

## **CHAPTER-1**

### **INTRODUCTION**

FM transmitter is an electronic device, which produces frequency-modulated waves with the help of an antenna. The FM transmitter is a low-power transmitter and it uses FM waves for transmitting the sound, this transmitter transmits the audio signals through the carrier wave by the difference of frequency.

A transmitter generates FM waves for various purposes such as communication, broadcasting a message, etc. The signal transmitted has a limited range for its reception, as we increase our distance from the source, the signal received is merged with noise and furthermore noise component dominates the signal transmitted hence message cannot be received successfully after a certain distance due to obstacles.

The power source is a 9v de battery. The information that is provided to the transmitter is in the form of an electronic signal. This includes audio from a microphone or any other means like aux-in. The transmitter combines the information signal that is to be carried with the RF signal (the carrier). This is called modulation. In an FM transmitter, the information is added to the radio signal by slightly varying the radio signal's frequency.

### **OVERVIEW**

- The Mini FM Transmitter project aims to design and construct a compact and portable device capable of transmitting audio signals over FM radio frequencies.
- The project utilizes modern electronic components and principles to create a cost-effective and efficient solution for individuals interested in broadcasting their audio content wirelessly within a limited range.
- The mini FM transmitter is designed to be user-friendly, requiring minimal technical expertise to assemble and operate. The project involves the integration of

key components such as aux-in for audio input, an audio amplifier to enhance the signal strength, and a frequency modulator to convert the audio signal into an FM radio frequency.

- These components are combined on a small circuit board, ensuring the portability and convenience of the device.
- To achieve optimal performance, the project focuses on maintaining a stable frequency output, providing clear audio reception within a limited range. The FM transmitter operates within the FM radio spectrum and can be adjusted to select an appropriate frequency based on local regulations and available frequencies.

## CHAPTER-2

### LITERATURE SURVEY

1. **"Stream Music to Every Radio in the House—Cheap!"**. **Gizmodo.com**. Gizmodo. 14 May 2012. Retrieved 14 October 2014. From this reference paper we can understand that a phone can be used as an audio input for FM transmission to FM radio
2. DeFelice, Bill (2011). **"Micro-Broadcasting: Getting The Most Out Of Part 15 Radio"**. **hobbybroadcaster.net**. Retrieved 14 October 2014. This tells us about the working of the circuit of an FM transmitter.
3. **"European Standards, Regulations and Law"**. Low Power Radio Association. Retrieved 14 October 2014. From this reference paper we can understand that for an FM transmitter for a particular range needs to be licensed. But no issues for our project
4. **"Frequently Asked Questions on Low-Power FM Broadcasting from Industry Canada"** (PDF). Industry Canada. 2008. Retrieved 14 October 2014.
5. **"Low Power Radio - General Information"**. Federal Communications Commission. 2015-12-08. Retrieved 2021-12-23. From this reference paper we get to know about all necessary information for a legal FM transmission
6. **"FM and TV Propagation Curves"**. Federal Communications Commission. 2015-12-11. Retrieved 2023-03-28. In this we get to learn about the graphs of the carrier wave and the modulated wave.
7. **"Regulation of the Extremely Low Power Radio Station"**. The Radio Use Website. Telecommunications Bureau of the Ministry of Internal Affairs and Communications

(Japan). Retrieved 14 October 2014. In this reference we get to know how the radio stations work.

## **CHAPTER-3**

### **OBJECTIVES**

FM transmitters aim to deliver high-quality and clear audio transmission. Maintaining a good signal-to-noise ratio and minimizing signal distortion are essential to ensure that the transmitted audio is received and reproduced accurately by FM receivers.

The main objective of an FM transmitter is to transmit audio signals, such as music, speech, or other forms of audio content, over the airwaves using Frequency Modulation (FM) technology. This allows the audio to be received and played back by FM radios within the transmitter's range.

The FM transmitter's objective is to modulate the frequency of the carrier wave with the audio signal. This process involves varying the frequency of the radio wave in proportion to the amplitude of the audio signal, allowing the audio content to be carried within the radio frequency spectrum.

### **AIM OF THE MINI-PROJECT WORK**

The aim of wireless FM transmitter is to communicate with others between long distance using same frequency.

### **PROBLEM STATEMENT**

Audio signals have an inherently low frequency. Transmission of low-frequency signals requires large antenna sizes due to high signal attenuation. Modulation of audio signals is typically achieved using amplitude modulation (AM) and frequency modulation (FM).

Frequency modulation is achieved by varying the carrier frequency with changes in the amplitude of the audio signal (i.e. the modulating signal). AM is the variation in carrier amplitude relative to the audio signal.

AM offers wider coverage than FM, but frequency modulation is more tolerant of noise and signal strength fluctuations than AM, making FM more suitable for mobile applications. We will make a low-power FM radio transmitter that broadcasts a signal from a portable audio device to a standard FM radio.

## CHAPTER-4

### BLOCK DIAGRAM, CIRCUIT DIAGRAMS AND WORKING PRINCIPLE

#### BLOCK DIAGRAM

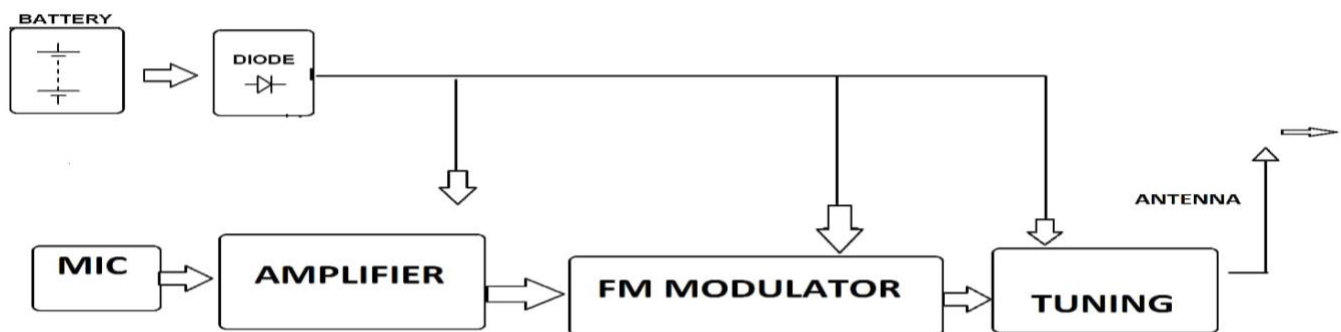


Fig 1: Block diagram of the proposed methodology

- **Block 1** gives information about the mic or the input audio signal that needs to be transmitted.
- **Block 2** gives information about the amplification that takes place in the first transistor
- **Block 3** gives information about the modulation that takes place near the second transistor around the oscillator circuit.
- **Block 4** gives information about the tuning of the frequency of the carrier wave to the required.

## CIRCUIT DIAGRAM

The overall circuit diagram of the proposed undergraduate mini-project work is shown in the Fig. 2.

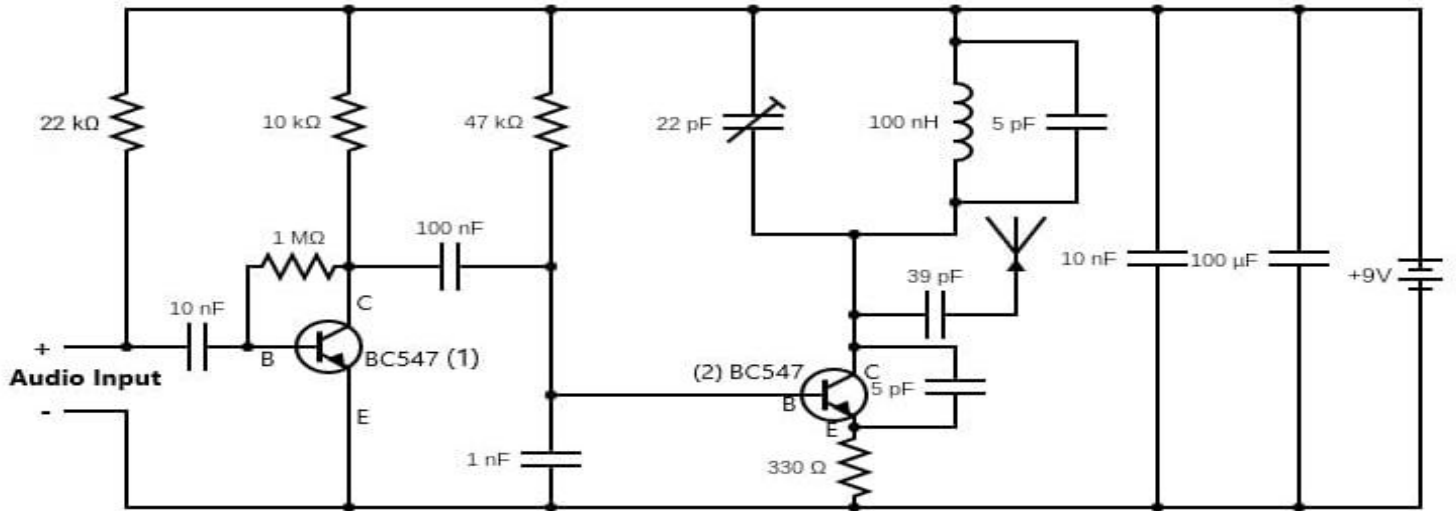


Fig. 2: Circuit Diagram

## WORKING PRINCIPLE

- What we have in this system built is a FM modulator that modulates the input signal and then transmit it in the FM band through the antenna of the system.
- This input signal is the electrical pulse generated by the phone that is connected to the circuit through aux-in which acts as a transducer that converts the voice or music into electrical pulse. The transmitted FM waves can be received by any standard FM Radio receiver of cell phones having FM receiver integrated in them.
- 88 MHz to 108 MHz is the range in which carrier frequency can be chosen. The modulation circuit consists of a coil, a transistor along with their biasing circuit.
- With the help of this modulation circuit the human voice which is range of 20 Hz to 20 kHz is converted into high frequency signal. This frequency signal is



transmitted through the antenna with the help of tuning circuit. This signal when received in any standard FM receiver and amplified and given to large speakers the voice of the addressee can reach to a large audience.

- The formation of the oscillating tank circuit can be done through the transistor of BC547 by using the inductor and variable capacitor. From this we can transmit FM radio frequency to the nearest FM receiver that can be any mobile or radio

## CHAPTER-5

### HARDWARE TOOLS USED

The hardware that is used for the mini-project work are

Components:

- a. Transistor : BC547
- b. Resistors : 47k  $\Omega$ , 22k  $\Omega$ , 10k  $\Omega$ , 330  $\Omega$ , 1M  $\Omega$
- c. Capacitors : 1n f, 10n f, 100n f, 5.6 pf, 39 pf, 100  $\mu$ f
- d. Inductor
- e. Trimmer capacitor : 1-22pf
- f. 9v battery
- g. Zero PCB board
- h. AUX -in

In our mini project these components are combined on a small circuit board, ensuring the portability and convenience of the device.

### DESCRIPTION OF COMPONENTS

#### 1. BC547 TRANSISTOR :

BC547 is a bipolar junction transistor i.e. the transistor is an NPN transistor. Transistor is nothing but the transfer of resistance. Main function of this transistor is to amplify as well as switch purposes. Maximum current gain of the transistor is 800A.



Fig 3: BC547 transistor

## 2. RESISTORS :

A variety of resistors have been used in the circuit such as 47k  $\Omega$ , 22k  $\Omega$ , 10k  $\Omega$ , 330  $\Omega$ , 1M  $\Omega$ . The main purpose of resistor is to reduce the current flow and to lower the voltage in any particular portion of the circuit. There are different types of resistors, and the type of resistor used in the circuit is carbon composition resistors. The value of the resistors is differentiated using the color bands on them.

Fig 4: 47k  $\Omega$       22k  $\Omega$       10k  $\Omega$       330  $\Omega$       1M  $\Omega$ 

## 3. CAPACITORS :

A capacitor is a two-terminal electrical device that can store energy in the form of an electric charge. In the circuit their main function is to maintain the voltage as a certain levels. A variety of capacitors have been used in the circuit to facilitate the mentioned functions namely 1n f, 10n f, 100n f, 5.6 pf, 39 pf, 100  $\mu$ f.

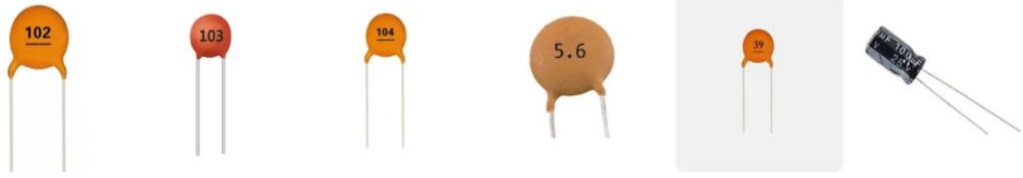


Fig 5:      1n f                      10n f                      100n f                      5.6 pf                      39 pf                      100  $\mu$ f

#### 4. INDUCTOR :

The inductor that has been used is called the air core inductor. As mentioned there is no solid core and works with the help of the air inside the coil. The coil is made of copper wire with insulation and non-stripped ends and tinned or bare ends as shown in the fig.6.



Fig 6: Air core inductor

#### 5. TRIMMER CAPACITOR :

Trimmer capacitor is nothing but the variable capacitor which is used for initial calibration and recalibration of the circuit. The main purpose of using the trimmer capacitor for FM transmitter is to set oscillator frequency (carrier frequency).



Fig 7: Trimmer Capacitor

## 6. BATTERY:

The 9V battery is an extremely common battery that was first used in transistor radios. It features a rectangular prism shape that utilizes a pair of snap connectors which are located at the top of the battery. A wide array of both large and small battery manufacturers produce versions of the 9V battery. Possible chemistries of primary (non-rechargeable) 9V batteries include Alkaline, Carbon-Zinc (Heavy Duty), Lithium. Possible chemistries of secondary (rechargeable) 9V batteries include nickel-cadmium (NiCd), nickel-metal hydride (NiMH), and lithium ion. The performance and application of the battery can vary greatly between different chemistries, meaning that some chemistries are better suited for some applications over others.



Fig 8: Battery

## 7. ZERO PCB BOARD :

Zero PCB is basically a general-purpose printed circuit board (PCB), also known as perfboard or DOT PCB. It is a thin rigid copper sheet with holes pre-drilled at standard intervals across a grid.



Fig 9: Zero PCB board

## 8. Aux-in :

Aux –in is a cord that allows your phone, computer, tablet, mp3 player, or whatever device you have connect with another device with an auxiliary port such as your car stereo, headphones, television etc.



Fig 10: Aux chord

## WORKING

- The following circuit diagram shows the FM transmitter circuit and the required electrical and electronic components for this circuit is the power supply of 9V, resistor, capacitor, trimmer capacitor, inductor, transmitter, and antenna. Let us

consider the aux-in to understand the sound signals, it produces according to the vibration to the change of air pressure and the AC signal.

- The formation of the oscillating tank circuit can be done through the transistor of BC547 by using the inductor and variable capacitor. The transistor used in this circuit is an NPN transistor used for general purpose amplification.
- It has two stages. The first stage amplifies the audio signal, generating a carrier signal using an oscillating, and the second stage modulates the carrier signal with the amplified audio signal.
- The first stage is at base of the transistor BC547(1) where audio input is provided using aux-in the converts the sound signal into an electrical signal and amplification takes place.
- The amplified signal from the transistor BC547(1) the passed to the base of the second transistor BC547(2) which further more amplifies the signal passed from the first transistor.
- To generate the radio frequency carrier waves the FM transmitter circuit requires an oscillator. The tank circuit is derived from the LC circuit to store the energy for oscillations. The input audio signal from the aux-in penetrated to the base of the transistor, which modulates the LC tank circuit carrier frequency in FM format. The variable capacitor is used to change the resonant frequency for fine modification to the FM frequency band.
- We are using an trimmer capacitor that can be used to vary the capacitance value in the oscillator circuit.
- The amplified signal along with the carrier signal generated by the LC circuit goes to the antenna.

- The modulated signal from the antenna is radiated as radio waves at the FM frequency band and the antenna is nothing but copper wire.



## CHAPTER-6

### PHOTOGRAPHS

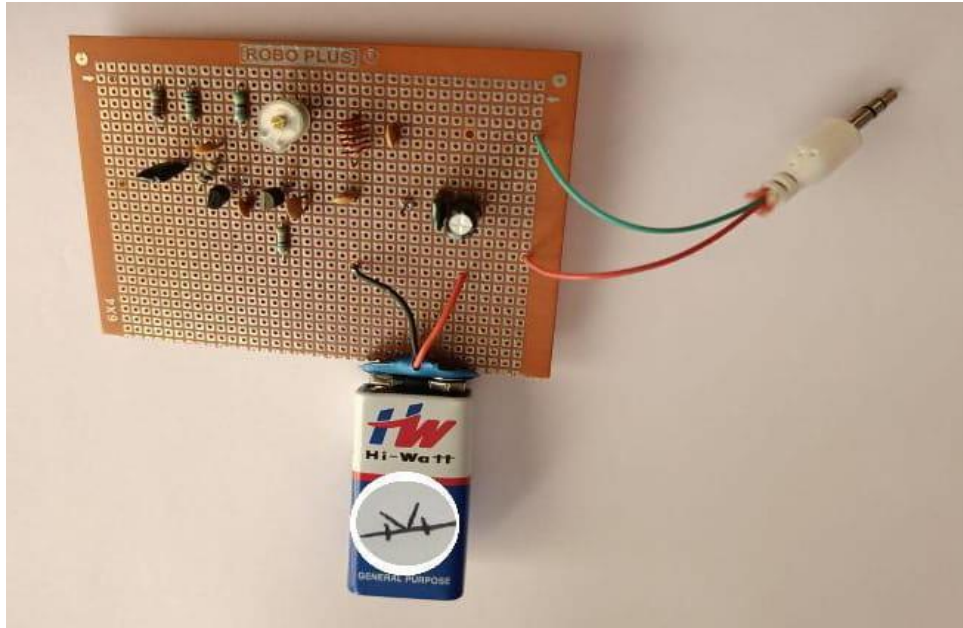


Fig 11: Photograph of the FM transmitter



Fig 12: Photograph of the FM transmitter along with the receiver

## CHAPTER-7

### RESULTS AND DISCUSSIONS

All connections have been built as per the circuit diagram on a zero PCB board. When testing the transmitter, the oscillator coil is tuned properly so that it transmits at the right frequency. This is done using a screwdriver for the adjustment. The operating frequency of the oscillator is supposed to be very high so every precaution is taken to avoid the use of tools such as a metal, or even bare fingers which can detune the oscillator.

The FM radio is tuned to the specified frequency 90MHz and kept within the maximum distance of 10 meters. Then the audio played via transmitter is received by the radio. Instantly the background noise diminishes and the audible message is heard. The FM tuning circuit can modulate a low frequency signal with the help of a high frequency signal and we can communicate with others with same frequency over a particular range. We faced difficulty in tuning the oscillator circuit as it was done manually. Even a slight nick in turning the variable capacitor while tuning can detune the whole circuit. For this design, a 6 turn coil of diameter 5 mm wound on a 7 mm length is used.

The Mini FM Transmitter project empowers individuals to engage in wireless audio transmission within a limited range. Its affordability, versatility, and educational value make it an accessible option for hobbyists, students, and small-scale broadcasters. Whether for personal enjoyment, educational exploration, or localized communication, the Mini FM Transmitter offers an exciting and practical solution for wireless audio broadcasting.

## CHAPTER-8

### APPLICATIONS, ADVANTAGES, OUTCOME AND LIMITATIONS

#### APPLICATIONS OF MINI PROJECT

- \* **FM radio and music:** Frequency modulation is widely used in radio broadcasting. It is a wideband FM, and its frequency is much larger than that of AM. Due to its low radio frequency interference, it is preferred to use FM to broadcast music on the radio.
- \* **Television sound:** The video information in a television broadcast is transmitted using AM, while FM is used for sound transmission due to low interference.
- \* **Satellite TV:** Some satellites use FM to broadcast video signals on the receiver's station.

#### ADVANTAGES OF THE MINI-PROJECT WORK

- The FM Transmitter Circuit could be made very easily as the very common components are used.
- Above circuit gives a very high efficiency in transmitting signal.
- The circuit is best suited for demonstration and FM transmitter circuit projects.
- The circuit does have large and complicated components.
- The transmitter circuit is capable to neglect the noise signal through the amplitude variation.

### **OUTCOME OF THE MINI-PROJECT WORK**

- We can transmit FM radio frequency to the nearest FM receiver that can be any mobile or radio.
- The range of the transmission is around 10-15 meters
- The FM Transmitter transmits the signal in the range of 87.5 to 90 MHz

### **LIMITATIONS OR DRAWBACKS OF THE MINI-PROJECT WORK**

- In the above FM Transmitter Circuit, there is a large wider channel needed.
- With the Circuit, the transmitter as well as the receiver tends to become more difficult.
- The received signal gets poor quality as there interference occurs in the medium.
- The above circuit is not good enough for high-power FM transmitter circuit purposes.

## **CHAPTER-9**

### **CONCLUSIONS AND FUTURE WORK**

- \* The Mini FM Transmitter project empowers individuals to engage in wireless audio transmission within a limited range.
- \* Its affordability, versatility, and educational value make it an accessible option for hobbyists, students, and small-scale broadcasters.
- \* Whether for personal enjoyment, educational exploration, or localized communication, the Mini FM Transmitter offers an exciting and practical solution for wireless audio broadcasting.
- \* Communication systems play a significant role in our daily lives. Frequency modulation is a type of modulation where frequency and phase remain constant. Frequency modulation is the process by which the frequency of the carrier signal changes with respect to the modulating frequency.
- \* It is broadly used in national radio broadcasts, satellite TV, TV, sound, music and video transmission instruments. It has various advantages over amplitude modulation and phase modulation. It provides noise immunity better than AM and PM. It offers low interference and a high sound-to-noise ratio.

### **FUTURE WORK OF THE MINI PROJECT**

To increase the efficiency and range of the FM transmitter and sort out the issues related to distortion.

## REFERENCES

- **"Tips on Using FM Transmitters"**. Guides at **Overstock.com**. Overstock.com. Retrieved 14 October 2014.
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- DeFelice, Bill (2011). **"Micro-Broadcasting: Getting The Most Out Of Part 15 Radio"**. **hobbybroadcaster.net**. Retrieved 14 October 2014.
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- **"Low Power Radio - General Information"**. Federal Communications Commission. 2015-12-08. Retrieved 2021-12-23.
- **^ Radio Frequency Devices "eCFR :: 47 CFR Part 15"**. Code of Federal Regulations. 2023-03-24. Retrieved 2023-03-28. **{{cite web}}: Check `|url=` value ([help](#))**.
- **^ "FM and TV Propagation Curves"**. Federal Communications Commission. 2015-12-11. Retrieved 2023-03-28.
- **^ "Regulation of the Extremely Low Power Radio Station"**. The Radio Use Website. Telecommunications Bureau of the Ministry of Internal Affairs and Communications (Japan). Retrieved 14 October 2014.

- **"FCC Public Notice Dated July 24, 1991"** (PDF). Archived from **the original** (PDF) on 2011-03-04.