NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

DESIGN, CONSTRUCTION AND INSTALLATION OF AN INTERCOM SYSTEM FOR AN EIGHT STOREY BUILDING

Graduation Project
EE-400

Student: Ehab Hasan Taher Abu Kishik (20040320)

Supervisor: Asst. Professor Dogan Haktanir

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Without the help and the support of some special persons, I would not be able to continue or to reach to this level of my education and I am taking this opportunity to thank my supervisor, who gave me the chance and the honor to do my graduation project with him, Assist. Prof. Dr. Doğan Haktanır.

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Ehab Hasan Taher Abu Kishik

Abstract

In many buildings which are under construction or the ones that have been constructed during the last 20 years some of the most important thing, which were taken in consideration during the design and the construction of most of those buildings were Security and safety systems such as fire alarm, emergency exits and intercom system.

The aim of this project is to design construct and install an intercom system for an eight storey building that has four quarters at each floor, the calculation of the voltage drop due to the distance of the installed points where the voltage is transmitted .Further using a transformer to supply and control the voltage at a suitable level for the intercom system and the circuit which the system is made of.

CONTENTS

Introduction

What do we mean by saying intercom? Intercom is a shortage of intercommunication which comes from intercommunicate or in another words to send or receive information between two stations to communicate within a limited area as between offices in the same building or intercom system for a building like the one which will be shown in this project .

Firstly let us start with the kinds of intercom systems.

Wireless intercom system

Wired intercom system.

This project will focus on the design, construction, and the installation of wired intercom system of a building by showing the connection, the relation between the distance or the length of the wire and the voltage drop by showing the calculation

As a beginning we have to get a direct voltage from the supply which is 240 V and then we have to lower it to the voltage needed to supply to the intercom and that by using a transformer which is an electrical device designed on the bases of the concept of magnetic coupling which uses it to transfer energy from one circuit to another and they are used in power system for stepping up or stepping down

Also we will face some voltage lose or drop due to the distance which we are going to transmit the voltage to also because of the resistively of the conductor which we are using

Chapter one deals with the electrical components which are used to construct the intercom their specifications the way they should be connected and safety guidelines

Chapter two deals with the construction of the intercom and the supply circuit, the simulation for showing the input and the output signals for both of them, also deals with comparing the output signal experimentally and theoretically.

Chapter three deals with the installation of the intercom by showing it schematically and showing the connection inside the building

Also deals with the calculation of the distances between the communication board and the flats, the wire which we are using

Chapter 1

ELECTRONIC COMPONENTS

1.1 Overview

Before starting the implementation of any circuit we have to know the component which the circuit is made of its characteristics and its effect on the voltage and the current.

This chapter introduces the electronic components which are used in the design of the intercom system and the Safety guidelines followed while making the project.

1.2The Components which are used to construct the project

For the Intercom

1- One Microphone (Dynamic)

2- One Speaker with 8Ω Resistance and 3W

3- Two 10kΩResistance

4- Two 1Ω Resistance

5- Two 4.7 μf Capacitor

6-One 2.2 μf Capacitor

7-One 1μf Capacitor

8-Two Transistor BC107

9- One Transistor 2N3019

For the Rectifier

1-One 240-24 V transformer

2-Two diodes

3- 680Ω Resistance

4- Zener Diode 12V

5- One 2200μf 25V Capacitor

6- Transistor 2N3019

1.3 Introduction to Electronics Components

Electronics gets its name from the knowledge of electron, which is that is composed of a proton, neutrons and electrons the whole setup is called atom electronic engineers are interested in the valance of electrons, that orbits around the nucleus .[1] This is the same with all elements in the world.

Some elements conducts electricity some don't and some are semi conductors .the following table shows some of these material

Type of conduction	Elements
Good conductors	Gold, Silver, copper, aluminum
Semi conductors	Water ,silicon, germanium
Insulators	Plastic, wood, air, rubber

Table 1.1 some conductors and insulators

1.4 Resistors

Electrons move easily through some materials more than others when a voltage is applied. In metals the electrons are held so loosely that they move almost without any difficulty. We call the opposition of current flow in any material Resistivety.

Resistors are electronic components like capacitors and inductors which are commonly used on the circuit boards of electronic equipment such as intercom systems. they are made of different kinds of materials and used for different purposes Carbon film resistor, Composite resistor, Metal film resistor, Metal oxide resistor, Thick film resistor, thin film resistor and Wire wound resistor Resistors are color coded with stripes to reveal their resistance value (in ohms) as well as their manufacturing tolerance.

The main function of resistors in a circuit is to control the flow of current to other components. The higher the value of resistance the lower the current will be. When a current flows through a resistor energy is wasted and the resistor heats up.

1.4.1 Types of resistor

Mainly there are two types of resistors which are used in circuits

1-Fixed value resistors
2-Variable resistors
3- thermistor

1.4.1.1 Fixed value resistors

It is resistor which comes from the manufacturing companies with a fixed value such as 10k = 10 000 ohms it is difficult to make a resistor with an exact value. Resistances are given with a certain accuracy or tolerance. This is expressed as a percentage plus or minus. For example a 10% resistor with a value of 100 ohms could have a resistance between 90 ohms and 110 ohms.

1.4.1.2 Resistor Color Code

The resistor color code is a way of showing the value of a resistor. Instead of writing the value of the resistance on its body, which would often be too small to read, color code uses ten different colors for representing the numbers from 0 to 9. The first two colored bands on the body are the first two digits of the resistance, and the third band is the multiplier which means the number of zeroes to add after the first two digits. for example a resistor with red, red, red bands has a resistance of 2 followed by 2 followed by 2 zeroes, which is the representation of 2 200 ohms. .Example of these resistors can be seen on the constructed project.

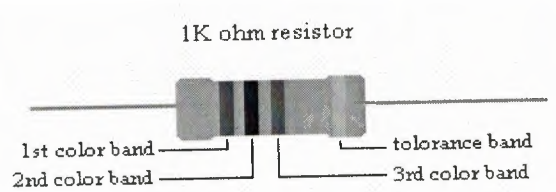


Figure1.1 Resistor

The values of these resistors can be determined by using the following color code. This pattern of recognition became an international code of practice.

Color	1stBand	2nd Band	3rd Band	Multiplier x	Tolerances ± %
Black	0	0	0	1	
Brown	1	1	1	10	± 1%
Red	2	2	2	100	± 2 %
Orange	3	3	3	1000	
Yellow	4	4	4	10,000	
Green	5	5	5	100,000	± 0.5 %
Blue	6	6	6	1,000,000	± 0.25 %
Violet	7	7	7	10,000,000	± 0.10 %
Grey	8	8	8	100,000,000	± 0.05 %
White	9	9	9	1,000,000,000	
Gold				0.1	± 5 %
Silver				0.01	± 10 %
None					± 20 %

Table 1.2 Resistor color code

1.4.1.3 Resistors in series and parallel

In a series circuit, the current flowing through the closed loop has the same value at all points. The circuit diagram belong shows two resistors connected in series with a voltage source V

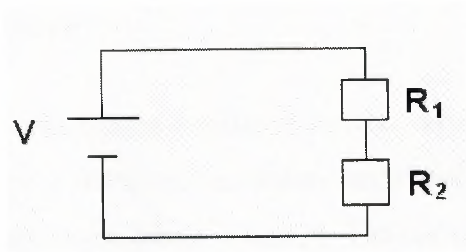


Figure 1.2 Resistors in series.

It does not matter where in the circuit of the current is measured the result will be the same.

To find the total resistance of the circuit we just add the values of the two resistors that are in series.

$$R_{Total}=R_1+R_2$$

The next circuit shows two resistors connected in parallel to a voltage source

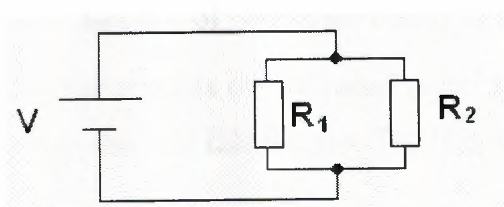


Figure 1.3 Resistors in parallel.

Parallel circuits always provide alternative pathways for current flow. Therefore the total current of the circuit is the addition of both currents passing through R_1 and R_2.

The total resistance is calculated as:

$$\frac{1}{R_{Total}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

1.4.1.4 Variable Resistors

Variable resistors are resistors whose resistance can be varied or adjusted by the user. The variable resistors have a metal wiper resting on a circular track of carbon. The wiper moves along the track as the preset is turned. The current flows through the wiper and then through part of the carbon track .The more of the track it has to go through the greater the resistance.

Variable resistors are used in circuits to vary the signal or voltage that need changing, like volume etc. In the design resistor. This type has been used to adjust the volume of the output of the voice communication.

1.5 Capacitors

A capacitor is an electronic storage device which stores electricity. Capacitor can be charged up with energy from a source, then return that energy back later. The capacitance of a capacitor is a measure of how much energy or charge it can hold.

In its simplest form a capacitor consists of two metal plates separated by a small gap. Air or another non-conducting material fills the gap .The bigger the plates the bigger the capacitance.

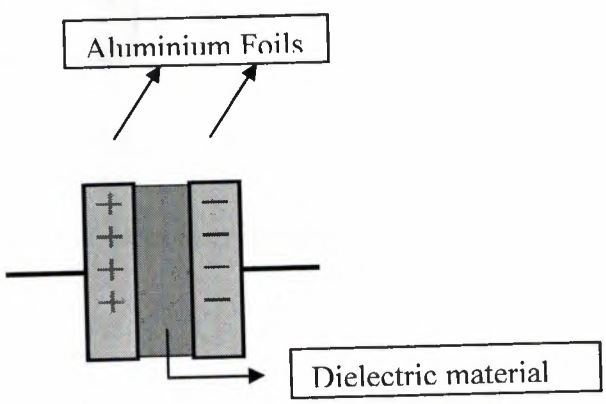


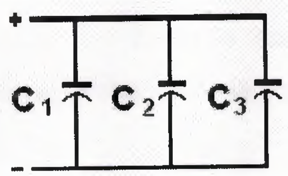
Figure 1.4 capacitor

1.5.1 Capacitor and DC voltage

When a DC voltage source is applied to a capacitor there is an initial flow of current, when the voltage across the terminals of the capacitor is equal to the applied voltage, the current flow stops.

1.5.2 Capacitors and AC voltage

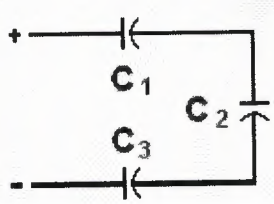
Generally, if an AC voltage source is connected to a capacitor, the current will flow through the capacitor until the source is removed. There are exceptions to this situation and the A.C. current flow through any capacitor is dependent on the frequency of the applied A.C. signal and the value of the capacitor. Capacitors in a circuit can be connected either in series or parallel. The following circuit shows a parallel connection.



$$C = C_1 + C_2 + C_3$$

Figure 1.5 Capacitors in parallel

The following circuit shows the capacitors in series connection.



$$C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$$

Figure 1.6 Capacitors in series

N.B: It should be noted that an electrolytic capacitor cannot be connected to an a.c. supply voltage. Such action will damage of explode the electrolytic capacitor.

1.6 Semiconductor

It is one of the most important materials if it is not the most important without semiconductors we would not be able to make diodes which the transistor is made of. Semiconductors as we understand from the name it is a material between conductors and insulators, such as germanium (Ge) and Silicon (Si).

1.7 Diodes

Diodes are non-linear circuit elements. It is made of two different types of semiconductors exactly next to each other. We can just think of an ideal diode has two regions, a conduction region of zero resistance and an infinite resistance non-conduction region. For many circuit applications, the behavior of a (junction) diode depends on its polarity in the circuit. If the diode is reverse biased (positive potential on N-type material) the current through the diode is very small. The following figure is shown the characteristic of diode.

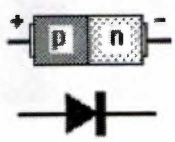
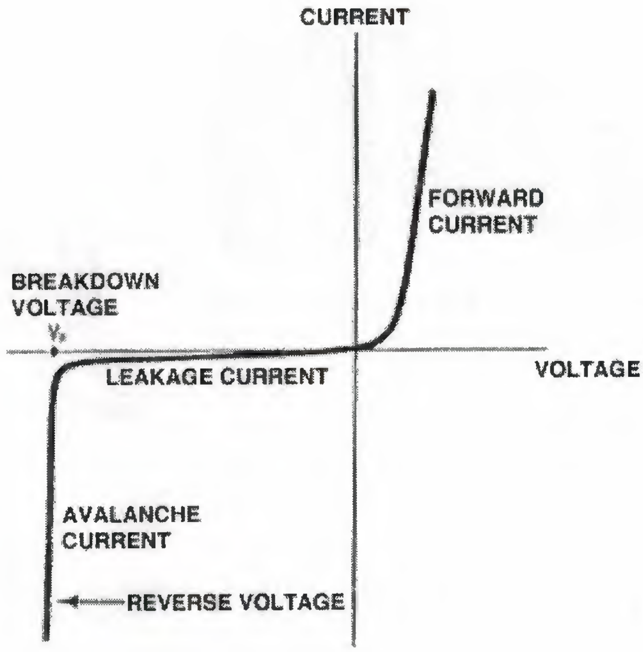


Figure 1.7 Diode

A typical diode characteristic is more like the following



Forward Biased P-N Junction: forward biasing the p-n junction drives holes to the junction from the p-type material and electrons to the junction from the n-type material. At the junction the electrons and holes combine so that a continuous current can be maintained.

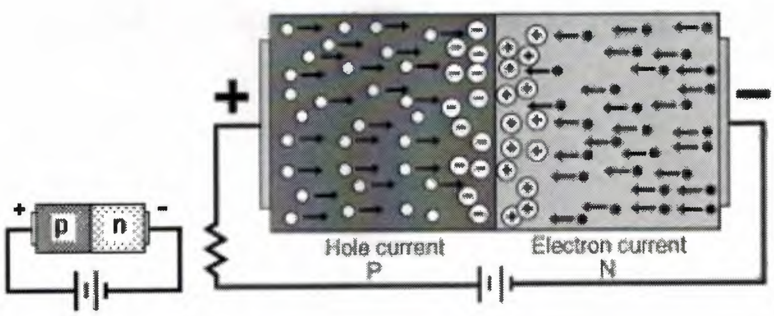


Figure 1.8 Forward Biased P-N Junction

Reverse Biased P-N Junction: the application of a reverse voltage to the p-n junction will cause a transient current to flow as both electrons and holes are pulled away from the junction. When the potential formed by the widened depletion layer equals the applied voltage, the current will cease except for the small thermal current.

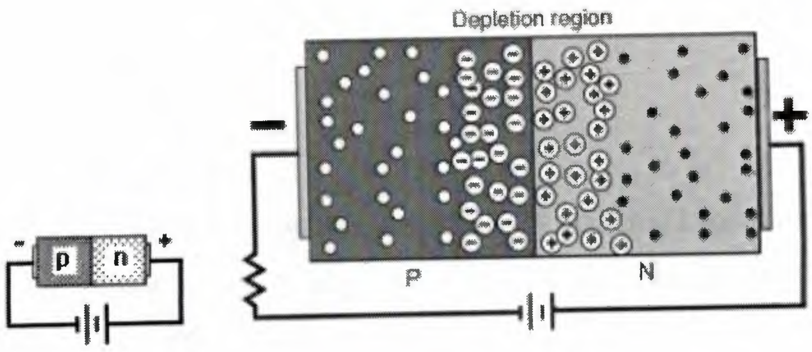
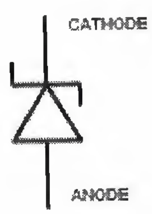


Figure 1.9 Reverse Biased P-N Junction

1.8 Zener diode

The connectional diode usually lets current flow through it in one direction only, however Zener diodes are made to permit current to flow also in the reverse direction if the voltage that is applied is larger than the rated Zener voltage. Zener diodes are therefore used in stabilized voltage sources, There are different Zener diodes being available to be used in different rated voltages.

Zener diodes are widely used in electronic circuits. Their most common function is to regulate the voltage across a circuit. When connected in parallel with a variable voltage source so that it is reverse biased, a zener diode acts as a short circuit when the voltage reaches the diode's reverse breakdown voltage, and therefore limits the voltage to a known value. A zener diode used in this way is known as a shunt voltage regulator



Figuer1.10 Zener diode symbol

In this project a 12.6V Zener diode has been used to stabilize the supply voltage for the power pack of the intercom system.

1.9 Transistors

A Bipolar Transistor essentially consists of a pair of PN Junction Diodes that are joined back-to-back. This forms a sort of a sandwich where one kind of semiconductor is placed in-between two others. There are therefore two kinds of bipolar sandwich, the NPN and PNP varieties. The three layers are conventionally called the Collector, Base, and Emitter.

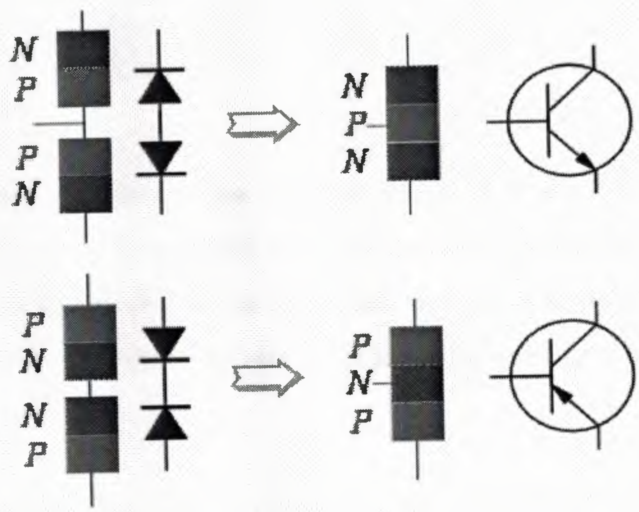


Figure 1.11 Symbol of NPN and PNP transistors.

1.9.1 Darlington transistor

The Darlington transistor is a semiconductor device which combines two bipolar transistors in tandem often called a "Darlington pair" as shown in figure 1.12 in a single device so that the current amplified by the first is amplified further by the second transistor. This gives it high current gain , and takes up less space than using two discrete transistors in the same configuration.This arrangement can be seen in the projects prototype circuiting.

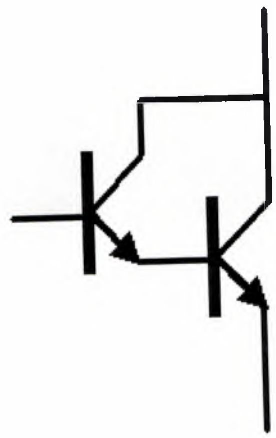


Figure 1.12 Symbol of Darlington transistors

1.10 Transformers

Transformer is an electrical device that function is based of the concept of magnetic coupling. It uses magnetically coupled coils to transfer energy from one circuit to another. They are used in power systems to isolate, step up or step down the ac voltage .transformers are used in electrical circuits such as radio, television and in this project for the inter com circuit

A simple single phase(1φ) transformer consists of two electrical conductors called the primary coil and the secondary coil. The primary is fed with a varying (alternating or pulsed continuous) electric current which creates a varying magnetic field around the laminated pure iron core. According to the principle of mutual inductance, the secondary, which is placed in this varying magnetic field, will develop an electromotive force or EMF. If the ends of the secondary are connected via a load to form an electric circuit, this EMF will cause a current to flow in the secondary. Winding of the transformer and the load the windings of the primary depends on the input voltage of the transformer. The secondary winding depends on the required voltage of the output. The ratio of the windings is prproportional to the voltage ratio.

In this project the input of the transformer used to find the project circuiting is 240 V.a.c. The outpuit voltage is 12-0-12 V.a.c.

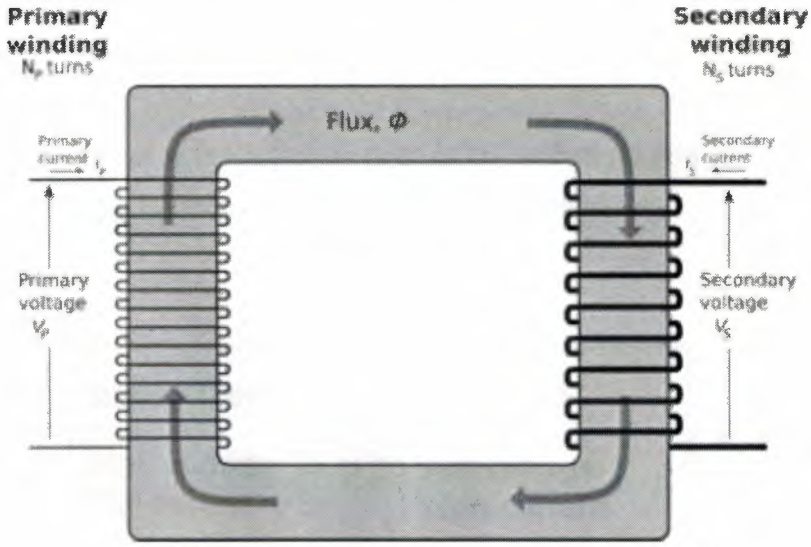


Figure 1.13 Symbol transformer

1.10.1 Classification of transformers

Transformers can be classified into various types according to the ratio of the numbers of turns in the coils, as well as their isolation method

1.10.1.1 Step-up transformer

This is a type of transformer whose secondary voltage is higher than its primary voltage hence secondary has more turns than the primary.

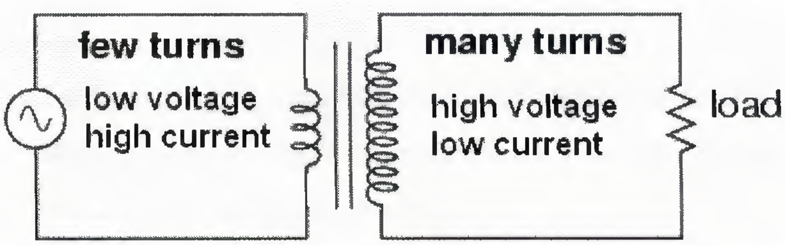


Figure 1.14 step up transformer

1.10.1.2 Step-down transformer

This type of transformer is secondary voltage is lower than its primary voltage therefore the secondary winding has fewer turns than the primary windings.

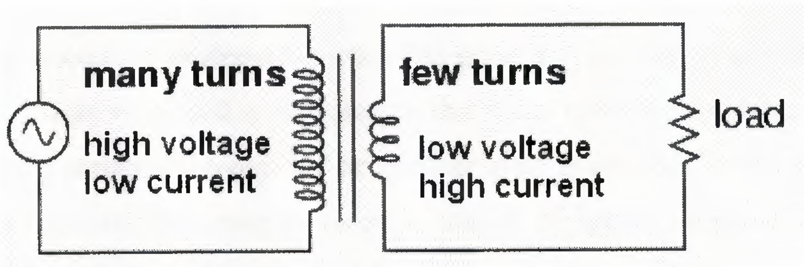


Figure 1.15 step down transformer

1.10.1.3 Isolating

Intended to transform it's output voltage the same as the input voltage .The two coils have approximately equal numbers of turns, though at the output windings there is a slight difference in the number of turns, in order to compensate for losses otherwise the output voltage would be a little less than, rather than the same as the input voltage.

1.10.2 Variable transformer

The primary and secondary have an adjustable number of turns which can be selected without reconnecting the transformer. The transformer may be an autotransformer used for regulation or adjustability. For example, a typical Variac can transform 120 volts to an adjustable voltage that ranges from zero to 140 volts are an autotransformer with a sliding tap on the winding to allow adjustment.

In all cases the primary winding, or the secondary winding, or both, may have taps that allow selection of one of several different ratios of primary to secondary turns. A transformer with a single winding where part serves as both primary and secondary is known as an autotransformer.

1.11 Loudspeaker

loudspeaker, or simply speaker, is an electromechanical device which converts an electrical signal into sound. The term is used to refer to both the transducer, and a complete system consisting of one or more transducers in an enclosure. The loudspeaker is the most variable element in an audio system, and is responsible for marked audible differences between systems.

An enormous amount of engineering work has gone into the design of today's dynamic loudspeaker. A light voice coil is mounted so that it can move freely inside the magnetic field of a strong permanent magnet. The speaker cone is attached to the voice coil and attached with a flexible mounting to the outer ring of the speaker support. Because there is a definite "home" or equilibrium position for the speaker cone and there is elasticity of the mounting structure, there is inevitably a free cone resonant frequency like that of a mass on a spring.

The frequency can be determined by adjusting the mass and stiffness of the cone and voice coil, and it can be damped and broadened by the nature of the construction, but that natural mechanical frequency of vibration is always there and enhances the frequencies in the frequency range near resonance.

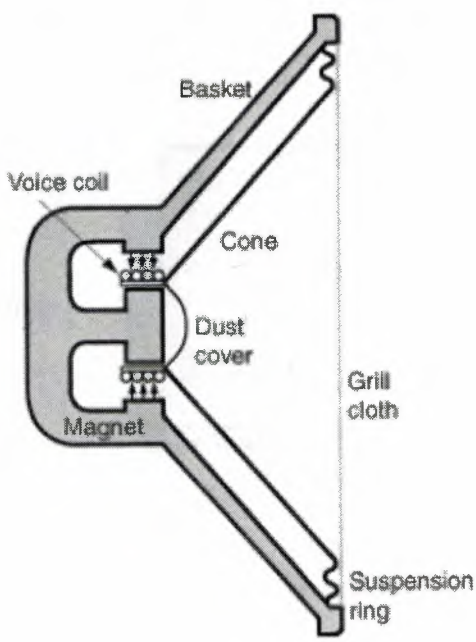


Figure 1.16 Loudspeaker

1.12 Microphones

A microphone is an example of a transducer, a device that changes information from one form to another. Sound information exists as patterns of air pressure; the microphone changes this information into patterns of electric current. The recording engineer is interested in the accuracy of this transformation, a concept he thinks of as fidelity.

A variety of mechanical techniques can be used in building microphones. The two most commonly encountered in recording studios are the magneto-dynamic and the variable condenser designs.

1.12.1 The dynamic microphone

In the magneto-dynamic, commonly called dynamic microphone, sound waves cause movement of a thin metallic diaphragm and an attached coil of wire. A magnet produces a magnetic field which surrounds the coil, and motion of the coil within this field causes current to flow. The principles are the same as those that produce electricity at the utility company, realized in a pocket-sized scale. It is important to remember that current is produced by the motion of the diaphragm, and that the amount of current is determined by the speed of that motion. This kind of microphone is known as velocity sensitive.

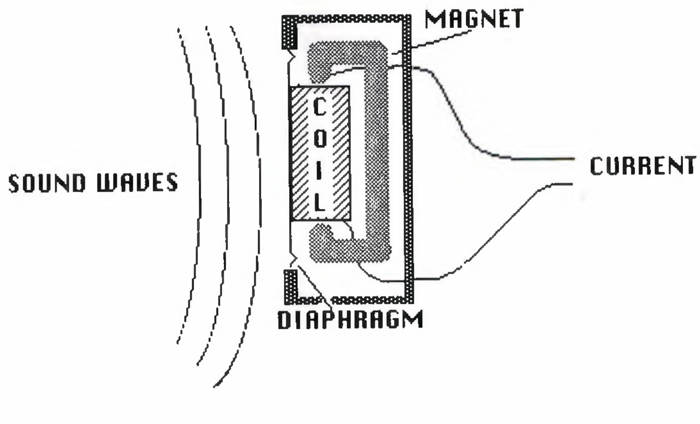


Figure 1.17 microphone

1.13 Safety

In this project, high and low voltage applications are used. Thus, safety guidelines are concern about human safety and components safety, although we cannot avoid the technical mistakes witch can occur during connecting parts and soldering them to the circuit.

- One of the components which are used for this project is a transformer from 240V to 12 V we have to insure that the connection points between the voltage source and the transformer is well protected.
- One of the components used in this circuit is loudspeaker, which has to be chosen to mach the out put signal not to destroy diaphragm.
- While connecting the circuit components to the power supply we have to be aware of the polarity to insure the safety of used components.
- While the circuit is on, avoid touching the sensitive components like the transistor, to avoid interfering with the out put signal.

1.14 Summary

This chapter represents an introduction to electronic components that are used in implementing an intercom system and the power supply for it, how they function and the way they must be connected.

Chapter 2

DESIGNING OF AN INTERCOM SYSTEM

2.1 Overview

After introducing the electrical components in the previous chapter and knowing there characteristics, this chapter will deal with the supply circuit, intercom circuit, the simulation program which is used to draw the circuits and simulate the output.

2.2 Introduction

In order to make this project (intercom) we have to know the amount of voltage which we have to supply for our intercom and depending on that value we have to design a supply circuit which will supply a suitable voltage for the intercom if needed in this project we have to design a circuit to convert 240V AC to about 12V DC which we call rectifier. Then we implement the intercom circuit.

2.3 AC and DC

An alternating current (AC) is an electrical current where the magnitude and direction of the current varies cyclically, as opposed to direct current, where the direction of the current stays constant. The usual waveform of an AC power circuit is a sine wave, as this results in the most efficient transmission of energy. However in certain applications different waveforms are used, such as triangular or square waves.

AC refers to the form in which electricity is delivered to businesses and residences. However, audio and radio signals carried on electrical wire are also examples of alternating current. In these applications, an important goal is often the recovery of information encoded (or modulated) onto the AC signal.

Alternating currents are usually associated with alternating voltages. An AC voltage v can be described mathematically as a function of time by the following equation

$$v(t) = A \times \sin(\omega t)$$

where

A is the amplitude in volts (also called the peak voltage),
ω is the angular frequency in radians per second, and
t is the time in seconds.
f is the frequency in hertz.

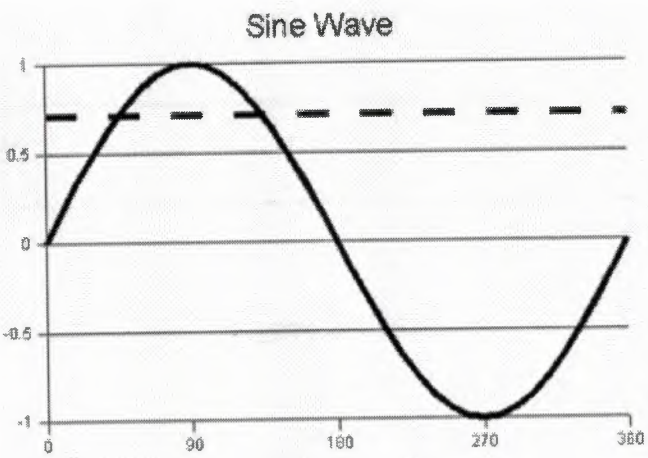


Figure 1.1 sine wave

The peak-to-peak value of an AC voltage is defined as the difference between its positive peak and its negative peak. Since the maximum value of sin(x) is +1 and the minimum value is −1, an AC voltage swings between +A and −A. The peak-to-peak voltage, written as V_{P-P}, is therefore (+A) − (−A) = 2 × A.

In power distribution, the AC voltage is nearly always given as a root mean square (rms) value, written V_{rms}. For a sinusoidal voltage:

$$V_{\mathrm{rms}} = \frac{A}{\sqrt{2}}$$

V_{rms} is useful in calculating the power consumed by a load. If a DC voltage of V_{DC} delivers a certain power P into a given load, then an AC voltage of V_{rms} will deliver the same average power P into the same load if $V_{rms} = V_{DC}$. Because of this fact rms is the normal means of measuring voltage in mains (power) systems.

Direct current (DC or "continuous current") is the constant flow of electric charge from high to low potential. This is typically in a conductor such as a wire, but can also be through semiconductors, insulators, or even through a vacuum as in electron or ion beams. In direct current, the electric charges flow always in the same direction, which distinguishes it from alternating current (AC).

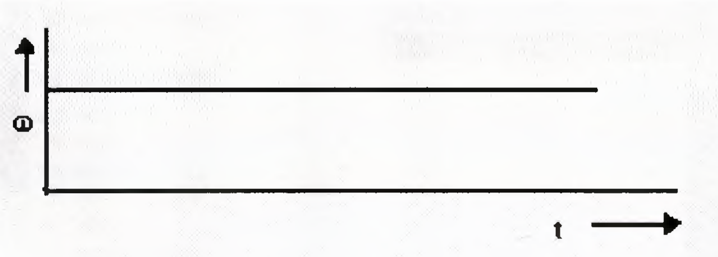


Figure 2.2 DC

AC is used for current transmission because it can easily be stepped up or down in voltage by a simple transformer. High voltage power lines transmit the same power at lower current (which causes lower heat) and it is then stepped down by substation transformers to the more managable voltages. Converting the voltage level of DC is much more complicated. One method is actually to convert to AC (using a device called an inverter), use a transformer to change the voltage, and then rectify it back to DC. DC is a requirement of the internal circuits of many everyday electrical and electronic items. Computers, telephones, television sets, clocks, solid state lighting, etc., are all designed to run on DC.

2.4 Introduction to circuit maker

To simulate any circuit we can use simulation program such as pspice or circuit maker I prefer to use circuit maker

First of all we have to open the start menu all programs circuit maker student circuit maker as shown in the figure below

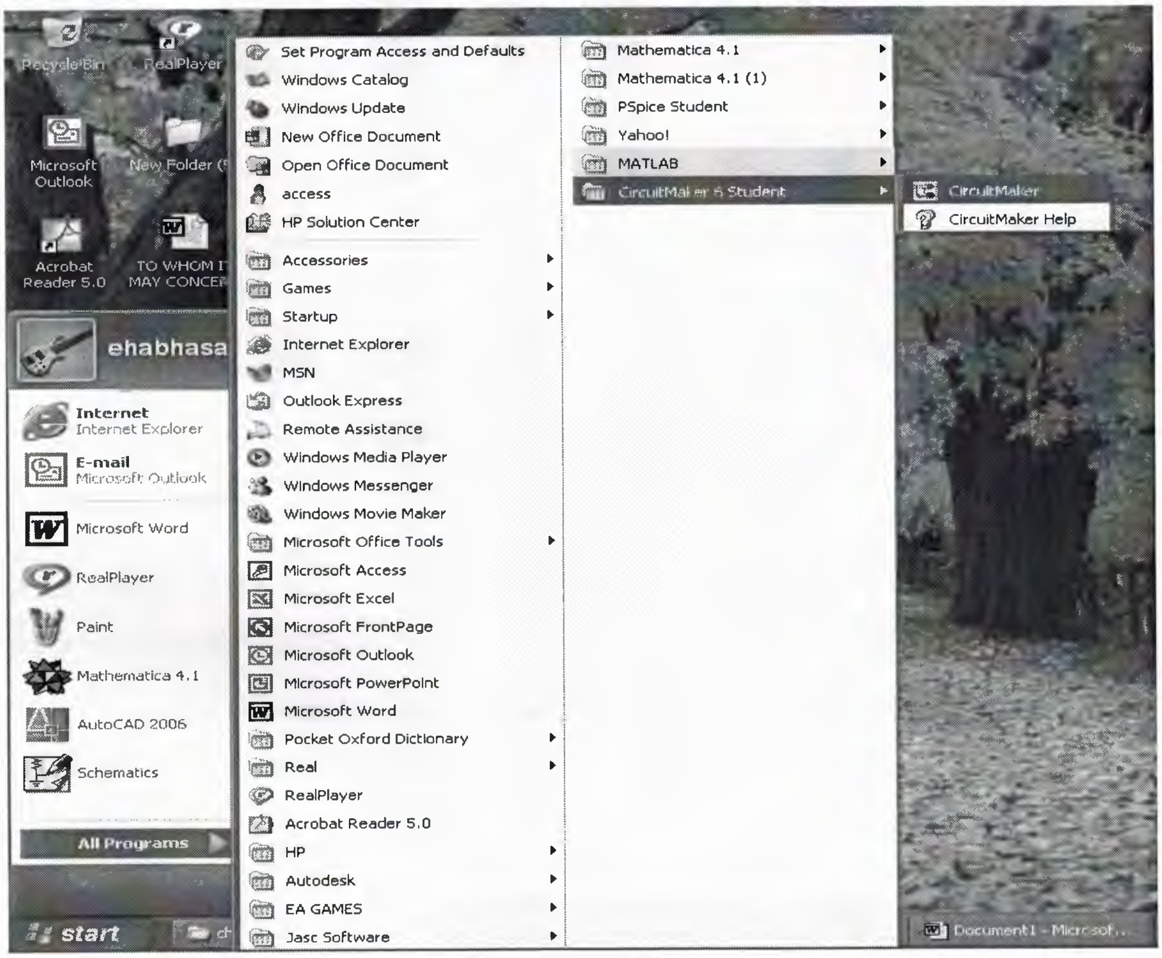


Figure 2.3 opening circuit maker

Once it opens we can see an empty page which we will start drawing the circuit on it.

To get the parts we can directly use the hot keys or from the menu as shown in the figure below.

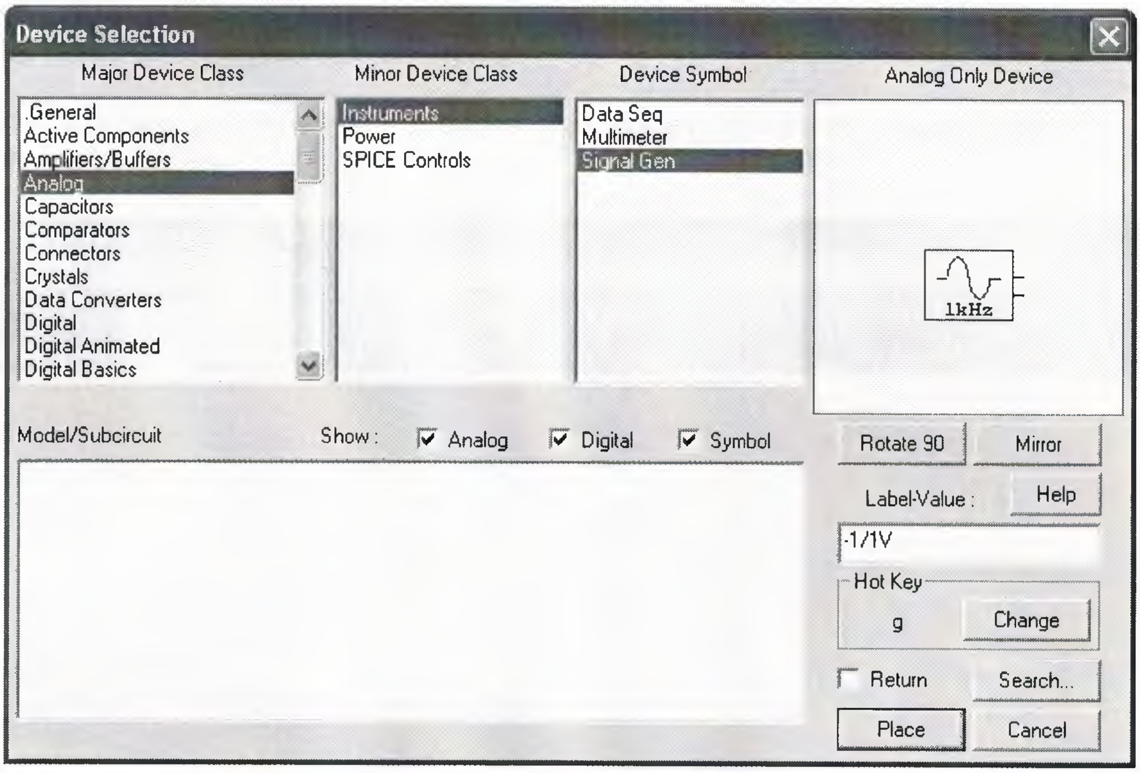


Figure 2.4 device selecting menu

After getting all the parts which we need to implement our circuit we start connecting them by using the wire tool.

We can change the value of the components by double clicking on the component, a small window will open it will show the values which we can change

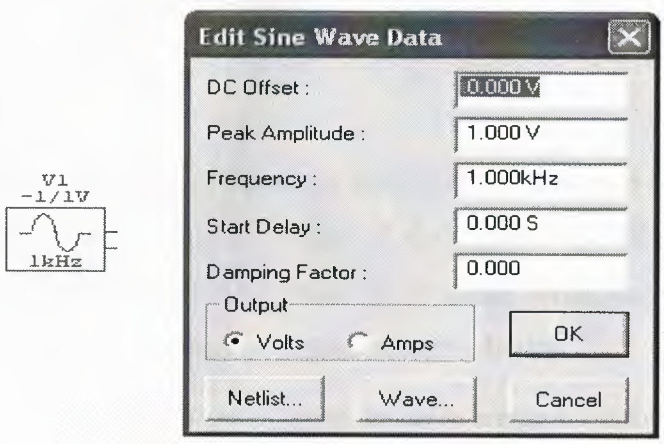


Figure 2.5 editing data

After butting all the values we can simulate or run the circuit by the simulation or the run button which is placed on the toolbar

That will open a window which will show the voltage or the current which the user will choose

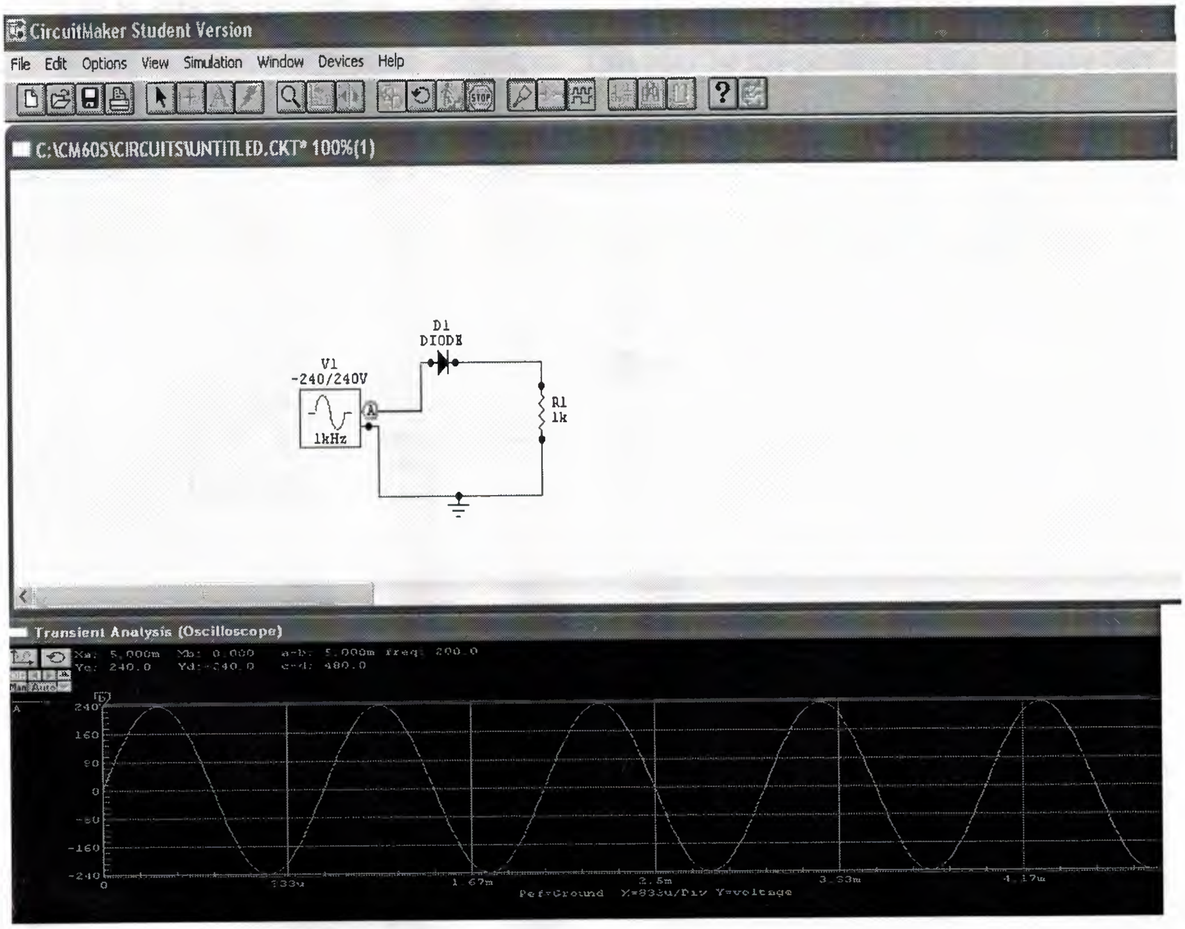


Figure 2.6 simulating the circuit

2.5 Rectifier

Rectification is a process where alternating current (AC) is converted into direct current. (DC) Almost all rectifiers contains a number of diodes in a specific arrangement for more efficiently convert AC to DC than is possible with just a single diode. Rectification is commonly performed by semiconductor diodes.

rectifier is an electrical device, comprising one or more semiconductive devices (such as diodes) arranged for converting alternating current to continuous current. When just one diode is used to rectify AC (by blocking the negative portion of the waveform) .

2.5.1 Half wave rectifier

In half wave rectification, either the positive or negative half of the AC wave is passed easily, the other half is blocked. Half wave rectification eliminates one half of the wave, and so is very inefficient. As its title implies, a half wave rectifier allows only one half of the input waveform to reach the output. This may be the positive or the negative half depending on the sense in which the diode is connected. Half wave rectification can be achieved by a single diode in a one phase supply.

By using the circuit maker we can empliment a half wave rectifier and see the output

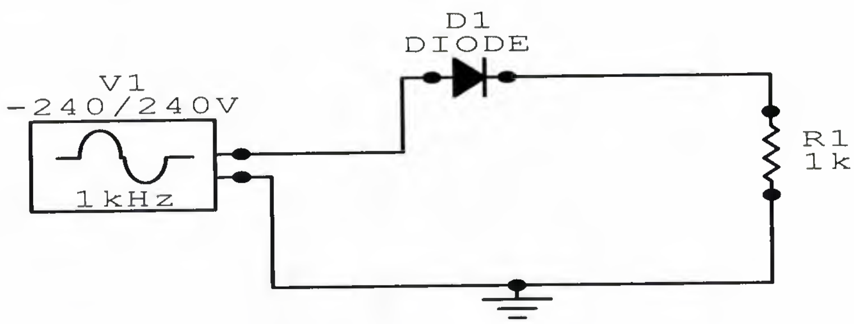


Figure 2.7 half wave rectifier

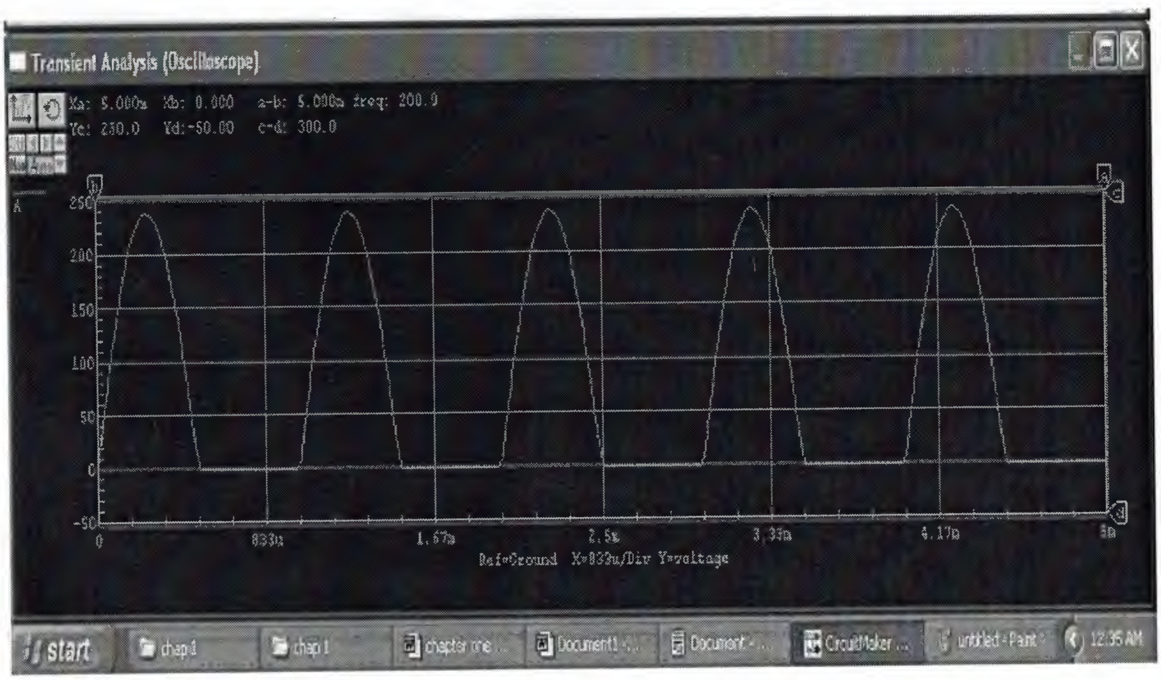


Figure 3.8 the output of half wave rectifier

2.5.2 Full-wave rectifier

Full-wave rectification converts both polarities of the input waveform to DC, and is more efficient. However,depending on the transformer configuration, it can require four times as many rectifiers as half-wave rectification. This is due to each output polarity requiring 2 rectifiers each, A full wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output by reversing the negative (or positive) portions of the alternating current waveform. The positive (negative) portions thus combine with the reversed negative (positive) portions to produce an entirely positive(negative) voltage/current waveform.

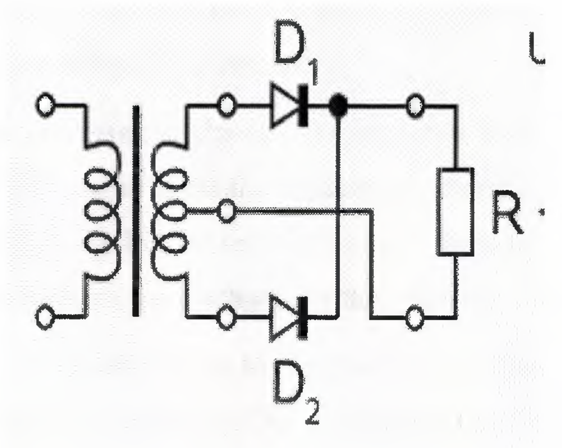


Figure 2.9 full wave rectifier

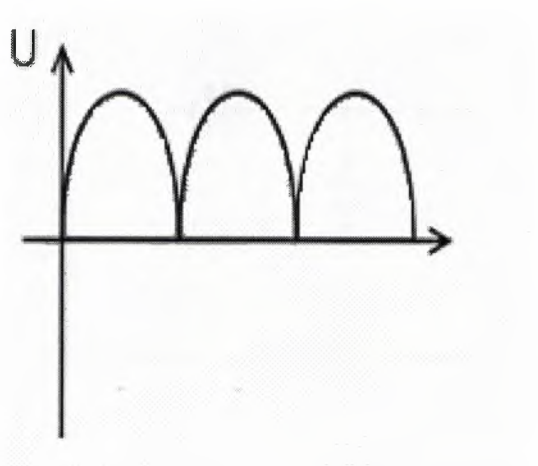


Figure 2.10 full wave rectifier output

2.6 Rectifier output smoothing

While half- and full-wave rectification suffices to deliver a form of DC output, neither produces steady DC. In order to produce steady DC from a rectified AC supply, a smoothing circuit is required. In its simplest form this can be what is known as a reservoir capacitor or smoothing capacitor, placed at the DC output of the rectifier. There will still remain an amount of AC ripple voltage where the voltage is not completely smoothed.

To further reduce this ripple, a capacitor-input filter can be used. This complements the reservoir capacitor with a choke and a second filter capacitor, so that a steady DC output can be obtained across the terminals of the filter capacitor. The choke effectively presents a high impedance to the ripple current.

As the rectifier voltage increases, it charges the capacitor and also supplies current to the load. At the end of the quarter cycle the capacitor is charged to its peak value Vm of the rectifier voltage. Following this the rectifier voltage starts to decrease as it enters the next quarter cycle. This initiates the discharge of the capacitor through the load.

The term 'filter capacitor' usually refers to a capacitor specifically intended to smooth the ripple voltage present in the pulsating DC voltage output of a power supply rectifier.

Sometimes the term merely refers to a capacitor that is part of an electrical or electronic filter circuit.

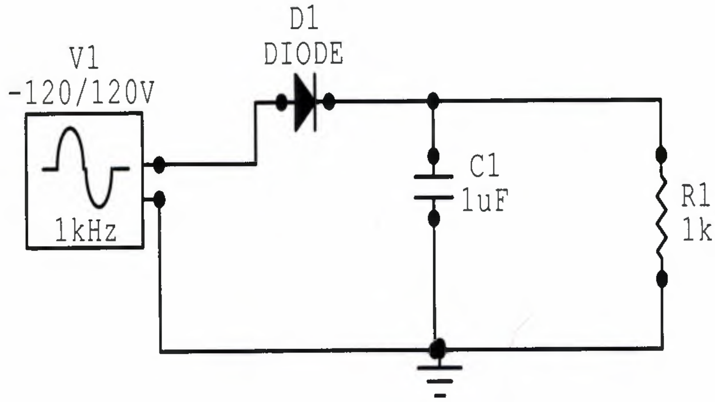


Figure 2.11 rectifier with filter(capacitor)

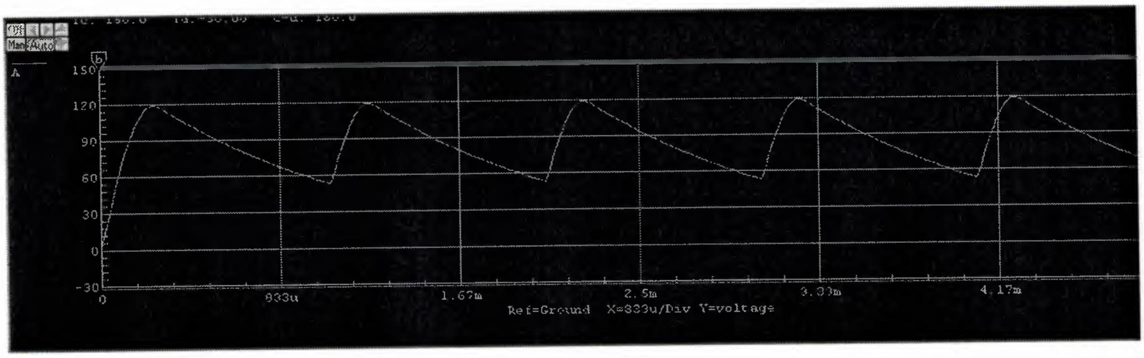


Figure 2.11 the output rectifier with filter(capacitor)

2.7 Rectification efficiency

Rectification efficiency measures how efficiently a rectifier converts AC to DC. It is defined as the ratio of the DC output power to AC input power, where DC output power is a product of the average current and voltage. A simpler way to calculate efficiency is with $\frac{V_{DC}^2}{V_{AC}^2}$.

Without smoothing, full-wave rectifiers have $\frac{8}{\pi^2}$ or 81% efficiency. Half-wave rectifiers have $\frac{4}{\pi^2}$ or 40.5% efficiency

2.8 rectifier circuit

In order to supply a 12 DC voltage for the intercom circuit we have to design a rectifier circuit which will transform 240V AC to 24V DC then convert this 24V to a 12V DC in order to make this sort of rectifier we need diodes capacitor resistor and transistor .

The circuit below is showing the schematics diagram of the rectifier circuit both the input and the output

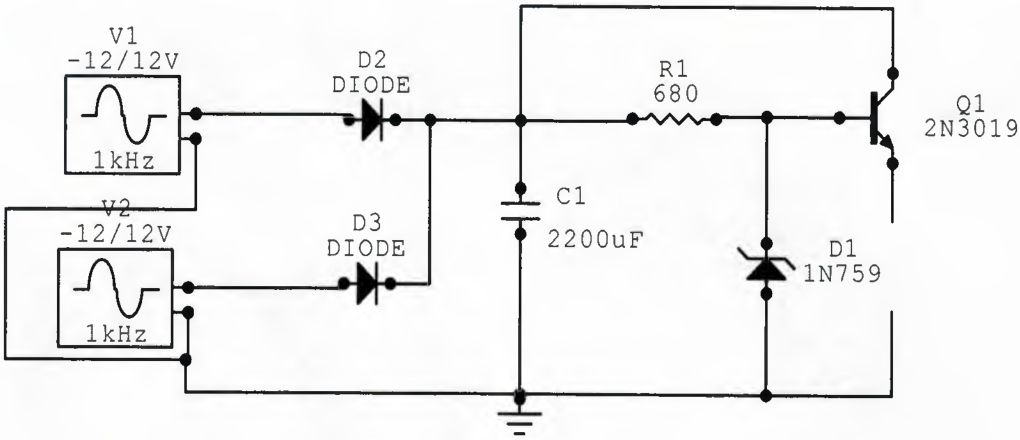


Figure 2.12 AC to DC converter circuit (rectifier)

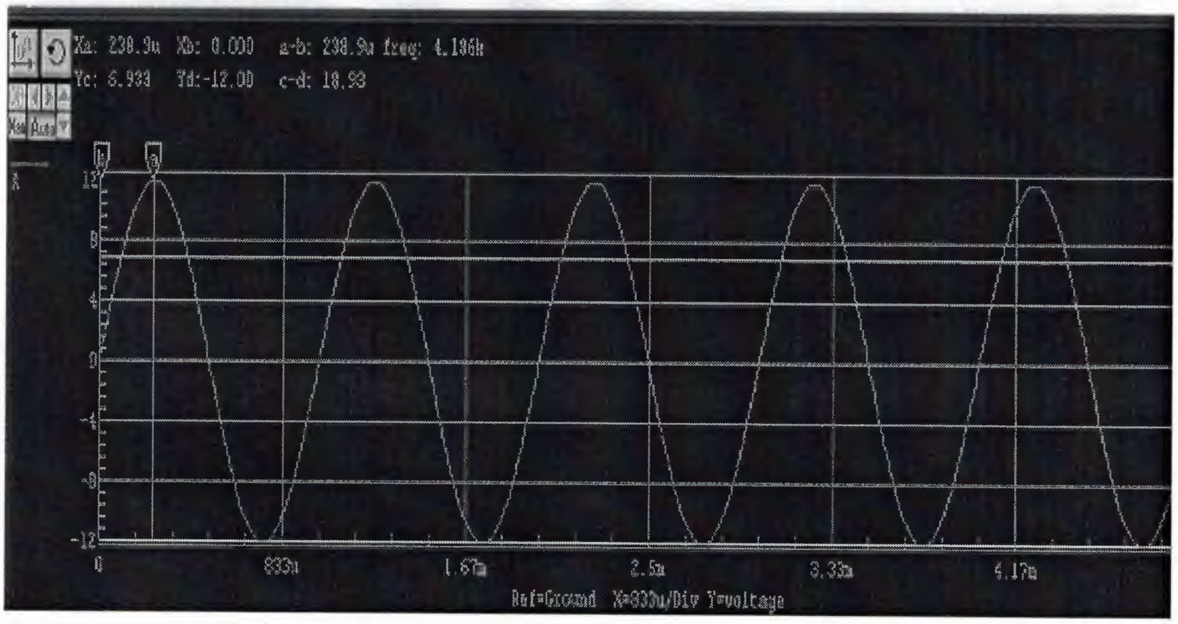


Figure 2.13 The input signal of the rectifier

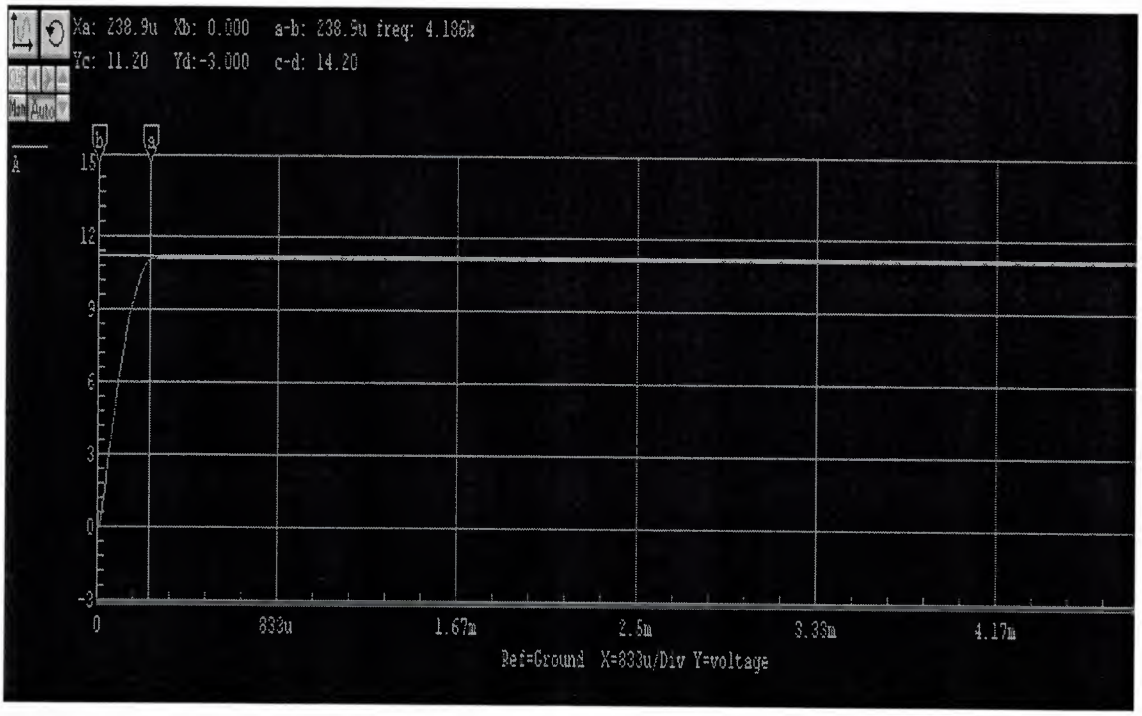


Figure 2.14 The output signal of the rectifier

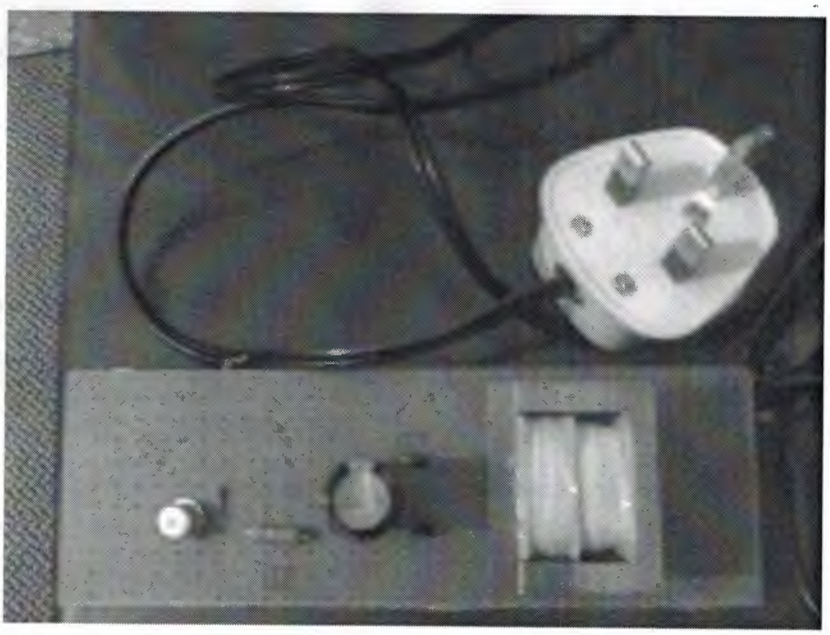


Figure 2.16 The real picture of the rectifire

By simulating the circuit using circuit maker we can see that the out put should be around 11.20 V and our actual value was 11.40V which is small error 0.2V. We know that in the experimental method always we have some error and that because of the tolerances in some components, resistively of the wires and also because of the atmosphere (temperature, humidity)

2.9 Intercom system

An intercom is an electronic communications system within a building or group of buildings. Intercoms are generally composed of fixed microphone/speaker units which connect to a central control panel. A small home intercom might connect a few rooms in a house. Larger systems might connect all of the rooms in a school or hospital to a central office. Intercoms in larger buildings often function as public address systems, capable of broadcasting announcements.

There are a lot of different uses for Intercom Systems. They can be used to know who is coming at your door For example, when some people live with a relative right next door. With both houses perhaps a couple of hundred feet apart at most, next-door relatives may wish to put in place a local intercom solution between the two homes. That may be to keep an eye on the elderly parent who lives next door. Most people will prefer a hard-wired solution for this kind of application to ensure reliability and security .Whereas some other people will be looking for inter-building intercom solutions for business purposes. They all wish to have a setup whereby they can grab the phone and call the other house without going thru the public telephone network.

2.10 Project Intercom Circuit

For this project we have two amplification stages for the intercom system an output transformer some capacitor and resistors for the purpose of examining and checking the out put of the circuit we simulate the circuit using circuit maker.

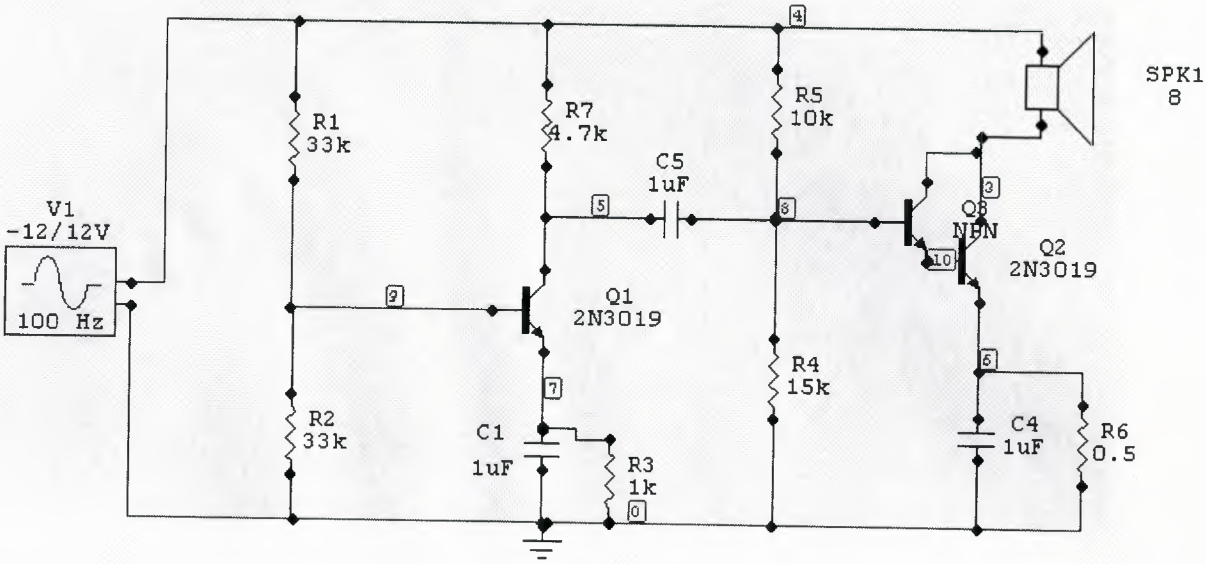


Figure 2.15 Intercom circuit

In order to do this the nodes of the circuit were given numbers to make it easy for us to show the out but at the nodes whish we are interested in, in this circuit we are interested in showing the output the noise and the input signal for that we connected a function generator to our circuit and we simulate it and the out puts for the nodes 3, 7 and the input were as follows

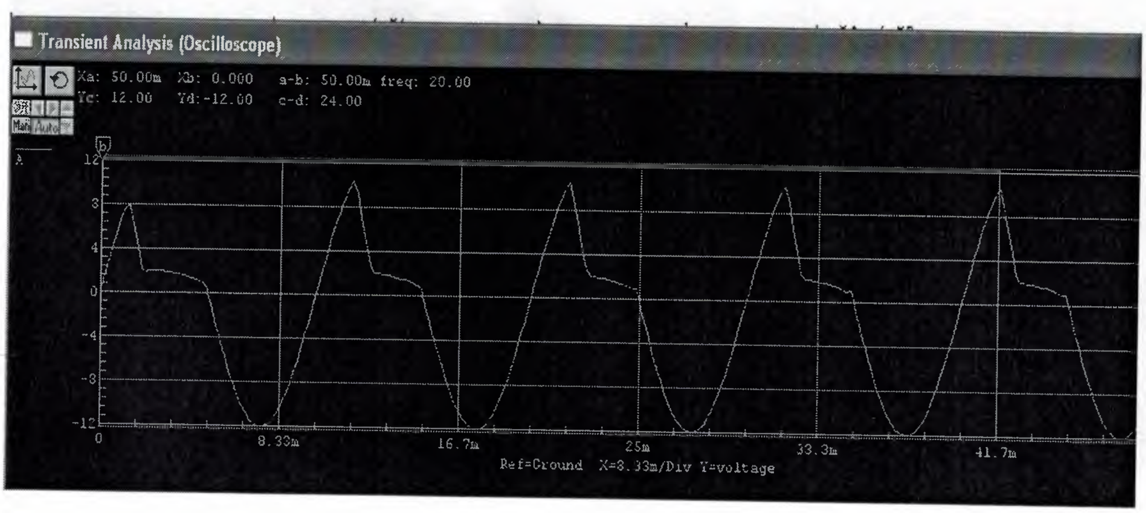


Figure 2.15 the signal for node 3

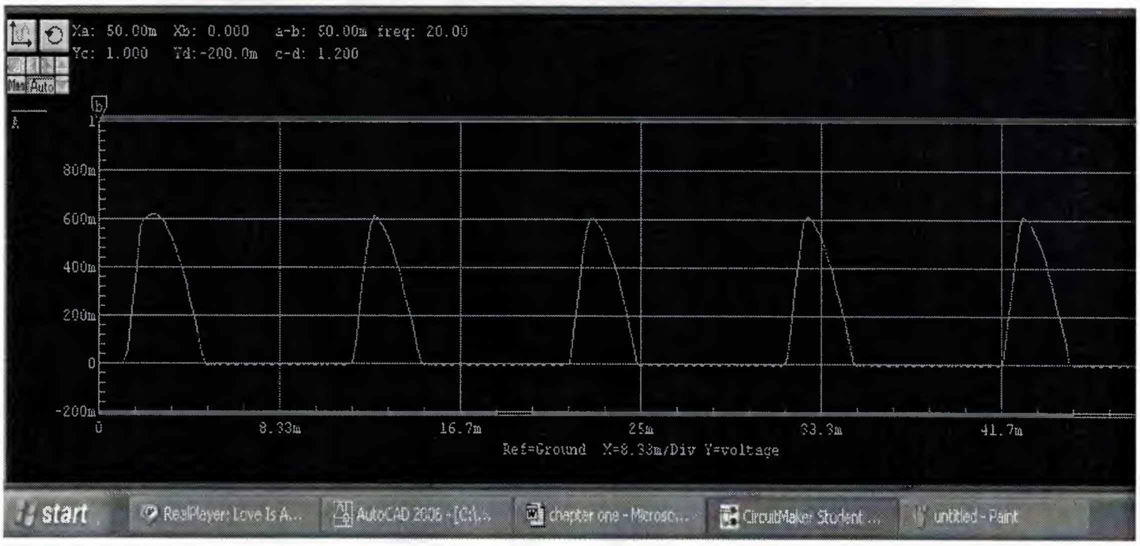


Figure 2.16 The output signal for node 6

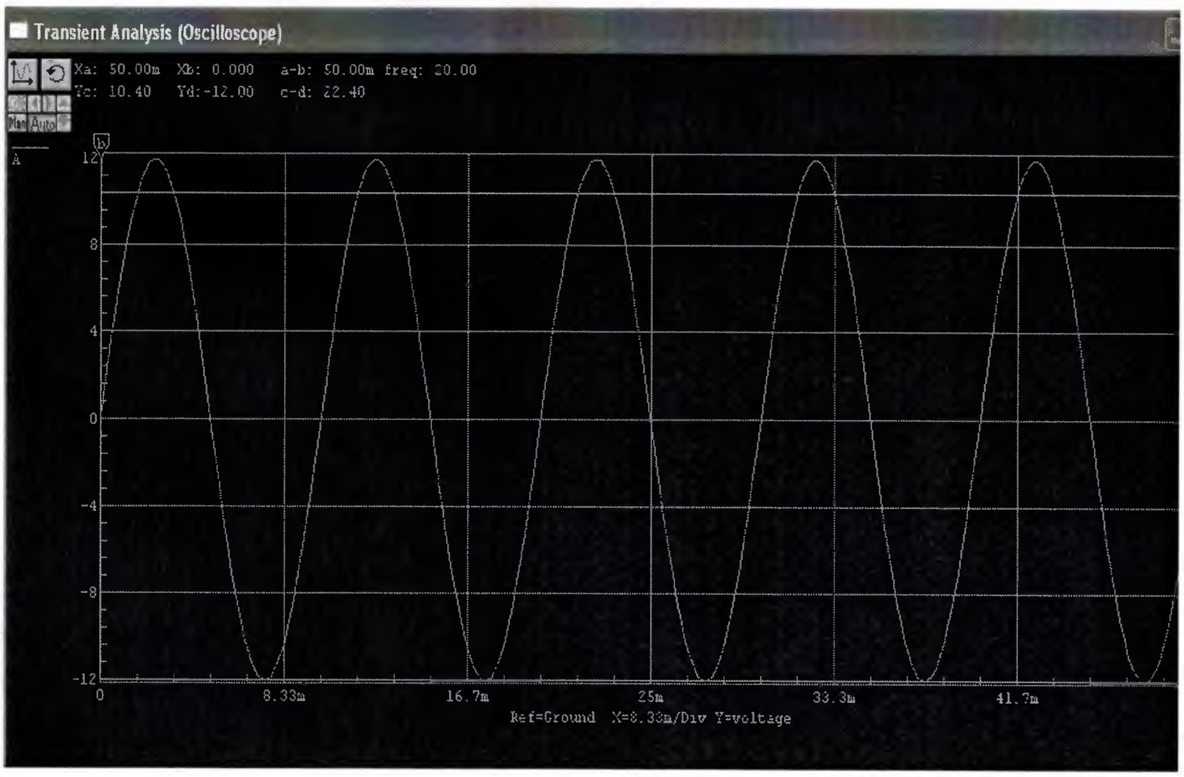


Figure 2.17 The input signal for the function generator

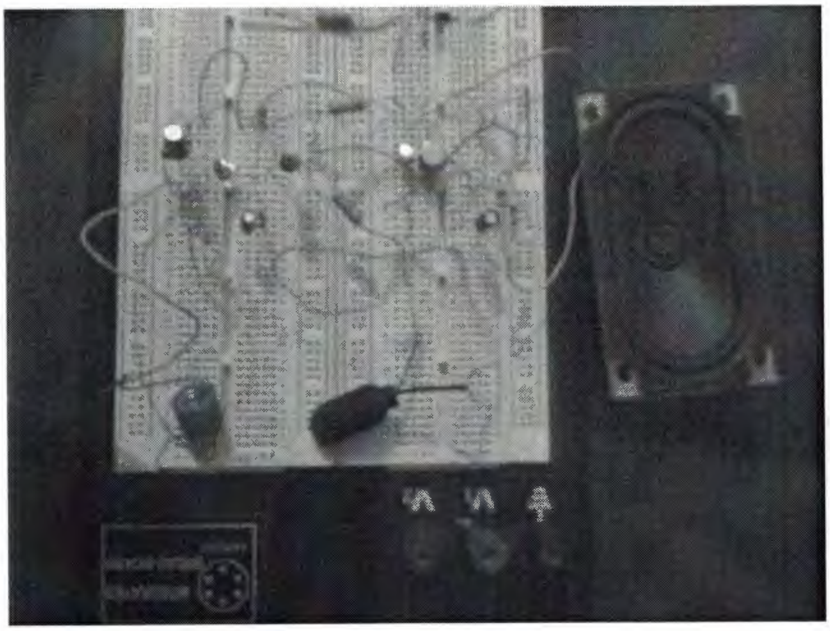


Figure 2.15 The Picture of the constructed intercom

2.11 Conclusion

After constractiong both circuits and checking both the inputs and the output we found that the result was similar to each other with a slight diffecence which was because of the loses of the current and voltage in the elements for the Intercom circuit we found that we can change the noise to voice ration by changing the Resistors which are connected to the emmiter and the collector which we the best result we get when both of them had the same value.

Chapter 3

INSTALLATION OF INTERCOM SYSTEM

3.1 Overview

After the designing and the constructing of our intercom system we have to make installation for our intercom

This chapter deals with the installation of the intercom and the calculation of the distance to calculate form it the voltage drop due to the length of the wire.

3.2 Designing the building

To start the installation we have to design a building so that we can show the installation points and to calculate the distances between our installation points to do this we have to use a program which is made specially for designing constructions for our case it will be a building with eight floors and each floor shall have four flats.

To draw this building we shall use AutoCAD program which is designed for this purpose.

3.3 installing the system

First of all we have to decide the place that we want to place our intercom on (the out part) it should be placed in such a way that it is visible to users or visitors, not to have any difficulties to contact the person which lives in our building on the other hand the other sending receiving part which in any flat should be placed some where near the door to make it easier for that person to open the door directly.

Also to know the distance between the tow stations so that we can calculate the length of the wires to know the thickness of the wire which we have to use to connect both stations.

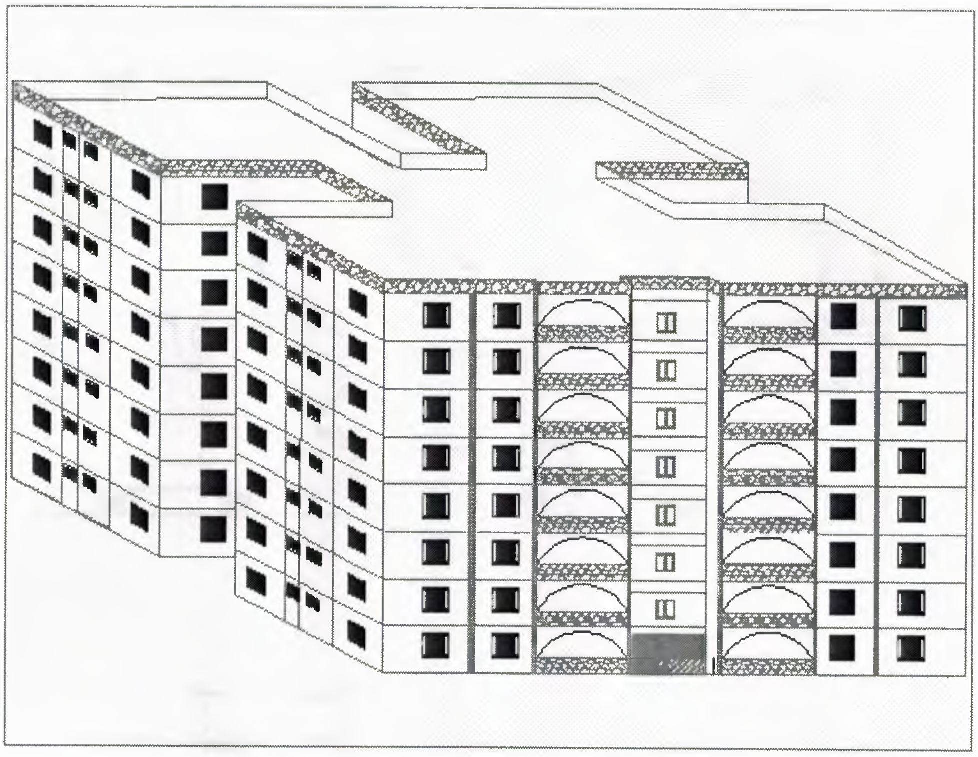


Figure 3.1 The eight storey building

Figure 3.1 is showing the three dimensional view of the building which we have to install our intercom this building has eight floors each one has four flats.

Before the installation of our intercom we have to calculate the distance between the intercom and the other one in each flat so we can decide the thickness of the wire which we will be using to install the system.

3.4 calculating the distance

To make this calculation we have to draw the plane for the building, because all the floors are symmetrical we can just draw the plane for one of the floors and show the calculation for that floor which will be the same for each floor.

The following figure is showing the plane and the connection of the system.

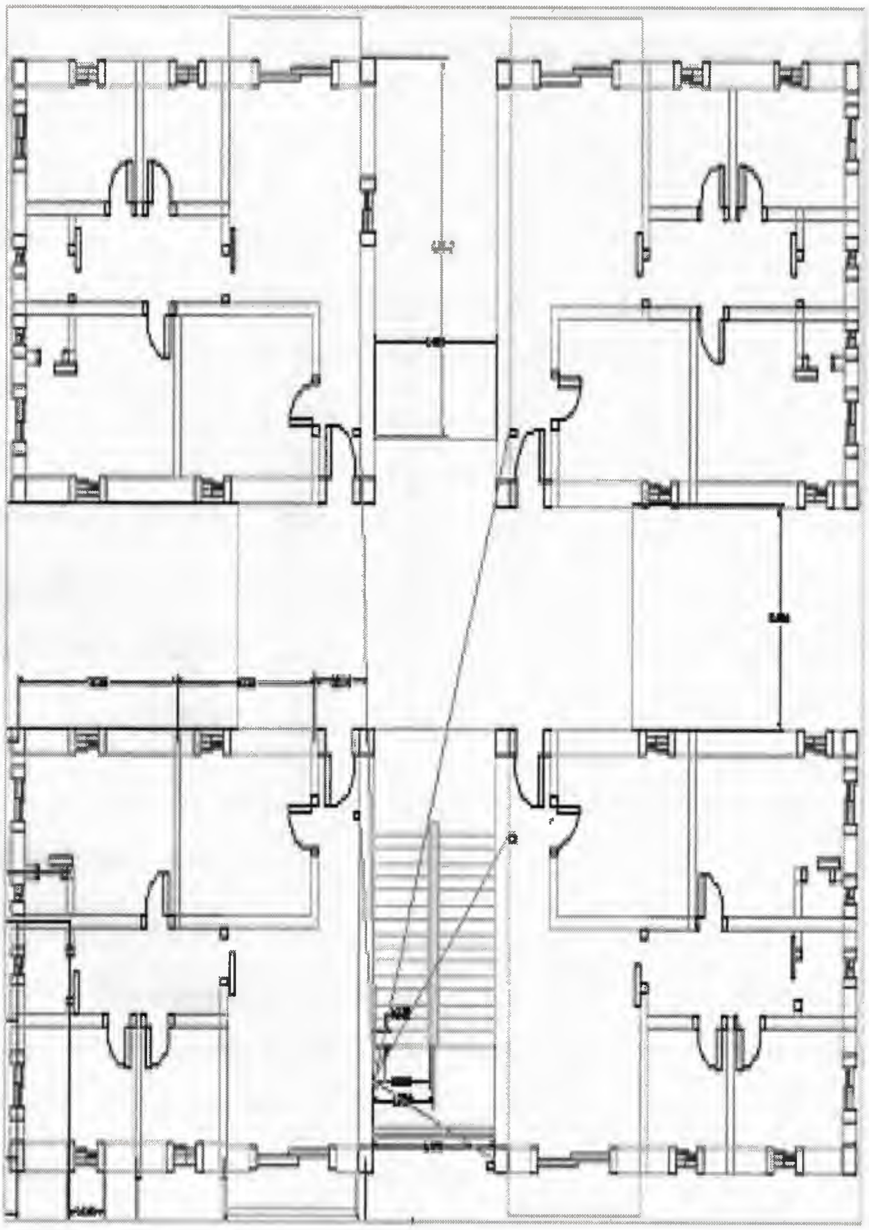


Figure 3.2 plane and the connection of the system

To choose the wire which will be used in the installation for this we have to calculate the worst case which is the last floor for this project it will be the 8^{th} floors which is the one has the longest distance from the communication board.

The distance between the communication board and the flats in the first floor is calculated as follows

1- for flat 1A

Distance = 5.4m

2- for flat 1B

Distance = 0.5m

3- for flat 1C

Distance= 1m+5.4m+1m=7.4m

4- for flat 1D

Distance^2 =7.4^2m+5.4^2 m

Distance= $\sqrt{54.75+29.16}$ = 9.1m

From this we can calculate the distances for the last"top" floor by knowing that the height of each floor is about 3 m

The height of the building $=3\times 8=24$

Knowing that the communication board nether on floor nor on the top we have to subtract about 3m 1.5m from up and 1.5 from down that makes the distance between the communication board and the upper box around

$24-3=21m$

1- for flat 8A

Distance = 5.4m+21m=26.4m

2- for flat 8B

Distance = 0.5m+21m=21.5m

3- for flat 8C

Distance= 1m+5.4m+1m=7.4m

7.5m+21m=28.5m

4- for flat 8D

Distance^2 =7.4^2m+5.4^2 m

Distance= $\sqrt{54.75+29.16}$ m= 9.1m

9.1m+21m=30.1m

3.5 Wires

After calculating the distance between the communication boards we have to choose suitable wire to connect the system to do this we have to get some information about wires in general and the specifications of the wire which we will use such as the maximum voltage and current which it can curry the voltage loss due per unit length

Amps in Wire	Watts at 12V	#14	#12	#10	#8	#6	#4	#2	1/0	2/0	3/0
1	12	84	131	206	337	532					
2	24	42	66	103	168	266	432	675			
4	48	18	33	52	84	133	216	337	543	675	
6	72	14	22	33	56	89	141	225	360	450	570
8	96	10	16	27	42	66	108	168	272	338	427
10	120	8.5	13	22	33	53	84	135	218	270	342
15	180	6	8.5	13	22	35	56	90	144	180	228
20	240		6.6	10	16	27	42	67	108	135	171
25	300			8	13	22	33	54	86	108	137
30	360			6.6	11	18	28	45	72	90	114
40	480				8	13	21	33	54	67	85

Table 3.1 voltage drop in wire

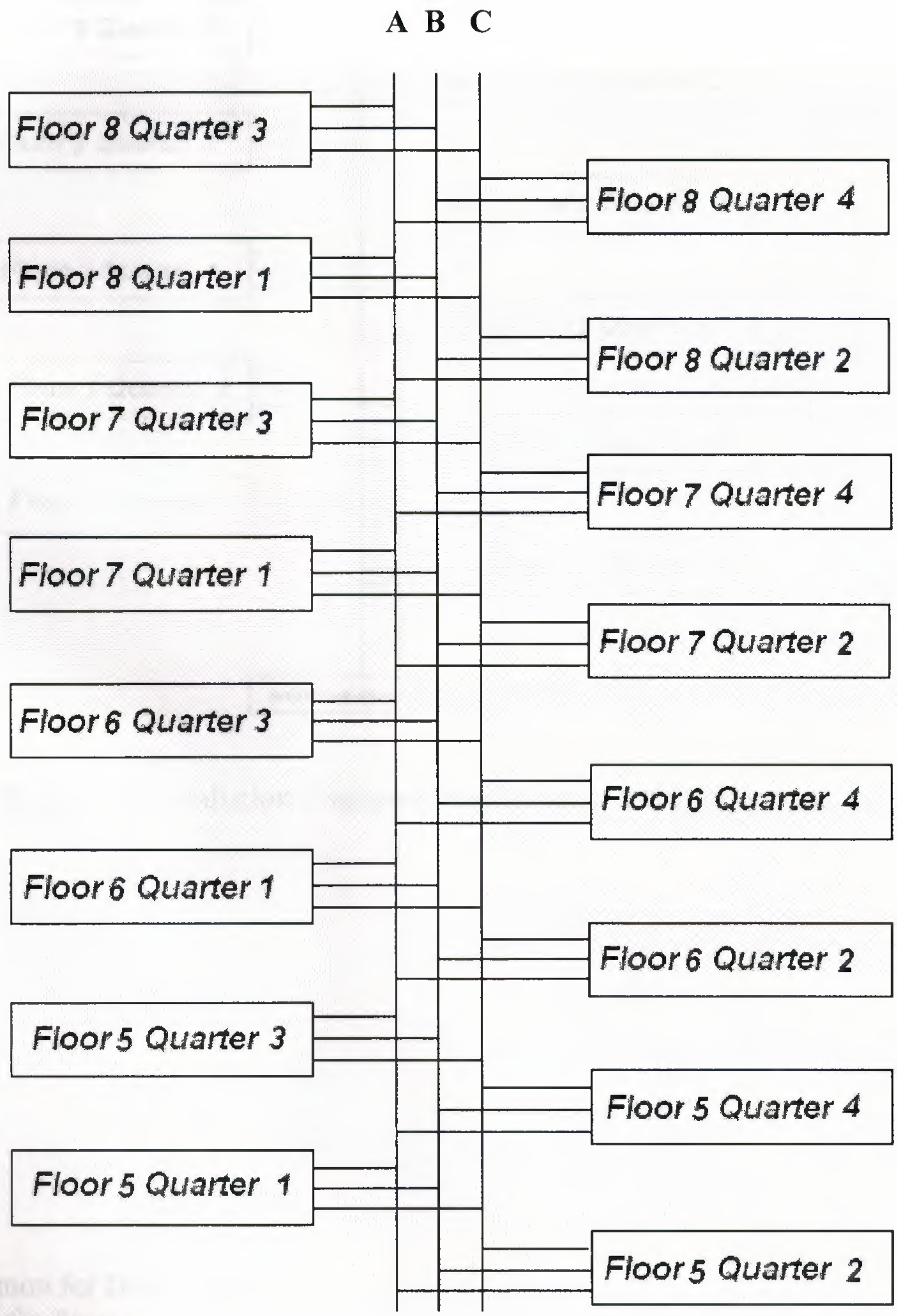
3.6 Installing the station

First choose the location for the Main Station or Power Supply. These units require access to AC power. They should be located away from other equipment they generates excessive amounts of heat. Also choosing locations for Remote Station and Speaker Station.

The following diagram shows the schematics representation for the installation of the intercom system and the door opener.

The way that it works as follows:

There are communication line, supply line and door opener line once one of communication line or the door opener line connects to power “supply” it activate the circuit for the door opener it opens the main door for the building on the other hand once the power supply connects to the intercom the person in the flat can communicate with the person down.



A B C

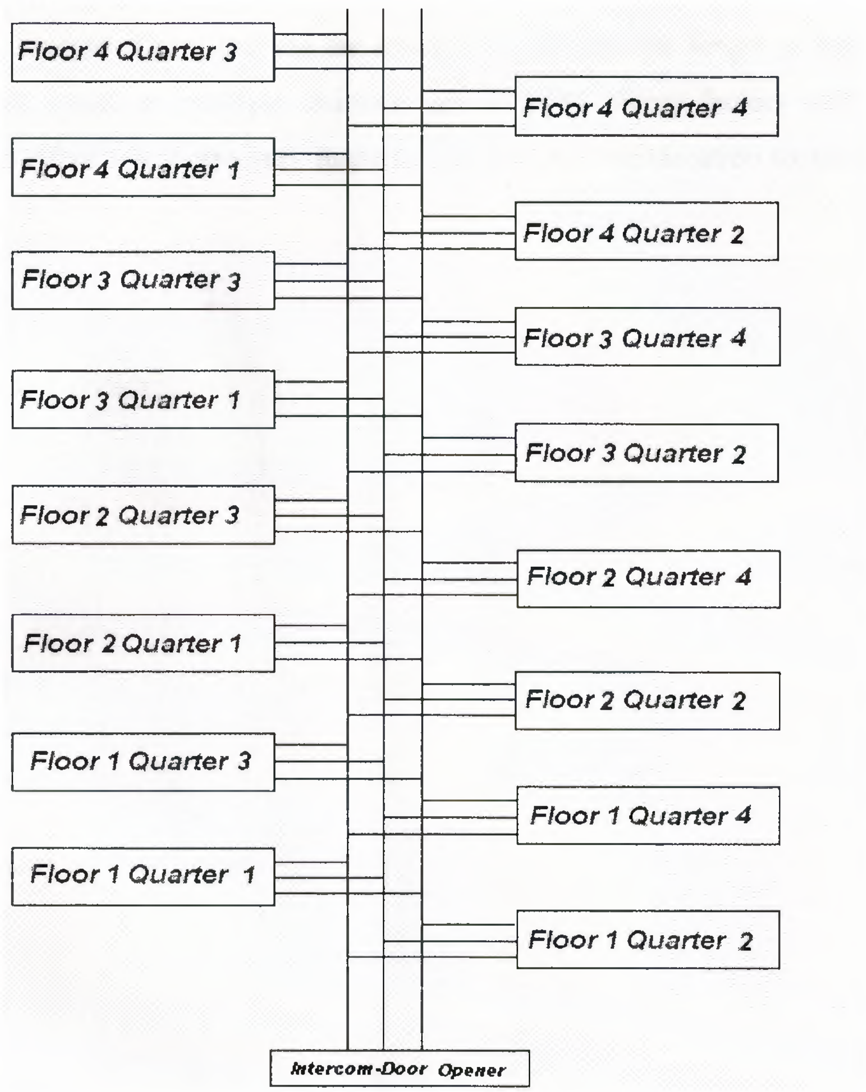


Figure 1.3 Installation diagram of the Intercom and door opener

(A) Is common for Door Opener.
(B) Is Feed for Power.
(C) Is feed for communication.

3.6 Conclusion

When considering how to install and wire an intercom system, several factors must be taken into account. These include the number of stations, the length of the cable runs and whether single or multiple channels are required. These factors will save time, money and effort which are very important to take in consideration to succed in any job.

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