NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

Construction of MW Radio

Graduation Project
EE 400

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ACKNOWLEDGMENT

First of all we would thank god who gave us power and supported us with the best instructors and advisors, and thanks to the projects advisor Dr. Ali serener who has shown patience and assistance in guiding us to overcome the difficulties in this project. So thanks after all to the N.E.U. who gave all students the opportunity to be better citizens in a better future.

Miar Dalloul:

I would thank my family who supported me financially and mentally within the recent terrible situation down in Palestine and dedicate this happiness to them and wish that I have made them proud of me after all, as I would dedicate it to all my friends in Palestine and Cyprus who shared with me the good times and the bad times.

ABSTRACT

As the life is getting more complicated, we figure out that most of the machines and equipments are replaced by more luxury or even more intelligent alternatives, only the radios are still taking the same place in this struggle, they still cover the whole planet, they still cheap to buy and even cheaper to maintain.

The only part which is developing is the competition in the broadcasting and the covering area of each channel in another word to take a bigger part in a bigger number of people.

This work presents a designed, built and tested MW radio circuit which can receive channels like a regular radio. Two different types of circuit designs have been created. The first design was not operational due to the problems occurring in the circuit layout. The problems that were part of the second design were fixed and the design is operating correctly.

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INTRODUCTION

World wide we can see that radios have the most flourishing production and usage, all the planet is covered by radio waves and signals holding millions of programs which are listened regularly by people in cars, houses, work places, markets....etc

The radio was used within this century widely in the communication purposes in almost the all life parts; as it was installed in some other products as an additional option; to give the opportunity to people to keep up dated and connected to latest news and other life branches. It is almost unimaginable to live without it anymore; radios become a part of our modern life.

The purpose of this project is to design, build and test a MW radio circuit with its basic elements. In five chapters we tried to show the work we have done clear as the theoretical and method in a simple way for readers to get the maximum usage and gain.

Chapter one will present components which will be used in building the circuit of the radio. Their characteristics, properties and functions will also be discussed. Also safety guidelines, which must be kept in mind when working on electronic projects, will be described.

Chapter two will present frequencies which are used in radio and other purposes are described of course MW transmission is included; differences and applications are also mentioned.

Chapter three will present in detail the operation of the circuit, starting with the input and how it is processed, through each component until it is ready to leave the circuit as a sound.

Chapter four will present the most probable problems counted, and also will indicate a suitable solution for each problem.

CHAPTER ONE

ELECTRONIC COMPONENTS

1.1 Overview

This chapter presents an introduction to electronic components that are commonly used in hardware projects. Safety guidelines for electronic projects will also be described.

1.2 Components

In this section a detailed explanation will be given for each hardware component used in setting up the electronic circuit.

1.2.1 Resistors

Resistors are electronic components used extensively on the circuit boards of electronic equipment. Resistors are usually used to limit current.

Resistors are electronic components used extensively on the circuit boards of electronic equipment. They are color coded with stripes to reveal their resistance value (in ohms) as well as their manufacturing tolerance.

Resistors, like diodes and relays, are another of the electrical components that should have a section in the installer's parts bin. They have become a necessity for the mobile electronics installer, whether it is for door locks, timing circuits, remote starts, or just to discharge a stiffening capacitor.

Resistors are components that resist the flow of electrical current. The higher the value of resistance (measured in ohms) the lower the current will be.

Resistors are color coded to read the color code of a common 4 band 1K ohm resistor with a 5% tolerance, start at the opposite side of the GOLD tolerance band and read from left to right. Write down the corresponding number from the color chart below for the 1st color band BROWN. To the right of that number, write the corresponding number for the 2nd band BLACK. Now multiply that number (you should have 10) by the corresponding multiplier number of the 3rd band (RED) (100). The answer will be 1000 or 1K, as shown in figure 1.1.

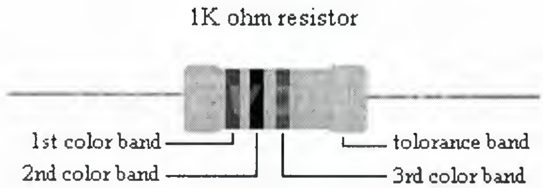


Figure 1.1 Resistor

How to read resister color codes:

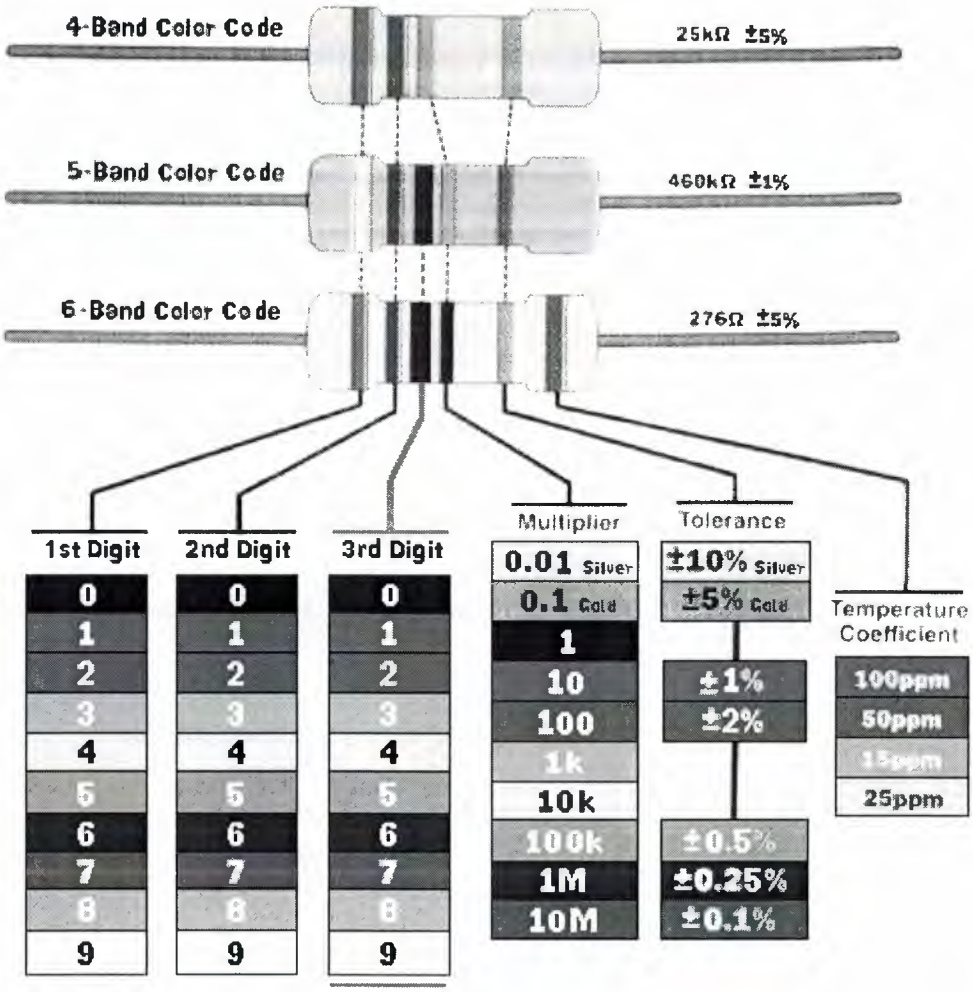


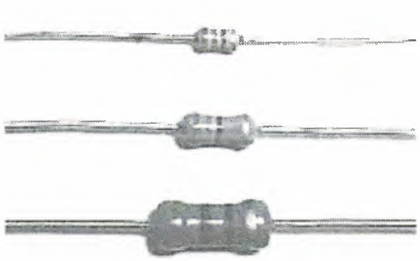
Figure 1.2 Resistor color code

If a resistor has 5 color bands, write the corresponding number of the 3rd band to the right of the 2nd before you multiply by the corresponding number of the multiplier band. If you only have 4 color bands that include a tolerance band, ignore this column and go straight to the multiplier.

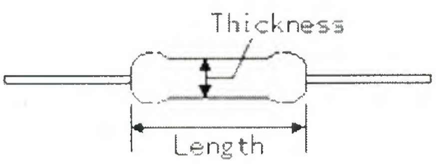
The tolerance band is usually gold or silver, but some may have none. Because resistors are not the exact value as indicated by the color bands, manufactures have included a tolerance color band to indicate the accuracy of the resistor. Gold band indicates the resistor is within 5% of what is indicated. Silver = 10% and None = 20%. Others are shown in the chart below. The 1K ohm resistor in the example above, may have an actual measurement any where from 950 ohms to 1050 ohms. If a resistor does not have a tolerance band, start from the band closest to a lead. This will be the 1st band[7].

1.2.1.1 Types of resistors

Carbon film resistors: This is the most general purpose, cheap resistor. Usually the tolerance of the resistance value is ±5%. Power ratings of 1/8W, 1/4W and 1/2W are frequently used. Carbon film resistors have a disadvantage; they tend to be electrically noisy. Metal film resistors are recommended for use in analog circuits.



From the top of the photograph
1/8W
1/4W
1/2W



Rough size

Rating power (W)	**Thickness (mm)**	**Length (mm)**
1/8	2	3
1/4	2	6
1/2	3	9

Figure 1.3 Carbon film resistors.

of radio. The other is semi-fixed resistor that is not meant to be adjusted by anyone but a technician. It is used to adjust the operating condition of the circuit by the technician. Semi-fixed resistors are used to compensate for the inaccuracies of the resistors, and to fine-tune a circuit. The rotation angle of the variable resistor is usually about 300 degrees. Some variable resistors must be turned many times to use the whole range of resistance they offer. This allows for very precise adjustments of their value. These are called "Potentiometers" or "Trimmer Potentiometers." The symbol is used to indicate a variable resistor in a circuit diagram is shown below.

Figure 1.4 Variable resistors symbol.

There are three ways in which a variable resistor's value can change according to the rotation angle of its axis. When type "A" rotates clockwise, at first, the resistance value changes slowly and then in the second half of its axis, it changes very quickly.

The "A" type variable resistor is typically used for the volume control of a radio, for example. It is well suited to adjust a low sound subtly. It suits the characteristics of the ear. The ear hears low sound changes well, but isn't as sensitive to small changes in loud sounds. A larger change is needed as the volume is increased. These "A" type variable resistors are sometimes called "audio taper" potentiometers. As for type "B", the rotation of the axis and the change of the resistance value are directly related. The rate of change is the same, or linear, throughout the sweep of the axis. This type suits a resistance value adjustment in a circuit, a balance circuit and so on. They are sometimes called "linear taper" potentiometers. Type "C" changes exactly the opposite way to type "A". In the early stages of the rotation of the axis, the resistance value changes rapidly, and in the second half, the change occurs more slowly. This type isn't too much used. It is a special use. As for the variable resistor, most are type "A" or type "B".

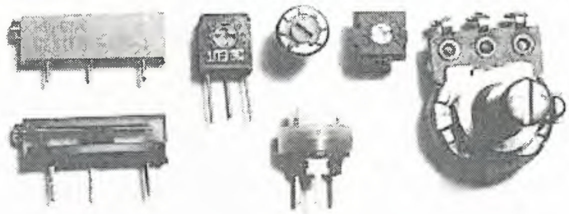


Figure 1.5 Variable resistors.

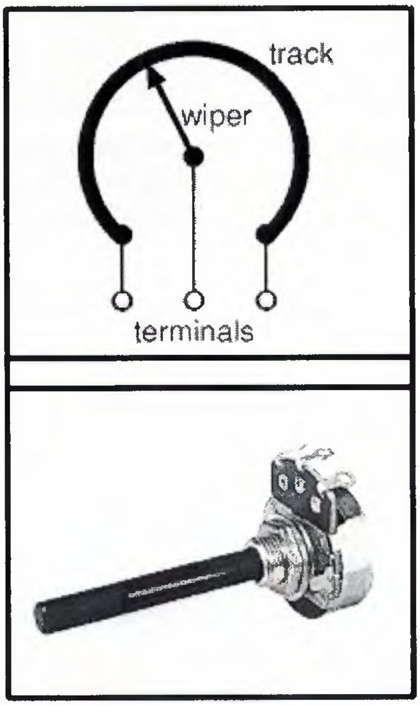


Figure1.6 Standard variable resistor

Wire wound resistors: There is another type of resistor other than the carbon-film type and the metal film resistors. It is the wire wound resistor. A wire wound resistor is made of metal resistance wire, and because of this, they can be manufactured to precise values. Also, high-wattage resistors can be made by using a thick wire material. Wire wound resistors cannot be used for high-frequency circuits. Coils are used in high frequency circuits. Since a wire wound resistor is a wire wrapped around an insulator, it is also a coil, in a manner of speaking. Using one could change the behavior of the circuit. Still another type of resistor is the Ceramic resistor. These are wire wound resistors in a ceramic case, strengthened with special cement. They have very high power ratings, from 1 or 2 watts to dozens of watts. These resistors can become extremely hot when used for high power applications, and this must be taken into account when designing the circuit. These devices can easily get hot enough to burn you if you touch one.

Composite resistor: Usually some medium power resistors are built in this way. Has low inductance, large capacitance, poor temperature stability, noisy and not very good long time stability. Composite resistor can handle well short overload surges.

1.2.2 Capacitors

A capacitor is an electronic device which consists of two plates (electrically conductive material) separated by an insulator. The capacitor's value (its 'capacitance') is largely determined by the total surface area of the plates and the distance between the plates (determined by the insulator's thickness). A capacitor's value is commonly referred to in microfarads, one millionth of a farad. It is expressed in micro farads because the farad is such a large amount of capacitance that it would be impractical to use in most situations. Figure 1.7 shows the types of capacitors [2].

. **Figure 1.7** Types of capacitors.

1.2.2.1 Types of capacitors

There are many types of capacitor but they can be split into two groups, polarized and unpolarized each group has its own circuit symbol.

1. Polarized capacitors

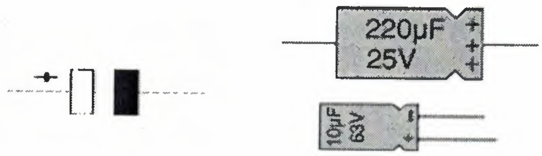


Figure 1.8 Circuit symbol & examples of the polarized capacitor.

Electrolytic Capacitors: Electrolytic capacitors are polarized and they must be connected the correct way round, at least one of their leads will be marked + or -. They are not damaged by heat when soldering. There are two designs of electrolytic capacitors; axial where the leads are attached to each end (220µF in picture) and radial where both leads are at the same end (10µF in picture). Radial capacitors tend to be a little smaller and they stand upright on the circuit board. It is easy to find the value of electrolytic capacitors because they are clearly printed with their capacitance and voltage rating. The voltage rating can be quite low (6V for example) and it should always be checked when selecting an electrolytic capacitor. It the project parts list does not specify a voltage; choose a capacitor with a rating which is greater than the project's power supply voltage. 25V is a sensible minimum for most battery circuits.

Figure 1.9 Electrolytic capacitor.

Tantalum Bead Capacitors: Tantalum bead capacitors are polarized and have low voltage ratings like electrolytic capacitors. They are expensive but very small, so they are used where a large capacitance is needed in a small size. Modern tantalum bead capacitors are printed with their capacitance and voltage in full. However older ones use a color-code system which has two stripes (for the two digits) and a spot of colors for the number of zeros to give the value in μF. The standard color code is used, but for the spot, grey is used to mean × 0.01 and white means × 0.1 so that values of less than 10μF can be shown. A third colors stripe near the leads shows the voltage (yellow 6.3V, black 10V, green 16V, blue 20V, grey 25V, white 30V, pink 35V). For example: blue, grey, black spot means 68μF , blue, grey, white spot means 6.8μF , blue, grey, grey spot means 0.68μF .

2. Unpolarized capacitor

Small value capacitors are unpolarised and may be connected either way round. They are not damaged by heat when soldering, except for one unusual type (polystyrene). They have high voltage ratings of at least 50V, usually 250V or so. It can be difficult to find the values of these small capacitors because there are many types of them and several different labeling systems! Many small value capacitors have their value printed but without a multiplier, so you need to use experience to work out what the multiplier should be! For example 0.1 means 0.1μF = 100nF. Sometimes the multiplier is used in place of the decimal point. For example: 4n7 means 4.7nF.

Capacitor Number Code: A number code is often used on small capacitors where printing is difficult: The 1st number is the 1st digit, the 2nd number is the 2nd digit, and the 3rd number is the number of zeros to give the capacitance in pF. Ignore any letters - they just indicate tolerance and voltage rating. For example: 102 means 1000pF = 1nF (not 102pF!), 472J means 4700pF = 4.7nF (J means 5% tolerance).

Capacitor Color Code: A color code was used on polyester capacitors for many years. It is now obsolete, but of course there are many still around. The colors should be read like the resistor code, the top three colors bands giving the value in pF. Ignore the 4th band (tolerance) and 5th band (voltage rating). For example: brown, black, orange means 10000pF = 10nF = 0.01μF.

Note that there are no gaps between the colors bands, so 2 identical bands actually appear as a wide band. For example: wide red, yellow means 220nF = 0.22μF.

Figure 1.10 Circuit symbol & examples of the unpolarized capacitor.

Polystyrene Capacitors: This type is rarely used now. Their value (in pF) is normally printed without units. Polystyrene capacitors can be damaged by heat when soldering (it melts the polystyrene!) so you should use a heat sink (such as a crocodile clip). Clip the heat sink to the lead between the capacitor and the joint. Real capacitor values (the E3 and E6 series) you may have noticed that capacitors are not available with every possible value, for example 22μF and 47μF are readily available, but 25μF and 50μF are not! Why is this? Imagine that you decided to make capacitors every 10μF giving 10, 20, 30, 40, 50 and so on. That seems fine, but what happens when you reach 1000? It would be pointless to make 1000, 1010, 1020, 1030 and so on because for these values 10 is a very small difference, too small to be noticeable in most circuits and capacitors cannot be made with that accuracy. To produce a sensible range of capacitor values you need to increase the size of the 'step' as the value increases. The standard capacitor values are based on this idea and they form a series which follows the same pattern for every multiple of ten. The E3 series (3 values for each multiple of ten) 10, 22, 47, then it continues 100, 220, 470, 1000, 2200, 4700, 10000 etc. Notice how the step size increases as the value increases (values roughly double each time).The E6 series (6 values for each multiple of ten) 10, 15, 22, 33, 47, 68, then it continues 100, 150, 220, 330, 470, 680, 1000 etc. Notice how this is the E3 series with an extra value in the gaps. The E3 series is the one most frequently used for capacitors because many types cannot be made with very accurate values.

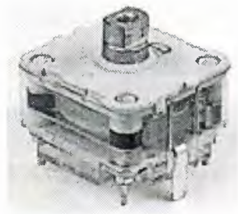
Figure 1.11 Polystyrene capacitor

Variable capacitor: Variable capacitors are mostly used in radio tuning circuits and they are sometimes called 'tuning capacitors'. They have very small capacitance values, typically between 100pF and 500pF (100pF = 0.0001μF). The type illustrated usually has trimmers built in (for making small adjustments - see below) figure1.12 as well as the main variable capacitor. Many variable capacitors have very short spindles which are not suitable for the standard knobs used for variable resistors and rotary switches. It would be wise to check that a suitable knob is available before ordering a variable capacitor. Variable capacitors are not normally used in timing circuits because their capacitance is too small to be practical and the range of values available is very limited. Instead timing circuits use a fixed capacitor and a variable resistor if it is necessary to vary the time period.

Trimmer capacitors: Trimmer capacitors (trimmers) are miniature variable capacitors. They are designed to be mounted directly onto the circuit board and adjusted only when the circuit is built. A small screwdriver or similar tool is required to adjust trimmers. The process of adjusting them requires patience because the presence of your hand and the tool will slightly change the capacitance of the circuit in the region of the trimmer.

Trimmer capacitors are only available with very small capacitances, normally less than 100pF. It is impossible to reduce their capacitance to zero, so they are usually specified by their minimum and maximum values, for example 2-10 pF. Trimmers are the capacitor equivalent of presents which are miniature variable resistors.

Variable Capacitor Symbol



Variable Capacitor

Figure 1.12 Variable capacitors symbol and a variable capacitor.

1.2.2.2 Capacity

This analogy should help you better understand capacity. In the following figure (Figure 1.13), you can see 2 tanks (capacitors) of different diameter (different capacitance). You should readily understand that the larger tank can hold more water (if they're filling to the same level (voltage)). The larger capacitor has more area in which to store water. Just as the larger capacitor's larger plate area would be able to hold more electrons.

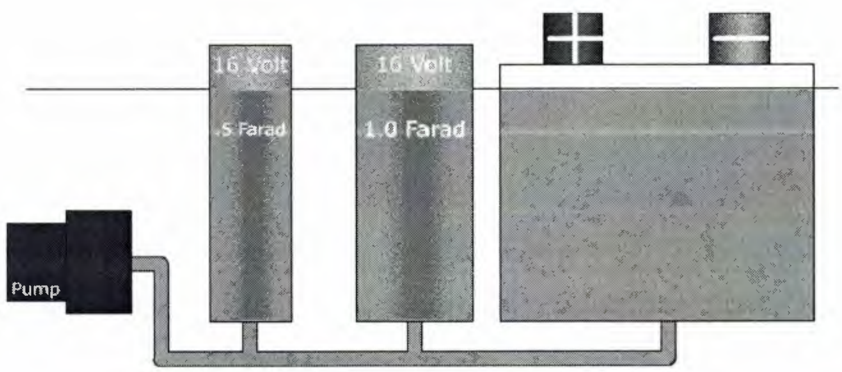


Figure 1.13 Capacities

1.2.2.3 Capacitors and DC voltage

When a DC voltage source is applied to a capacitor there is an initial surge of current, when the voltage across the terminals of the capacitor is equal to the applied voltage, the current flow stops. When the current stops flowing from the power supply to the capacitor, the capacitor is 'charged'. If the DC source is removed from the capacitor, the capacitor will retain a voltage across its terminals (it will remain charged). The capacitor can be discharged by touching the capacitor's external leads together. When using very large capacitors (1/2 farad or more) in your car, the capacitor partially discharges into the amplifier's power supply when the voltage from the alternator or battery starts to fall. Keep in mind that the discharge is only for a fraction of a second. The capacitor can not act like a battery. It only serves to fill in what would otherwise be very small dips in the supply voltage [2].

1.2.2.4 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.

1.2.3 Semiconductor

Semiconductor has a large amount of types. Transistors have three lead-out wires are called the base, emitter and conductor. It is essential that these are connected correctly, as there is no chance of project working if they are not. Fortunately modern transistors are not easily damaged, and incorrect connection is not likely to damage a device (or other components in the circuit) only one type is used in this project.

1.2.3.1 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 of the sandwich are conventionally called the Collector, Base, and Emitter. The reasons for these names will become clear later once we see how the transistor works. As shown in figure 1.14 there are two symbol of type of bipolar transistors.

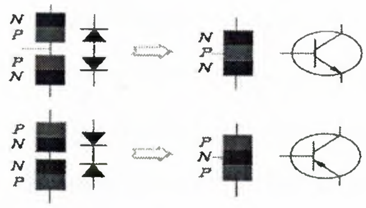


Figure 1.14 Symbol of NPN and PNP transistors.

Some of the basic properties exhibited by a Bipolar Transistor are immediately recognizable as being diode-like. However, when the 'filling' of the sandwich is fairly thin some interesting effects become possible that allow us to use the Transistor as an amplifier or a switch. To see how the Bipolar Transistor works we can concentrate on the NPN variety. Figure 1.15 shows the energy levels in an NPN transistor.

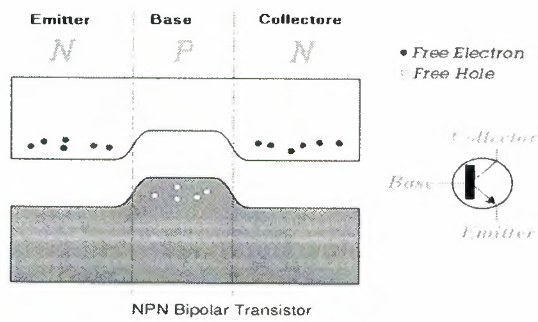


Figure 1.15 The energy levels in an NPN transistor. [2]

Figure 1.15 shows the energy levels in an NPN transistor when we aren't externally applying any voltages. We can see that the arrangement looks like a back-to-back pair of PN Diode junctions with a thin P-type filling between two N-type slices of 'bread'. In each of the N-type layers conduction can take place by the free movement of electrons in the conduction band. In the P-type (filling) layer conduction can take place by the movement of the free holes in the valence band. However, in the absence of any externally applied electric field, we find that depletion zones form at both PN-Junctions, so no charge wants to move from one layer to another.

Consider now what happens when we apply a moderate voltage between the Collector and Base parts of the transistor. The polarity of the applied voltage is chosen to increase the force pulling the N-type electrons and P-type holes apart. (i.e. we make the Collector positive with respect to the Base.) This widens the depletion zone between the Collector and base and so no current will flow. In effect we have reverse-biased the Base-Collector diode junction. The precise value of the Base-Collector voltage we choose doesn't really matter to what happens provided we don't make it too big and blow up the transistor! So for the sake of example we can imagine applying a 10 Volt Base-Collector voltage. Figure 1.16 shows how collector-base voltage is applied. [2]

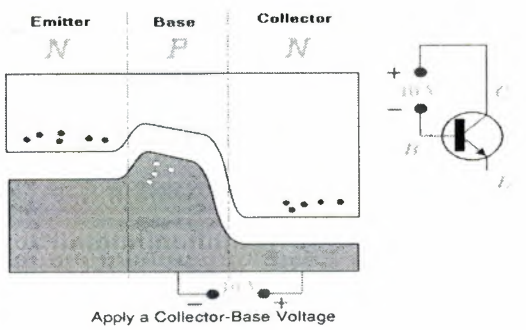


Figure 1.16 Applying collector-base voltage. [2]

1.2.3.2 LM380

The LM380 is a power audio amplifier for consumer applications. In order to hold system cost to a minimum, gain is internally fixed at 34 dB. A unique input stage allows ground referenced input signals. The output automatically self-centers to one-half the supply voltage.

The output is short circuit proof with internal thermal limiting. The package outline is standard dual-in-line. The LM380N uses a copper lead frame. The center three pins on either side comprise a heat sink. This makes the device easy to use in standard PC layouts.

Uses include simple phonograph amplifiers, intercoms, line drivers, teaching machine outputs, alarms, ultrasonic drivers, TV sound systems, AM-FM radio, small servo drivers, power converters, etc. A selected part for more power on higher supply voltages is available as the LM384. The figure 1.10 shows the LM380N construction.

```
        +--()--+
  BYPASS | 1  14| VCC
NON-INV INPUT | 2  13| NC
     GND | 3  12| GND
     GND | 4  11| GND
     GND | 5  10| GND
INVERTING INPUT | 6   9| NC
     GND | 7   8| VOUT
        +------+
```

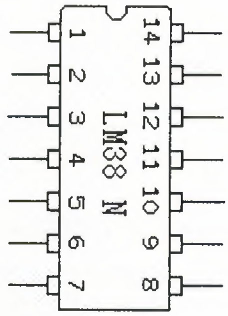


Figure 1.17 The LM380N construction.

1.2.4 Loudspeaker Details

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. Part of the role of a good enclosure is to minimize the impact of this resonant frequency [4].

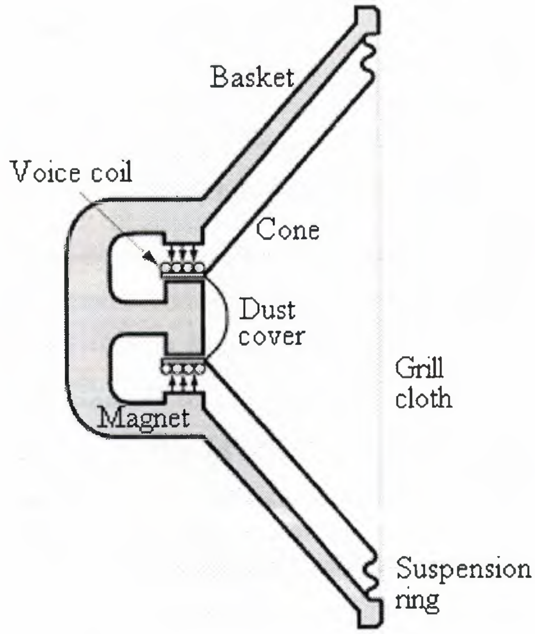


Figure 1.18 Loudspeaker.

1.2.5 Switches

It is not important to use a specific type of switches due to the similarity of creating a circuit. In this section the switch type which is used in the project is described, miniature toggle switch is range of low coast panel mounting miniature toggle switches providing exceptional value available in single pole and double pole options including momentary biased options, as shown in figure 1.19.

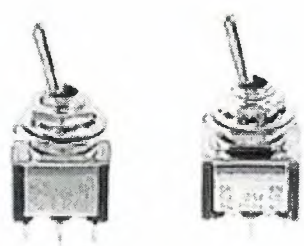


Figure 1.19 Miniature toggle switches.

- Contact rating: 6A, 125V, 3A 250V AC.
- Initial contact resistance: <20mΩ.
- Insulation resistance: >100mΩ at 500V DC.
- Contact material: copper alloy with silver inlay silver plated.

- Body material: flame retardant alkyd.
- Electrical life: > 1 x 104 cycles at full load (min.).
- Operating temperature -20°C to +65°C.
- For biased switches (on) indicates momentary action [5].

1.2.6 Ferrite Aerial

The radio receiver in this project uses a medium-wave ferrite aerial, and a suitable type is MW5FR.like all ferrite aerials, this consists of a coil of wire on a piece of ferrite. In the case of the MW5FR the piece of ferrite is a rod measuring about 172mm x 9.5 mm and there are two coils of wire on a paper former which is slipped onto the rod. The two coils are a large (tuned) winding and a smaller (coupling) winding. They are wound using wires of different colors so that it is easy to determine which lead-outs come from which windings. The coils are wound using lids wire (a number of thin enameled copper wire twisted together and given an overall layer of insulation as well), and the ends of the lead-out wires are ready-tinned with solder so that they should fit into the breadboard without too much difficulty.

It is not essential to use MW5FR aerial, and the circuits have been also tested using an MWC2 aerial coil on a 140 mm x 9.5 mm ferrite rod. However, this aerial coil has tag connections rather than lead-out wires, the leads must either be soldered to the tags or connecting using small crocodile clips. The circuits should work properly using any other standard medium-wave ferrite aerial provided the coil has the small coupling windings (figure 1.20) [10].

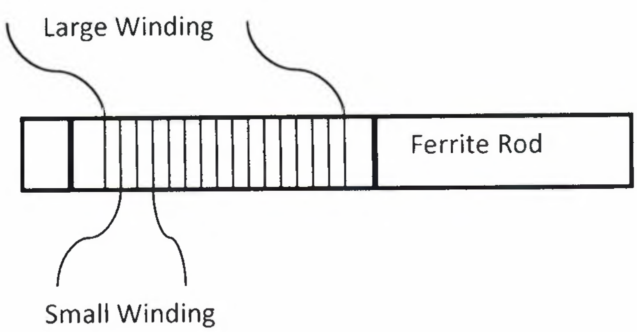


Figure 1.20 Ferrite aerial.

1.3 Safety

In this project, low voltage applications are used. Thus, safety guidelines are not in concern of human safety but in components safety, although we cannot avoid the technical mistakes witch can occur during connecting parts and soldering them to the circuit, so we have to be careful from current and heat.

- One of the components which are used in this circuit is the chemical capacitor, this element has two poles and when connected to the circuit we have to care about its polarity so as to avoid damaging it.

- One other component is the I.C., which is so sensitive, so while connecting its pins to the circuit they have to be attached in accordance with the manufacturing instructions layouts in order to keeping it working properly and without damaging it.

- Another component used in this circuit is loudspeaker, which has to be chosen suitable to the out put signal so as not to destroy diaphragm.

- While connecting the circuit components to the power supply we have to be aware of misconnecting its polarity to assure the safety of used components.

- While the circuit is on, avoid touching the sensitive components like the transistor, diodes and I.C. to avoid interfering with the out put signal.

- While soldering the parts to the circuit we have to be careful so as not to burn the parts which are sensitive and can be harmed by heat.

1.4 Summary

This chapter presented an introduction to electronic components that are commonly used in hardware projects and how they function, how they must be connected. By applying the safety guidelines, the circuit should work smoothly.

In the next chapter, frequencies of transmitting radio waves and other used frequencies will be presented.

CHAPTER TWO

RADIO WAVE PROPAGATION AND ITS FREQUENCIES

2.1 Overview

This chapter presents the propagation of radio waves and the affect of atmosphere layers on it, how a radio wave travels and the types of propagation. As this chapter presents classifications of frequencies which are used in radio and other purposes, and describe of course MW and VHW transmission, differences and application is also will be mentioned.

2.2 Introduction

Radio waves have the longest wavelengths in the electromagnetic spectrum. These waves can be longer than a football field or as short as a football. Radio waves do more than just bring music to your radio. They also carry signals for your television and cellular phones.

Electromagnetic waves are formed when an electric field couples with a magnetic field. Magnetic and electric fields of an electromagnetic wave are perpendicular to each other and to the direction of the wave.

2.3 Waves and the electromagnetic spectrum

We do not know exactly what really electromagnetic waves are, excepting that they look sometimes like waves, sometimes like particles (quanta) shown (figure 2.1). The simplest representation of a wave is a three dimensional structure made of an electric and a magnetic field crossed-polarized in both vertical and horizontal planes. Its energy is moving back and forth from one field to the other; this phenomenon is known as oscillation. If the signal is omni directional, this complex field evolves evenly into space like waves that we observe on the water surface or still better, like a sphere that gradually become more a larger. If the signal is directional the sphere becomes a cardiod more or less extended in the propagation direction.

Radio waves are a form of electromagnetic radiation sensible to charged particles like free electrons. In free space they travel in straight line (in fact following geodesics) at the velocity of light (300000 km/s) and reduce a bit in denser medium. Their intensity is defined in volts per meter (practically in $\mu V/m$); in effective or peak values like AC current or by reference to the signal strength expressed in dB another dBW unit.

The wavelength is defined as the distance between two points of equal phase or period taken as unit of time measurement. It is also defined as the ratio between the velocities of the wave to the current field frequency (f). For a free space wave the wave length is λ

$$\lambda(m) = \frac{300}{f(MHZ)} \tag{2.1}$$

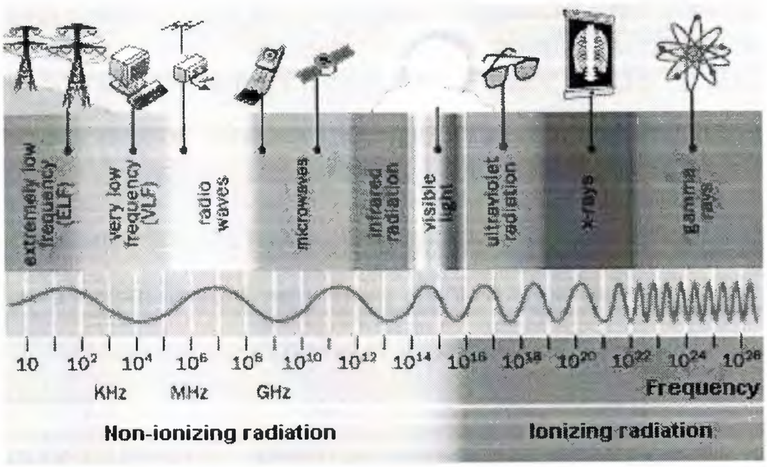


Figure 2.1 The electromagnetic spectrum [10]

2.4 How a radio wave travels

All radio signals will have their own coverage area. The coverage area of a radio transmitter will depend on several things like how much power is being transmitted from the antenna, and the terrain around the transmitter - hilly or mountainous ground will restrict signals coverage. Within the coverage area, the signal will be strong and easy to receive. Moving further away from the transmitter will result in the signal getting weaker and reception is degraded. On a stereo FM station for instance the signal will become noisy. On a television picture there will be a snowy appearance and perhaps a loss of color.

The weather can play a big part in reception. Yet even an object as far away as the sun, over 93 million miles away from the earth, can affect the way radio signals behave.

Signals can travel further over sea paths and this is why people at coastal locations may be able to receive radio or TV stations from nearby countries. Even the trails of meteors in the night sky are able to bounce radio signals way beyond their normal coverage area.

2.5 Radio Frequencies

Radio frequencies are ranging from a few hertz, wavelengths of several thousands of km from peak-to-peak for brain waves, subsonic and oscillating at less than one cycle per second, to several thousands of gigahertz, wavelengths of a few mm from peak-to-peak for microwaves. Above we enter in the world of light (IR, visible, UV, X-ray and gamma).

This spectrum is divided in octaves, the natural way to represent frequencies. An octave represents eight diatonic degrees or a gradual frequency increasing of a 10-factor. Humans can hear sounds (vibrations) between 20 Hz and 20 kHz, a range of 3 octaves. Their wavelengths are ranging between 1500 and 15 km. The electromagnetic spectrum is also arbitrary divided into "bands". Each band extends over 3 octaves or so, the energy level increasing of about 10 times between the beginning and the end of the band. Natural radiation becomes a health hazard only from the UV light and above frequencies, even though, because all depends on the duration of exposure to the radiation, the distance to the source, and its intensity.

ELF is only used by some submarines and to carry AC over power lines. Otherwise, its main use is of course to carry the sound of low and mid frequencies as well infrasonic vibrations (animals).

VLF is also the carrier of sound up to about 20 kHz. This band is also used for long distance communications (few thousands km) and experimentation by scientists and the Navy.

LF is mainly used for regional broadcasting purposes while MF is used for worldwide broadcasting. HF are of our concern, these are formerly frequencies ranging from 1.8 to 30 MHz (160-10 m bands). Know as "short waves", these bands are very appreciated by all radio services and operators as they allow long distance communications, broadcasting and trans horizon radar operations.

VHF and **UHF** begin at 30 MHz (10 m) to end well above 1 GHz and are mainly used for radio and TV broadcasting as well as mobile communications over short distances (a few hundreds km) and more recently by cell phones.

Above these frequencies we find cent metric and mill metric waves, the famous microwaves. We know them essentially through home devices like microwave ovens (Short or S-band), wireless LAN (compromise or C-band), and some satellite and radar transmissions (Kurtz or K-bands). Then close your ears and open your eyes, you enter in the near infrared and visible parts of the spectrum! Over it, wear your anti UV-glasses to protect you against ultraviolet radiations. At last take your lead protection, we enter the world of X and γ rays.

Most services work in the lower bands of the electromagnetic spectrum, the only one frequency able to transport information on long distances with a very simple technology and low energy.

Each band requests special receivers and aerials according to the frequency used and the type of waves (ground, space, ionosphere, etc). However these waves are affected by the medium in which they propagate its electronic density and its dielectric constant.

2.5.1 MF Medium Frequencies

This segment of spectrum is between 300-3000 KHz. Within this segment there is Medium Wave radio broadcasting band which is between 520-1610 KHz.

Channel spacing is 9 kHz for Continental Europe and the Middle East and 10 kHz for north and South America. MW is quite different than LW as to reflection effect of ionosphere; half of MW frequencies below 1000 kHz are almost similar to LW frequencies; however frequencies above 1000 kHz are almost similar to short wave frequencies in the high frequency segment of the frequency spectrum. Especially at night, MW frequencies maybe reflected from the ionosphere and may reach to far distances. For instance many Middle Eastern MW transmitters can be received in Turkey while Turkish MW transmitters can be received at far distances such as Cairo. This characteristic requires that MW frequencies are not purely domestic frequencies and they have to be regionally planned. Such plans must be realized with close relationship of neighboring countries. In the history of MW broadcasting there had been many instances of tense relationships between the countries with hostile positions.

Due to the ionospheric reflection possibilities of MW frequencies, MW is a band not only for domestic radio broadcast but also for international radio broadcast. This may easily be seen in the relays that carry a program of a far distanced transmitter. VOA (Voice of America has MW relays in Rhodes while BBC has in Southern Cyprus (1323 KHz. Radio Monte Carlo (relays also Trans World Radio program) has a MW relay in Southern Cyprus (1233 KHz). Lower and upper ends of MW band are allocated for navigation finding and wireless communication. 2182 KHz.

2.5.2 VHF Very High Frequencies

They range between 30- 300 MHz. Within this segment of the spectrum there exist FM radio broadcast band between 88 and 108 MHz. FM radio band is usually for local radio broadcasters since the electromagnetic waves on this band can only travel on the surface up to 100 Km. if there are no physical obstacles such as mountains. Relay (repeaters) stations must be used if a larger geographic area is to be covered in FM band. FM band is very suitable for music broadcasting because it has a wider audio bandwidth nearly enough for Hi-Fi music reproduction. Additionally in FM band stereo broadcasting is also possible and this is vital for good quality music reproduction in the receiver. TV Band I, S- Band (for cable-TV) and TV Band III are also in VHF segment of the spectrum. Other portions of the segment are used for several telecommunication services [10]. (figure 2.2).

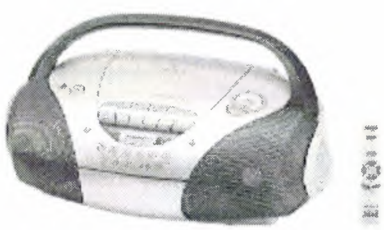


Figure 2.2 Radio

Table 2.1 Radio bands [10]

Band	Abbreviation	Frequency	Wavelength	Energy
X-rays	X-rays	30.3 PHz - 3 EHz	10 - 0.1 nm	125 - 12.5 keV
Extreme ultraviolet	EUV	4.5 - 30.3 PHz	70 - 10 nm	18 - 125 eV
Visible (red - violet)	....	398 - 750 THz	800 - 400 nm	1.6 - 3.1 eV
Super High Frequency,	SHF	3 - 30 GHz	10 - 1 cm	13 - 132 μeV
Ultra High Frequency	UHF	300 MHz - 3 GHz	100 - 10 cm	1.1 - 13 μeV
Very High Frequency	VHF	30 - 300 MHz	10 - 1 m	132 neV - 1.1 μeV
High Frequency	HF	3 - 30 MHz	100 - 10 m	13 - 132 neV
Medium Frequency	MF	300 kHz - 3 MHz	1000 - 100 m	1.3 - 13 neV
Low Frequency	LF	30 - 300 kHz	10 - 1 km	120 peV - 1.3 neV
Very Low Frequency	VLF	3 - 30 kHz	100 - 10 km	13 - 120 peV
Extreme Low Frequency	ELF	30 Hz - 3 kHz	10000 - 100 km	125 - 13 peV

2.6 Propagation of waves

Propagation is defined as the travel of waves through or along a medium. In practice this medium is the earth's atmosphere which is divided up into layers those of main importance being the Troposphere and the ionosphere.

The success or the failure of a radio transmission depends on the way that radio signals travel around the earth. Basically there are five types of propagation:

1. **Ground waves**: Also called evanescent or surface waves, these waves propagate along the earth surface, close to the ground, and never reach the ionosphere. Typically signals carried by ground waves can be heard up to a distance of 160 km or more during the daytime. They are however subject to a high attenuation throughout HF bands to reach distances less than 15 km at 30 MHz.. Therefore these surface waves are mainly used at low frequencies below 1.8 MHz (MW, LW and VLF) by geophysicists and the U.S Navy (submarines).
2. **Tropospheric waves:** Below 10 km or so of the atmosphere, where weather patterns and temperature inversions form, VHF can be refracted permitting short distances contact (a few thousands km). This activity will be shortly discussed as well as the atmospheric ducting, also induced by temperature inversions.
3. **Space waves:** These waves travel directly from an antenna to another without reflection on the ground. This phenomenon occurs when both antennas are within line of sight of each another. This distance is longer that the line of sight because most space waves bend near the ground and follows practically a curved path. In the field we must also add the effects of the atmospheric refraction and diffraction near the earth surface that extend this distance of about 20% in the lowest bands. On V/UHF on the contrary diffraction is very small and signals tend to drop off quite rapidly at a shorter distance. In this way of propagation antennas must display a very low angle of emission in order that all the power is radiated in direction of the horizon instead of escaping in the sky. A high gain and horizontally polarized antenna is thus highly recommended.
4. **Sky waves:** They essentially concern frequencies below 30 MHz (longer than 10 meters) and V/UHF in a less extent that are able to escape into free space (that begins over 800 km aloft). Called sky waves these waves are however stopped in their travel by the ionospheric layers and, under low incidence angles, they are reflected to the ground. These waves are then called ionospheric waves. They are very influenced by the presence of electrons gas and plasma in the upper atmosphere of the Earth. Under certain conditions these layers reflect or refract

short waves, permitting amateurs to reach stations located on the other side of the Earth in a succession of jumps between the ground and the ionosphere, called multihops. We will develop this subject in depth on the next page as they are the most used by radio amateurs. In another article we will deal about perturbations affecting sky waves propagation in the ionosphere.

5. **Free space waves:** They are the most common but the less used! We encounter them working in VHF or UHF where, due to their very high frequency, at incidence angles higher that the critical angle, short waves escape into space instead of be reflected by ionospheric layers.

If waves travel in straight line and at the velocity of light in free space, on Earth, the ground, the air and the ionosphere affect wave propagation; radio waves do no more travel from one point to another in straight line and their signals are often altered. Radio waves are mainly subject to four effects and they are Attenuation, Reflection, Refraction and Diffraction (figure 2.3).

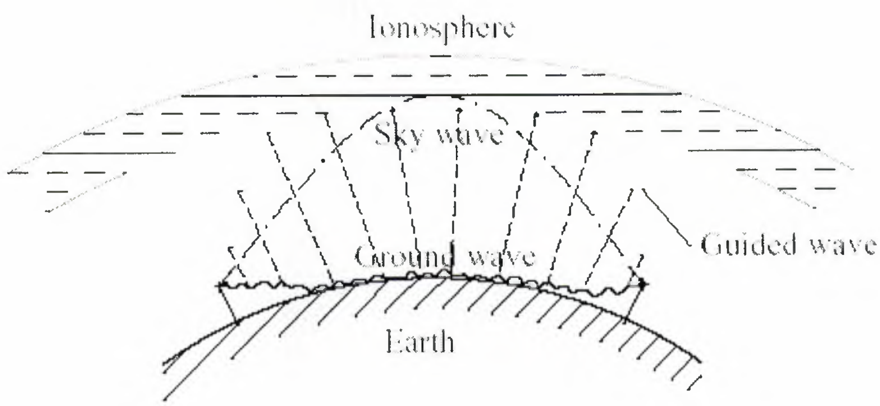


Figure 2.3 Wave propagation [11]

2.7 Modulation

The important thing in any communications system is to be able to send information from one place to another. This means we have to find a way to impress that information on the radio wave in such a way that it can be recovered at the other end. This process is known as modulation. In order to modulate a radio wave, we have to change either or both of the two basic characteristics of the wave: the amplitude or the frequency.

2.7.1 Amplitude Modulation (AM)

If we change the amplitude, or strength, of the signal in a way corresponding to the information we are trying to send, we are using amplitude modulation, or AM. The earliest means of radio communications was by Morse code, and the code key would turn the transmitter on and off. The amplitude went from nothing to full power whenever the key was pressed, a basic form of AM. Modern AM transmitters vary the signal level smoothly in direct proportion to the sound they are transmitting. Positive peaks of the sound produce maximum radio energy, and negative peaks of the sound produce minimum energy. The main disadvantage of AM is that most natural and man made radio noise is AM in nature, and AM receivers have no means of rejecting that noise. Also, weak signals are (because of their lower amplitude) quieter than strong ones, which requires the receiver to have circuits to compensate for the signal level differences (figure 2.4).

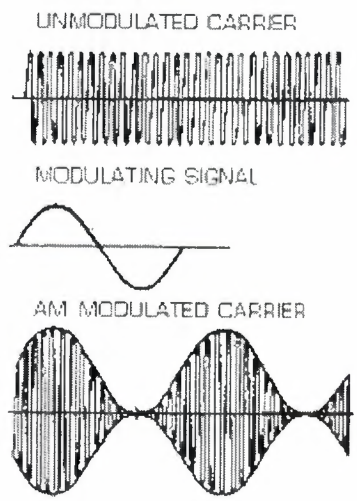


Figure 2.4 Amplitude Modulation

2.7.2 Frequency Modulation (FM)

In an attempt to overcome these problems, a man named Edwin H. Armstrong invented a system that would overcome the difficulties of amplitude noise. Instead of modulating the strength (or amplitude) of the transmitted signal, or carrier, he modulated the frequency. Though many engineers at that time said that FM was not practical, Armstrong proved them all wrong, and FM today is the mainstay of the broadcast radio services. In a frequency modulated system, the frequency of the carrier is varied according to the modulating signal. For example, positive peaks would produce a higher frequency, while negative peaks would produce a lower frequency. At the receiving end, a limiting circuit removes all amplitude variations from the signal, and a discriminator circuit converts the frequency variations back to the original signal. In this way, the effects of amplitude noise are minimized. Since the recovered audio is dependent only on the frequency, and not the strength, no compensation for different signal levels is required, as is the case with AM receivers (figure 2.5)

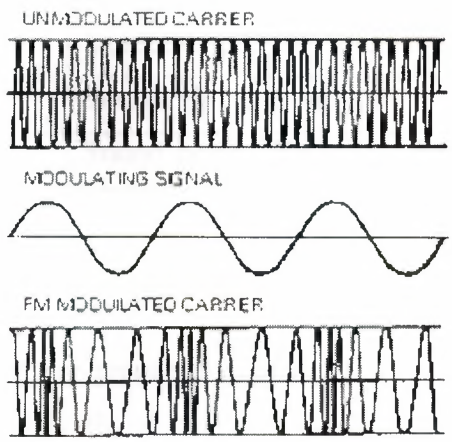


Figure 2.5 Frequency Modulation [12]

2.8 Application

Each band of frequency has its own applications which are used in our life, these application are shown in table 2.2.

Table 2.2: Bands and its applications [10]

Band	Applications
X-rays	X-ray machines, sun flare
Extreme ultraviolet	UV, ionosphere ionization
Visible (red - violet)	Visible spectrum, light
Super High Frequency,	Microwaves, satellite
Ultra High Frequency	Microwaves, GSM
Very High Frequency	FM Radio, Television channels
High Frequency	SW Radio, Emergency services radio
Medium Frequency	AM Radio
Low Frequency	Beacons, AM, LW Radio
Very Low Frequency	Sound, Navy, geophysics
Extreme Low Frequency	Sound, power, Navy

2.9 Summary

This chapter presented the propagation of radio waves, how a radio wave travels, the types of propagation and kinds of modulations. It also presented classifications of frequencies which are used in radio and other purposes.

CHAPTER THREE
HARDWARE APPROACH

3.1 Overview

This chapter presents the components used in the circuit and the circuit diagram. The operation of each part of the circuit will be described.

3.2 Radio Circuit

AM radio circuit

This circuit for AM radio which is shown below in figure 3.1 was the first design but there were too many problems that could not be fixed. As a result, a second design was implemented which is shown in figure 3.2

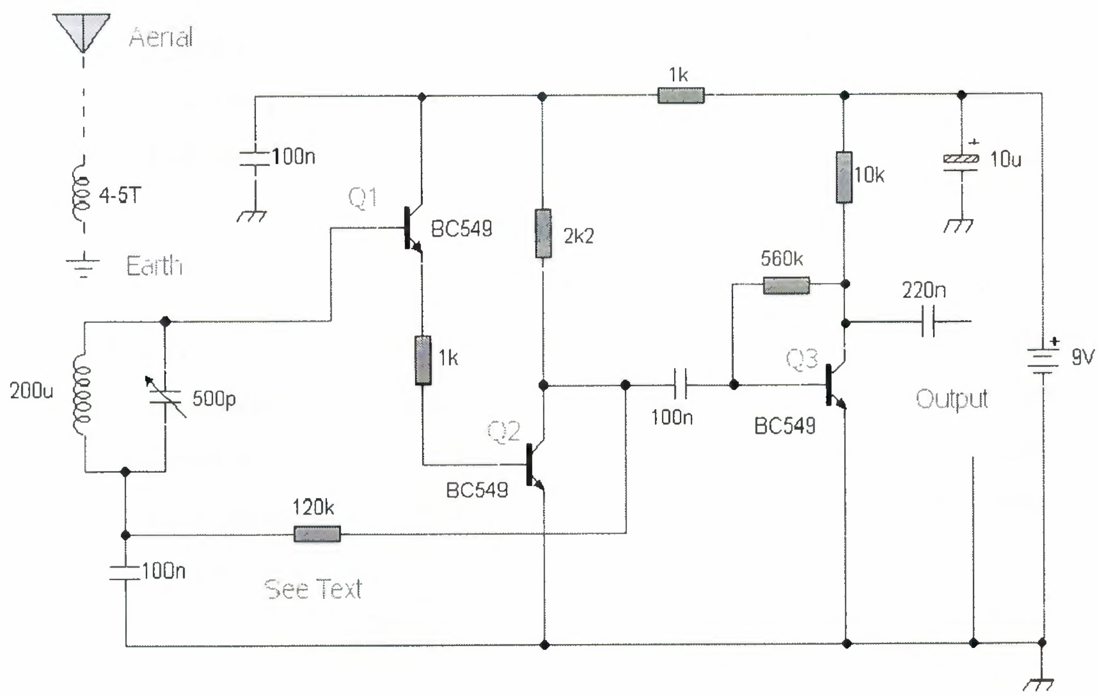


Figure 3.1 Circuit diagram of AM radio

The circuit as shown in figure 3.2 is a bit complicated and it is difficult to understand the function of each component, so it is better to separate the circuit into two sides, each side has specific job to do, oscillating side and amplifying one.

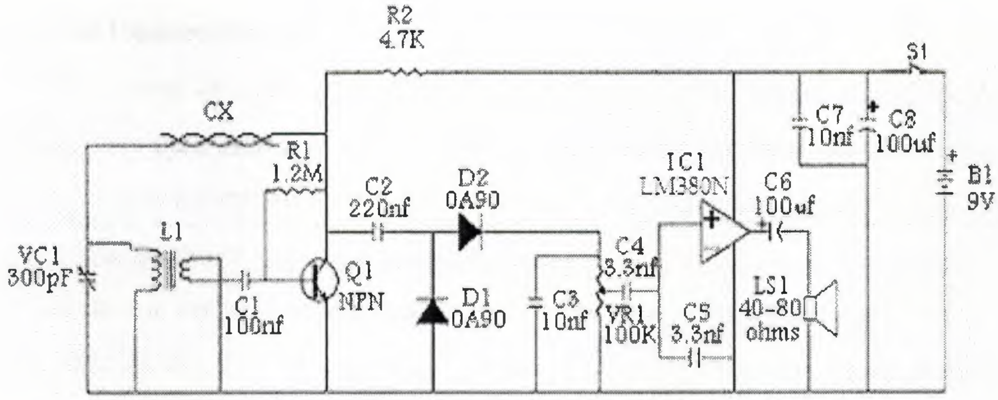


Figure 3.2 Circuit diagram of MW radio.

3.3.1 Oscillating Part

The oscillating part as shown in figure 3.3 is quit smoother than it was shown above. Here the connection between variable capacitor (VC 1) and the ferrite aerial (L1) is the receiving part of the radio, the ferrite aerial is the component which converts the radio waves into electrical signals, but it is convert all waves in the MW transmission frequencies, so the connection between it and VC1 is introduced to pass the desired frequency. But how is that happens?

$$f_0 = \frac{1}{CLW} \tag{3.1}$$

The above equation gives the output of a capacitor and inductor connected in parallel, this frequency is called resonance frequency. And when the resonance frequency equal to transmission frequency, the transmitter radio signal enter to the circuit as electrical signal and passed into the circuit through the LC connection.

After the desired signal enters through the parallel connection between VC 1 and L1, the signal reaches C1, which is used to filter any DC voltage carried with desired signal, which is an AC type.

After the signal has been filtered out from any undesired DC voltage it is ready to enter the phase of pre-amplifying process. This process is performed by the NPN transistor and R1 which is used as feedback path, it is know in general that the larger the feedback resistance the better the amplifying process, but this rule has a limit, and for this transistor, the value of R1 is the best value can be used.

Again after the desired signal has a DC voltage supplied by the battery, so another capacitor (C2) is used to prevent this DC voltage from continuing its way up to the next part of the circuit (it is know that a DC voltage will act as a noise or unwanted signal in the loudspeaker).

D1 is used to cancel the negative part of the desired signal as the loudspeaker use the positive part. And that happens because the anode is connected to the ground, so the D1 is not in the forward bias until the cathode becomes more negative than zero, and that means the negative side of the desired signal.

D2 has a minor role compared to D1; its role is to cancel the residue of the negative side of the desired signal, as D1 allow a small value of negative side of the desired signal to reach D2. That happens due to the triggering voltage which is needed to change the statues of D1 from isolator to conductor, and this voltage depends on the type of the diode, so if the diode is made of silicon, this needed voltage equal to -0.7V, and Wit is made of germanium -0.3V is the needed voltage to trigger D1.

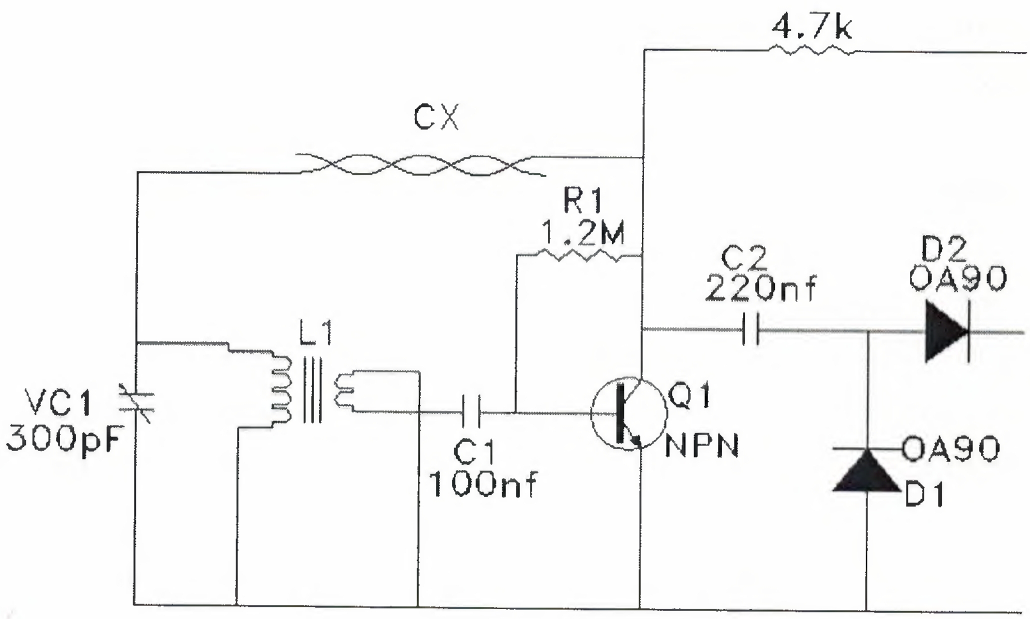


Figure 3.3 Oscillating part diagram of MW radio.

3.3.2 Amplifying part

After the desired signal is cleanly out of the huge number transmission frequencies, and prepared to be amplified by filtering any DC voltage from it, it is almost ready to enter to the amplifying phase (figure3.3).

This extremely simple circuit provides an output of power of about 200 mW RMS (about equal in volume to a small or medium-size transistor radio) and has an input sensitivity of about 50 mV RMS into 100 kΩ for maximum output. This enables the unit to be fed from a variety of signal sources, such as a crystal or ceramic pickup, radio tuner, etc.

The circuit is primarily intended as a simple one to demonstrate the properties of the LM386N audio-power amplifier device, and it makes a very useful and inexpensive workshop amplifier if the circuit is built as a proper, cased project.

When a capacitor is connected between the earth and the path of any signal, it allows a certain band of frequency to pass through (it acts like a band pass filter), so to make sure that no any other radio waves entered to the circuit, C3 is used to let only the desired signal to pass, the values of the capacitance and the impedance of C3 control the range of allowed frequencies to pass, in MW it allows frequencies up to 3000 kHz.VRl is the volume control resistance; by tuning it we can control the input signal going to IC (LM380N) and coming in from the radio circuit and which has been filtered by the C3 capacitor which is connected parallel with VR1.

As a final assurance of eliminating any DC voltage C4 is used, so that almost pure AC will enter to the amplifier from pin-2 (the non inverting input pin).

C5 has not a vital role in filtering process, but it is important for LM380N's gain value determining, actually the gain of this amplifier varies as the value of C5 change, the gain range is from 34 dB to 40 dB.

IC1 has an internal bias circuit that gives a quiescent output voltage at the output terminal (pin 8) of nominally half the supply voltage, the AC input signal causes the output to swing positive and negative of this quiescent level by about plus and minus 3 volts or so, and this enables a reasonably high output power to be obtained without the output going fully positive or fully negative, and serious distortion being caused by clipping of the output waveform.

If a DC component on the input signal was allowed to reach the input of IC 1 this would alter the quiescent output voltage of IC 1, and could result in the output going almost fully positive or negative. Only a very small output power would then be possible without the signal becoming badly distorted.

C6 provides DC blocking at the output so that loudspeaker only receives the varying output voltage from IC 1, and not the quiescent (DC) output voltage, which would Give a high standing current through the loudspeaker produce a very high level of current consumption.

The LM380N has a class AB output stage, and this means that the average current consumption of the device (which is around 10 mA) remains virtually constant at low and medium output powers, but increases somewhat at high output powers. This gives reasonable battery economy, and a PP6 or larger 9-volt battery makes a suitable power source. There is some variation in the supply voltage due to variations in the loading on the battery by IC 1 as the output power inevitably fluctuates quite rapidly and over a fairly wide range with any practical input signal This can result in a loss of performance or instability, and decoupling capacitors C7 and C8 are included to prevent either of these occurring.

As finally the C7 and C8 are connected in parallel with battery to cancel any AC signal coming from it.

An additional decoupling capacitor can be added from pin 1 of IC 1 to the negative supply, and this decouples the supply to the preamplifier stages of the device.

This is not normally necessary when the LM380N is employed with a battery supply, and is a facility give a high standing current through the loudspeaker produce a very high level of current consumption.

An additional decoupling capacitor can be added from pin 1 of 10 to the negative supply, and this decouples the supply to the preamplifier stages of the device.

This is not normally necessary when the LM380N is employed with a battery supply, and is a facility that is normally only required when the device is used with a mains power supply that has high ripple content. One lead to IC1 in Figure 3.3 is marked "3, 4, 5, 7, 10, 11, and 12". This lead is marked with six pin numbers merely because these six pins are internally interconnected, and a connection to one of them is a connection to the other five.

The case should ideally be an all-metal type so that it screens the Circuitry from stray pick-up of mains hum and similar electrical signals, and the case should be earthed to the negative supply. With most types of audio socket, this chassis connection will be automatically provided through the earth lead to the socket. The test leads should use screened cable (the outer braiding connecting to the chassis of the amplifier).

An interesting feature of the LM380N device is that it has two inputs, pin 2 is the non-inverting input and pm 6 is the Inverting input. An input signal to pin 6 produces a change in output voltage that is of the opposite polarity, whereas an input to pin 2 gives a change in output voltage that is of the same polarity as the input signal.

There is no audible difference between the two, and the fact that the signal is inverted through IC 1 if the input at pin 6 is used is not really of any practical importance. The circuit works equally well whichever of the two inputs is used and this fact can easily be demonstrated in practice.

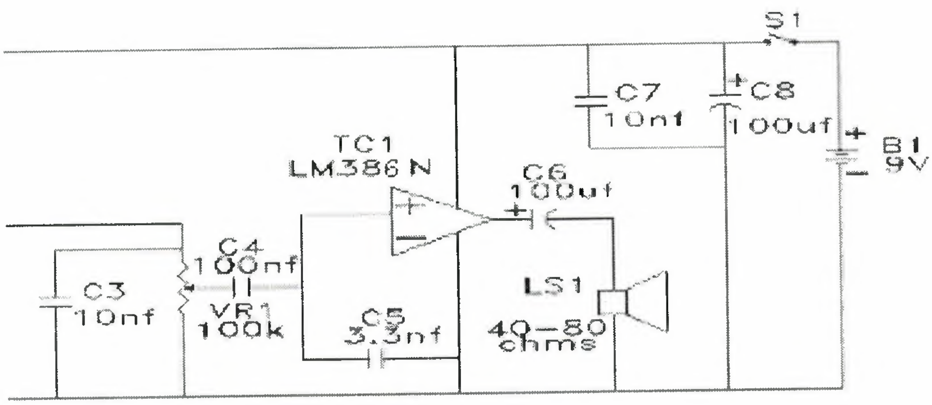


Figure 3.3 Amplifying part diagram of MW radio

3.3 Project's Components' List

In chapter one, a description of the components and the practical use of each one were given, but in this section, the value and type of each component, see table 3.1.

Table 3.1 Components' list

Symbol of the component	Value and description
R1	1.2M
R2	4.7k
VR1	100k log. carbon
C1	100nF, polyester
C2	220nF, polyester
C3	10nF, polyester
C4	100nF, polyester
C5	3.3nF, ceramic
C6	100μF, 10V electrolytic
C7	10nF, polyester
C8	100μF,10 electrolytic
VC1	300pF solid dielectric
TR1	BC101C
IC1	LM386N
D1	OA90
D2	OA90
S1	SPST miniature toggle type
LS1	Miniature type having an impedance in the range 40-80 ohms
L1	Ferrite aerial
B1	PP6 size 9V and connector to suit

3.4 Summary

This chapter has presented the components of the radio and amplifier circuit and the function of each component, and how does it contribute in the process of filtering and amplifying, it is possible to connect the circuit and have MW radio circuit as shown in figure 3.4.

But it is not guaranteed 100 % to work properly using exactly the theoretical way of connection as described, because practical work has very different circumstances than theoretical one, and so many problems may occur. Chapter four will discuss the most problems probable to happen and it presents some suggested solution

CHAPTER FOUR
PROBLEMS & SOLUTIONS

4.1 Overview

In this chapter we will illustrate the problems that we have faced in this project and solutions we used the radio should work properly now, and the results for this will be shown in the next chapter. As we know; in practical electronic hardware projects there will always be problems and probable solutions.

4.2 Variable Capacitor

Again the problem was how to determine which two of the three lead-out pins will be connected, variable capacitors designed to be facilitated in two ways, first it can be used as fixed value capacitor (normal capacitor), it will be in the maximum value of possible capacitance for this capacitor, and the other way, it can be used as variable one, but how to make it function in the way needed?

As shown in figure 4.1 which shows variable capacitor from below, if pin A or pin B are connected to the source voltage (or positive side) and pin C connected to earth, the capacitor will act as variable capacitor, you cannot connect A and B to the same side in the same time, some variable capacitors have bigger number of pins with ranges of the capacity, to make sure which pair of pins with correct capacity value sought you can use trial and error by using an ammeter. The biggest the value; the bigger collection of radio channel you will find.

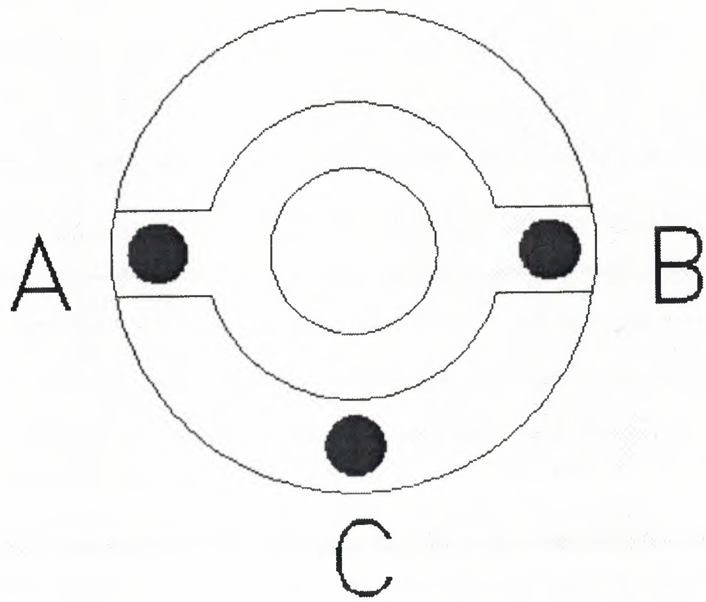


Figure 4.1 Below view of variable capacitor.

4.3 Polarized Capacitors

Here, the problem while setting up the circuit is how to determine the positive and negative sides of the polarized capacitor. Polarized capacitors usually have a marker which indicates the polarity, but if there is no marker, how polarity can be decided? Unfortunately, it is not possible by using ammeter or any other measuring instrument. So the solution is to observe the two lead-out pins, as it is shown in figure 4.2 it is clear that there is one pins is shorter than the other, shorter one is the negative one and the longer is the positive, and usually a dark line is placed a side of the negative pin.

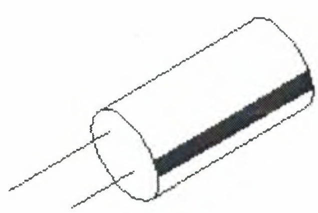


Figure 4.2 Polarized capacitor

4.4 Ferrite Aerial

Ferrite aerial has four lead-out wires, actually it consists of two windings, large and small one, it is quite hard to decide which of them is connected to the other because of the aerial delicate manufacturing, to determine which wires are connected to each other, ammeter is used and adjusted to measure the existence of a connection by put the function controller to diode position, if the ammeter shows any value, that means the two tested wires are the two ends of same winding, if the ammeter shows nothing that means it is time to test another wire. By using the ohmmeter we test two wires out of four, in case of reading the smallest value it shows the small winding, in case of reading the biggest value it shows the large winding.

Usually red and green colored wires are the two ends of the small winding, and skin and black colored wires are the two ends of the large winding (figure 4.3).

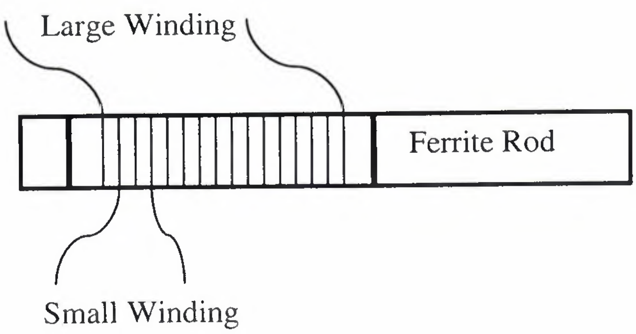


Figure 4.3 Ferrite aerial.

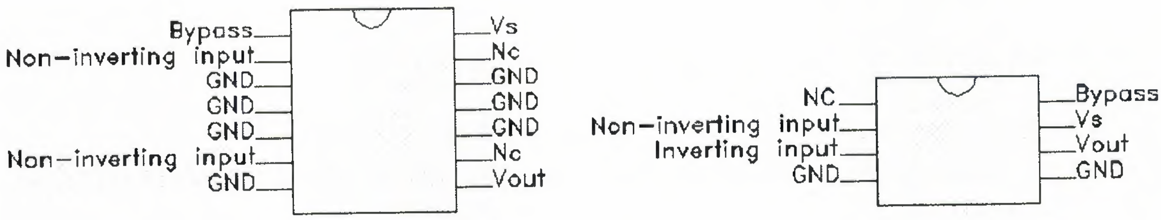
4.5 LM380N

LM380N is an ordinary operational amplifier I.C. so it is not a big deal to know how to connect it, but what if the required LM380N 14-pins are not available.

The alternative chip is LM380N 8-pins can be used instead, but a new connection method is applied, to know better about what each pin in the 14-pins and 8-pin represent (figure 4.4)

Each pin represents a specific job, so if the 14-pins chip connection is reconnected to 8-pins chip by the right configuration, the same job well be done.

But, what if there is no chip LM380N at all? The solution of this problem is to build a circuit that will do the function of this chip; the circuit diagram is shown in figure 4.5.



LM380n 14-pins

LM380N 8-pins

Figure 4.4 Detailed lead-out pins of LM380N 14-pins and LM380N 8-pins.

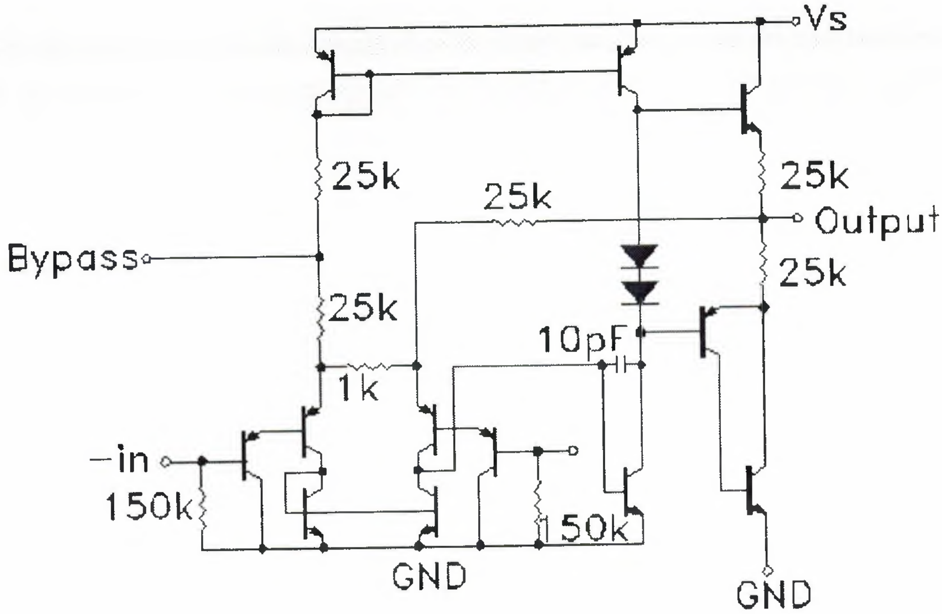


Figure 4.5 Circuit diagram of LM380N chip.

4.6 LM386

Another solution for amplifying problem, if again the amplifying solutions which given above do not work, LM386 comes as a suitable alternative for the LM38ON chip (figure 4.6)

It is an 8-pins chip with the same gain but less input impedance value, so a change in the variable resistance must take place, and the best available variable resistance in stocks is lOkohms variable resistance. And also LM386 must have low output impedance, so it is advised if LM386 is installed to the circuit to connect 4 ohms impedance loudspeaker rather than 80 ohms.

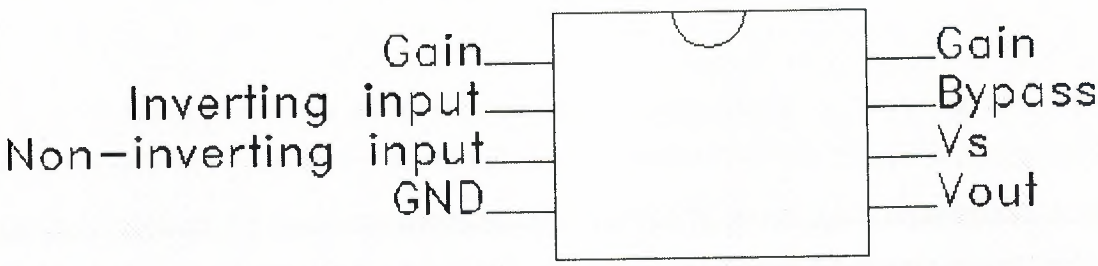


Figure 4.6 LM 386 chip diagram.

4.7 Diodes

In the radio circuit the given diodes values are not available in the market, by searching in the references we founded other values of the diodes that can come instead of the diodes mentioned in the circuit.

4.8 Variable resistance

In the radio circuit the given variable resistance is also not available; we replaced it by 20kohms variable resistance and connected to it series 80kohms constant resistance.

4.9 Loud speaker

The required loud speaker in the radio circuit was 40-80ohms; we replaced another loud speaker with 4-8ohms and connected to it series of constant resistance have value of 70ohms.

4.10 Summary

In this chapter we have illustrated the problems that we faced in this project and the practical solutions we used, the radio should work properly now, and the results for this will be shown in the next chapter which will be fully as a conclusion for the whole work.

CONCLUSION

After a great deal of working over this experiment of preparing this project theoretically and practically; we found out how much knowledge we gained and how much techniques we learnt in receiving, filtering and amplifying the input signal in MW radio, and how to manage to have alternatives for not available components, how to enhance filtering process, to understand amplifying one.

This project consists of four chapters; each chapter presented a specific aspect of MW radio subject as a working principle, components which the radio circuit consists of and more.

Chapter one presented sought components in details, how they function and how they must be connected. Also safety guidelines for electronics projects mentioned to prevent possible mistakes that may damage the circuit.

Chapter two presented the techniques of transmission and propagations, the frequencies which are used as channels to transmit information as radio waves in specific and electromagnetic waves in general.

Chapter three was the most important chapter of this project, it presented the operation of the circuit and how it does affect the behavior of the input signal by filtering and amplifying processes with used techniques, also describe the contribution of each components in mentioned processes.

Chapter four was the section where we presented the problems that we faced in setting up the circuit, and suggesting suitable solution for each problem by give better explanation of the job of a component or how it must be connected to the circuit, or how to use an alternatives for some components.

The main guidelines of this project were:

- To design, build and test a working MW radio.
- To gain experience as much as we could with practical electronics projects.
- To sort out problems within the circuits and suggest modifications, to overcome the problems.

Firstly while the project was in progress, we realized the components which were supposed to be used in the project, then we started connecting the circuit as planned.

When the circuit got ready, we started testing the circuit and detecting the problems were preventing circuit from working properly.

While connecting the radio circuit; and during some of unpleasant conclusions we realized that we were doing mistakes in some positions. By trial we got more careful and aware while we were working, and also gave us the motivation and determination to make the circuit work.

The main problem was when a component was not available and since the market in North Cyprus is too limited we were forced to find alternative components by using the internet or some references and also by asking some advices from experienced people and our tutor who gave us great deal of advices.

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