

**DESIGN AND CONSTRUCTION OF
THREE-WAY OFFICE INTERCOM**

BY

KOLAJO TEMITOPE JOHN

2000/10660EE

**DEPARTMENT OF ELECTRICAL AND
COMPUTER ENGINEERING**

**SCHOOL OF ENGINEERING AND
ENGINEERING TECHNOLOGY**

**FEDERAL UNIVERSITY OF
TECHNOLOGY
MINNA
NIGER STATE**

NOVEMBER 2005

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SUBMITTED TO

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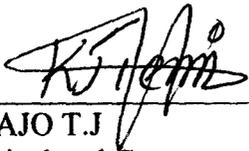
MINNA, NIGER STATE

**IN PARTIAL FULFILMENT OF THE AWARD OF
BACHELOR OF ENGINEERING (B. ENG) IN
ELECTRICAL AND COMPUTER ENGINEERING**

NOVEMBER 2005

DECLARATION

I, KOLAJO TEMITOPE JOHN DECLARED that the work is carried out by me and all source of information has been fully acknowledged by reference attached.



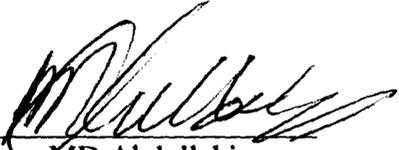
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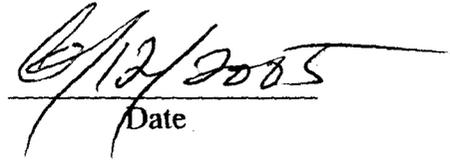
DATE

CERTIFICATION

This project titled "3-way office intercom" by Kolajo Temitope John with registration no 2001 /10660EE, in partial fulfillment of the award of the degree of B.ENG of Electrical & Computer Engineering, Federal University of Technology, Minna and approved for its contribution to scientific knowledge and literary presentation.



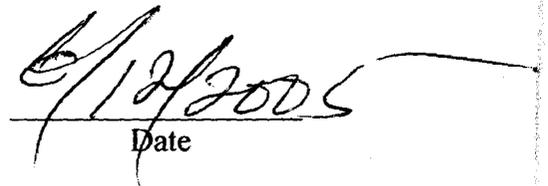
Engr MD Abdullahi
Project Supervisor



Date



Engr Abdulahi
Head of Department



Date

External Examiner

Date

DEDICATION

With grateful in my heart, I dedicate this project to the God Almighty in whose revealed word I have found refuge an comfort in this world of war.

ACKNOWLEDGEMENT

I appreciate the Lord God Almighty whose life I live and whose love has kept me.

My profound gratitude goes to my Parents Mr & Mrs. Kolajo Samuel and my elder brothers and their families. Mr. Kolajo Ekundayo Israel, Mr. Kolajo Jethro Olorunyomi, Mr. Kolajo Ilesanmi Raphael, Mr. Kolajo Logbon Joshua and Mr. Segun Kolajo, and to the family of Mr. and Mrs. Ayanleye Taiwo who had given me all the financial, spiritual, and moral support I needed to pass through school.

I appreciate my Pastor, Pastor W.F Kumuyi that whenever I am down his word through the bible study encourage me to forge ahead during school days and as the as the course of this project. My warm gratitude goes to my colleague. Mr. Adebayo Patrick (Pascal) and Mr. Imoru Odunayo who are always there for me

Engineer M.D. Abdullahi was a father indeed, a good supervisor in the course of this project, guiding and directing on how to go about this interesting work, I appreciate God for his life.

Also I want to appreciate department Project Coordinator for her support, in person of Dr (Mrs.) E. Onwuka.

God bless you all, I love you.

ABSTRACT

Over the years, telecommunication has witnessed tremendous and interesting development with more effective and cost saving methods being discovered.

However, the primary needs of a man as regards communication to communicate with his immediate environment are of vital importance.

The design and construction of a 3-way Intercom System is aptly described in this project. The project is intended to provide a cheap but yet effective means of communication with a house or an establishment.

The system made use of LM386 amplifier which is primary responsible for the amplification of sent signals at the channel where it sent.

Digital devices were used at the exchange to achieve to achieve/realize the aim of the design. Channels were linked via the use of button switches through an auto exchange.

TABLE OF CONTENTS

CORVER PAGE	i
TITLE	ii
DECLARATION	iii
CERTIFICATION	iv
DEDICATION	v
ACKNOWLEDGEMENT	vi
ABSTRACT	vii
TABLE OF CONTENTS	vii
CHAPTER ONE: INTRODUCTION	
1.1 THE NEED FOR COMMUNICATION	1
1.2 CONCEPT AND DEFINATION OF COMMUNICATION	1
1.3 THE INTERCOM COMMUNICATION	2
1.4 OBJECTIVES OF STUDY	3
1.5 SCOPE OF STUDY	3
1.6 PROJECT METHODOLOGY	4
1.7 JUSTIFICATION	5
CHAPTER TWO: LITERATURE REVIEW	
2.1 HISTORICAL BACKGROUND OF COMMUNICATION	6
2.2 BELL'S MAGNET TELEPHONE	7
2.3 MORDERN COMMUNICATION SYSTEM	9
2.3.1 CATEGORIZATION OF TELEPHONE SYSTEM	10
2.4 INPUT TRANSDUCER	13

2.5 TRANSMITTER	13
2.6 THE CHANNEL	14
2.7 THE RECEIVER	14
2.8 THE OUTPUT TRANSDUCER	14
2.9 THE EXCHANGE	15
2.10 THE INTERCOM	15
CHAPTER THREE	
3.1 DESCRIPTION OF COMPONENTS	17
3.1.1 LM 386	17
3.1.1.1 LM 386 FEATURES	17
3.1.1.2 APPLICATION OF LM 386	18
3.1.2 4060B	19
3.1.3 4013B	21
3.1.4 4017B	23
3.1.5 4066B	26
3.2 THE COMMUNICATION PROCESSES DESCRIPTION	28
3.3 CIRCUIT DIAGRAMS	32
3.4 POWER SUPPLY UNIT	35
CHAPTER FOUR: LAYOUT AND CONSTRUCTION	
4.1 CONSTRUCTION OF AMPLIFIER CIRCUIT	37
4.2 CONSTRUCTION OF THE CASING	38
4.3 PROBLEM ENCOUNTERED	39
4.4 PRECAUTIONS	39

CHAPTER FIVE

5.1 CONCLUSION

40

5.2 ACHIEVEMENT S

40

5.3 RECOMMENDATIONS

40

5.4 SUMMARY

41

REFERENCES

CHAPTER ONE

INTRODUCTION

1.1 THE NEED FOR COMMUNICATION

Communication and expressiveness are vitals to the biological survival of all living creatures. Recent studies have dealt with the range of animal's communication have that this creatures communicate by movement or by making sounds to indicate dangers, discovery or desire.

Primitive man developed method of communicating with his immediate society and even longer distances. Early methods include drum beat, fire smoke and instrument such as ram's horn. e t c.

As man increase in wisdom and knowledge his method and mode of communication have also becomes more sophisticated and efficient. Communication continues to be back bone of social development and hence its development is necessary.

1.2 CONCEPT AND DEFINITION OF COMMUNICATION

In the light of the fact that all living creature communicate with each other and also with their environment, communication in electrical engineering term; can therefore be define as the sending, processing and reception of signals using electrical means. The information to be processed takes the form of written message, voice message or an electrical signal. e t c. a communication system can be defined as a system of sending, transmitting, processing and receiving signals. The means of communication can be in the form of the radio links, optical fibre, satellite and telephone network.

Telecommunication is therefore the transfer of information from one point to a distant one. It is the bedrock of modern civilization without it commences and industry as we know it today would not have existed. Certainly man's probing into space would be impossible, it is difficult to imagine what the effect on our life would be without reliable economical and efficient means of communication.

In the technological field, communication development focuses on researching more efficient and faster means of transmitting information and message over any distance.

Efficient means of communication and quick access to requisite information are great needs of fast developing world which even exposed beyond its horizon. Scientist and engineers have been told to so far provide for the communication needs of our world, there by actualizing the concept of the world has been the global village.

1.3 THE INTERCOM COMMUNICATIONS

Intercom is a simple development utilizing telephone for the purpose of communicating with the people with specified area. It is adequately suited to cater for the communication within an area which is consanguine, eliminating all the unnecessary accesses and ensuring quick access to be desired part of call. The intercom is a cheap and effective means of communication. Within an office block or a complex, an organization or even a parrastatal or a residential buildings The design of the intercoms system is made suit the specified needs of the environments in which it is to be utilized with consideration for future expansion.

Intercom can either be automatically or normally operated, the manually operated intercom requires the presence of an operator at the master station to connect a caller to its

part or cells. The automatically operated, however does not require a master station or an operator to connect a caller to its part, all cells are passed through the digital exchange with automatically operated switches.

1.4 OBJECTIVES OF STUDY

This project is aimed at developing an easy but efficient means of communication for any personal establishment/organizations. Bearing in mind that the building and installation would to be cheap and affordable. The device is designed to achieve a low cost communication involving three location or points. The features of the electronics device make it very useful for office and home use. In which a person in a particular room can talk to the other in another room. The device is described as a 3-1 because three communication points or locations are possible for instance, a person A can communicate with B, also C and D. and B and C can communicate with two links which sums up to six different possible ways or links. Evens the device can be adjusted so that the three can communicate at the same time which makes the electronic communication system of great importance.

The circuit is designed using complementary metallic oxide semiconductor (CMOS) integrated circuit (ICs). That is because of their low cost and flexibility. Also, the logic technology consumes far less power as compared to transistor-transistor -logic (TTL).

1.5 SCOPE OF STUDY

The scope of this project focuses on short distance transmission of information and messages within an establishment, or small organization. The study of only wire telephone

transmission is outline in this project with provision for 3-channel system which will automatically operated from one call to the other is discussed in this project.

There is however the need for greater communication needs for which a wireless communication system be more desirable, but the scope of this project specified the design and construction of a 3-way automatic intercom telephone system.

1.6 PROJECT METHODOLOGY

The device operates with direct current when the line is not logged on. Basically' when person lift his handset and call the other , direct current flows through to the exchange with low power conversion and operate the combinational logic circuit of the bell of the called subscriber. As the called subscriber picks his hand set, circuit current automatically seizes with A C flowing through the amplifiers due to the establishment of communication link between the two.

The system operates in a way that when, person A with device A presses button 2 in its device, sends a signal into the central control unit through A, and B. the signal tell the central control unit that the person wants a links with person B, with device B, and device B starts to ring to call the attention of the person. And the person picks up to communicate with the corresponding person.

The operation works in the sense that when the central control unit receives the logic signal from A, and B, it now connect the amplifier input of A to the microphone output of and amplifier input of B to the microphone output of A which makes the 3-way communication possible. And end button resent connection when is pressed. Along with an integrated logic unit inverting common gates

The selection of a particular multiplexer connection enables communication on to be possible between two links. So that there are six possible ways So the analogue multiplexer can be adjusted so that the communication is on to the three terminals at the same time.

A ring unit is incorporated into the design and the communication boxes are supplied by the central control unit which makes the system more compact and economical.

1.7 JUSTIFICATION

It is generally accepted that to travelling long distance just to deliver a simple but maybe significant message, may be wasted of time and resources to continually move from one section of an establishment to the other to deliver messages and information. A simple communication system cheap, affordable and easy to maintain that adequately caters for the need of small establishment, parrastatal; home with a tight budget will be most welcome development. The fact that it needs no master station to operate it eliminates need for second operator. All this beyond reasonable doubt has provided justification to the reason(s) for which this has been carried out.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORICAL BACKGROUND OF COMMUNICATIONS

Telecommunication is the transfer of information from one point to a distinct one. It is the key ingredients of modern civilization. The prefix "Tele" is from the ancient Greek word meaning "far". It is therefore difficult to imagine what modern living would be like without ready access to reliable, economical and efficient means of communication. Therefore in the world of constant competition communication expressiveness is vital to the biological survival of living creatures.

The technology of communications is a vast subject and anyone who undertakes to learn all that there is to know about it must prepare to study for many years, some would say for a lifetime. But even if this monument task were complete, there would still be many questions left unanswered. His is because telecommunications is not just concerned with technology, nor is technology the most important part. Telecommunications is primarily concerned with people, and in the last analysis any telecommunications administration must be judged not by its equipment, but by how well it meets the needs and aspirations of the people it serves.

To understand this broader aspect of communications it is necessary to know a little, sociology, some history, and perhaps even a smartening of art.

Man has always sought a means of more efficient means of transmitting information at faster speeds. As noted earlier, drumbeats, fire, smoke signals and the ram's horn were methods used in the early times. During the middle ages, homing pigeons were used to transmit messages. During the 17th century, a significant step was taken in the area of

telecommunications development when in 1667 the English physicist Robert Hooke invented a strong telephone that conveyed sound over an extended wire by means of mechanical vibrations.

Since then, some speedy developments/inventions had been witnessed. It was however in 1876 that Alexander Graham Bell was granted the patent for electric speaking telephone; he had discovered that electricity (steady current) could be used to transmit musical notes (human voice) over a wire. Bell developed a telephone using the same instrument as a transmitter (the speaking part of a telephone) and a receiver (the listening part). As a receiver it worked very well, but it was less successful as a transmitter.

However, in the following year, 1887 the American inventor Thomas Alva Edison produced an improved transmitter which exploited the properties of carbon. Bell's receiver combined with Edison's carbon transmitter formed a very efficient telephone, and although there had been many improvements, the telephone has remained basically the same right up to the present day.

2. 2 BELLS MAGNETIC TELEPHONE.

The basic unit of Bell's invention consisted of a transmitter, a receiver and a single wire. The transmitter and the receiver were identical, each containing a flexible metallic diaphragm and a horse-shoe magnetic with a wire coil.

Sound waves striking the diaphragm caused it to vibrate in the field of the coil that varied in proportion to vibrations of the diaphragm.

The current travelled through the wire to the receiving station where changes in the strength of the magnetic field were produced. This variation in strength caused the receiving diaphragm to vibrate, producing the original sound.

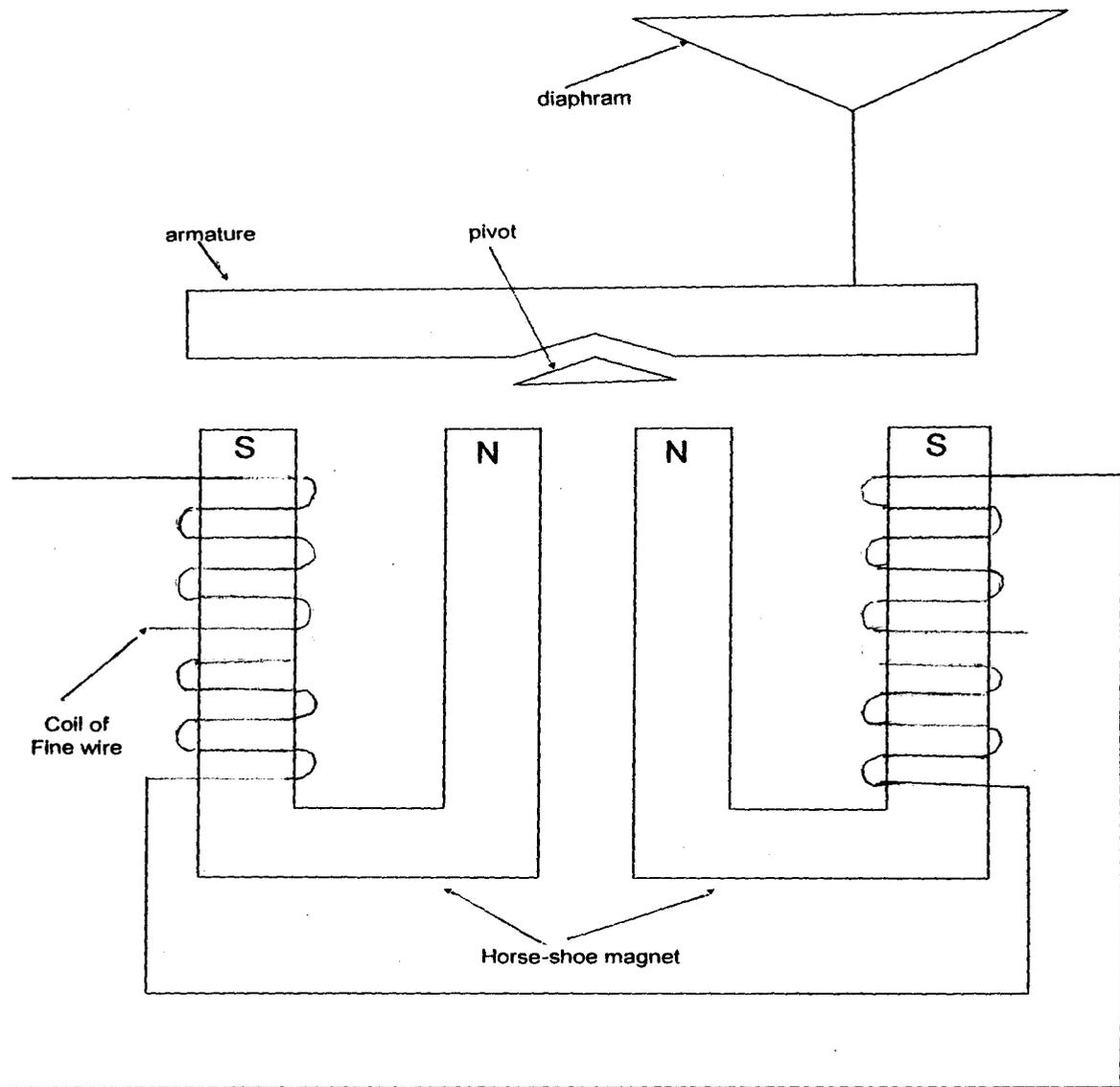


Fig 2.1- Bell's early receiver

2.3 MODERN COMMUNICATION SYSTEM.

The modern communications system was developed through research and by identifying the needs of a fast-developing world. The block diagram of a modern system is shown below:

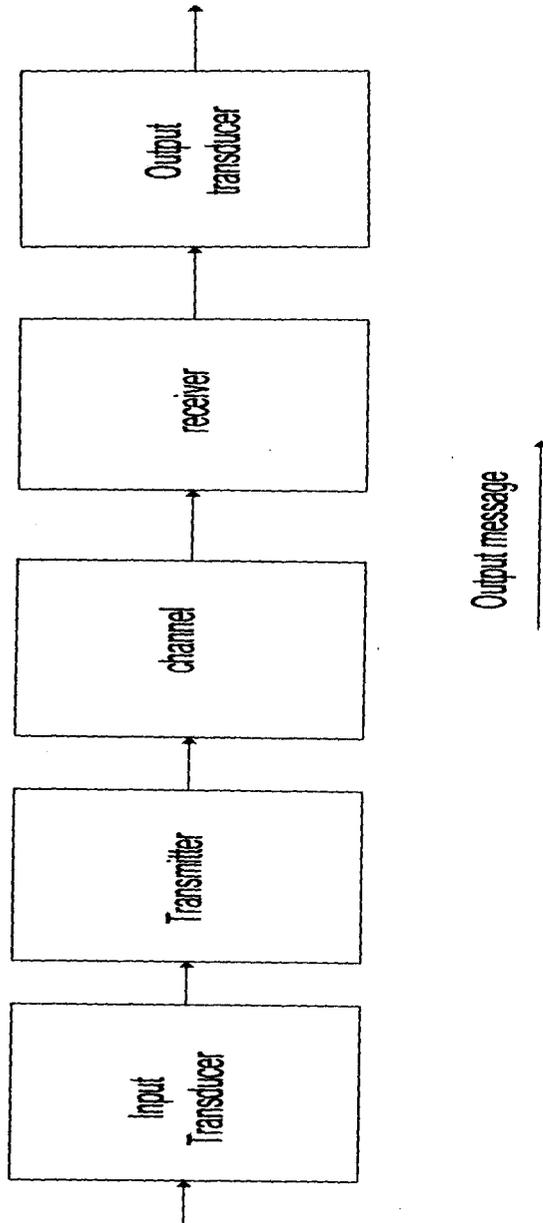


Fig 2.2- Simple communication system

Fig 2 Simple communication system

2.31 CATEGORIZATION OF TELEPHONE SYSTEM.

Telephone system may be categorized by the nature of transmission used

SIMPLEX SYSTEM: - the system allows transmission in one direction at a time .It provides communication in rather direction alternatively in instances where transmission is unidirectional.

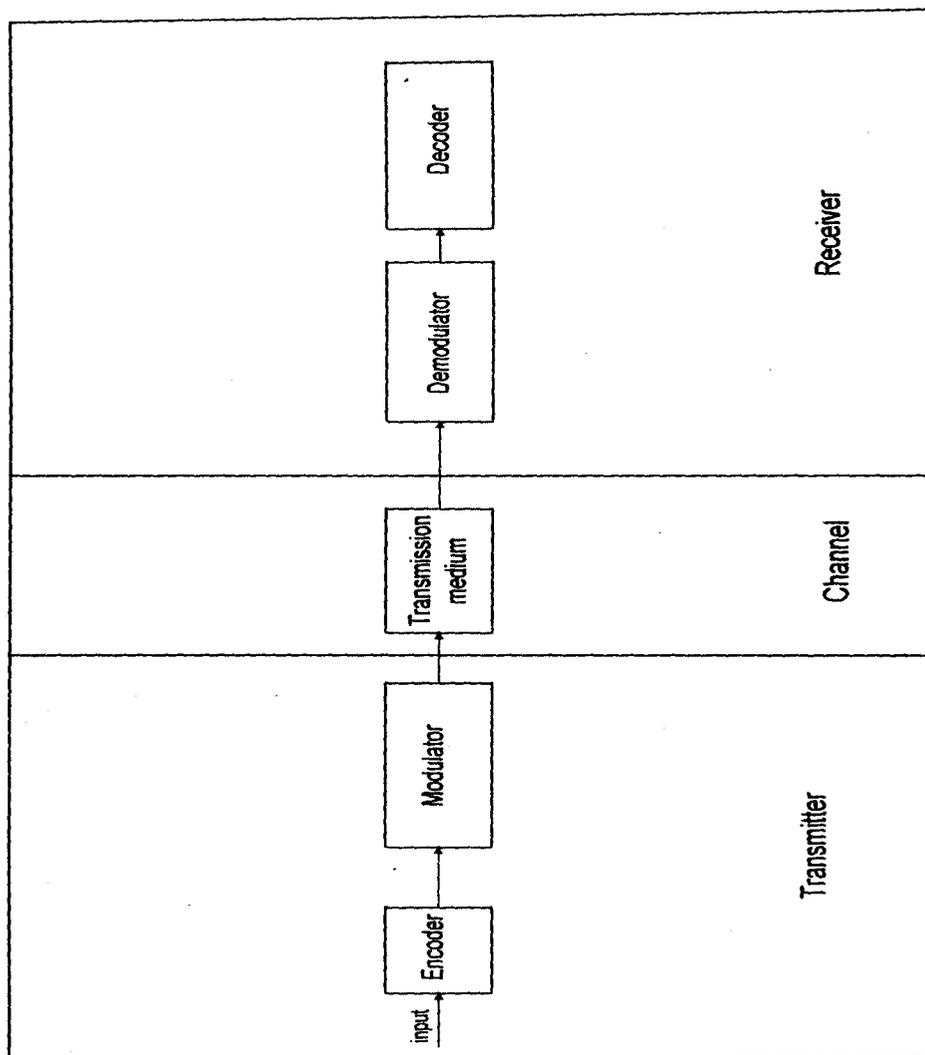
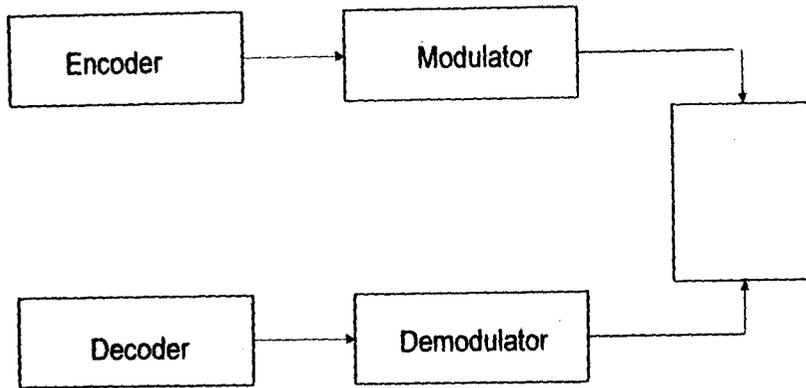


Fig 2.3- Simple communication system

1. HALF -DUPLEX:-this allows transmission in both direction but one at a time.



OR

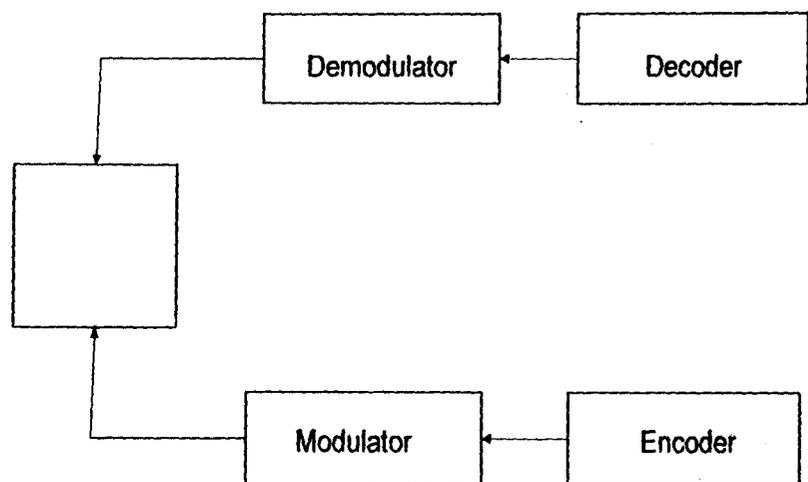


Fig 2.3- Half duplex

2. FULL -DUPLEX:-this allows simultaneous transmission in both directions- This is normally accomplished by using two separate circuits. One circuit for each direction although it not economical because of duplication of facilities.

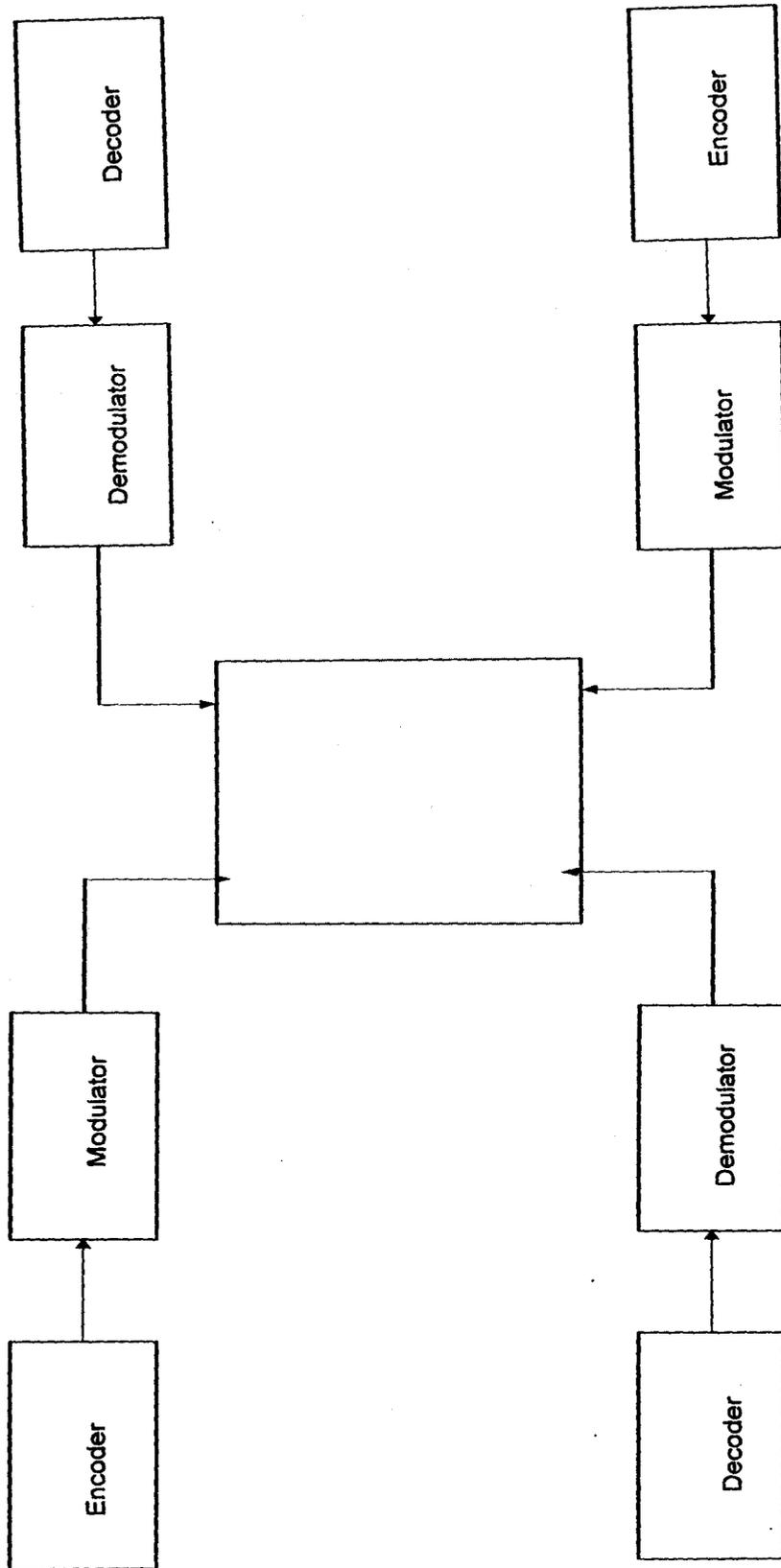


Fig 2.4- Full duplex

2.4 INPUT TRANSDUCER

A transducer is a device that converts from one system into energy in another system, the converted energy usually being in a different form.

The input message, being in the form of sound waves in the frequency range of 300Hz to 3400Hz is sent into the input transducer by a person speaking into the sound waves are then converted to voltage variations by the microphone and sent through the wires on the transmitter.

2.5 TRANSMITTER

The transmitter essentially couples the message (which has been constructed into electrical signals by input transducer) to the channel. It is at the transmitter that the sound waves are modulated. It is necessary that sound waves are passed through the transmitter for the following reasons:

- For multiplexing
- To overcome equipment limitation e.g. size and weight
- To reduce noise and interference, especially at low frequencies
- For channel assignment, each message signal is transmitted at a unique

frequency band to avoid mix-up with other signals.

2.6 THE CHANNEL

This is the medium through which the transmitted signals get into the receiver. There are different forms in which channels can be found, ranging from the ground (earth) to wires in the sky or space. The transmitter could therefore, be hand-wired or wireless.

The signal passing through the channel undergoes degradation which may result from noise or interference, fading or ticking and therefore the use of the best available channel for a specified need is of great importance in telecommunications development.

2.7 THE RECEIVER

The receiver extracts and processes the desired signal from the various signals received at the output of the channel. The desired signal is converted into a suitable form for the output transducer stage. This indicates amplification of the received signal level is low. An important factor in receiver designs is that it should be able to select the desired signal well and reject the unwanted signal well.

2.8 THE OUTPUT TRANSDUCER

This is a device that converts the electrical output signal of the receiver into the desired by the user. A loudspeaker converts electrical signals into the sound waves. The output transducer has the same operational functions as the input transducer, except that it converts the electrical signal into audible sound, the device used for output transducer could therefore be the same as that used for the input transducer.

2.9 THE EXCHANGE

The exchange is the switching center where a person with a line would be able to speak to any other person with a similar connection.

The exchange has the following;

Cable chamber, main distribution frame, apparatus room where one has the electronics cards slots into the frame, meter room, battery room and generator room

There has been three generations of exchanges

1. The analogue exchange which is purely mechanical is considered as the first generation. In this type of exchange an operator makes the connection between subscribers
2. The semi exchange: there mechanical and electronic circuits are combined its an example of semi-electronic exchange, we have the cross bar switching system
3. The third generation of exchanging is the purely electronics one. In this digital system, the interconnections are made by the exchange central processor which is usually with the aid of decoders, gates, PROMS.

2.10 THE INTERCOM

With the rapid development of telecommunication, making it possible to link areas which are miles away from a station, telecommunications has become the most interesting subject of study in the world. As much as it is important to communicate over great distance, communicating with one's own immediate environment is still of great importance.

The intercom therefore still plays a great role in telecommunications. The simple design and implementation of the intercom makes it desirable as it is also very effective.

The intercom has the same operating principles as telephone network system, the distinguishing factor being the type of transmitter employed in the intercoms. An intercom is desirable mainly for the expandability feature i.e. it designed imply so that more system can therefore compromise as few as two channels or as many as desired by the users.

The intercom system can either be manually operation or operated automatically. The manually operated intercom requires the presence of a person at the master station to the caller to has port of call. The automatically operated intercom does not need a master station as calls are passed through to their ports by switches operated automatically which could be digital system or analogue systems.

CHAPTER THREE

INTRODUCTION

The communication device is designed with new and quite effective electronic components. They provide an optimal performance with such merits as low power consumption, high flexibility, low cost, high availability, increase simplicity and lot more.

Moreover most of the integrated circuits are complimentary metallic oxide semiconductor (CMOS) which are attributed to better relative performance as compare to the other type transistor-transistor logic (TTL). The leading is the best so far for low power consumption application and total cost.

3.1 DESCRIPTION OF COMPONENTS

3.1.1 LM 386

It is a power amplifier designed for use in low voltage consumer application. The gain is internally set 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 grounded 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 lm 386 ideal for battery operation

3.1.1.1 LM 386 FEATURES

This includes:

- i. Battery operation
- ii. Minimum external parts

- iii. Wide supply voltage range (4-12V) or (5-18V)
- iv. Low quiescent current drain 4mA
- v. Voltage gains from 20 to 200
- vi. Ground reference input
- vii. Self centering output quiescent voltage
- viii. Low distortion
- ix. Available in 8 pin MSOP package

3.1.1.2 APPLICATIONS OF LM 386

- i. AM-FM radio amplifiers
- ii. Portable tape player amplifiers
- iii. Intercoms
- iv. TV sound systems
- v. Power converters
- vi. Small servo drivers

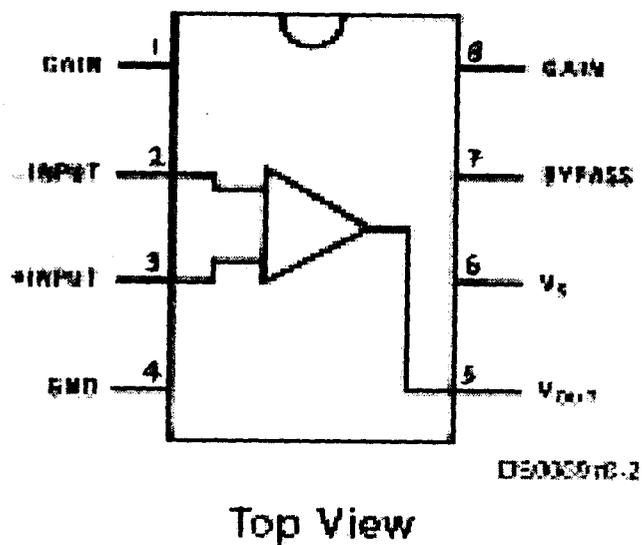


Fig 3.1- Pin assignment of Im 386

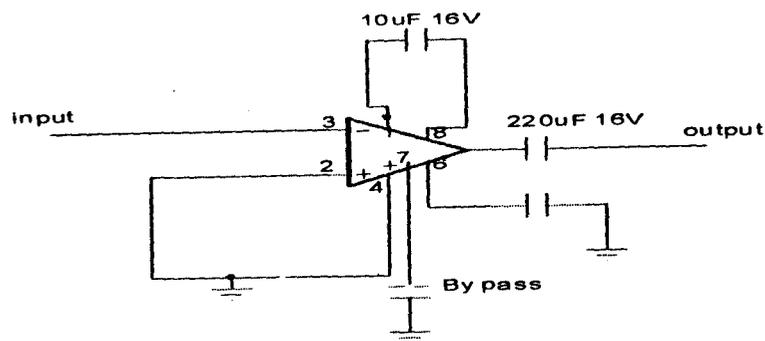


Fig 3.2- A simple LM386 amplifier

3.1.2 4060B

It is a complementary metallic oxide semiconductor (CMOS) integrated circuit designed as a 14-stage binary ripple counter. It is a very important oscillator/divider integrated circuit. It can operate both an RC and crystal mode. Also included in the chip is a reset function which places all outputs into zero state and disables the oscillator. The oscillator can produce ten frequencies at a time. A negative transition on clock will advance the counter to next state. Schmitt trigger action on the input line permits very slow input rise and fall times. The integrated circuit is far of use than the common 555 timer. In term of stability and total implementation circuit for instance, a circuit which let say five frequencies are involved. So that five 55 timers are involved. A single 4060B can be simply replaced the early time

PIN ASSIGNMENT

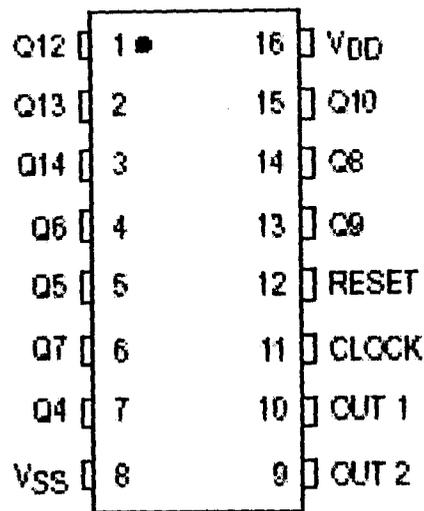


Fig 3.3- Pin assignment of 4060B

The Q outputs are the frequency pins. And for the integrated circuit to be operational, a low level logic is required at pin 12. Pin 10, 11 and 9 are responsible for the oscillation. The values of the resistor and capacitor at the pins determine the frequency of oscillation of the integrated circuit.

Moreover, when using 4060b in the RC configuration, the frequency of the oscillator stage is estimated as

$$f=1/(2.3 R_{tc} C_{tc})$$

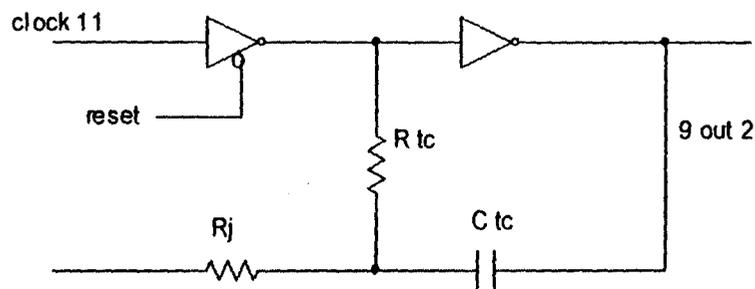


Fig 3.4- Oscillator circuit using RC configuration

If $1 \text{ kHz} \leq f \leq 100 \text{ kHz}$.

and $2 R_{tc} < R_s < 10 R_{tc}$

(f in Hz, R in Ohms, C in Farads).

The formula may vary for other frequencies.

Recommended maximum value for the resistor is $1 \text{ m}\Omega$

$$R_s = 100\text{k}\Omega$$

$$R_{tc} = 33\text{k}\Omega \text{ and}$$

$$C_{tc} = 0.001\mu\text{f}$$

In the circuit the value of R_s , R_{tc} and C_{tc} are $100\text{k}\Omega$, $33\text{k}\Omega$ and $0.001\mu\text{f}$ respectively.

So that the frequency of operation of the oscillator is

$$= 1 / (2.3 * 33 * 1000 * 0.001 * 0.000001)$$

$$= 13175.2$$

$$\approx 13.2 \text{ kHz}$$

This leading frequency undergoes multiple divide-by-2 division to result to other lower frequencies.

3.1.3 4013B

The integrated circuit is a dual D-type latch or flip-flop. Each D-latch has a clock input, reset, set, D input and Q outputs. When a data or logical level either 1 or 0 is at the D input while reset and set inputs are low logical level., a positive trigger at the clock

input transfers the data at the D-input to the Q outputs. For Q output holds the data and (not Q), the complementary logic. Also, a high level at the set pin while the reset is at low logical level makes Q logical high and (not Q), low. The reset input does otherwise. There, the latch can only be use in the SR mode by putting both D and clock input to ground.

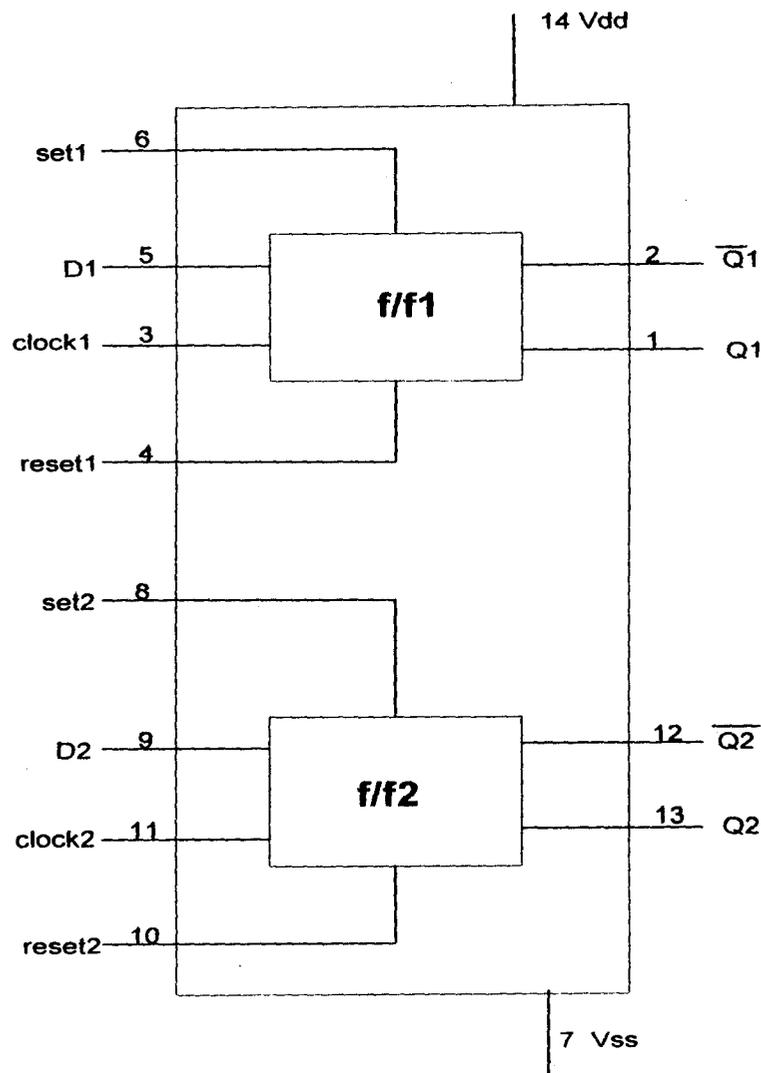


Fig 3.5- Functional diagram of 4013B

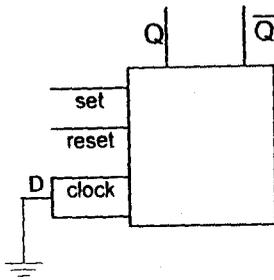


Fig 3.6- Conversion of the D-latch to SR-latch

3.1.4 4017B

The integrated circuit is a 5-stage divide-by-10 Johnson counter with 10 decoded outputs and a carry out bit. The counter is cleared to its zero count by a logical “1” on its reset input. The counter is advanced on the positive edge of the clock signal when the clock enable signal is in the logical “D” state.

The counter has a configuration which permits medium speed operation and assures a hazard free counting sequence. The ten decoded outputs are normally in the logical “0” state and go to the logical “1” state only at their respective time slot. Each decoded output remains high for one full clock cycle for every ten clock input cycles and used as a ripple carry signal to any succeeding stages.

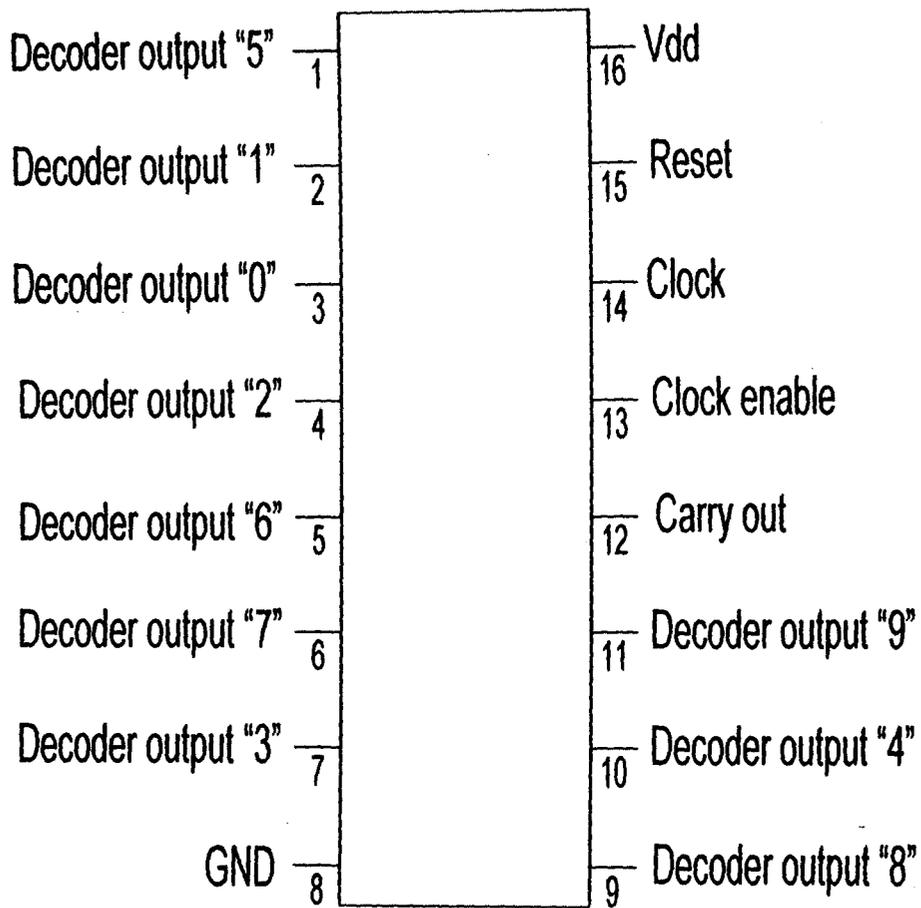


Fig 3.7- Pin assignment of 4017B

Table 3.1-A table showing how the output response to clock input when the clock enable and reset pins is both low logical levels.

PULSE INPUT	OUTPUT									
	O ₀	O ₁	O ₂	O ₃	O ₄	O ₅	O ₆	O ₇	O ₈	O ₉
0	1	0	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0	0	0
2	0	0	1	0	0	0	0	0	0	0
3	0	0	0	1	0	0	0	0	0	0
4	0	0	0	0	1	0	0	0	0	0
5	0	0	0	0	0	1	0	0	0	0
6	0	0	0	0	0	0	1	0	0	0
7	0	0	0	0	0	0	0	1	0	0
8	0	0	0	0	0	0	0	0	1	0
9	0	0	0	0	0	0	0	0	0	1

3.1.5 4066B

It is a quad bilateral switch, a very important component in the circuit. It is used for controlling the flow of audio signal from one part to the other. It is generally used for transmission or multiplexing of analogue or digital signals. It consists of four bilateral switches, each with independent controls. Both the P and the N devices in a given switch are biased on or off simultaneously by the control signal. As shown in figure 3.8, the well of the n-channel device on each switch is tied to either the input (when the switch is on) or to V_{SS} (when the switch-transistor threshold voltage with input signal and thus, keeps the on-state resistance low over the full operating- signal range.

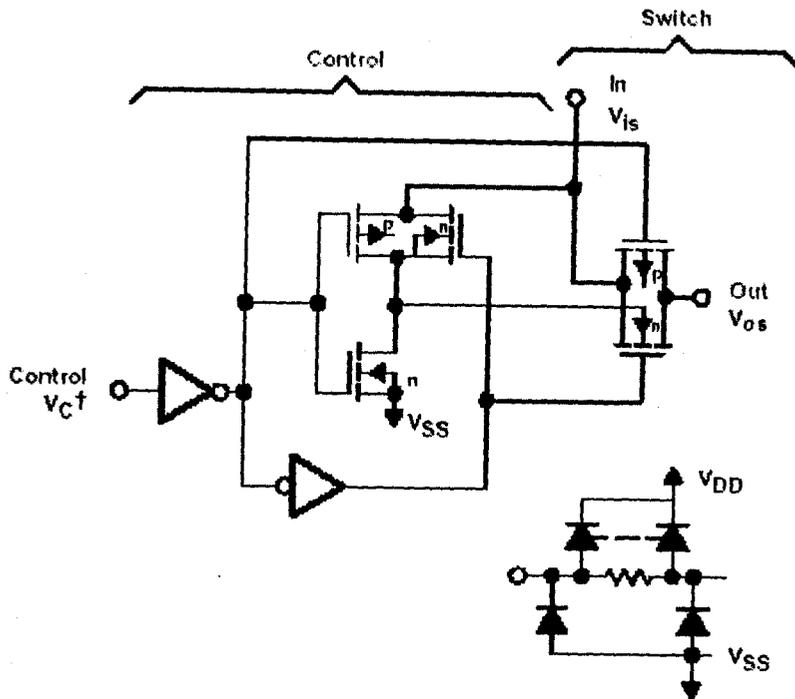


Fig 3.8- Schematic Diagram of One-of-Four Identical Switches and Associated Control Circuitry

Note

- 1) All substrates are connected to the positive terminal.
- 2) Normal operation control-line biasing switch on (logic 1), switch off (logic 0)
- 3) Signal- level range $\text{ground} \leq v \leq \text{positive terminal}$.

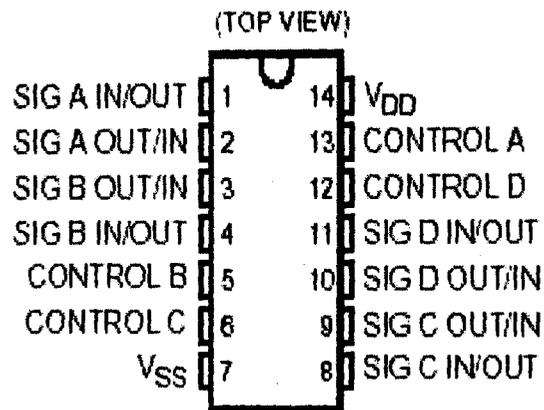


Fig 3.9- Pin assignment of 4066B

Applications of 4066B are:

- Analogue signal switching 1 multiplexing: signal gating, modulator, squelch control, demodulator, chopper, communicating switch.
- Digital signal switching 1 multiplexing
- Transmission- gate logic 1 multiplexing
- Analogue-to-digital and digital-to-analogue conversion.

3.2 THE COMMUNICATION PROCESSES DESCRIPTION

The circuit designed as a 3-channel communication-system. It holds three units. Each unit can contact or link another and only one way is possible at a time. They altogether system is attributed to four devices. Three are similar in design and the last is the central part. It coordinates the other three, so that the three other send and receive signal with the leading device.

Each of the three is referred to as communication box.

The leading device embodies a low power audio amplifier, CMOS ringing circuit and control logical unit.

The low power audio amplifier is LM386 which produces an output of about 1Watt and using a 50k Ω variable resistor as volume. The output strength can be adjusted. The circuit of the amplifier is attributed to the manufacturer's data sheet. The external components such as capacitor are specified in the sheet.

The on-line channel indicators he received communication box just like the number of a caller shows on a communication handset. The incoming signal from the caller is inform of a high logical level and it passes through a 1k Ω limiting resistor before reaching the P side of the corresponding light emitting diode (LED). The 25C945 is designed to cause a blinking negative or effect on the leading light emitting diodes (LEDs).

Moreover, it is quite evident that each communication box can only link to the other two. Therefore, the buttons or switches X_j and Y_j are used to contact the other boxes.

When one of them is pressed, a High logic level passed through the summing OR gate and the signal passes through a_j or b_j to the central device.

Apparently, there are six links or lines

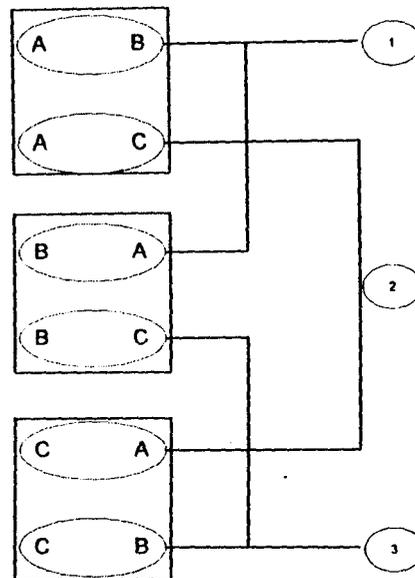


Fig 3.10- Possible communication links.

But precisely there are three true links or line of communication. The central control latch is designed to select a particular analogue multiplexer to link two particular communication boxes together. The microphone of one is connected to the amplifier of the other, so that the signal or voice from the microphone is heard at the other side.

The control latch is clocked by an oscillator. And it makes the operation dynamic in the sense that not more than one link is achieved at a time.

The control oscillator operates at f_0 which is given by:

$$f_0 = 1 / (2.3 \times 10 \times 10^3 \times 1 \times 10^{-6}) / 2^7$$

$$= 128 / 0.023$$

$$=5565.217\text{Hz} \approx 5.56 \text{ kHz}$$

The stepper (4017B) enables the three outputs AND gates one after the other. The AND gates are connected to the three input OR gates. So that the first signal to be enabled, causes the output of the 3-input OR gate whose output is connected to the set input of the control latch HIGH logical level. This changes Q output of the latch from LOW to HIGH logical level. The stepping effect of the stepper stops and a corresponding analogue multiplexer is enabled through the HIGH logical level from the corresponding AND gate passing through an OR gate to the enabling input of the analogue multiplexer.

The multiplexer causes the link and to quit the connection, the end button is pressed. This causes corresponding outputs a_j and b_j of the particular communication box HIGH logical unit senses the incoming command. And it is designed to reset the control latch. This results to revert to the initial condition achieved by the stepper is active once again. The corresponding analogue multiplexer is disabled. And the communication link is cut-off.

Moreover, a complementary metallic oxide semiconductor (CMOS) ringing tune unit is designed to indicate signals from external communication boxes. For signal from terminal I_j and Q_j are sum together by a 2-input OR gate whose output is connected to a ringing-tune latch. The Q output of the latch. The Q output of the latch changes HIGH logical level and the output activates a set of oscillators which generate the audio alarm output. There is another 4060B oscillator. It is designed to automatically reset or contact signal from other communication box. The frequency of operation is the same as that control oscillator. The output of the ringing alarm is connected to a simple one-stage

NPN amplifier. Using a 2SC945 transistor, the output a speaker is connected to the collector of the switching device.

The ringing alarm holds two frequencies and there frequencies are as follow:

$$f_1 = 1 / (2.3 \times 10 \times 10^3 \times 1 \times 10^{-6})$$

$$= 1 / 0.023 = 43.48 \text{ Hz}$$

$$f_2 = 1 / (2.3 \times 2.2 \times 10^3 \times 0.02 \times 10^{-6})$$

$$= 1 / 0.0001012 = 9881.42 \text{ Hz} \approx 9.89 \text{ kHz.}$$

The mixing of the two causes a ringing tune alarm effect.

Moreover, the three communication boxes can be linked together in a usual mode by pressing the first contact of the communication devices at the same time. They are fed into the central control unit. And the inputs are fed into the central control unit. And the inputs are connected to a 3-input AND gate. The output of the AND gate is connected to the set of the common latch. The Q output of the latch change HIGH from LOW logical level and this results to the enabling of the entire analogue multiplexer. This connects the whole communication boxes together.

The same process is required to switched off or cut the link. That is by pressing the "end button".

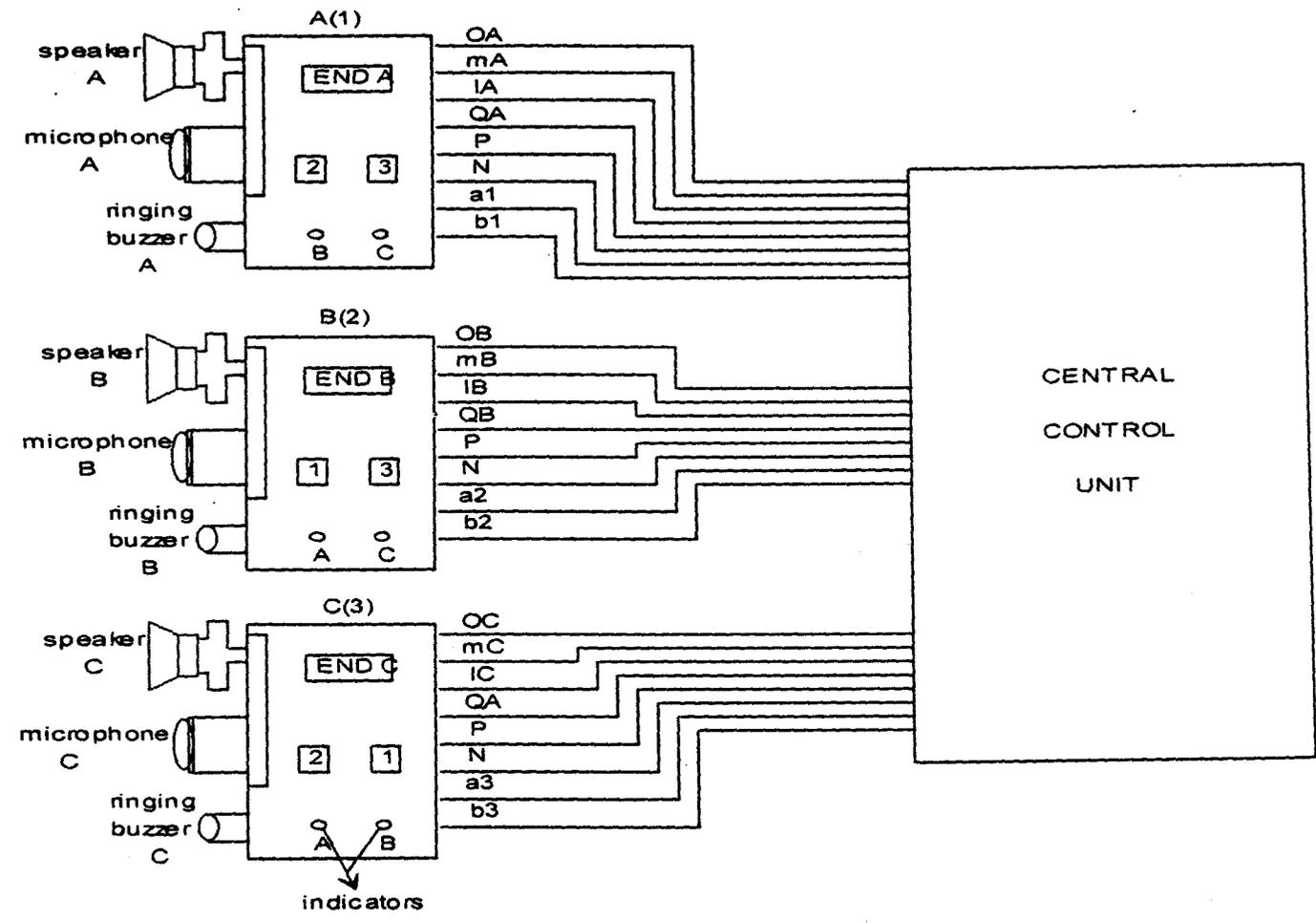


Fig 3.11-Block diagram of central control unit

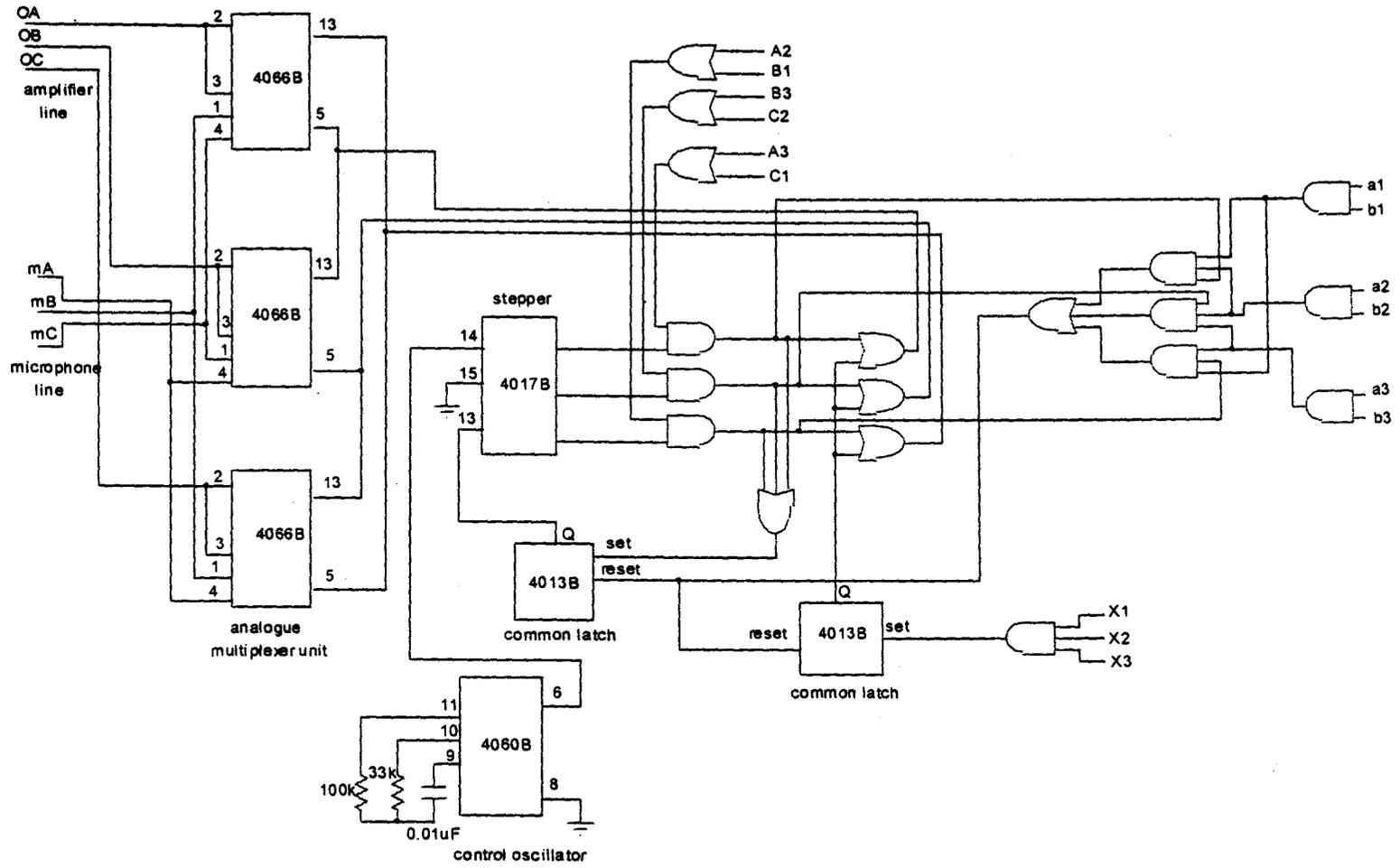


Fig 3.12-Functional diagram for the central control unit

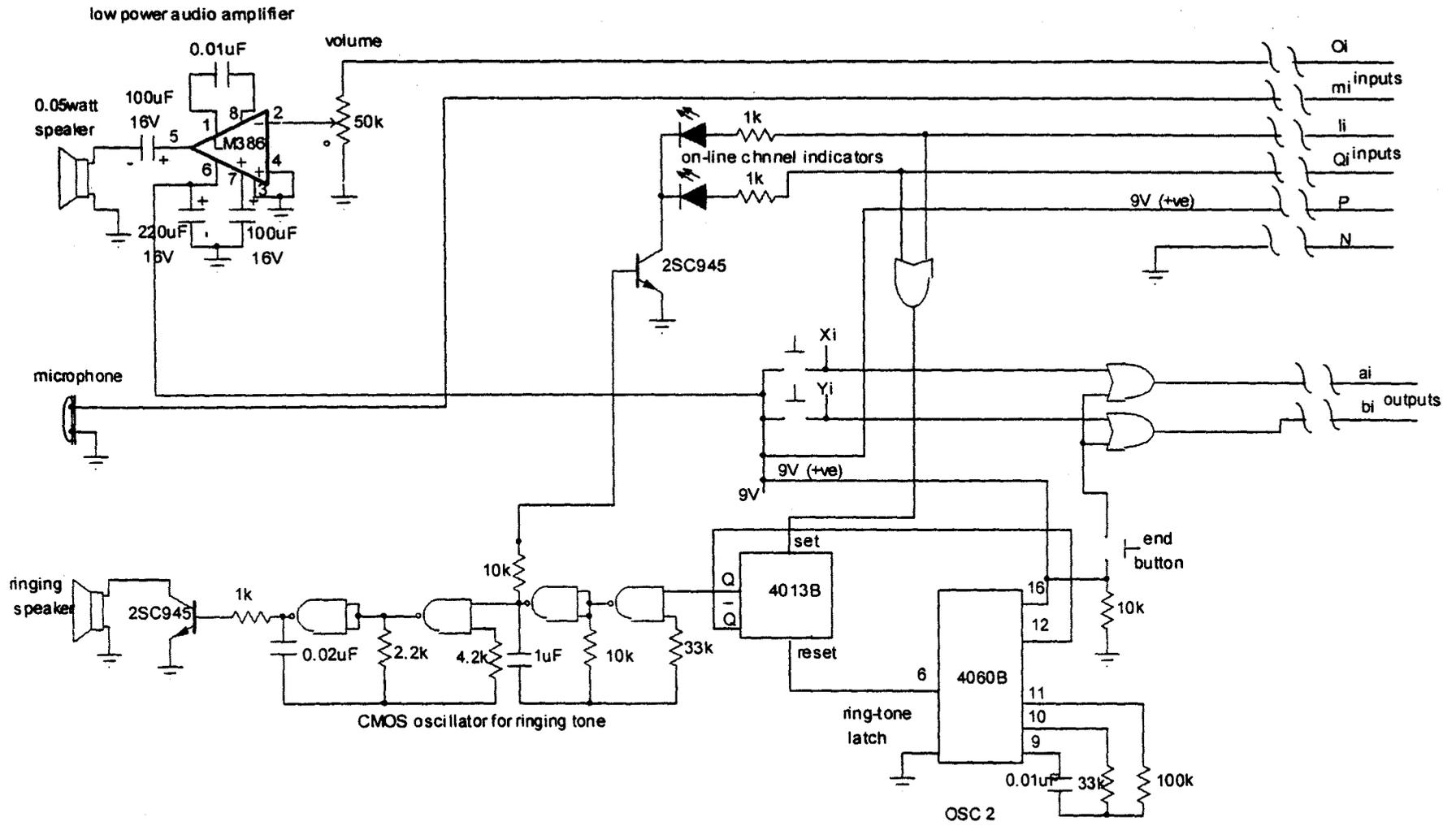


Fig 3.13-Circuit for each box

3.4 POWER SUPPLY UNIT

All electronic devices utilize a direct current (D.C) Voltage source for operation. The main electricity supply is an alternating current (A.C) at a voltage of 220V and has to be converted to D.C supply of the required value.

The use of batteries is an alternative power supply to the rectification process, However it has some disadvantages which include: limited life span – this results from the manner in which the internal resistance increases with age thereby deteriorating the battery. It cannot satisfy the amount of current drawn by most electronic devices for a long time as the battery is quickly drained and thus becomes inefficient, hence an AC to DC conversion is done by the power supply unit to avoid these inadequacies of the battery.

The power supply unit consists of transformer bridge rectifier, a filter and a voltage regulator which all function together to perform the AC voltage supply from the main into a regulated D.C supply as the output of the power supply unit.

The block diagram of the power supply unit is shown.

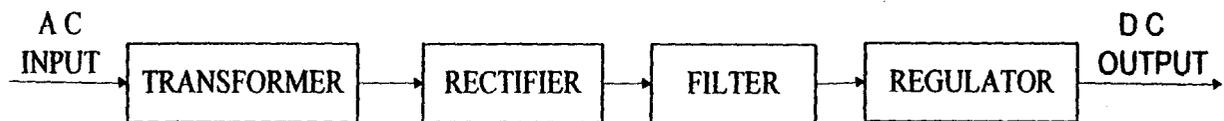


Fig 3.14- Block diagram of the power supply unit

The input A.C supply voltage is single phase voltage obtained from the mains supply of PHCN with a value of 220V, 50Hz.

Fig 3.15 is the circuit diagram of power supply unit.

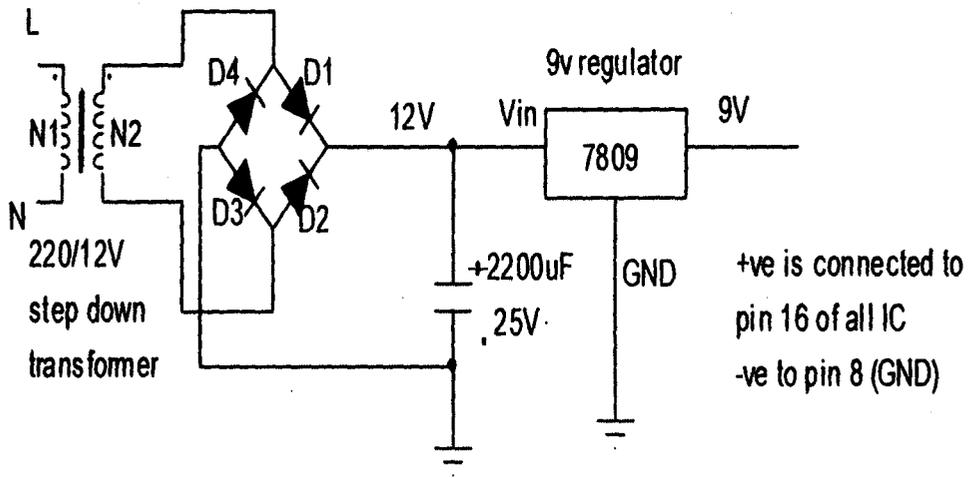


Fig 3.15 – Power supply circuit diagram

CHAPTER FOUR

LAYOUT AND CONSTRUCTION

In this chapter, an over view of the types of material used in the construction and general layout of the project is seen. The complete assembly is also outlined.

4.1 CONSTRUCTION OF THE AMPLIFIER CIRCUIT

The design of the various circuits comprising the intercom system was tested using specified components and testing them on a breadboard to ensure full workability of the design. When the system was certified to be working, the components were then permanently fixed by soldering on a Vero board.

Breadboards are prototype boards, which are modules containing well arranged pin sockets for fixing components.

The bread board is ideal for testing full working of the system and components are serving as a temporary construction board. For this project, all components used in the work were laid out on the breadboard according to the specification of the project design. All adjustment was made using the breadboard, and the effects of interchanging component was observed and noted.

The breadboard proved to be very convenient, and played integral role in the circuit design of this project, as theoretical designs were realized with ease and component were easily experimented with.

The Vero board is an insulator strip, comprising several parallel tracks of strips with small holes drilled along its length giving a matrix format. It is made of hard plastic, and provides adequate insulation between connected components.

The components are fixed to the Vero-board by placing each pin of the component in a separate hole, and then the pin will be soldered into the circuit in accordance with the specified design.

This ensures immovability of the components, hence this stage of construction is referred to as the final circuit construction. Soldering the components was done with great care to prevent damage to the components. The tip of the soldering iron was cleaned and sharpened with a chisel, and high grade soldering lead was used. The temperature of the solder was regulated to stop over-heating, and soldering were applied.

Uniformity of the arrangement of the component with the tested design was ensured, to ease the need to removed components for the purpose of connection, after the circuit would have been completely soldered.

4.2 CONSTRUCTION OF THE CASING

The concept of a conventional telephone casing was considered for the design of the project casing to allow for familiarity for would-be-users. The choice material was wood because of its light weight and relative cheapness.

The dimensions of the casing were considered with respect to size of the component, and space was given for any subsequent additions. The casing was first designed on paper, and modifications were made before the actual construction was made to ensure that the finished work closely resembled what was conceived.

The various components comprising the whole intercom system were put together by fixing them in their appropriate places on the constructed wooden casing.

4.3 PROBLEM ENCOUNTERED

The problem of radio interference was experienced but this was solved by making adjustments to the value of the variable resistor used to set the gain at the pre-amplification stage

Another major problem in the design of the circuit came up in the use of the LM 386 at the amplifier. A 470uF 16V capacitor was then used as the calculated value of the capacitor which was found to reduce the noise.

4.4 PRECAUTIONS

Quite a number of precautions were observed in the design and construction of this project work. This was done to ensure the system worked well, and components were not damage in the process of construction, so as to maintain a low cost of construction.

Some of the precautions include:

Proper soldering techniques were applied. Strong solders were carefully removed to avoid short-circuit and bridging. High mode soldering lead was used , and the best of the soldering irons was regulated to avoid damage to the components. The circuit design was made to be easy to understand, noting methods used in previous designs, so as to save time and prevent too much experimentation with component.

The values of the circuit components were ensure to be very close to their calculated values. Proper identification of components was ensured and their parts and values were made, both at the time of purchase and during the circuit construction.

CHAPTER FIVE

5.1 CONCLUSION

After carrying out this work, I now know better than ever the important role of telecommunication in technology, social and economic development of our society. I have also been able to know to a reasonable extent the working principle, applications and shortcomings of the industry.

5.2 ACHIEVEMENTS

The conclusion of an intercom system was achieved at low cost with the best available materials. The system was designed to have a good quality low noise output by taking into consideration the gain and the feedback of the amplifiers. The overall design and construction is also very user-friendly.

5.3 RECOMMENDATIONS

I will suggest that the work as presented in this project be improved upon by those who will carry out subsequent projects so as to make the system more efficient in the modern day technology. This improvement can be made in the following ways.

The analogue exchange should be replaced by a more sophisticated digital exchange.

Extra care should be taken when mounting the components on the Vero-board to avoid breakage of IC legs or simply plastic IC bases should be used so as to avoid sudden damage of ICs.

5.4SUMMARY

Working on this project was challenging, but it turned out to be very interesting and very enlightening.

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