Cell phone Detection, Alarming & Reporting System

EC 15L1 MINI PROJECT

PROJECT REPORT

Submitted by

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In partial fulfilment for the award of the degree

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Department of Electronics & Communication Engineering

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DEPARTMENT OF ELECTRONICS ENGINEERING

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

BONAFIDE CERTIFICATE

This is to certify that the Mini Project report entitled

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Fifth Semester B. Tech. Electronics & Communication Engineering students, under our guidance and supervision.

Prof. Pradeep M	**Sheeba P S**	**Dr. Jobymol Jacob**
Head of department	**Project coordinator**	**Project guide**

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Abstract

The main aim of this project is to design a system such as to sense the presence of an active cell phone within a specified range and to inform the same to the authorities concerned. This system can detect a cell phone when someone is making a phone call, sending or receiving a message and using mobile data.

In the presence of an active cell phone, an alerting circuit is activated and a message is sent to the concerned authority. This device comes in handy at certain places like exam halls, offices, prisons, petrol bunks, government and military premises etc., where use of mobile phone is prohibited.

Contents

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Abbreviations

GSM	- Global System for Mobile Communication
RF	- Radio Frequency
IC	- Integrated Chip
DIP	- Dual Inline Package
PCB	- Printed Circuit Board
LCD	- Liquid Crystal Display
LED	- Light Emitting Diode
MV	- Multivibrator
GMSK	- Gaussian Minimum Shift Keying

Chapter 1

Introduction

The rapid increase of cell phones at the beginning of the 21st century to near ubiquitous status eventually raised problems such as their potential use to invade privacy or contribute to a widespread and egregious academic cheating. In addition, public backlash was growing against the intrusive cell phones introduced in daily life. While older analog cell phones often suffered from chronically poor reception and could even be disconnected by simple interference such as high frequency noise, increasingly sophisticated digital phones have led to more elaborate usage. This work concentrates in designing a system that will sense the presence of GSM signals from an unauthorized user in restricted areas which will in turn trigger an alarm alert an authority to stop the use of the same. This Mobile phone detection project is an advanced device which can be improved widely to fit in various applications in the modern fields of communication and surveillances. This work is very useful for the private meetings, examination hall, defense establishments, military camp, hospitals, petrol pumps etc., where the use of active Mobile Communication devices are prohibited.

1.1 Case Analysis

1.1.1 Present Scenario

In recent years, there has been an increasing focus on issues relating to the use of mobile phones in restricted, prohibited, and unauthorized areas. The reason for this increased interest is largely due to disturbance, as well as wrong and inappropriate usage of mobile phones by the owners and users alike. Other areas like churches, mosques, offices, and prisons, just to mention a few, are not left out. There is need for the detection of mobile phone signals in areas like these.

1.1.2 Proposed Solution

Efforts have been put in place in tackling this issue but they all have their own shortcomings, one of which is the mobile phone detector. A mobile phone detector is an instrument used to detect cellular phones during reception of signals from base stations. This device can be used practically in any location, but are found primarily in places where a phone call would be particularly disruptive because silence is expected.

Chapter 2

System Description & Hardware Details

2.1 Block diagram

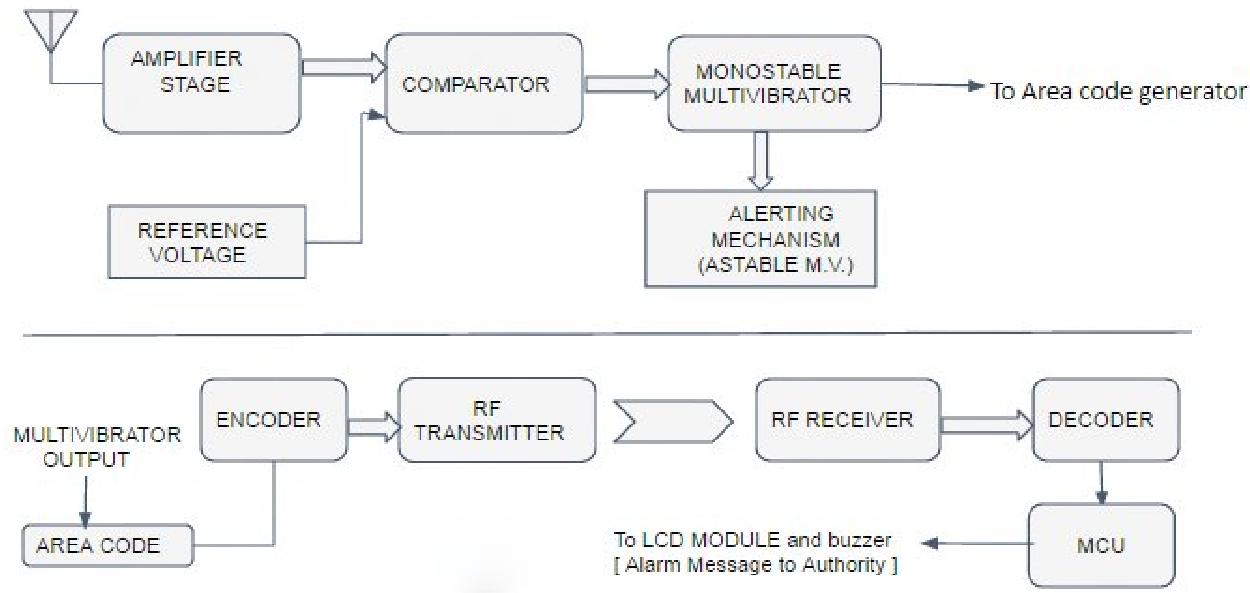


Fig 2.1: General Block Diagram

2.1.1 Block diagram description

2.1.1.1 Power supply

The microcontroller and peripherals require power supply to operate on. The 9V dc is obtained from the adapter. The RF module requires 5V and other components also require 5v.A rechargeable battery can also be used to charge from the power supply and to give an Uninterruptable Power for the mode of operation. The input voltage is regulated to 5V using regulator IC and supplied to processor and peripherals.

2.1.1.2 Detector Stage

Since the receiving signal is of radio frequency, a decision of using RF amplifier was made. To improve accuracy, a comparator was added so that noise signals are, to an extent, avoided.

The RF amplifier specifically amplifies the signals produced in the working frequency range of cell phones. The frequency range was found to be 0.9 to 3 GHz .The RF amplifier circuit includes a band pass filter and a high frequency transistor to amplify the RF signals .The output is then fed to a comparator. The comparator checks whether the input has reached the predetermined value set by the user. The threshold is set such that it lies above the background noise present in the environment and below that of the radiated noise from a nearby cell phone .This predetermined value is set and given as one of the inputs of the comparator and the RF amplifier output as the other input .If the input from amplifier is greater than the threshold value, the comparator output goes high and the decision making system is activated.

2.1.1.3 Alerting stage

This stage was brought in to alert the area where the device is installed and to send an alert message to distant authorized people. While analysing the situation, the need of alerting a distant person was found to be unavoidable.
An alerting circuit and an RF transmitter are used to implement this stage. On detection of a signal, the alerting circuit is activated. The alerting circuit alerts the area where the device is installed.It consists of a 555 timer ic working in its astable mode. RF transmitter sends the area code (place where device is installed) to the distant receiver's end. Hence the usage of cell phone is informed in one or another way to an authorized person.

2.2 Circuit diagram

2.2.1 Detector Stage Circuit diagram

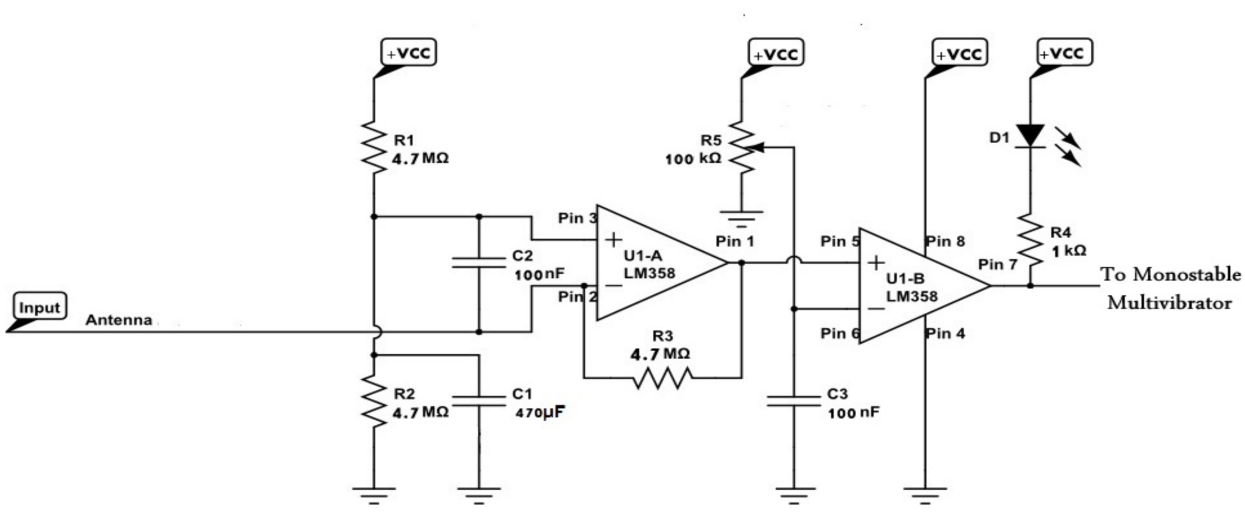


Fig 2.2: Detector Stage Circuit Diagram

2.2.2 Circuit Description

The basic detector circuit consists of a preamplifier using opamp LM358.The cell phone signal envelope is detected at the antenna which is connected to the negative terminal of the first opamp. R1 and R2 form a voltage reference connected to U1-A Pin3. R3 and C2 form a RC circuit. Any sudden energy picked up by the antenna connected to Pin2 causes U1-A output Pin1 to change. Pin1 output remains changed during the period of RC or the antenna energy (cell phone radio waves) is removed. R5 creates a reference voltage on Pin6 and R5 must be very carefully set by the user to an appropriate threshold above the background noise present in the environment and below that of the radiated noise from a nearby cell phone. The setting of R5 is critical and must be adjusted with the greatest of small adjustment tweaks to find this zone above the background noise yet not above the noise of a nearby cell phone.. At the same time the output of the comparator is connected to the monostable multivibrator.The monostable mv output thus activates the astable mv which turns on the buzzer and LED. It also activates transmission of the message from RF transmitter.

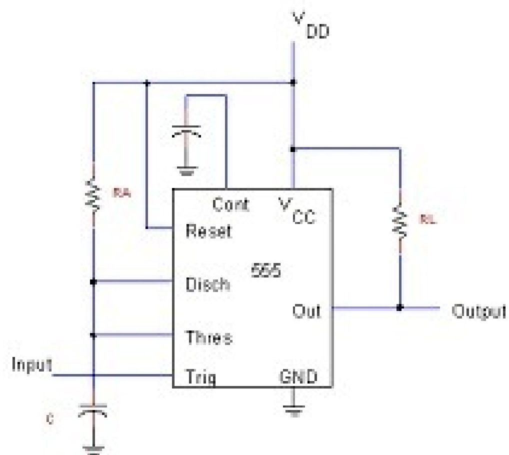


Fig 2.3: 555 circuit for Monostable operation

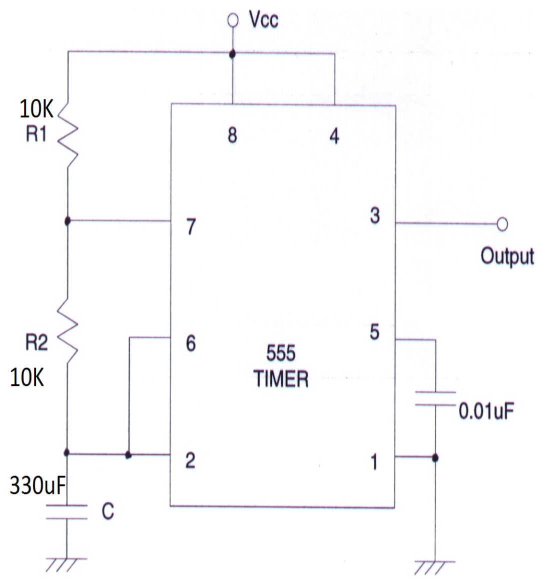


Fig 2.4: 555 circuit for Astable operation

2.2.3 RF Transmitter Stage

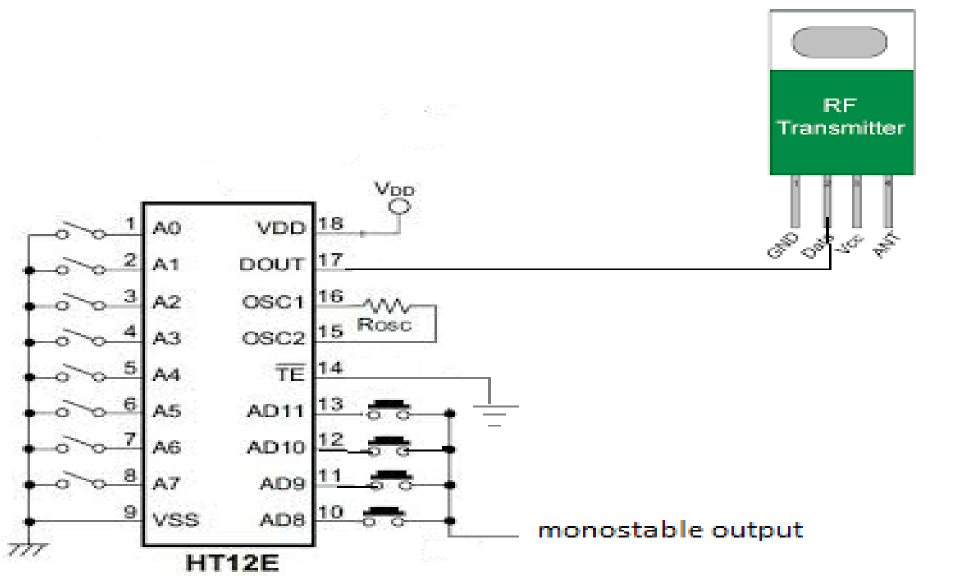


Fig 2.5: RF Transmitter Stage

Monostable output is given as input to the data pins (area code).An encoder(HT12E) along with an RF transmitter module is used to send the area code when a cell phone usage is detected. The area code can be set in the encoder by manipulating the data pins (pins 10,11,12,13).The encoder converts the parallel data to serial data. This data is transmitted to a distant receiver. The RF transmitter module has an open space range of 100m which is suitable for this project.

2.2.4 RF Receiver Stage

Fig 2.6: RF Receiver Stage

The transmitted serial data is received by an RF receiver module and given to a decoder. The HT12E decoder IC converts serial data from receiver to parallel data which is then used as area code. Decoded data is given to the 8051 microcontroller interfaced with LCD. LCD then displays the area code.

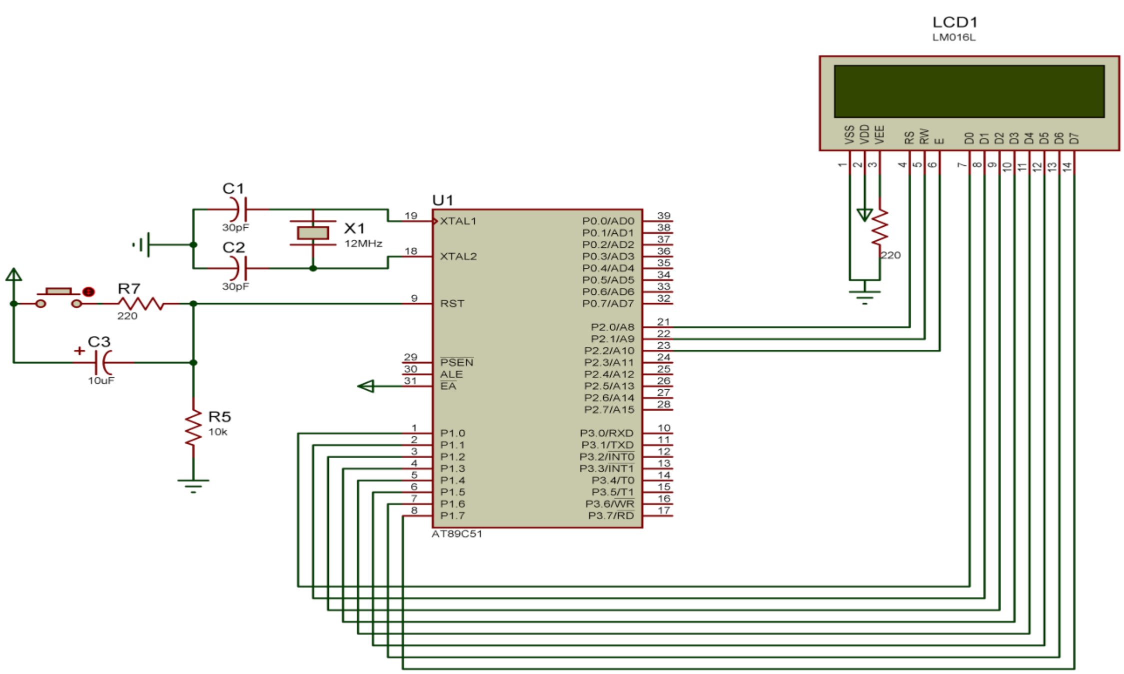


Fig 2.7: 8051- LCD Interface

2.3 LM358 Op-Amp

The LM358 is a great, easy-to-use dual-channel op-amp. This dual op-amp features low power drain, a common mode input voltage range extending to ground/VEE, and single supply or split supply operation.
It can handle a supply of 3-32VDC and source up to 20mA per channel. This op-amp is great if there is a need to operate two individual op amps from a single power supply. The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. It comes in an 8-pin DIP package.

Features:

- Two internally compensated op-amps
- Internally frequency compensated for unity gain
- Large DC voltage gain: 100 dB
- Wide bandwidth (unity gain): 1 MHz (temperature compensated)
- Wide power supply range:
  - Single supply: 3V to 32V
  - or dual supplies: +/-1.5V to +/-16V

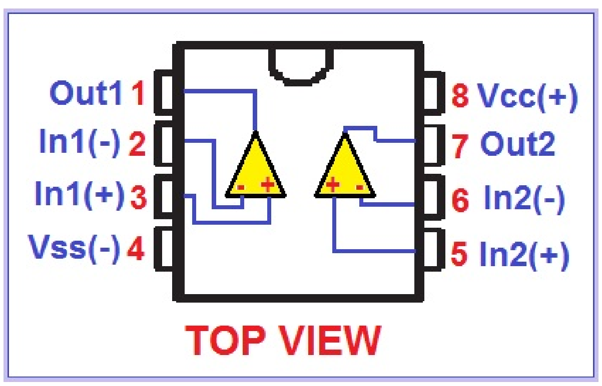


Fig 2.8: Pinout Diagram of a typical LM358 IC

In our system, the first op-amp acts as a comparator. Any difference between + and - pins is reflected on the output. The second opamp is a noise rejector based on fine tuning using a potentiometer.

2.4 555 Timer

555 timer is a robust, stable and most commonly used IC in the area of electronics. IC 555 is a square wave generator and its duty cycle ranges from 50% to 100%. The time delay in the circuit is provided by an oscillator. 555 timer IC got its name from the three 5 kilo-ohm resistor attached as a pattern of voltage divider.

2.4.1 Functional Parts of 555 Timer IC:

555 Timer IC has basically three functional parts. They are as follows:

a) Comparator: It is used to compare two voltages at the input level which is inverting (-) one and non-inverting (+). If the voltage at the non-inverting is higher than other than the output is high. For ideal comparator input resistance is infinite.

b) Voltage Divider: As the input resistance is infinite in the comparator so the voltage among all three resistors is being divided equally.
Value across each resistor is Vin/3.

c) Flip/Flop: Digital electronic device with memory. If the input is high while low at R then the output at Q is high. It means when S is high Q output is high and if R is high Q output is low.

2.4.2 Pin Description of 555 Timer:

1. **Trigger Input:** If the input <1/3Vs than at that condition output is high. It is useful in examining the timing capacitor discharging in a stable circuit.
2. **Threshold Input:** This pin is attached to the first comparator at the non-inverting input terminal. If the threshold voltage is higher than (2/3) Vin than the output is high at the comparator thus reset the output from high to low in the flip flop.
3. **Reset Input:** As based on the internal condition of the flip-flop this pin reset the output of the flip-flop. To get rid of any noise interference an active low pin is attached to high state till any reset operator is required. So for most of the time it is attached to the supply voltage as in the figure.
4. **Control Input:** An external voltage applied to this terminal changes the threshold as well as trigger voltage. Thus by imposing a voltage on this pin or by connecting a pot between this pin and ground, the pulse width of the output wave can be varied. When not used, the control pin should be bypassed to ground with a 0.01uF capacitor to prevent any noise problem.
5. **Discharge Pin:** When the timer output is low this pin is connected to 0 volts. It is used to discharge the timing capacitor in astable and monostable mode.
6. **Ground:** The reference point or ground point of IC555 is connected to the ground terminal of the dc voltage source, Voltages of the entire circuit are measured with respect to this terminal.
7. **Output:** The output of timer and the load is connected to this pin.
8. **Supply:** This voltage must be a pure ripple free DC voltage which is obtained by connecting a positive regulated power supply.

2.4.3 Modes of Operation

The 555 Timer has three operating modes and the details are explained below.

1. Monostable Mode: In this mode, the 555 functions as a “one-shot” pulse generator. Applications comprise many things viz timers, missing pulse detection also included bounce free switches, touch switches as well as frequency divider, capacitance measurement and pulse-width modulation (PWM) and many more.

2. Astable Mode: In this mode, the 555 work as a free running mode. The output of this astable multivibrator toggle between low and high continuously there by generating a train of pulse, that is why it is known as pulse generator. They are used as an inverter and also used in many of the internal part of the radio. Selecting a thermistor as a timing resistor allows the use of the 555 in a temperature sensor.

3. Bistable Mode or Schmitt Trigger: If there is no capacitor as well as there is no DIS pin used, then 555 timer can work as a flip flop. Its uses Include bounce free latched switches.

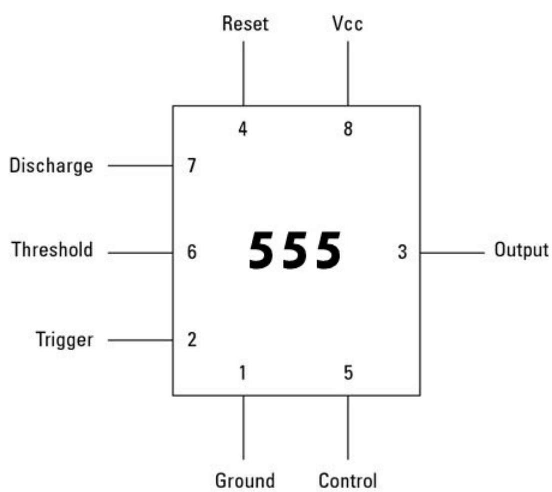


Fig 2.9: Pinout Diagram of a 555 Timer

555 timer is used both as Astable and Monostable, in this project.

2.5 Regulator IC 7805 and 7812

Here we use LM 7805 regulator IC to get regulated output of 5V. The LM 7805 is a 3-terminal fixed output positive voltage regulator IC.

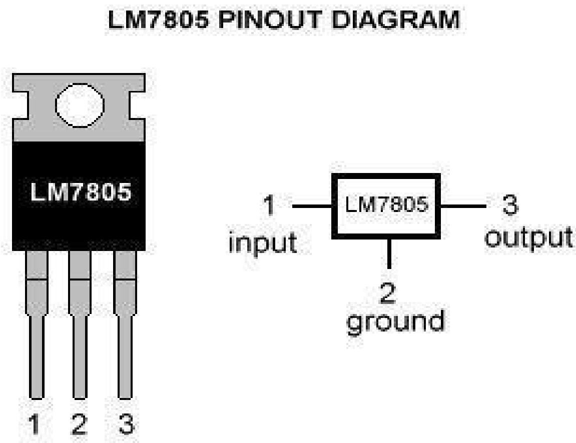


Fig 2.10: Voltage regulator LM7805

The pin details are as follows:

7805 Pin	Function	Name
1	Input voltage (7.2V – 35V)	IN
2	Regulated output (4.8V-5.2V)	OUT
3	Ground (0V)	COM

Table 2.1 shows the pinout of LM7805

It delivers up to 1.5A of current. The internal current-limiting and thermal shutdown features essentially make them immune to overloading. It regulates the voltage to a steady output of 5V only if the input voltage falls in the range of 7.2V to 35V. If the input voltage is close to 7.2V, power loss as heat is minimum and requires no heat sink. A 470 pF capacitor in shunt is used to minimize the high frequency noise. The 47pF and decade capacitor is used to pull more power from the power source. 7812 is a famous IC which is being widely used in 12V voltage regulator circuits. It is a complete standalone voltage regulator. There is a need to use only two capacitors, one on the input and second one on the output of 7812 in order to achieve clean voltage output and even these capacitors are optional to use. To achieve 12V 1A current, 7812 should be mounted on a good heatsink plate. Thanks to the transistor like shape of 7812 which makes it easy to mount on a heatsink plate. 7812 has built in over heat and short circuit protection which makes it a good choice for making power supplies.

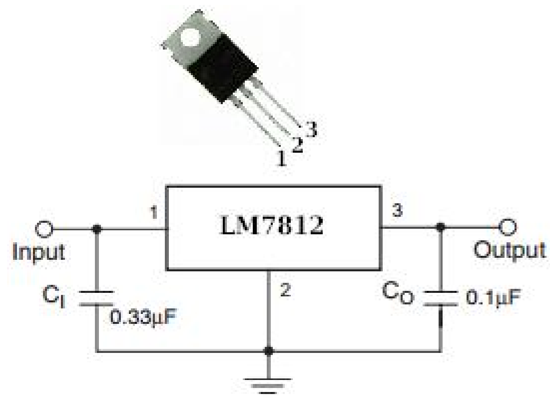


Fig 2.11: Voltage regulator LM7812

2.6 HT12E Encoder

HT12E is an encoder integrated circuit of 2^{12} series of encoders. They are paired with 2^{12} series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format. Simply put, HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits. HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium. HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

Pin Description:

Pin No	Function	Name
1	8 bit Address pins for input	A0
2		A1
3		A2
4		A3

5		A4
6		A5
7		A6
8		A7
9	Ground (0V)	Ground
10	4 bit Data/Address pins for input	AD0
11		AD1
12		AD2
13		AD3
14	Transmission enable; active low	TE
15	Oscillator input	Osc2
16	Oscillator output	Osc1
17	Serial data output	Output
18	Supply voltage; 5V (2.4V-12V)	Vcc

Table 2.2

2.7 HT12D Decoder

HT12D is a decoder integrated circuit that belongs to 2^{12} series of decoders.In simple terms, HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by, say, an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin.

HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits. The data on 4 bit latch type output pins remain unchanged until new is received.

Pin Description:

Pin No	Function	Name
1	8 bit Address pins for input	A0
2		A1
3		A2
4		A3
5		A4
6		A5
7		A6
8		A7
9	Ground (0V)	Ground
10	4 bit Data/Address pins for output	D0
11		D1
12		D2
13		D3
14	Serial data input	Input

15	Oscillator output	Osc2
16	Oscillator input	Osc1
17	Valid transmission; active high	VT
18	Supply voltage; 5V (2.4V-12V)	Vcc

Table 2.3

2.8 RF Module

The detected cell phone location (Area code) is sent to the authorised person using an RF transmitter. An RF module (radio frequency module) is a small electronic device used to transmit and/or receive radio signals between two devices. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver. An RF module helps in fast transfer of detected cell phone location to a long distance effectively overcoming obstacles. .Several carrier frequencies are commonly used in commercially-available RF modules such as 434 MHz, 915 MHz, and 2400 MHz. These frequencies are used because of national and international regulations governing the use of radio for communication.
RF module with a carrier frequency of 434 MHz is used for this project.

2.9 LCD display panel

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

The LCD displays “CELL PHONE DETECTOR” in its idle state and when an input has been detected on lower 4 bits of port 1 of 8051, an alarm is sounded and LCD backlight blinks.The area code from which detection has been made is displayed on the LCD display screen.

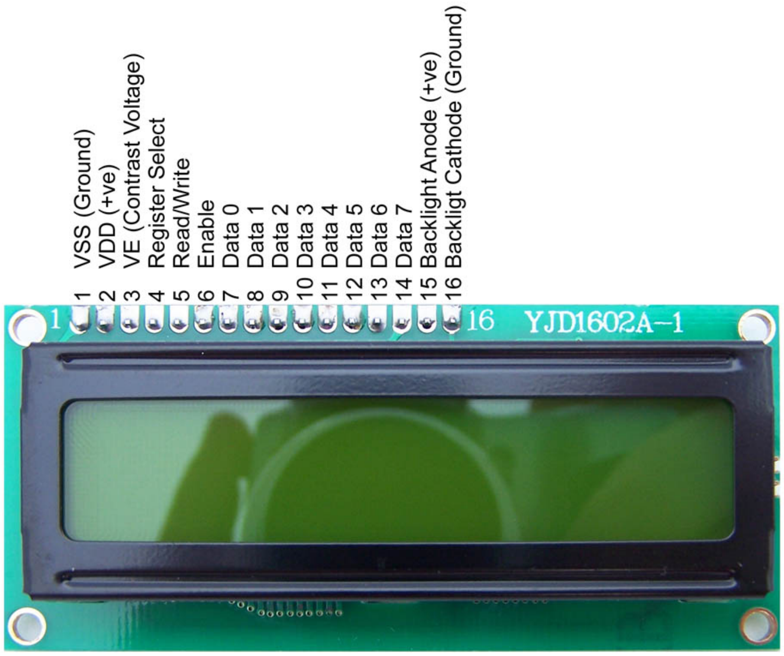


Fig 2.12: LCD Display

2.10 Power supply circuit

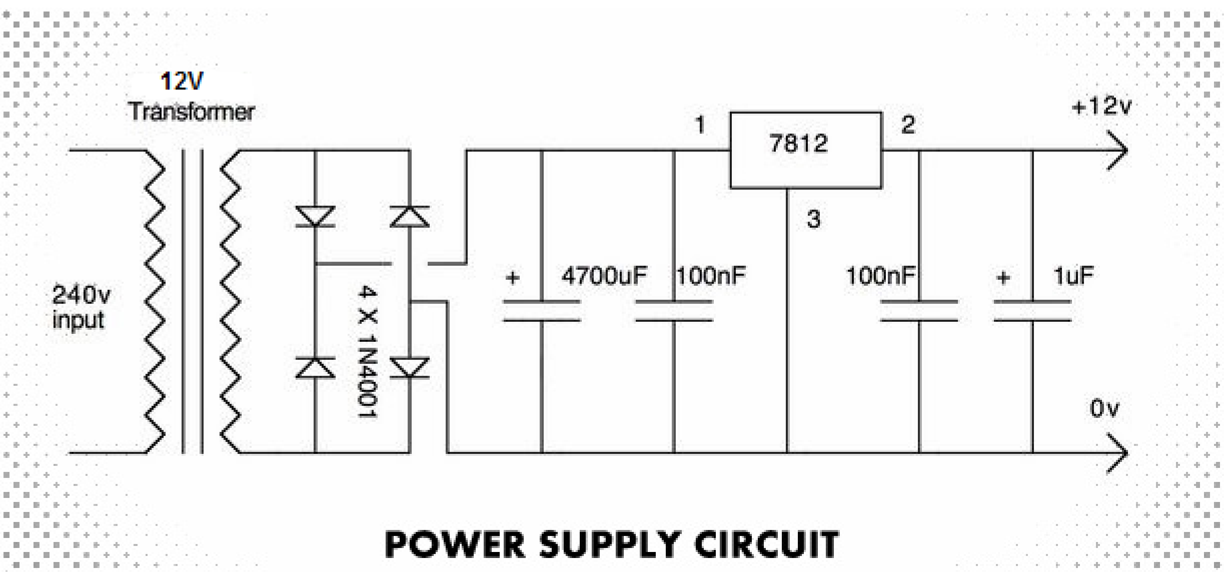


Fig 2.13: Power supply circuit

2.10.1 Power supply description

All devices will have a certain power supply limit and the electronic circuits inside these devices must be able to supply a constant DC voltage within this limit. That is, all the active and passive electronic devices will have a certain DC operating point (Q-point or Quiescent point), and this point must be achieved by the source of DC power. The DC power supply is practically converted to each and every stage in an electronic system. Thus a common requirement for all this phases will be the DC power supply. All low power system can be run with a battery. But, for long time operating devices, batteries could prove to be costly and complicated.

The power supply circuit has a step down transformer, a bridge rectifier circuit, a regulator IC and a filter circuit. The voltage regulation IC is used to get a regulated voltage of 12v. At the output another capacitor is connected again to reduce ac ripples if present and to capacitively couple the output of regulated voltage to the circuit.

Fig 2.14: LCD display on detecting phone

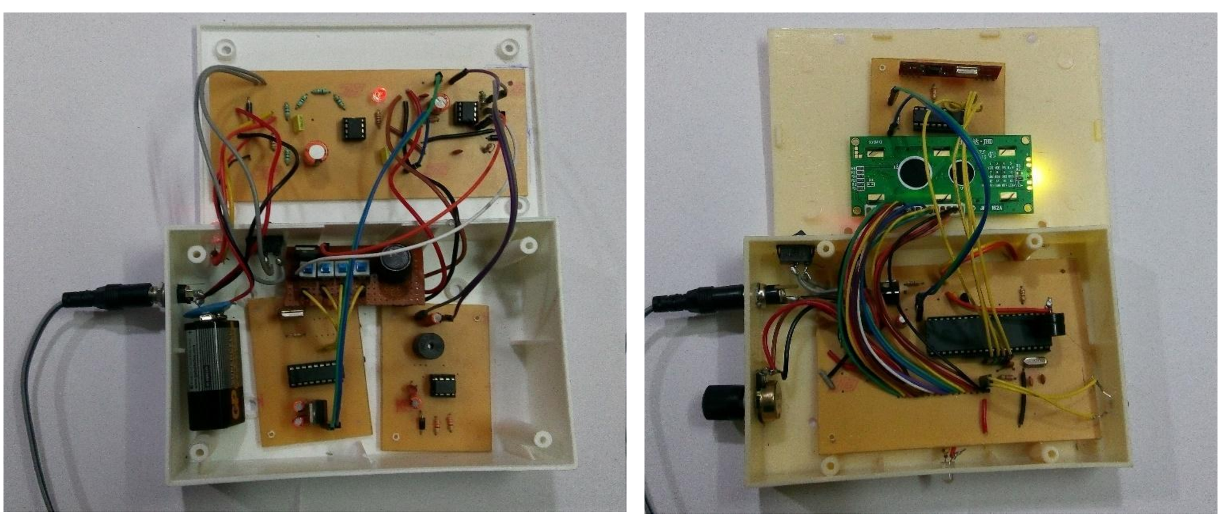


Fig 2.15: Implemented Circuit

Chapter 3

PCB Fabrication

The materials required for PCB fabrication are copper clad sheet, little paint drilling machine and ferric chloride solution.
The PCB fabrication involves the following steps:

1. Preparation of the pcb layout
The layout is commonly prepared in the scale of *2:1*. It offers a reasonable compromised below accuracy gain and handling convenience as *2:1* part of artwork has the actual PCB area. Grid systems are commonly used for preparation of the layout. The use of the grid sheet gives more convenience in placement of components and conductors. The grid system based on 0.1 is found to be too coursing, a grid equidistant of *0.1mm* is recommended.

Procedure:
• Each and every PCB is viewed from component side.
• The designing of the layout is started with an absolutely clear component list and circuit diagram.
• The large components are placed first and the space in between is filled with smaller area.
• In the designing of PCB layout, it is very important to divide circuit into sub units. Each of these subunits are realized in the defined portion of the board.
• The components are placed in the print sheet tanning and standard length and width.
• The punched component layout is circled to taking the standard size of the land pads.

2. Pattern transfer
After the film is processed the film master are obtained. The transfer of the conductor which is on the film master on to the copper clad base material is done by two methods mainly photo printing and screen printing. Photo printing is extremely accurate which is also applied to the fabrication of semiconductors. Screen printing is comparatively cheap and simple method for pattern transfer although less precise than photo printing. But this is less costly, so this method commonly-used.

3. Screen printing
In screen printing, the processing is very simple. A screen fabric with uniform meshes and opening stretched and fixed on a solid frame of metal or wood. The circuit pattern is photographically transferred on to queue through the opening master onto the surface of the material to be printed. The light sensitive material is coated on to the screen and using film master the pattern is transferred to the screen. Then using ink the pattern is transferred to the copper clad sheet. Two methods are used for screened printing pattern into screen.
1. Direct method
2. Indirect method

In direct method the photographically sensitive film is transferred to screen. The film is exposed and then pasted to the screen. The pattern is then transferred to screen using the links and squeegee.

4. Etching

The removal of unwanted copper from copper clad sheet is known as etching.
For these 4 types of tanks are used.
1. Ferric Chloride
2. Cupric Chloride
3. Chromic acid
4 .Alkaline ammonia

Among these Ferric Chloride is cheap and also suited for home and industrial applications. The high corrosive power of FeCl leads to short etching time and little under etching. Ferric chloride matches well photo and screen printed resists.

5. Drilling

Drilling of components, mounting holes into the PCBs is by the most important mechanical machining operation in PCB production process. The importance of hole drilling on PCB has further group with electronic component miniaturization and its need for smaller hole diameters and higher packing density where hole punching is practically routed out.
Four types of drilling are commonly used.
1. Drilling by direct sight
2. Drilling by optical sight
3. Jig drilling
4. NC Drilling

6. Component mounting

Component is basically mounted on one side of the board. On polarized two lead components are mounted to give the marking or the orientation throughout the board. The component orientation can be both horizontal as well as vertical but uniformly, direction is placed. The uniformity in orientation of polarized component is determined during design of PCB.

Software Used

DipTrace is an Electronic Design Automation(EDA)/Computer Aided Design(CAD) software for creating schematic diagrams and printed circuit boards.
DipTrace has 4 modules: Schematic Capture Editor, PCB Layout Editor with built-in shape-based autorouter and 3D Preview & Export, Component Editor, and Pattern Editor.
The entire PCB was developed using DipTrace software. The various requirements were adjusted in the software and manual routing was done. The final softcopy of PCB developed was printed on a glossy paper for developing PCB.

Chapter 4

Software Details

4.1 Flow Chart

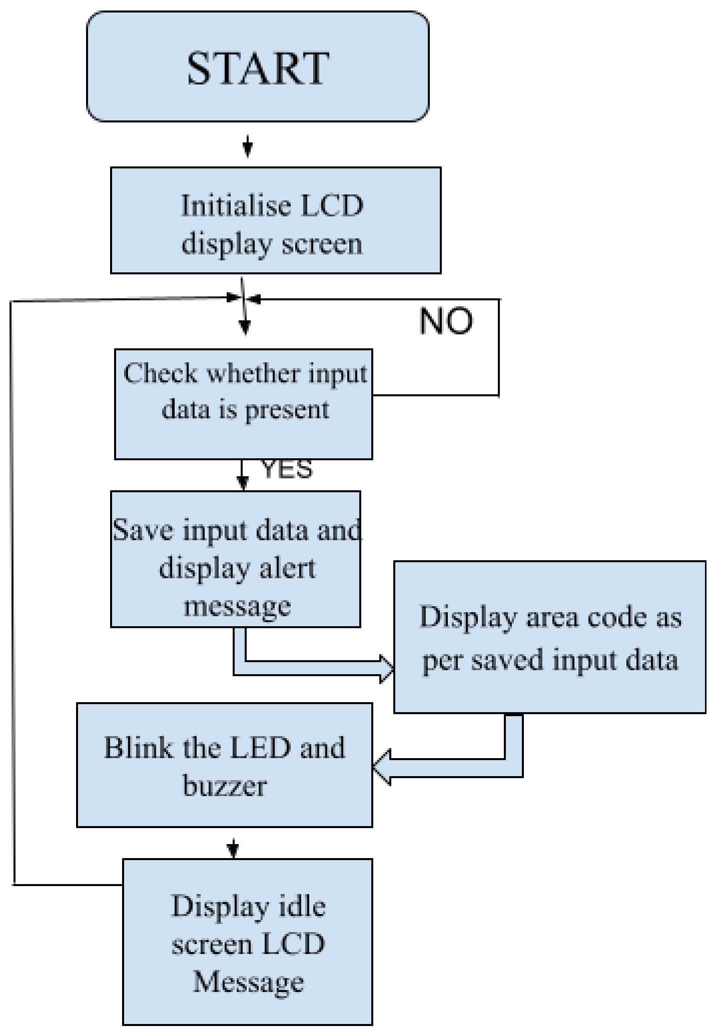


Fig 4.1: Program Flowchart

4.1.1 Flow Chart Description

When the system is powered on the microcontroller initializes the LCD display unit and the message “CELL PHONE DETECTOR” is seen by default. This screen persists until an input to the port 1 is given.The microcontroller constantly checks for input. If an input is detected, i.e. a sequence not equal to 00h the microprocessor jumps to the alert segment of code. The input code is saved and the alert message is displayed. The area code is also displayed by using input code as an offset to a look up table containing area codes. An LED blinks and a buzzer sounds an alarm. After a small delay, the default message is displayed and the program jumps to the main loop, where it constantly checks for input. The cycle repeats again when an input code is detected.

4.2 Softwares Used

4.2.1 PROTEUS 8

Proteus PCB design combines the ISIS schematic capture and ARES PCB layout programs to provide a powerful, integrated and easy to use suite of tools for professional PCB Design. All Proteus PCB design products include an integrated shape based autorouter and a basic .It combines a superb mixed mode circuit simulator based on the industry standard SPICE3F5 with animated component models. It provides an architecture in which additional animated models may be created by anyone, including end users.
Indeed, many types of animated model can be produced without resort to coding. Consequently PROTEUS VSM allows professional engineers to run interactive simulations of real designs. Powerful tools for selecting objects and assigning their properties. Total support for buses including component pins, inter-sheet terminals, module ports and wires. It supports both interactive and graph based simulation. CPU Models available for microcontrollers such as the PIC and 8051 series. Interactive peripheral models include LED and LCD displays, a universal matrix keypad, and a whole library of switches, potentiometers, lamps, LEDs etc.
Proteus was used to simulate the monostable and astable multivibrators. The trigger signal from the detector was designed as observed on a DSO and given as input to the monostable

multivibrator in the simulation.The interfacing of the LCD to the 8051 microcontroller was also simulated, with the data from the RF module being simulated by the use of push button switch.

4.2.2 MCU 8051 IDE

MCU 8051 is a graphical interface development environment for the 8051 microcontroller developed by Moravia Microsystems. It has its own assembler and support for 2 external assemblers. This IDE contains simulator, source code editor, assembler, HW programmer and much other tools. Simulator supports over 79 MCU primarily from Atmel. There is also support for simple hardware simulation (like LEDs, keys, etc.).Supported programming languages are C language and assembly. For C language the compiler used is SDCC compiler.
The software is user friendly and also shows real time status of various ports,registers etc. and also simulates hardware without any connections.It also allows step by step execution which is very useful for debugging the assembly code.

The assembler is one of the integral parts of MCU 8051 IDE. The
assembler is capable of generating four kinds of output code:

- Object code (machine code) as an hexadecimal file, with .hex extension and in Intel 8 HEX format.
- Object code (machine code) as a binary file, with .bin extension and in format of raw binary data.
- Code listing, in .lst extension.
- Code for integrated MCU simulator, in .adf extension.

The simulator is a software component intended for the simulation of the chosen microcontroller in a virtual environment. It allows user to monitor precisely what is happening in the MCU in an exact moment in time, as well as to modify its components, for instance by altering the value of a register, cancelling an interrupt or forcing a subprogram to return.

The entire program was developed and compiled using MCU 8051 IDE. The generated HEX file was burned to the 8051 IC AT89C51 using Topwin.

Chapter 5

Implementation and Results

5.1 Implementation

Contemporary 'digital' mobile phones in India operate using the GSM (Global Systems Mobile) system. There are two frequency bands allocated to GSM mobile phones, one at 900MHz, and one at 1800MHz. GSM uses a combination of frequency division multiple access (FDMA) and time division multiple access (TDMA). What this means in reality is that within each band there are a hundred or so available carrier frequencies of 200kHz spacing (the FDMA bit), and each carrier is broken up into time-slots so as to support 8 separate conversations (the TDMA bit). Correspondingly, the handset transmission is pulsed with a duty cycle of 1:8; and the average power is one eighth of the peak power. Once a call is in progress, the phones are designed to reduce the radiofrequency (RF) output power to the minimum required for reliable communication - under optimum conditions, the power can be set as low as 20 mW (one hundredth of full power). Battery consumption and radiation output of the handset is further reduced by using 'discontinuous transmission' (DTX); the phone transmits very much less data during pauses in the conversation.

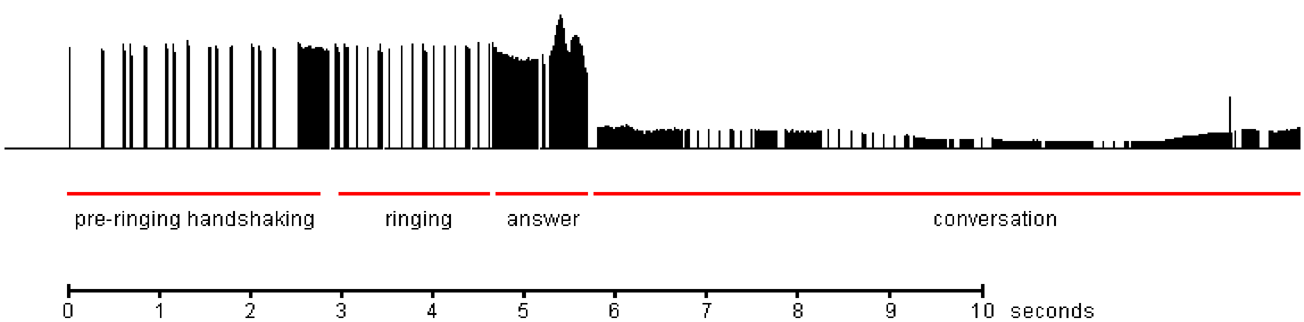


Fig 5.1: Signal Amplitude during Call

This represents a section of the voice transmission, the timescale of the whole plot being a little over.1.second.

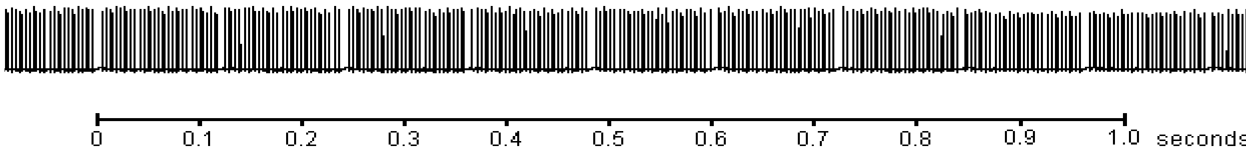


Fig 5.2: Cell phone Voice Transmission I

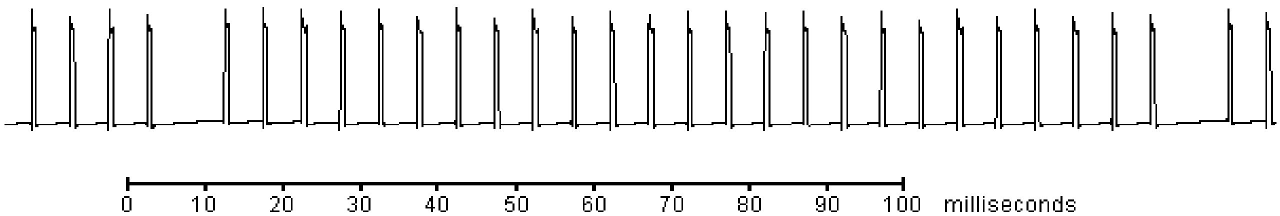


Fig 5.3: Cell phone Voice Transmission II

Expanding the timescale further, the detail of the pulse structure is revealed. The pulses come at 4.62 millisecond intervals (approx. 217 Hz frequency), each lasting 0.57 milliseconds. This gives a mark:space ratio of 1:7, allowing up to eight calls to be time-multiplexed (TDMA) onto the same carrier frequency. Every 26th pulse is omitted, causing an 8.3Hz periodicity in the signal. The plot below shows some detail of the effect of the discontinuous transmission.

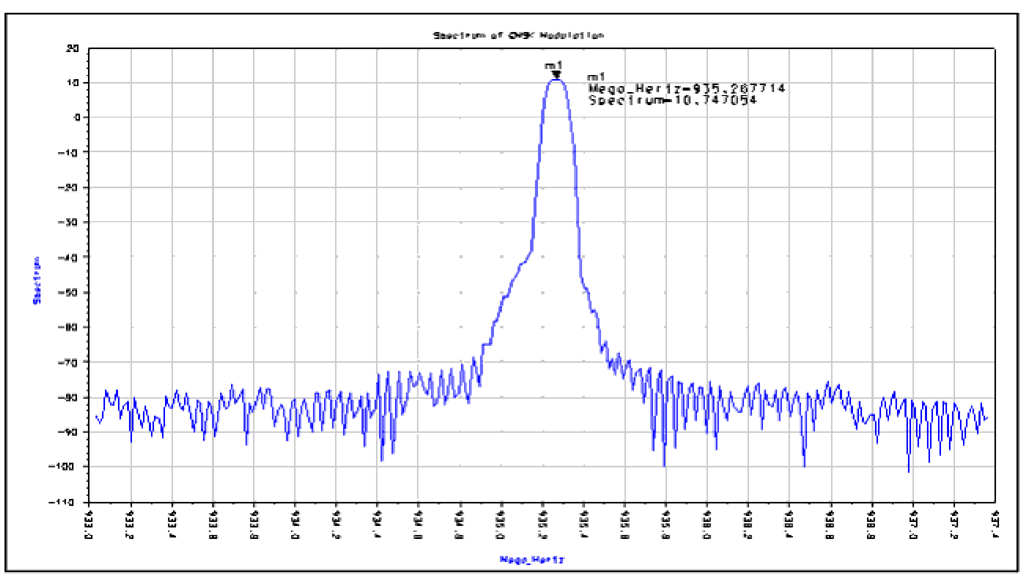


Fig 5.4: **Spectrum of GMSK Modulation**

5.1.1 Pre Amplifier Stage

The pre amplifier amplifies the output from the antenna. When a cell phone is detected, a significant amplitude and frequency change is observed at the pre amplifier output

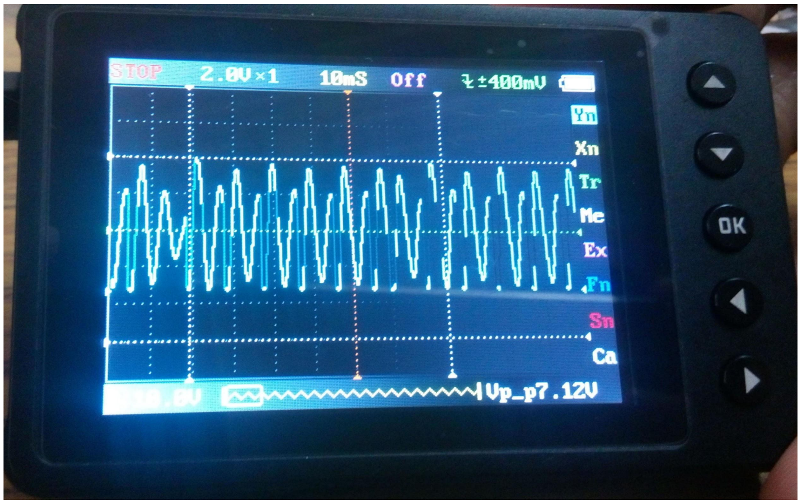


Fig 5.5: Observed Waveform from Input Amplifier

5.1.2 First comparator output

A threshold value is practically set for the comparator using a pot which distinguishes the ambient noise from the required signal.If it crosses this threshold,a similar waveform (as seen below) is obtained at the output of the comparator.

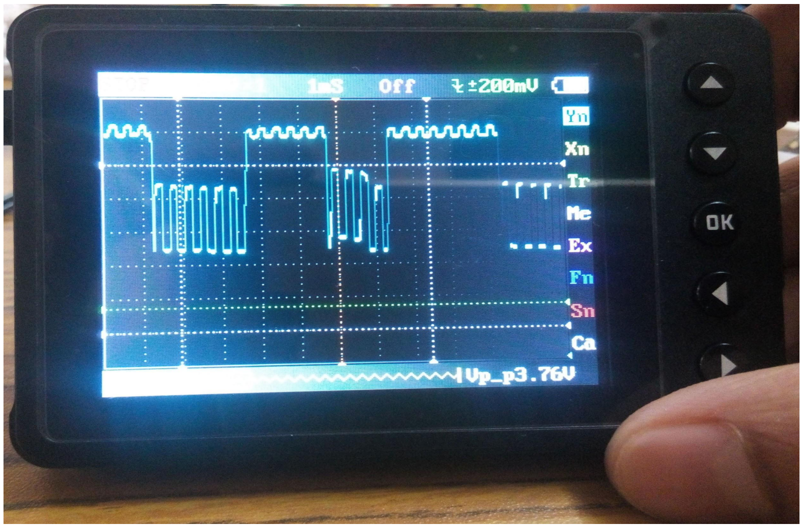


Fig 5.6: Observed Waveform from Comparator

5.2 Challenges and issues faced

The circuit had to be redesigned for a higher gain by replacing the feedback resistance due to poor range of detection. The alarming circuit had to be modified for clear and louder beeping of buzzer. The output- voltage from the first comparator was not sufficient enough to generate a square pulse at the astable multivibrator stage of alarming circuit, thus a pnp transistor as switch had to be employed.

Use of GSM module for sending information directly to another cell phone was dropped as it was very expensive and would triple the product cost.

Since the 1st comparator output were fast rising and falling pulses, so a monostable multivibrator stage was added after detector stage to generate a single pulse so that the message would be sent only once by RF stage.

Estimation of Cost

Component	Quantity	Cost
PCB Fabrication	-	600
Passive Components (R, C, Pot.,etc.)	-	50
Active Components(Diode, Reg. etc)	-	50
555 Timer & LM 358 IC	2 + 1	30
Battery	1	25
Transformer	2	120
LCD Module	1	150
Antenna	1	170
Casing,Switches and other plastic	2	250
RF module(TX and RX)	1	300
Encoder and Decoder	1+1	60
Connecting Wire	-	50
Microcontroller	1	60

TOTAL COST = Rs. 1915 ~ Rs. 1900
One Detector - 1 Power supply + Op-amp & 555 IC + Casing + Antenna + RF Transmitter + Encoder
ONE DETECTOR'S COST = Rs. 970

Conclusion And Future Improvements

This system is very useful in examination hall, defense establishments, military camps, Hospitals, Petrol pumps etc., where the use of active Mobile Communication devices are prohibited. With the aid of this system, one can detect the active mobile phone device-like objects and GPS systems from the range of few centimeters to few meters depending upon the objects transmission strength and other useful parameters. This device can detect objects within a radius of 3.5 meters in a given area and operating frequency of the phone is between 900-1870MHz. The system has no way of discriminating between two phones within the same frequency range and user cannot be traced. Therefore it is expected that future research will look into this area.

Appendix

Appendix 1: Data Sheets

Product Folder | Sample & Buy | Technical Documents | Tools & Software | Support & Community

TEXAS INSTRUMENTS

LM555

SNAS548D – FEBRUARY 2000 – REVISED JANUARY 2015

LM555 Timer

1 Features

- Direct Replacement for SE555/NE555
- Timing from Microseconds through Hours
- Operates in Both Astable and Monostable Modes
- Adjustable Duty Cycle
- Output Can Source or Sink 200 mA
- Output and Supply TTL Compatible
- Temperature Stability Better than 0.005% per °C
- Normally On and Normally Off Output
- Available in 8-pin VSSOP Package

2 Applications

- Precision Timing
- Pulse Generation
- Sequential Timing
- Time Delay Generation
- Pulse Width Modulation
- Pulse Position Modulation
- Linear Ramp Generator

3 Description

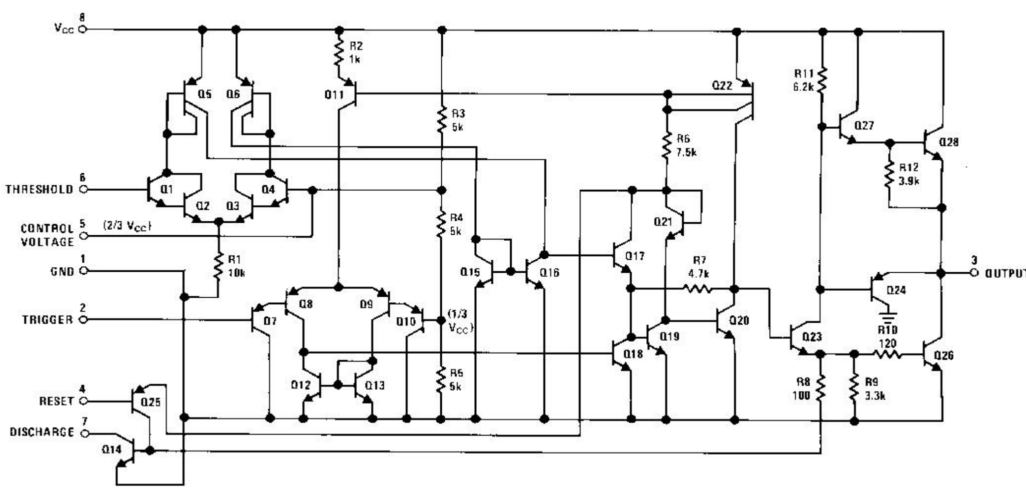
The LM555 is a highly stable device for generating accurate time delays or oscillation. Additional terminals are provided for triggering or resetting if desired. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and duty cycle are accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output circuit can source or sink up to 200 mA or drive TTL circuits.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM555	SOIC (8)	4.90 mm × 3.91 mm
	PDIP (8)	9.81 mm × 6.35 mm
	VSSOP (8)	3.00 mm × 3.00 mm

(1) For all available packages, see the orderable addendum at the end of the datasheet.

Schematic Diagram



6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)[1][2]

			MIN	MAX	UNIT
Power Dissipation[3]		LM555CM, LM555CN[4]		1180	mW
		LM555CMM		613	mW
Soldering Information	PDIP Package	Soldering (10 Seconds)		260	°C
	Small Outline Packages (SOIC and VSSOP)	Vapor Phase (60 Seconds)		215	°C
		Infrared (15 Seconds)		220	°C
Storage temperature, T_{stg}			–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications.
(3) For operating at elevated temperatures the device must be derated above 25°C based on a 150°C maximum junction temperature and a thermal resistance of 106°C/W (PDIP), 170°C/W (S0IC-8), and 204°C/W (VSSOP) junction to ambient.
(4) Refer to RETS555X drawing of military LM555H and LM555J versions for specifications.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±500[2]	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) The ESD information listed is for the SOIC package.

6.3 Recommended Operating Conditions

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

	MIN	MAX	UNIT
Supply Voltage		18	V
Temperature, T_A	0	70	°C
Operating junction temperature, T_J		70	°C

6.4 Thermal Information

THERMAL METRIC[1]		LM555 PDIP	LM555 SOIC	LM555 VSSOP	UNIT
		8 PINS			
$R_{\theta JA}$	Junction-to-ambient thermal resistance	106	170	204	°C/W

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.

6.5 Electrical Characteristics

(T_A = 25°C, V_{CC} = 5 V to 15 V, unless otherwise specified)(1) (2)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage		4.5		16	V
Supply Current	V_{CC} = 5 V, $R_L = \infty$		3	6	mA
	V_{CC} = 15 V, $R_L = \infty$ (Low State) (3)		10	15	
Timing Error, Monostable					
Initial Accuracy			1 %		
Drift with Temperature	R_A = 1 k to 100 kΩ,		50		ppm/°C
	C = 0.1 µF, (4)				
Accuracy over Temperature			1.5 %		
Drift with Supply			0.1 %		V
Timing Error, Astable					
Initial Accuracy			2.25		
Drift with Temperature	R_A, R_B =1 k to 100 kΩ,		150		ppm/°C
	C = 0.1 µF, (4)				
Accuracy over Temperature			3.0%		
Drift with Supply			0.30 %		/V
Threshold Voltage			0.667		x V_{CC}
Trigger Voltage	V_{CC} = 15 V		5		V
	V_{CC} = 5 V		1.67		V
Trigger Current			0.5	0.9	µA
Reset Voltage		0.4	0.5	1	V
Reset Current			0.1	0.4	mA
Threshold Current	(5)		0.1	0.25	µA
Control Voltage Level	V_{CC} = 15 V	9	10	11	V
	V_{CC} = 5 V	2.6	3.33	4	
Pin 7 Leakage Output High			1	100	nA
Pin 7 Sat (6)					
Output Low	V_{CC} = 15 V, I_7 = 15 mA		180		mV
Output Low	V_{CC} = 4.5 V, I_7 = 4.5 mA		80	200	mV
Output Voltage Drop (Low)	V_{CC} = 15 V				
	I_{SINK} = 10 mA		0.1	0.25	V
	I_{SINK} = 50 mA		0.4	0.75	V
	I_{SINK} = 100 mA		2	2.5	V
	I_{SINK} = 200 mA		2.5		V
	V_{CC} = 5 V				
	I_{SINK} = 8 mA				V
	I_{SINK} = 5 mA		0.25	0.35	V

(1) All voltages are measured with respect to the ground pin, unless otherwise specified.
(2) *Absolute Maximum Ratings* indicate limits beyond which damage to the device may occur. *Recommended Operating Conditions* indicate conditions for which the device is functional, but do not ensure specific performance limits. *Electrical Characteristics* state DC and AC electrical specifications under particular test conditions which ensures specific performance limits. This assumes that the device is within the *Recommended Operating Conditions*. Specifications are not ensured for parameters where no limit is given, however, the typical value is a good indication of device performance.
(3) Supply current when output high typically 1 mA less at V_{CC} = 5 V.
(4) Tested at V_{CC} = 5 V and V_{CC} = 15 V.
(5) This will determine the maximum value of $R_A + R_B$ for 15 V operation. The maximum total ($R_A + R_B$) is 20 MΩ.
(6) No protection against excessive pin 7 current is necessary providing the package dissipation rating will not be exceeded.

LMx58-N Low-Power, Dual-Operational Amplifiers

1 Features

- Available in 8-Bump DSBGA Chip-Sized Package, (See AN-1112, SNVA009)
- Internally Frequency Compensated for Unity Gain
- Large DC Voltage Gain: 100 dB
- Wide Bandwidth (Unity Gain): 1 MHz (Temperature Compensated)
- Wide Power Supply Range:
  - Single Supply: 3V to 32V
  - Or Dual Supplies: ±1.5V to ±16V
- Very Low Supply Current Drain (500 μA)—Essentially Independent of Supply Voltage
- Low Input Offset Voltage: 2 mV
- Input Common-Mode Voltage Range Includes Ground
- Differential Input Voltage Range Equal to the Power Supply Voltage
- Large Output Voltage Swing
- Unique Characteristics:
  - In the Linear Mode the Input Common-Mode Voltage Range Includes Ground and the Output Voltage Can Also Swing to Ground, even though Operated from Only a Single Power Supply Voltage.
  - The Unity Gain Cross Frequency is Temperature Compensated.
  - The Input Bias Current is also Temperature Compensated.
- Advantages:
  - Two Internally Compensated Op Amps
  - Eliminates Need for Dual Supplies
  - Allows Direct Sensing Near GND and V_{OUT} Also Goes to GND
  - Compatible with All Forms of Logic
  - Power Drain Suitable for Battery Operation

2 Applications

- Active Filters
- General Signal Conditioning and Amplification
- 4- to 20-mA Current Loop Transmitters

3 Description

The LM158 series consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, dc gain blocks and all the conventional op-amp circuits which now can be more easily implemented in single power supply systems. For example, the LM158 series can be directly operated off of the standard 3.3-V power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional ±15V power supplies.

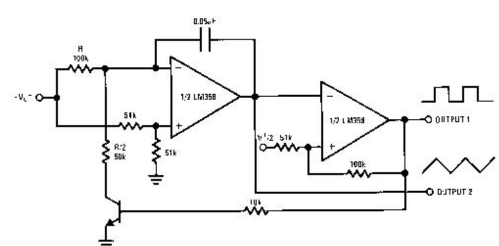
The LM358 and LM2904 are available in a chip sized package (8-Bump DSBGA) using TI's DSBGA package technology.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM158-N	TO-CAN (8)	9.08 mm x 9.09 mm
	CDIP (8)	10.16 mm x 6.502 mm
LM258-N	TO-CAN (8)	9.08 mm x 9.09 mm
LM2904-N	DSBGA (8)	1.31 mm x 1.31 mm
	SOIC (8)	4.90 mm x 3.91 mm
	PDIP (8)	9.81 mm x 6.35 mm
LM358-N	TO-CAN (8)	9.08 mm x 9.09 mm
	DSBGA (8)	1.31 mm x 1.31 mm
	SOIC (8)	4.90 mm x 3.91 mm
	PDIP (8)	9.81 mm x 6.35 mm

(1) For all available packages, see the orderable addendum at the end of the datasheet.

Voltage Controlled Oscillator (VCO)



6 Specifications

6.1 Absolute Maximum Ratings

See (1)(2)(3).

			LM158, LM258, LM358, LM158A, LM258A, LM358A		LM2904		UNIT
			MIN	MAX	MIN	MAX	
Supply Voltage, V^+				32		26	V
Differential Input Voltage				32		26	V
Input Voltage			−0.3	32	−0.3	26	V
Power Dissipation (4)	PDIP (P)			830		830	mW
	TO-99 (LMC)			550			mW
	SOIC (D)			530		530	mW
	DSBGA (YPB)			435			mW
Output Short-Circuit to GND (One Amplifier) (5)	$V^+ \le 15$ V and $T_A = 25°C$			Continuous		Continuous	
Input Current ($V_{IN} < -0.3V$) (6)				50		50	mA
Temperature			−55	125			°C
	PDIP Package (P): Soldering (10 seconds)			260		260	°C
	SOIC Package (D)	Vapor Phase (60 seconds)		215		215	°C
		Infrared (15 seconds)		220		220	°C
Lead Temperature	PDIP (P): (Soldering, 10 seconds)			260		260	°C
	TO-99 (LMC): (Soldering, 10 seconds)			300		300	°C
Storage temperature, T_{stg}			−65	150	−65	150	°C

(1) *Absolute Maximum Ratings* indicate limits beyond which damage to the device may occur. *Recommended Operating Conditions* indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.
(2) Refer to RETS158AX for LM158A military specifications and to RETS158X for LM158 military specifications.
(3) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications.
(4) For operating at high temperatures, the LM358/LM358A, LM2904 must be derated based on a 125°C maximum junction temperature and a thermal resistance of 120°C/W for PDIP, 182°C/W for TO-99, 189°C/W for SOIC package, and 230°C/W for DSBGA, which applies for the device soldered in a printed circuit board, operating in a still air ambient. The LM258/LM258A and LM158/LM158A can be derated based on a +150°C maximum junction temperature. The dissipation is the total of both amplifiers—use external resistors, where possible, to allow the amplifier to saturate or to reduce the power which is dissipated in the integrated circuit.
(5) Short circuits from the output to V^+ can cause excessive heating and eventual destruction. When considering short circuits to ground, the maximum output current is approximately 40 mA independent of the magnitude of V^+. At values of supply voltage in excess of +15 V, continuous short-circuits can exceed the power dissipation ratings and cause eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.
(6) This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the op amps to go to the V^+voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than −0.3 V (at 25°C).

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 (1)	±250	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

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

	MIN	MAX	UNIT
Supply Voltage (V+ - V-):LM158. LM258, LM358	3 (±1.5)	32 (±16)	V
Supply Voltage (V+ - V-):LM2904	3 (±1.5)	26 (±13)	V
Operating Temperature: LM158	-55	125	°C
Operating Temperature: LM258	-25	85	°C
Operating Temperature: LM358	0	70	°C
Operating Temperature: LM2904	-40	85	°C

6.4 Thermal Information

THERMAL METRIC(1)		LM158-N, LM258-N, LM358-N	LM158-N	LM2904-N, LM358-N			UNIT
		LMC	NAB	YPB	D	P	
		8 PINS					
$R_{\theta JA}$	Junction-to-ambient thermal resistance	155	132	230	189	120	°C/W

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.

6.5 Electrical Characteristics: LM158A, LM358A, LM158, LM258

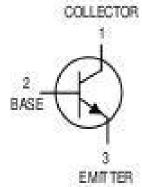
V^+ = +5.0 V, See(1), unless otherwise stated

PARAMETER	TEST CONDITIONS	LM158A			LM358A			LM158, LM258			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	See(2), T_A = 25°C		1	2		2	3		2	5	mV
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$, T_A = 25°C,		20	50		45	100		45	150	nA
	V_{CM} = 0 V, (3)										
Input Offset Current	$I_{IN(+)} - I_{IN(-)}$, V_{CM} = 0V, T_A = 25°C		2	10		5	30		3	30	nA
Input Common-Mode Voltage Range	V^+ = 30 V, (4) (LM2904, V^+ = 26V), T_A = 25°C	0		V^+−1.5	0		V^+−1.5	0		V^+−1.5	V
Supply Current	Over Full Temperature Range										
	R_L = ∞ on All Op Amps										
	V^+ = 30V (LM2904 V^+ = 26V)		1	2		1	2		1	2	mA
	V^+ = 5V		0.5	1.2		0.5	1.2		0.5	1.2	mA
Large Signal Voltage Gain	V^+ = 15 V, T_A = 25°C, R_L ≥ 2 kΩ, (For V_O = 1 V to 11 V)	50	100		25	100		50	100		V/mV
Common-Mode Rejection Ratio	T_A = 25°C, V_{CM} = 0 V to V^+−1.5 V	70	85		65	85		70	85		dB
Power Supply Rejection Ratio	V^+ = 5 V to 30 V (LM2904, V^+ = 5 V to 26 V), T_A = 25°C	65	100		65	100		65	100		dB

(1) These specifications are limited to –55°C ≤ T_A ≤ +125°C for the LM158/LM158A. With the LM258/LM258A, all temperature specifications are limited to −25°C ≤ T_A ≤ 85°C, the LM358/LM358A temperature specifications are limited to 0°C ≤ T_A ≤ 70°C, and the LM2904 specifications are limited to –40°C ≤ T_A ≤ 85°C.
(2) V_O ≅ 1.4 V, R_S = 0 Ω with V^+ from 5 V to 30 V; and over the full input common-mode range (0 V to V^+ −1.5 V) at 25°C. For LM2904, V^+ from 5 V to 26 V.
(3) The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
(4) The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3 V (at 25°C). The upper end of the common-mode voltage range is V^+ −1.5 V (at 25°C), but either or both inputs can go to 32 V without damage (26 V for LM2904), independent of the magnitude of V^+.

Amplifier Transistors
NPN Silicon

BC546, B
BC547, A, B, C
BC548, A, B, C



CASE 29–04, STYLE 17
TO–92 (TO–226AA)

MAXIMUM RATINGS

Rating	Symbol	BC 546	BC 547	BC 548	Unit
Collector–Emitter Voltage	V_{CEO}	65	45	30	Vdc
Collector–Base Voltage	V_{CBO}	80	50	30	Vdc
Emitter–Base Voltage	V_{EBO}		6.0		Vdc
Collector Current — Continuous	I_C		100		mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D		625 5.0		mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D		1.5 12		Watt mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}		–55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W

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

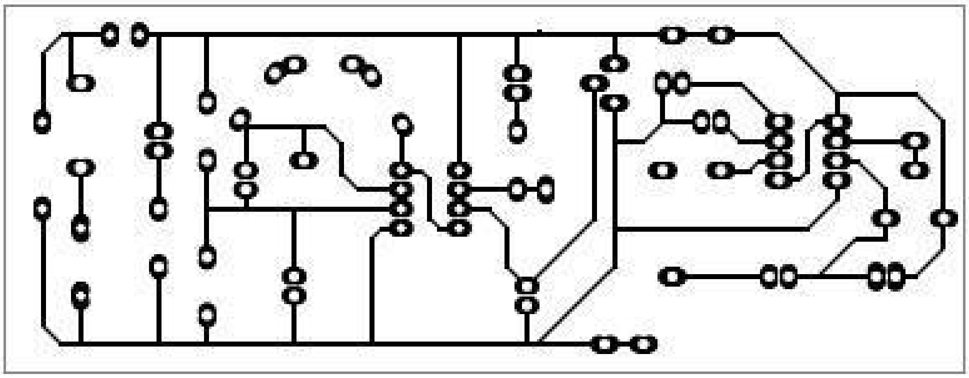
Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector–Emitter Breakdown Voltage (I_C = 1.0 mA, I_B = 0)	BC546 BC547 BC548	$V_{(BR)CEO}$	65 45 30	— — —	— — —	V
Collector–Base Breakdown Voltage (I_C = 100 μAdc)	BC546 BC547 BC548	$V_{(BR)CBO}$	80 50 30	— — —	— — —	V
Emitter–Base Breakdown Voltage (I_E = 10 μA, I_C = 0)	BC546 BC547 BC548	$V_{(BR)EBO}$	6.0 6.0 6.0	— — —	— — —	V
Collector Cutoff Current (V_{CE} = 70 V, V_{BE} = 0) (V_{CE} = 50 V, V_{BE} = 0) (V_{CE} = 35 V, V_{BE} = 0) (V_{CE} = 30 V, T_A = 125°C)	 BC546 BC547 BC548 BC546/547/548	I_{CES}	 — — — —	 0.2 0.2 0.2 —	 15 15 15 4.0	 nA μA

REV 1

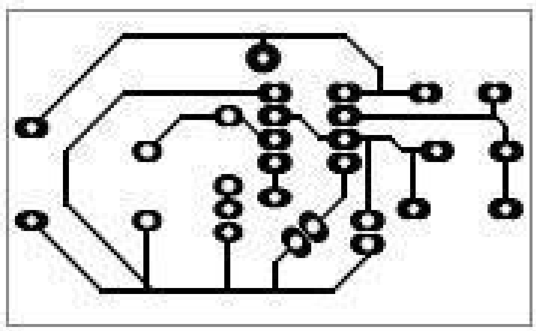
MOTOROLA

Appendix 2: PCB Layout

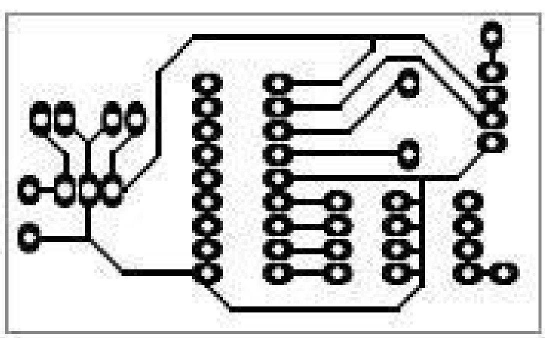
Detector Stage and Monostable Multivibrator



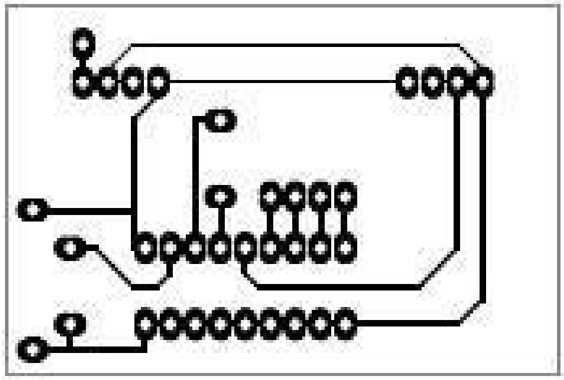
Astable Multivibrator



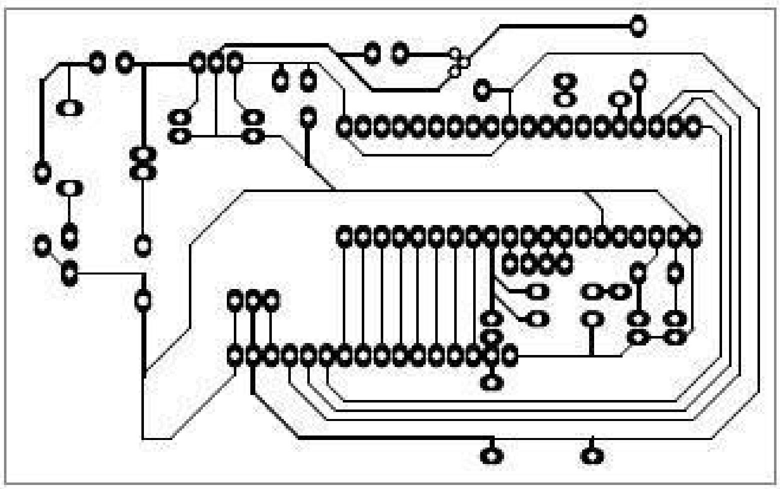
Encoder and Transmitter



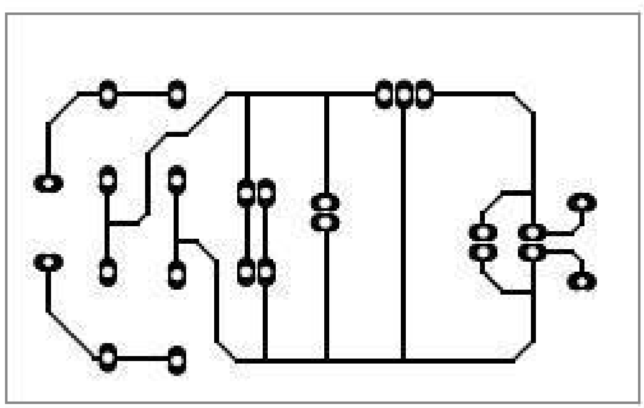
Receiver and Decoder



8051 and LCD



Power Supply



Appendix 3: References

1) https://www.seattleu.edu/scieng/ece/laboratory/cellphone/

2) http://cp.literature.agilent.com/litweb/pdf/ads2008/gsm/ads2008/GSM_Design_Examples.html

3) http://www.techmind.org/gsm/index.html