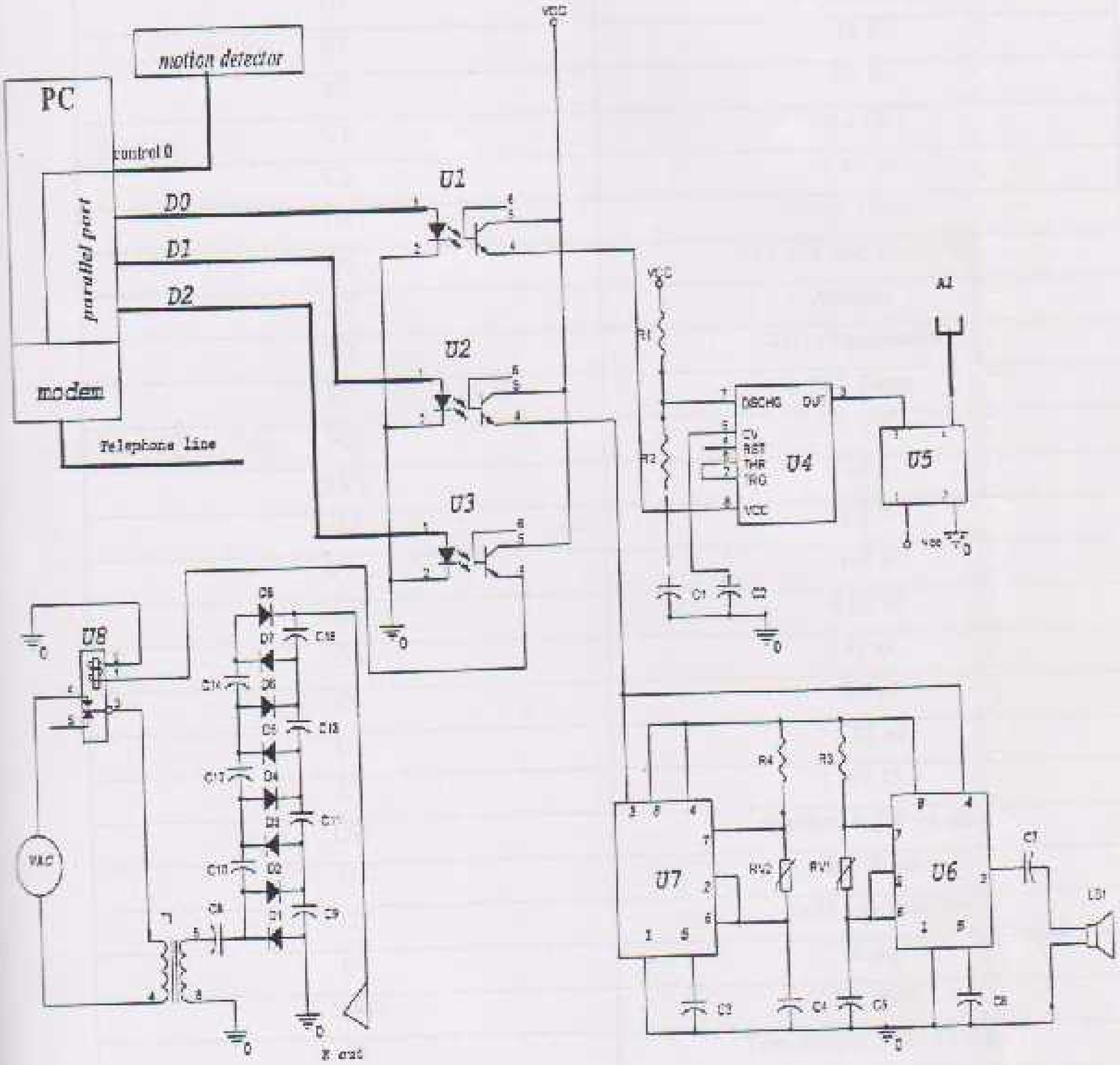
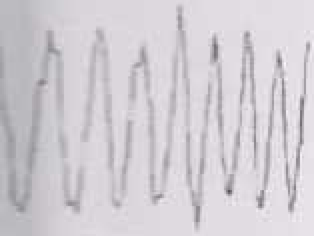
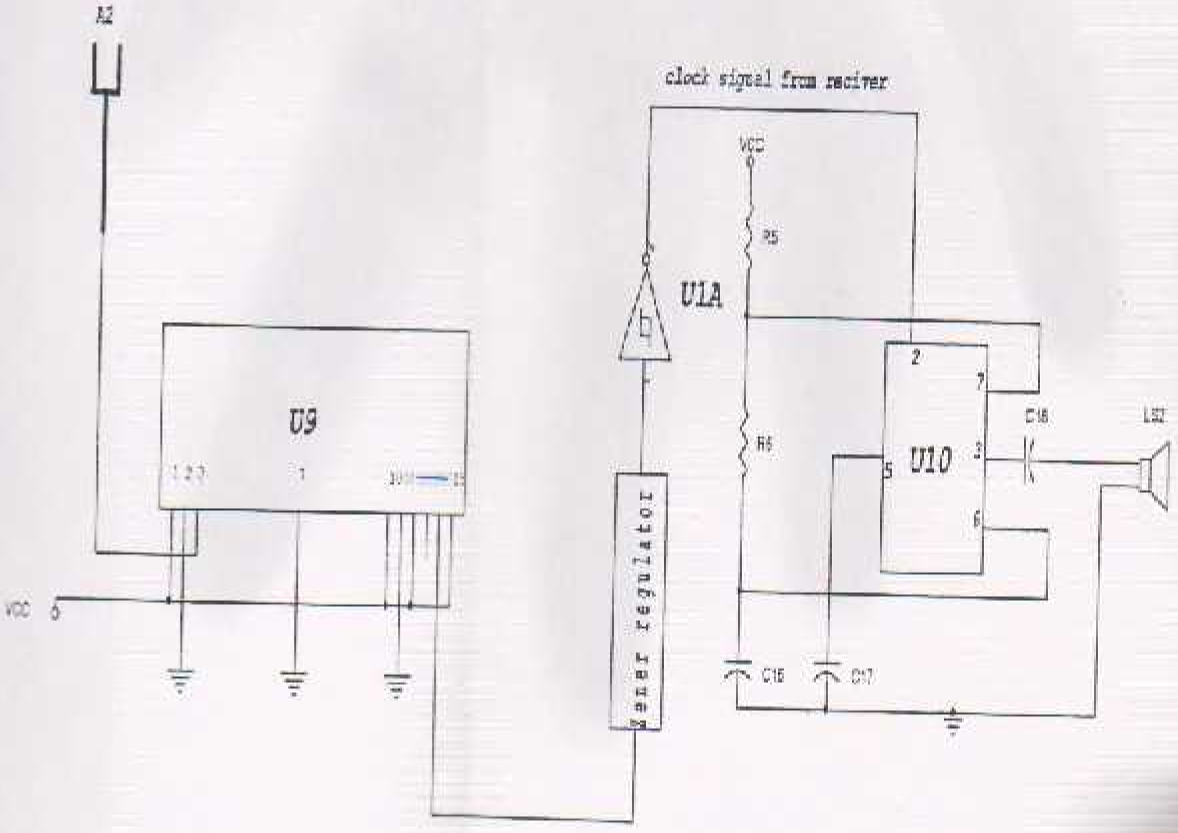


Figure (4.2) : overal





4.2) : overall system schematic