REMOTE RADIO MONITERING SYSTEM USING DTMF

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The Project report submitted in partial fulfillment of the requirements of MCS/NUST for the award of BE degree in telecommunication Engineering

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Project Statement

To design a Remote Radio Monitoring System using DTMF and interfacing it with computer using Visual BASIC.

Approved by:

Maj (Retd) Fazal Ahmed

Dedication

To our beloved Parents and dedicated and honorable teachers

Acknowledgments

We extend our sincere felicitation to all those who helped us complete the project successfully. We thank our internal supervisor ,Maj (retd) Fazal Ahmed whose experienced advice was of great help in understanding DTMF and antenna design .Our supervisor’s keen interest and support showed us right through every stage of the project.

Special thanks to Mr. of AWC whose continuous assistance and encouragement enabled us to complete the project.

Declaration

This project has been completed with entirely our own efforts and our supervisor’s guidance and has not been submitted to any other university or for any other academic award in National University of Sciences and Technology (NUST) or else where.

Abstract

The aim of this project is to develop a multi purpose Transmitter and Receiver to be used in Specialized applications such as infra red remote surveillance system, flood detection, sound detection or any other use depending upon ingenuity of the user .The final module made is ensured to be portable, small, flexible, inexpensive and power efficient. It has been made keeping in view certain military considerations like less on air time and immunity to the interference .For this purpose the FM is preferred over the AM technique FM is less susceptible to the interference and noise .Also the signal to noise ratio of FM is much greater than AM signal Further more to achieve greater flexibility ,we have used DTMF for identification of different transmitters. In this way we can use a number of transmitters with one receiver. Receiver has been interfaced with computer serial port. A small program in visual BASIC has been written in order to display the area of activity.

The activity in any of the sensors shall activate the FM transmitter circuit, which will send its identification code to the receiver using DTMF. The code will be interpreted by the PC and indicated on the screen.

CHAPTER 1

INTRODUCION AND MAJOR APPLICATION

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION AND MAJOR APPLICATIONS

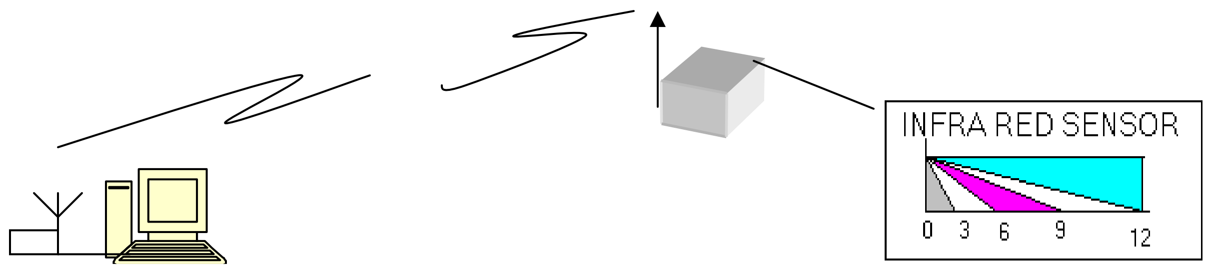
In the modern world the technological advancements have benefited mankind in many ways, but at the same time man is feeling more insecure and vulnerable. Countries spend large amount of budget foe national security against natural and human disasters .To counter any such threats many security systems have been developed. Security systems are any of various means or devices designed to guard persons and property against a broad range of hazards, including crime, fire, accidents, espionage, sabotage, subversion, and attack. Most security and protection systems emphasize certain hazards more than others .In retail store, for example, the principal security concerns are shop lifting and employee dishonesty (e.g. pilferage, embezzlement and fraud). A typical set of categories to be protected includes the personal safety of people in the organization, such as employees, customers, or residents, tangible property, such as the plant, equipment, finished products, cash and securities and intangible property, such as highly classified national-security information or “proprietary” information (e.g. trade secrets) of private organizations .

Security systems are found in a wide variety of organizations, ranging from government agencies and industrial plants to apartment buildings and schools and military setups .Sufficiently large organizations may have their own proprietary security systems or may purchase security services by contract from specialized security organizations.

But in reality no security system can be perfect and fool proof .The main purpose of the security system is to provide the early warning to decide any future course of action .In market special security systems are available which are very expensive .After 56 years of independence Pakistan has struggled with its economy .The aim of our project was to make such a general purpose security system which is cheap , flexible and easily adaptable .The slight modification in the design can adjust system for any users demands.

1.1.1 <u>General description and block diagram</u>

Before, we start detailed discussion on the project. First of all let us briefly about the basic components of the project. These are shown in figures (1-2,1-3).On the remote station (Fig1-2),if something passes in front of the infrared sensor ,it will activate the electromagnetic relay switch .The activation of the relay switch shall provide the power



DTMF decoder and computer interface

IR sensor DTMF encoder and FM transmission

FIGURE 1.1 PROJECT BLOCK DIAGRAM

supply to DTMF generator and FM transmitter .The DTMF transmitter shall send the pre selected DTMF signal to the FM transmitter .The DTMF signal is the unique identity of the remote terminal .The FM transmitter shall process the signal through its different stages .After final amplification the signal is transmitted into air ,through antenna .

The transmitted signal is received in the control station (Fig 1-3) through antenna .The FM receiver shall receive the signal through synchronous detection .The DTMF receiver will identify the tone of the remote transmitter .This 4 bit data is fed into PC through parallel port .Software in Visual BASIC is written .It shall detect the in put and display the warning on the map .Further more the auto mode warning system has been incorporated in software .When on auto mode the computer shall automatically dial the predefined number .Incase the system is used in the field environments ,where no PC is present .The warning can be detected through LEDs and 7 segments display .We can use total 16 remote station modules with one receiver .Each module can have an type of sensor (i.e. smoke ,temperature radiation ,flood etc .) as per user demand .However ,in the extended mode we can have 256 remote stations ,which can even be further increased but it will not be feasible .This product can have numerous applications depending upon the ingenuity of the user mind .We shall be discussing few of the major applications .

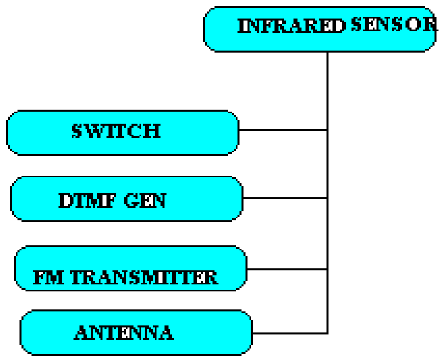


FIGURE 1.2 THE COMPONENTS ON REMOTE STATION

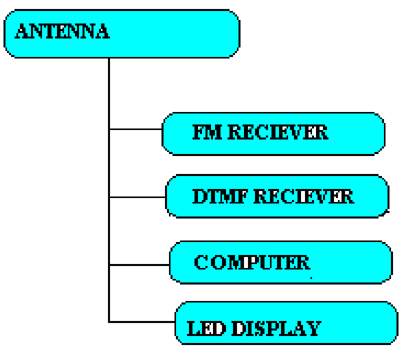


FIGURE 1.3 THE COMPONENTS ON CONTROL STATION

1.2 Major Features of the product

Feature name	Description
Freq range	88- 108 Mhz.
Modulation type	Frequency modulation

Coding	Dual tone multiple frequency
Power requirements	2 x 12 VDC Tx 8 – 12 VDC Rx.
Range of operation	350- 500 sq. meters
Power output	0.7W
Monitoring Operating system	Normal/Automatic

TABLE 1.1 Major Features

1.3 Military Specific Applications

This project has special implications for military. Some of these are as under.

- Reduction of Manpower on guard duties
- Monitoring of endangered places where life risk involved
- Very small on airtime so nearly non detectable.
- Easily deployed and activated.
- Quick deployment possible due to highly mobile and miniature size of remote stations
- User-friendly software.
- Can be used in number of applications

With ingenuity the uses of this product are unlimited .For military, few are discussed.

1.3.1 Infra Red Sensing Remote Monitoring

For our project we shall be primarily discussing this application in detail .This can be extremely useful to check movements in the defiles and roads .We have already discussed about it in section 1.1 of chapter 1. Rest of the details shall be covered in the subsequent chapters.

1.3.2 Radiation Remote Sensing

The process by which energy is emitted from a source and propagated through the surrounding medium is called radiation. Familiar examples of radiant energy include light (a form of electromagnetic radiation) and sound (a form of acoustic radiation) .The biomedical effects of ionizing radiation have been investigated more thoroughly than those of any other environment agent .Evidence that harmful effects may result from small amounts of such radiation has prompted growing concern about the hazards that may be associated with low-level irradiation from the fallout of nuclear weapons ,medical radiography ,nuclear power plants ,and other sources .

Radiation monitoring is one of the most important application of the project .In today's nuclear environments there is always a chance of radiation leakage from the reactor .Power production from nuclear material is becoming common day by day .The population around the nuclear plants is always endanger of radiation exposure .Although ,there are precautionary measure taken at the plants .But these are only available in some proximity of the plant .Further more troops in the battlefield can also become victim of tactical nuclear warheads without any knowledge of it .There is no such system available in Pakistan to detect radiation hazard .A sophisticated security system is required to be developed basing on the idea given in our project .The major features for remote radiation sensing in our project are :-

- Centralized Control for close Monitoring
- Fully Automatic System
- Easily Deployable and flexibility of Use
- Predicting of Damage on the data available
- User friendly software

The Radiation sensors are deployed (Figure 1-4) in the area susceptible for radiation leakage .Whenever there is some leakage ,the sensor in the area shall be activated and the information shall be sent to control station .As the radiation spreads it will activate the second sensor at some distance and this information shall also be sent to control station .Similarly as the radiation spreads further more sensors shall be activated and the information shall be sent to the control station .

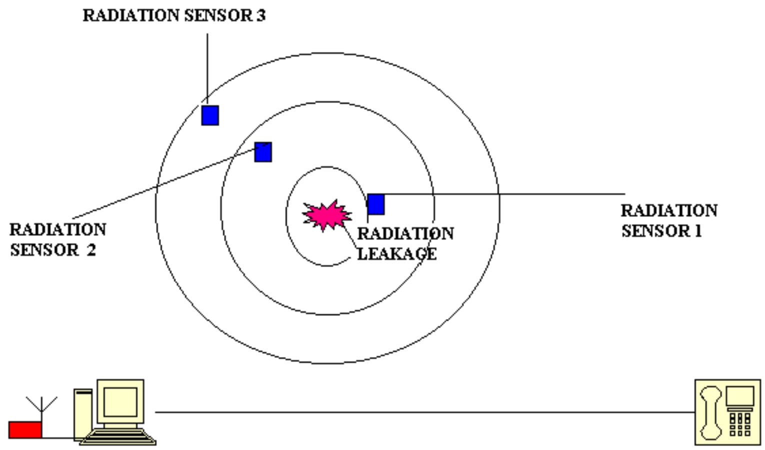


FIGURE 1.4 DEPLOYMENT IN RADIATION HAZARD ZONE

1.3.3 Flood Remote Monitoring

High- water stage in which water overflows its natural or artificial banks onto normally dry land ,such as a river inundating its floodplain is called flood .The effects of flood on human well –being range from unqualified blessings to catastrophes . Floods can be measured for height, peak discharge, area inundated, and volume of flow .These factors are important to judicious land use ,construction of bridges and dams ,and prediction and control of floods .Common measures of flood control include the improvement of channels ,the construction of protective levees and storage reservoirs .

Floods have always been a cause of great destruction and damage to precious lives and the property .If no advance reporting systems are available ,timings of the floods can always surprise the occupants of the area .If early warning is provided to the people well in time ,the effect of floods can be minimized .

Our security system can be deployed on the bridges ,barrages and shallow areas .When the water level rises it shall send the warning signal to the control station ,where 24 hour automatic monitoring is possible .In the following figure 1-5 ,we shall discuss one such deployment of the product for flood protection .The flood sensors along with FM transmitters are deployed at the obvious sites .Whenever the water level rises the information shall be sent to the control station .

1.3.4 <u>Temperature Remote Monitoring</u>

Measure of hotness or coldness expressed in terms of any of several arbitrary scales is called temperature .In many plants, installations and factories it is desirable to keep temperature under certain limits .If the temperature exceeds those limits it may cause fire and damage to the equipment or personnel. Therefore is required to have security system to immediately report any undesirable variation in temperature .Our project can help us doing so with the help of thermostat.

Thermostat is a device to detect temperature changes for the purpose of maintaining the temperature of an enclosed area essentially constant .In a system including relays, valves, switches, etc., the thermostat generates signals, usually electrical, when the temperature exceeds or falls below the desired value .It usually is used to control the flow of fuel to a burner, of electric current to a heating or cooling unit, or of a heated or cooled gas or liquid into the area it serves .The thermostat is also an element in some types of fire –detection warning systems .Alarms are set to go off whenever the thermostat shows a rapid temperature rise .The thermostat is usually placed at or near the ceiling ,where it will be most immediately affected by increase in temperature .We shall use FM transmitter with a number of thermostat .As the temperature variation is detected in a particular area that transmitter shall be activated and the information shall be sent to the control station .

1.4 <u>General Applications</u>

This product can be used as security systems for shops, banks, libraries, and offices etc. Different sensors can be used for doors, windows and gates. Further more it can be used for following applications

1.4.1 Motorway speed checking system

It has always been difficult to implement the traffic laws .In Pakistan first time ever motorway has been constructed, so people like to test their driving skills, which results into accidents. With this system the motorway police can check speed of vehicles.

We can deploy two remote stations at a particular distance from each other figure (1.6). These stations can be well concealed. When the vehicle passes in front of one remote station it is activated and the information sent to control station. Similarly when the vehicle passes in front of the second remote station it is also activated and information sent to the control station .As the distance is already known, the control station computes the time between activation of two remote stations and thus gives the speed of the vehicle .If the speed is above certain limit alarm messages can be displayed.

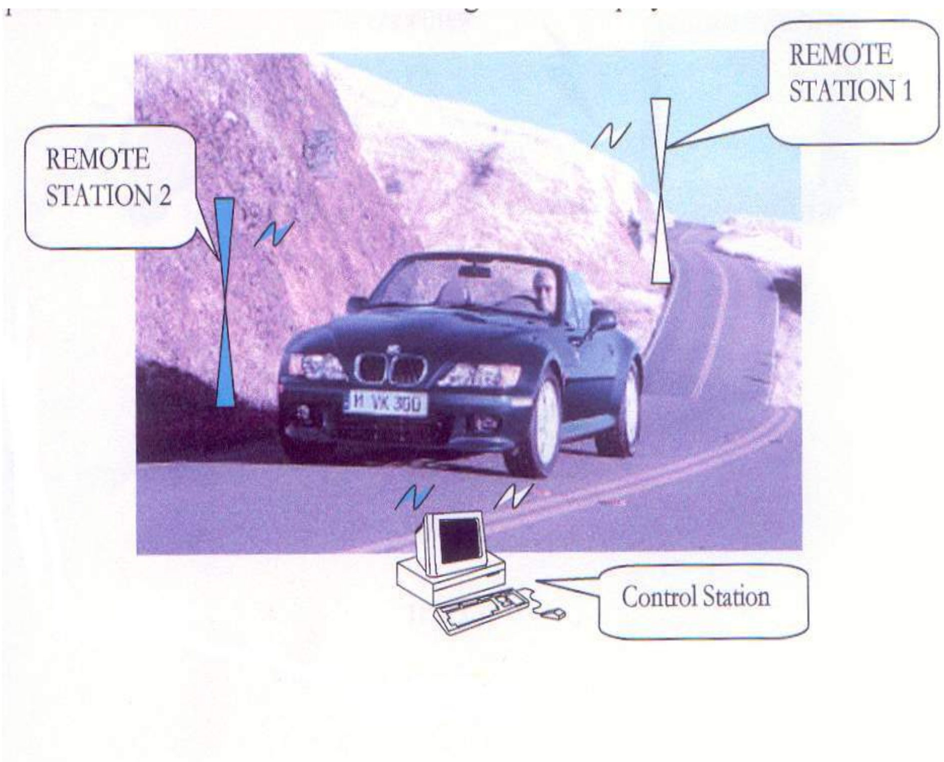


FIGURE 1.5 MOTORWAY SPEED CHECKING SYSTEM

1.4.2 Remote activation of devices

With the slight modification in our project we can use it to remotely operate certain devices from computer figure (1-7) or manual remote control .The modification would be in a way that the transmitter can be interfaced with the computer or manual remote control. And number of receiver stations can be connected to the devices to be operated. Every receiver will have unique code to activate its device .We can have sixteen remotely operated devices. When the remote control or computer sends a certain code it will be identified by the particular receiver, which shall activate the device.

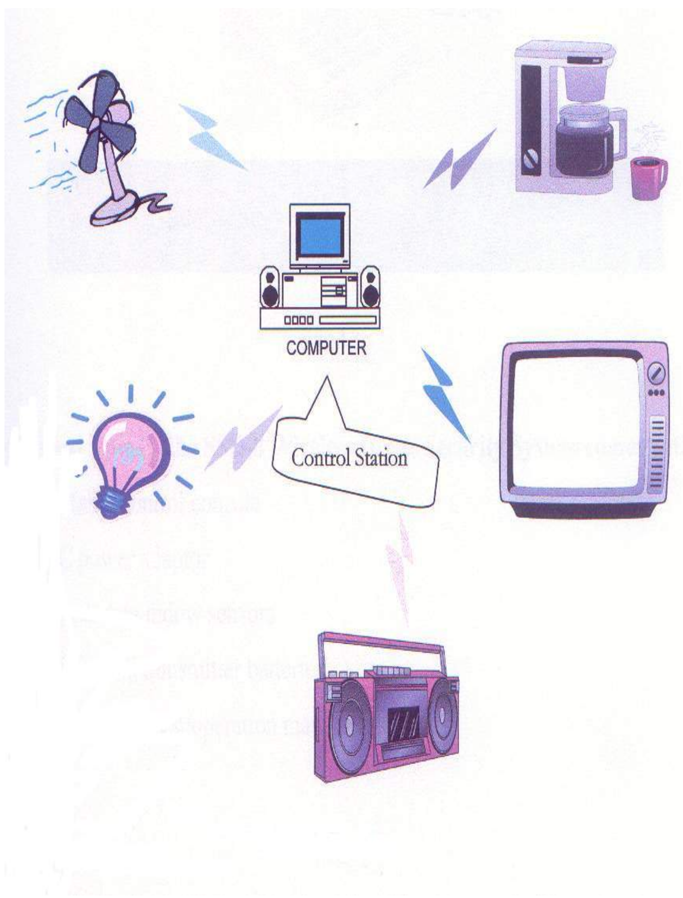


FIGURE 1.6 REMOTE ACTIVATION OF DEVICES

1.5 Comparison with Available Systems in Market

After completing our project we just searched the local market and Internet for any such product like ours .It was interesting to find out that in local market shopkeepers didn’t even understand what we were asking for.

And on Internet we found one product. SSD-8 SECURITY SYSTEM, which is used in USA .It, would be interesting to compare it with our product.

The SSD-8 Wireless Home Security System comes with:

- Portable control console
- AC power adaptor
- Two door/window batteries
- Plus installation/operational manual

FEATURE	***SSD 8 SYSTEM***	***OUR PROJECT***
Frequency	315 Mhz	**88- 108 Mhz adjustable**
Range	275 feet, typical	**350 – 500 sq meters**
Current consumption	50 ma max, 300 ma max with siren on	**150 mA**
Modes	Off, chime , home and away	**Normal automatic**
Transmitter zone displays	8 (red led)	**PC monitor and o7 segment display**
Audio/siren	Internal speaker provided	**Buzzer**
Transmitter capability	Door window sensor	**Many different sensors can be used**
Arm /disarm	Single 1 to 5 digit code	**None**

Table 1.2 Comparison of features

By comparing the products we can easily find out that both have nearly the same features; rather ours have some additional features. While looking at SSD-8, we might be impressed by watching its attractive plastic case, brochure, a price in dollars and a foreign label. But its far more expensive tans our research price and also lacks in many features .The audience may draw its own conclusion about the comparison. But we shall only begin our technical part by saying that “let us have faith in our capabilities and lets build this country together“.

CHAPTER 2

ELECTRONIC COMPONENTS AND THEIR PROPERTIES

2.1 Resistor

Electrical component that opposes the flow of either direct or alternating current, employed to protect, operate, or control the circuit.

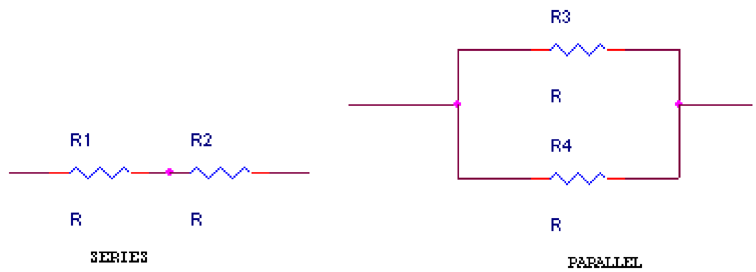


FIGURE 2.1 RESISTORS IN SERIES AND PARALLEL

Voltages can be divided with the use of resistors, and in combination with other components resistors can be used to make electrical waves into shapes most suited for the electrical designer's requirements. For a resistor the voltage dropped across it is proportional to the amount of current flowing on tile resistor, V=IR. Resistors can have a fixed value of resistance or they can be made variable or adjustable with in a certain range, in which case they may be called rheostats or potentiometers.

2.1.1 Rheostat

Adjustable resistor used in applications that require the adjustment of current or the varying of resistance in an electric circuit. The rheostat can adjust generator characteristics, dim lights, and start or control the speed of motors.

2.1.2 Potentiometer

A special type of rheostat is the potentiometer, an instrument that measures an unknown voltage or potential difference by balancing it, wholly or in part, by a known potential difference. A more common potentiometer is simply a resistor with two fixed terminals and a third terminal connected to a variable contact arm; it is used for such purposes as a volume control in audio equipment.

2.2 Inductor

In an electric circuit, one or more turns, usually roughly circular or cylindrical, of current carrying wire designed to produce a magnetic field or to provide electrical resistance or inductance is called inductor. The voltage across an inductor leads the current through it by 90 degrees; it is due to the fact that the voltage across an inductor depends on the rate of change of current entering the inductor.

2.2.1 Self made Inductor

Inductors can be easily wound around air cored formers; self made inductors are very useful when a particular inductance is required.

$$L = N^2\{ d^2/(18d+40b)$$

Where L = inductance in MH, d = diameter in inches,

b = coil length in inches, N = Number of turns.

2.3 Capacitor

Property of an electric conductor or set of conductors that is measured by the amount of separated electric charge that can be stored on it per unit change in electrical potential is called capacitance. Such a device is known as capacitor.

Capacitance also implies an associated storage of electrical energy. If electric charge is transferred between two initially uncharged conductors, both become equally charged, one positively, the other negatively, and a potential difference is established between them. The capacitance C is the ratio of the amount of charge q on either conductor to the potential difference V between the conductors, or simply $C = q/V$.

In both the practical and the meter-kilogram-second scientific systems, the unit of electric charge is the coulomb and the unit of potential difference is the volt, so that the unit of capacitance--named the farad (symbolized F)--is one coulomb per volt. One farad is an extremely large capacitance. Convenient subdivisions in common uses are one-millionth of a farad, called a microfarad *(F),* and one-millionth of a microfarad, called a Pico farad (pF; older term, micro microfarad, F). In the electrostatic system of units, capacitance has dimensions of distance.

Capacitance in electric circuits is deliberately introduced by a device called a capacitor, A capacitor also called a condenser, is thus essentially a sandwich of two plates of conducting material separated by an insulating material, or dielectric. Its primary function is to store electrical energy. Capacitors differ in the size and geometrical arrangement of the plates and in the kind of dielectric material used. Hence, they have such names as mica, paper, ceramic, air and electrolytic capacitors. Their capacitance may be fixed or adjustable over a range of values for use in tuning circuits. The energy stored by a capacitor corresponds to the work performed (by a battery, for example) in creating opposite charges on the two plates at the applied voltage. The amount of charge that can be stored depends on the area of the plates, the spacing between them, the dielectric material in the space, and the applied voltage, A capacitor incorporated in an alternating-current (AC) circuit is alternately charged and discharged each half cycle. The time available for charging or discharging thus depends on the frequency of the current, and if the time required is greater than the lengtl1 of the half cycle, the polarization is not complete, Under such conditions, the dielectric constant appears to be less than that observed in a direct-current circuit and to vary with frequency, becoming lower at higher frequencies.

During the alternation of polarity of the plates, the charges must be displaced through the dielectric first in one direction and then in the other, and overcoming the opposition that they encounter leads to a production of heat known as dielectric loss, a characteristic that must be considered when applying capacitors to electrical circuits, such as those in radio and television receivers. Dielectric losses depend on frequency and the dielectric material. Except for the leakage (usually small) through the dielectric, no current flows through a capacitor when it is subject to a constant voltage. Alternating current will pass readily, however, and is called a displacement current.

2.4 High Frequency Response of Components

Since we are working at very high frequency range; so the basic components have different properties than they would have under normal conditions.

2.4.1 Wire

$$R = Þ\ L/A$$

The resistance of a piece of wire decreases as the diameter of the wire increases, where **p** is the resistivity, **L** is the length of the wire and A is its cross sectional area. But beyond a particular frequency the resistance of the wire increases strong magnetic fields build up at the center of the wire. So now there is less available cross sectional area, because due to high frequency this force pushes the majority of the charge carriers away from the center and towards the outside the wire. So the resistance increases at high frequencies. This phenomenon is known as the "skin effect".

2.4.2 Inductor

Since wire is the main ingredient of the inductors and since the resistance of wire increases with increasing frequency, therefore the losses of the inductor will increase with increasing frequency therefore the losses of the inductor will increase with increasing frequency.

Dissipation = Q^{-1}= R(series)/2fL

Therefore, since R series increases with frequency, therefore Q factor will decrease with increasing frequency.

2.4.3 Capacitor

At very high frequency Xc approaches zero. A capacitor is equivalent to an open circuit at very low frequencies and it is equivalent to a short circuit at very high frequencies.

The dissipation factor of the capacitor is also the inversely associated with the Q factor. The efficiency in capacitors at high frequencies are generally better than the inductor as regards the Q factor.

2.5 Resonant Circuits

The components discussed above are basic building blocks used in any radio frequency section of any What makes them important is there response at certain frequencies. Any electrically conducting pathway contains both inductive and capacitive elements. At low frequency the impedance of an inductor is small and the impedance of a capacitor is quite high. At high frequency the inductor's impedance becomes quite high and the capacitors impedance drops. The resistor maintains its impedance. At a certain frequency the impedance of inductor will be equal to that of capacitor; this is called the **resonant frequency**.

2.5.1 Series Resonant Circuit

If the basic elements are connected in series, the circuit presents low impedance to alternating current of the resonant frequency, which is determined by the values of the inductance and capacitance, and high impedance to current of other frequencies.

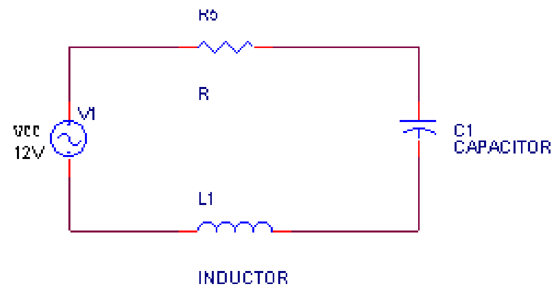


FIGURE 2. 2 SERIES RESONANT CIRCUIT

2.5.2 Parallel Resonant Circuit

In a parallel-connected tuned circuit, the impedance is high at the resonant frequency, low at others.

2.6 Frequency

The number of waves that pass a fixed point in unit time; also the number of cycles or vibrations undergone during one unit of time by a body in periodic motion. A body in periodic motion is said to have undergone one cycle or one vibration after passing through a series of events or positions and returning to its original state. If the period, or time interval, required to

complete one cycle or vibration is 1/2 second, the frequency is 2 per second; if the period is 1/100 of an hour, the frequency is 100 per hour. In general, the frequency is the reciprocal of the period, or time interval--i.e**, frequency = l/period** = l/(time interval). The frequency with which the Moon revolves about the Earth is slightly more than 12 cycles per year. Usually frequency is expressed in the **hertz** unit, named in honor of the 19th-century German physicist Heinrich Rudolf Hel1z, one hertz being equal to one cycle per second, abbreviated **Hz**; one **kilohertz (kHz)** is 1,000 Hz, and one **megahertz (MHz)** is 1,000,000 Hz.

2.7 Alternating electric currents

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Many applications of electricity and magnetism involve voltages that vary in time. Electric power transmitted over large distances from generating plants to users involves voltages that vary sinusoidally in time, at a frequency of 60 hertz (Hz) in the United States and Canada and 50 hertz in Europe. (One hertz equals one cycle/per second). This means that in the United States, for *example,* the current alternates its direction in the electric conducting *wires* so that each second it flows 60 times in one direction and 60 times in the opposite direction.

2.7.1 Alternating currents (AC) used in AM radio

Alternating currents (AC) are also used in radio and television transmissions. In an (amplitude-modulation) radio broadcast, electromagnetic waves with a frequency of around one million hertz are generated by currents of the same frequency flowing back and forin the antenna of the station. The information transported by these waves is encoded in the rapid variation of the wave amplitude. When voices and music are broadcast, these variations correspond to the mechanical sound and have frequencies from 50 to 5,000 hertz.

2.7.2 Alternating currents (AC) used in FM radio

In an FM (frequency-modulation) system, which is used by both television and FM radio stations, audio information is contained in the rapid fluctuation of the frequency in a narrow range around the frequency of the carrier wave. Circuits that can generate such oscillating currents are called ***oscillators;*** they include, in addition to transistors and vacuum tubes, such basic electrical components as resistors, capacitors, and inductors. As was mentioned above, resistors dissipate heat while carrying a current. Capacitors store energy in the form of an electric field in the volume between oppositely charged electrodes. Inductors are essentially coils of conducting wire; they store magnetic energy in the form of a magnetic field generated by the current in the coil. All three components provide some impedance to the flow of alternating currents. In the case of capacitors and inductors, the impedance depends on the frequency of the current. With resistors, impedance is independent of frequency and is simply the resistance. This is easily seen from **Ohm's law**, when it is written as **i = V/R**. For a given voltage difference V between the ends of a resistor, the current varies inversely with the value of R. The greater the value R, the greater is the impedance to the flow of electric current.

2.8 Integrated Circuits

(IC), also called ***microcircuit***, an assembly of electronic components, fabricated as a single unit, in which active devices (transistors and diodes) and passive devices (capacitors and resistors) and their interconnections are built up on a chip of material called a substrate (most commonly made of silicon). The circuit thus consists of a unitary structure with no connecting wires. The individual circuit elements are microscopic in size.

The range of electronic functions that can be performed by integrated circuits is vast and includes digital circuits, such as tile logic circuits used in computers, and analog circuits, such as those used in amplifiers. In many as of application, the performance of integrated circuitry is far superior to that of conventional circuits. Because of their

- Small size
- Low power requirements and heat generation
- Modest cost
- Reliability
- speed of operation

They make possible electronic systems that would otherwise be impractical. Most important, computer technology would be severely restricted without the capabilities of integrated circuits. Integrated circuitry continues to grow in sophistication and complexity even as it shrinks in size. Cost effectiveness and mass production have made the technology available to all levels of the electronics industry: The revolution in consumer electronics, manifested in the enormous popularity of such devices as self-focusing cameras, programmable microwave ovens, and personal computers, would have been unthinkable without integrated circuitry.

CHAPTER 3

ACTIVE INFRARED SENSOR

3.1 Background

Close to 0.01 percent of the mass/energy of the entire universe occurs n the form of electromagnetic radiation. All human life is immersed in it and modern communications technology and medical services are particularly dependent on one or another of its forms. In fact, all living things on Earth depend on the electromagnetic radiation received from the Sun and on its transformation of solar energy by photosynthesis into plant life. The eyes of many animals, including those of humans, are adapted to be sensitive to and hence to see the most abundant part of the Sun's electromagnetic radiation-- namely, light, which comprises the visible portion of its wide range of frequencies. Green plants also have high sensitivity to the maximum intensity of solar electromagnetic radiation, which is absorbed by a substance called chlorophyll that is essential for plant growth via photosynthesis. Practically all the fuels that modern society uses--gas, oil, and coal--are stored forms of energy received from the Sun as electromagnetic radiation millions of years ago. Only the energy from nuclear reactors does not originate from the Sun. Everyday life is pervaded by man-made electromagnetic radiation: food is heated in microwave ovens, airplanes are guided by radar waves, television sets receive electromagnetic waves transmitted by broadcasting stations, and infrared waves from heaters provide warmth. Infrared waves also are given off and received by automatic self-focusing cameras that electronically measure and set the correct distance to the object to be photographed. As soon as the sun sets, incandescent or fluorescent lights are turned on to provide artificial illumination, and cities glow brightly with the colorful fluorescent and neon lamps of advertisement signs. Familiar too is ultraviolet radiation, which the eyes cannot see but whose effect is felt as pain from sunburn.

Ultraviolet light represents a kind of electromagnetic radiation that can be harmful to life. Such is also true of X rays, which are important in medicine as they allow physicians to observe the inner parts of the body but exposure to which should be kept to a minimum. Less familiar are gamma rays, which come from nuclear reactions and radioactive decay and are part of the harmful high-energy radiation of radioactive materials and nuclear weapons.

3.2 Basic properties and behavior of electromagnetic radiation

3.2.1 Classical Theory

In terms of classical theory, the flow of energy at the universal speed of light through free space or through a material medium in tile form of the electric and magnetic fields that make up electromagnetic waves such as radio waves, visible light and gamma rays. In such a wave, time-varying electric and magnetic fields are mutually linked with each other at right angles and perpendicular to the direction of motion. An electromagnetic wave is characterized by its intensity and the frequency of the time variation of the electric and magnetic fields.

3.2.2 Quantum Theory

In terms of the modem quantum theory, electromagnetic radiation is the " flow of photons (also called light4quanta) through space. Photons are packets of energy h that always move with the universal speed of light. The symbol h is Planck's constant, while the value of is the same as that of the frequency of the electromagnetic wave of classical theory. Photons having the same energy h are all alike, and their number density corresponds to the intensity of the radiation. Electromagnetic radiation exhibits a multitude of phenomena as it interacts with charged particles in atoms, molecules, and larger objects of matter. These phenomenon as well as the ways in which electromagnetic radiation is created and observed, the manner in which such radiation occurs in nature, and its technological uses depend on its frequency.

3.3 The Frequency Spectrum

The spectrum of frequencies of electromagnetic radiation extends from very low values over the range of radio waves, television waves, and: microwaves to visible light and beyond to the substantially higher values of ultraviolet light, X rays, and gamma rays.

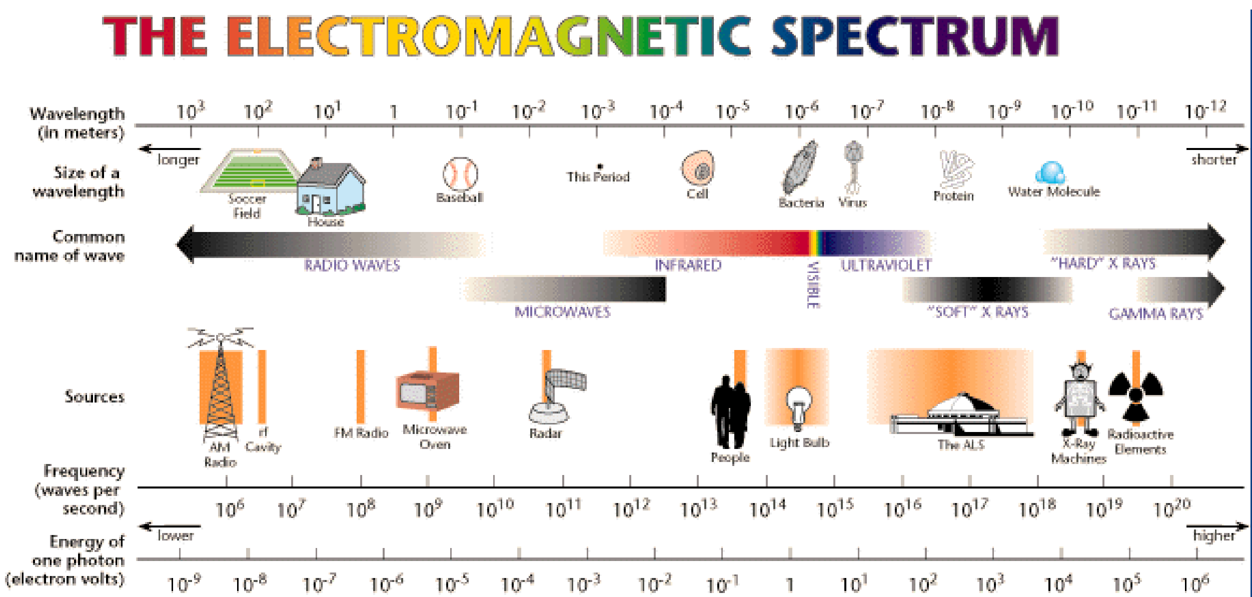


FIGURE 3.1 ELECTROMAGNETIC SPECTRUM

3.4 Infra red Radiation

The term "infrared" refers to a broad range of frequencies, beginning at the top end of those frequencies used for communication and extending up the the low frequency (red) end of the visible spectrum. The wavelength range is from about 1 millimeter down to 750 nm. The range adjacent to the visible spectrum is called the "near infrared" and the longer wavelength part is called "far infrared". n astronomy, any of various celestial objects that radiate measurable quantities of energy in the infrared region of the electromagnetic spectrum. Such objects include the Sun and the planets, certain stars, nebulae, and galaxies.

Frequencies: .003 - 4 x 10^14 Hz
Wavelengths: 1 mm - 750 nm
Quantum energies: 0.0012 - 1.65 eV

That portion of the electromagnetic spectrum that extends from the long wavelength, or red, end of the visible-light range to the microwave range. . Invisible to the eye, it can be detected as a sensation of warmth on the skin. The infrared range is usually divided into three regions: **near infrared** (nearest the visible spectrum), with wavelengths 0.78 to about 2.5 micrometers (a micro meter, or micron, is 10e-6 meter); **middle infrared**, with wavelengths 2.5 to about 50 micrometers; and **far infrared,** with wavelengths 50 to 1,000 micrometers. Most of the radiation emitted by a moderately heated surface is infrared; it forms a continuous spectrum. Molecular excitation also produces copious infrared radiation but in a discrete spectrum of lines or bands.

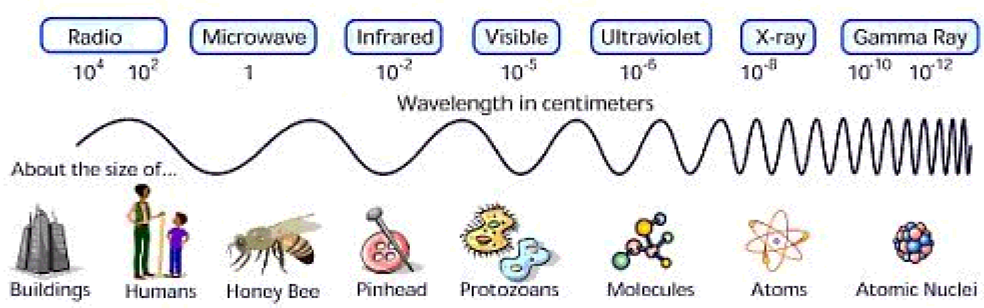


FIGURE 3.2 INFRA RED SPECTRUM

Today, infrared technology has many exciting and useful applications. In the field of infrared astronomy, new and fascinating discoveries are being made about the Universe. Medical infrared imaging is a very useful diagnostic tool. Infrared cameras are used for police and security work as well as in fire fighting and in the military. Infrared imaging is used to detect heat loss in buildings and in testing electronic systems. Infrared satellites have been used to monitor the Earth's weather, to study vegetation patterns, and to study geology and ocean temperatures.

3.5 External Active Infra Red Intruder Detector / Sensor

The external active infra-red detector is designed using a 555 IC timer. It is a pulse modulated infrared beam barrier, which is activated when the invisible beam is interrupted. The system is suitable for use over any distance up to 15m externally, which may be increased to 20m when the unit is used indoors. These ranges are minimum ranges attainable and may be extended under favorable operating conditions.

3.6 Active infra Red sensor

3.6.1 Infra red transmitter

LM 555 IC timer is used to generate pulses of variable frequency depending upon value of resister and capacitor. 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, one external resistor and capacitor precisely control the time. For astable 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 200mA or drive TTL circuits.

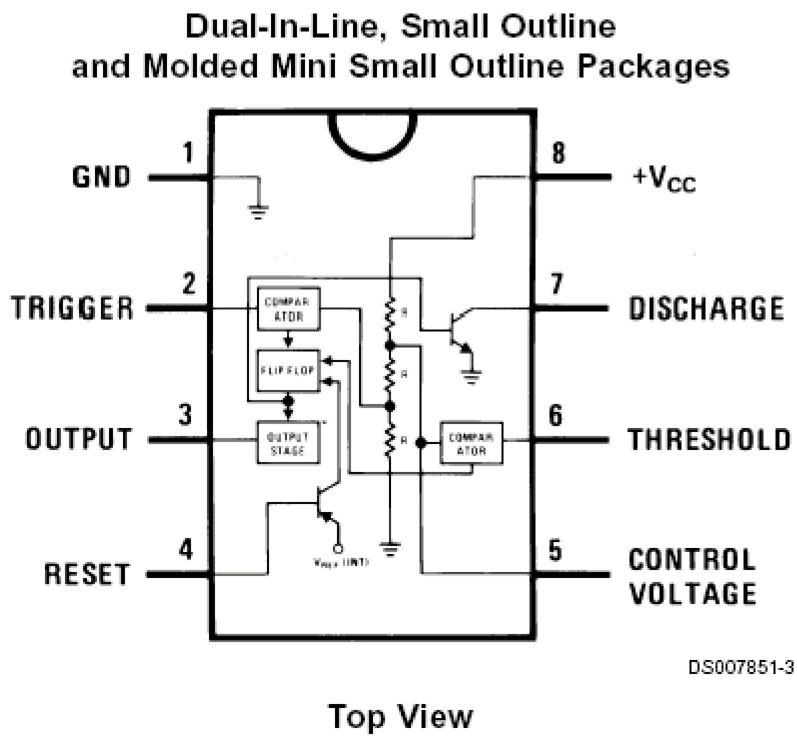


FIGURE 3.3 LM 555 IC TIMER

3.6.1.1 Features of LM 555

- 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 MSOP package.

3.6.2 ASTABLE OPERATION

We are using 555 IC timer in astable mode If the circuit is connected as shown in Figure 4(pins 2 and 6connected) it will trigger itself and free run as a multivibrator. The external capacitor charges through RA + RB and discharges through RB. Thus the duty cycle may be precisely set by the ratio of these two resistors. In this mode of operation, the capacitor charges and discharges between 1/3 V_{cc} and 2/3 V_{cc}. The charge and discharge times, and therefore the frequency are independent of the supply voltage.

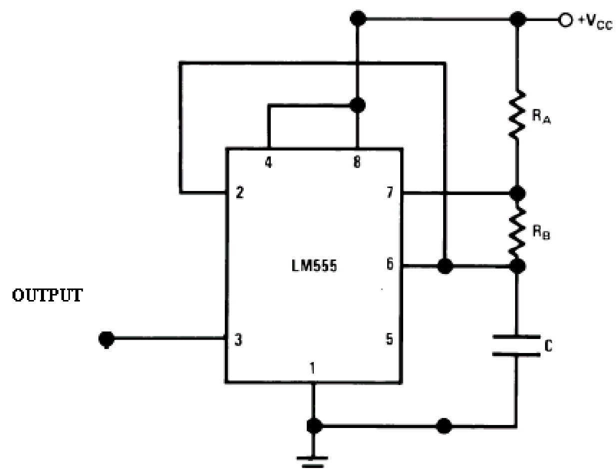


FIGURE 3.4. ASTABLE

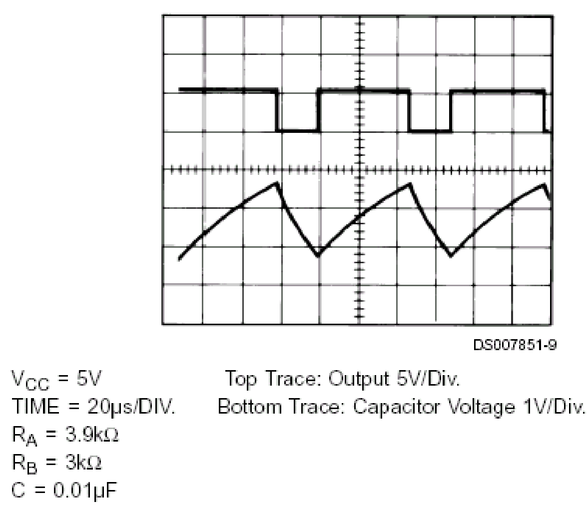


FIGURE 3.5 ASTABLE WAVEFORMS

Cct used in our project was

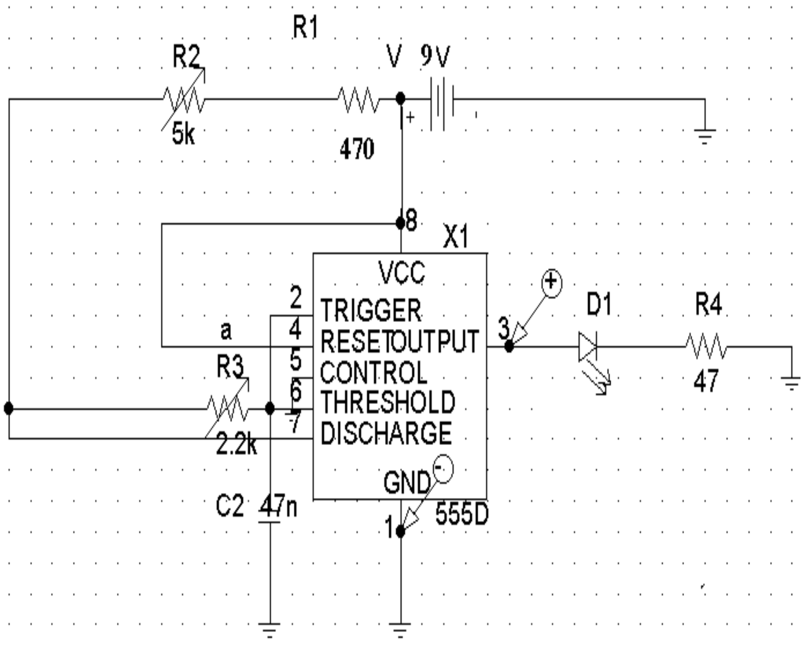


FIGURE 3.6 CCT USED IN PROJECT

The charge time (output high) is given by:

$$t_1 = 0.693\ (R_A + R_B)\ C$$

And the discharge time (output low) by:

$$t_2 = 0.693\ (R_B)\ C$$

Thus the total period is:

$$T = t_1 + t_2 = 0.693\ (R_A + 2R_B)\ C$$

The frequency of oscillation is:

$$F = 1/T = 1.44/\ (R_A + 2R_B)\ C$$

The duty cycle is:

$$D = RA\ /(RA + 2RB)$$

C = 47 nf

Rb =2.2k

$t_1 = 0.693\ (R_A + R_B)\ C$

t_1 =

t_2 = 0.693 (R_B) C

t_2 =

T = t_1 + t_2 = 0.693 (R_A +2R_B) C

T =

F = 1/T = 1.44/ (R_A +2R_B) C

F =

Figure 6 may be used for quick determination of these RC

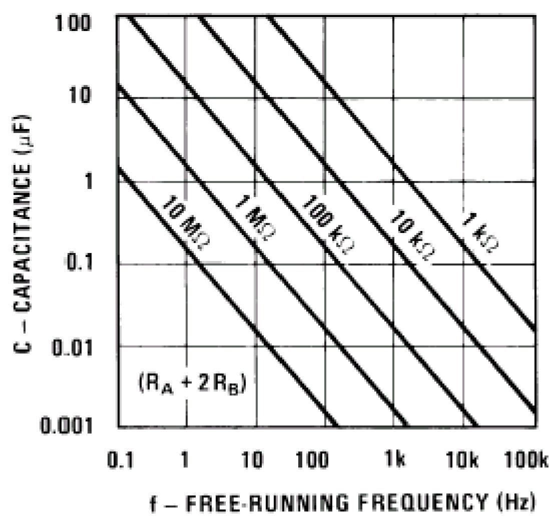


FIGURE 3.7 FREE RUNNING FREQUENCY

Output o 555 is taken at pin 3 it is a sequence of waves with period T.IR LED attached to output generates an IR beam with same frequency as that of the beam.47 ohm series resister is connected for over current protection.

3.6.3 IR reception

IR receiver LED receives the IR beam. The resistance of this LED .The resistance of this LED varies with IR light .As long of it receives the beam it has high resistance. It is to connected to pin 3 (non inverting input) of LM 741 through a coupling or DC blocking capacitance of 0.01uf.IR reception is connected to Vdd through 47k of resistance . As long as IR is received LED has high resistance IR is received, and thus high voltage drop. As beam is interrupted by a intruder it is blocked, resistance of IR LED drops and its voltage drops. Op amp is used because firstly the received signal is too week to be entirely used as it is, and secondly because we want to make control cct. for controlling of TP 5089(DTMF generator IC).

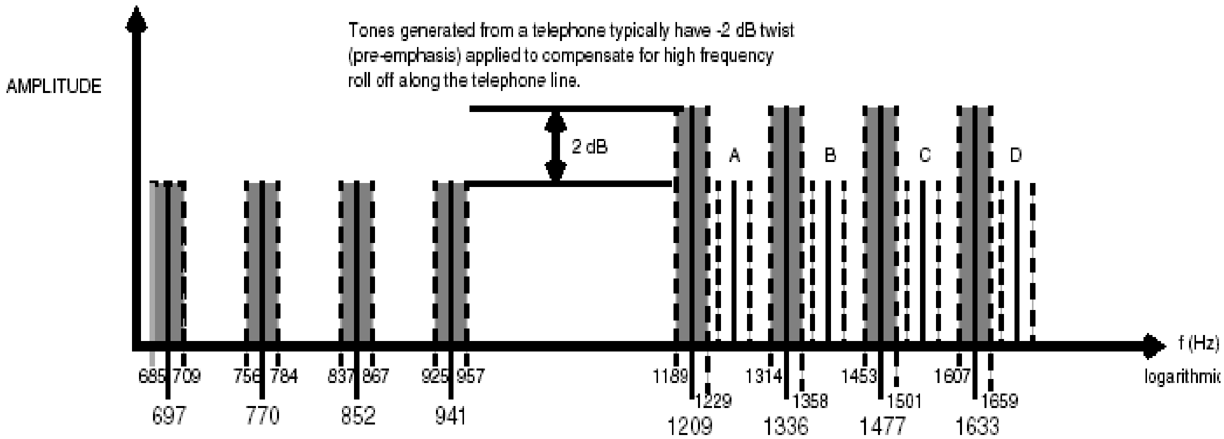
CHAPTER 4

DTMF (Dual tone multiple frequency)

4.1 DTMF Background

In the 1950 ,after conducting extensive studies, AT&T concluded that push button dialing was twice as efficient as rotary dialing. Trails had already been conducted of special telephone instruments that incorporated mechanically vibrating reeds, but in 1963 an electronic push button system, known as Touch-Tone dialing, was offered to AT&T costumers. Touch-tone soon became standard U.S dialing system, and eventually it became the standard worldwide.

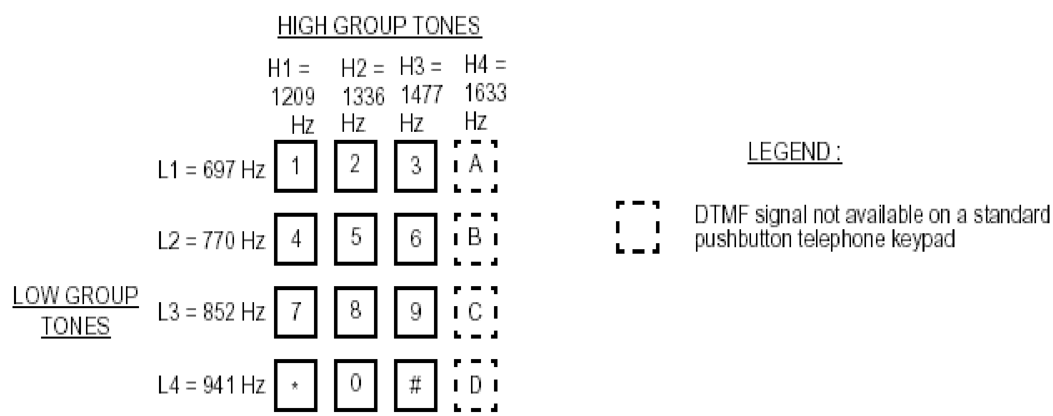
The Touch-Tone system is based on a concept known as dual-tone multiple frequency (DTMF). The 10 dialing digits (0 through 9) are to specific push buttons, and the buttons are arranged in a grid with four rows and three columns (figure 4.2).(The pad also has two more buttons bearing the star[*] and a pound [#] also known as Hash symbols, to accommodate various data services and customer-controlled calling feature.)Each of the rows and columns is assigned a tone of a specific frequency, the columns having higher-frequency tones and the rows having tones of lower frequency. When a button is pushed, a dual-tone signal is generated that corresponds to the frequencies assigned to the column and row that intersect at that point. This signal is translated in to a digit at the local office. A valid DTMF signal is the sum of two tones, one from a low group (697-941hz) and one from a high group (1209-1633 hz) with each group containing four individual tones. The tone frequencies were carefully chosen such that they are not harmonically related and that their intermodulation products result in minimal signaling impairments (figure 4.1). This scheme allows for 16 unique combinations.



Standard DTMF frequency spectrum ± (1.5% + 2 Hz). Second harmonics of the low group (possibly created due to a non-linear channel) fall within the passband of the high group (Indicated by A,B,C,D). This is a potential source of interference.

FIGURE 4.1: STANDARD DTMF FREQUENCY SPECTRUM

Ten of these codes represent the numerals zero through nine, the remaining six (*,#,A,B,C,D) being reserved for special signaling . Most telephone keypads contain ten numeric push buttons plus the asterisk (*) and octothorp (#). The buttons are arranged in a matrix , each selecting its low group tone from its respective row and its high group tone from its respective column (figure 4.2) .



Telephone DTMF keypad matrix. Column H_4 is normally not available on a telephone keypad and is reserved for special signalling.

FIGURE 4.2 DTMF KEY PAD MATRIX

4.2 DTMF Basics

DTMF (Dual-tone Multi Frequency) is a tone composed of two sine waves of given frequencies. Individual frequencies are chosen so that it is quite easy to design frequency filters, and so that they can easily pass through telephone lines (where the maximum guaranteed bandwith extends from about 300 Hz to 3.5 kHz). DTMF was not intended for data transfer; it is designed for control signals only. With standard decoders, it is possible to signal at a rate of about 10 "beeps" (=5 bytes) per second. DTMF standards specify 50ms tone and 50ms space duration. For shorter lengths, synchronization and timing becomes very tricky.

4.3 DTMF Description

4.3.1 Composition of DTMF signals

DTMF stands for *Dual-Tone Multi-Frequency*. That is, a DTMF signal is one that consists of only the sum of two pure sinusoids at valid frequencies.

The table shows how to compose any DTMF code. Each code, or "beep", consists of two simultaneous frequencies mixed together (added amplitudes). Standards specify 0.7% typical and 1.5% maximum tolerance. The higher of the two frequencies may have higher amplitude (be "louder") of 4 dB max. This shift is called a "twist". If the twist is equal to 3 dB, the higher frequency is 3 dB louder. If the lower frequency is louder, the twist is negative. **Frequency table :**

	1209 Hz	1336 Hz	1477 Hz	1633 Hz
697 Hz	**1**	**2**	**3**	**A**
770 Hz	**4**	**5**	**6**	**B**
852 Hz	**7**	**8**	**9**	**C**
941 Hz	*****	**0**	**#**	**D**

Table 4.1 : Frequency table

This table resembles a matrix keyboard. The X and Y coordinates of each code give the two frequencies that the code is composed of. Notice that there are 16 codes; however, common DTMF dialers use only 12 of them. The "A" through "D" are "system" codes. Most end users won't need any of those; they are used to configure phone exchanges or to perform other special functions.

In DTMF, the tone '8' is represented with the sum of 852 Hz and 1477 Hz sinusoids. We understand that the energy of the sinusoids present in the generated tone should exceed the energy present at any other frequencies by 30dB. Also, notice that the DTMF frequencies are effectively divided into two subsets. One contains the lower four frequencies, and the other contains the upper four. Each DTMF tone is defined by the presence of exactly one of the frequencies from each of those subsets.

4.3.2 <u>CCITT DTMF Recommendations</u>

Frequency Tolerance: Operation: <= 1.5%

Non-Operation: >= 3.5%

Signal Duration: Operation : 40ms max

Non-Operation : 23ms min

Signal Interruption : 10ms max

Twist: Normal : 8db max

Reverse: 4db max

Any frequency within 1.5% of the DTMF frequency should be detected. Frequencies with 3.5% error should never be detected. Inside the 1.5% - 3.5% range is a don't care. DTMF signals lasting 40ms should always be detected. Signals less than 23ms should never be detected. Inside the 23ms-40ms range is a don't care. DTMF signals that are interrupted for 10ms or less should not detect two separate signals. Twist is caused by a non-uniform power loss across the frequency spectrum. Normal twist is when low frequency power is greater than high frequency. Reverse twist is obviously the reverse condition. The detector must be reject 8db and 4db for normal and reverse twist respectively.

We have not found any DSP DTMF implementations that are able to meet these specifications. Some algorithms come much closer than others, but none meet the specifications completely. We are attempting to improve upon the current DTMF implementations and hopefully meet most (if not all) of the CCITT recommendations.

4.4 DTMF usage

DTMF is the basis for voice communications control. Modern telephony uses DTMF to dial numbers, configure telephone exchanges (switchboards), and so on. Occasionally, simple floating codes are transmitted using DTMF - usually via a CB transceiver (27 MHz). It is used to transfer information between radio transceivers, in voice mail applications, etc.

Almost any mobile (cellular) phone is able to generate DTMF after establishing connection. If your phone can't generate DTMF, you can use a stand-alone "dialer". DTMF was designed so that it is possible to use acoustic transfer, and receive the codes using standard microphone.

4.4.1 How to transmit DTMF

Most often, dedicated telephony circuits are used to generate DTMF (for example, MT8880). On the other hand, a microprocessor can do it, too. Just connect a RC filter to two output pins, and generate correct tones via software. However, getting the correct frequencies often requires usage of a suitable Xtal for the processor itself -

at the cost of non-standard cycle length, etc. So, this method is used in simple applications only.

4.4.2 How to decode DTMF

It is not easy to detect and recognize DTMF with satisfactory precision. Often, dedicated integrated circuits are used, although a functional solution for DTMF transmission and receiving by a microprocessor (a PIC in most cases) exists. It is rather complicated, so it is used only marginally. Most often, a MT 8870 or compatible circuit would be used.

Most decoders detect only the rising edges of the sine waves. So, DTMF generated by rectangular pulses and RC filters works reliably. The mentioned MT 8870 uses two 6th order bandpass filters with switched capacitors. These produce nice clean sine waves even from distorted inputs, with any harmonics suppressed.

4.5 DTMF GENERATOR

Designing a DTMF generator using a conventional circuit elements is a big deal .DTMF generator integrated circuits are available which are commonly used in dial pad module of house hold telephone sets .the most popular one is TP 5089 IS which is a complete DTMF generator . the external elements are of course required to use the IC for generation DTMF.

The TP 5089 is a 16 pins, low threshold voltage, field implanted, metal gate CMOS integrated circuit designed by national semiconductors USA .it interfaces directly to a standard telephone keypad and generates all dual tone multi frequency pairs required in tone dialing systems . the tone synthesizers are locked to an on-chip reference oscillator using an in expensive 3.579545 MHz crystal for high tone accuracy . the crystal and a an output load resistor are the only external components required for tone generation .

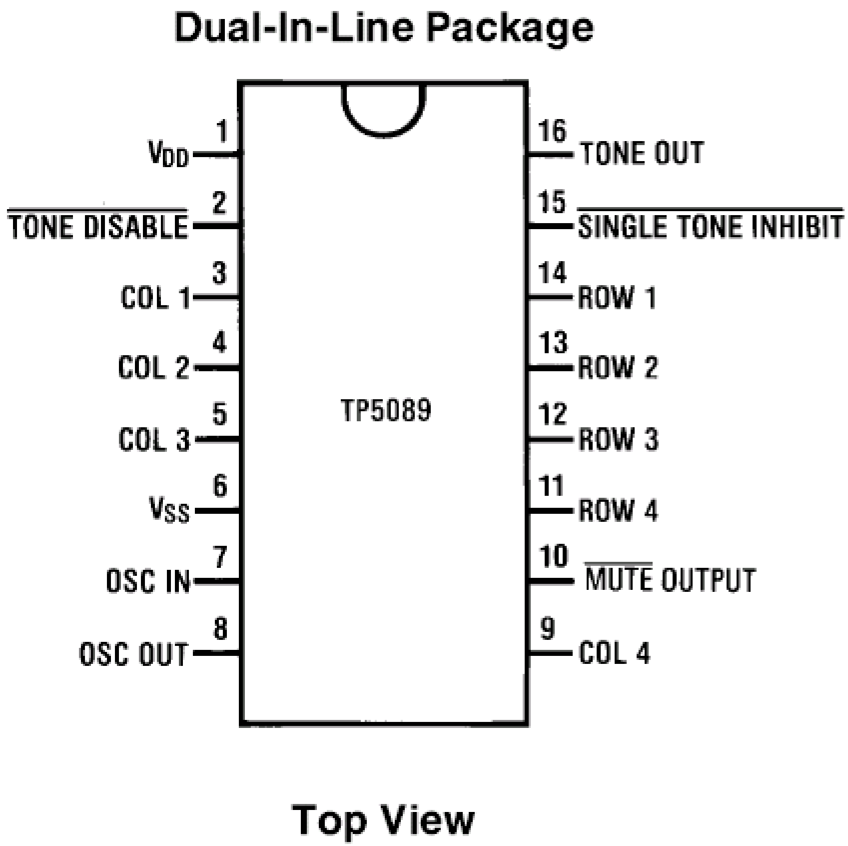


FIGURE 4.3 TP 5089 IC

4.5.1 General Description

The TP5089 is a low threshold voltage, field-implanted, metal gate CMOS integrated circuit. It interfaces directly to a standard telephone keypad and generates all dual tone multi-Frequency pairs required in tone-dialing systems. The tone Synthesizers are locked to an on-chip reference oscillator using an inexpensive 3.579545 MHz crystal for high tone accuracy. The crystal and an output load resistor are the only external components required for tone generation. A MUTE OUT logic signal, which changes state when any key is depressed, is also provided.

4.5.2 General features of TP 5089 DTMF Generator IC

- 3.5V±10V operation when generating tones
- 2V operation of key scan and MUTE logic
- Static sensing of key closures or logic inputs
- On-chip 3.579545 MHz crystal-controlled oscillator
- Output amplitudes proportional to supply voltage
- High group pre-emphasis
- Low harmonic distortion
- Open emitter-follower low-impedance output

4.5.3 Internal Block diagram

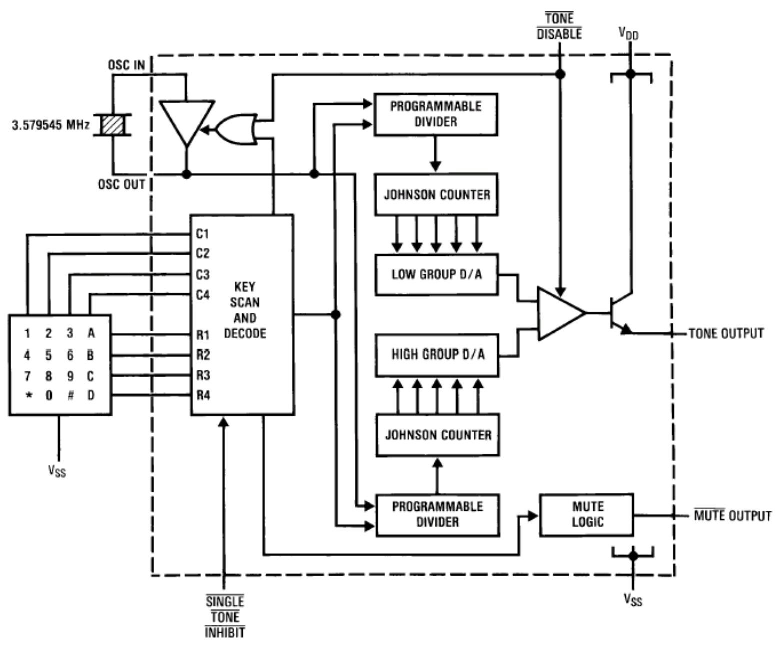


FIGURE 4.4 INTERNAL BLOCK DIAGRAM

4.5.5 Pin Descriptions

VDD This is the positive voltage supply to the device, referenced
to VSS. The collector of the TONE OUT transistor is connected to this pin.

VSS This is the negative voltage supply. All voltages are referenced to this pin.

OSC IN, OSC OUT All tone generation timing is derived from the on-chip oscillator circuit. A low cost 3.579545 MHz A-cut crystal (NTSC TV color-burst) is needed between pins 7 and 8. Load capacitors and a feedback resistor are included on-chip for good start-up and stability. The oscillator stops when column inputs are sensed with no valid input having been detected. The oscillator is also stopped when the TONE DISABLE input is pulled to logic low.

Row and Column inputs When no key is pushed, pull-up resistors are active on row and column inputs. A key closure is recognized when a single row and a single column are connected to VSS, which starts the oscillator and initiates tone generation. Negative-true logic signals simulating key closures can also be used.

TONE DISABLE The TONE DISABLE input has Input an internal pull-up resistor. When this input is open or at logic high, the normal tone output mode will occur. When TONE DISABLE input is at logic low, the device will be in the inactive mode, TONE OUT will be at an open circuit state.

MUTE Output The MUTE output is an open-drain N-channel device that sinks current to VSS with any key input and is open when no key input is sensed. The MUTE output will switch regardless of the state of the SINGLE TONE INHIBIT input.

SINGLE TONE INHIBIT The SINGLE TONE INHIBIT Input is used to inhibit the generation of other than valid tone pairs due to multiple row-column closures. It has a pull-down resistor to VSS, and when left open or tied to VSS any input condition that would normally result in a single tone will now result in no tone, with all other functions operating normally. When tied to VDD, single or dual tones may be generated.

TONE OUT This output is the open emitter of an NPN transistor, the collector of which is connected to VDD. When an external load resistor is connected from TONE OUT to VSS, the output voltage on this pin is the sum of the high and low group sine waves superimposed on a DC offset. When not generating tones, this output transistor is turned OFF to minimize the device idle current. Adjustment of the emitter load resistor results in variation of the mean DC current during tone generation, the sine-wave Signal current through the output transistor, and the output distortion. Increasing values of load resistance decrease both the signal current and distortion.

4.5.6 Functional Description

With no key inputs to the device the oscillator is inhibited, the output transistor is pulled OFF and device current consumption is reduced to a minimum. Key closures are sensed statically. Any key closure activates the MUTE output, starts the oscillator and sets the high group and low group programmable counters to the appropriate divide ratio. These counters sequence two radioed-capacitor D/A converters through a series of 28 equal duration steps per sine-wave cycle. A mixer amplifier sums the two tones, with pre-emphasis applied to the high group tone. The output is an NPN emitter-follower requiring the addition of an external load resistor to VSS. This resistor facilitates adjustment of the signal current flowing from VDD through the output transistor. The amplitude of the output tones is directly proportional to the device supply voltage.

4.6 Schematic for the Project

Following diagram shows the standard connections used to put TP 5089in operation condition. Pins 1 and 15 are connected with 5 volt DC source.

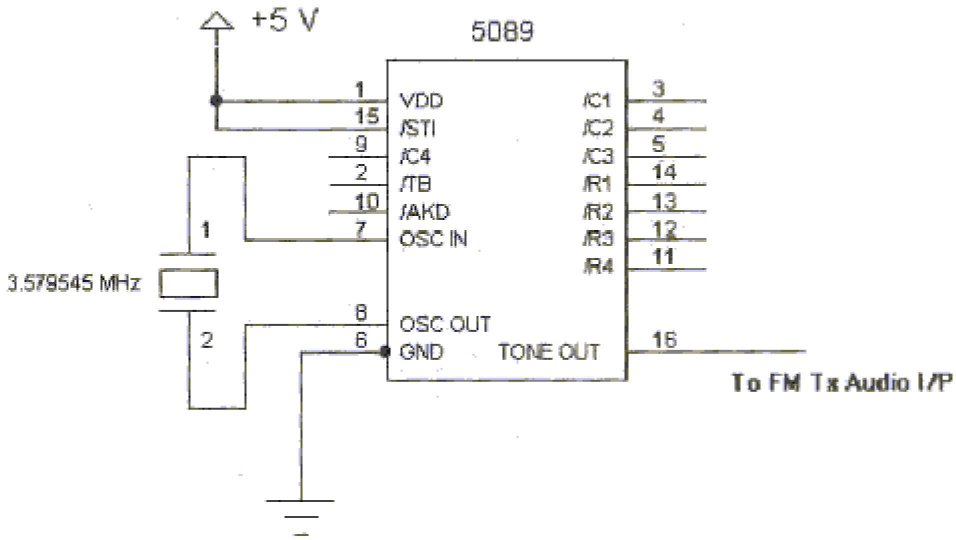


FIGURE 4.5 TP 5089 IC

Pin 6 is ground . 3.579545 MHz crystal is connected with pin 7 and 8 of TP 5089 IC .The figure 4.6 is showing which pair of pins once grounded together will let the IC to generate which DTMF tone . e.g. if pins 12 (R3) and (C1) are grounded. The DTMF frequencies generated will be 852 Hz and 1209Hz thus producing the tone used for digit 7 in DTMF dialing . This output is taken from pin 16 of the TP-5089 IC and is given to the audio pre amplifiers input of the FM transmitter . The output for this DTMF tone in time and frequency domain is shown in the following diagram

LOW-FREQUENCIES	
ROW #	FREQUENCY (HZ)
R1: ROW 0	697
R2: ROW 1	770
R3: ROW 2	852
R4: ROW 3	941
HIGH-FREQUENCIES	
COL #	FREQUENCY (HZ)
C1: COL 0	1209
C2: COL 1	1336
C3: COL 2	1477
C4: COL 3	1633
C4 not used in phones	

Table 4.2: DTMF Low and High Freq.

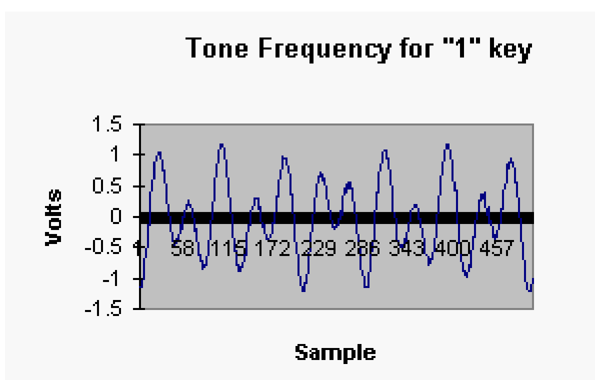


FIGURE 4.6 PLOT OF THE TONE FREQUENCY FOR THE "1" KEY

4.8 Development of DTMF Receivers

The DTMF coding scheme ensures that each signal contains one and only one component from each of the high and low groups. This significantly simplifies decoding because the composite DTMF signal may be separated with band pass filters , into its two single frequency components each of which may be handled individually. As a result DTMF coding has proven to provide a flexible signaling scheme of excellent reliability , hence motivating innovative and competitive decoder design.

Early DTMF decoders (receivers) utilized banks of band pass filters. Making them somewhat cumbersome and expensive to implement. This generally restricted their application to central offices (telephone exchanges) . The first generation receiver typically used LC filters, active filter and /or phase locked loop techniques to receive and decode DTMF tones .Initially single chip band pass filters were combined with currently available decoders enabling a two chip receiver design . A further advance in integration has merged both functions onto a single chip allowing DTMF receivers to be realized in minimal space at a low cost .

4.9 Integrated Circuit MT8870(DTMF Receiver)

The MT 8870 is a state of the art single chip DTMF receiver incorporating switched capacitor filter technology and an advanced digital counting / averaging algorithm for period measurement. The block diagram (Figure 4.9) illustrates the internal workings of this device . To aid design flexibility , the DTMF input signal is first buffered by an input op-amp which allows adjustment of gain and choice of input configuration . The input stage is followed by a low pass continuous RC active filter which performs an anti aliasing function . Dial tone at 350 and 440 Hz is then rejected by a third order switched capacitor notch filter. The signal , still in its composite form , is then split into its individual high and low frequency components by two sixth order switched capacitors and pass filters . Each component tone is then smoothed by an output filter and squared up by a hard limiting comparator . The two resulting rectangular waves are applied to digital circuitry where a counting algorithm measures and averages their periods. An accurate reference clock is derived from an inexpensive external 3.58MHz burst crystal.

f_{LOW}	f_{HIGH}	KEY	TOE	Q_4	Q_3	Q_2	Q_1
697	1209	1	1	0	0	0	1
697	1336	2	1	0	0	1	0
697	1477	3	1	0	0	1	1
770	1209	4	1	0	1	0	0
770	1336	5	1	0	1	0	1
770	1477	6	1	0	1	1	0
852	1209	7	1	0	1	1	1
852	1336	8	1	1	0	0	0
852	1477	9	1	1	0	0	1
941	1209	0	1	1	0	1	0
941	1336	*	1	1	0	1	1
941	1477	#	1	1	1	0	0
697	1633	A	1	1	1	0	1
770	1633	B	1	1	1	1	0
852	1633	C	1	1	1	1	1
941	1633	D	1	0	0	0	0
-	-	ANY	0	Z	Z	Z	Z

Table 4.2 :MT8870 Output Truth table

If both tones are present for the minimum guard time , t GTP , which is determined by the external RC network , the DTMF signal is decoded and the resulting data (Figure 4-8) is latched in the out put register . The Delayed Steering (StD)output is raised and indicates that new data is available . The time required to receive a valid DTMF signal , t REC , is equal to the sum of t DP and t GTP.

4.9.1 <u>Functional Description</u>

The CAMD MT8870 DTMF Integrated Receiver provides the design engineer with not only low power consumption, but high performance in a small 18-pin DIP, SOIC, or 20-pin PLCC, TSSOP, or QSOP package configuration. The MT8870's internal architecture consists of a bandsplit filter section which separates the high and low tones of the received pair, followed by a digital decode (counting) section which verifies both the frequency and duration of the received tones before passing the resultant 4-bit code to the output bus.

4.9.1.1 Filter Section

Separation of the low-group and high-group tones is achieved by applying the dual-tone signal to the inputs of two 9th-order switched capacitor bandpass filters. The bandwidths of these filters correspond to the bands enclosing the low-group and high-group tones . The filter section also incorporates notches at 350Hz and 440Hz which provides excellent dial tone rejection. Each filter output is followed by a single order switched capacitor section which smooths the signals prior to limiting. Signal limiting is performed by high-gain comparators. These comparators are provided with a hysteresis to prevent detection of unwanted low-level signals and noise. The outputs of the comparators provide full-rail logic swings at the frequencies of the incoming tones.

4.9.1.2 Decoder Section

The MT8870 decoder uses a digital counting technique to determine the frequencies of the limited tones and to verify that these tones correspond to standard DTMF frequencies. A complex averaging algorithm is used to protect against tone simulation by extraneous signals (such as voice) while providing tolerance to small frequency variations. The averaging algorithm has been developed to ensure an optimum combination of immunity to "talk-off" and tolerance to the presence of interfering signals (third tones) and noise. When the detector recognizes the simultaneous presence of two valid tones (known as "signal condition"), it raises the "Early Steering" flag (ESt). Any subsequent loss of signal condition will cause ESt to fall. Steering Circuit Before the registration of a decoded tone pair, the receiver checks for a valid signal duration (referred to as "character-recognition-condition"). This check is

performed by an external RC time constant driven by E_{St}. A logic high on ESt causes V_C (See Figure 4) to rise as the capacitor discharges. Providing signal condition is maintained (ESt remains high) for the validation period (t_{GTP}), V_C reaches the threshold (V_{TSt}) of the steering logic to register the tone pair, thus latching its corresponding 4-bit code (See Figure 2) into the output latch. At this point, the GT output is activated and drives VC to V_{DD}. GT continues to drive high as long as ESt remains high, signaling that a received tone pair has been registered. The contents of the output latch are made available on the 4-bit output bus by raising the three-state control input (TOE) to a logic high. The steering circuit works in reverse to validate the interdigit pause between signals. Thus, as well as rejecting signals too short to be considered valid, the receiver will tolerate signal interruptions (drop outs) too short to be considered a valid pause.
This capability together with the capability of selecting the steering time constants externally, allows the designer to tailor performance to meet a wide variety of system requirements.

4.9.1.3 Guard Time Adjustment

In situations which do not require independent selection of receive and pause, the simple steering circuit of Figure 4 is applicable. Component values are chosen according to the following formula:

$$tREC = tDP + tGTP$$
$$tGTP = 0.67\ RC$$

The value of t_{DP} is a parameter of the device and t_{REC} is the minimum signal duration to be recognized by the receiver. A value for C of 0.1uF is recommended for most applications, leaving R to be selected by the designer. Different steering arrangements may be used to select independently the guard times for tone-present (t_{GTP}) and tone absent (t_{GTA}). This may be necessary to meet system specifications which place both accept and reject limits on both tone duration and interdigit pause. Guard time adjustment also allows the designer to tailor system parameters such as talk-off and noise immunity. Increasing t_{REC} improves talk-off performance, since it reduces the probability that tones simulated by speech will maintain signal condition for long enough to be registered. On the other hand, a relatively short t_{REC} with a long t_{DO} would be appropriate for extremely noisy environments where fast acquisition time and immunity to drop-outs would be requirements.

4.9.1.4 Input Configuration

The input arrangement of the MT8870 provides a differential input operational amplifier as well as a bias source (V_{REF}) which is used to bias the inputs at mid-rail. Provision is made for connection of a feedback resistor to the op-amp output (GS) for adjustment of gain. In a single-ended configuration, the input pins are connected with the op-amp connected for unity gain and VREF biasing the input at ½ V_{DD}. Differential configuration, which permits the adjustment of gain with the feedback resistor R5.

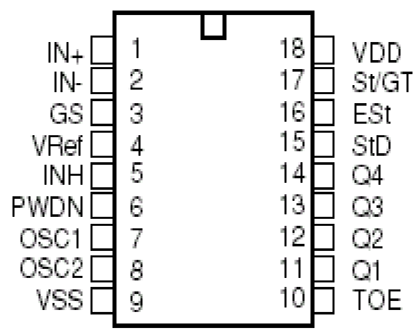


FIGURE 4.7 MT 8870

4.9.1.5 Power Down and Inhibit Mode

A logic high applied to pin 6 (PD) will power down the device to minimize the power consumption in a standby mode. It stops the oscillator and functions of the filters. Inhibit mode is enabled by a logic high input to the pin 5 (INH). It inhibits the detection of tones representing characters A, B, C and D. The output code will remain the same as the previous detected code.

4.9.2 Pin description of MT 8870

Pin #		Name	Description
18	20		
1	1	IN+	**Non-Inverting Op-Amp (Input)**.
2	2	IN-	**Inverting Op-Amp (Input)**.
3	3	GS	**Gain Select.** Gives access to output of front end differential amplifier for connection of feedback resistor.
4	4	V_{Ref}	**Reference Voltage (Output).** Nominally $V_{DD}/2$ is used to bias inputs at mid-rail (see Fig. 6 and Fig. 10).
5	5	INH	**Inhibit (Input).** Logic high inhibits the detection of tones representing characters A, B, C and D. This pin input is internally pulled down.
6	6	PWDN	**Power Down (Input).** Active high. Powers down the device and inhibits the oscillator. This pin input is internally pulled down.
7	8	OSC1	**Clock (Input)**.
8	9	OSC2	**Clock (Output)**. A 3.579545 MHz crystal connected between pins OSC1 and OSC2 completes the internal oscillator circuit.
9	10	V_{SS}	**Ground (Input)**. 0V typical.
10	11	TOE	**Three State Output Enable (Input).** Logic high enables the outputs Q1-Q4. This pin is pulled up internally.
11-14	12-15	Q1-Q4	**Three State Data (Output).** When enabled by TOE, provide the code corresponding to the last valid tone-pair received (see Table 1). When TOE is logic low, the data outputs are high impedance.
15	17	StD	**Delayed Steering (Output).** Presents a logic high when a received tone-pair has been registered and the output latch updated; returns to logic low when the voltage on St/GT falls below V_{TSt}.
16	18	ESt	**Early Steering (Output).** Presents a logic high once the digital algorithm has detected a valid tone pair (signal condition). Any momentary loss of signal condition will cause ESt to return to a logic low.
17	19	St/GT	**Steering Input/Guard time (Output) Bidirectional.** A voltage greater than V_{TSt} detected at St causes the device to register the detected tone pair and update the output latch. A voltage less than V_{TSt} frees the device to accept a new tone pair. The GT output acts to reset the external steering time-constant; its state is a function of ESt and the voltage on St.
18	20	V_{DD}	**Positive power supply (Input)**. +5V typical.
	7, 16	NC	No Connection.

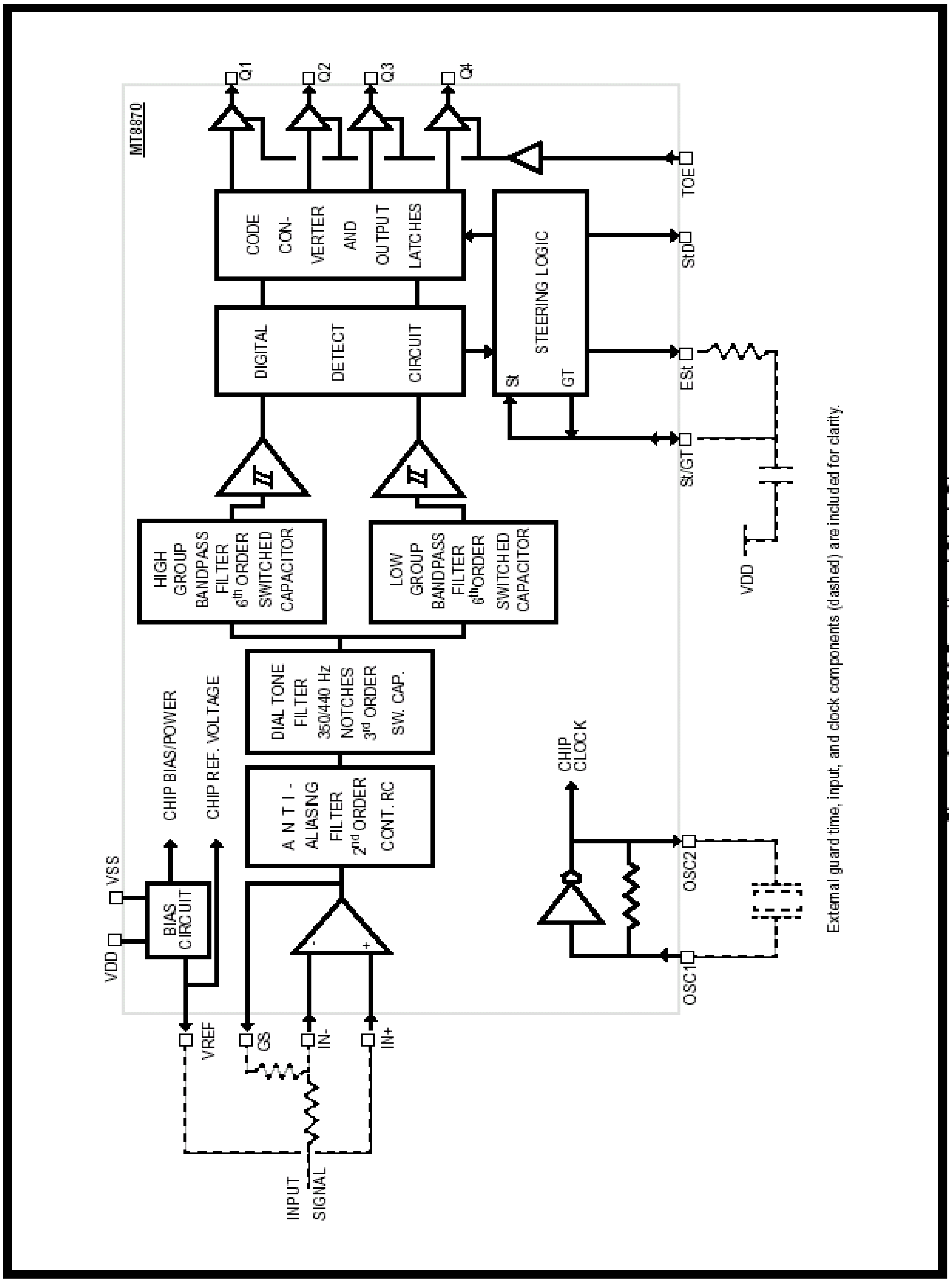


FIGURE 4.8 BLOCK DIAGRAM MT 8870

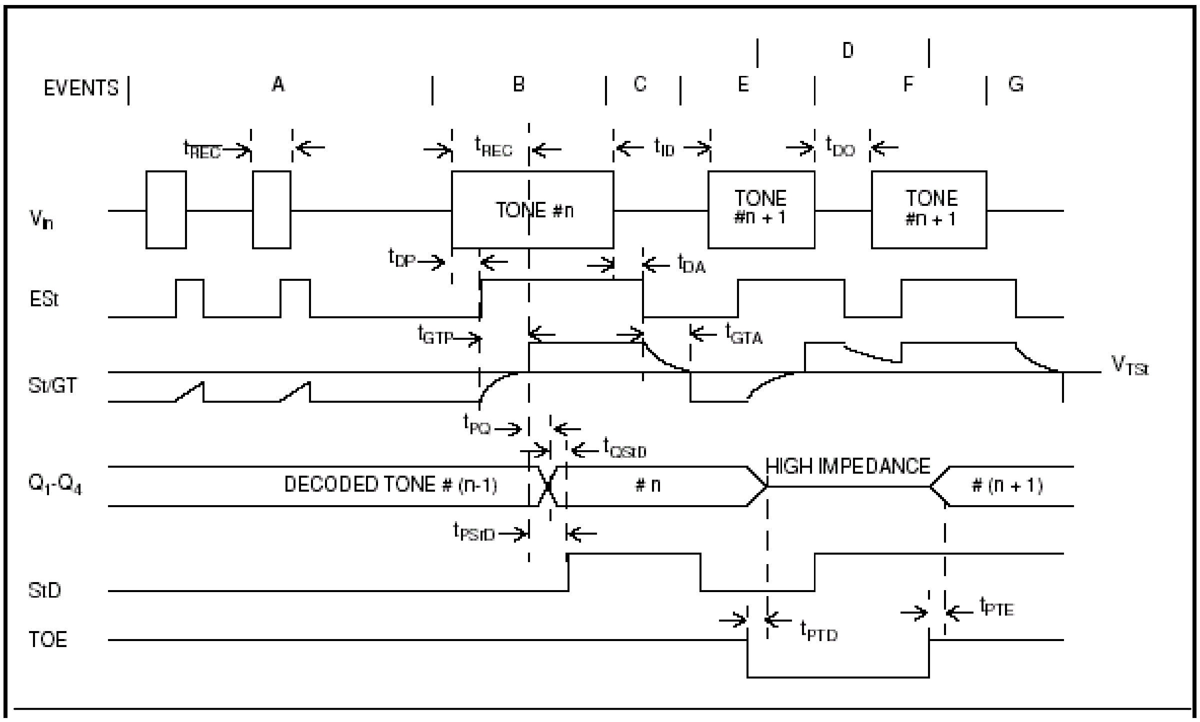


FIGURE 4.9: TIMING DIAGRAM OF MT 8870

4.9.3 <u>Explanation of events</u>

A. Tone bursts detected, tone duration invalid, outputs not updated.

B. Tone #n detected, tone duration valid, tone decoded and latched in outputs

C. End of tone #n detected, tone absent duration valid, outputs remain latched until next valid Tone.

D. Outputs switched to high impedance state.

E. Tone #n + 1 detected, tone duration valid, tone decoded and latched in outputs currently high Impedance).

F. Acceptable dropout of tone #n + 1, tone absent duration invalid, outputs remain latched.

G. end of tone #n + 1 detected, tone absent duration valid, outputs remain latched until next valid Tone.

4.9.4 Explanation of symbols

Vin	DTMF composite input signal.
Est	Early steering output. Indicates detection of valid tone frequencies.
St/gt	Steering input/guard time output. Drives external rc timing circuit.
Q1-q4	4-bit decoded tone output.
Std	Delayed steering output. Indicates that valid frequencies have been present/absent for the Required guard time thus constituting a valid signal.
TOE	Tone output enable (input). A low level shifts q1-q4 to its high impedance state.
$\overline{\text{TREC}}$	Maximum DTMF signal duration not detected as valid.
TREC	Minimum DTMF signal duration required for valid recognition.
tid	Maximum time between valid DTMF signals.
tdo	Maximum allowable drop out during valid DTMF signal.
tdp	Time to detect the presence of valid DTMF signals.
tda	Time to detect the absence of valid DTMF signals.
tgtp	Guard time, tone present.
tgta	Guard time, tone absent.

4.10 Applications

There is a vast array of potential applications for DTMF signaling using the existing telephone network. Considering that there are millions of ready-made data sets installed in convenient locations (i.e. the Touch Tone telephone) remote control and users may perform data entry without requiring them to carry around bulky data modems.

Potential applications include:

- Home remote control
- Remote data entry from any Touch-Tone keypad
- Credit card verification and inquiry
- Salesman order entry
- Catalogue store (stock/price returned via voice synthesis)
- Stock broker buy/sell/inquire -using stock
- Exchange listing mnemonics
- Answering machine message retrieval
- Automatic switchboard extension forwarding

The proven reliability of DTMF signaling has created a vast spectrum of possible applications. Until recently, many of these applications were rendered ineffective due to cost or size considerations. Now that a complete DTMF receiver can be designed with merely a single chip and a few external passive components one can take full advantage of a highly developed signaling scheme as a small, cost-effective signaling solution.

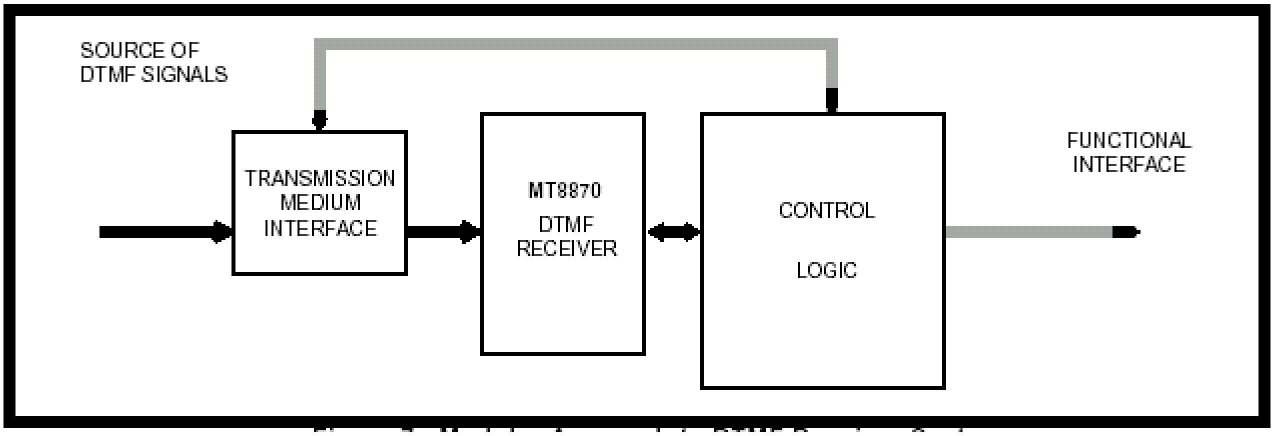


FIGURE 4.10 MODULAR APPROACH TO DTMF RECEIVER SYSTEMS

The design of a DTMF receiving system can generally be broken down into three functional blocks (Fig. 7). The first consideration is the interface to the transmission medium. This may be as simple as a few passive components to adequately configure the MT8870's input stage or as complex as some form of demodulation, multiplexing or analog switching system. The second functional block is the DTMF receiver itself. This is where the receiving system's parameters can be optimized for the specific signal conditions delivered from the front end" interface. The third, and perhaps most widely varying function, is the output control logic. This may be as simple as a 4 to 16 line decoder, controlling a specific function for each DTMF code, or as complex as a full blown computer handling system protocols and adaptively varying the tone receiver's parameters to adjust for changing signal conditions. Several currently applied and conceptually designed applications are described subsequently but first let's consider the design of a typical input stage. The input arrangement of the MT8870 provides a differential input op amp as well as a bias source (V_{REF}) which is used to bias the inputs at mid-rail. The output of this op amp is available to provide feedback for gain adjustment. A typical single ended input configuration having unity gain is shown in Figure 4.9.In both cases, the inputs are biased to ½ V_{DD} by V_{Ref}. In figure 4.13, the calculation for tGTP and tGTA is shown which are dependant upon the values of capacitor C and resistor R connected as external elements of th IC MT 8870 as shown . Both tGTA and tGTP are equal for validity of these equations. Where VTst =VDD/2

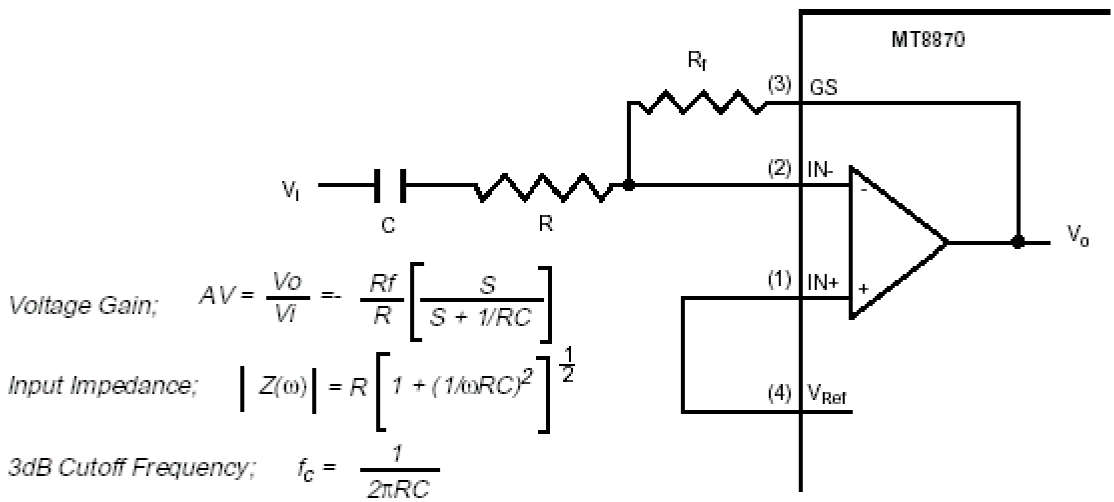


FIGURE 4.11: SINGLE ENDED INPUT CONFIGURATION

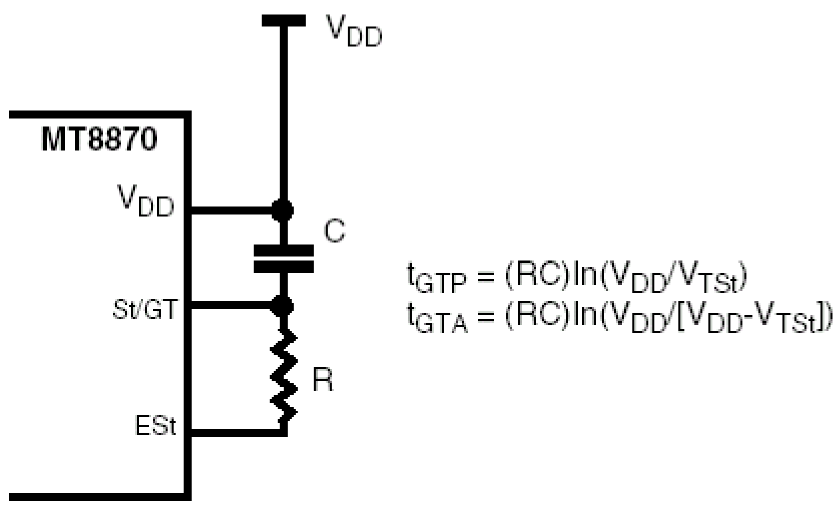


FIGURE 4.12 CALCULATION FOR TGTA AND TGTP

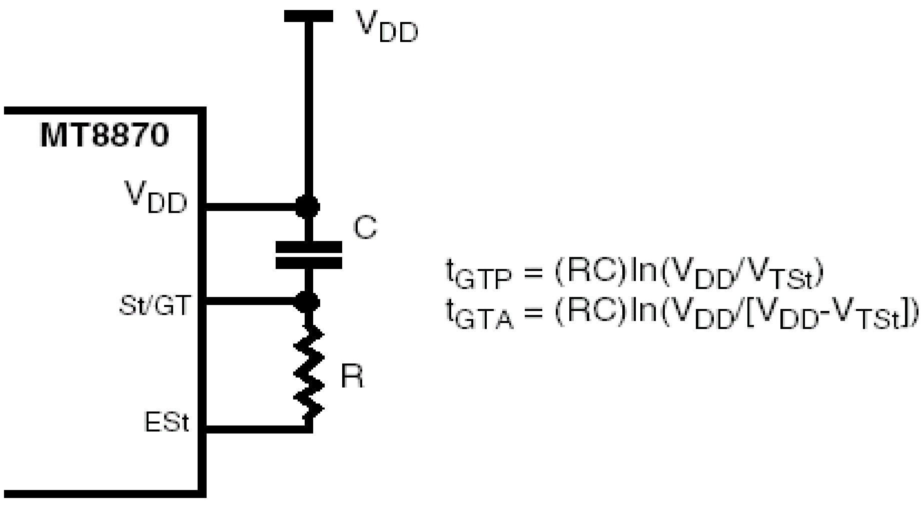


FIGURE 4.13 CALC. FOR tGTA AND tGTP

4.11 DTMF Receiver Circuit for the Project

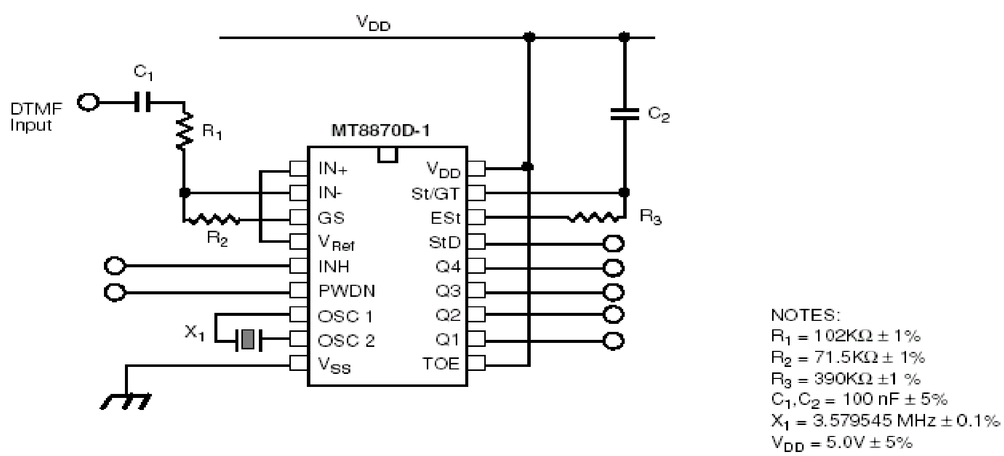


FIGURE 4.14 DTMF RECEIVER USED IN OUR PROJECT

The above figure is showing the connections and external ccts used in our project.

Pin 1 and 4 are connected to each other . pin 5 and 6 are grounded . pin 7 and 8 are connected with legs of 3.579545 Mhz crystal. Pin 10 and 18 are connected to +5 v DC regulate voltage source. Connections for pins 2,3,,16 and 14 , where pin 11 shows the LSB and pin 14 shows the MSB. Pin 15 is the StD pin which gives %V high output when an input DTMF signal is recognized and the decoding is done to gives 4 bits output . Pin 11 to 14 gives 5v DC for high and 0~3 Vfor low output. The output of these 5 pins i.e Pin 11 to Pin 15 are given to micro controller 89c51 for its Led display and conversion to serial data for the PC.

CHAPTER 5

FM TRANSMITTER

5.1 FM Theory

Under Frequency Modulation the carrier wave deviates in frequency a small range in accordance with the audio wave form in an FM transmission the instantaneous amplitude of the audio signal determines the extent of the deviation of the carrier from the selected center (operational) frequency. The noise immunity of FM transmission results primarily from the fact that FM demodulators (The device that removes the audio information from the modulated signal) respond to variations in frequency rather than to variations in amplitude. By incorporating amplitude limiters or clippers into receiver most of the amplitude variations that may have been produced by undesired electrical noise can be removed or clipped off. As a result FM transmissions are virtually free of noise as compared with AM. As with any system however FM is not 100% noise free. A certain amount of noise will be generated inside the radio receiver itself and no FM demodulator is perfectly immune to amplitude variations.

It is also found that the high frequency portions of the audio spectrum contribute more noise to FM reception than do the lower frequency .The highs therefore tend to have a lower Signal to Noise ratio than the lows .The noise contribution of the high frequency region can be reduced by transmitting the highs at increased relative volume levels and then reducing the level by the same amount at the receiver This boosting of the highs at the transmitter is known as Pre emphasis and the reduction of the highs at the receivers is called Deemphasis .For realistic reproduction ,the amount of deemphasis at the receiver must equal the preemphasis at the transmitter .the standard frequency band for FM transmission is 88 to 108 MHz world wide

5.2 Basic Building Blocks for an FM Transmitter

When creating a system for transmitting a frequency modulated wave in RF spectrum range, a number of basic building blocks have to be considered. The diagram below gives a very broad impression of the transmitter and tits individual parts.

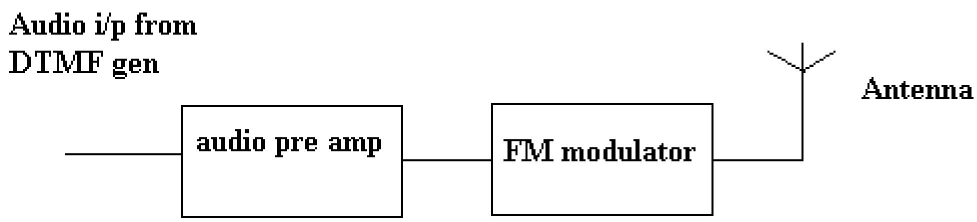


FIG 5.1 THE BASIC BUILDING BLOCKS FOR AN FM TRANSMITTER

The block diagram of an FM transmitter shown above gives a conceptual idea for an FM transmitter. The weak audio signal from DTMF generator is amplified by the audio pre-amplifier stage .This input signal is amplified in terms of a few tens of the input voltage level .The second stage audio amplifier further amplifies this amplified signal coming from audio preamplifier stage .The output of the second stage audio amplifier has a sufficient gain which is given to the input of FM modulator/oscillator stage .FM oscillator produces carrier frequency usually within the range of 88 to 108 MHz ,which is a standard frequency band for FM transmission . Amplified audio signal is frequency modulated on this carrier frequency and is radiated through an antenna in air . Another stage can be introduced after FM Modulator /Oscillator and before antenna which is an RF Power Amplifier stage .This stage in fact increases the radiating power of the modulated signal thus resulting in long-range transmission .In our project ,we have not used this stage due to some difficult technicalities involved in its practical design .

5.3 Transmitter Circuit Design

Now we have a basic idea from Figure 5.1 ,what all stages are required to design a transmitter circuit .We are going to discuss the designing of each stage in detail and in the end we will be able to design a fully operational FM transmitter .We have selected common emitter configuration for biasing of a bipolar transistor to use it as an amplifier .Moreover all transistors use in the circuit design are of NPN type .After a transistor has been biased with a Q point near the middle of the DC load line ,we can couple a small AC signal into the base .This produces fluctuations in the collector current of the same shape and frequency .For instance ,if the input is a sine wave with a frequency of 1 kHz ,the output will be enlarged sine wave with a frequency of 1 kHz .The amplifier is called a linear (or high-fidelity) amplifier if it does not change the shape of the signal .As long as the amplitude of the signal is small ,the transistor wil use only a small part of load line and the operation will be linear .

On the other hand ,if the input signal is too large ,the fluctuation along the load line will drive the transistor into saturation and cutoff .This clips the peaks off a sine wave ,and the amplifier is no longer linear .If we listen to such an output with a loud speaker ,it sounds terrible because the signal is grossly distorted .

5.3.1 Audio Pre-amplifier Circuit Design .

Now we start designing the very first stage of an FM transmitter ,which ia an audio pe-amplifier .The configuration for biasing of transistor is Common Emitter .The main characteristics of this configuration are :

- Phase inversion
- High voltage gain
- High input impedance
- Low output impedance

The typical schematic which is generally used for CE amplifier is shown in Figure 5.3. R1 and R2 are the biasing resistors which are used for DC biasing of transistor using single DC voltage source .Rc is the load resistor connected to the collector of the NPN transistor Q1.Re is the emitter resistor which performs stability for CE amplifier by giving a negative feedback .C1 and C2 are coupling capacitors used to isolate the effect of biasing voltages on the other connected stages and perform impedance matching .Ce is an AC by-passed capacitor for grounding undesired AC signals .

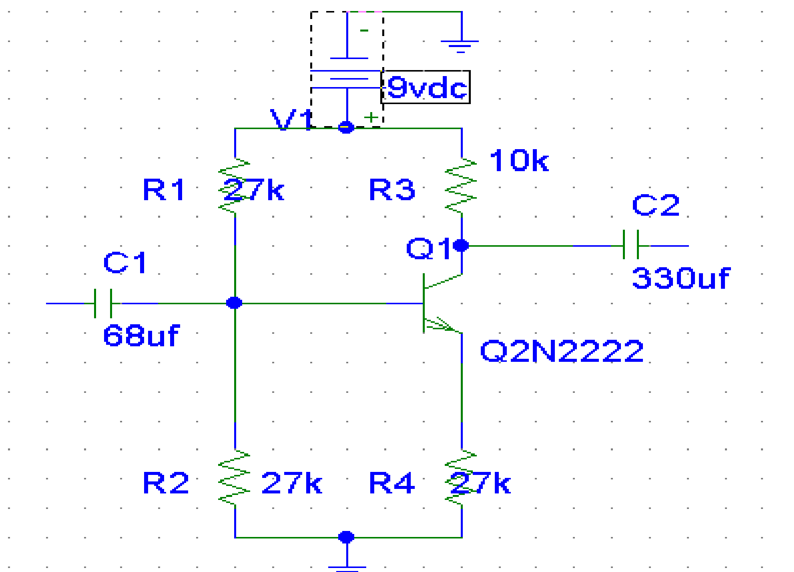


FIG 5.2 CE AMPLIFIER USED FOR AUDIO PRE-AMPLIFIER STAGE

5.3.1.1 Transistor Biasing Calculations

Transistor =2N2222/2N2222A, hfe=175 ,hie =1kΩ

DC voltage source Vcc =9V

Vbe =0.7 V

Assumed Values

Vcc =9V ,Emitter Voltage Ve =.2Vcc =.2 *9V=1.8V

Vce =Vcc/2.5=9V/2.5=3.6V

Collector Voltage Vc=Vcc+Ve

Vc=3.6+1.8=5.4V

Collector Current Ic≈Emitter Current Ie=0.4mA

Base Voltage Vb=Ve+0.7=1.8+0.7=2.5V

Calculating Emitter Resistor Re

Re =Ve/Ie=1.8V/0.4mA

Re=4.5kΩ

Calculating Load Resistor Rc

Rc=(Vcc-Vc)/Ic

Rc=(9V-5.4V)/0.4mA

Rc=9kΩ

Calculating R1 and R2 (Biasing Resistors)

R2/(R1+R2)=Vb/Vcc

R2/(R1+R2)=2.5/9   where Vb =2.5V and Vcc=9V

R2/(R1+R2)=o.28

R1+R2=3.6R2   ……eq 1

Ic=hfe*Ib

Ib=Ic/hfe=o.mA/175=2.29uA

Current across R1 is I1and current across R2 is I2

I1 =I2=100*Ib =229uA=230 uA approx

Also R1+R2 =Vcc/I1

R1+R2=9/230uAR1+R2= 39kΩ

Equating eq1 and eq 2

3.6 R2 =29kΩ

R2=10.8kΩ

R1=?

R1+R2=39kΩ

R1=39kΩ-R2

R1=39kΩ-10.8kΩ

R1=28.2kΩ

5.3.1.2 Coupling and Bypass Capacitors

A coupling capacitor passes an AC signal from one point to another .The size of the coupling capacitor depends on the lowest frequency we are trying to couple .We use the following rule :

$$Xc \leq 0.1R$$

At the lowest frequency to the amplifier .Where R is the total resistance of the loop .This equation means that the capacitance reactance of the coupling capacitor must be less than or equal to one-tenth of the total series resistance .Satisfying this10:1 rule means that the alternating current is down less than 1 percent at the lowest frequency .The magnitude of the AC in a one-loop RC circuit equals

$$I=V/\sqrt{}(R^2+Xc^2)$$

By the given rule the above eq ecomes :

$$I=V/(R^2+(0.1R)^2)$$

$$I=.995V/R$$

This shows that the alternating current is down only half a percent at the lowest frequency .We will refer to any coupling capacitors that satisfies the 10:1 rule as a stiff coupling capacitor .For example ;we are designing a transistor stage for audio range ,20Hz to 20kHz.If the input coupling capacitor sees a total series resistance of 10k Ω ,then Xc must be equal to or less than 1kΩ at the lowest frequency ,20Hz .We proceed as follows :

$$Xc =1/2\pi fc =1/2\pi(20Hz)C= 1k\Omega$$

This gives C=7.96 uf

This is the minimum capacitance needed for stiff coupling .In practice ,we would use 10uf for the above example , the next higher standard value .This provides stiff coupling for all frequencies above 20 Hz .A coupling capacitor acts like a switch that is open o direct current but shorted to alternating current .Because of this ,a coupling capacitor blocks direct current but allows AC to pass through it .This action allows us to get an AC signal from one stage to another without disturbing the biasing of each stages .

For our practical circuit i.e. audio pre-amplifier stage of FM transmitter we can set the value for C1 between the range of 10uf to 100uf .From the above example it is obvious that greater the capacitance more provision of stiff coupling for the frequencies above the selected lower frequency .Since we are designing the stage for 1 kHz frequency in general which is approximately an average frequency for a DTMF band ,we can use a value say 68 uf for C1 .For C2 we select a large value which is 330 uf .These values have been tested in the circuit simulation using ORCAD 9.0 software . Now we are just left to decide the value for bypass capacitor Ce for this stage of FM transmitter circuit .A bypass capacitor is similar to a grounded point .This capacitor simply grounds the AC signal because AC can pass through a capacitor .The unwanted signals from emitter are grounded using this bypass capacitor Ce which does not effect DC biasing of the circuit .Ce=2.2 uf provides very small impedance for low frequencies thus quite effective in bypassing these low frequencies .

Now we have values for R1 ,R2 Rc and Re as follow :

Element	Calc Values	Practical Values
R1	28.2kΩ	27kΩ
R2	10.8kΩ	10kΩ
Rc	9kΩ	10k Ω
Re	4.5kΩ	4.7k Ω
C1	-------	68uf
C2	-------	330uf
Ce	-------	2.2uf

5.3.1.4 Orcad Simulation for Audio Pre-amplifier

Figure 5.4 to figure are showing different test points and the respective outputs of waveforms present at these nodes .

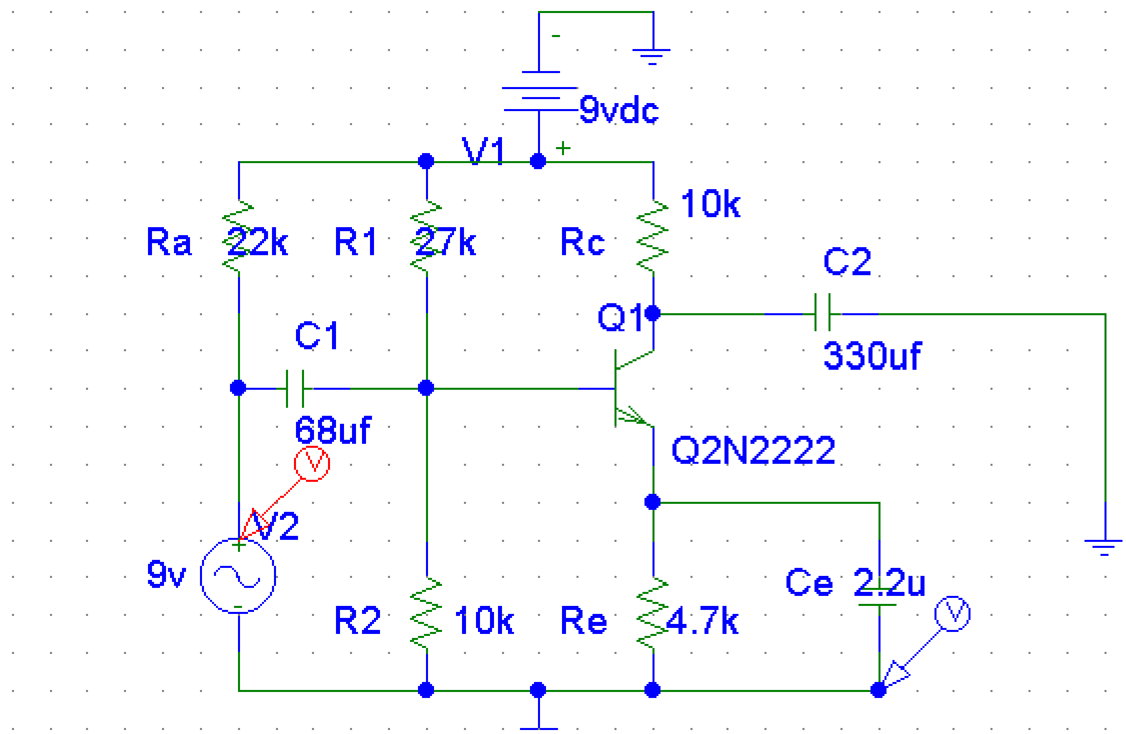


FIG 5.3 TEST POINTS FOR ANALYZING INPUT SIGNAL

If we see fig 5.5 it is obvious that input signal is a 1 kHz sine wave having a peak to peak voltage equals to 20mV. In figure 5.6 the test point is taken at the output of audio pre-amplifier with reference to ground after coupling capacitor C2.From figure 5. It is obvious that the input signal has been amplified approximately 50 times at the output of this stage with a load resistor of 10kΩ i.e.

Voltage Gain =Vo /Vin =500 /10mv= 50

In Figure 5.4 there is an introduction of resistor Ra=22k Ω .This is to raise the AC signal slightly up by adding a small amount of DC in it .Practically we have checked so many resistances to select the value for Ra and we achieved satisfactory result with 22kΩ.In fact without Ra ,noise is experienced at the receiver end and the DTMF tone cannot be recognized by the DTMF decoder .

5.3.3 <u>Oscillator Stage</u>

The carrier oscillator is used to generate a stable sine wave at the carrier frequency ,when no modulating signal is applied to it .When fully modulated it must change frequency linearly like a voltage controlled oscillator .At frequencies higher than 1 MH a Colpitts (split capacitor configuration) or Hartley oscillator (split inductor configuration) may be used .A parallel LC circuit is the heart of the oscillator with an amplifier and a feedback network which gives positive feedback .Oscillator works on positive feedback because any amplifier with a positive feedback becomes unstable and starts oscillating .Therefore oscillator is an amplifier with positive feedback .

In our project we are going to use a Colpitts oscillator reason being the easy availability of capacitors rather than inductors .In figure 5.11, a schematic of Colpitts oscillator is shown which we have designed for FM Band 88 – 108 MHz.TC1 and L1 make an LC tank circuit which in connection with C5 ,C6,C7 and internal capacitances of Q4 define the carrier frequency .Since we are injecting amplified audio signal from the second stage audio amplifier to the base of Q4 through coupling capacitor C4,the audio signal is frequency modulated on this carrier frequency .Or we can say the frequency of the carrier signal will be varying with respect to the amplitude of the injected audio signal to the base of Q4 .The modulated signal being in RF range can be radiated in space with the help of a simple rod Antenna .TC1 and TC2 are trimmer capacitors .TC2 is for impedance matching of the oscillator output with the antenna .For a 50 Ω load antenna ,TC2 with a value of 4pfF is suitable for best impedance matching .

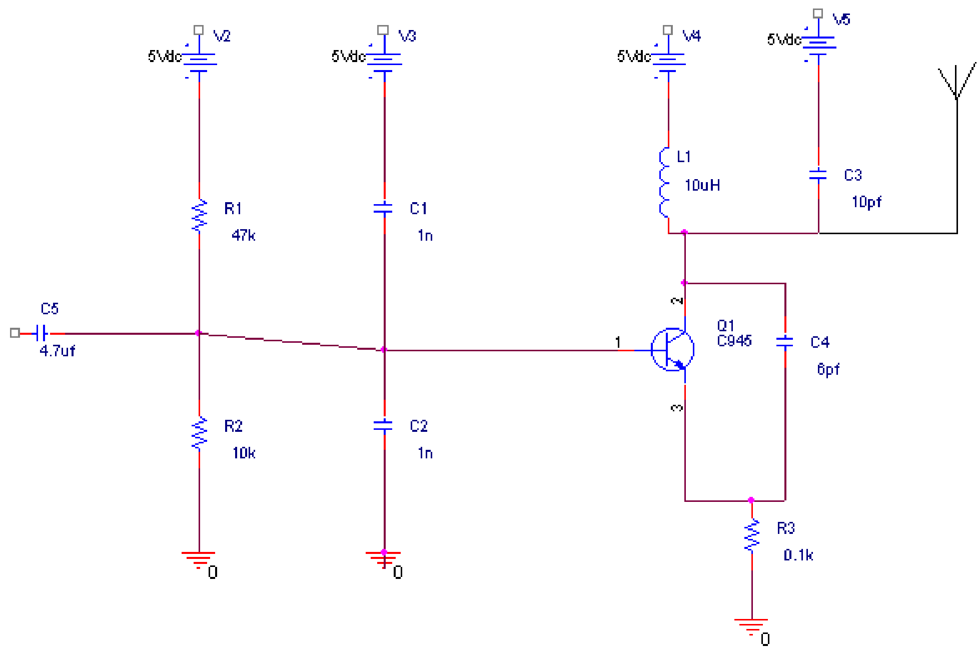


FIG 5.4 COLPITT'S OSCILLATOR DESIGNED FOR FM BAND 88 –108 MHZ

Now the question arises ,how to make a 50 Ω antenna ? A simple telescopic antenna is having an impedance of 50Ω to 75Ω which is the best choice in selecting an antenna for this transmitter .As far as length of telescopic rod is concerned ,it is not a difficult job because the antenna length can be varied easily according to λ /2 , λ/4 or λ/8 formulae .Where λ is the wave length of the carrier signal in meter .For example what should be the length of this telescopic rod antenna if our transmitter is transmitting at a carrier frequency equal to 100MHz .

Here we have f=100Mhz

We know velocity of light c=fλ

And also c=300,000,000 meters /sec thus

Wavelength λ =300,000,000 /100,000,000

=3meters

The length of ant can be λ /2 ,λ/4 , λ/8 thus can be 1.5 meters ,0.75 m or 0.375 m

Chapter 6

89c51 for LED display and computer Interface

6.1 7 segment display using 89c51

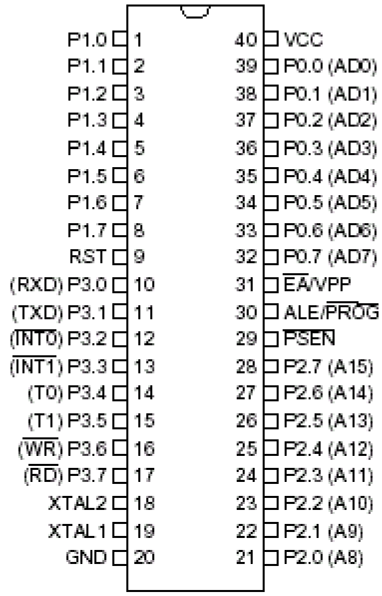


FIGURE 6.1 89C51 MICROCONTROLLER

6.2 89c51 Microcontroller characteristics

- Operating Temperature.................................. -55°C to +125°C
- Storage Temperature .... -65°C to +150°C
- Voltage on Any Pin
  with Respect to Ground ....-1.0V to +7.0V
- Maximum Operating Voltage 6.6V
- DC Output Current.. 15.0 mA

6.2.1 Features

- Compatible with MCS-51™ Products
- 4K Bytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 128 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Two 16-bit Timer/Counters
- Six Interrupt Sources
- Programmable Serial Channel
- Low-power Idle and Power-down Modes

6.3 Description

The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer, which provides a highly flexible and cost-effective solution to many embedded control applications.

The AT89C51 provides 4Kbytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator and clock circuitry. In addition, the AT89C51 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The Power-down Mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.

6.3.1 Pin Description

VCC

Supply voltage.

GND

Ground.

Port 0

Port 0 is an 8-bit open-drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high impedance inputs.Port 0 may also be configured to be the multiplexed low order address/data bus during accesses to external program and data memory. In this mode P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pullups are required during program verification.

Port 1

Port 1 is an 8-bit bi-directional I/O port with internal pullups. The Port 1 output buffers can link/source four TTL inputs. When 1s are written to Port 1 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (I_{IL}) because of the internal pullups. Port 1 also receives the low-order address bytes during Flash programming and verification.

Port 2

Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (I_{IL}) because of the internal pull-ups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses. In this application, it uses strong internal pull-ups when emitting 1s. During accesses to external data memory that use 8-bit addresses, Port 2 emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3

Port 3 is an 8-bit bi-directional I/O port with internal pullups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pullups and can be used as inputs. As inputs,
Port 3 pins that are externally being pulled low will source current (I_{IL}) because of the pullups.

RST

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

ALE/PROG

Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation ALE is emitted at a constant rate of 1/6 the oscillator frequency, and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external Data Memory.

If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the micro controller is in external execution mode.

PSEN

Program Store Enable is the read strobe to external program memory. When the AT89C51 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during
each access to external data memory.

EA/VPP(External Access Enable)

EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (V_{PP}) during Flash programming, for parts that require 12-volt V_{PP}.

XTAL1

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2

Output from the inverting oscillator amplifier.

6.3.2 Oscillator Characteristics

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier, which can be configured for use as an on-chip oscillator, as shown in Figure 1. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven .There are no requirements on the duty cycle of the external clock signal, since the input to the internal clocking circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high and low time specifications must observed.

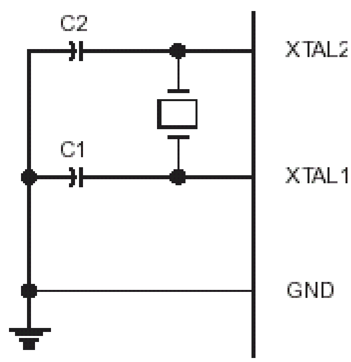


FIGURE 6.2-CRYSTAL OSCILLATOR

6.3.3 Idle Mode

In idle mode, the CPU puts itself to sleep while all the onchip peripherals remain active. The mode is invoked software. The content of the on-chip RAM and all the special functions registers remain unchanged during mode. The idle mode can be terminated by any enabled interrupt or by a hardware reset.It should be noted that when idle is terminated by a ware reset, the device normally resumes program execution, from where it left off, up to two machine cycles before the internal reset algorithm takes control. On-chip hardware inhibits access to internal RAM in this event, but access the port pins is not inhibited. To eliminate the possibility an unexpected write to a port pin when Idle is terminated reset, the instruction following the one that invokes should not be one that writes to a port pin or to external memory.

.

6.3.4 Power-down Mode

In the power-down mode, the oscillator is stopped, and the instruction that invokes power-down is the last instruction executed. The on-chip RAM and Special Function Registers retain their values until the power-down mode is terminated. The only exit from power-down is a hardware

reset. Reset redefines the SFRs but does not change the on-chip RAM. The reset should not be activated before V_{CC} is restored to its normal operating level and must be held active long enough to allow the oscillator to restart and stabilize.

6.3.5 Program Memory Lock Bits

On the chip are three lock bits which can be left unprogrammed (U) or can be programmed (P) to obtain the additional features listed in the table below. When lock bit 1 is programmed, the logic level at the EA pin is sampled and latched during reset. If the device is powered up without a reset, the latch initializes to a random value, and holds that value until reset is activated. It is necessary that the latched value of EA be in agreement with the current logic level at that pin in order for the device to function properly.

6.4 Application in our project

We used in out project 89c51 for two purposes

- To give the no. of the station in seven segment LED
- To convert the data to serial and enter it to the computer

4 bit data from the four pins of Mt 8870(11 to 14) are entered in to the port 1 of the micro controller in pins 1 to pin 4,with pin 4 the most significant bit and pin 1 LSB. Since 89c51 is active low device , so as long as the pin 12 is active high so it will not operate and when it is low the device will operate . When the tone is detected then pin 12 is made low and 89c51 starts working. It is programmed in KALE which is just like c++.It gives the seven segment display on the Led using the pins 33 1o 39 (port 0).

Pin 10 an 11 are for receiving and transmitting data respectively. They are connected to RS232 which is used to convert TTL serial data coming from micro controller in to CMOS to be entered in to the serial port of the computer. Three 10uf capacitors are used in 232.and it uses +5vdc. Voltage regulater 7805 is used for regulating the 5 volts. Output from pin 13 and 14 are taken to the serial port.

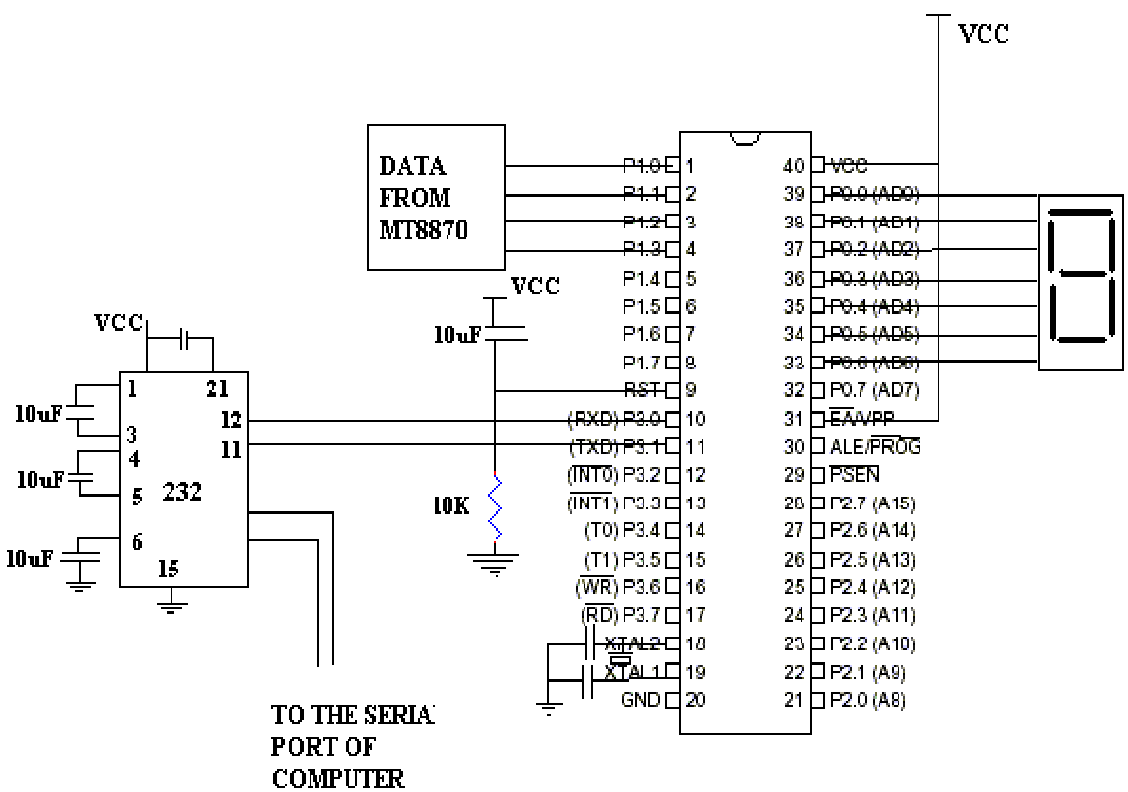


FIGURE 6.3 CCT USED IN OUR PROJECT

6.5 Program written

```
#include <AT89x51.h>
#include <my.h>

#define strobe P3_2

void main(void)
{
unsigned char ar[10];
unsigned int i = 0;

SCON = 0x52; // serial port mode 1
TMOD = 0x20; // timer 1 mode 2 ( 8 bit auto reload )
TH1  = -13;  // reload count for 2400 baud
TR1  = 1;    // start timer 1

ar[0]=63;
ar[1]=6;
ar[2]=91;
ar[3]=79;
ar[4]=102;
ar[5]=109;
ar[6]=125;
ar[7]=7;
ar[8]=127;
ar[9]=111;
```

```
P0 = ar[0];
/*
test:
for (i = 0; i < 10; i++)
{
P0 = ar[i];
delay(500);
}
goto test;
*/
/*
test:
if(P1 == 1)
{
SBUF = '1';
delay(500);
}

if(P1 == 2)
{
SBUF = '2';
delay(500);
}

if(P1 == 3)
{
SBUF = '3';
delay(500);
}
```

```
if(P1 == 4)
{
SBUF = '4';
delay(500);
}

goto test;
*/
main:
if(strobe == 0)
{

if(P1 < 7)
{

P0 = ar[P1];

if(P1 == 1)
{
SBUF = '1';
delay(500);
}

if(P1 == 2)
{
SBUF = '2';
delay(500);
}

if(P1 == 3)
{
```

```
SBUF = '3';
delay(500);
}

if(P1 == 4)
{
SBUF = '4';
delay(500);
}

if(P1 == 5)
{
SBUF = '5';
delay(500);
}

}
}

goto main;

}
```

Chapter 7

Interconnectivity of system modules

7.1 Interconnectivity of system modules

We have discussed so far different parts of the project ,in this chapter we will discuss the interconnectivity of these modules in the system. Following are the two modules

- **Transmitting Unit**
    - Infra red transmitter
    - Infrared receiver
    - DTMF tone encoder
    - Fm transmitter

- **Receiving unit**
    - Fm receiver
    - DTMF decoder
    - LED display
    - Computer interface

7.2 Transmitter side:

7.2.1 Infra red transmitter

555 IC timer is used as a IR transmitter .Time period is controlled by resisters and capacitors.

The charge time (output high) is given by:

$$t1 = 0.693 (RA + RB) C$$

And the discharge time (output low) by:

$$t2 = 0.693\ (RB)\ C$$

Thus the total period is:

$$T = t1 + t2 = 0.693\ (RA + 2RB)\ C$$

The frequency of oscillation is:

$$F = 1/T = 1.44/\ (RA + 2RB)\ C$$

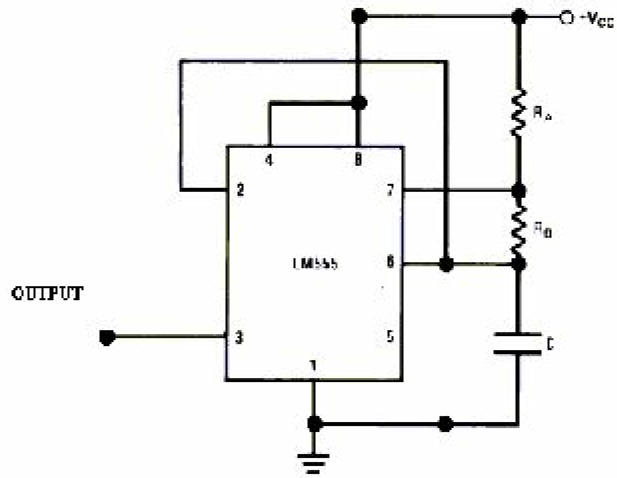


FIGURE 7.1 555 IC TIMER IN ASTABLE MODE

actual cct values used the project are.

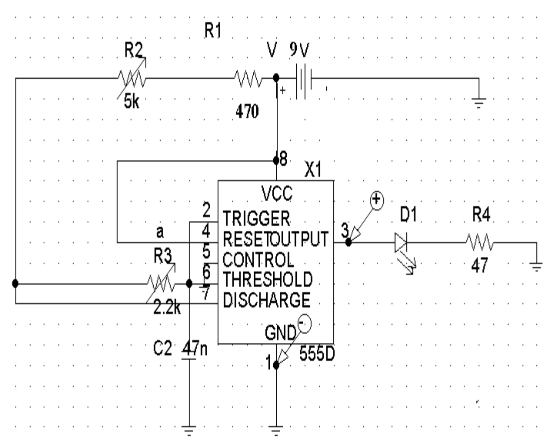


FIGURE 7.2 ACTUAL IR TRANSMITTING CCT

7.2.2 IR reception and tone Encoding

IR receiver LED receives the IR beam. The resistance of this LED .The resistance of this LED varies with IR light .As long of it receives the beam it has high resistance. It is to connected to pin 3 (non inverting input) of LM 741 through a coupling or DC blocking capacitance of 0.01uf.IR reception is connected to Vdd through 47k of resistance . As long as IR is received LED has high resistance IR is received, and thus high voltage drop. As beam is interrupted by a intruder it is blocked, resistance of IR LED drops and its voltage drops. So op amp has low voltage of non-inverting input and thus charged capacitor of 1uf has high voltage and it is amplified and we get a inverted output or zero at output. Two 47k resister R4 and R5 are used for feed back and gain control output of op amp is coupled through a 2.2uf capacitor and passed through diodes that only position voltage go ahead and stop negative supply .5.6k of resister is used for over current protection so in short as long as we have pulses we get one in output and zero   when there is intrusion.

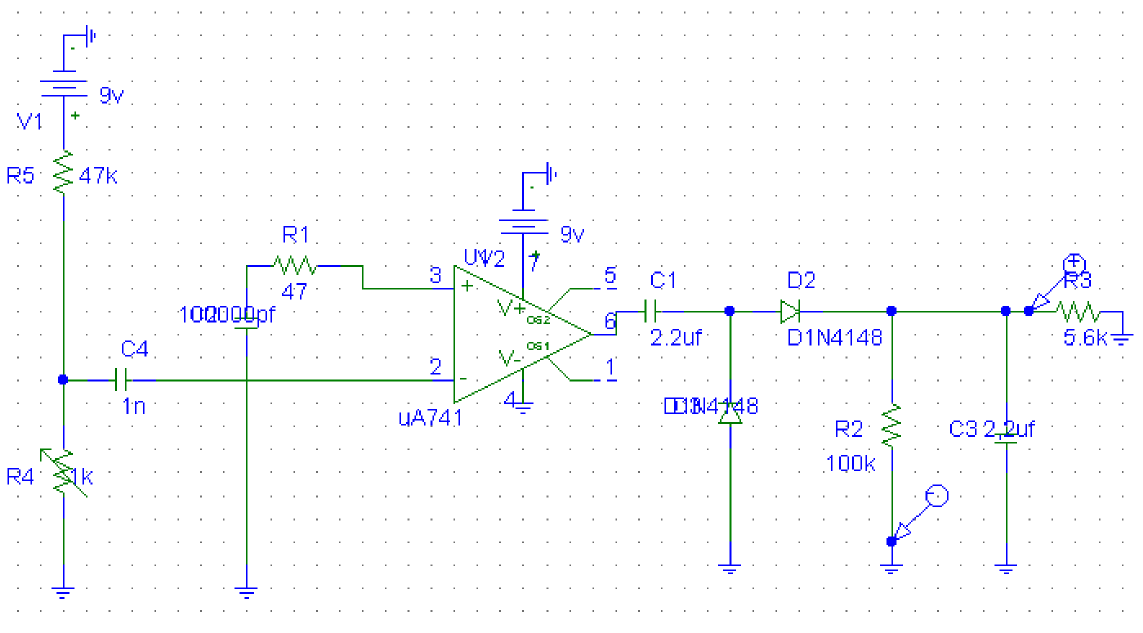


FIGURE 7.3 LM 741 /C

The TONE DISABLE (pin 2) input has Input an internal pull-up resistor. When this input is open or at logic high, the normal tone output mode will occur. When TONE DISABLE input is at logic low, the device will be in the inactive mode,

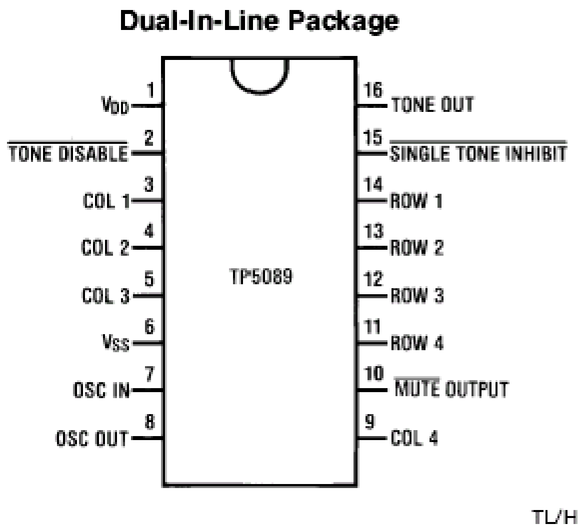


FIGURE 7.4 TP 5089

This signal of one and zero is used to trigger the DTMF IC TP5089.We are using a the transistor as a active switch and it act as a inverter. It is turned off as long as it pin 2 is active low and goes on when pin 2 is active high and when we get intrusion op amp gives zero and active switch or inverter goes off and pin2 is no more connected to ground through emitters and goes high triggering Tp5089 output is taken from pin 16.

So we are sing IR beam to control the activation of TP5089 IC .it is activated as soon as there is some intrusion. The preassigned DTMF code using the ground connection to the row and column pins is produced for the period equal to the intrusion .As soon as the intrusion is removed again the output of op amp goes high and so we get zero at the pin 2 i.e. tone disable input. This is done because we want that cct is reset by itself and we don't have to reset after each intrusion. Therefore output is taken from pin 16, as long there is intrusion.

The out put of this Tp 5089 tone encoder is modulated by an FM modulator and is transmitted at about 100 Mhz.

7.3 Receiving unit

7.3.1 FM receiver DTMF tone decoder

Any good FM receiver can be used to receive transmission from the transmitting unit. The only requirement is the fine tuning of the radio receiver for transmission frequency in the band 88 to 108 Mhz. Requirements is to inject DTMF tone signal received , in to the input of DTMF receiver/decoder. The connection are shown below

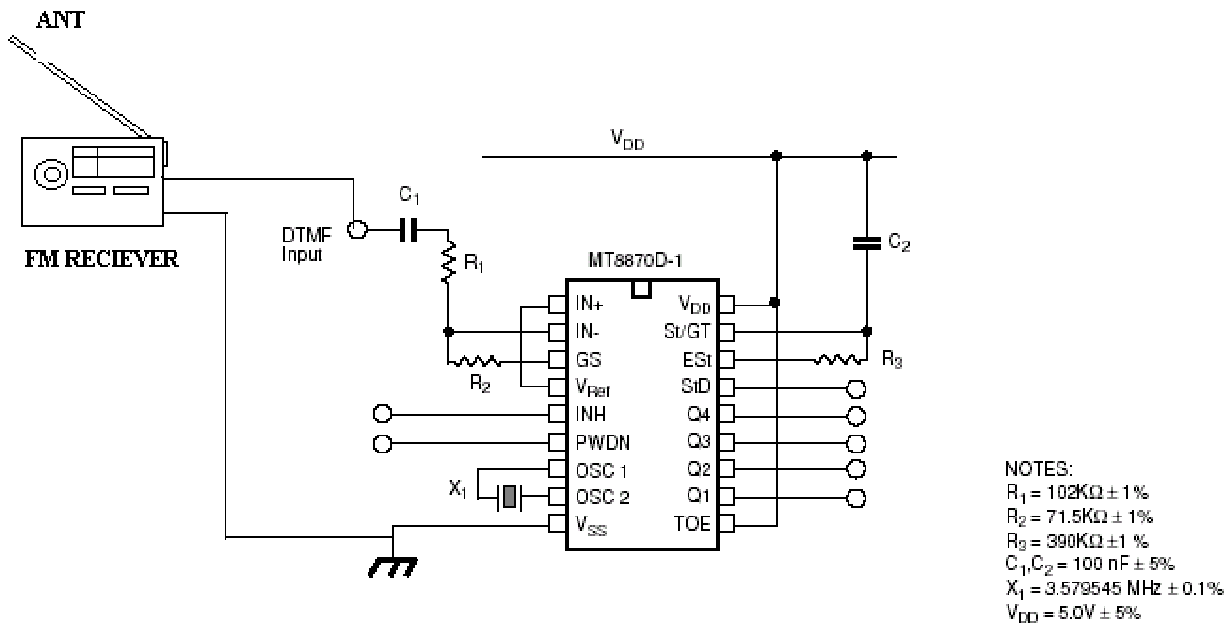


FIGURE 7.5 DECODER CCT USED IN THE PORJECT

The tone enters the IC in its pin 9 and the output is in bits from the four pins .the voltage applied to the IC is 5V regulated by the use of 7805 IC .

7.3.2 Serial port interface and LED display

Output from the decoder IC is entered in to the 89c51 micro controller to be converted in to the serial data an also for it display in to LED.

89c51 has 3 ports , in put rom he DTMF decoder is entered in port zero with its corresponding control signalto activate the IC. when it receives a code in binary form it uses a program prefeeded in to it for its display in the 7 segment LED and also a for its transmission to computer. IC rs232 is used for conversion of TTL signal from the micro controller to CMOS for the PC. It enter s the serial port from where data is picked up by a program written visual basic and hence station number is shown where intrusion was occurred.

Chapter 8

Software for IR Surveillance System (Visual Basic)

8.1 General

In the previos chapters we discussed about reading data from DTMF decoder with the help of a PC, serial port interface. In this chapter we shall use a software to display th the data graphically on monitor, the location of transmitting unit .This is a user friendly software written in visual basic. The environment of the software is shown in the figure 8.1

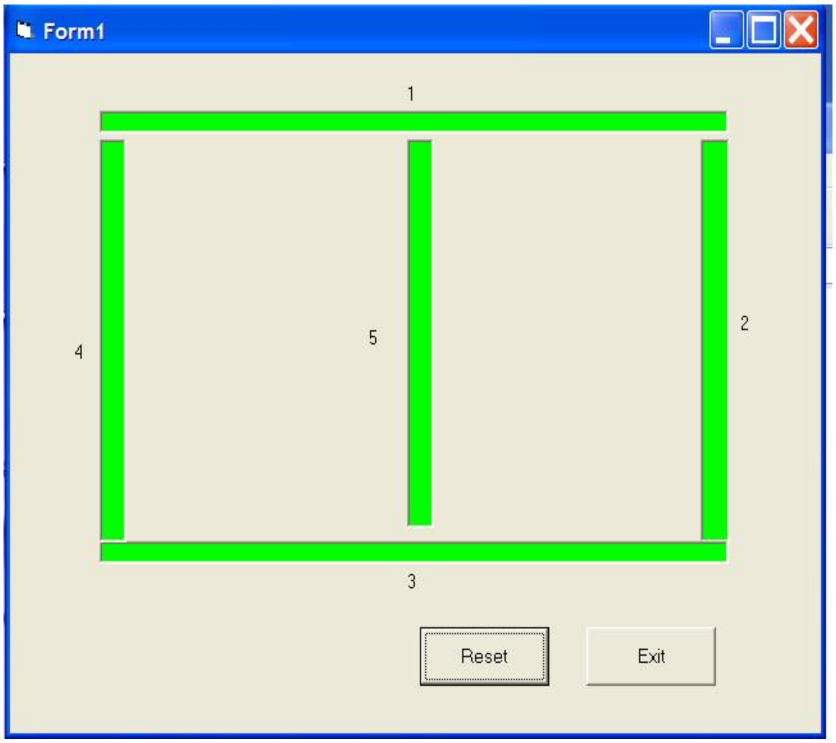


FIGURE 8.1 THE ENVIRONMENT OF THE SOFTWARE UNDER NORMAL CONDITIONS

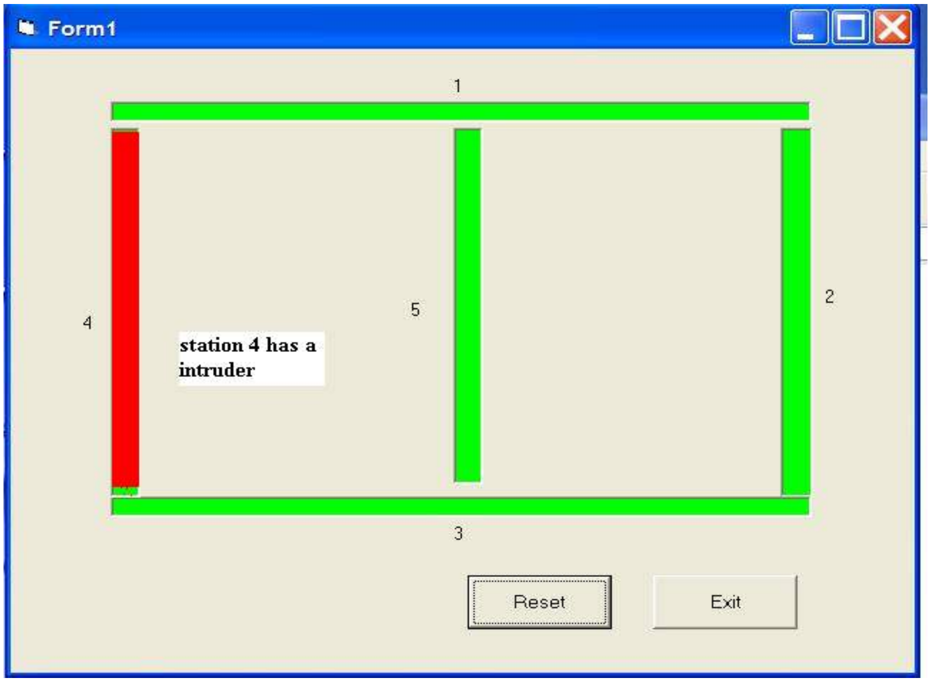


FIGURE 8.2 THE ENVIRONMENT OF THE SOFTWARE UNDER THREAT FOR STATION 4

8.2 Real time screening for Alarm Signals

The software can continuously read serial port for the data. The screening is done in real time. Once the monitoring is active program keeps on reading data from the serial port. If a transmitting unit sends a DTMF signal via carrier , it is received by a FM radio receiver next to PC.DTMF receiver /decoder recognizes the DTMF tone received and gives its desired data to serial port . the status port reads it with help of this software and searches data value which resembles this incoming data in the program. once the value is matched then it gives the indication on the screen. This software can gives location of up to 5 transmitters but can be increased to 16.

8.3 Source Code in Visual Basic

Writing source code in VB is quite different from as those written in Pascal or c++ VB has its own graphical environment that is why it is called VISUAL BASIC IN which the forms are and written and objects like commands button are placed on the by just dragging and dropping using mouse .The source is given with comments

Private Sub Command1_Click ()

```
Unload Me
End Sub

Private Sub Command2_Click()
boundry2.BackColor = vbRed
End Sub

Private Sub Command3_Click()
boundry3.BackColor = vbRed
End Sub

Private Sub Command4_Click()
boundry4.BackColor = vbRed
End Sub

Private Sub Command5_Click()
Boundry1.BackColor = vbGreen
boundry2.BackColor = vbGreen
boundry3.BackColor = vbGreen
boundry4.BackColor = vbGreen
boundry5.BackColor = vbGreen
End Sub

Private Sub Form_Load()
MSComm1.PortOpen = True
Timer1.Interval = 1
Boundry1.BackColor = vbGreen
boundry2.BackColor = vbGreen
boundry3.BackColor = vbGreen
boundry4.BackColor = vbGreen
boundry5.BackColor = vbGreen
```

```
End Sub

Private Sub Timer1_Timer()
Text1.Text = MSComm1.Input
If Text1.Text = "1" Then
Boundry1.BackColor = vbRed
Else
If Text1.Text = "2" Then
boundry2.BackColor = vbRed
Else
If Text1.Text = "3" Then
boundry3.BackColor = vbRed
Else
If Text1.Text = "4" Then
boundry4.BackColor = vbRed
Else
If Text1.Text = "5" Then
boundry5.BackColor = vbRed
End If
End If
End If
End If
End If
End Sub
```

TABLE OF FIGURES

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