

# ***Basic Design of FM Transmitter circuit***

Frequency modulation or FM is a form of modulation which conveys information by varying the frequency of a carrier wave and keeps the amplitude constant according to information signal.

- **FM broadcasting** is a method of radio broadcasting using frequency modulation (FM) technology. Invented in 1933 by American engineer Edwin Armstrong.
- The Transmitter of FM utilizes FM wave to transmit sound. It transmits audio signals over a carrier wave by varying the frequency, where carrier wave frequency is equivalent to the amplitude of the audio signal.
- The circuit generates frequency in the VHF band i.e. 88 to 108MHz.

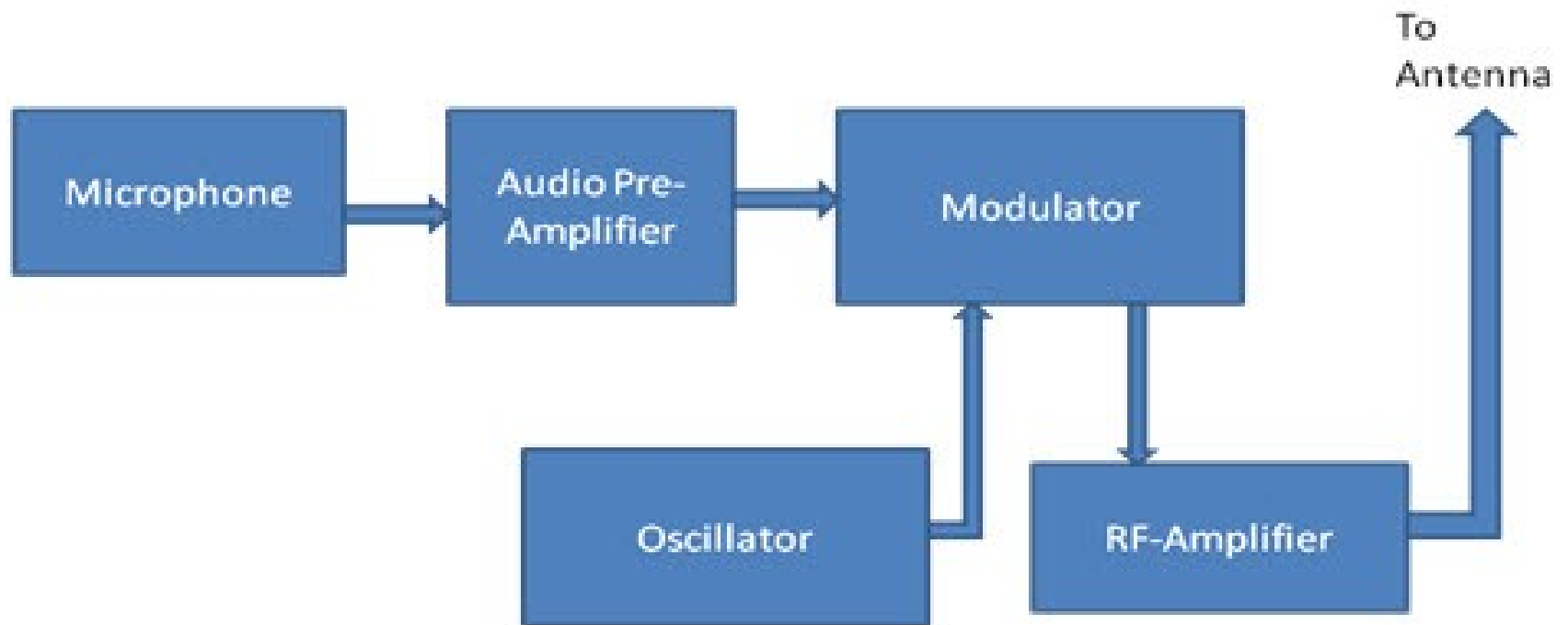
# FM Transmitter Circuit Principle:

➤ FM transmission is done by the process of **audio pre amplification**, **modulation** and then **transmission**. Here we have adapted the same formula by first amplifying the audio signal, generating a carrier signal using an oscillating and then modulating the carrier signal with the amplified audio signal. The amplification is done by an amplifier, whereas the modulation and carrier signal generation is done by a variable frequency oscillator circuit. The power of the FM signal from the oscillator is then amplified using a power amplifier to produce a low impedance output, matching that with the antenna.

## **Basic components of transmitter:**

- Micro-phone
- Audio pre-amplifier
- RF oscillator
- Amplification stage
- Antenna

# Basic Block Diagram:



## Components of FM Transmitter:

### The Microphone:

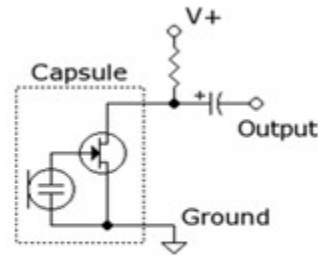
Microphones are changes over audio signals into electrical signals of the equal recurrence and of amplitudes in the same extent as a force variation. It enhances the signal 100 times before transmitting the signal to the first stage. The supply voltage of microphone is less than 0.5V.

A Capacitor on the output of the micro-phone couples the sign to the first sound pre-amplifier stage. This capacitor is intended to divide the DC voltage on the receiver from the voltage with respect to the transistor.

A variable resistor at micro-phone is utilized to alter the audio quality of amplifier and modify the variable resistor to get best quality.



Electrets microphone



A typical electrets microphone circuit

## **Audio Pre-Amplifier:**

Pre-amplifier is a self-biasing emitter fit for amplifying the signals got by the micro-phone. It conveys these to the oscillator stage. The capacitor disconnects the micro-phone from the base voltage of the transistor and permits just AC signs to pass through. The output waveform at the micro-phone is passes through a coupling capacitor to an emitter stage.

In this stage the signal is amplified moreover 70-100 times and is currently huge enough to be infused into the RF stage. Just an exceptionally self-biasing emitter stage is used for the sound enhancer. This stage is said to be AC coupled as it has a capacitor on both the input and output so the DC voltages of the different stages don't impact the voltage on the stage.

## **RF Oscillator:**

RF oscillator, it is a modulation stage. In this stage the amplified audio input signal is adjusted for transmission. Each transmitter circuit needs an oscillator part to create the RF waves. The transistor and its components encompassing the tuned circuit essentially keep the tuned circuit working at its resonant frequency.

Basic circuit for RF Oscillator is Colpitt Oscillator which produces oscillations with required frequency.

Basic principle of Colpitt Oscillator is depends upon Inductor and Capacitor variation according to our requirement.

$$f = 1/(2\pi\sqrt{LC})$$

using this we can select frequency.

## **Final Amplification Stage:**

This stage amplifies the output RF signal. The signal handled by the oscillator stage is not exceptionally capable so we pass it to an amplifying stage called an output stage to increase the amplitude. The FM transmitter circuit is enhanced by including this buffer or output stage so that oscillator is not driving antenna. This will give the circuit more dependability and more output.

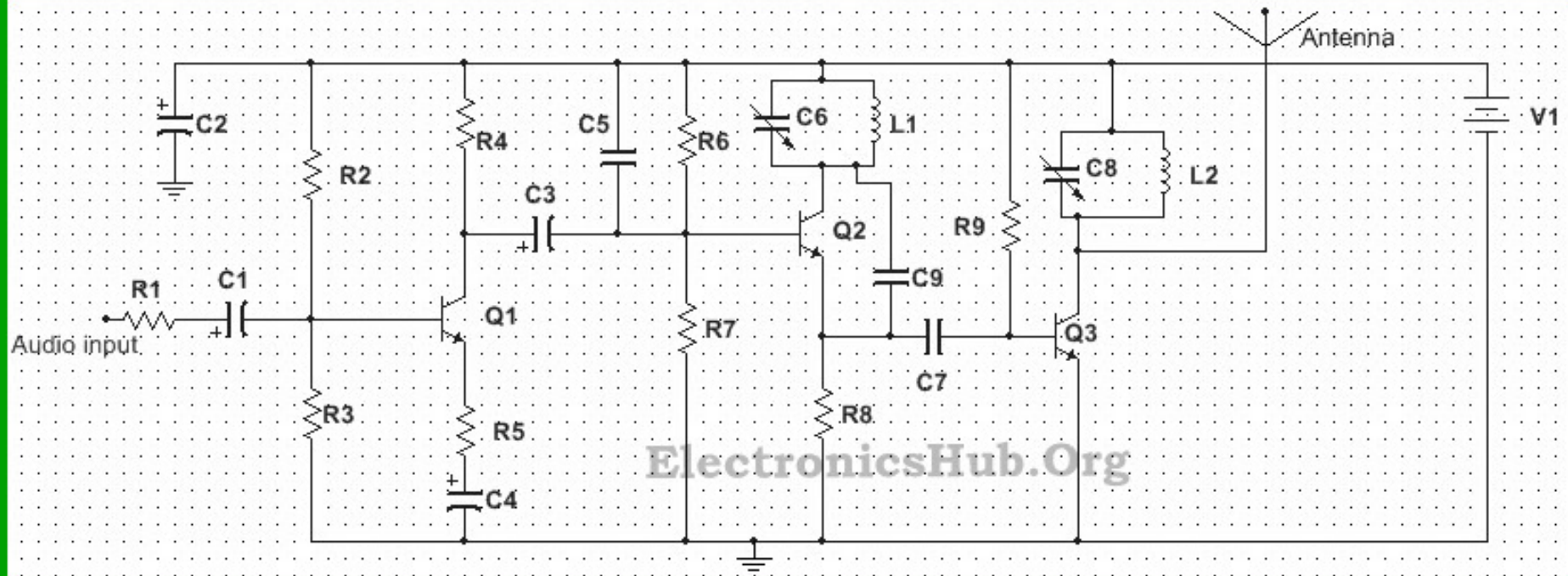
## **FM Antenna:**

The last/final stage of any FM transmitter is the FM antenna. This is the place where the electronic FM signal is changed over to electromagnetic waves, which are transmitted into the atmosphere. A 22 measure copper wire is suitable for antenna. We have to keep this wire in vertical. In that capacity you can utilize a telescopically extendable antenna for example ones discovered in radios. Its length ought to be give or take  $\frac{1}{4}$  the FM wavelength; review that duplicating frequency and wavelength equivalents the speed of light. For about 30-50 meters range, a 15cm antenna is sufficient but if you need to get a most extreme range you can utilize a half-wave antenna.





# Circuit Diagram for FM Transmitter:



## Components required:-

- R1-18K, R2-22K,
- R3-90K, R4-5K,
- R5-540 Ohms, R6-9K, R7-40K, R8-1K, R9-20K,
- C1-5uF Electrolyte, C2-47uF Electrolyte,
- C3-0.01uF Electrolyte ,C4-15uF Electrolyte,
- C5-0.01uF Ceramic, C6-20pF Variable Capacitor ,
- C7-10pF Ceramic ,C8-20pF Variable Capacitor ,C9-5pF ceramic,
- L1, L2-0.2uH ,
- Antenna 30 Inches Long Wire or Telescopic Antenna ,V1-9V Battery ,
- Audio Input Microphone.

## **FM Transmitter Circuit Design:**

### **Design of Audio Pre-amplifier:**

- Selection of  $V_{cc}$
- Selection of Load Resistor,  $R_4$
- Selection of Voltage Divider Resistors  $R_2$  and  $R_3$
- Selection of Emitter Resistor  $R_5$
- Selection of coupling capacitor,  $C_1$
- Selection of Microphone Resistor  $R_1$
- Selection of Bypass Capacitor,  $C_4$

## **Design of Oscillator Circuit:**

- Selection of tank circuit components – L1 and C6
- Selection of Tank Capacitor, C9
- Selection of bias resistors R6 and R7
- Selection of coupling capacitor, C3
- Selection of emitter resistor, R8

## **Design of Power Amplifier Circuit:**

- Since we require a low power output, we prefer using a class A power amplifier with LC tank circuit at the output. The values of the tank circuit components are same as that in oscillator circuit. Here we select the biasing resistor to be about 20 K and coupling capacitor of about 10 pF

# Operation of the Circuit:

- Audio input from the microphone or any other device is first amplified using the common emitter configuration of BC109. This amplified signal is then given to the oscillator circuit through the coupling capacitor. The oscillator circuit generates a signal with a frequency determined by the value of the variable capacitor. The output signal from the emitter of the transistor is coupled to the input of the power amplifier transistor using the coupling capacitor. As this signal is amplified, the variable capacitor in the power amplifier section tends to maintain an output matching with that of the oscillator. The amplified RF signal is then transmitted using antenna.

## **Testing the FM Transmitter:**

The voltages around the oscillator stage cannot be measured with an ordinary multimeter as the leads of millimeter will act an antenna when the circuit is operating and kill the operation of the circuit. This is certainly the case on the emitter of the second transistor, where the leads of a multimeter will draw off so much energy that the stage will stop working. Therefore, a field strength meter is used to test the output of FM transmitter. A field strength meter shows the strength of the actual field being radiated from your antenna. It is used to determine the basic radiation pattern of your antenna and see which direction your signal is strongest. You can make changes to your antenna and instantly know if it radiates better or worse.

### **Application of Fm Transmitter :**

The FM transmitters are used in the homes like sound systems in halls to fill the sound with the audio source.

These are also used in the cars and fitness centers.

The correctional facilities have used in the FM transmitters to reduce the prison noise in common areas.

### **Advantages of the FM Transmitters :**

The FM transmitters are easy to use and the price is low

The efficiency of the transmitter is very high

It has a large operating range

This transmitter will reject the noise signal from an amplitude variation.

### **Disadvantages of the FM Transmitter :**

In the FM transmitter the huge wider channel is required.

The FM transmitter and receiver will tend to be more complex.

Due to some interference there is poor quality in the received signals.

- **Conclusion:-**

Here we built the FM transmitter Circuit and detected by the receiver. Here we know the working and applications of fm transmitter.