DESIGN AND CONSTRUCTION OF A FULL DUPLEX INTERCOM SYSTEM

BY

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING DEGREE (B.ENG) IN THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

NOVEMBER, 2004

CERTIFICATION

This project has been approved by the department of electrical /computer engineering of federal university of technology minna Niger State, Nigeria. The project meets the requirement for the award of bachelor of engineering technology degree (B.Eng).

ENGR. ATTAH

(Project supervisor)

5th Dec, 2009

Date

ENGR. MUSA ABBULLAHI

Head of Department

6/12/2009

Date

EXTERNAL EXAMINER

Date

DECLARATION

I hereby declare that this project work is entirely my original work and my effort under the supervision of Engineer Paul Attah of Electrical Computer Department of Federal University of Technology Minna. Niger state and to best of my knowledge has never been submitted elsewhere, this I declare.

DEDICATION

This thesis is dedicated to Almighty God who has seen me through the years of my studies, to Him be the glory and honor. It is also dedicated to my parent Mr. H.F Arotiba, Mrs E.O Arotiba who have supported me in every aspect of my life may the Almighty God in his infinite mercy continue to bless them (Amen).

ACKNOWLEDGMENT

I give glory, honor and majesty to the Almighty God for His immeasurable help at every time of my need.

My gratitude goes to my supervisor, Engineer Paul O. Attah for his useful suggestions and constructive advice, encouragement during the course of the project

My special thanks also goes to the entire lecturers of the electrical engineering department, my profound gratitude goes to the entire family of Mr and Mrs Toba Abayomi for their support during my course of study may Almighty God reward them in Hundred folds. My unmixed love gratitude goes to the following people who have in one way or the other contributed to the successful completion of this work. Mr. And Mrs. Sanisi, Ayodele Arrow Arotiba, Joyce Funmilayo Arotiba; Wumi Arotiba. Toyin Kolawale, Temitope Arotiba, Adeola Alade, Olumide Oluleye, Iyabo Aderemi, Omowunmi Adegbesote, Nike Omoniyi, Joshua Adedayo Alao, Tawakalit Salau, Ayobola Olorunimbe, Bukola Adenola.

Lastly, my gratitude goes to Harold Samuel, Samuel Idowu Omokere for their support and help in the project may God in His infinite mercy reward every one of them.

ABSTRACT

This project is based on the design and construction of a system that converts sound signals into electrical signals, amplifier these signals transmits the signal over wire and reconverts the electrical signal into sound signal. The design allows for bi-directional transmission of information. It has two identical sections that equally transmits and receives information at the same time. This is built around an audio amplifier circuit, power by 9v d.c source: it also has a signaling facility, which consists of a tone generator and an alarm system. This design is cost effective, simple and easy to install.

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CHAPTER ONE

1.0 GENERAL INTRODUCTION

Communication is a very important aspect of life that cannot be neglected; it is defined as the transfer of information from one point to another at a distance, which can be either long or short. Being a vital tool for exchange of information, its plays a vital role in the development of the society. The need for information exchange between people separated by a considerable distance makes communication technology necessary.

Telecommunication is an aspect of communication that transmit electronic signal across a distance so as to enable people to send and receive messages or information. This begins with messages that are converted into electronic signals. The signals are then sent over a medium to a receiver; where they are decoded back into a form that the person receiving the message can understand. There are varieties of ways to create and decode signals also different ways to transmit signals. Telecommunication messages can be sent in different ways and wide range of devices but this project is restricted to an aspect of telephony known as **INTERCOM SYSTEM**

The intercom system helps to enhance civilization also has made one to know what is taking place in the society at large. This is widely used in industries, home, offices, and hospitals, banking halls, airports for different purposes; to achieve different goals. Intercom system comprises of some basic components such as microphones, speakers, diodes amplifier, transformer, and Cmos oscillators for audio alarm, all these are coupled together to get an effective intercom system. Each of these components plays an important role and function to produce an effective system, which enables

information to be passed from one person to another or one place to another. An information sent from one sender to a single receives is known as point to point, while from one sender to many receiver is called point to multi point. The intercommunication system can be classified into two transmission signals these are stated below.

i. Unidirectional way of transmitting communication signal

ii. Bi-directional way of transmitting communication signal

For uni-directional way, the transmission of the signal is only in one direction that is it allows flow of information in one direction and the person at the receiving end is not expected to reply back to the sender of the information. It is mostly regarded as SIMPLEX MODE OF TRANSMISSION, the figure below represent a block diagram of the simplex transmission system

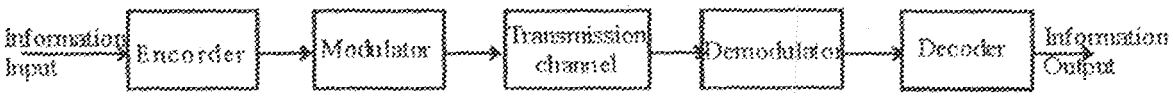


Fig1 Simplex Transmission System

In the case of bi-directional transmission mode, this system allows the flow of information in both directions. This means that there is room for conversation between the person at the sending and receiving end of the system.

This bi-directional transmission can be divided into two basic part stated below

i. Half duplex transmission mode

ii. Full duplex transmission mode

Half duplex maintain two way communication by sending the message back to the original source, either for verification of the message for comparison or control, it

requires the flow of information only one way at a given time. A Schematic block diagram below represents it.

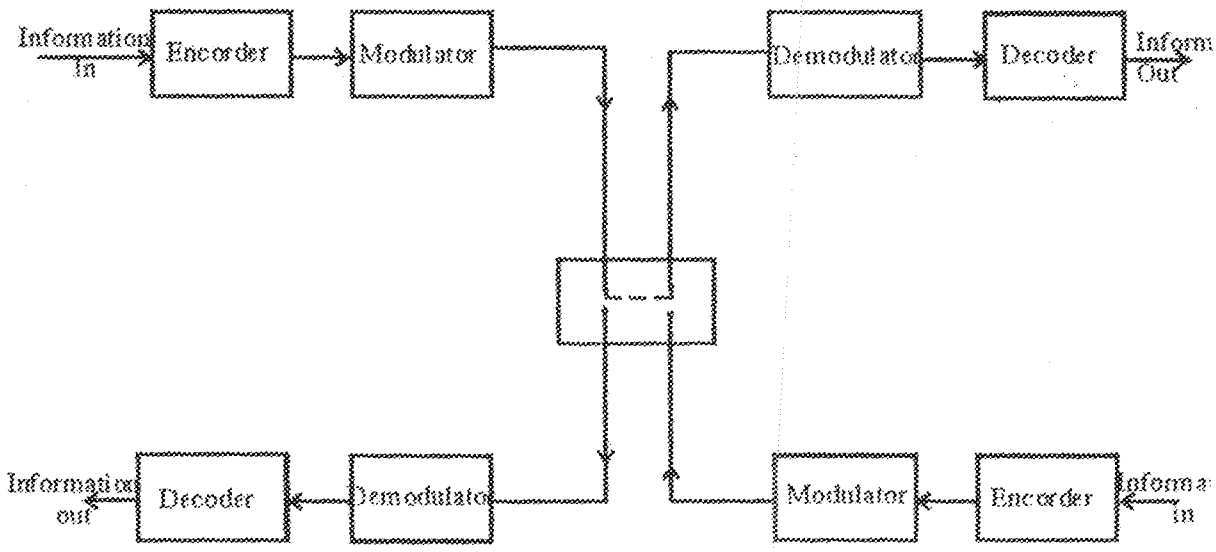


Fig 2. Half Duplex Transmission System

Full duplex mode of transmission is quite similar to that of half duplex but in this case the transmission of the signal is simultaneous in both direction that means information can be sent and received at the same time. It block diagram is represented below.

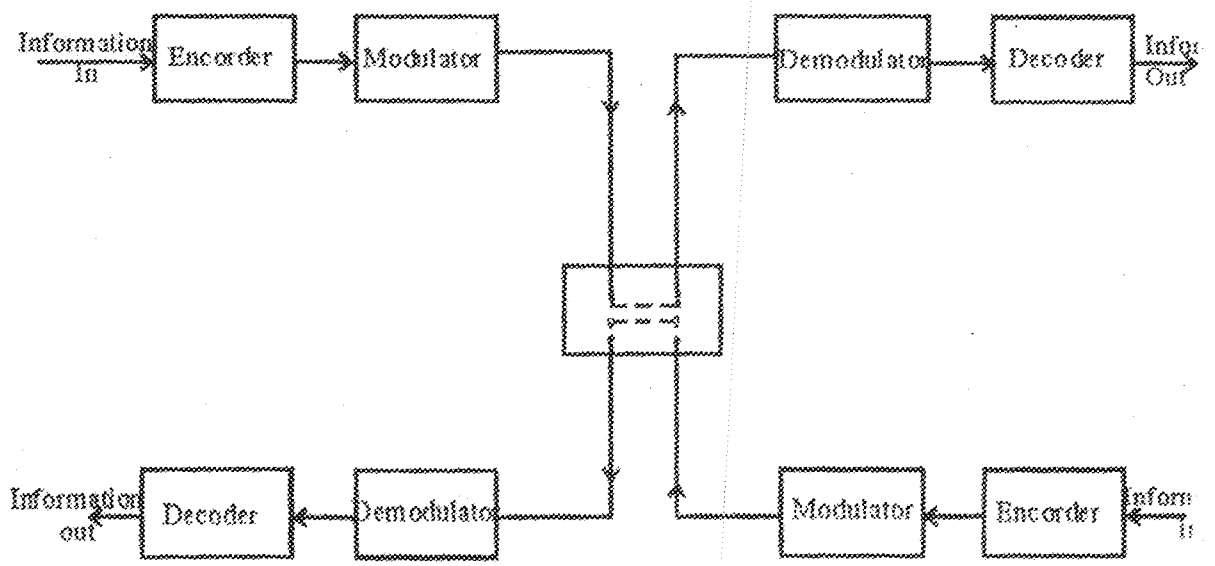


Fig 3. Full Duplex System

1.1 Literature Review

A good and effective communication system is paramount for the development of the society. For civilization to take place basic communication system has to be put in place.

Communication is a very important aspect that must have full regard to reliability, efficiency and economic operation. There are various means of communication, but this project is dealing with the intercom system. Devices and systems that transmit electronic signals over a certain distance is known as telecommunication. This allows people around the world to contact one another to access information instantly. This usually involves the senders of the information to one or more recipients linked by technology such as intercom system. Telecommunication devices converts different types of information such as sound, video into electrical signals which can be transmitted by means of telephone wires, radio waves. When the signal reaches its destination, the device on the receiving end converts the electronic signal back into an understandable message such as sound over a telephone, moving images on television words pictures on a computer screen.

The intercom system can be used for communication in an office, between the boss and the staff, in a residential building, hospital and even at the airport. Through an intercom system, communication can be carried out among a limited number of subscribers; the desired connections are done by the subscribers themselves with the half of the switching system. This system is provided with amplifiers, which amplify the conversation and reproduces it through the loud speakers.

Communication over a distance has been a challenge throughout history. In ancient times runners were used to carry important messages between rulers or other important people. Other form of communication included smoke signals, chains of search light, carrier pigeons, horse, ringing of bells, town criers, flags to send a message from one tower to another over a specific distance either long or short distance. Modern telecommunication began with the discovery that electricity can be used to transmit a signal; for the first time, a signal could be sent faster than any other mode of transportation. The first practical telecommunication devices to make use of this discovery was the telegraph; the telegraph was discovered and was mostly used in the mids 1800s to deliver the first intercity, transcontinental and transoceanic messages in the world. This was first invented by an American art professor Samuel f. B Morse using principles of electromagnetism and by 1861-1870's it was widely spread and used.

In 1876 American inventor Alexander graham bell ushered in a new era of voice and sound telecommunication, using a prototype telephone, which became a vast improvement over the telegraph system, which could transmit coded words and numbers. The telephone is an instrument that sends and receives voice messages and data, it convert speech and data to electrical energy; telephone are linked by complex switching system called central officers or exchanges, which establish the pathway for information to travel. The telephone system is used more because it was more convenient, faster and personal than telegraph, which required, trained operators, written messages and then deliverered by hand to the receiving part, which took much time. The origin of the wire telephony system dates back to the eighteen-fifties. The word telephone word derived from the Greek word "tele" meaning for and "phone" which means sound. This transmitted actual sound messages and made

communication immediate it got improved over time using switching technology which is used to transfer calls from one local network to another and could be connected for personal conversation

The telephone system involves the conversion of sound signals into audio-frequency electrical signals, which can later be transmitted over an electric transmission system and converted back to sound signal at the receiving end of the transmission line. In 1878, a telephone exchange linked telephone in a given area together so a connection between the telephone and exchange was all that was needed; this was a two-way telephone system. This was achieved by using two separate circuit-one for each direction of transmission. Ever since, there has been a series of improvement on this discovery, which has led to the more sophisticated intercom system that is used today.

In late 1960's the intercom system came into existence, but in the form of private branch exchange (PBx), which was used by large business. It has it's own switching machine. The switch machine made it possible for hundred, thousands of lines to be reached by just drawing a single number; while in small-business calls were been transferred through this means too. By 1971-1975 the intercom system was now in used due to the advancement in technology, this was brought about by HARRISON MIYAHIRA ELECTRONICS, 1978 the first full duplex intercom for professional audio in industries was discovered. In 1982-1993 wireless full duplex wireless communication system, which enable natural communication between customers and employee and wireless multipoint communication system. All these improvement was done by the Harrison Miyahira electronics and since then a lot of new technology has come into existence.

1.2 Types Of Intercommunication System

The intercommunication system is basically sub divided into

i. Telephone intercommunication system

ii. Wire intercommunication system

iii. Wireless intercommunication system

1.2.1 Telephone Intercommunication System

In this system, there is need for key and hybrid key telephone/private branch exchange (PBX) telephone system. The intercom system is built in the same telephone instrumental that is used to access the public network. There are two types; the single link and the multi link. The single link provides a single intercom path in the telephone system regardless of the number of station that might utilize the system. The multi-link system provides two or more intercom paths that mean more than one conversation can be in progress at the same time.

1.2.2 The Wire Intercommunication System

The wire intercom system is a two-way station in which the stations are connected to each other by using a simple pair cabling wire. An example of this is the one used in offices for communication between boss and secretary. Some wire intercom has multiple stations, where the user must dial a code to get the person intended to be spoken with.

1.2.3 The Wireless Intercommunication System

This type of intercom system consists of a base station transmitter with an antenna and a number of other stations turned to different frequencies. The base station can

communicate with any of the other stations by selecting the corresponding specific frequency of that unit.

1.3 PROJECT MOTIVATION

The main reason for this project is to enhance an effective communication system especially in our industries. An effective communication system will increase the level of productivity in all industries, by passing necessary information to the worker; with this the management will monitor or will be well informed about the workers performance and output. This will help to avoid the production of low quality goods and make sure that the time spent by the worker is not wasted but well spent in the industry. It also ensures that work is carried out effectively according to the initial plan (production of high quality goods needed or intended by the management).

1.4 AIMS AND OBJECTIVES

The intercommunication system plays an important role in the development of the society. Some of these are stated below.

a) For effective communication between two separate location so as to increase the level of productivity in offices, industries, workshop and hospital.
b) For the security and life safety.
c) To make communication link as cheap as possible.

1.5 PROJECT OUTLINE

This project is divided into four chapters:

Chapter one deals with general introduction, literature review, aims and objection, project motivation and project outline.

Chapter two contains the system design and overview, design analysis, calculation, block diagram and circuit operations.

Chapter three: deals with design construction, testing, observation, discussion of result, problems encountered and preventive measures.

Chapter Four: contains recommendation, conclusion appendix and references.

CHAPTER TWO

2.1 SYSTEM DESIGN INTRODUCTION

A full duplex intercom system, or circuit consist of two identical intercommunication units, where each unit consist of a microphone, speaker, an audio amplifier, diodes e.t.c, all these are coupled together to produced an effective intercom system.

This full duplex intercom system uses wires that runs between each intercom unit; which is a means of conveying the signal from the sender to the receives and vice versa.

The push button is used just to sound the alarm system, to alert the receiver that an information is about to be passed acrossed, the switch serves a very important role, to either put on or off the power supply into the intercommunication system.

In this chapter the design of the full duplex intercom system will be discussed, followed by a detailed design analysis of the two-way system.

2.2 DESIGN OVERVIEW

As earlier mentioned in chapter one, that a full duplex intercommunication system consist of some very important components, where each performs different roles and functions in the intercom system.

2.2.1 Cmos Oscillator

This is an electrical component with complete electronics circuit in which both active and passive components are fabricated on an extremely tiny single silicon chip, it consist of a these components that are working dependently to give a fast and accurate

response. Integrated circuit can be classified based on the function they perform as well as how they are constructed. The integrated circuit has its advantages and its disadvantages. Some of its advantages are

i. It has an extremely small physical size

ii. They are very cheap due to reduction in size and weight.

iii. They are extremely reliable and consume very low power

iv. They are suitable for small signal operation.

Disadvantages

i. They cannot withstand rough handling or excessive heat.

ii. They can handle only a very limited amount of power.

iii. Coils and inductors cannot be fabricated in integrated circuit form.

The Cmos Oscillator, which helps in the reinforcement of sound, it is a combination of AND gates and transistors, which boost the sound input into the actual frequency needed. The output procedures the actual frequency pulse needed. The CMOS oscillator has a greater advantage over the other integrated circuit because of.

i. Low power dissipation typically 10nW per gate

ii. Excellent noise immunity.

iii. Wide operating supply voltage range

iv. Wide operating temperature range- 40°C to + 85°C

v. Inputs and outputs are protected against electrostatic voltage.

While its greatest disadvantages is that it cannot withstand rough handling bill requires special storing method

The CMOS Oscillator used is a 4011B, it is an amplifier, which helps in the reinforcement of sound, it is a combination of AND gates ad transistors, which boost the sound input into the actual frequency needed, the output of this produces an actual pulse frequency needed.

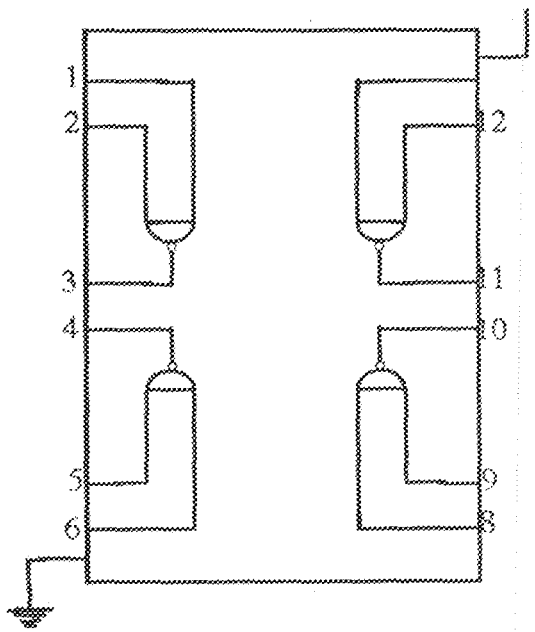


Fig 4: 4011B CMOS Oscillator

The CMOS oscillator can be expressed as

C- Complimentary

M- Metallic

O – Oxide

S – Semi conductor

2.2.2 Lm 386 Integrated Circuits (Ic)

This is a power amplifier, which has been designed to work with low voltages, between 4v to 15 volts, it is a high gain voltage amplifier which is also designed to amplify signal over a wide range it consist of an internal configuration of linear circuit

(IC), designed in such a way that external components like resistors, capacitors can be connected to its' terminals to change it

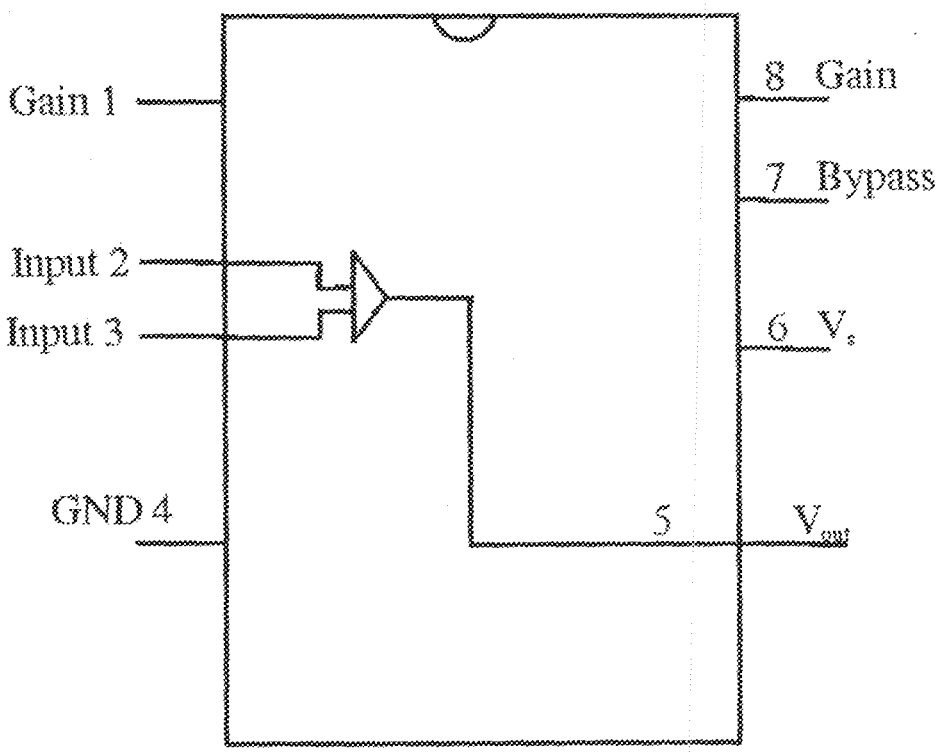


Fig 5 Internal Configuration of Lm 386

Table 1 LM 386 configuration

Electrical characteristics	Conditions	Minimum	Type	Maximum	Units
Operating supply voltage (vs) Lm 386v –1-3, Lm 36m-2, Lm 836mm-1, Lm386n-4		4 5		12 18	✓ ✓
Quiescent Curr entgi	Vs= 6v, V_{in}=6		4	8	M_A
Output power (coul) Lm 36\86N –1, Lm 386m-1, Lm 386mm-1	Vs=6V, Rl=8 THD = 10%	250	325		Mw
Lm 386N-3 Lm 386N-4	Vs=9V, Rl=*, THD =10%, 16v, 32v, 10%	500 700	700 1000		Mw Mv
Voltage gain (Pv)	Vs= 6v, f = 1khz, 10uf from pin 1 to 8		26 46		dB dB
Bandwidth (Bw)	Vs=6v, pin 1 and 8 open		300		Khz
Total Harmonic distortion THD	Vs=6v, R1=8, Pout =125mw, F= 1khz, pin 1 80pen		0.2		%
Power supply rejection	Vs= 6v,		50		dB

ration (PSRR)	f=1khz By pass=10uf Pin 1 8 poen referred to output				
Input resistance (R_{in}) input bias current (I bias)	Vs=6v, pin 2 3 open		50 250		K nA

It's external characteristics. The gain is internally set to 20 V 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 200V. The inputs are ground reference while the output is automatically biased to one half the supply voltage, the quiescent power drain is only 24miliwatts when operating from a 6V supply making the Lm 386 Ideal for a battery operating. The Lm386 1c is manufactured in an 8 pin dual in line package and it can deliver p to 0.5 watts without any kind of heat sink, it is when a 8Ω - 16Ω loudspeaker is attached to the output, together with a 9V/12V power supply.

The Lm386 Ic can be used in Am-Fm radio amplifier, portable tape player amplifier (which amplifiers the level of the alternating voltage converted from the audio frequency level to a level that can effectively drive speakers), power converter, small servo driver and intercoms.

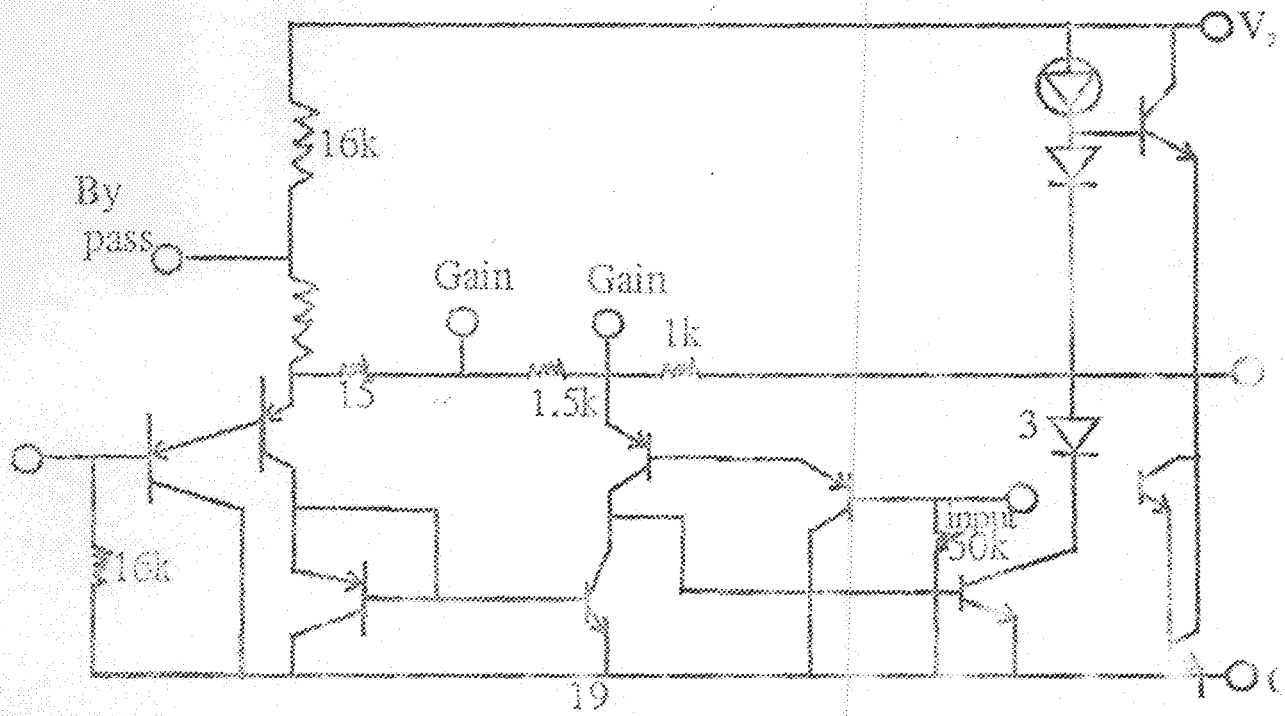


Fig 6 Equivalent Schematic and Connection Diagram

2.2.3 Loud Speaker

A loud speaker converts electrical impulse into audible sounds. It has a coil that move in a magnetic field when a current is applied to it. The loud speakers used in this project have an impedance of 4 Ω each.

2.2.4 Capacitor

It is a passive component for storing electric charges and has a capacitance C that is the ability of a dielectric to store electric charge. A capacitor can be used to filter unwanted frequencies also to block direct current from reaching a section of a circuit.

$C = QV$ ----------2.1

Capacitor functions in many electronic circuit as a decouples and as well as a smoother.

In a circuit where both a.c and d.c is present, it is used to eliminate ac ripple, mostly in dc power supply ie. Smoothening the peaks and the voltage by working on the reservoir principles. It charges the capacitor during the peaks and discharges during the through to give an over all smoothed output. The value of a capacitor is determined using the equation below.

$C = IT/Vpeak-Vreg$----------2.2

Where I = current

T = period

V_{peak} = maximum voltage

V_{reg} = regulated voltage

Note $V_{ripple} = V_{peak}-V_{reg}$ ----------2.3

2.3 DESIGN ANALYSIS

This design of a full duplex intercom system is divided into three sections.

i. Power section

ii. Amplifier section

iii. Sound alarm section

Power section

Rectification is a process of changing an Ac voltage or current to a D.C voltage or current.

There are basically two types of rectification

- Half wove rectifier

- Full wave rectifier

A full wave rectifier can be sub divided into

a. Center tap rectifier

b. Bridge rectifier

In this project report, a full wave bridge rectifier will be discussed.

FULL WAVE RECTIFICATION

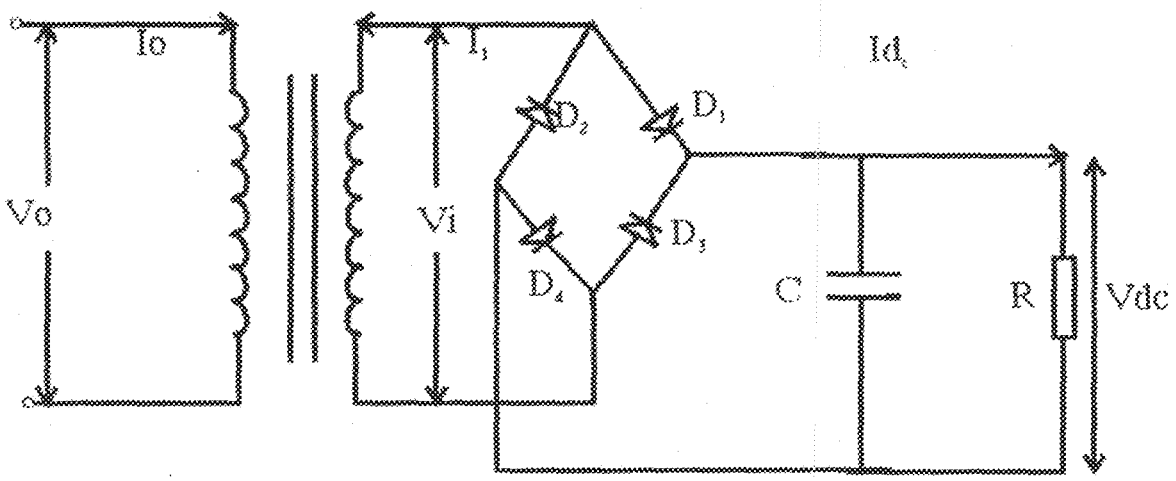


Fig 7 Full-Wave Rectifiers With Resistive Load And Capacitive Filter

$V_1 = VmSinwt$ ---------- 2.4

$I_1 = \mathrm{Im}Sinwt$ ---------- 2.5

$I_{rms} = {}^{1}/_{2\pi}\int_0^{2\pi} I^2 d(wt) = {}^{I_m}/_{\sqrt{2}}$ ---------- 2.6

$Vrms = {}^{1}/_{2\pi}\int_0^{2\pi} V_1 d(wt) = {}^{V_m}/_{\sqrt{2}}$ ---------- 2.7

$I_{dc} = {}^{1}/_{2\pi}\int_0^{2\pi} I(wt) = {}^{2I_m}/_{\sqrt{\pi}}$ ---------- 2.8

$V_{dc} = {}^{1}/_{2\pi}\int_0^{2\pi} V_1(wt) = {}^{2V_m}/_{\pi}$ ---------- 2.9

With a resistance load

$$V_{dc} = \frac{2\sqrt{2}}{\pi} I_{rms} = 0.9 V_{rms} \text{ ---------- (2.10)}$$

$$I_{dc} = \frac{2\sqrt{2}}{\pi} I_{rms} = 0.9 I_{rms} \text{ ---------- (2.11)}$$

With a capacitive filter

$V_{dc} = 1.41\ V_{ac}$

$I_{dc} = 0.62\ I_{ac}$

Due to the diode voltage drop Vd

$V_{dc} = 1.42\ V_{ac} - V_d$ ---------- (2.12)

The power unit supplies power to the whole circuit, this convert a.c power supply. The component that makes up of the power supply is the transformer, rectifier and capacitor filter.

The primary side of the transformer is connected to the a.c mains supply (240V). The power supply is passed from the secondary side of the transformer to the rectifier circuit, from the rectifier to the filter circuit; from which the regulated d.c supply can bet tapped. Each function of the components of the power supply unit will be discussed.

2.3.1 The Transformer

A transformer is a stationary electric device the transforms electric power in one circuit to another circuit at the same frequency. This operates on the principles of induction between two circuits linked by common magnetic flux.

The coils of the transformers are electrically linked through a path of low resistance, the coil connected to the a.c mains is called the primary coil while the one from which energy is tapped is called the secondary coil. The number of turns of coil on either side depends on whether the transformer is a step down or a step-up transformer.

The step-up transformer has greater number of turns in the secondary winding than in the primary winding and reserve is the ease for step-down transformer

2.3.2 Capacitor Filter

The function of a filter circuit is to minimize the ripple content in the rectifier output. The output of the rectifier output is pulsating. It has a d.c value and some a.c components called ripples. This type of output is not useful for driving sophisticated electronic circuits because these circuits require a steady d.c output that approaches the smoothness at battery's output.

The filter converts the pulsating output from a rectifier into a very steady d.c level. The operation of the filter circuit depends on the property of a capacitor to charge up (store energy) during the half cycle of the input voltage and discharge during the non conducting half cycle.

In this project a large value electrolytic capacitor is used when the positive half cycle of the a.c input is applied, the diode is forward biased (turned on). This allows the capacitor to quickly charge up to the peak value of the input voltage. After being fully charged. The capacitor with charge till input a.c supply to the rectifier goes negative.

During the negative half cycle, the capacitor discharge. However, it cannot discharge through the diode, which is now reversed biased. Hence the capacitor discharge through the load resistance. During the next half cycle, when the rectifier voltage

exceeds the capacitor voltage the capacitor is again quickly charged. Once more, input voltage goes negative, opening the diodes and forcing the capacitor to discharge through the load resistance

In this way the load resistance sees a nearly constant d.c voltage across it at all times.

2.3.3 The Rectifier Circuit

The function of a rectifier is to convert sinusoidal voltage (a.c voltage) into pulsating d. c signal. There are two types of rectifiers, the half wave and full wave rectifier. The full wave bridge rectifier uses four-diode, it is available in three distinct physical forms, but for this project design and bridge rectifier using form discrete diode is used.

MODE OF OPERATION

During the positive half cycle of the input voltage the secondary terminal of the transformer is positive and the primary terminal is negative. Diodes D_1 and D_3 become forward biased (ON) and D_2, D_4 are reversed biased (OFF). Hence current flows from secondary terminal to the diodes producing a drop across RL (load resistance).

During the negative half cycle of the input voltage, the transformer primary terminal becomes positively and secondary negatively charged and Now D_2, D_4 forward biased where D_1 and D_3 are reserved and current flow along primary terminal of transformer to the diodes, hence current keeps flowing through the load resistance in the same direction. At any instant, two of the diodes are in the conducting state and they are effectively in series with the load. The Output voltage waveform across RL (Load resistance) are depicted in the Appendix

2.4 BLOCK DIAGRAM

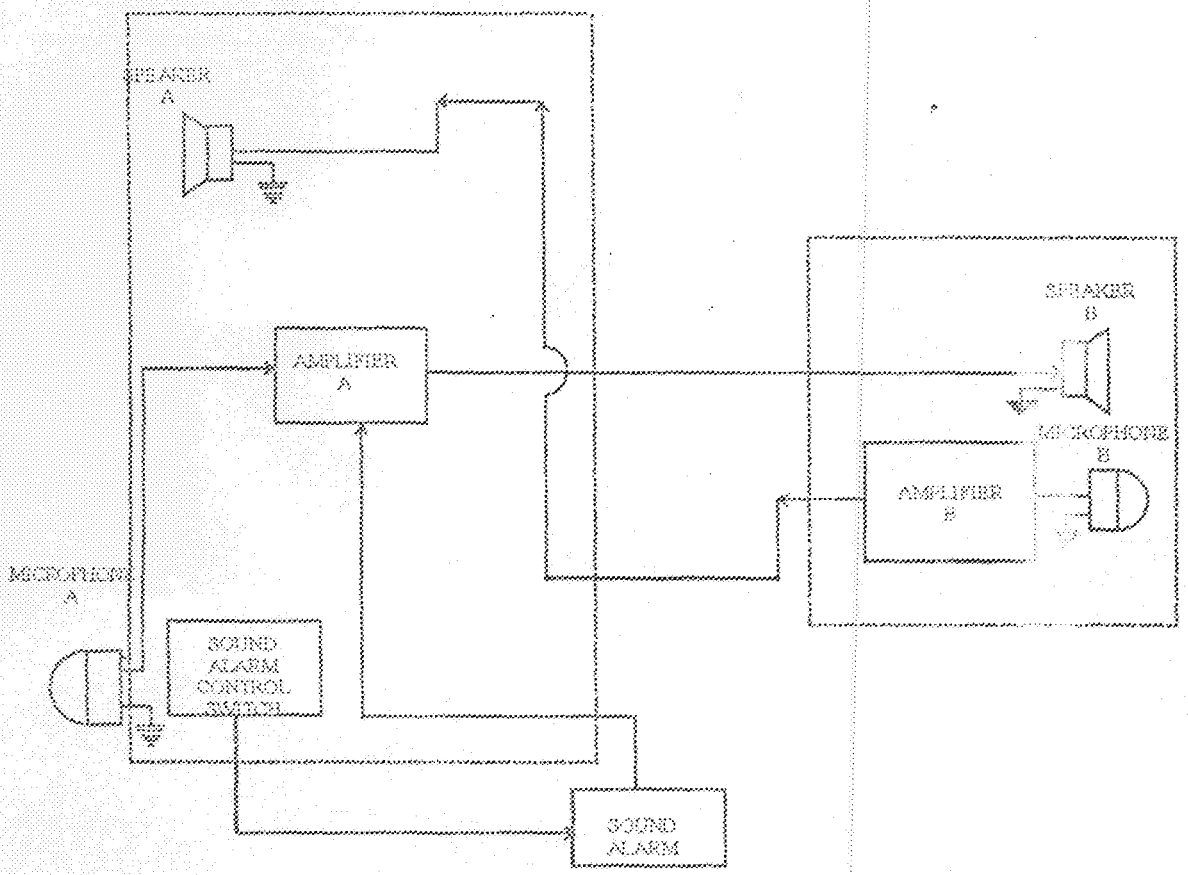


Fig 8 Block Diagram of a Full Duplex Intercom System

2.5 CIRCUIT OPERATIONS AND DESIGN

The power section supply power to the amplifier section and alarm section, it supplies 9vd.c to the circuit by converting a 220v a.c mains to a 9v d.c with the aid of an iron core transformer and a bridge rectifier which is made up of four IN 4001 diode and a 1000uf capacitor to remove ripple and distortion.

The amplifier section is found in the transmitter and the receiving end, it is built around an Lm 386 operation amplifier with the input from the microphone and the output connected to the speaker at the receiving section. The Lm 386 is typically configured as a gain amplifier with pins 8 and pin 1 used as a gain. This is also seen at the receiving section, where inputs of the amplifier are filtered with the help of a

capacitor and the output via a coupling capacitor. This coupling capacitor makes the output cleaner and serves, as a snubber circuit to eliminate high frequency oscillation at the output. It is also needed when driving the speaker to prevent signals from feeding back into the input stage.

Alarm section is built around the 4011 CMOS Oscillator which supplies a pulsating sound to the input of the Lm 386 operational amplifier where the alarm button is pressed. The pulsating sound is amplified by the Lm 386 and heard at the receiving section. When the alarm button is pressed, power is supplied to 4011 CMOS oscillator and the output of the 4011CMOS oscillator is connected to the positive input of the Lm 386 by the same action that is, when the button is pressed, but when button is released, power is cut off from the 4011D oscillator and circuit returns to the default state.

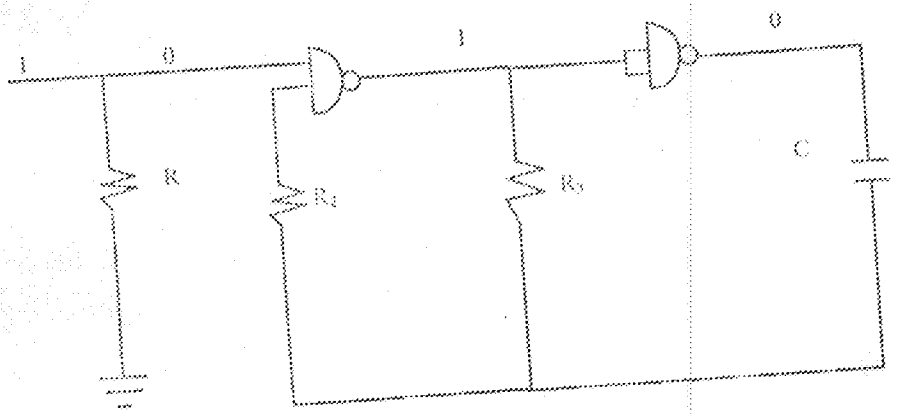


Fig 9 CMOS oscillator

When the pulsating effect, it produces a square shape wave form where

1- High

2- Low (stop

The pulse produced from the ground is low, when it transfers through the first NAND gate it becomes high, passes through the most next gate it becomes low and it

continues like that to produce a pulsating effect that results to a square shape wave form. The truth table can be developed for the CMOS oscillator.

Table 2.0. Truth Table of Cmos Oscillator

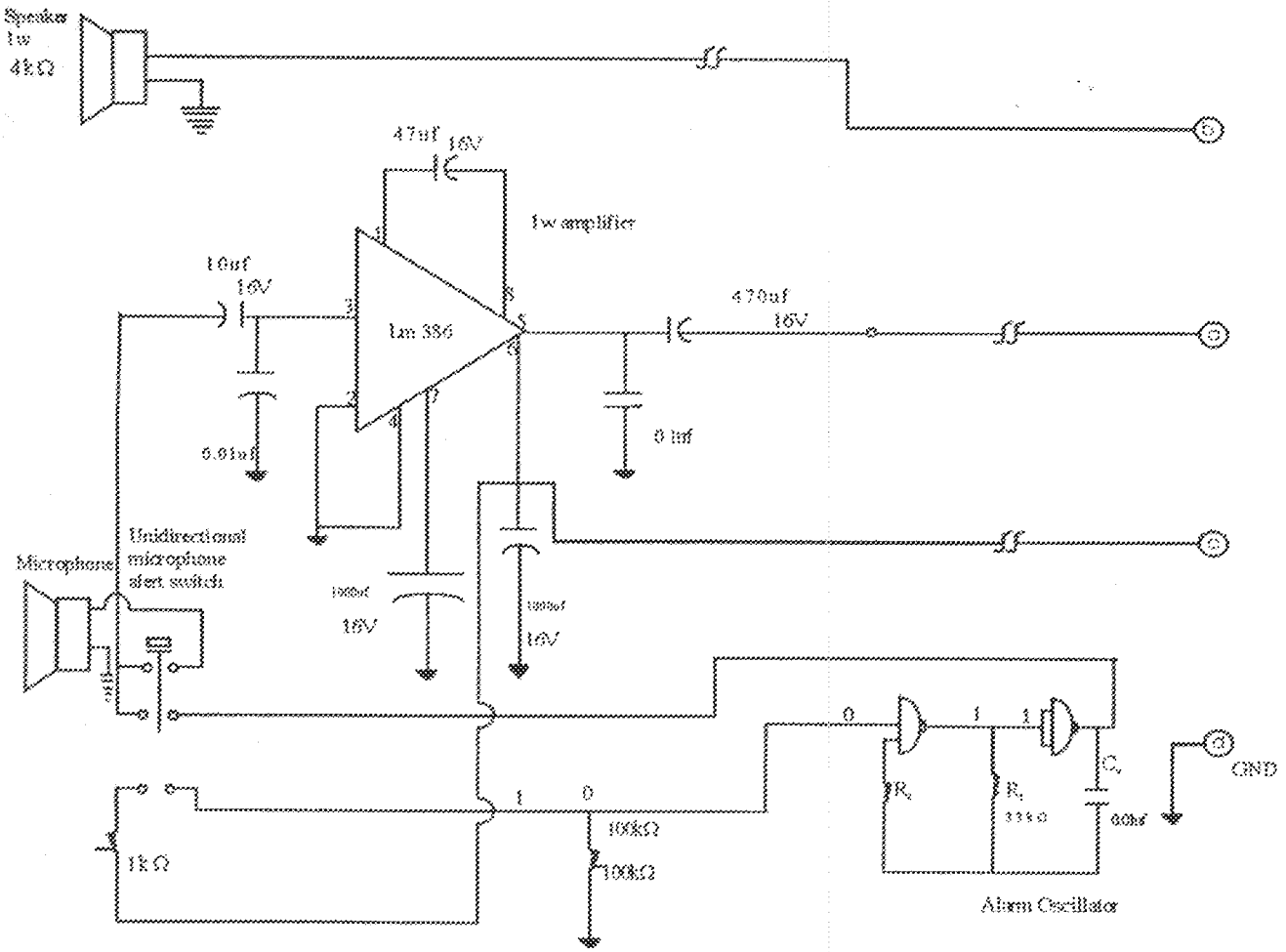
A	B	OUTPUT
0	0	1
0	1	1
1	0	1
1	0	1
1	1	0

Fig.10 Pulsating Square Shape Waveform

When the power button at part a e transmitter section is switched on a 9v d.c is supplied to the receiver and any voice input at the transmitter or receiving section is amplified and heard at both part a and b respectively. Power supplied to the 4011 CMOS oscillator and pulsating signal appears at the output of the oscillator which is in turn transferred to the input of the Lm 386 amplifier of transmitter section, which is heard at the speaker of the receiver section signifying that there is a call to be answered, but as soon as the button is released the sound been heard will no longer be heard, indicating that power supply has been cut off from 4011 CMOS oscillator and output disconnected from the input of the Lm 386 operational amplifier of the transmitter section. Also when the button is released the switch connects the

microphone back to the input of the leading amplifier so that conversation is possible through the two terminals.

PART A



2.6 Circuit Diagram

PART B

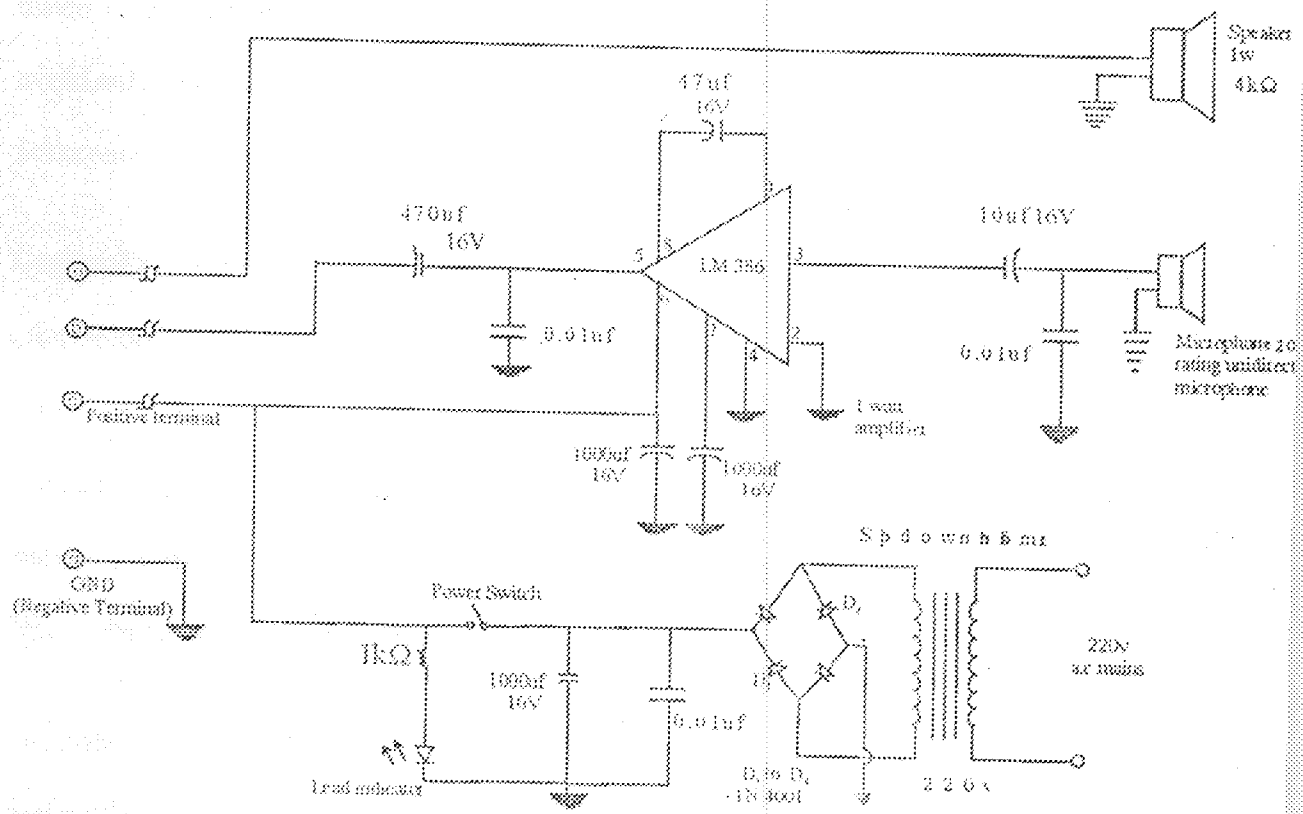


Fig. 11 Circuit diagram of a full Duplex Intercom System

and was found to be 8.5V instead of the normal value of 9V; this was due to wrong connection in the power supply circuit. The output voltage of the d.c supply was measured to ensure that the voltage is not too low and not too high for the components connected to the power supply circuit. The stability of the amplifier, sound alarm was tested using an oscilloscope across the output to check for in audible frequencies that may be present in the system. It was also noticed that if the distance between the transmitter and receiver is large (i.e. above 10ft) its reception is better compared to shorter distance. It was discovered that amplification is not that high, which results to a low voice level signal at the receiving end and shorter cable length gives a clearer reception.

3.3 PROBLEMS ENCOUNTERED

The major problem encountered was that of the humming heard noise when the system was left on stand still during display tests. This was reduced, by blocking stray a.c components to the amplifier using a capacitor.

Coupling of capacitor, diodes and other components constituted their own problems too, most of the problems were due to wrong connection of capacitors and improper soldering. This was rectified by giving consideration to the polarity of the capacitors during soldering, poor soldering made the circuit network not to work, so all the soldering joints were carefully checked under good light and ensure that all components to be soldered are in correct position and in good working state before it is been soldered.

3.4 PREVENTIVE MEASURES

Some of the preventive measures that should be taken so as to enable this design work effectively are stated below.

i. Avoid using power supply greater than 9v d.c with tolerance in between (8.5v- 9v)

ii. The intercom-system should be switched off after use.

iii. The intercom- system should be kept in a dry place.

iv. Batteries should be used during power failure; uninterrupted power supply (UPS) can also be used when there is a power failure.

v. System should be kept under a temperature it can withstand between 0°C-42°C.

vi. Avoid self-servicing the part in case any fault develops rather it should be refereed to trained personnel.

CHAPTER FOUR

4.1 RECOMMENDATION

The intercom system is multi-purpose equipment but his project is subjected only to make communication easy. Considering the performance of the intercom system and its` usefulness, it is recommended that power failure should have no effect on the system. This can be ensured by making provision for the used of dry cell (batteries). In the circuitry of its power supply unit, this involves the introduction of a semiconductor junction diode biased in the reverse mode into the power supply unit. Another method is to incorporate a U.P.S (Uninterrupted Power Supply) into the power supply unit.

For further work, the system can be extended to a small private branch exchange by connecting it to the same telephone instrument that is used to access the public network. In this case it will better to adopt the device connection of the multi-section intercom system. It can be recommended that since communication is an essential part of life small financial requirement should be involve so that it can be affordable. A multiplexing circuit could be incorporated to reduce the amount of wires used to connect the transmitter and receiver. A multiplexer is a device that merges several low speed transmission channels into one high-speed channel at one end of the link.

Multiplexing is a technique that transmits several signals over a single communication channel, but we have different means of multiplexing frequency-division multiplexing which separates the signals by modulating the data into carrier frequencies. For time-division multiplexing it divides the available time among the various signal, while

statistical multiplexing uses statistical techniques to allocate transmission space depending on the traffic pattern.

Finally, effort should be made to eliminate completely the humming sound in circuit.

4.2 CONCLUSION

This project serves as a very important part of the degree programme in engineering because through the design and construction stages, it exposed me to the techniques of realizing circuit design on paper in their hardware forms. In the course of my design I have been able to construct an equipment that makes communication easy, so as to improve an effective productivity in industries.

APPENDIX

COMPONENTS VALUE

Transformer 220/9v

Speakers (2) 4Ω/1watt

Diodes IN 4001 for each

Audio amplifier LM386

CMOS 4011B

Resistors

Ra-------1k

Rb--------100k

Rc--------100k

Rd--------33k

Capacitors

Co-------1000uf (filter capacitor)

C1, C4, C8, C16----------0.01uf

C2, C13----------1000uf

C3,C12----------1000uf

C15, C5----------470uf (Coupling capacitor)

C6, C9----------47uf (capacitor gain)

C7, C10----------10uf

C11----------0.001uf

C14----------0.1uf

Transformer section

The transformer has the primary and secondary section, the A.C input to the transformer 220v, the desired output 9v

Therefore the desired ratio is obtained by the given formula below

Vs/Vp=Ns/Np =Is/Ip

Where Vs=secondary voltage

Vp=primary voltage

Vs/Vp=220v/9v

Transformer ratio---24:1

Light emitting diode

This is an electronic component, which can be used as an indicator (power) that serves as a sign of power availability. This is available in various colors such as red, green, yellow e.t.c. Using ohms law, assuming LED resistance is negligible.

K=V/I

Voltage drop across LED=1.7 and forward current of 7.3

Therefore R=(9-1.7)/7.3

=7.3/7.3 =1,000 Ω

Power Section

Yt = 1/Fc RL 4 √3

Where RL =Load Resistor

Yt = Ripple Factor

F = Frequency

Making c subject of the formula

C =1/F RL Yt 4√ 3

Assuming Y to be 0.3%

Where F =50 hz
RL = 1k

C = 1/50×1000 x 0.003x4√ 3

C =0.96 x 0.001 ≈ 1mf
=1000uf

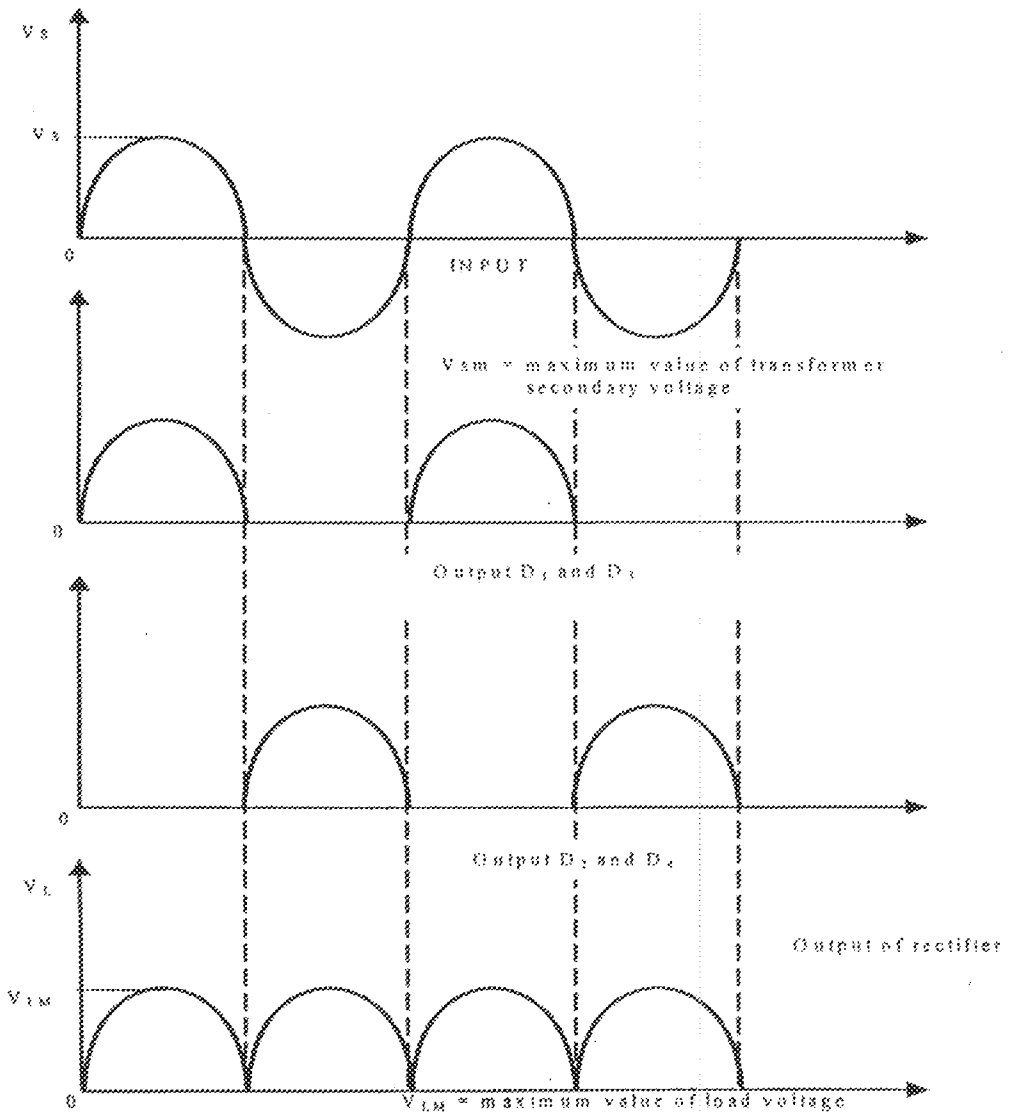
The peak secondary voltage = $\sqrt{2}$ x12 =16.97

Where each diode has a threshold voltage of 0.7

Peak full wave rectifier voltage at filter input

Vp = (16.97- 2 x 0.7.) 15.5 ≈16V

Therefore the output voltage are represented in the figure



Design of casing

The casing fabricated for this device is made of wood, it's dimensions are given below including the cross sectional area.

Dimension of the plans and side view of the casing.

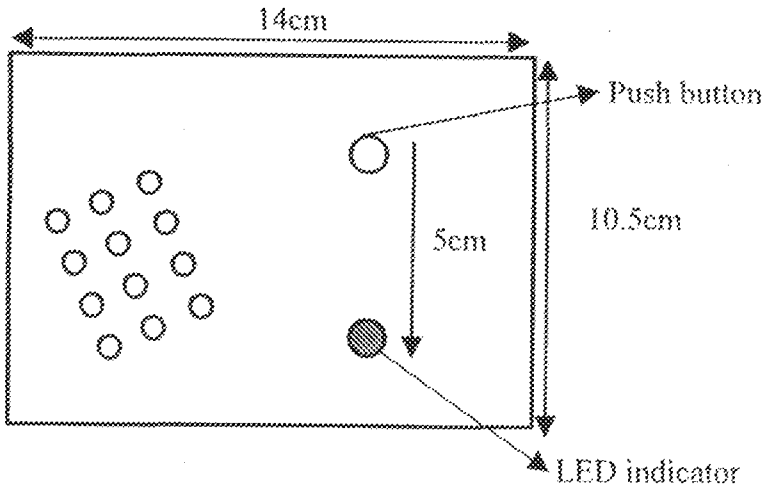
Transmitter section

Length -------- 14cm

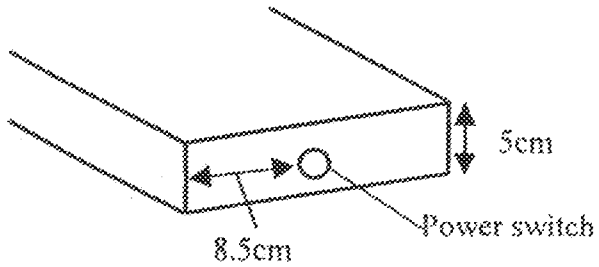
Breadth-------- 10.5cm

Height--------- 5cm

Distance between the LED and the push button ---------5cm

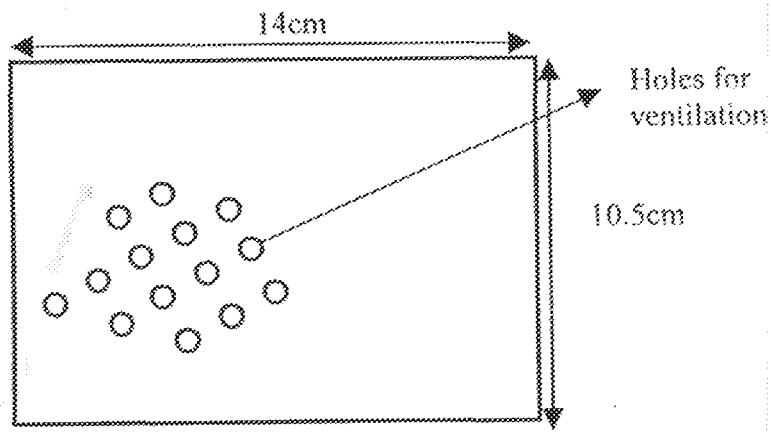


PLAN

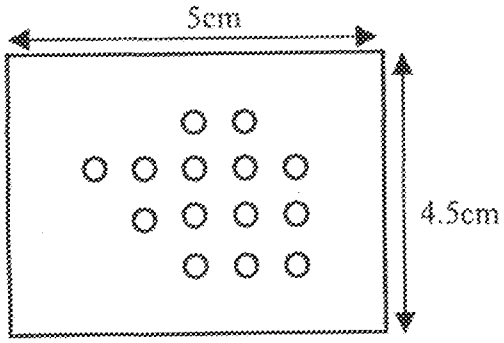


SIDE VIEW

RECEIVING SECTION



EXTERNAL MICROPHONE



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