**CHAPTER 1**

**INTRODUCTION**

The communication flow of today is very high. Many applications are operating at high speed and a fixed connection is often preferred. If the power utilities could supply communication over the power-line to the costumers it could make a tremendous breakthrough in communications. Every household would be connected at any time and services being provided at real-time. Using the power-line as a communication medium could also be a cost-effective way compared to other systems because it uses an existing infrastructure, wires exists to every household connected to the power-line network.

The deregulated market has forced the power utilities to explore new markets to find new business opportunities, which have increased the research in power-line communications the last decade. The research has initially been focused on providing services related to power distribution such as load control, meter reading, tariff control, remote control and smart homes. These value-added services would open up new markets for the power utilities and hence increase the profit. The moderate demands of these applications make it easier to obtain reliable communication. Firstly, the information bit rate is low; secondly, they do not require real-time performance.

* 1. **AIM OF THE PROJECT**

The main aim of the project is to design and develop a communication system in the real time using the power lines such that it can communicate with maximum efficiency.

This device is:

* Economical
* User friendly
* Reliable
  1. **LITERATURE SURVEY**

Power line communication has been around for quite some time, but has only been used for narrow band tele-remote relay applications, public lighting and home automation.

\* 1950: at a frequency of 10Hz, 10kW of power, one-way: town lighting, relay remote control.

\* Mid 1980s: beginning of research into the use of the electrical grid to support data transmission, on bands between 5 – 500Khz, always in a one-way direction,

\* 1997: first tests for bidirectional data signal transmission over the electrical supply network and the beginning of research by Ascom (Switzerland) and Norweb (U.K.)

Broadband over PLC only began at the end of the 1990s:

In the late 1990s, a number of companies from all over the world began serious research into exactly how to get high-speed signals across the network of electrical power lines. By 2004, the technology advanced to the point where hundreds of megabits per second could be transferred around the home - enough to carry multiple HDTV signals, whole-house audio, telephony, gaming, internet television, and dozens of other applications.

Making a connection is now as easy as finding the nearest power outlet.  
The technology is known as Powerline communications or PLC. Groups like the Home Plug Powerline Alliance are now working to let the world know how easy it is to unlock the incredible bandwidth found in common already-installed power lines.

* 1. **OVERVIEW OF THE PROJECT**

The term communication can broadly be defined as a unilateral or bilateral or bilateral transfer of meaningful data between two points through a medium. The data to be transferred may be analog or digital in nature.

The transmission medium, which is used in Power line modem, is mains line that provides a very cheaper and easier means of communication. In this system we are transferring files from one computer to another computer located at a remote place using mains signalling system. The data is being transferred with the help of modem which uses a principle of ASK (Amplitude Shift Keying). A modem is a circuit that translate digital data into audio tone frequencies for transmission

To communicate within a building or between two nearer buildings a power line intercom is a very practical means. They are very practical and economical since no wiring is needed between two intercoms. Instead they use the mains line to pass the signal. Frequency modulation is done on this carrier with the audio and transmitted to the mains line. Since FM is used, the noises and interruptions present in the power line do not affect the clarity of the audio.

MAIN FEATURES OF THE PROJECT:

* Since a majority of components are common for the transmitter and the receiver, the cost and size of the intercom are reduced almost to half.
* When there is no audio, the amplifier input is disconnected in order to avoid the noise in the speaker.
* When receiving an audio do not change over to transmitter even if we press the push-to-talk button and hence the audio is not lost.
* No separate wiring is required since power lines will be utilized.
* The results obtained are quite reliable.
  1. **STATEMENT OF THE PROBLEM**

Several options, with different costs, can provide voice and data communication service. The simplest solution is connecting lines. This solution is potentially quite costly because of the number of lines involved. A wireless system has also been suggested for communication. This option reduces local loop fees, but increases hardware costs and radiation issues would be there. Another alternative involves running high bandwidth lines. These lines could be fiber, ATM, or broadband coaxial cable. This option avoids local loop fees, but is beset by equipment fees. Communication between various departments in the large industries, schools or in hospitals requires large amount of resources and it is so difficult to maintain.

* 1. **PROBLEM FORMULATION**

The actual deployment of Digital Powerline will probably involve a mix of alternatives, optimized for cost efficiency in different areas and with different service providers. The proposed system is to develop a communication system that is easy to setup and even easier to use. Without new wires, powerline communications can be used to bring high-speed communication. So by using powerline communication we can achieve efficient way of communication between various departments in industries, schools or in hospitals.

Powerline communications over wireless technologies provide:

• More reliable for streaming media

• Faster speeds with fewer dropouts

• Whole-home coverage

• Extends the range of wireless technology through Wi-Fi extenders that bridge your wireless and power line networks

• Greater security (all products are sold with encryption turned on)

• Setup takes just a few minutes - just plug in!

**CHAPTER 2**

**SYSTEM OVERVIEW**

The concept of this project is to show how the power line will help for communication. In this section we discuss about the block diagram, circuit design and working. The block diagram shows the connection between different hardware components. The next part is the circuit diagram. The discussion is then proceeded to the working of the project.

**2.1 BLOCK DIAGRAM**

**2.1.1 VOICE COMMUNICATION THROUGH POWER LINE**

This system’s main concept, which is used by Power Authority, Power Line Carrier Communication or PLCC, is better explained as follows:

To avoid dependency over often jammed P & T telephones for exchanging the valuable, important information and emergency messages, the electricity boards have their exclusive, highly reliable communication networks. For this purpose, no extra lines are laid, but the wires which carry medium and high voltage power supplies (i.e. 220kV, 132kV, 66kV etc) are also used as carriers for a few volts strong communication signals. This communication system, called power line carrier communication (PLCC), serves as a grid to grid hotline.

The survival of a 3-to-4-volts-weak communication signal traveling along an astonishing 220-thoousand-volts-strong power signal is made possible by modulation, a process by which the communication signal is given a separate identity by transforming it to a high-frequency range (10kHz to 450kHz), whereas the power supply is at much lower range (50Hz). So the two signals can be separated out easily at the receiving station.

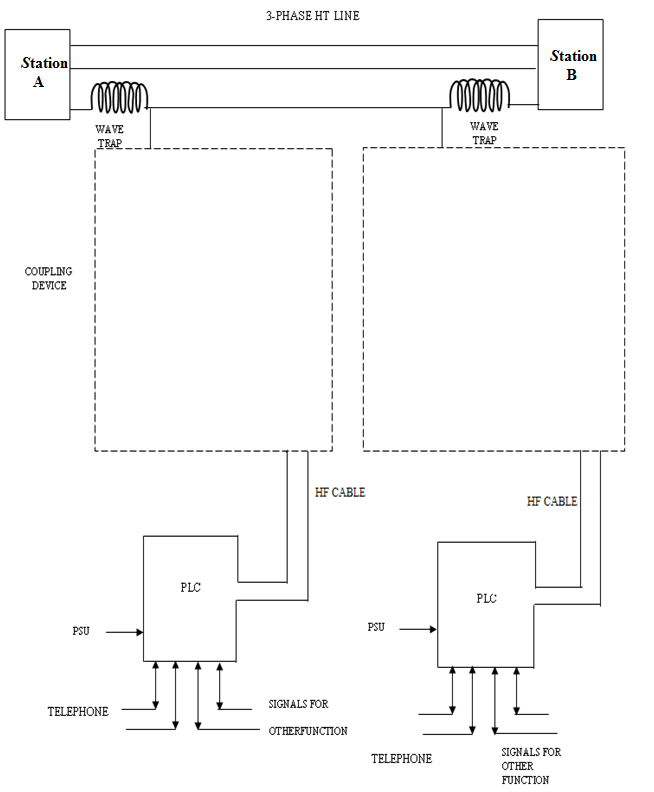


FIG 2.1 BLOCK DIAGRAM OF VOICE COMMUNICATION THROUGH POWERLINE

METHODOLOGY

A PLCC channel consists of two PLC terminals at the two stations A and B connected together by the high tension (HT) transmission line and coupling equipment’s like wave traps, coupling capacitors, coupling devices and high frequency (HF) cables. Information is accepted by a PLC terminal at station A and passed on to its counterpart at the remote station B in the form of HF signal. The remote PLC terminal delivers the same, in original form, to local users or passes it on to the adjoining PLC terminal, after amplification, for transmission to the next station C over the next line section. Thus two PLC terminals at different stations communicate with each other.PLC terminals use frequency modulation to save the bandwidth.

Tele-protection signals are available from and delivered to protection couplers and protection relays connected to the PLC terminals at the two stations, meant to protect the transmission line between these stations against fatal accidents. Telemetry signals from electrical transducers and tele-control signals for opening or closing of HT circuit breakers are also sent through PLCC.

If the computers are interfaced to the PLC terminals, digital data can be transmitted for electronic mail and fax, and hence the electricity boards can become independent of public delivery of mail.

#### MAINS

COUPLING UNIT

AC MAINS

#### PLL TRANSCEIVER

#### RING TONE

GENERATOR

#### DUPLEXER

#### AUDIO

AMPLIFIER

SPEAKER

FIG 2.2 DETAILED BLOCK DIAGRAM OF VOICE COMMUNICATION

mains coupling unit: This block couples the Power Line Intercom unit with power line. This unit has power down transformer with its own power supply section. The bidirectional unit draws power and data signals from this unit only.

PLL TRANSCIEVER: This Phase Locked Loop block acts as transmitter Unit at receiving end and Receiver Unit at transmitting end. The system transmits and receives data signals through this unit, hence is bidirectional and controlled by a switching block Duplexer. If duplexer is in receiving mode, ring tone is fed to Ring Tone Generator unit to attract the called party. If called party lifts the hand set, this unit switches to transceiver mode and hence allows both parties to make a conversation.

DUPLEXER: The duplexer is a multiplexer and acts as digital switch. This change-over-switch is fast enough to change each unit as signal transmitter and receiver, as per the need.

RING TONE GENERATOR: Whenever the caller party lifts his Intercom unit’s handset, it automatically generates ring tone signal. This signal is fed to called party’s unit to attract the attention of intended end user. It is a unidirectional signal and flows form caller party Intercom to called party Intercom.

AUDIO AMPLIFIER: The audio amplifier block amplifies caller and called party’s audio signals to sufficient level. The amplification is necessary as a data signal has to travel long distance from one intercom to another. This block is bidirectional as each intercom receives/transmits data signals simultaneously.

SPEAKER: This audio output device is used to transmit ring tone signals to attract the end user towards the hand set. When the hand set is on cradle this speaker is connected with Ring Tone Generator unit, thus rings whenever caller party lifts his hand set to make a call. When called party lifts his hand set from cradle then the speaker gets connected with Audio Amplifier so that data signals can be heard clearly.

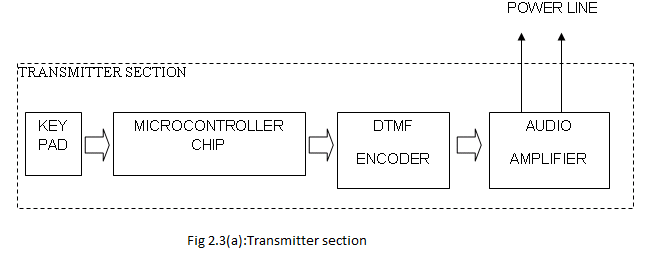
HAND SET: The hand set which is not shown in block diagram, is common in construct as any other telephone hand set. It also contains mouth piece for receiving talked signals and speaker for listening received audio signals.

**2.1.2 POWER LINE DEVICE SWITCHING SYSTEM**

The Block Diagram of Power Line Device Switching System is as shown in Fig 2.3 and its brief explanation is as follows:

The hex Key Pad has sixteen keys for entering password and device number, to which is to be switched ON/OFF. This Transmitter Section as shown in fig 2.3(a) has one Microcontroller Chip which processes the keys pressed in Key Pad and fed to DTMF Encoder. In DTMF Encoder the respective DTMF or Dual Tone Multi Frequency code is generated which is further amplified by Audio Amplifier and fed to Earth & Neutral of the Power Line for transmitting purpose.

In Receiver Section shown in fig 2.3(b) DTMF Decoder decodes the DTMF coded signals and fed to Microcontroller Chip. This Chip converts BCD or Binary Coded Decimal numbered signals into Binary form and fed to Buffer & Driver Unit. Here unit gain amplification is done and given to driver stage to drive the switching stage. The switching stage has relays which in turn switch ON/OFF respective load.



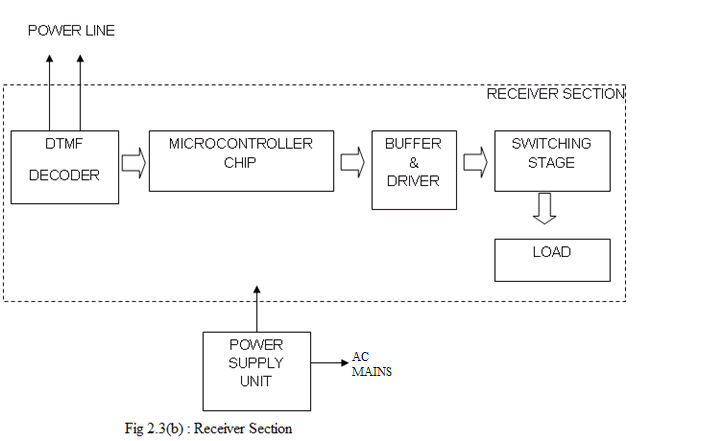


Fig 2.3 BLOCK DIAGRAM OF POWERLINE DEVICE SWITCHING SYSTEM

**TRANSMITTER SECTION**

KEY PAD: This is sixteen keys key pad, which is used to enter the password and device number to be switched ON/OFF. This 4x4 matrix key pad is interfaced with input port of Microcontroller Chip.

MICROCONTROLLER CHIP: The Input Port of the chip receives the password and device number and fed to DTMF Encoder through Output Port.

DTMF ENCODER: This stage encodes the password and device number into Dual Tone Multi Frequency code and given to Audio Amplifier.

AUDIO AMPLIFIER: The DTMF encoded signals are further amplified by audio amplifier, as DTMF codes falls in audio band, and fed to Earth and Neutral of the power line for transmitting purpose.

**RECEIVER SECTION**

DTMF DECODER: At receiving end, the DTMF encoded signals are decoded by this stage and four bit BCD code signals are given to Microcontroller chip.

MICROCONTROLLER CHIP: This chip converts 4-bit BCD codes into Binary form and makes the output pin high of the device, whose switch is pressed in Transmitting Section. The Input Port takes the BCD numbers and Output Port gives out binary numbers to Buffer & Driver Unit. Each bit indicates one device or load.

BUFFER & DRIVER UNIT: The present system shows only four loads, four Buffer & Driver pairs are used. The Buffer provides unit gain amplification and impedance matching work. The Driver stage, which is also a power amplifier, is used to drive the relays of Switching Stage.

SWITCHING STAGE: This stage has four relays for each device, and switches ON/OFF according to the signal received.

LOAD: These are anything which are switched ON/OFF by 230V AC supply viz., fan, light, TV, Fridge etc.

POWER SUPPLY UNIT: This specially designed +12 V and +5 V regulated power supply gives out the necessary power to entire system.

**2.2 Circuit dIAGRAM & ITS Description**

**2.2.1 VOICE COMMUNICATION THROUGH POWER LINE**

Depends upon the Circuit construction, this ‘POWER LINE DATA COMMUNICATION’ project is divided into these parts: Mains Coupling Unit, Phase Locked Loop Transceiver, Duplexer and Audio Amplifier.

In brief the circuit diagram explanation goes like this: the Mains Coupling Unit couples the Intercom unit with power line. This unit provides working voltage of the Intercom and allows ring tone & data signals to enter the gadget. The cradle switch decides which section of the Intercom has come-in-to-action. When caller lifts his cradle for communication, called party’s cradle will be on hook only. In such situation the cradle switch activates PLL Transceiver section, such that ring tone generator gets activated and attract the called party’s attention towards the Intercom. When called party lifts his Intercom’s hand set the PLL Transceiver with a digital change over switch Duplexer acts as telephone and switch over the Intercom circuit between listening mode and talking mode, as per the need. The Audio Power Amplifier circuit amplifies the ring tone and incoming data signals.

MAINS COUPLING UNIT: This unit provides the working voltage of the Intercom and allows data signals to flow between two units over power line. The Mains step down transformer with voltage rating of 0-9V is used to draw the required voltage. This stepped down 9V across secondary winding is AC in nature but circuits need DC. Hence bridge rectifier is constructed using four 1N4007 rectifier diodes and gets rectified +9V across end points. This is further regulated continuously by employing two filter capacitors, 470μF/50V & 0.1μF and 9V rating zener diode.

The coupling stage uses two coupling transformers between power line and Intercom unit. The incoming signals are filter using two 022μF/680V paper capacitors. The coupling transformers are isolating the heavy mains line from +9V regulated DC volts Intercom unit and allowing only low frequency data signals to pass through it.

PHASE LOCKED LOOP TRANSRECEIVER: This PLL Transceiver has two sections viz., cradle switch with PLL IC and Band Pass Filter with Audio Amplifier IC.

The incoming ring signal pass through two coupling transformers through power line. If cradle switch is On-Hook, the base biasing voltage of cradle switch transistor BC148 maintains at 6V [in cut-off state] with the help of zener diode and 100μF/50V capacitor. Thus the PLL IC LM567 acts as Voltage Controlled Oscillator [VCO] and thus generates ring tone signals, which are fed to Audio Power Amplifier IC LM386 through Duplexer**.**

As soon the cradle is Off-Hook, the transistor BC148 goes into saturation region and starts conducting. Thus the PLL IC LM567 acts as tone decoder and allows incoming data signals to be broadcasted through the same LM386 Audio Power Amplifier IC with speaker.

Simultaneously the other coupling transformer gets into picture and transmits the talked data signals to the other end. This is done by employing one microphone, the data pick-up transducer, and the weak data signals are amplified using another Audio Power Amplifier IC LM386. These amplified data signals are fed to Band Pass Filter circuit for modulation and transmission over power line through coupling transformer. The switching action is done using Duplexer IC, and is done using voltage variation across microphone.

LM567 (8-pin TONE DECODER/Phase locked loop IC)

This LM567 is a tone decoder IC consists of a twice frequency voltage-controlled oscillator [VCO] and quadrature dividers which establish the reference signals for phase and amplitude detectors. The phase detector and VCO form a phase-locked loop [PLL] which locks to an input signal frequency which is within the control range of the VCO. When the PLL is locked and the input signal amplitude exceeds an internally pre-set threshold, a switch to ground is activated on the output pin. External components set up the oscillator to run at twice the input frequency and determine the phase and amplitude filter time constants.

The IC can be operated at supply voltages of 2V to 9V and at input frequencies ranging from 1 Hz up to 500 KHz. Pin 4 is supply pin, which gets its working voltage from coupling transformer through cradle switch transistor.

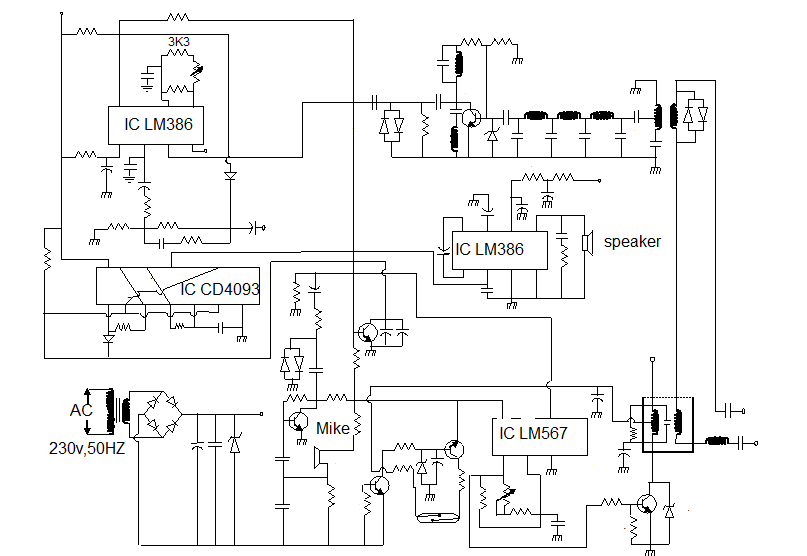
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FIG 2.4 CIRCUIT DIAGRAM OF VOICE COMMUNICATION THROUGH POWER LINE

The voltage-controlled oscillator [VCO] on the LMC567 must be set up to run at twice the frequency of the input signal tone to be decoded. The center frequency of the VCO is set by timing resistor Rt and timing capacitor Ct connected to pins 5 and 6 of the IC. The center frequency as a function of Rt and Ct is given by:

FOSC≈ 1/1.4 RtCt Hz…………………………………………………………...Eq.1.0

Since this will cause an input tone of half FOSC to be decoded,

FInput≈ 1/2.8 RtCt Hz…………………………………………………………..Eq.2.0

This equation is accurate at low frequencies; however, above 50 kHz (FOSC =100 kHz) internal delays cause the actual frequency to be lower than predicted. The choice of Rt and Ct will be tradeoff between supply current and practical capacitor values. However, the desired frequency will dictate an Rt Ct product such that increasing Rt will require a smaller Ct. Below Ct=100pF, circuit board stray capacitances begin to play a role in determining the oscillation frequency which ultimately limits the minimum Ct. To allow for I.C. and component value tolerances, the oscillator timing components will require a trim. This is generally accomplished by using a variable resistor as part of Rt, although Ct could also be padded.

Pin 2 is the combined output of the phase detector and control input of the VCO for the phase-locked loop [PLL]. Capacitor 1μF/50V in conjunction with the nominal 80Kohm pin 2 internal resistance forms the loop filter. For small values of capacitor, the PLL will have a fast acquisition time and the pull-in range will be set by the built in VCO frequency stops, which also determine the largest detection bandwidth [LDBW]. Increase capacitor results in improved noise immunity at the expense of acquisition time, and the pull-in range will begin to become narrower than the LDBW. However, the maximum hold-in range will always equal the LDBW.

DUPLEXER: The Duplexer is nothing but a digital switch, whose switching action takes place only if any one of two inputs goes low. The CD4093 has Quad 2-Input NAND Gates which are acting like Schmitt Trigger and gets triggered whenever anyone input goes low. In this Intercom Unit, IC’s three NAND gates are used to carry over the switching action between PLL Transceiver and Audio Power Amplifier with Speaker.

VCC

14

Input signals from PLL Transceiver unit

Gnd

7

To Audio Power Amplifier with Loudspeaker

CD 4093

The switching action is again depends upon the condenser microphone, whose voltage variations [caused due to picked up data signals] are fed as input to two NAND gates. It simply means no data signals at microphone end then audio amplifier with speaker comes into action.

AUDIO POWER AMPLIFER with SPEAKER: This circuit is constructed using 8-pin Audio Power Amplifier IC LM386. It comes into action when cradle is ON-Hook [to transmit Ring tone] and in conversation [to transmit called party’s data] via loud speaker.

To make the LM386 a more versatile amplifier, two pins (1 and 8) are provided for gain control. If a capacitor is put from pin 1 to 8 the gain will go up to 200 (46 dB). When using the LM386 with higher gains (bypassing the 1.35 kΩ resistor between pins 1 and 8) it is necessary to bypass the unused input, preventing degradation of gain and possible instabilities. This is done with a 0.1 µF capacitor or a short to ground depending on the dc source resistance on the driven input.

**2.2.2 POWER LINE DEVICE SWITCHING SYSTEM**

The Power Line Device Switching system is made of following circuit modules: DTMF Encoder, DTMF Decoder, Hex Key Pad, Mother Board, Buffer-Driver & Switching Stage, Audio Amplifier and finally Power Supply Unit.

**2.2.2.1 DTMF Encoder**

DTMF: The telephone is the most extraordinary element of the telecommunication systems. A telephone works on the principle of varying the line current in proportional to sound. The transducer which converts sound waves to an electrical signal is called a microphone, and the one which does the reverse function is called a speaker/earphone. Signaling is the most critical

function of any telecommunication system. Normally alternating voltages of low value are used for signaling or ringing, as commonly referred. In modern telephones, the rotary dial has been replaced by pushbutton matrix dial. These telephones use ICs to generate the DC pulses. The pulse dialing is slower and susceptible to noise. It takes over 10 seconds to dial a 6-digit number. This is very slow as compared to the processing speed of modern electronic exchanges. Besides it has the following limitations: The subscriber can signal only up to the exchange, and end to end or subscriber to subscriber signaling is not possible. Only ten codes, i.e. from 0 to 9, are possible. Time required to dial each digit is different. To overcome these limitations, modern telecommunication uses two distinct tones, which correspond to a particular number. This is called the Dual Tone Multi Frequency [DTMF] dialing. If one dials, say, number ‘5’, then two tones of 770 Hz and 1336 Hz is transmitted. These tones are sensed and decoded by the exchange and converted to the dialed digit, which is digit ‘5’ in this case. The column pertaining to tone 1633 Hz is used for special facilities like flash, pause etc.

DTMF ENCODER OR TONE DIALER IC UM95089:

Each digit in DTMF (dual tone multi-frequency) code corresponds to a combination of two discrete frequencies, one each from a low and high group of frequencies, which are generated when any switch on a dialer key-pad is pressed. Such a key-pad along with the frequencies associated with each row and column. The key-pad is used in conjunction with a dialer IC such as UM9214 or UM9215 to generate the pair of frequencies as mentioned [this job is done by microcontroller chip in our system].

1

3

4

5

9

14

13 16

12

11

7

8 6 15

R4

TO AUDIO AMPLIFIER

C1

C2

C3

C4

R1

R2

R3

R4

+Vcc

X1

R1

D1

R2

R3

FROM MICROCONTROLLER CHIP

Q1

**IC1**

FIG 2.5 CIRCUIT DIAGRAM OF DTMF ENCODER

Parts List

|  |  |  |
| --- | --- | --- |
| IC1 | UM 95089 TONE DIALER | 1 |
| Q1 | SL 100 NPN TRANSISTOR | 1 |
| R1 | 2.2 K OHM, ¼ WATT, CARBON RESISTOR | 1 |
| R2 | 22 K OHM, ¼ WATT, CARBON RESISTOR | 1 |
| R3 | 100 OHM, ¼ WATT, CARBON RESISTOR | 1 |
| R4 | 150 OHM, ¼ WATT, CARBON RESISTOR | 1 |
| D1 | RED INDICATOR LED | 1 |
| X1 | 3.58 M HZ CRYSTAL | 1 |

**Circuit Description:** The Tone Dialer IC, UM 95089 is used as DTMF Encoder. It takes 4x4 signals from Microcontroller Chip in 4 columns and 4 rows form. This eight input pins are as follows: 3 [C1], 4 [C2], 5 [C3], 9 [C4], 14 [R1], 13 [R2], 12 [R3], 11 [R4] and all are active low signals. The 3.58 M Hz [used usually in color TV] crystal is used between oscillator pins, pin- 7 & 8 [active Low], to provide stabilized tone generator frequency to internal circuitry. The ground pin is pin-6. The Single Tone pin, pin-15 [active Low], is made ground so that IC can work in dual tone mode. The power supply pin is pin-1.

The Tone Output pin, pin-16 [active High], is taken out to emitter follower circuit configured by NPN transistor Q1. This transistor provides impedance matching and maintains signal level. At collector biasing resistor R4 is used and emitter is grounded through bypass resistor R3. The Tone Output is directly fed to base of transistor Q1. The base has bypass resistor R2, to stabilize tone output signals. The indicator LED D1 is connected to this Tone Output pin along with current limiting resistor R1 to indicate the user that DTMF encoded signals are coming out. The output is taken across emitter and ground and fed to audio amplifier for more amplification purpose.

**2.2.2.2 DTMF Decoder**

DTMF Decoder and BCD to Binary Converter Module

This Section decodes the DTMF form Command signal sent by caller and converts it into eight bit binary output signals such that eight loads can be controlled independently.

Before going in deep on actual circuit & its explanation, let us have details of the terms & components used in this section.

DTMF:The Power Line Carrier Communication is the most extraordinary element of the telecommunication systems. A Power Line Carrier Communication works on the principle of varying the line current in proportional to sound. The transducer which converts sound waves to an electrical signal is called a microphone, and the one which does the reverse function is called a speaker/earphone. Signaling is the most critical function of any telecommunication system. Normally alternating voltages of low value are used for signaling or ringing, as commonly referred. In modern Power Line Carrier Communications, the rotary dial has been replaced by pushbutton matrix dial. These Power Line Carrier Communications use ICs to generate the DC pulses. The pulse dialing is slower and susceptible to noise. It takes over 10 seconds to dial a 6-digit number. This is very slow as compared to the processing speed of modern electronic exchanges. Besides it has the following limitations: The subscriber can signal only up to the exchange, and end to end or subscriber to subscriber signaling is not possible. Only ten codes, i.e. from 0 to 9, are possible. Time required to dial each digit is different. To overcome these limitations, modern telecommunication uses two distinct tones, which correspond to a particular number. This is called the Dual Tone Multi Frequency [DTMF] dialing. If one dials, say, number ‘5’, then two tones of 770 Hz and 1336 Hz is transmitted. These tones are sensed and decoded by the exchange and converted to the dialed digit, which is digit ‘5’ in this case. The column pertaining to tone 1633 Hz is used for special facilities like flash, pause etc.

**DTMF DECODER KT3170/MT8870 IC refer data sheet for IC details & pin configurations**

The DTMF signals transmitted over the Power Line Carrier Communication lines can be received and decoded using a DTMF receiver/decoder IC such as UM92870 or KT3170 or Motorola’s MT8870. The decoded outputs can be suitably used along with certain additional circuitry to design a Call-Line-Identification-Product unit [popularly known as CLIP]. The four hexadecimal output obtained from the DTMF receiver/decoder IC corresponding to each digit on the Power Line Carrier Communication key-pad together with the associated dual-tone frequencies can be put-it in a table form for easy reference

The DTMF digits transmitted over the Power Line Carrier Communication lines would have a nominal width of 50 ms followed by a pause (no signal) of similar duration between consecutive digits. Thus, ten consecutive digits would be transmitted in one second. Note that the DTMF codes for the CLIP service are transmitted in between the handset is On-Cradle. Hence it is essential to detect On-Cradle and Off-Cradle status of called subscriber as well as the ringing signal.

Table 2.1: DTMF SIGNAL OUTPUT CODES

Digit Low Group High Group Row Col. Hexadecimal O/P)

(Hz) (Hz) Q1 Q2 Q3 Q4

1 697 1209 1 1 0 0 0 0

2 697 1336 1 2 0 0 0 1

3 697 1477 1 3 0 0 1 0

4 770 1209 2 1 0 0 1 1

5 770 1336 2 2 0 1 0 0

6 770 1477 2 3 0 1 0 1

7 852 1209 3 1 0 1 1 0

8 852 1336 3 2 0 1 1 1

9 852 1477 3 3 1 0 0 0

0 941 1336 4 1 1 0 0 1

• 941 1209 4 2 1 0 1 0

# 941 1477 4 3 1 0 1 1

A 697 1633 2 4 1 1 0 0

B 770 1633 2 4 1 1 0 1

C 852 1633 3 4 1 1 1 0

The On-Cradle and Off-Cradle status of the handset can be detected, based on the voltage state, before the start of ringing (which is between 40 and 52V DC approximately). The voltage drops to 10 to 12V DC on lifting of the handset from the cradle. The ringing status can be detected with the use of either a coactively coupled rectifier bridge or an AC Opto-coupler (or even a DC Opto-coupler with an external diode shunted in anti-parallel across the internal diode of the Opto-coupler together with a current limiting series resistor.

DTMF Matrix Dial

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Hi-Group  Low-Group | 1290 | 1336 | 1477 | 1633 |
| 697 | 1 | 2 | 3 | ? |
| 770 | 4 | 5 | 6 | ? |
| 852 | 7 | 8 | 9 | ? |
| 941 | \* | 0 | # | ? |

FIG 2.6 DTMF KEYPAD

The end of calling-number can be detected from the knowledge of inter-digital pause. A time-out e.g. 150 ms or so, can be fixed for this purpose. This is termed as inter-digit time-out (IDT). For the purpose of calculation of IDT, as also for shifting of the consecutive digits, one can make use of active high DSO (delayed steering output) signal from pin 15 of IC8870/KT3170.

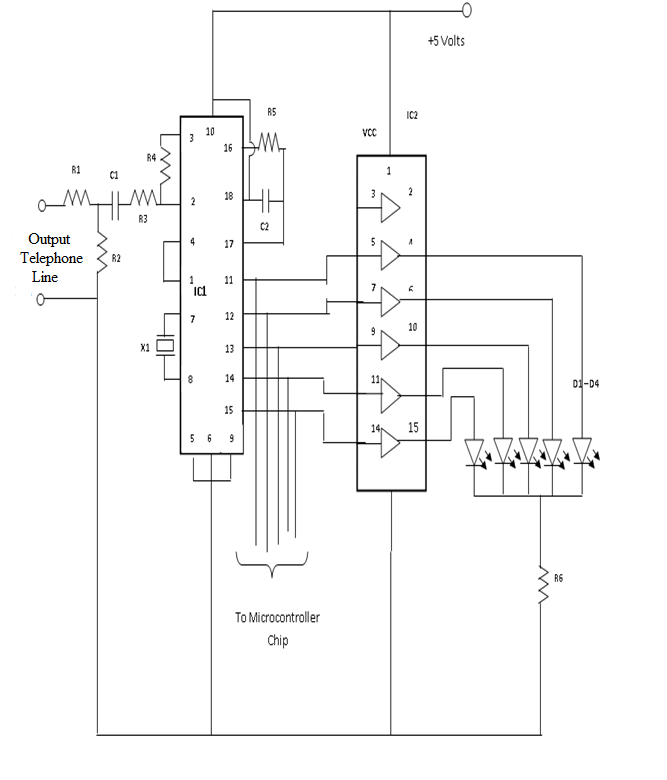


FIG 2.7 CIRCUIT DIAGRAM OF DTMF DECODER

Parts List:

|  |  |  |
| --- | --- | --- |
| **SEMICONDUCTORS** |  |  |
| IC1 | KT3170/MT8870, DTMF to BCD Converter IC | 1 |
| IC2 | CD 4049 Buffer / Converter IC | 1 |
| **RESISTORS** |  |  |
| R1& R2 | 22 K Ohms ¼ Watt Carbon Resistor | 2 |
| R3 | 10 K Ohms ¼ Watt Carbon Resistor | 1 |
| R4 | 1 M Ohms ¼ Watt Carbon Resistor | 1 |
| R5 | 330 Ohms ¼ Watt Carbon Resistor | 1 |
| R6 | 470 Ohms ¼ Watt Carbon Resistor | 1 |
| **CAPACITORS** |  |  |
| C1 & C2 | 0.1 µF CERAMIC DISC TYPE | 2 |
| **MISCELLANEOUS** |  |  |
| X1 | 3.5795 M Hertz Crystal | 1 |
| D1 – D4 | Red Indicator LEDs | 4 |

Circuit Description:

The circuit uses IC KT3170 (DTMF-to-BCD converter) and accepts 0 to 9 keys from the Mobile hand set key pad.

This circuit is to be connected in parallel to the telephone instrument. The DTMF Signals from Mobile handset are entering this stage through RC network formed by R1, R2, C1 & R3 components. Pin-3 of IC1 is biased with input telephone line through resistor R4. The Crystal X1 is fitted to pins 7 & 8 of IC1 for internal oscillation purpose. The pin-10 is Vcc and given to power supply line. Internal circuitry of IC1 needs biasing hence pin-16, 18, and 17 are connected with R5 and C2. The IC1 outputs DTMF signals coming from Telephone line into 4-bit BCD form at pins 11, 12, 13 &14. The Conversion checking bit is get from pin-15 of IC1. This pin output goes HIGH if DTMF-to-BCD conversion is successful. These outputs are taken out for Microcontroller chip input.

The Buffer section comprises of IC2, which has six buffers. Five Buffers of IC2 are used to drive five LEDs for output indication. These Buffers provide unit gain amplification to the DTMF outputted signals.

**2.2.2.3 Hex Key Pad**

Most Micro-controller projects will include switches, a key pad, or some other way of allowing users to control the circuits inside. The control might involve flipping a switch beign an operation, pressing a key to select an option, or entering a number for the program to use in its operations. For simple tasks, one can use toggle, slide, or pushbutton switches. Other project might call for a keypad with an array of switches, with each labeled with a number, letter, or other description.

DETECTING THE SWTICH PRESS

Momentary switches are useful when any body want to get the attention of busy Micro-controller. For example a program that normally displays the current room temperature and time, but switches to a setup routine when user press a switch. On a normally open pushbutton [momentary] switch, the contacts close when user press the switch, then open as user relase it. In a normally closed mementary switch, the contacts open when user press, and close on release. Usually external INTERRUPTs are used to detect the pressed Switch.

Geneal tasks of the program related with switches is:

* Scan for any key press continuously
* Debounce the key switch
* Determine which key is pressed
* Take appropriate action once for that press of the key
* Wait for release of that key

POLLING

When user do not whant to use an INTerrupt, an alternative way to detect a keypress is by polling, which consists of having the program check periodically to see if the switch has been pressed. In a program that prompts for input and then waits for the user to press a key, and poll continuously until response is seen. While using POLLING user has to be sure to check the switch often enough so that Micro-controller will not miss a switch press.

SWITCH DEBOUNCING

Switch bounce occur because manual presses of mechanical switches ten to be sloppy. When user press a switch, the contacts normally bounce open and closed several times before they close positively, and bounce again as user lift his finger and the contacts open. It is Micro-controller’s job check whether the received signal is genuine Key Press signal or Debounce signal. And one way to handle switch bounce is to ignore keypresses that are less than a certain length, usually around 10 – 20 milliseconds, with the exact value depending on the switch characteristics,. Ignoring switch bounce is called switch debouncing.

KEY PAD TYPES

Some keypads have attached cables that terminate in a connnector. Others have headers to which user can solder wires or connect own cable.

Different keypads follow different decoding schemes for detecting which key is pressed.  
Some have a dedicated connector pin for each key and a single common pin to which the pins connect when a key is pressed. One can wire and access these like a series f individual switches,with a pull-up or pull-down resistor at each switch.

Other keypads use matrix encoding, where the switch connections are arranged in a rectangular array. There are four rows and four columns to which the switches connect. Each key corresponds to a hexadecimal digit.

In this Key board, each key acts as a normally open push button whose contacts connect one row and one column when the key is pressed. That is, for example Key S5 is pressed then R2 row and C2 column are connected. By determining which row and column are shorted, Micro-controller can detect which key has been pressed.

This Matrix encoding saves on hardware, since each key does not require a dedicated signal line. That means using eight signal lines [4 for scanning and 4 for getting Key press signal] one can detect any of 16 key presses.

In this Matrix Key board, pull-up resistors are used with respect to +Vcc to make all rows and columns HIGH. It is necessary, as when 89C51 Micro-controller checks for Key Press it actually looks for HIGH *s*ignal level at Scanning lines.

R1

R1

R1

R1

R1

R1

R1

R1

R1

R1

R1

**Scanning** Signals from Output PINS

**R1**

**R2**

**R3**

**R4**

**KEY PRESS** SIGNAL TO INPUT PINS

**C4 C3 C2 C1**

+Vcc

S5

S9

SD

S1

S4

S8

SC

S0

S7

SB

SF

S3

S6

SA

SE

S2

FIG 2.8 CIRCUIT DIAGRAM OF DTMF MATRIX KEY PAD

Parts list

|  |  |
| --- | --- |
| R1 | 10 K Ω, ¼ Watt Carbon Resistor |
| S1….S12 | Push-to-On Tactile Switches |

**CIRCUIT DESCRIPTION**

This Key board is arranged in four rows and four columns in matrix form. There are four rows R1, R2, R3, R4 and four columns C1, C2, C3, C4 to which the switches are connected. Each key corresponds to a hexadecimal digit, i.e., from 0 to 9 and A to F.

In this Key board, each key acts as a normally open push button whose contacts connect one row and one column when the key is pressed. That is, for example Key S5 is pressed then R2 row and C2 column are connected. By determining which row and column are shorted, 89C51 Micro-controller can detect which key has been pressed.

In this Matrix Key board, pull-up resistors are used with respect to +Vcc to make all rows and columns HIGH. It is necessary, as when 89C51Micro-controller checks for Key Press it actually looks for HIGH signal level at Scanning lines.

It is the function of the 89C51 Micro-controller to scan the Key board continuously by sending Scanning pulses to Rows to detect and identify the key pressed. And the Key pressed signal is monitored across the columns of Key Board through Input Pins.

If no Key has been pressed, reading the input port will yield 1s for all columns since they are all connected to High [+Vcc]. If all the rows are ground and a key is pressed, one of the columns will have zero since the key pressed provides the path to ground.

initially, all the keys will be in the released state, and hence when 89C51Micro-controller scans through rows the +Vcc voltage appears at all the Columns [C1, C2, C3 & C4]. This +Vcc at all columns is detected as High signal and hence 89C51Micro-controller comes to know that Key is not pressed.

When any one key is pressed, say S5, then corresponding row and column gets shorted [row R2 and column C2]. This shorting provides ground path to +Vcc, which is present in the Matrix. This HIGH to LOW signal transition will be detected by 89C51Micro-controller during the scanning. By knowing the row and column which are shorted [here R2 & C2], the 89C51Micro-controller identifies which key is pressed [S5].

**CHAPTER 3**

**HARDWARE DESCRIPTION**

The hardware part consists of the description about different hardware components that are used in the project. It starts with the discussion about the Microcontroller. Eventually the discussion proceeds towards the other hardware components used like POWER TRANSFORMER, Audio Power Amplifier, 8-pin TONE DECODER/Phase locked loop IC, and QUAD 2-INPUT NAND SCHMITT TRIGGER.

**3.1 AT89C51 Microcontroller**

The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 8K 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 80C51 and 80C52 instruction set and pin out.

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 the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, three 16-bit timer/counters, a six-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.

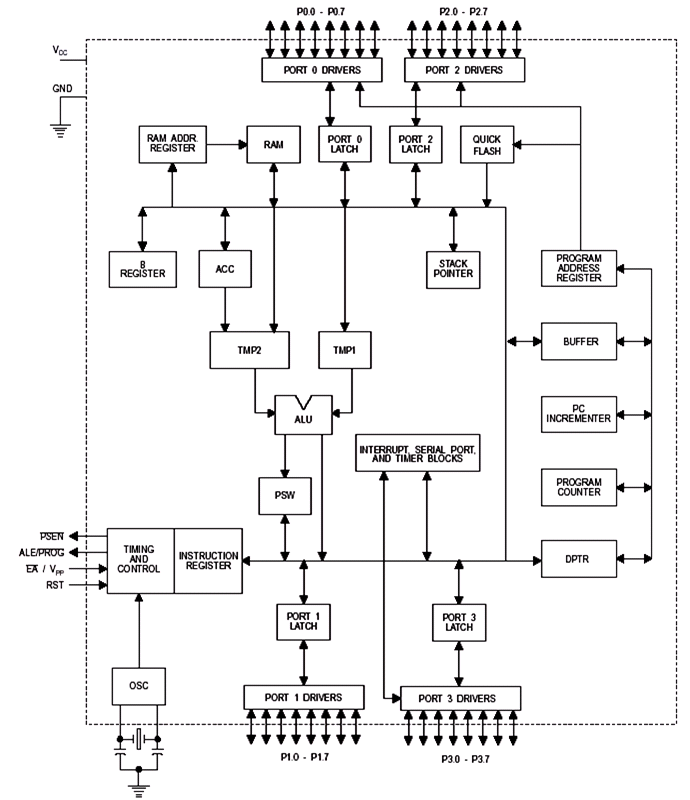


FIG 3.1 BLOCK DIAGRAM OF MICROCONTROLLER 89C51

**Features:**

* Compatible with MCS-51™ Products
* 8K 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
* 256 x 8-bit Internal RAM
* 32 Programmable I/O Lines
* Three 16-bit Timer/Counters
* Eight Interrupt Sources
* Programmable Serial Channel

**3.2 LM 386 IC [8-pin Audio Power Amplifier]**

The LM386 is a power amplifier designed for use in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value up to 200.

The inputs are ground referenced while the output is automatically biased to one half the supply voltages. The quiescent power drain is only 24 mill watts when operating from a 6 volt supply, making the LM386 ideal for battery operation.

Three variations of these ICs are available:

* LM386-N1 cheapest variety 300mW
* LM386-N3 500mW
* LM386-N4 expensive variety 700Mw

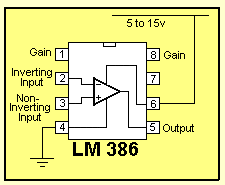


FIG 3.2 LM 386 IC [8-pin Audio Power Amplifier]

**Features**

* Battery operation
* Minimum external parts
* Wide supply voltage range: 4V–12V or 5V–18V
* Low quiescent current drain: 4 mA
* Voltage gains from 20 to 200
* Ground referenced input
* Self-centering output quiescent voltage
* Low distortion
* Available in 8 pin MSOP package

**3.3 LM567 IC [8-PIN TONE DECODER/PLL]**

The NE567 or SE567 is a Phase Locked Loop (PLL) Tone Decoder. It is highly stable with synchronous AM lock detection and power output circuitry. Its primary function is to drive a load whenever a sustained frequency within its detection band is present at the self-biased input. The bandwidth center frequency and output delay are independently determined by means of four external components.

The LM567 and LM567C are general purpose tone decoders designed to provide a saturated transistor switch to ground when an input signal is present within the pass band. The circuit consists of an I and Q detector driven by a voltage controlled oscillator which determines the center frequency of the decoder. External components are used to independently set center frequency, bandwidth and output delay.

Small Outline and Dual-In-Line Packages

GROUND

OutPut Filter c3

OUTPUT

INPUT VOLTAGE

LM 567

Loop Filter C2

Timing Capacitor

R1/C1

Timing resistor

R1

Vcc

FIG 3.3 LM567 IC [8-PIN TONE DECODER/PLL]

**Features**

* 20 TO 1 frequency range with an external resistor
* Logic compatible output with 100mA current sinking capability
* Bandwidth adjustable from 0 to 14% [Independently controllable bandwidth]
* High rejection of out of band signals and noise
* Inherent Immunity to false frequency
* Highly stable center frequency
* Center frequency adjustable from 0.01 Hz to 500 KHz
* Supply voltage: 5v typical
* Touch-Tone decoding
* Carrier current remote controls
* Ultrasonic controls (remote TV, etc.)
* Communications paging
* Frequency monitoring and control
* Wireless intercom
* Precision oscillator

# 3.4 CD 4093 QUAD 2-INPUT NAND SCHMITT TRIGGER

**14**

**13**

**1**

**8**

**9**

**10**

**12**

**11**

**4**

**7**

**6**

**5**

**3**

**2**

**Gnd**

**VCC**

# FIG 3.4 CD 4093 QUAD 2-INPUT NAND SCHMITT TRIGGER

General Characteristics:

* Voltage Rating : 3V-18V max
* Operating Temperature : 70°C
* Max Power Dissipation : 0.01mW
* Propagation Delay : 30 ns
* Max Toggle Speed : 10 MHz
* Fan Out : >50
* Noise Immunity : 4.5V

**3.5 Power Supply Unit**

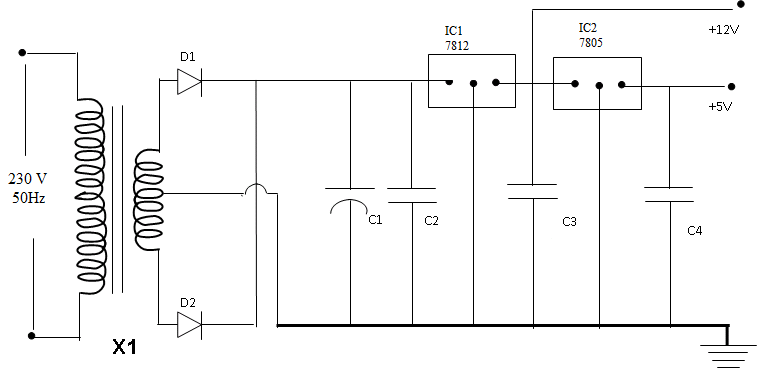
The circuit needs two different voltages, +5V & +12V, to work. These dual voltages are supplied by this specially designed power supply.

Fig 3.5 POWER SUPPLY UNIT

Parts List

|  |  |  |
| --- | --- | --- |
| SEMICONDUCTORS |  |  |
| IC1  IC2 | 7812 Regulator IC  7805 Regulator IC | 1  1 |
| D1& D2 | 1N4007 Rectifier Diodes | 2 |
| CAPACITORS |  |  |
| C1 | 1000 µf/25V Electrolytic | 1 |
| C2 to C4 | 0.1µF Ceramic Disc type | 3 |
| MISCELLANEOUS |  |  |
| X1 | 230V AC Pri,14-0-14 1Amp Sec Transformer | 1 |

A d.c power supply which maintains the output voltage constant irrespective of a.c. mains fluctuations or load variations is known as regulated d.c. power supply.It is also referred as full-wave regulated power supply as it uses four diodes in bridge fashion with the transformer. This laboratory power supply offers excellent line and load regulation and output voltages of +5V & +12 V at output currents up to one amp.

1. Step-down Transformer: The transformer rating is 230V AC at Primary and 12-0-12V, 1Ampers across secondary winding. This transformer has a capability to deliver a current of 1Ampere, which is more than enough to drive any electronic circuit or varying load. The 12VAC appearing across the secondary is the RMS value of the waveform and the peak value would be 12\*1.414 = 16.8 volts. This value limits our choice of rectifier diode as 1N4007, which is having PIV rating more than 16Volts.

2. Rectifier Stage: The two diodes D1 & D2 are connected across the secondary winding of the transformer as a full-wave rectifier. During the positive half-cycle of secondary voltage, the end A of the secondary winding becomes positive and end B negative. This makes the diode D1 forward biased and diode D2 reverse biased. Therefore diode D1 conducts while diode D2 does not. During the negative half-cycle, end A of the secondary winding becomes negative and end B positive. Therefore diode D2 conducts while diode D1 does not. Note that current across the centre tap terminal is in the same direction for both half-cycles of input a.c. voltage. Therefore, pulsating d.c. is obtained at point ‘C’ with respect to Ground.

3. Filter Stage: Here Capacitor C1 is used for filtering purpose and connected across the rectifier output. It filters the a.c. components present in the rectified d.c. and gives steady d.c. voltage. As the rectifier voltage increases, it charges the capacitor and also supplies current to the load. When capacitor is charged to the peak value of the rectifier voltage, rectifier voltage starts to decrease. As the next voltage peak immediately recharges the capacitor, the discharge period is of very small duration. Due to this continuous charge-discharge-recharge cycle very little ripple is observed in the filtered output. Moreover, output voltage is higher as it remains substantially near the peak value of rectifier output voltage. This phenomenon is also explained in other form as: the shunt capacitor offers a low reactance path to the a.c. components of current and open circuit to d.c. component. During positive half cycle the capacitor stores energy in the form of electrostatic field. During negative half cycle, the filter capacitor releases stored energy to the load.

4. Voltage Regulation Stage: Across the point ‘D’ and Ground there is rectified and filtered d.c. In the present circuit KIA 7812 three terminal voltage regulator IC is used to get +12V and KIA 7805 voltage regulator IC is used to get +5V regulated d.c. output. In the three terminals, pin 1 is input i.e., rectified & filtered d.c. is connected to this pin. Pin 2 is common pin and is grounded. The pin 3 gives the stabilized d.c. output to the load. The circuit shows two more decoupling capacitors C2 & C3, which provides ground path to the high frequency noise signals. Across the point ‘E’ and ‘F’ with respect to ground +5V & +12V stabilized or regulated d.c output is measured, which can be connected to the required circuit.

**CHAPTER 4**

**SOFTWARE IMPLEMENTATION**

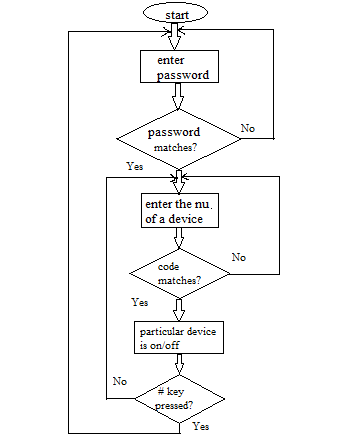
We are using embedded C language programming to implement this project.

**4.1 KEIL C COMPILER**

The program for this project is written in embedded C language (KeilCx51 compiler).The C programming language is general purpose programming language that provides code efficiency and rich set operators. Its generality combined with its absence restrictions, makes C a convenient and effective programming solution for a wide variety of software tasks. Many applications can be solved more easily and effectively with C than with other more specialized languages. The Cx51 optimizing C compiler is a complete implementation of American National Standards Institutes (ANSI) standards for C language. Cx51 is not a universal C compiler adapted for the 8051 target. It is a ground up implementation dedicated to generating extremely fast and compact code for the 8051 microcontroller. Cx51 provides the flexibility of programming in C and speed of assembly language.

The C language on its own is not capable of performing operations (such as input and output) that would normally require intervention from operating system. Instead, these capabilities are provided as part of the standard library because these functions are separate from the language itself, C is especially suited for producing codes that is portable across a wide number of platforms.

**4.2 FLOWCHART**

****

The flowchart shown in this section .Here the initial stage is one in which password is entered on the Hex Keypad. Different keypads follow different decoding schemes for detecting which key is pressed which is encoded by the microcontroller. In the next stage microcontroller verifies the entered password with the password stored in its buffer register. If the password matches we can control the switching actions of the different devices .If the password doesn’t matches then it refers to invalid user thus remote maintenance is not possible. If the password is valid the user is asked to enter the device code. If the device code matches then particular devices can be controlled.

**CHAPTER 5**

**ADVANTAGES**

The advantages of the project are as listed below:

* **No need for additional networking:**

The power grid is ubiquitous; it constitutes an existing network infrastructure to billions of private consumers and businesses. The power grid offers last-mile conductivity. The power grid supports information based services with strong growth potential.

* **High transmission rate**:

Right now 3 mbps in uploading and downloading. The data transmission rate is expected up to 200 mbps in the future by improving the PLC chip.

* **Lower investment cost**:

Lower costs are achieved because the service is implemented on standard electrical lines. The service is also convenient because it’s already in your home.

* **Security service**:

With no new wiring. From any power outlet, you can monitor your children and the people you love who may need regular help.

**5.1 LIMITATIONS**

The limitations of the project are as listed below:

* **Electro-Magnetic Radiation Issues**

Powerline solutions, like phone line solutions, are unintentional radiators. Emissions can potentially cause interference with radio, television, community antenna television, telephone and DSL services.

Second generation PLC technologies are using techniques like OFDM, which substantially reduce the potential of interference to radio users, thanks to a decrease in transmitted power spectral density. The OFDM modulation spreads the signal over a very wide bandwidth, thus reducing the amount on power injected at a single frequency.

* **Addressing issue**

As the number of users and devices connected to Power Lines increases by orders of magnitude, it becomes clear that we cannot satisfy the demand using IPv4/NAT, at least not without enormous administrative complexity. A much larger address space is needed to provide end-to-end connectivity in a simple manner and to allow new applications and services to work in a transparent manner.

* **Security:**

The transmission of data over a network that anybody has access to could also pose a data security problem, however. Tapping the signal could allow somebody to eavesdrop on communications. Only data encryption eliminates that problem.

* **Noise interference**

Power line networking is also vulnerable to interference from devices connected to the power infrastructure, such as microwaves and computers.

This can be solved by either using repeaters or dynamic change of frequencies.

**5.2 APPLICATIONS**

The applications of the project are as listed below:

1. Powerline communications can be used to bring high-speed connectivity to:

* Residential zones (where broadband internet connectivity is required)
* Business zones (where an alternative communication system to cellular networks is required)
* Important civilian regions (where a high degree of service availability is required)
* University campuses (where inexpensive campus-wide network coverage can be provided)
* Wi-Fi Hotspots
* Multi Tenant / Multi Dwelling Units
* Hotels and Hospitality Suites

1. High-speed digital Internet  
   Fast and secure whole-house connectivity to the Internet for surfing, email, gaming, internet television, connecting your TV, etc.
2. Whole-house Audio  
   New and elegantly designed whole-house audio systems can provide music in every room in an existing house. These systems can also connect to your favorite Internet radio stations and music services - forever changing how you listen to music.
3. Security & Monitoring  
   Surveillance systems with both visual and motion detectors that can be monitored by you and a security service - with no new wiring. From any power outlet, you can monitor your children and the people you love who may need regular help.
4. Smart Homes  
   Remote maintenance and in-house control of internet-enabled household appliances like refrigerators, heating systems, smoke and fire alarm systems.
5. Internet Telephony

Powerful telephone connection using the internet that offers security and good speech quality. You can even send and receive fax messages.

1. Power management (near energy services)

Near energy serv**i**ces are defined as energy services within the confines of current business which ads new forms, features and scales. Examples are remote billing, remote metering, demand side e management distribution automation and remote control of supply. Advantages of such system for utilities lie in their potential for cost cutting and improving customer loyalty

1. Used in industries for remote operation of devices.

### CHAPTER 6

### FUTURE SCOPE & CONCLUSION

Power line communication provides an alternative way of communication. This project provides an efficient way of communication through the existing power lines as a communication medium. Our project is more applicable in large industries, schools or in hospitals where we want to communicate between various departments.

Power-line communication, communicates over the existing power lines. The main advantage of this kind of communication system is the existing infrastructure, which simplifies the implementation. A general introduction to power-line communication, by doing some measurements of basic properties, to understand the behavior of the power-line as a communication channel. Then we use these results combined with coding, modulation methods, different receiver structures, diversity and coding to present a communication strategy for the power-line channel.

Our approach in designing a communication system for the power-line channel is a simple implementation of the receiver, which lowers the cost. A robust set of methods, which are able to handle unknown phase and attenuation. These methods are then used combined with coding, frequency diversity (similar to Orthogonal Frequency Division Multiplex) to suggest a communication system for the power-line channel, a flexible structure that can be upgraded to future needs.

Future Scope:

The following modifications can be made to the present project, which leads to still smarter project.

* This system can be used in Nuclear Power Stations or Power Grid Stations, which are very hazardous for human beings to work in and needs heavy data transmission between the points.
* The present data signal transmission system can be further modified to send mixed signals such as graphics, video & audio signals over the power line.
* PLC technology is used to provide broad band internet over ordinary power lines.
* This project is open for developments from all sides. It is the users’ imagination which limits the working of this project. One can go on adding the extra, rich features to this project.
* The system can be further modified to get the current status & execution of command of the load by audible beep.
* The above mentioned developments can be used in many public sector offices such as Railway enquiries, Bus Reservation Counter or in Electricity or Power Line Carrier Communication enquiry centers.
* Replacing the micro-controller with computer, one can make the system fully automatic and smarter one. The system can be more secured and comfortable with computer based control unit.

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APPENDIX A

SOURCE CODE

/\* PROGRAM FOR PASSWORD PROTECTED DEVICE SWWITCHING \*/

#include<stdio.h>

#include<at89x51.h> //HEADER FILE FOR ATMEL 89C51

#include<string.h>

sfr port0 = 0x80;

sfr port1 = 0x90;

sfr port2 = 0xa0;

sfr port3 = 0xb0;

sbit bitout = port2 ^ 0;

sbit dev1 = port3 ^ 0;

sbit dev2 = port3 ^ 1;

sbit dev3 = port3 ^ 2;

sbit dev4 = port3 ^ 3;

sbit led1 = port3 ^ 4;

bit e1;

unsigned char bcdin,digit,store;

unsigned int ptr=0, val=0;

unsigned int telno = 43219;

void delay() // DELAY FUNCTION

{

unsigned int i;

for (i = 0;i < 5000 ; i++ )

}

void displaycno(unsigned char);

void main()

{

bitout = 1;

port1 = 0xff;

port0 = 0x00;

port3 = 0x00;

e1 = 1;

while (1)

{

while( bitout == 0 )

{

e1 = 0;

}

delay();

if (bitout == 1 && e1 == 0)

{

led1 = 1;

delay(); delay(); delay(); delay(); delay(); delay(); delay(); delay(); delay(); delay();

led1 = 0;

bcdin = port1;

e1 = 1;

displaycno(bcdin);

}

if ((val == telno) && (ptr == 0))

{port0 = 0x01; ptr = 1;}

else if (ptr == 0) port0 = 0x00;

if (ptr == 1)

{

if (digit == 1)

dev1 = 1;

if (digit == 2)

dev1 = 0;

if (digit == 3)

dev2 = 1;

if (digit == 4)

dev2 = 0;

if (digit == 5)

dev3 = 1;

if (digit == 6)

dev3 = 0;

if (digit == 7)

dev4 = 1;

if (digit == 8)

dev4 = 0;

}

}

}

void displaycno(unsigned char dig)

{

dig = dig & 0x0f;

if (dig == 0x0c)

{val = 0; ptr=0; dig=0;}

if (dig == 0x0a)

dig = 0;

digit = dig;

val = val \* 10 + dig;

}

APPENDIX B

DATASHEETS

**89C51RB2/RC2/RD2**

**80C51 8-bit Flash microcontroller family16KB/32KB/64KB ISP/IAP Flash with 512B/512B/1KB RAM**

**1. General Description**

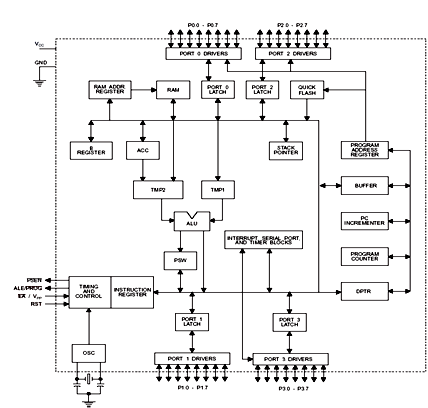
The 89C51RB2/RC2/RD2 device contains a non-volatile16kB/32kB/64kB Flash program memory that is both parallel programmable and serial In-System and In-Application Programmable. In-System Programming (ISP) allows the user to download new code while the microcontroller sits in the application In-Application Programming (IAP) means that the microcontroller fetches new program code and reprograms itself while in the system. This allows for remote programming over a modem link. A default serial loader (boot loader) program in ROM allows serial In-System programming of the Flash memory via the UART without the need for a loader in the Flash code. For In-Application Programming, the user program erases and reprograms the Flash memory by use of standard routines contained in ROM.

This device executes one machine cycle in 6 clock cycles, hence providing twice the speed of a conventional 80C51. An OTP configuration bit lets the user select conventional 12 clock timing if desired.This device is a Single-Chip 8-Bit Microcontroller manufactured in advanced CMOS process and is a derivative of the 80C51 microcontroller family. The instruction set is 100% compatible with the 80C51 instruction set.The device also has four 8-bit I/O ports, three 16-bit timer/event counters, a multi-source, four-priority-level, nested interrupt structure, an enhanced UART and on-chip oscillator and timing circuits. The added features of the P89C51RB2/RC2/RD2 makes it a powerful microcontroller for applications that require pulse width modulation, high-speed I/O and up/down counting capabilities such as motor control.

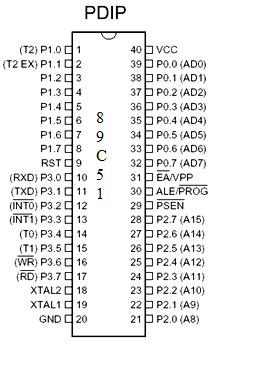
**2. Features**

* 80C51 Central Processing Unit
* On-chip Flash Program Memory with In-System Programming(ISP) and In-Application Programming (IAP) capability.
* Boot ROM contains low level Flash programming routines for downloading via the UART.
* Can be programmed by the end-user application (IAP)
* 6 clocks per machine cycle operation (standard)
* 12 clocks per machine cycle operation (optional)
* Fully static operation
* RAM expandable externally to 64 kB.
* level priority interrupt
* 8 interrupt sources.
* Four 8-bit I/O ports.
* Full-duplex enhanced UART
* Power control modes.
* Programmable clock out.
* Second DPTR register
* Asynchronous port reset
* Low EMI (inhibit ALE)
* Programmable Counter Array (PCA)

**3. Block diagram**



**Pin configuration**







**LM386**

**Low Voltage Audio Power Amplifier**

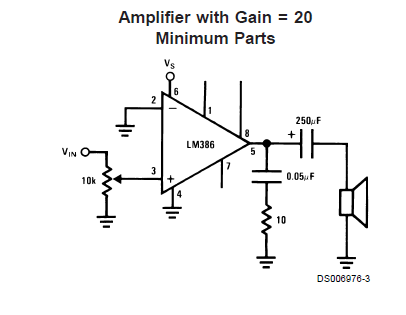
**General Description**

The LM386 is a power amplifier designed for use in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value from 20 to 200. The inputs are ground referenced while the output automatically biases to one-half the supply voltage. The quiescent power drain is only 24 milliwatts when operating from a 6 volt supply, making the LM386 ideal for battery operation.

**Features**

* Battery operation
* Minimum external parts
* Wide supply voltage range: 4V–12V or 5V–18V
* Low quiescent current drain: 4mA
* Voltage gains from 20 to 200
* Ground referenced input
* Self-centering output quiescent voltage
* Available in 8 pin MSOP package

**Typical application**



Absolute Maximum Ratings

* Supply Voltage
* (LM386N-1, -3, LM386M-1) 15V
* Supply Voltage (LM386N-4) 22V
* (LM386N) 1.25W
* (LM386M) 0.73W
* (LM386MM-1) 0.595W
* Input Voltage ±0.4V
* Storage Temperature -65°C to +150°C
* Operating Temperature 0°C to +70°C
* Junction Temperature +150°C
* Minimum supply voltage 5v
* Maximum supply voltage 15v

**Application**

* AM-FM radio amplifiers
* Portable tape player amplifiers
* Intercoms
* TV sound systems
* Line drivers
* Ultrasonic drivers
* Small servo drivers
* Power converters

**LM340/LM78XX Series**

**3-Terminal Positive Regulators**

**General Description**

The LM140/LM340A/LM340/LM78XXC monolithic 3-terminal positive voltage regulators employ internal current-limiting, thermal shutdown and safe-area compensation, making them essentially indestructible. If adequate heat sinking is provided, they can deliver over 1.0A output current. They are intended as fixed voltage regulators in a wide range of applications including local (on-card) regulation for elimination of noise and distribution problems associated with single-point regulation. In addition to use as fixed voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents. Considerable effort was expended to make the entire series of regulators easy to use and minimize the number of external components. It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is located far from the filter capacitor of the power supply. The 5V, 12V, and 15V regulator options are available in the steel TO-3 power package. The LM340A/LM340/LM78XXC series is available in the TO-220 plastic power package, and the LM340-5.0 is available in the SOT-223 package, as well as the LM340-5.0 and LM340-12 in the surface-mount TO- 263 packages.

**Features**

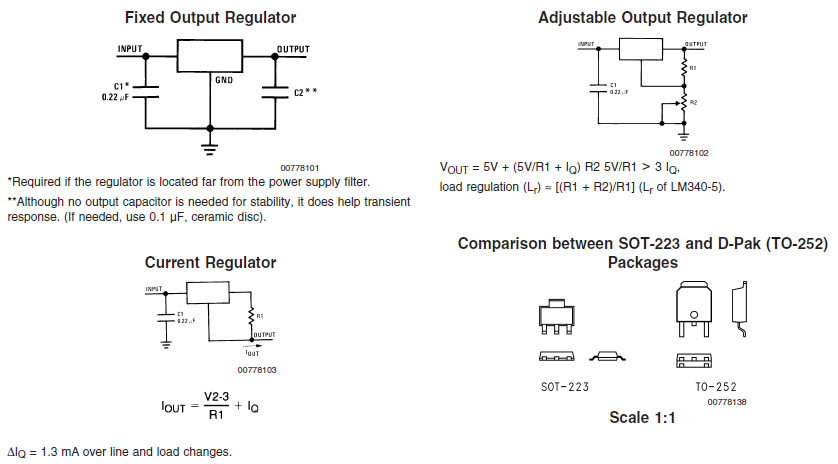
* Complete specifications at 1A load
* Output voltage tolerances of ±2% at Tj = 25°C and ±4%

over the temperature range (LM340A)

* Line regulation of 0.01% of VOUT/V of ΔVIN at 1A load

(LM340A)

* Load regulation of 0.3% of VOUT/A (LM340A)
* Internal thermal overload protection
* Internal short-circuit current limit
* Output transistor safe area protection
* P+ Product Enhancement tested

**Typical application**

Connection diagrams



**LM567**

**8-pin TONE DECODEr/Phase locked loop IC**

**General Description**

The NE567 or SE567 is a Phase Locked Loop (PLL) Tone Decoder. It is highly stable with synchronous AM lock detection and power output circuitry. Its primary function is to drive a load whenever a sustained frequency within its detection band is present at the self-biased input. The bandwidth center frequency and output delay are independently determined by means of four external components.

The LM567 and LM567C are general purpose tone decoders designed to provide a saturated transistor switch to ground when an input signal is present within the passband. The circuit consists of an I and Q detector driven by a voltage controlled oscillator which determines the center frequency of the decoder. External components are used to independently set center frequency, bandwidth and output delay.

Small Outline and Dual-In-Line Packages

GROUND

OutPut Filter c3

OUTPUT

INPUT VOLTAGE

LM 567

Loop Filter C2

Timing Capacitor

R1/C1

Timing resistor

R1

Vcc

**Absolute Maximum Ratings**

Supply Voltage 9V

Power Dissipation 1100 mW

V8 15V

V3 -10V

V4 + 0.5V

Storage Temperature -65°C to +150°C

Operating Temperature 0°C to +70°C

**GENERAL CHARACTERISTICS**:

1. Supply voltage range : 5v - 10v

2. Frequency range : 0.01Hz to 500 KHz

3. Working temp. Range : 0°C to 65°C

4. Power dissipation : 35mW quiescent

5. Controllable Bandwidth : 14% max

6. Current consumption : 15mA typ.

7. Package type : 8 pin DIL

**Applications**

* Touch tone decoding
* Precision oscillator
* Frequency monitoring and control
* Wide band FSK demodulation
* Ultrasonic controls
* Carrier current remote controls
* Communication paging decoders

# CD 4093

**QUAD 2-INPUT NAND SCHMITT TRIGGER**

14

13

1

8

9

10

12

11

4

7

6

5

3

2

Gnd

VCC

General Characteristics:

1. Voltage Rating : 3V-18V max
2. Operating Temperature : 70°C
3. Max Power Dissipation : 0.01mW
4. Propagation Delay : 30 nsec
5. Max Toggle Speed : 10 MHz
6. Fan Out : >50
7. Noise Immunity : 4.5V