FABRICATION OF MINI-EPABX

BY

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JAYPEE UNIVERSITY OF
INFORMATION TECHNOLOGY

DECEMBER -2008

Submitted in partial fulfillment of the Degree of Bachelor of Technology

DEPARTMENT OF E.C.O.

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CERTIFICATE

This is to certify that the work entitled, "FABRICATION OF MINI-EPABX" submitted by KARAN SHARMA and HARSHIT CHANDEL in partial fulfillment for the award of degree of Bachelor of Technology in E.C.E of Jaypee University of Information Technology has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award of this or any other degree or diploma.

Prof. D.S Chauhan

Vice chancellor JUIT

ACKNOWLEDGMENT

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We are also indebted to our parents as they have always been our pillars of strength. Finally and most importantly, we would like to thank Almighty for his blessing and kindness, a boundless and an endless source of inspiration for us always.

Dec 01, 2008
Solan

Karansharma (Karan Sharma)   Harshit (Harshit Chandel)

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LIST OF ABBREVIATIONS

1	EPABX	Electronic Private Automatic Branch Exchange
2	IC	Integrated Circuit
3	RL	Relay
4	AC	Alternating Current
5	DIAC	DIode Alternating Current
6	LED	Light Emitting Diode
7	VCC	Source Voltage
8	F/F	Flip-Flop
9	DTMF	Dual Tone Multi Frequency
10	CAMD	CAL MICRO DEVICES
11	DIP	Dual In Line Package
12	SOIC	Small-Outline Integrated Circuit
13	PLCC	Plastic Leaded Chip Carrier
14	BCD	Binary Coded Decimal
15	LAN	Local Area Network
16	WAN	Wide Area Network
17	HOD	Head of Department
18	C1 to C9	Computer1 to computer 9

ABSTRACT

MINI-EPABX is well known as "Electronic Private Automatic Branch Exchange". This circuit is able to handle nine independent telephones (using a single telephone line pair) located at nine different locations, say, up to a distance of 100 m from each other, for receiving and making outgoing calls, while maintaining conversation secrecy. This circuit is useful when a single telephone line is to be shared by more members residing in different rooms/apartments.

Present work reports on the fabrication and working of MINI - EPABX. Brief description of the project report is given below;

Chapter I is about the Introduction of MINI - EPABX.

Chapter II includes experimental details about different components used in the fabrication of MINI EPABX.

Chapter III is about the Data Sheets of ICs used in fabrication of MINI EPABX.

Chapter IV comprises of working of MINI EPABX.

Chapter V includes theoretical aspects, application& conclusion.

CHAPTER – I

INTRODUCTION

This circuit is able to handle nine independent telephones (using a single telephone line pair) located at nine different locations, say, up to a distance of 100m from each other, for receiving and making outgoing calls, while maintaining conversation secrecy. This circuit is useful when a single telephone line is to be shared by more members residing in different rooms/apartments.

Normally, if one connects nine phones in parallel, ring signals are heard in all the nine telephones (it is also possible that the phones will not work due to higher load), and out of nine persons eight will find that the call is not for them. Further, one can overhear others' conversation, which is not desirable. To overcome these problems, the circuit given here proves beneficial, as the ring is heard only in the desired extension, say, extension number '1'.

For making use of this facility, the calling subscriber is required to initially dial the normal phone number of the called subscriber. When the call is established, no ring-back tone is heard by the calling party. The calling subscriber has then to press the extension number, say, '1', within 10 seconds. (In case the calling subscriber fails to dial the required extension number within 10 seconds, the line will be disconnected automatically). Also, if the dialed extension phone is not lifted within 10 seconds, the ring-back tone will cease.

The ring signal on the main phone line is detected by opto-coupler MCT-2E (IC1), which in turn activates the 10-second 'on timer', formed by IC2 (555), and energizes relay RL10 (6 V, 100-ohm, 2 C/O). One of the 'N/O' contacts of the relay has been used to connect +6 V rail to the processing circuitry and the other has been used to provide 220-ohm loop resistance to de-energize the ringer relay in telephone exchange, to cut off the ring.

When the caller dials the extension number (say, '1') in tone mode, tone receiver CM8870 (IC3) outputs code '0001', which is fed to the 4-bit BCD-to-10 line decimal decoder IC4 (CD4028). The output of IC4 at its output pin 14 (Q1) goes high and switches on the transistor (TH-1) and associated relay RL1. Relay RL1, in turn, connects, via its N/O contacts, the 50Hz extension ring signal, derived from the 230 V AC mains, to the line of telephone '1'. This ring signal is available to telephone '1' only, because half of the signal is blocked by diode D1 and DIAC1 (which do not conduct below 35 volts).As soon as phone '1' is lifted, the ring current increases and voltage drop across R28 (220-ohm, 1/2W resistor) increases and operates opto-coupler IC5 (MCT-2E). This in turn resets timer IC2 causing:

(a) Interruption of the power supply for processing circuitry as well as the ring signal relays RL1 through RL9, and signal relays RL1 through RL9, and
(b) Removal of loop resistance R16, via the second contact of relay RL10.

As a result, the telephone line voltage shoots up to 48V, DIAC1 and diode D1 connected in series with phone 1 conduct within a few milliseconds, and phone 1 comes into operation. The telephone exchange does not interpret this as break in off-hook condition, since some delay margin is set at exchange. When phone '1' is busy, the other eight phones will not work, since line voltage will again drop to 10 V and the other diacs will not conduct. Thus conversation secrecy will be maintained. The other extensions also work in a similar manner when another extension number is dialed and its corresponding relay energizes to extend the 50 Hz ring to another extension. The 24 V, 50 Hz ring signal derived from transformer X1 is sufficient for working with phones of Beetel and ITI make, but for Pretel and some other makes, it may be necessary to increase the ring voltage to about 30 volts or even higher.

CHAPTER – II

EXPERIMENTAL DETAILS

Different components are used in the fabrication of MINI EPABX. Detailed description is given in the present section.

2.1 Integrated Circuit (IC)

Integrated circuits were made possible by experimental discoveries which showed that semiconductor devices could perform the functions of vacuum tubes, and by mid-20th-century technology advancements in semiconductor device fabrication. The integration of large numbers of tiny transistors into a small chip was an enormous improvement over the manual assembly of circuits using discrete electronic components. The integrated circuit's mass production capability, reliability, and building-block approach to circuit design ensured the rapid adoption of standardized ICs in place of designs using discrete transistors.

There are two main advantages of ICs over discrete circuits: cost and performance. Cost is low because the chips, with all their components, are printed as a unit by photolithography and not constructed one transistor at a time. Performance is high since the components switch quickly and consume little power, because the components are small and close together. Different models of IC used are given in table 2.1.

Table 2.1

IC'S	Model	No. of Pins
IC 1	MCT2E	6
IC 2	NE555	8
IC 3	CM8870	18
IC 4	CD4028	16
IC 5	MCT2E	6

2.2 Resistor

A resistor is a two-terminal electrical or electronic component that opposes an electric current by producing a voltage drop between its terminals in accordance with Ohm's law; V = I.R. The *electrical resistance* is equal to the voltage drop across the resistor divided by the current through the resistor while the temperature remains the same. Resistors are used as part of electrical networks and electronic circuits. Values of different resistance used are tabulated in table 2.2.

Table 2.2

Resistance	Value (Ω)
R1 To R9 ,R14	120
R10	15K
R11	10K
R12	1.5K
R13	18K
R15	100K
R16 ,R17	220
R18	330K
R19 To R27	100
R28	220 (0.5W)
R29	330

2.3 Capacitor

A capacitor is an electrical/electronic device that can store energy in the electric field between a pair of conductors (called "plates").The process of storing energy in the capacitor is known as "charging", and involves electric charges of equal magnitude, but opposite polarity, building up on each plate. Capacitors are often used in electric and electronic circuits as energy-storage devices. They can also be used to differentiate between high-frequency and low-frequency signals. This property makes them useful in electronic filters. Values of capacitor used are given in table 2.3.

Table 2.3

Capacitance	Value
C1	2.2 μF (160V)
C2	1000 μF (16V)
C3 ,C6	0.1 μF
C4 ,C5	0.47 μF (160V)
C7	470 μF (10V)

2.4 Diode

In electronics, a diode is a two-terminal device (except that thermionic diodes may also have one or two ancillary terminals for a heater). Diodes have two active electrodes between which the signal of interest may flow, and most are used for their unidirectional current property. The directionality of current flow most diodes exhibit is sometimes generically called the *rectifying* property. The most common function of a diode is to allow an electric current to pass in one direction (called the *forward biased* condition) and to block it in the opposite direction (the *reverse biased* condition). Different models are given in table 2.4.

Table 2.4

Diode	Model
D1 To D9 ,D11 ,D12	1N4007
D10	1N4001
D13 To D21	SN104

2.5 Relay

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. It was invented by Joseph Henry in 1835. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier. Values of Relay used are given in table 2.5.

Table 2.5

Relay	Value
RL1 ToRL9	6V,100 ohms,1C/ORelay
RL10	8V,100 ohms,2C/O Relay

2.6 DIac

The DIac, or Diode for Alternating Current, is a bidirectional trigger diode that conducts current only after its breakdown voltage has been exceeded momentarily. When this occurs, the resistance of the diode abruptly decreases, leading to a sharp decrease in the voltage drop across the diode and, usually, a sharp increase in current flow through the diode. The diode remains "in conduction" until the current flow through it drops below a value characteristic for the device, called the holding current. Below this value, the diode switches back to its high-resistance (non-conducting) state. When used in AC applications this automatically happens when the current reverses polarity.

Table 2.6

DIAC	Model
DIAC1 To DIAC9	DB3

2.7 Transistor

A transistor is a semiconductor device, commonly used to amplify or switch electronic signals. The transistor is the fundamental building block of computers, and all other modern electronic devices. Some transistors are packaged individually but most are found in integrated circuits.

Table 2.7

Transistor	Model
T1	BC558

2.8 Crystal

Table 2.8 shows the value of crystal used in MINI – EPABX.

Table 2.8

Crystal	Value
XTAL	3.58 MHz

2.9 Other

2.9.1 LED

2.9.2 Regulated Supply (+6 V ,1 Amp)

2.9.3 X1 (230 V AC Primary to 0-24 V AC ,500 mA Secondary Transformer)

2.9.4 Phone Sets (Beetel)

CHAPTER – III

IC-DATA SHEETS

3.1 IC - MCT2E

3.1.1 Pin diagram

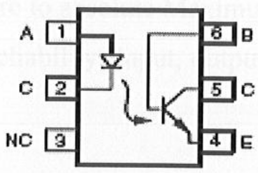


Figure 3.1

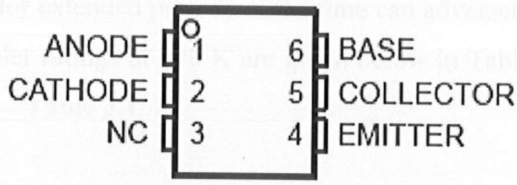


Figure 3.2

3.1.2 Features

- Interfaces with common logic families.
- Input-output coupling capacitance < 0.5 pF.

3.1.3 Applications

- AC mains detection
- Reed relay driving
- Telephone ring detection
- Telephone/telegraph line receiver
- Twisted pair line receiver
- General Purpose Switching Circuits

3.1.4 Description

Standard Single Channel Phototransistor Couplers .The MCT2/ MCTE family is an Industry Standard Single Channel Phototransistor. Each opt coupler consists of gallium arsenide infrared LED and a silicon NPN phototransistor. The MCT2XXX series opt isolators consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a 6-pindual in-line package.

3.1.5 Absolute Maximum Ratings

Stresses in excess of the absolute Maximum Ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute Maximum Rating for extended periods of the time can adversely affect reliability. Input, output and coupler ratings at 298 K are given below in Table 3.1;

Table 3.1

Input

Parameter	Test condition	Symbol	Value	Unit
Reverse voltage		V_R	6.0	V
Forward current		I_F	60	mA
Surge current	$t \leq 10\,\mu s$	I_{FSM}	2.5	A
Power dissipation		P_{diss}	100	mW

Output

Parameter	Test condition	Symbol	Value	Unit
Collector-emitter breakdown		V_{CEO}	70	V
Emitter-base breakdown voltage		BV_{EBO}	7.0	V
Collector current		I_C	50	mA
	$t < 1.0$ ms	I_C	100	mA
Power dissipation		P_{diss}	150	mW

Coupler

Parameter	Test condition	Symbol	Value	Unit
Isolation test voltage		V_{ISO}	5300	V_{RMS}
Creepage			≥ 7.0	mm
Clearance			≥ 7.0	mm
Isolation thickness between emitter and detector			≥ 0.4	mm
Comparative tracking index per DIN IEC 112/VDE0303,part 1			175	
Isolation resistance	$V_{IO} = 500$ V, $T_{amb} = 25$ °C	R_{IO}	10^{12}	Ω
	$V_{IO} = 500$ V, $T_{amb} = 100$ °C	R_{IO}	10^{11}	Ω
Storage temperature		T_{stg}	- 55 to + 150	°C
Operating temperature		T_{stg}	- 55 to + 100	°C
Junction temperature		T_j	100	°C
Soldering temperature	max. 10 s dip soldering: distance to seating plane ≥ 1.5 mm	T_{sld}	260	°C

Typical Characteristic of MCT2E

Typical I-V Characteristic of MCT2E are plotted below;

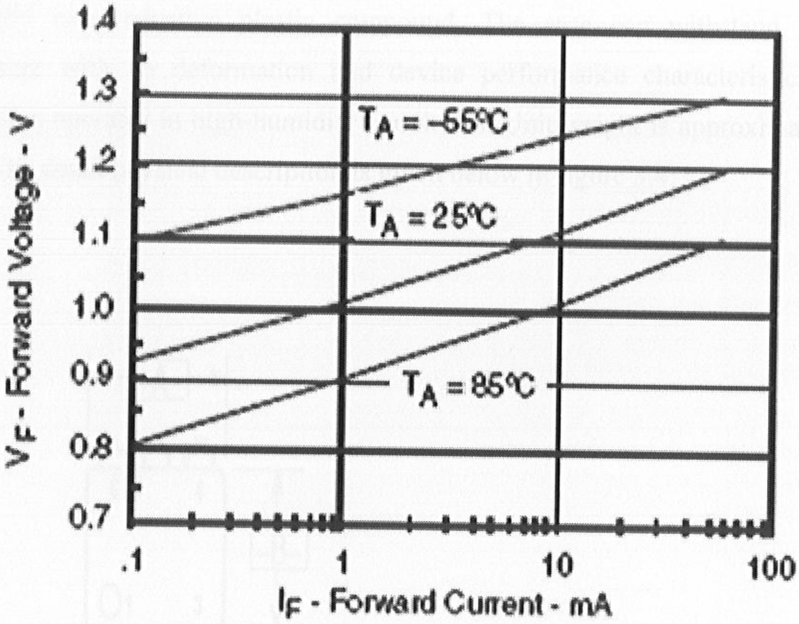


Figure 3.3 Plot of Forward Voltage vs. Forward Current

In the typical characteristic we see that the IC MCT2E have real graphical pattern between forward voltage and forward current in the range of room temperature (Ta 24 to 34 °C). But we see that if the temperature goes abruptly too high (above 100 °C) or too low (below - 100 °C) the initial value for forward voltage goes low and high respectively.

This change in temperature effect the ideal working of IC in a circuit .Hence can affect the proper working of the project. So it's important to maintain room temperature condition for the proper working of any electronic gazette.

3.1.7 *Mechanical Information*

The package consists of a gallium-arsenide infrared-emitting diode and an n-p-n silicon phototransistor mounted on a 6-lead frame encapsulated within an electrically nonconductive plastic compound. The case can withstand soldering temperature with no deformation and device performance characteristics remain stable when operated in high-humidity conditions. Unit weight is approximately 0.52 grams. The detail physical description is given below in figure 3.4;

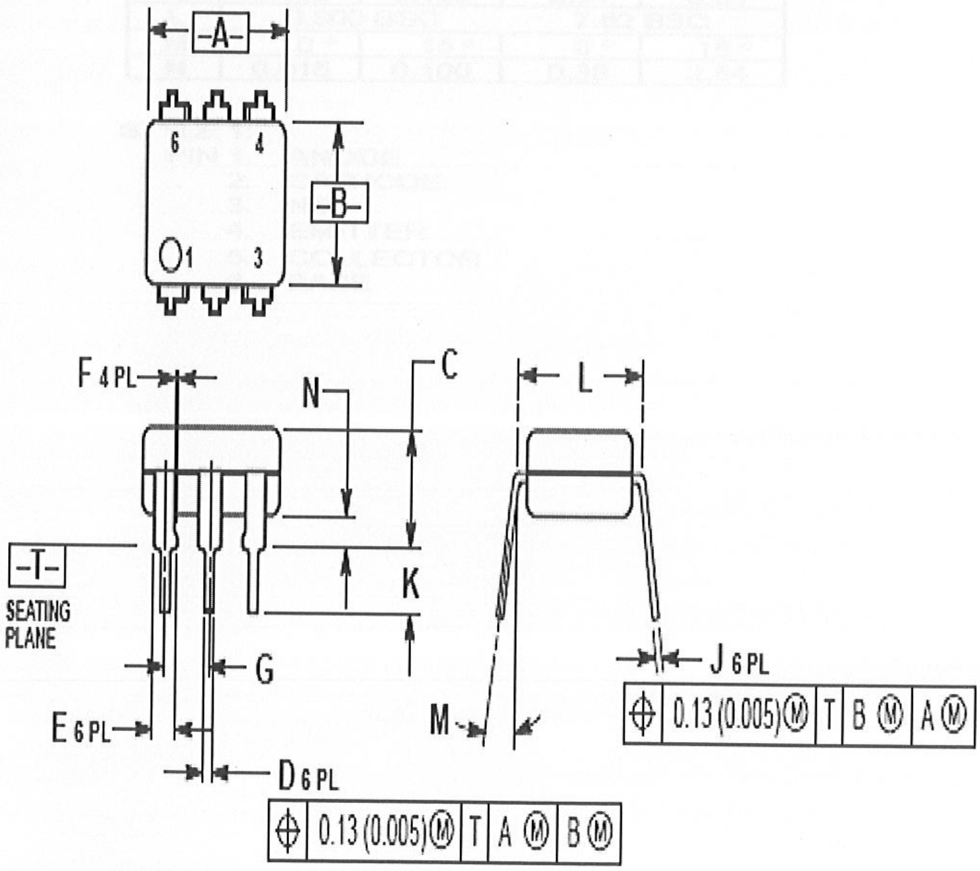


Figure 3.4 Mechanical information of IC MCT2E

Table 3.2

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.320	0.350	8.13	8.89
B	0.240	0.260	6.10	6.60
C	0.115	0.200	2.93	5.08
D	0.016	0.020	0.41	0.50
E	0.040	0.070	1.02	1.77
F	0.010	0.014	0.25	0.36
G	0.100 BSC		2.54 BSC	
J	0.008	0.012	0.21	0.30
K	0.100	0.150	2.54	3.81
L	0.300 BSC		7.62 BSC	
M	0 °	15 °	0 °	15 °
N	0.015	0.100	0.38	2.54

STYLE 1:

PIN 1. ANODE
2. CATHODE
3. NC
4. EMITTER
5. COLLECTOR
6. BASE

3.2 NE555

3.2.1 *Pin diagram*

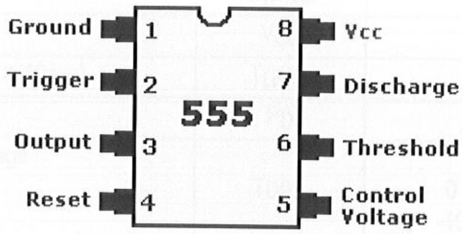


Figure 3.5

3.2.2 *Features*

- High Current Drive Capability (200 mA)
- Temperature Stability of 0.005%/°C
- Timing from μ Sec to Hours

3.2.3 *Applications*

- Pulse Generation
- Time Delay Generation
- Sequential Timing

3.2.4 *Description*

The NE555 silicon monolithic timing circuit is a highly stable controller capable of producing accurate time delays, or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output structure can source or sink up to 200 mA.

3.2.5 *Absolute Maximum Ratings (TA = 25°C)*

Table 3.3

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	16	V
Lead Temperature (Soldering 10sec)	T_{LEAD}	300	°C
Power Dissipation	P_D	600	mW
Operating Temperature Range LM555/NE555 SA555	T_{OPR}	0 ~ +70 -40 ~ +85	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C

3.2.6 *Application Information*

Below is the basic operating table of 555 timer:

Table 3.4

Threshold Voltage (V_{th})(PIN 6)	Trigger Voltage (V_{tr})(PIN 2)	Reset(PIN 4)	Output(PIN 3)	Discharging Tr. (PIN 7)
Don't care	Don't care	Low	Low	ON
V_{th} > 2Vcc / 3	V_{th} > 2Vcc / 3	High	Low	ON
Vcc / 3 < V_{th} < 2 Vcc / 3	Vcc / 3 < V_{th} < 2 Vcc / 3	High	-	-
V_{th} < Vcc / 3	V_{th} < Vcc / 3	High	High	OFF

When the low signal input is applied to the reset terminal, the timer output remains low regardless of the threshold voltage or the trigger voltage .Only when the high signal is applied to the reset terminal, the timer's output changes according to threshold voltage and trigger voltage. When the threshold voltage exceeds 2/3 of the supply voltage while the timer output is high, the timer's internal discharge Tr. turns on, lowering the threshold voltage to below 1/3 of the supply voltage. During this time, the timer output is maintained low. Later, if a low signal is applied to the trigger voltage so that it becomes 1/3 of the supply voltage, the timer's internal discharge Tr. turns off, increasing the threshold voltage and driving the timer output again at high.

3.2.6.1 Monostable Operation

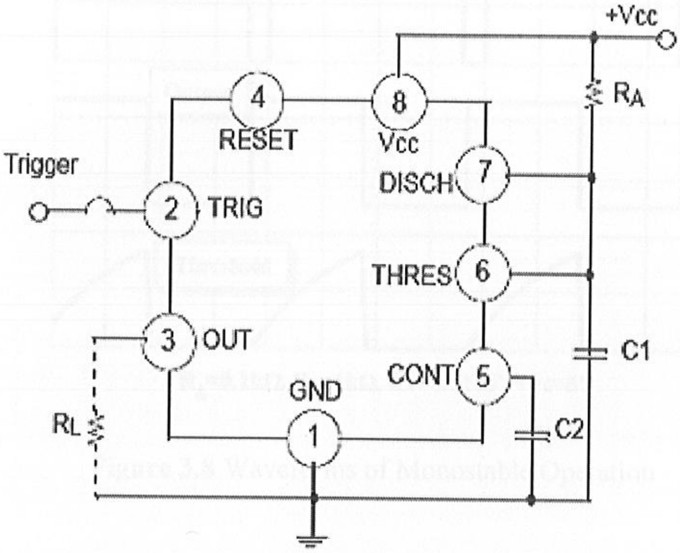


Figure 3.6 Monostable circuit

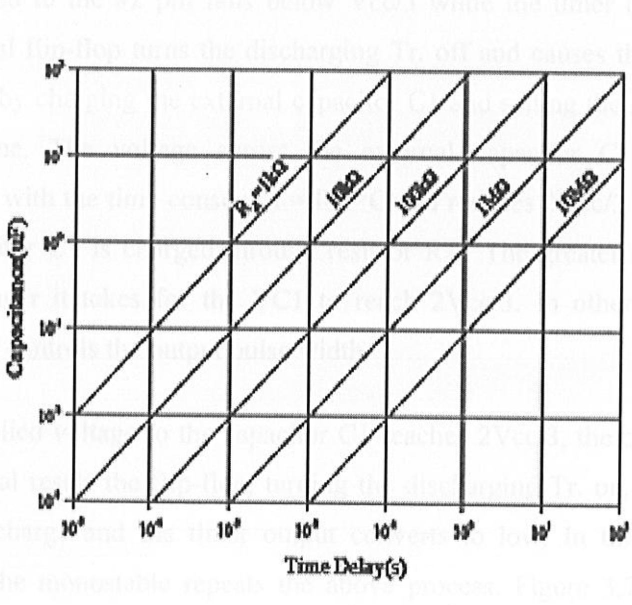


Figure 3.7 Resistance and capacitance vs. Time Delay (Td)

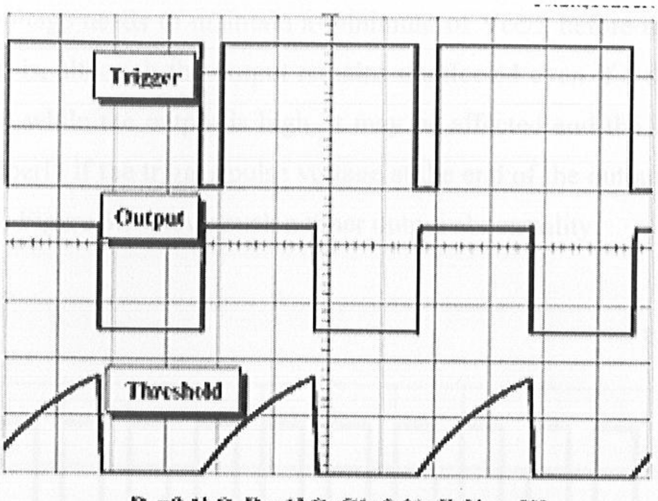
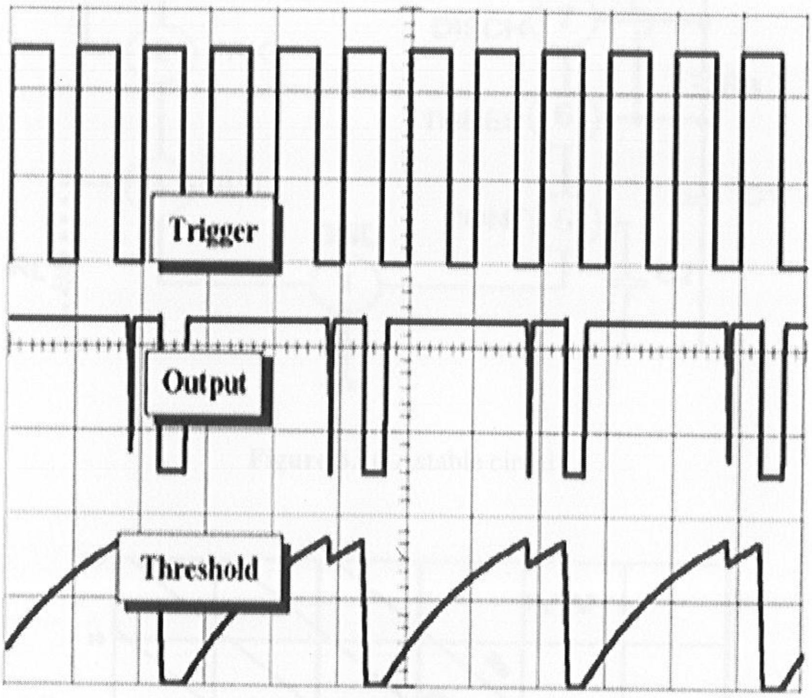


Figure 3.8 Waveforms of Monostable Operation

Figure 3.6 illustrates a monostable circuit. In this mode, the timer generates a fixed pulse whenever the trigger voltage falls below Vcc/3. When the trigger pulse voltage applied to the #2 pin falls below Vcc/3 while the timer output is low, the timer's internal flip-flop turns the discharging Tr. off and causes the timer output to become high by charging the external capacitor C1 and setting the flip-flop output at the same time. The voltage across the external capacitor C1, VC1 increases exponentially with the time constant t = RA*C and reaches 2Vcc/3 at td = 1.1RA*C. Hence, capacitor C1 is charged through resistor RA. The greater the time constant RAC, the longer it takes for the VC1 to reach 2Vcc/3. In other words, the time constant RAC controls the output pulse width.

When the applied voltage to the capacitor C1 reaches 2Vcc/3, the comparator on the trigger terminal resets the flip-flop, turning the discharging Tr. on. At this time, C1 begins to discharge and the timer output converts to low. In this way, the timer operating in the monostable repeats the above process. Figure 3.7 shows the time constant relationship based on RA and C. Figure 3.8 shows the general waveforms during the monostable operation. It must be noted that, for a normal operation, the trigger pulse voltage needs to maintain a minimum of Vcc/3 before the timer output turns low. That is, although the output remains unaffected even if a different trigger pulse is applied while the output is high, it may be affected and the waveform does not operate properly if the trigger pulse voltage at the end of the output pulse remains at below Vcc/3. Figure 3.9 shows such a timer output abnormality.



R_A=9.1kΩ, R_L=1kΩ, C1=0.01uF, Vcc=5V

Figure 3.9 Waveforms of Monostable Operation (abnormal)

3.2.6.2 Astable Operation

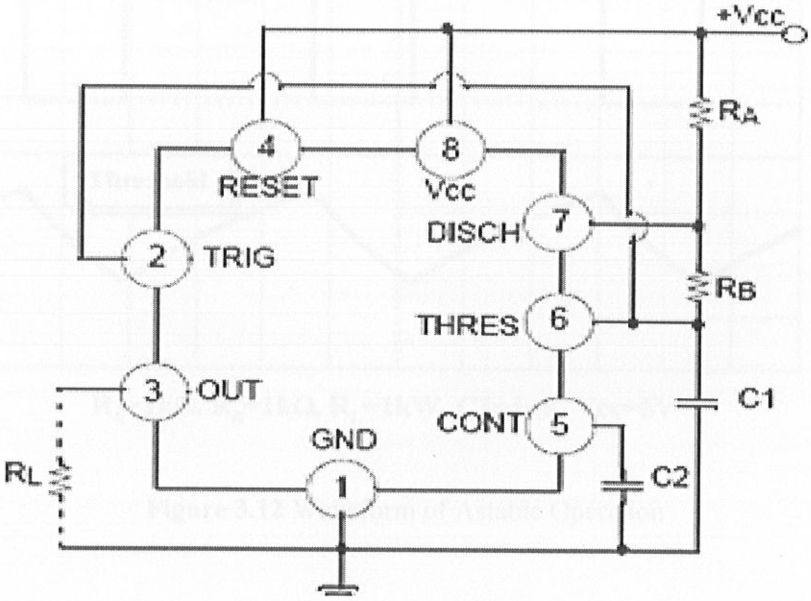


Figure 3.10 Astable circuit

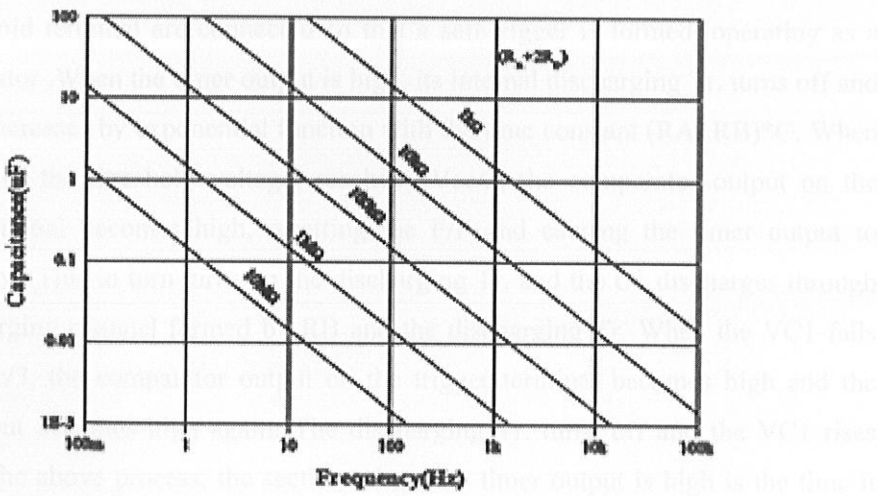
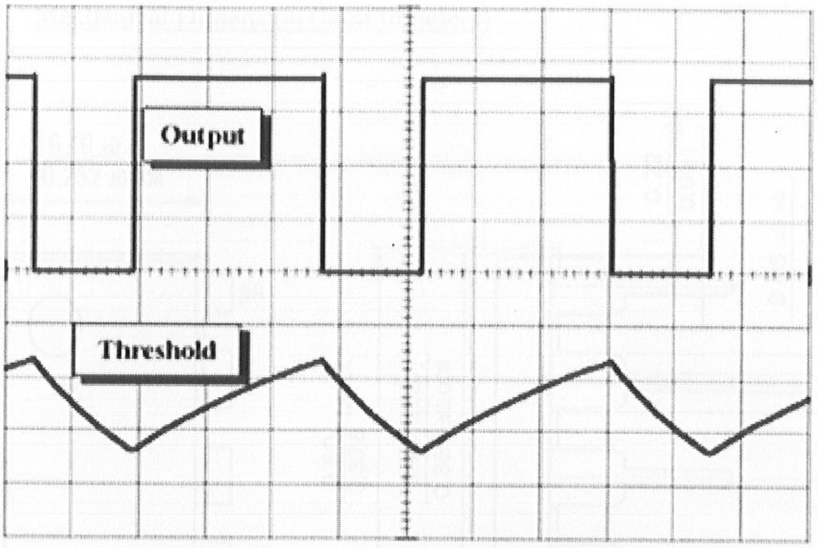


Figure 3.11 Capacitance and Resistance vs. Frequency



R_A=1kΩ, R_B=1kΩ, R_L=1kW, C1=1uF, Vcc=5V

Figure 3.12 Waveform of Astable Operation

An astable timer operation is achieved by adding resistor RB to Figure 3.6 and configuring as shown on Figure 3.10. In the astable operation, the trigger terminal and the threshold terminal are connected so that a self-trigger is formed, operating as a multi vibrator .When the timer output is high, its internal discharging Tr. turns off and the VC1 increases by exponential function with the time constant (RA+RB)*C. When the VC1, or the threshold voltage, reaches 2Vcc/3, the comparator output on the trigger terminal becomes high, resetting the F/F and causing the timer output to become low. This in turn turns on the discharging Tr. and the C1 discharges through the discharging channel formed by RB and the discharging Tr. When the VC1 falls below Vcc/3, the comparator output on the trigger terminal becomes high and the timer output becomes high again. The discharging Tr. turns off and the VC1 rises again. In the above process, the section where the timer output is high is the time it takes for the VC1 to rise from Vcc/3 to 2Vcc/3, and the section where the timer output is low is the time it takes for the VC1 to drop from 2Vcc/3 to Vcc/3.

3.2.7 Mechanical Dimension (in millimeters)

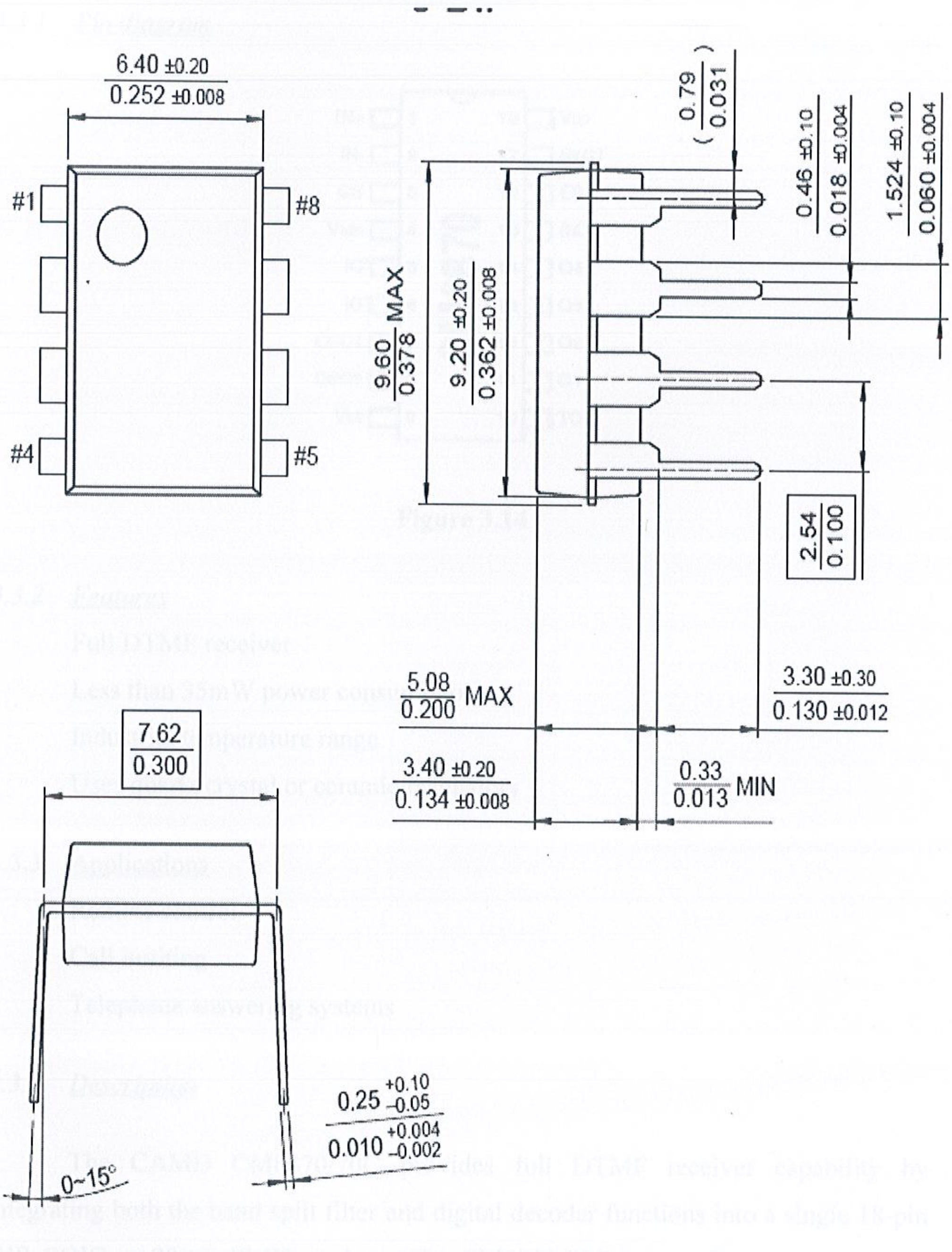


Figure 3.13 Mechanical Dimension of IC NE555

3.3 CM8870

3.3.1 Pin diagram

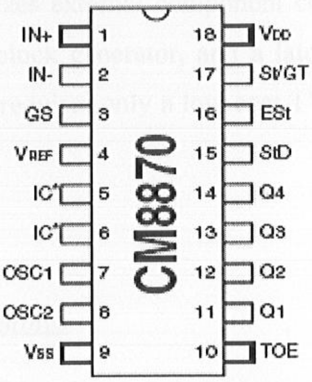


Figure 3.14

3.3.2 Features

- Full DTMF receiver
- Less than 35mW power consumption
- Industrial temperature range
- Uses quartz crystal or ceramic resonators

3.3.3 Applications

- Remote control
- Call limiting
- Telephone answering systems

3.3.4 Description

The CAMD CM8870/70C provides full DTMF receiver capability by integrating both the band split filter and digital decoder functions into a single 18-pin DIP, SOIC, or 20-pin PLCC package. The CM8870/70C is manufactured using state-of-the-art CMOS process technology for low power consumption (35 mW, max.) and precise data handling.

The filter section uses a switched capacitor technique for both high and low group filters and dial tone rejection. The CM8870/70C decoder uses digital counting techniques for the detection and decoding of all 16 DTMF tone pairs into a4-bit code. This DTMF receiver minimizes external component count by providing an on-chip differential input amplifier, clock generator, and a latched three-state interface bus. The on-chip clock generator requires only a low cost TV crystal or ceramic resonator as an external component.

3.3.5 *Absolute Maximum Ratings*

Table 3.5

ABSOLUTE MAXIMUM RATINGS		
Parameter	**Symbol**	**Value**
Power Supply Voltage (V_{DD}-V_{SS})	V_{DD}	6.0V Max
Voltage on any Pin	Vdc	V_{SS}-0.3V to V_{DD}+0.3V
Current on any Pin	I_{DD}	10mA Max
Operating Temperature	T_A	-40°C to +85°C
Storage Temperature	T_S	-65°C to +150°C

3.3.6 *Pin Function Table*

Table 3.6

PIN FUNCTION		
Name	**Description**	
IN+	Non-inverting Input	Connection to the front-end differential amplifier
IN-	Inverting Input	
GS	Gain Select	Gives access to output of front-end differential amplifier for connection of feedback resistor.
V_{REF}	Reference voltage output (nominally $V_{DD}/2$). May be used to bias the inputs at mid-rail.	
INH	Inhibits detection of tones represents keys A, B, C, and D	
OSC3	Digital buffered oscillator output.	
PD	Power Down	Logic high powers down the device and inhibits the oscillator.
OSC1	Clock Input	3.579545 MHz crystal connected between these pins completes internal oscillator.
OSC2	Clock Output	
V_{SS}	Negative power supply (normally connected to OV).	
TOE	Three-state output enable (input). Logic high enables the outputs Q_1-Q_4. Internal pull-up.	
Q_1 Q_2 Q_3 Q_4	Three-state outputs. When enabled by TOE, provides the code corresponding to the last valid tone pair received. (See Fig. 2).	
StD	Delayed steering output. Presents a logic high when a received tone pair has been registered and the output latch is updated. Returns to logic low when the voltage on St/GT falls below V_{TSt}.	
ESt	Early steering output. Presents a logic high immediately when the digital algorithm detects a recognizable tone pair (signal condition). Any momentary loss of signal condition will cause ESt to return to a logic low.	
St/Gt	Steering input/guard time output (bidirectional). A voltage greater than V_{TSt} detected a St causes the device to register the detected tone pair . The GT output acts to reset the external steering time constant, and its state is a function of ESt and the voltage on St. (See Fig. 2)	
V_{DD}	Positive power supply.	
IC	Internal Connection.	Must be tied to V_{SS} (for 8870 configuration only)

3.4 <u>CD4028</u>

3.4.1 Pin diagram

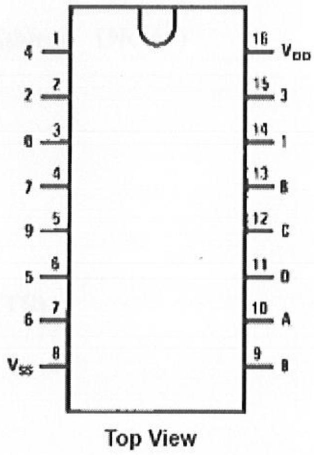


Figure 3.15

3.4.2 Features

- Wide supply voltage range: 3.0V to 15V
- High noise immunity: 0.45 VDD (typ.)
- Low power

3.4.3 Applications

- Code conversion
- Address decoding
- Indicator-tube decoder

3.4.4 Description

The CD4028BC is a BCD-to-decimal or binary-to-octal decoder consisting of 4 inputs, decoding logic gates, and10 output buffers. A BCD code applied to the 4 inputs, A, B, C, and D, results in a high level at the selected 1-of-10 decimal decoded outputs. Similarly, a 3-bit binary code applied to inputs A, B, and C is decoded in octal at outputs 0–7. A high level signal at the D input inhibits octal decoding and causes outputs 0–7 to go LOW. All inputs are protected against static discharge damage by diode clamps to VDD and VSS.

3.4.5 <u>*Absolute Maximum Ratings*</u> (Note1)
(Note 2)

Supply Voltage (VDD)	-0.5 to +18V
Input Voltage (VIN)	-0.5 to VDD +0.5V
Storage Temperature Range (TS)	-65°C to +150°C
Power Dissipation (PD)	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead temperature (TL)	
(Soldering, 10 seconds)	260°C

3.4.6 <u>*Recommended Operating Conditions*</u> (Note 2)

Supply Voltage (VDD)	3 to 15V
Input Voltage (VIN)	0 to VDDV
Operating Temperature Range (TA)	-40°C to +85°C

(Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed, they are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual device operation.

Note 2: VSS = 0V unless otherwise specified.

Note 3: IOL and IOH are tested one output at a time.)

3.4.7 AC Electrical Characteristics (Note 4)

TA = 25°C, CL = 50 pF, RL = 200k, Input tr = tf = 20 ns, unless otherwise specified

Table 3.7

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHL} or t_{PLH}	Propagation Delay Time	V_{CC} = 5V		240	480	ns
		V_{CC} = 10V		100	200	ns
		V_{CC} = 15V		70	140	ns
t_{THL} or t_{TLH}	Transition Time	V_{CC} = 5V		175	350	ns
		V_{CC} = 10V		75	150	ns
		V_{CC} = 15V		60	110	ns
C_{IN}	Input Capacitance	Any Input		5	7.5	pF

Note 4: AC Parameters are guaranteed by DC correlated testing.

3.4.8 *Switching Time Waveforms*

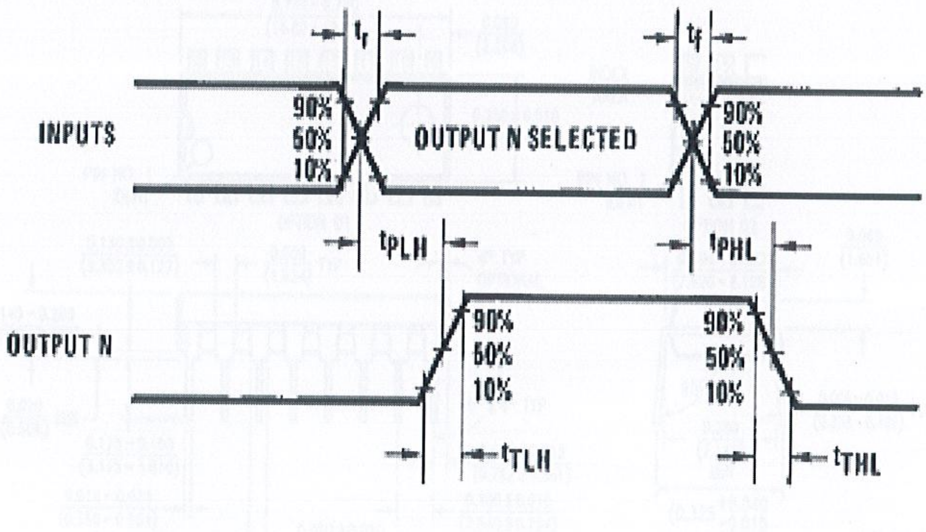
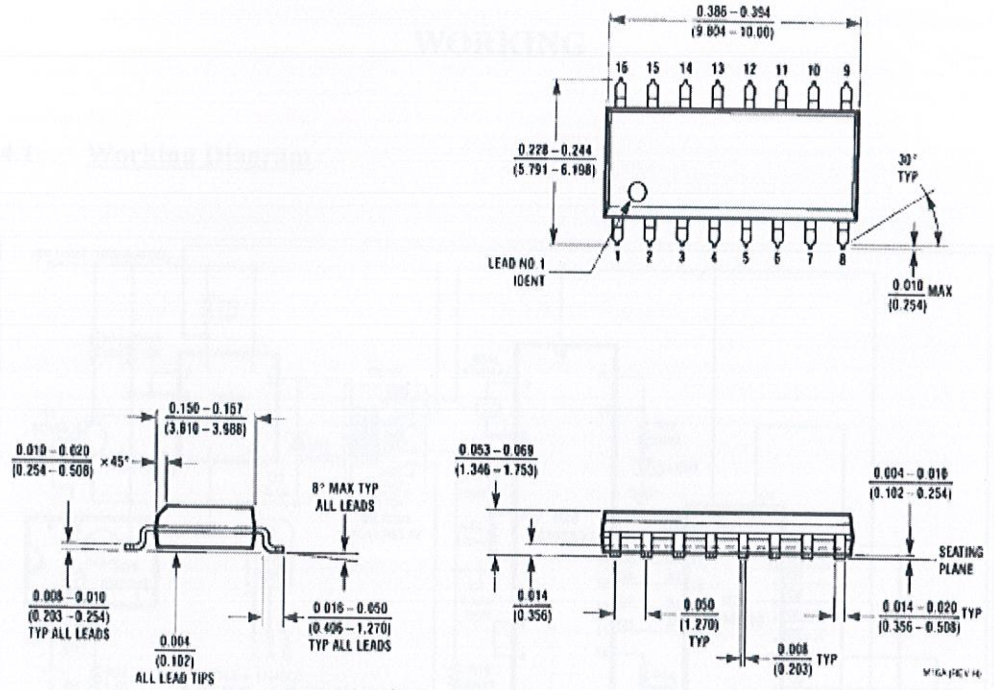


Figure 3.16 Switching Time Waveform of IC CD4028

3.4.9 *Physical Dimensions* (inches (millimeters) unless otherwise noted)



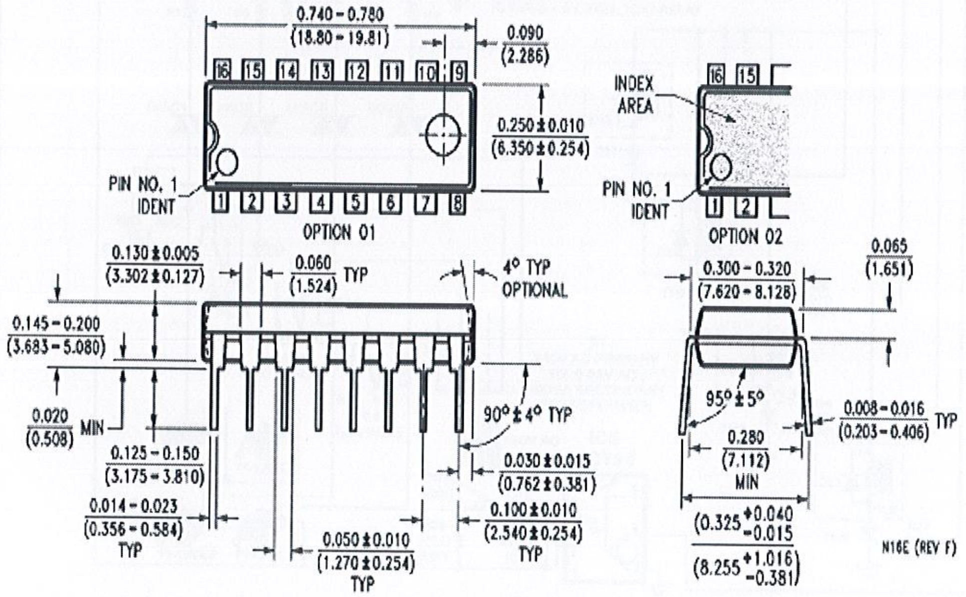


Figure 3.17 Physical Dimension of IC CD4028

CHAPTER – IV

WORKING

4.1 Working Diagram

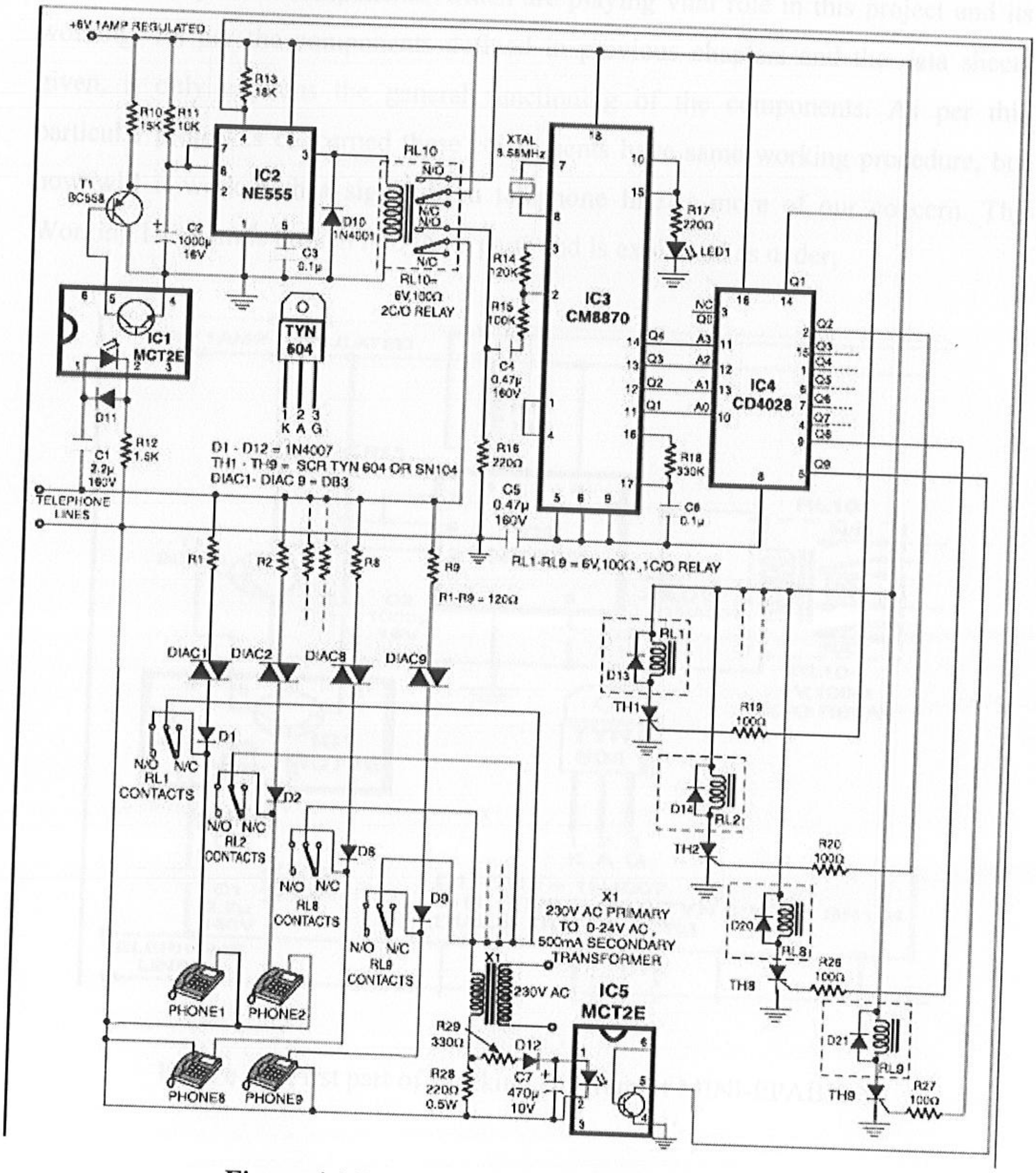


Figure 4.1 Working Diagram of MINI-EPABX

4.2 Explanation

Mini EPABX, has the capability of holding 9(nine) individual phones connected in parallel with a single Telephone Line. Its working is simple and easy to understand.

Before we start with the point to point working of the project. It is necessary to know about few important components, which are playing vital role in this project and its working. As per the components defined in previous chapters and the data sheets given, it only explains the general functioning of the components. As per this particular project is concerned these components have same working procedure, but how will it work with a signal from telephone line is more of our concern. The Working Diagram is broken into three parts and is explained as under;

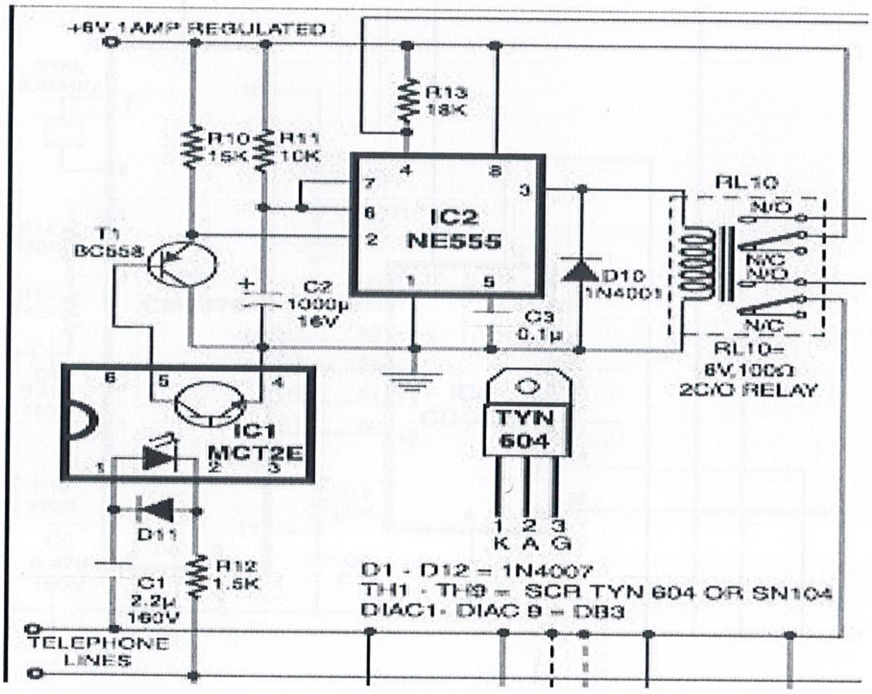


Figure 4.2 First part of Working Diagram of MINI-EPABX

The ring signal on the main phone line is detected by opto-coupler MCT-2E (IC1),when the signal comes from telephone line the LED converts that signal into a wave form and then it is transmitted through the transistor in the opto-coupler, which is then received by IC2 NE555, which has the property of producing clock cycle, therefore after receiving the signal from IC1 MCT2E, it activates the 10-second 'on timer', formed by IC2 (555), and energizes relay RL10 (6V, 100-ohm, 2 C/O). One of the 'N/O' contacts of the relay has been used to connect +6 V rail to the processing circuitry and the other has been used to provide 220-ohm loop resistance to de-energize the ringer relay in telephone exchange, to cut off the ring.

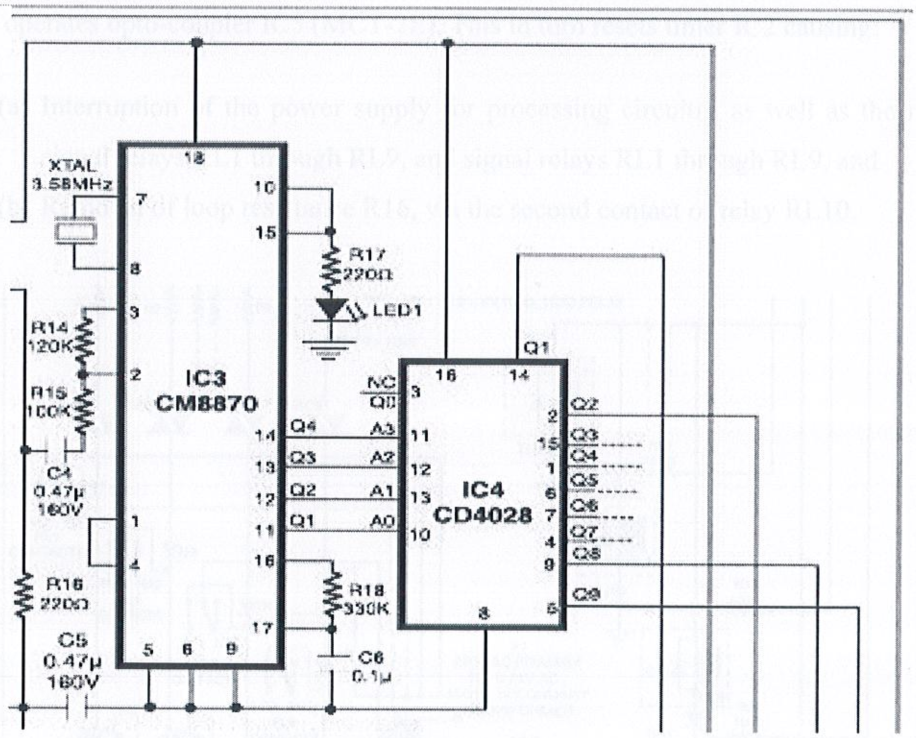


Figure 4.3 Second part of Working Diagram of MINI-EPABX

Now the signal goes to IC3 CM8870, as I have explained in the data sheets CM8870 decoder uses digital counting technique for the detection and decoding of all 16 DTMF tone pair into a 4 bit code .So When the caller dials the extension number (say, '1') in tone mode, tone receiver CM8870 (IC3) outputs code '0001', which is fed to the 4-bit BCD-to-10 line decimal decoder IC4 (CD4028). The output of IC4 at its output pin 14 (Q1) goes high and switches on the transistor (TH-1) and associated relay RL1. Relay RL1, in turn, connects, via its N/O contacts, the 50Hz extension ring signal, derived from the 230V AC mains, to the line of telephone '1'. This ring signal is available to telephone '1' only, because half of the signal is blocked by diode D1 and DIAC1 (which do not conduct below 35 volts).As soon as phone '1' is lifted, the ring current increases and voltage drop across R28 (220-ohm, 1/2W resistor) increases and operates opto-coupler IC5 (MCT-2E). This in turn resets timer IC2 causing:

(a) Interruption of the power supply for processing circuitry as well as the ring signal relays RL1 through RL9, and signal relays RL1 through RL9, and
(b) Removal of loop resistance R16, via the second contact of relay RL10.

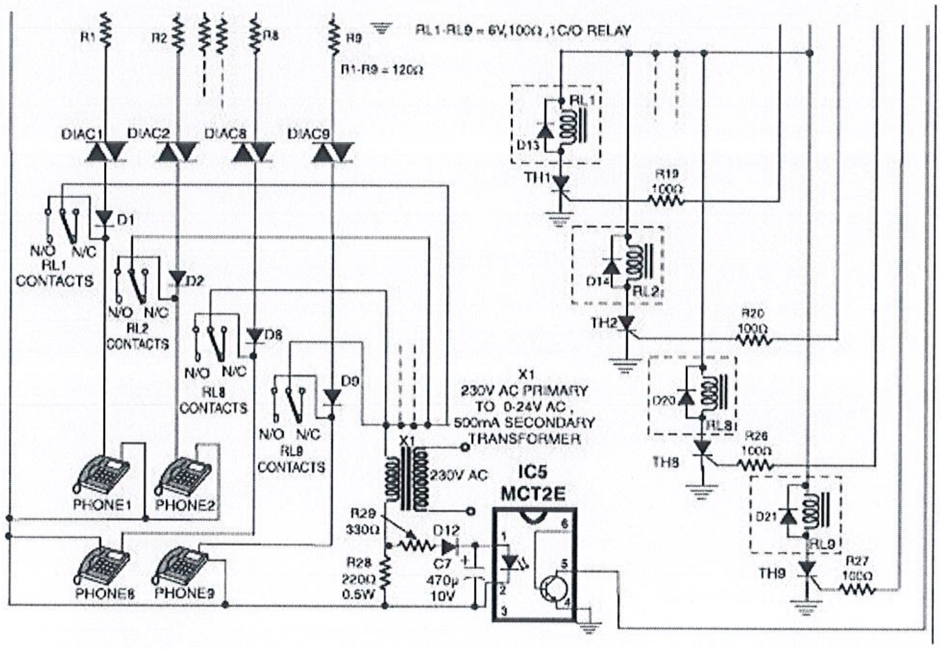


Figure 4.4 Third part of Working Diagram of MINI-EPABX

As a result, the telephone line voltage shoots up to 48 V, DIAC1 and diode D1 connected in series with phone 1 conduct within a few milliseconds, and phone 1 comes into operation. The telephone exchange does not interpret this as break in off-hook condition, since some delay margin is set at exchange. When phone '1' is busy, the other eight phones will not work, since line voltage will again drop to 10 V and the other diacs will not conduct. Thus conversation secrecy will be maintained. The other extensions also work in a similar manner when another extension number is dialed and its corresponding relay energizes to extend the 50Hz ring to another extension. The 24 V, 50 Hz ring signal derived from transformer X1 is sufficient for working with phones of Beetel and ITI make, but for Pretel and some other makes, it may be necessary to increase the ring voltage to about 30 volts or even higher.

CHAPTER – V

THEORETICAL ASPECTS AND APPLICATIONS

5.1 Theoretical Aspects and Applications

As explained earlier about the working of project .let us see how it will be connected and actually, how the codes are distributed among 9 different phones.

Also we will see how can a user use internet services on it, and how this project be connected in order to make a LAN,WAN etc. we will also briefly see how can we increase the capacity from 9 phones to hundred and thousand phones in this project.

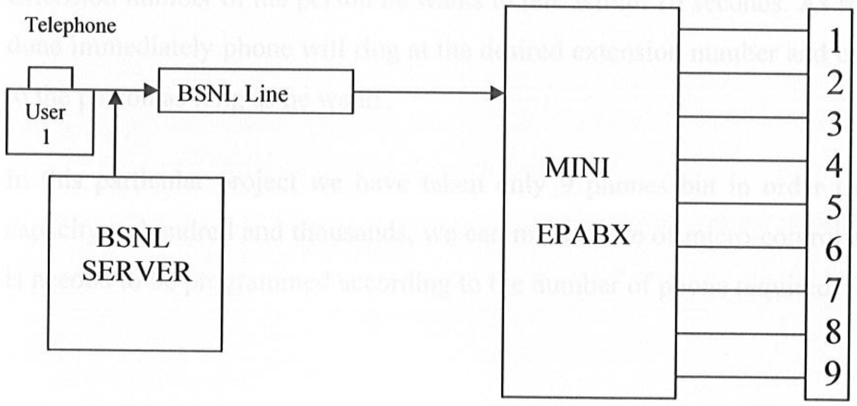


Figure 5.19 Phones Extensions Distribution Diagram

In the figure above we can clearly see that how an unknown person making a call can connect himself with any of 1 to 9 extension phones.1 to 9 is the extension numbers given to each phone connected to the project and also there is a BSNL server which provides a fixed landline number to our BSNL line which is connected to our project.

Now when any person (user 1 as shown in diagram) wants to talk with any person connected with our project, user 1 has to dial the fixed landline number of our project followed by the extension number of a person he wants to talk.

Let us take an example in order to make the working clearer:-

We take the above project and divide its all phones in the academic block of JUIT. Let's say extension 1 is for Vice Chancellor, extension 2 is for Dean, extension 3 is for Registrar and extension 4 to 9 is for HOD of all the departments.

Now let us suppose that BSNL server has given us a landline number say 222222.now if user 1 wants to contact with any of these users of JUIT, he will dial 222222 then immediately phone is picked up by the project itself then user 1 has to dial the extension number of the person he wants to talk within 10 seconds. As soon all this is done immediately phone will ring at the desired extension number and user 1 can talk to the person as long as he wants.

In this particular project we have taken only 9 phones but in order to increase its capacity to hundred and thousands, we can make a use of micro-controllers. This MC is needed to be programmed according to the number of phone required.

Now lets see how this project be modified and be used as LAN. Before we do this lets us first learn the basic structure of LAN which is shown as:-

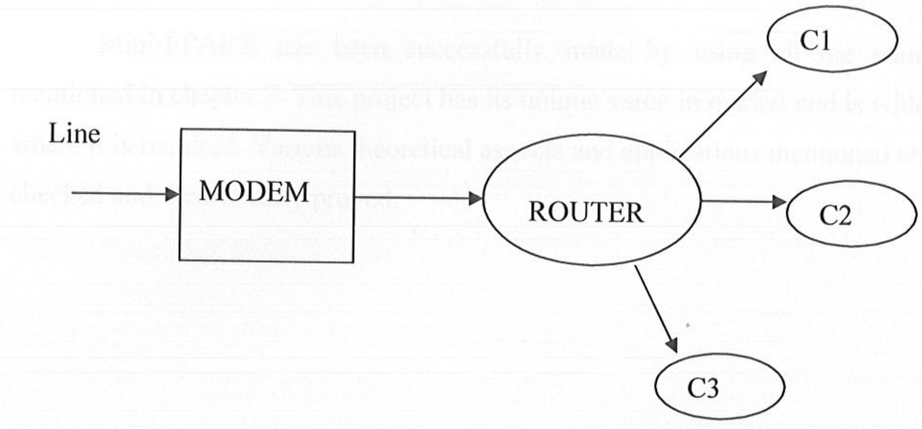


Figure 5.2 Basic home and office LAN

Above shown is the basic home or office LAN. In our project it can be used as:-

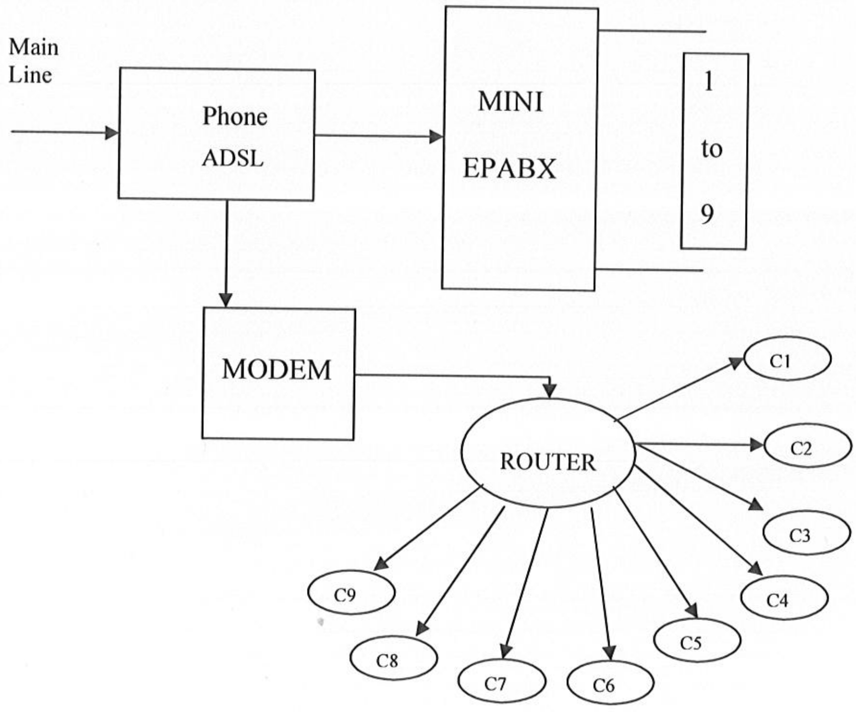


Figure 5.3 Application of Mini-EPABX as LAN

5.2 Conclusion

Mini-EPABX has been successfully made by using all the components mentioned in chapter 2. This project has its unique value in market and is widely used where it is required. Various theoretical aspects and applications mentioned above are checked and theoretically proved.

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FABRICATION OF MINI – EPABX

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