TITLE

“FM BUGGER”

ABSTRACT

The first archaic radio transmitter was built by the German physicist "HEINRICH HERTZ" in 1887. They It produced radio waves from a high voltage spark between two metals (conductor). The goal of the project is He designed the miniature low-power FM transmitter and used it in various applications. For example, hearing aids for the tourist guide system, the security of small areas and for entertainment purposes. The FM transmitter has many merits AM (amplitude modulation). Protects the signal from interference and unwanted signals, or noise. It provides High S / N (noise signal) of AM. An FM transmitter is an electronic circuit that converts electrical energy from alternating radio frequency (AC) battery. The energy of such a rapid reversal current radiates from the antenna as EM waves (electromagnetic waves). An FM transmitter is a low power FM radio transmitter that lets you listen to music or any other audio message. from a CD player, a portable media player or any other audio system that can be played on a nearby FM radio. Due to the low cost of equipment for an FM transmitter, it leads to rapid growth in the year of World War II. Then At 3 years of war, 600 FM stations were broadcast in the United States. UU. and at the end of 1980 there were More than 4,000 stations. Due to the overcrowding in the AM transmission and the failure of the basic AM receiver to eliminate noise. the transmission helped us overcome these disadvantages and, therefore, can be used to transmit music or audio signals and this can lead to an increase in the number of classical and famous music auditors, for which the FM station design higher audience ratings than AM stations. The FM transmitter is made up of mice from which an audio comes the signal is transmitted to the different sections of the transmitter, after processing the signal of this section, it will transmit through the antenna and these signals are captured by the antenna on the receiver side.

CHAPTER 01

INTRODUCTION

'FM BUGGER', so basically, we know that bugger is a device which gives the information of one person to other person in the remote location. Normally bugger is used for finding out the status of the person like where he is going, what he is talking etc. This is illegal but most of spy agencies use this bugger.

Here in this project we have a small circuit with which you can listen to another people conversation from long distance using the normal FM radio set also, and with this we can also play mp3 songs and transmit it also.

but here along with building a transmitter, a receiver is also been made. This FM bugger circuit is kept in room where you want to listen the conversation. You can listen to this conversation using the FM receiver.

From the mentioned block diagram, we can easily understand that the message signal or conversation signal is modulated with the carrier frequency which is generated by the tank circuit. The message signal and carrier signal are modulated by the transistor and transmit the modulated signal in the air through the antenna. The modulated signal is received by the receiver antenna and gives to the FM radio where the user can listen to the conversation. User should adjust the receiver frequency in the radio for receiving the signal from the transmitter.

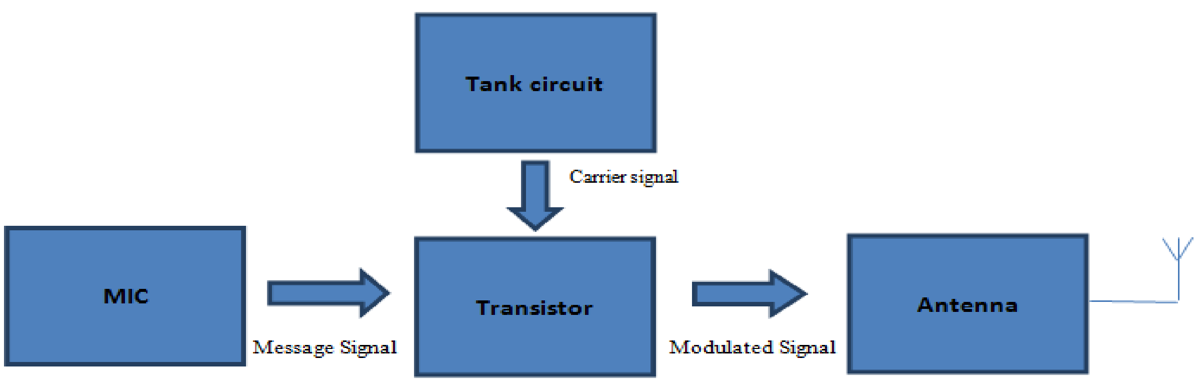

FIGURE 1: TRANSMITTER SECTION

Further the modulated signal is received at the receiver and it is then demodulated and with an help of an simple amplifier circuit using an OP-AMP the signal is then amplified, and outputted through an speaker.

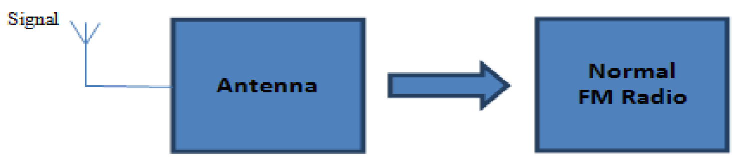

FIGURE 2: RECEIVER SECTION

CHAPTER 02

LITERATURE SURVEY

- AUTHOR: Jeong-Tak Ryu and Kyung Ki Kim.
- TITLE: low cost FM transmitter.

This paper proposes the low-power miniaturized FM transmitter with a built-in antenna for robust short-range communications. Recently, short-range wireless communication systems in mobile applications have been researched extensively, and the FM transmitter is one of the most important blocks in the short-range wireless communication systems. The proposed FM transmitter uses FM radio waves to transmit sounds from a mobile system (MP3, PMP, PDA, MP3 Phone et.) to radio or stereo systems within a short distance from the mobile system. The size of the proposed transmitter is 2.6 cm x 2.6 cm x 2.6 cm. The operating voltage of the transmitter is 3.7 V. The proposed system deploys a built-in storage battery and can be operated continuously for 7 hours after fully charging the battery. The transmission frequency of the proposed transmitter is selected as one of three frequencies (88.1 MHz, 88.3 MHz, or 88.5 MHz) depending on utility condition, and the channel separation ability is 40 dB.

- AUTHOR: D. Lalitha Kumari
- TITLE: FM modulation in FM transmitter.

The transmission of audio signals is usually accomplished through the frequency modulation strategies. FM transmitter is the sub-system that transmits the data from one place then onto the next place with no wired-connections. It is used to address a large public within the transmission range, for instance to make announcements of college. For a superior quality and proficient communication, digital modulation strategy is employed. The main advantages of the digital modulation are higher noise immunity, bandwidth availability and permissible power. In digital modulation, an analog message signal is changed into digital message, and afterward modulated by using a carrier wave. FM transmitter system comprises of an input signal source i.e., microphone (for speech) or auxiliary cable (for recorded audio), modulator and antenna to transmit the signal over large range. The transmission begins with a sound source (human voice or recorded audio), which makes sound waves (acoustical energy). These waves are recognized by a microphone or auxiliary cable, which converts them in to electrical energy. The signal is then modulated and transmitted at the desired frequency using the antenna. The transmitted signal can be heard by the users through their mobile phones.

- WEBSITE: https://www.instructables.com/id/How-to-Make-FM-Transmitter/
- WRITER NAME: JunezRiyaz.

A short-range FM transmitter is a low-power FM radio transmitter that transmits a signal from a portable audio device (such as an MP3 player) to a standard FM radio. Most of these transmitters are connected to the device's headphone jack and then transmit the signal through an FM broadcast band frequency, so that it can be picked up by any nearby radio. This allows portable audio devices to use the best or best sound quality of a car or home stereo sound system without the need for a cable connection. Being low power, most transmitters usually have a short distance of 100–300 feet (30–100 meters), depending on the quality of the receiver, obstacles and height. They usually transmit on any FM frequency from 87.5 to 108.0 MHz in most parts of the world. In this project, we design the circuit so that the circuit picks up the input through the auxiliary cable and transmits it with a range of FM frequencies. The transmission output can be picked up with an FM radio.

CHAPTER 03

PROPOSED METHODOLOGY

➢ Project definition:

- ✓ This project is used to send the audio signal or even the music.
- ✓ the transmitted sound is received at the receiver.
- ✓ the sound or the signal is sent through the electromagnetic waves to the receiver.
- ✓ And finally, the at the receiver end the signal or audio is received and outputted through the speaker.

➢ Objectives:

- ✓ Design different stages of electric circuits
- ✓ Use and design voltage amplifier
- ✓ Design appropriate filters that select the desired band of frequencies
- ✓ Design a suitable FM modulator and demodulator circuits
- ✓ Learn about inductor design and their Characteristics.
- ✓ Produce a small, portable and low-cost Device.

➢ Project methodology:

The project consists of two devices

A transmitter and a receiver. The transmitter detects the sound from the condenser microphone or receives the input audio signals of music and then it amplifies it. A filter (that it is a ceramic capacitor used to block DC and allow only AC) is used after that to select the desired frequency band to be sent. The output of the filter is fed to an FM modulation circuit to shift the signal into higher frequency. The signal is then transmitted using antenna.

In the receiver, the signal is received with a similar antenna. Fed to a band pass filter. The demodulation circuit follows the band pass filter to separate the information from the carrier. The sound is then amplified and fed to the speaker. The receiver should be able to receive the sent information.

CHAPTER 04

PROJECT DESCRIPTION

➢ TANK CIRCUIT

An LC circuit, also called a resonant circuit, tank circuit or tuned circuit, is an electrical circuit consisting of an inductor, represented by the letter L, and a capacitor, represented by the letter C, connected together. The circuit can act as an electrical resonator, an electrical analogue of a tuning fork, storing energy that oscillates at the resonance frequency of the circuit.

LC circuits are used to generate signals at a particular frequency, or select a signal at a particular frequency from a more complex signal; This function is called band-pass filter. They are key components in many electronic devices, particularly radio equipment, used in circuits such as oscillators, filters, tuners and frequency mixers.

An LC circuit is an idealized model since it assumes that there is no dissipation of energy due to resistance. Any practical implementation of an LC circuit will always include the loss resulting from a small but non-zero resistance inside the connection components and cables. The purpose of an LC circuit is generally to oscillate with minimal damping, so the resistance becomes as low as possible. Although no practical circuit is without losses, it is instructive to study this ideal form of the circuit to gain understanding and physical intuition. For a circuit model that incorporates resistance, see RLC Circuit

The two-element LC circuit described above is the simplest type of inductor-capacitor network (or LC network). It is also known as second order LC circuit to distinguish it from the more complex LC networks (higher order) with more inductors and capacitors. Such LC networks with more than two reactance can have more than one resonance frequency.

The order of the network is the order of the rational function that describes the network in the complex frequency variables s. In general, the order is equal to the number of elements L and C in the circuit and, in any case, it cannot exceed this number.

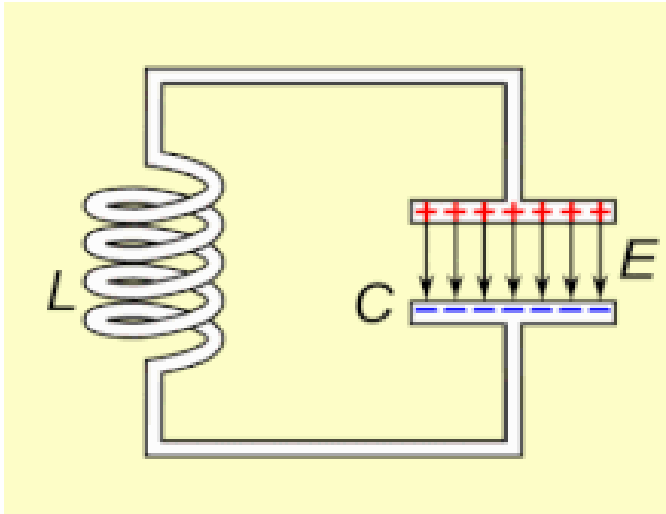

FIGURE 3: TANK CIRCUIT (L & C)

The above diagram showing the operation of a tuned circuit (LC circuit). The capacitor C stores energy in its electric field E and the inductor L stores energy in its magnetic field B (green). The animation shows the circuit in progressive oscillation points. The oscillations slow down; In a true tuned circuit, the load can oscillate back and forth from thousands to billions of times per second.

An LC circuit, which oscillates at its natural resonance frequency, can store electrical energy. Watch the animation A capacitor stores energy in the electric field (E) between its plates, depending on the voltage passing through it, and an inductor stores energy in its magnetic field (B), depending on the current that flows through it.

If an inductor is connected through a charged capacitor, the voltage across the capacitor will conduct a current through the inductor, creating a magnetic field around it. The voltage across the capacitor drops to zero when the current flow runs out of charge. At this point, the energy stored in the coil's magnetic field induces a voltage across the coil, because the inductors oppose current changes. This induced voltage causes a current to start recharging the capacitor with a voltage of polarity opposite to its original charge. Due to Faraday's law, the EMF that drives the current is caused by a decrease in the magnetic field, so the energy required to charge the capacitor is extracted from the magnetic field. When the magnetic field is completely dissipated, the current will stop and the charge will be memorized again in the capacitor, with the polarity opposite to the previous one. Thus, the cycle will start again, with the current flowing in the opposite direction through the inductor.

The charge flows from side to side between the condenser plates, through the inductor. The energy oscillates from one side to the other between the condenser and the inductor until (if it is not supplied by an external circuit) the internal resistance makes the oscillations disappear. The action of the tuned circuit, known mathematically as a harmonic oscillator, is similar to a pendulum swinging back and forth or to water moving back and forth in a tank; For this reason, the circuit is also called the tank circuit. The natural frequency (i.e. the frequency at which it will oscillate when isolated from any other system, as described above) is determined by the capacitance and inductance values. In most applications, the tuned circuit is part of a larger circuit that applies alternating current, driving continuous oscillations. If the frequency of the applied current is the natural resonance frequency of the circuit (natural frequency below), resonance will occur and a small activation current can excite large amplitude oscillations and currents. In the tuned circuits typical of electronic equipment, the oscillations are very fast, from thousands to billions of times per second.

- **<u>Resonance effect</u>**

Resonance occurs when an LC circuit is driven by an external source at an angular frequency ω0 at which the inductive and capacitive reactance's are of equal amplitude. The frequency at which this equality is maintained for a particular circuit is called resonance frequency. The resonance frequency of the LC circuit

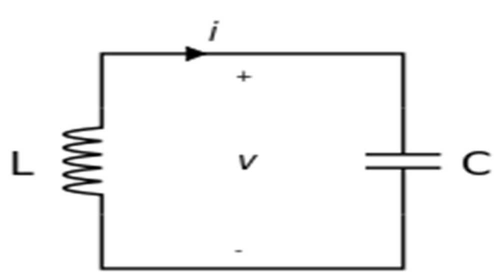

FIGURE 4: LC RESONANCE

where L is the inductance in henrys, and C is the capacitance in farads. The angular frequency ω0 has units of radians per second.

$$fo = {}^{1}/_{2\pi\sqrt{l * c}}$$

EQUATION 1: RESONANCE FREQUENCY FORMULA

- **<u>Applications</u>**

The resonance effect of the LC circuit has many important applications in signal processing and communication systems.

- ✓ The most common application of tank circuits is to tune radio transmitters and receivers. For example, when we tune a radio to a station, the LC circuits are set to resonance for that particular carrier frequency.
- ✓ A series resonant circuit provides greater voltage.
- ✓ A parallel resonant circuit provides a greater current.
- ✓ A parallel resonant circuit can be used as load impedance in the output circuits of the RF amplifiers. Due to the high impedance, the amplifier gain is maximum at the resonance frequency.
- ✓ Resonant circuits in parallel and in series are used in induction heating.

- <u>LC CIRCUITS USES</u>

LC circuits behave as electronic resonators, which are a key component in many applications:

- Amplifiers
- Oscillators
- Filters
- Tuners

- Mixers
- Foster-Seeley discriminator
- Contactless cards
- Graphics tablets
- Electronic article surveillance

In telecommunications and signal processing, frequency modulation (FM) is the encoding of information in a carrier wave by varying the instantaneous frequency of the wave.

In analogue frequency modulation, such as the FM radio transmission of an audio signal representing the voice or the music, the instantaneous deviation of the frequency, the difference between the carrier frequency and its central frequency, is proportional to the modulation signal.

Digital data can be encoded and transmitted via FM by changing the carrier frequency between a predefined set of frequencies representing the digits; for example, a frequency can represent a binary 1 and a second can represent a binary 0. This modulation technique is known as FSK (Frequency Change Coding) and is widely used in modems like fax modems and can also be used to send Morse code. [1] Radioteletype also uses FSK. [2]

Frequency modulation is widely used for FM radio transmission. It is also used in telemetry, radar, seismic detection and neonatal monitoring to detect attacks via EEG, [3] two-way radio systems, music synthesis, recording systems on magnetic tape and some video transmission systems. In radio transmission, an advantage of frequency modulation is that it has a higher signal-to-noise ratio and therefore rejects radio frequency interference better than an equal power amplitude modulation signal (AM). For this reason, most of the music is transmitted from the FM radio.

Frequency modulation and phase modulation are the two main complementary methods of angular modulation; Phase modulation is often used as an intermediate step to obtain frequency modulation. These methods contrast with the amplitude modulation, in which the amplitude of the carrier wave varies, while the frequency and the phase remain constant.

➢ Modulation

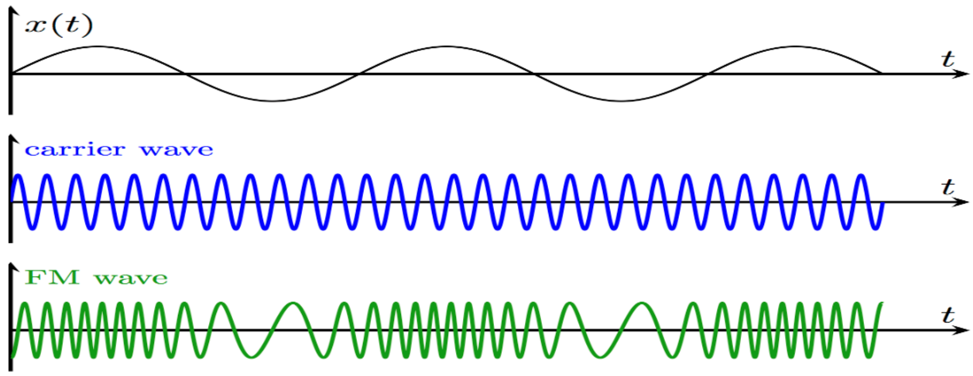

FIGURE 5: FM MODULATION WAVEFORM

FM signals can be generated using direct or indirect frequency modulation:

- ✓ Direct FM modulation can be obtained by directly feeding the message to the input of a voltage-controlled oscillator.
- ✓ For indirect FM modulation, the message signal is integrated to generate a phase modulated signal. This is used to modulate a crystal-controlled oscillator and the result is passed through a frequency multiplier to produce an FM signal. In this modulation, narrow band FM is generated which subsequently leads to FM broadband and, therefore, modulation is known as indirect FM modulation.

➢ Demodulation

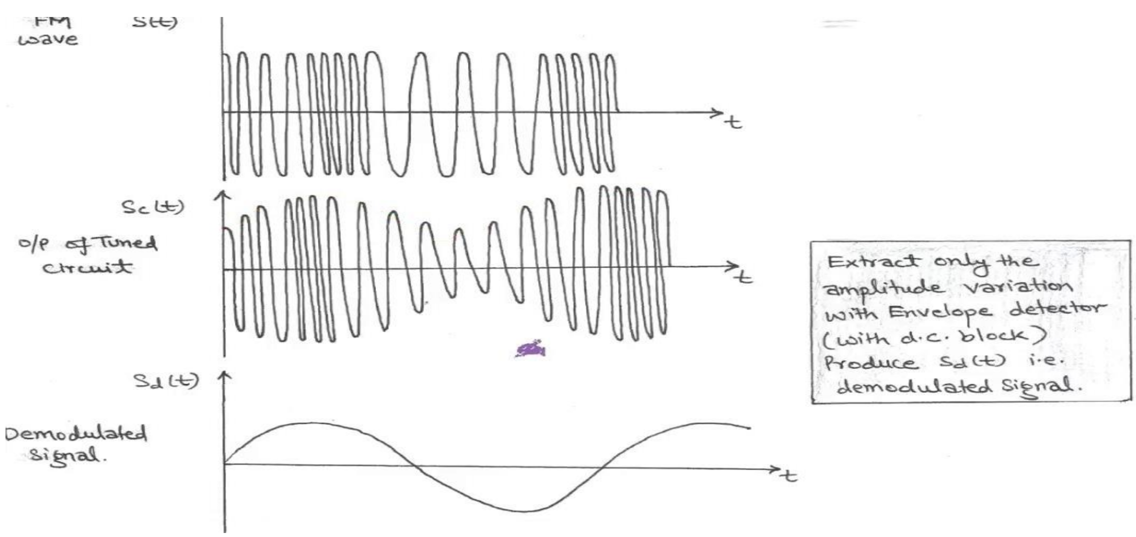

FIGURE 6: FM DEMODULATION WAVEFORM

There are many FM detector circuits. A common method to retrieve the information signal is through a Foster-Seeley discriminator or a relationship detector. A locked phase loop can be used as an FM demodulator.

Slope detection demodulates an FM signal using a tuned circuit with a resonance frequency slightly shifted by the carrier. As the frequency increases and decreases, the tuned circuit provides a variable response amplitude, converting FM to AM. AM receivers can detect some FM broadcasts with this medium, although they do not provide an effective means of detection for FM broadcasts.

- <u>Electret Microphone</u>

FIGURE 7: ELECTRET / CONDENSOR MICROPHONE

An electret microphone is a type of electrostatic condenser microphone, which eliminates the need for a polarized power supply using a permanently charged material.

An electret is a stable dielectric material with a permanent static electric dipole moment (which, due to the high strength and chemical stability of the material, does not decompose for hundreds of years). The name derives from electrostatics and magnets; make an analogy with the formation of a magnet by aligning the magnetic domains in a piece of iron. The electrodes are commonly produced by first melting a suitable dielectric material, such as a plastic or a wax containing polar molecules, and then allowing it to solidify again in a powerful electrostatic field. The polar molecules of the dielectric align in the direction of the electrostatic field, producing a permanent electrostatic "bias". Modern electret microphones use PTFE plastic, in the form of a film or solute, to form the electret.

foil type or diaphragm type

A film of electret material is used as the diaphragm itself. This is the most common type, but also of lower quality, since the electret material is not a particularly good diaphragm.

Rear electret

An electret film is applied to the back plate of the microphone capsule and the diaphragm is made of a vacuum material, which can be mechanically more suited to the design of the transducer.

Front electret

In this new type, the back plate is removed from the design and the condenser is formed by the diaphragm and the inner surface of the capsule. The electret film is attached to the inner front cover and the metallized diaphragm is connected to the FET input. It is equivalent to the rear electret in which any conductive film for the diaphragm can be used.

Unlike other condenser microphones, electret types do not require a polarization voltage, but usually contain an integrated preamplifier, which requires a small amount of energy (often mistakenly called polarization or polarization). This preamp is often phantom in the studio and sound reinforcement applications. Other types simply include a 1.5V battery in the microphone case, which is often left permanently as the power consumption is usually very low.

- <u>variable capacitor</u>

FIGURE 8: VARIABLE CAPACITOR (tuning capacitor)

A variable capacitor is a capacitor whose capacity can be changed intentionally and repeatedly mechanically or electronically. Variable capacitors are often used in L / C circuits to establish resonance frequency, e.g. to tune a radio (so it is sometimes called a tuning capacitor or tuning capacitor) or as a variable reactance, p. for impedance matching in antenna tuners

Principle of the variable rotary capacitor:

In the mechanically controlled variable capacitors, it is possible to change the distance between the plates or the amount of surface of the plate that overlaps.

The most common form organizes a group of semicircular metal plates on a rotating shaft ("rotor") that are positioned in the spaces between a series of fixed plates ("stator") so that the overlapping area can be modified by rotating the tree. Air or plastic sheets can be used as a dielectric material. By choosing the shape of the turntables, you can create different capacity functions vs. corner, p. to get a linear frequency scale. Different forms of reduction mechanisms are often used to obtain a finer regulation control, that is to extend the capacity variation on a wider angle, often more turns

A variable vacuum condenser uses a series of plates consisting of concentric cylinders that can slide inside or outside an opposite series of cylinders [1] (sleeve and piston). These plates are sealed inside a non-conductive envelope such as glass or ceramic and placed under high vacuum. The mobile part (piston) is mounted on a flexible metal membrane that seals and maintains the vacuum. A screw stem is fixed to the plunger, when the stem is rotated, the plunger moves in or out of the sleeve and the value of the condenser changes. The vacuum not only increases the working voltage and the capacitor current management capacity, but also considerably reduces the possibility of arching the plates. The most common use for vacuum variables is found in high power transmitters such as those used for broadcasting, military and amateur radio, as well as in high power RF tuning networks. Vacuum variables can also be more convenient; Since the elements are under vacuum, the working voltage can be higher than an air variable of the same size, which allows to reduce the dimensions of the vacuum condenser.

Very cheap variable capacitors are constructed with layers of aluminum and plastic in layers that are pressed in a variable way by means of a screw. However, these so-called juicers cannot provide a stable and reproducible capacity. A variant of this structure is also used which allows the linear movement of a series of plates to modify the overlapping area of the plate and could be defined as a sliding device. This has practical advantages for makeshift or domestic construction and can be found on resonant circuit antennas or glass radios.

- **<u>2N3904 Transistor</u>**

FIGURE 9: BJT TRANSISTOR (2N39040

The 2N3904 is a common NPN bipolar junction transistor used for low-power amplification or switching applications for general purposes. It is designed for low current and power, half a volt. The type was registered by Motorola Semiconductor in the mid-1960s, along with the complementary type PNP 2N3906, and represented a significant performance / cost improvement, with the TO-92 plastic case replacing metal cans. This transistor is economical, widely available and robust enough to be used by experimenters and electronics enthusiasts. [Looking at the flat side with the wires facing down, the three wires coming out of the bottom are connected, from left to right, with the emitter, the base and the collector. Some manufacturers mark "EBC" on the printed part, but all must have such connections for a part that is a "2N3904".

It is a transistor of 200 mA, 40 V, 625 mW with a transition frequency of 300 MHz, [1] with a minimum beta gain or current of 100 at a collector current of 10 mA. It is used in a variety of analog amplifications and switching applications.

The 2N3904 is very frequently used in hobby electronics projects, including homemade radio amateurs, oscillators for code practice and as an interface device for microcontrollers.

Small variable capacitors that work with a screwdriver (for example, to fine-tune a factory resonant frequency and therefore never adjust again) are called control capacitors. In addition to air and plastic, the trims can also be made with a ceramic dielectric, such as mica.

- <u>INDUCTOR</u>

FIGURE 10: INDUCTOR

An inductor, also called a coil, coil or reactor, is a passive two-terminal electrical component that stores energy in a magnetic field when electric current flows through it. An inductor generally consists of an insulated wire wrapped in a coil around a core.

When the current flowing through an inductor changes, the time-varying magnetic field induces an electromotive force (e.m.f.) (voltage) in the conductor, described by the Faraday induction law. According to Lenz's law, the induced voltage has a polarity (direction) that is opposed to the current change that created it. Consequently, the inductors oppose any change in the current through them.

An inductor is characterized by its inductance, which is the relationship between the voltage and the rate of change of the current. In the International System of Units (SI), the unit of inductance is Henry (H) which takes its name from the nineteenth-century American scientist Joseph Henry. In the measurement of magnetic circuits, it is equivalent to weber / amp. The inductors have values that generally vary from 1 µH (10-6 H) to 20 H. Many inductors have a magnetic core made of iron or ferrite inside the coil, which serves to increase the magnetic field and, therefore, the inductance. Together with capacitors and resistors, inductors are one of the three elements of the passive linear circuit that form electronic circuits. Inductors are widely used in alternating current (AC) electronic equipment, particularly radio equipment. They are used to block alternating current while letting direct current pass; The inductors designed for this purpose are called accelerators. They are also used in electronic filters to separate signals of different frequencies and, in combination with capacitors to create tuned circuits, are used to tune the radio and TV receivers.

- USES OF INDUCTORS

Inductors are widely used in analog circuits and in signal processing. Applications range from the use of large inductors in power supplies, which together with filter capacitors eliminate ripple, which is a multiple of the network frequency (or switching frequency for switching mode power supplies) from the current output continuous, to the small inductance of the ferrite cable or to the bull installed around a cable to prevent radio frequency interference from being transmitted through the cable. Inductors are used as energy storage devices in many switching power supplies to produce direct current. The inductor supplies energy to the circuit to maintain the current flow during the disconnection periods and allows topographies in which the output voltage is greater than the input voltage. A tuned circuit, consisting of an inductor connected to a capacitor, acts as a resonator for the oscillating current. The tuned circuits are widely used in radiofrequency equipment, such as radio transmitters and receivers, as narrow bandpass filters to select a single frequency of a composite signal and in electronic oscillators to generate sinusoidal signals. Two (or more) proximity inductors that have a coupled magnetic flux (mutual inductance) form a transformer, which is a fundamental component of each utility grid. The efficiency of a transformer can decrease as the frequency increases due to eddy currents in the core material and the effect of the skin on the windings. The size of the core can be reduced to higher frequencies. For this reason, airplanes use an alternating current of 400 hertz instead of the usual 50 or 60 hertz, which allows a great weight saving with the use of smaller transformers. The transformers allow switching power supplies that isolate the input output.

Inductors have parasitic effects that distance them from the ideal behavior. They create and suffer electromagnetic interference (EMI). Their physical dimensions prevent them from integrating into semiconductor chips. Therefore, the use of inductors is decreasing in modern electronic devices, particularly in compact portable devices. True inductors are increasingly being replaced by active circuits like the spinner that can synthesize inductance using capacitors.

- **Types**

The term air core coil describes an inductor that does not use a magnetic core made of ferromagnetic material. The term refers to coils wrapped in plastic, ceramic or other non-magnetic shapes, as well as those that have only air inside the windings. The air core coils have lower inductance than the coils of the ferromagnetic core, but they are often used at high frequencies because they have no energy losses called core losses that occur in ferromagnetic nuclei, which increase with frequency. A side effect that can occur in the coils of the air core in which the winding is not rigidly supported in one way is the "microphonic": the mechanical vibration of the windings can cause variations in the inductance.

Radio-frequency inductor

At high frequencies, particularly radio frequencies (RF), inductors have greater resistance and other losses. In addition to causing power loss, in resonant circuits this can reduce the circuit's Q factor, increasing bandwidth. In RF inductors, which are mostly air core types, specialized construction techniques are used to minimize these losses. The losses are due to these effects:

Skin effect

The resistance of a cable to the high frequency current is greater than its resistance to direct current due to the effect of the skin. The alternating radiofrequency current does not penetrate much into the body of a conductor, but travels along its surface. For example, at 6 MHz, the depth of the copper cable sheath is about 25 µm (0.001 inch); Most of the current is within this surface depth. Therefore, in a solid cable, the inner part of the cable can carry little current, effectively increasing its resistance.

Proximity effect

Another similar effect that also increases cable resistance at high frequencies is the proximity effect, which occurs in parallel cables close to each other. The single magnetic field of the adjacent turns induces eddy currents in the coil cable, which causes the current in the conductor to concentrate on a thin strip on the side near the adjacent cable. Like the skin effect, this reduces the effective cross-sectional area of the conductive current of the cable, increasing its resistance.

Dielectric losses

The high frequency electric field near the conductors in a coil of a tank can cause the movement of polar molecules in nearby insulating materials, dissipating energy in the form of heat. Therefore, the coils used for tuned circuits are often not wrapped in coil form, but are suspended in the air, supported by thin strips of plastic or ceramic.

Parasitic capacity

The capacity between the individual turns of the bobbin thread, called parasitic capacitance, does not cause energy losses, but can change the behavior of the coil. Each revolution of the coil has a slightly different potential, so the electric field between the nearby curves stores the charge in the cable, so the coil acts as if it had a parallel capacitor. At a sufficiently high frequency, this capacity can resonate with the inductance of the coil which forms a tuned circuit, making the coil resonate.

To reduce the parasitic capacitance and the proximity effect, the high Q RF coils are built to avoid having many turns together, parallel to each other. RF coil windings are often limited to a single layer and the curves are separated. To reduce the resistance due to the effect of the skin, in high power inductors, such as those used in transmitters, the windings are sometimes made up of a strip or a metal tube that has a wider surface and the surface is silver.

➢ LM 386 OP-AMP

IC LM386 Audio Amplifier Pin Configuration and Its Working

The LM386 IC is a low power audio amplifier and uses a low power supply as batteries in electrical and electronic circuits. This IC is available in the 8-pin mini DIP package. The voltage gain of this amplifier can be set to 20 and the voltage gain will be improved to 200 by using external components such as resistors and capacitors between pins 1 and 8. When this amplifier uses a 6 V power supply for the operation, then the static power consumption will be 24 milliwatts to make the amplifier work optimally with the battery. This amplifier consists of 8 pins where pin 1 and pin 8 are the control pins of the amplifier and this IC is the most used IC that allows the customer to increase the volume.

FIGURE 11: LM386 OP-AMP

The IC LM386 audio amplifier consists of 8-pins where each pin of this IC is discussed below.

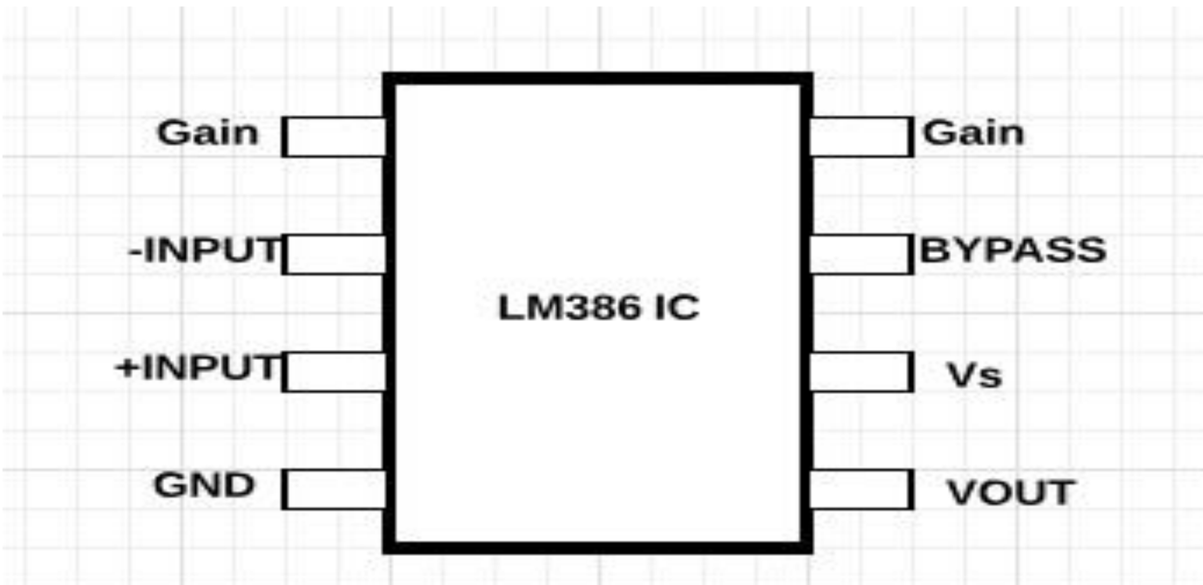

FIGURE 12: LM386 PIN DIAGRAM

Pin1 (Ga+-gain Pin): Pin-1 is gain pin, used adjust the amplifier gain by connecting this IC to an external component capacitor.

Pin2 (+IN-Non-inverting): Pin-2 is the non-inverting pin, is used to provide the audio signal.

Pin3 (+IN): Pin-3 is the inverting terminal and it is normally connected to ground.

Pin4 (GND): Pin-4 is a ground pin connected to the ground terminal of the system

Pin5 (Vout): Pin-5 is the output pin, used to provide amplified output audio, and allied to the speaker.

Pin-6 (VCC or VSS): Pin-6 is connected to the power

Pin-7 (Bypass): Pin-7 bypass pin is used to connect a decoupling capacitor.

Pin-8 (Gain): Pin-8 is the gain setting pin

➢ LM386 Audio Amplifier Circuit Diagram and Working

The audio amplifier can be built with LM386 IC, capacitors such as 100 µF, 1000 µF, 0.05 µF, 10 µF, potentiometer - 10 KΩ, resistance-10 KΩ, 12V power supply, 4Ω speaker, test board and connection cables. Basically, this audio amplifier includes 3-function blocks such as power supply, as well as output, bypass, gain control. The design of this circuit is very simple. Initially, connect the two pins of the power supply, i.e. pin4 and pin6 to GND, as well as the corresponding voltage.

Next, it connects the input of any type of audio source, like a cell phone or a microphone. Here this circuit uses a mobile phone as an audio source with the help of the 3.5 mm jack. This connector will have three connections as the right and left ground audio. This LM386 IC is a simple amplifier and connects the left or right audio to this amplifier using an audio source with the ground terminal. The input level in this circuit can be controlled by connecting a potentiometer to the input. Furthermore, a capacitor will be connected to the serial input to remove the DC components. This IC gain will be set to 20 and will connect a capacitor (10 µF) between the two pins 1 and 8 of this IC, so the gain will be increased to 200.

Although the data sheet of the audio amplifier informs that the bypass capacitor in the seventh pin is an option, we believe that the connection of a capacitor (100 µF) was really useful because it helps to reduce the noise. For the output connection, a capacitor (0.05 µF) and a resistor (10 Ω) will be connected in series between the GND and a fifth pin of the IC. This constitutes a Zobel network, a filter that includes a capacitor and a resistor will be used to adjust the input impedance.

The speakers can be connected using impedance ranges from 4 Ω to 32 Ω, since the IC can control any type of speaker in this field. The audio amplifier circuit uses a speaker (4 Ω). This speaker can be connected using a capacitor (1000 µF) it was really useful because it eliminates unnecessary CC signals.

Electrical Characteristics of LM386 IC

The voltage gain of this amplifier can be set from 20 to 200 with a power supply range of 4 volts to 12 volts or 5 volts to 18 volts depending on the model. There are three models of amplifiers available on the market, namely LM386N-1, LM386N-3 and LM386N-4

For LM386N-1: the minimum voltage is 4 V, the maximum voltage is 12 V, the minimum power of o / p is 250 mW and the typical power of o / p is 325 mW.

For LM386N-3: the minimum voltage is 4 V, the maximum voltage is 12 V, the minimum power of o / p is 500 mW and the typical power of o / p is 700 mW.

For LM386N-4: the minimum voltage is 5 V, the maximum voltage is 18 V, the minimum power of o / p is 500 mW and the typical power of o / p is 1000 mW.

The amplifier inputs are indicated by ground, while the output usually tilts towards the center of the voltage supply. The low static current of the amplifier is 4 mA and the harmonic distortion will be up to 0.2%

Features of IC LM386

The main features of LM386 chip include the following.

- ✓ IC LM386 is obtainable in the package of 8-pin MSOP
- ✓ Exterior components are minimum
- ✓ Operation of Battery
- ✓ Low static power drain- 4mA
- ✓ The range of supply voltage is wide which is ranges from 4Volts to 12Volts or 5Volts to 18 Volts.
- ✓ Input is referenced by ground
- ✓ Distortion is less 0.2%
- ✓ Self-centering o/p static voltage
- ✓ The voltage gain range will be from 20 to 200

LM386 Applications

The IC LM386 is the most important integrated circuit used in the audio section, and it is commonly used in the following applications.

- ✓ Wien bridge oscillator
- ✓ Power converters
- ✓ Ultrasonic drivers
- ✓ Small servo drivers
- ✓ Intercoms
- ✓ Line drivers
- ✓ TV sound systems
- ✓ Portable tape player amplifiers
- ✓ AM to FM radio amplifiers
- ✓ Audio boosters
- ✓ Used in speakers of laptop & portable
- ✓ Used for voice record from microphone, battery operated speakers.

Therefore, this is LM386 IC and this article gives an overview of how to design an LM386 IC audio amplifier circuit and the creation of this circuit is very simple, small in size and lower in cost. So, the sound of this amp will be very loud.

Different types of amplifiers can be built with the help of the LM386 IC, but the main disadvantage of this circuit is interference and noise. The proposed system can be designed with less noise. This circuit will provide 1 watt of power and can be applied to a wide range of audio devices, such as portable speakers, practical speakers, etc.

1.TRANSMITER

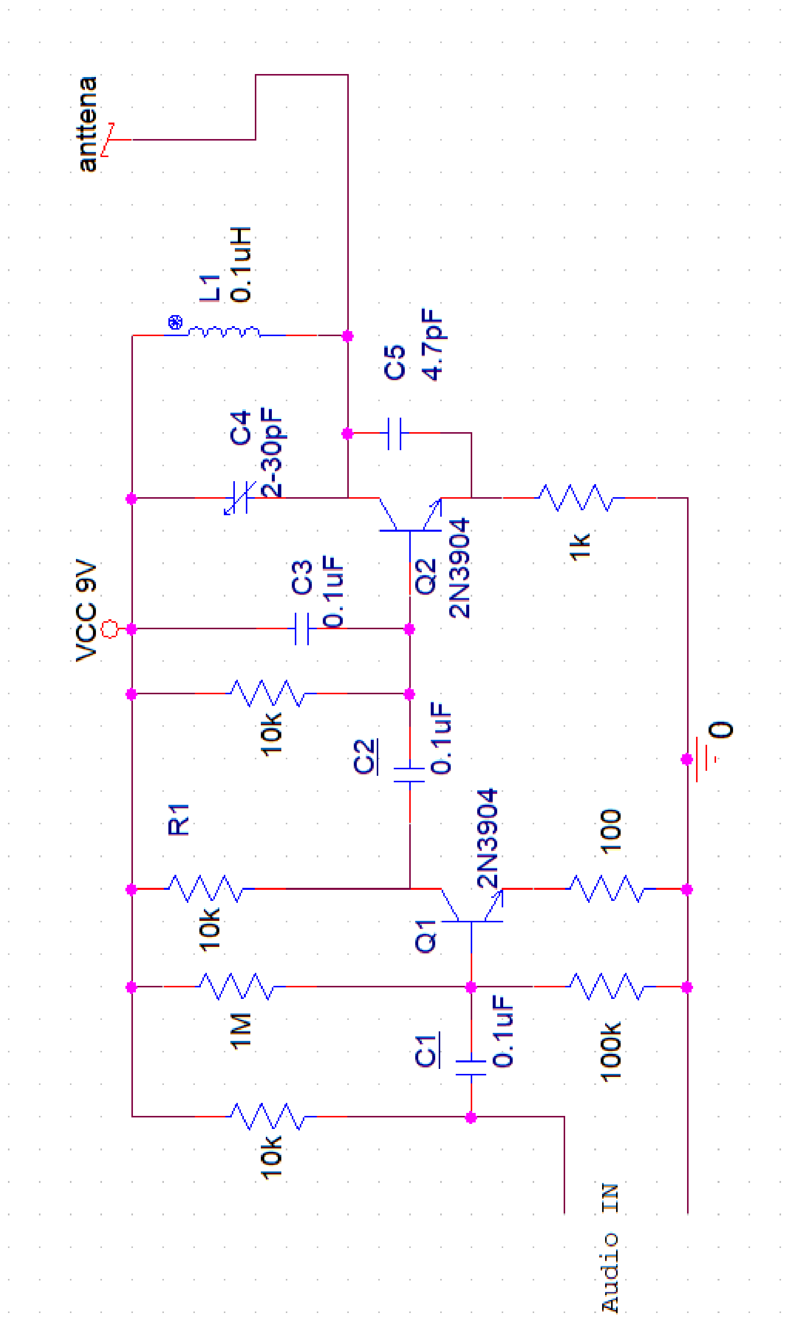

FIGURE 13: FM TRANSMITTER CIRCUIT DIAGRAM

Components Required:

- Transistor QN3904 (x3)
- Resistors

  10kΩ(x3)

  100kΩ

  100Ω

  1kΩ.
- Capacitor

  0.1µF(x3)

  4.7pF

  3-30pF trimmer.
- Transistor

  2N3904(x2)
- Condenser Mic.

FIGURE 14: CAPACITORS

- MIC is placed in the room in which you want to listen to the conversation of the people and MIC will decode the conversation in to the signal which is given to the capacitor where it is used for removing the noise in and turn on the transistor, which it is a voltage divider circuit.
- Further the transistor is use to amplify the input signal.
- The tank circuit (capacitor C and L) which produce the carrier signal for the conversation or message signal, the transistor will amplify the both the signals and send to air through the antenna. The capacitor at output is used to remove the noise in the transmitted signal.
- A capacitor 4.7pf is used as a feedback.
- The capacitor in tank circuit is variable because you can adjust the capacitor for producing your own carrier signal. Remember carrier signal should be in range of 88 to 105 MHz so that FM radio receiver set can receive your transmitted signal.
- The FM radio receiver set is adjusted your frequency for listening to the conversation.

2.RECEIVER:

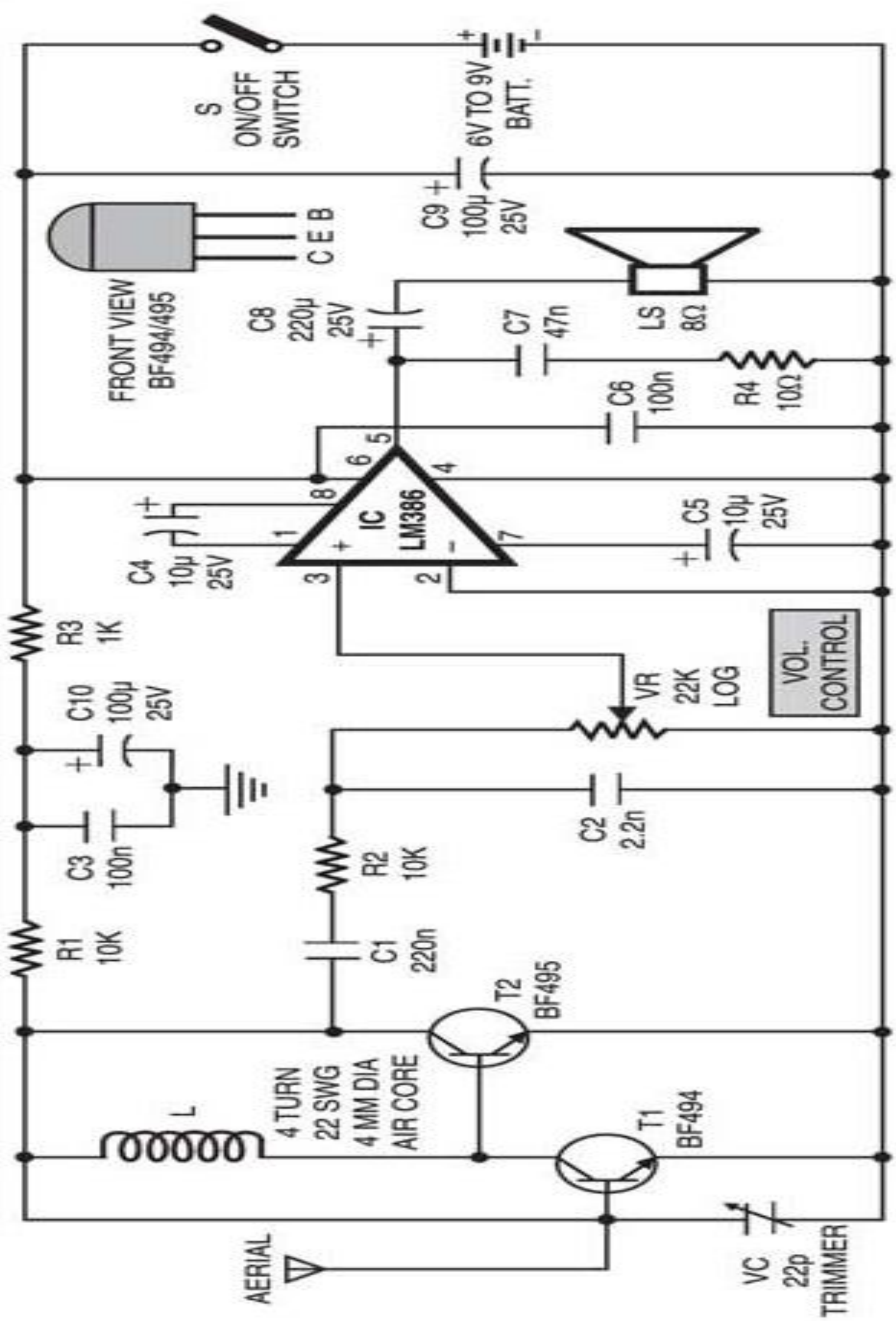

FIGURE 15: FM RECEIVER CIRCUIT DIAGRAM

A radio or FM receiver is an electronic device that receives radio waves and converts the information they carry into a usable format. An antenna is used to trap the desired frequency waves. The receiver uses electronic filters to separate the radio-frequency signal desired from all the other signals collected by the antenna, an electronic amplifier to increase the signal strength for further processing and finally recover the desired information through demodulation.

Of the radio waves, FM is the most popular. Frequency modulation is widely used for FM radio transmission. It is also used in telemetry, radar, seismic detection and neonatal monitoring to detect seizures via EEG, two-way radio systems, musical synthesis, recording systems on magnetic tape and some video transmission systems. An advantage of frequency modulation is that it has a higher signal-to-noise ratio and, therefore, rejects radio frequency interference better than an equal-power amplitude modulation signal (AM).

FM FREQUENCY RANGES

The frequency modulation is used in a radio transmission in the VHF band 88-108 MHz This bandwidth range is marked as FM in the band scales of the radio receivers and the devices that can receive these signals are called FM receivers. The FM radio transmitter has a 200kHz wide channel. The maximum audio frequency transmitted in FM is 15 kHz compared to 4.5 kHz in AM. This allows you to transfer a much wider range of FM frequencies and, therefore, the quality of the FM transmission is significantly higher than that of the AM transmission. Below is an electronic circuit for the FM receiver along with its complete explanation

List of Components

- IC- LM386
- T1 BF494
- T2 BF495
- 4 turn 22SWG 4mm diameter air core
- C1 220nF
- C2 2.2nF
- C 100nF * 2
- C4 10uF
- C5 10uF (25 V)
- C7 47nF
- C8 220 uF (25 V)
- C9 100 uF (25 V) * 2
- R 10KΩ * 2
- R3 1KΩ
- R4 10Ω
- Variable resistance
- Variable capacitance
- Speaker
- Antenna
- Battery

FIGURE 16: RESISTOR

FM RECEIVER CIRCUIT

Here is a simple FM receiver with minimal components for local FM reception. The transistor BF495 (T2), together with a resistor 10k (R1), coil L, variable capacitor 22pF (VC) and internal capacitors of transistor BF494 (T1), includes the oscillator Colpitts. The VC trimmer adjusts the resonance frequency of this oscillator on the frequency of the transmitting station that we wish to listen to. That is, it must be tuned between 88 and 108 MHz The information signal used in the transmitter to perform the modulation is extracted in the resistor R1 and sent to the audio amplifier through a 220nF coupling capacitor (C1).

You should be able to change the capacitance of the variable capacitor of a pair of picofarads to about 20 pF. Therefore, a 22pF trimmer is a good option to use as a VC in the circuit. It is easily available on the market. If you use another capacitor with a higher capacity and cannot receive the full FM bandwidth (88-108 MHz), try changing the VC value. Its capacity will be determined experimentally self-supporting L has four coils of 22 strands of SWG enameled copper, with an air core with an internal diameter of 4 mm. It can be built on any cylindrical object, such as a pencil or a pen, which has a diameter of 4 mm. When the required number of reels of the reel is reached, the reel is removed from the cylinder and stretched a little so that the turns do not touch. The capacitors C3 (100nF) and C10 (100µF, 25V), together with R3 (1k), include a band-pass filter for very low frequencies, which is used to separate the low-frequency signal from the high-frequency signal in the receiver

The telescopic antenna of any unused device can be used. However, good reception can also be obtained with a piece of insulated copper wire about 60 cm long. The optimal length of the copper wire can be found experimentally.

The performance of this small receiver depends on several factors, such as the quality and the turns of the L coil, the type of antenna and the distance from the FM transmitter. IC LM386 is an audio power amplifier designed for use in low-power applications. It provides 1 to 2 watts, which is enough to handle any small speaker. The 22k (VR) volume control is a logarithmic potentiometer connected to pin 3 and the amplified output is obtained on pin 5 of the LM386 IC. The receiver can work with a 6V-9V battery.

CHAPTER 05

RESULT AND DISCUSSION

RESULT: in the below figure 17 we can the observe the FM transmitter built on a breadboard, at the transmitter with the help of the variable capacitor the frequency is set at around 97.8MHz, and the input via aux cable the music is input in it. And the music is transmitted through the transmitter. And in the figure 18 there is a receiver which is fixed tuned at the 97.8MHz frequency, the transmitted signal is received and played through the speaker.

And the range around 100 meters is achieved.

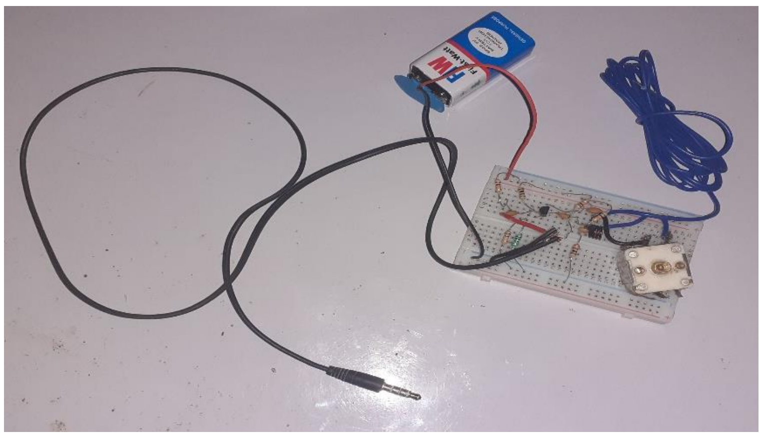

FIGURE 17:FM TRANSMITTER MODEL

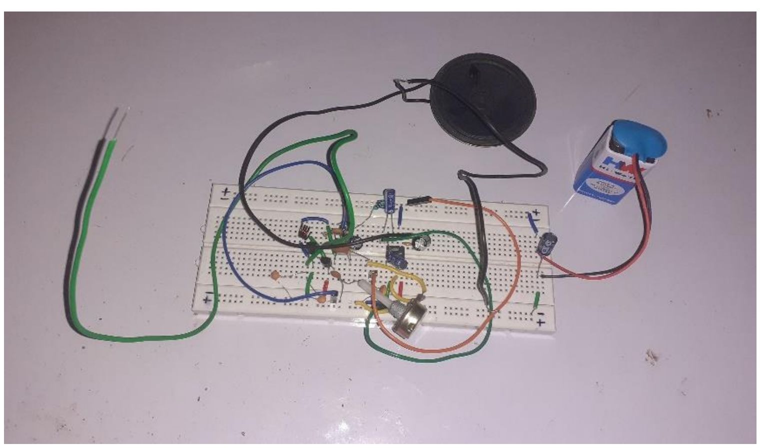

FIGURE 18: FM RECEIVER MODEL

CHAPTER 06

CONCLUSION AND FUTURE SCOPE

Conclusion:

Thus, the FM transmitter is implemented to transmit the voice signals using mic and the required audio music files using the aux cable connected to the input part the transmitter. This particular FM transmitter is implemented to transmit signals at the frequency of 97.8MHz covering area of radius 100-200 meters. And the receiver is able to receive the transmitted frequency, and it is then amplified and outputted through the speaker.

Future scope:

- Use printed circuit board technique,
- Use Arduino to send a message to cellphone.
- Use ISD1110 to play a sound.