

FM Transmission Using Single Bipolar Junction Transistor

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ABSTRACT

The project comprises of single bipolar junction transistor (BJT) for carrying information via frequency modulation (FM) technique. The circuit is rather clever; it uses same transistor for three purposes they are, Amplification of baseband signal, Acts as an oscillator and to develop the RF voltage at the emitter terminal (that is the input signal which is amplified at the collector).

Keywords: Bipolar Junction Transistor; Radio Frequency; Modulation; Frequency Modulation

INTRODUCTION

The FM transmitter circuit (Frequency modulation) is a circuit with a single BC 547 transistor.

It is a NPN transistor. In a communication through wireless, there are many types the (frequency modulation) FM is one of a kind. It carries the information (message) or data by changing the carrier wave frequency according to the message signal.

It is a VHF (Very High Frequency) radio signal, Bandwidth s in the range of 88MHZ to 108 MHZ in both transmission as well as receiving sections. The FM Transmitter consumes very less power compared to any other transmitters.

The transmission frequency of the FM circuit depends upon the values of inductor and capacitor(Tank circuit) used. The construction and design of the FM transmitter circuit is well discussed below.

1. FM TRANSMISSION

FM transmitter is a circuit that uses low power to operate and does uses FM(Frequency Modulation) Waves to transmit the modulated signal. The carrier waves with different frequency are used to transmit audio waves given through a microphone. A range of VHF from 87.5 MHZ to 108 MHZ is produced by the FM transmitter. Components required for FM transmitter circuit are modulator-to modulate the message signal over carrier, oscillator-to produce carrier, RF-Amplifier-to amplify the RF signal to travel to long distances, Audio pre-amplifier to amplify the baseband signal, Transducer(microphone) to convert audio signal to electrical signals and an antenna to radiate electromagnetic waves. There are two types of frequency signals in the signal:

1. Carrier signal (with carrier frequency)
2. Baseband signal (With audio frequency)

The carrier frequency is obtained by the oscillator. The LC tank circuit present in the schematic below act as an oscillator to produce the carrier waves. The Baseband signal (Message signal) is produced by a transducer or can be provided by audio device. FM signal (Frequency Modulation) is obtained by changing carrier frequency with respect to the amplitude of the baseband signal. The oscillator function is done by the tank circuit.

2.1 MESSAGE SIGNAL

Message signal is basically an audio signal or baseband signal which is provided by the user through a transducer device (microphone) or through an audio device. Amplitude of the message is taken as a reference for modulation process in which carrier signal frequency is varied according to the amplitude of the audio signal provided.

2.2 CARRIER SIGNAL

Carrier signal can be defined as a high frequency signal that is modulated by the modulating signal or the baseband signal. This carrier signal increases the range and travel distance of the information signal. Apart from the distance it also improves the quality of the signal.

We can consider a carrier signal as some vehicle. It carries the information as the passengers inside a bus, train or any vehicle.

2.3 MODULATION

The process of varying one or more properties of a periodic waveform is called as modulation. It contains baseband signal with carrier frequency. Frequency modulation (FM) or amplitude modulation (AM) is used in most of the present day radio systems

2.4 Antenna

An antenna is a device used to convert electric signals into electromagnetic signals. A radio frequency alternating current is generated by the transmitter which is applied to the antenna .The interface between radio waves propagating through space and electric currents moving in metal conductors, is antenna used. In transmission, a radio transmitter supplies an electric current to the antenna's terminals, and the antenna radiates the energy from the current as electromagnetic waves.

3. BLOCK DIAGRAM

Basic block diagram is mentioned in the figure below,

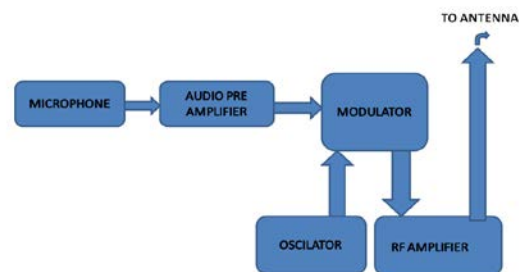


Fig. 1. Block diagram of basic F.M transmission section.

Here Base band signal is amplified and given to modulator, where modulated signal is given to RF amplifier which amplifies the power of modulated signal to send the baseband signal to longer distances, the antenna radiates the modulated signal in the form of electromagnetic radiation.

4. WORKING

The circuit diagram shown for FM transmitter circuit and the electronic components are inductor, capacitor with capacitance 0.001 μ F, trimmer capacitor, the resistors with values of 330 ohms and 4.7k ohms, transistor, microphone, 9v of power supply or 7809 Voltage regulator (in case if you are using RPS regulated power supply) and an antenna. The microphone, it is assumed to grab the sound signals and there is a presence of sensor with capacitance value inside the microphone. The change in pressure of air or capacitance causes in production of such AC signals. Or 3.5mm jack when connected to a mobile or other audio device. Is considered as input base band signal . The Oscillator is possible with the help of Transistor BC547, Inductor and the trimmer capacitor. The transistor BC547 is used in FM transmitter circuit. It is a NPN transistor which is basically used for signal and voltage amplification purposes., The FM Transmitter Circuit will start oscillating with the resonant to that of the carrier frequency (frequency of the carrier signal) If the current is passed through L1 Inductor and the variable capacitor.

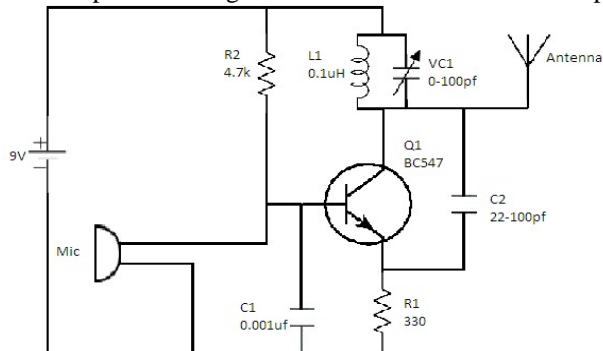


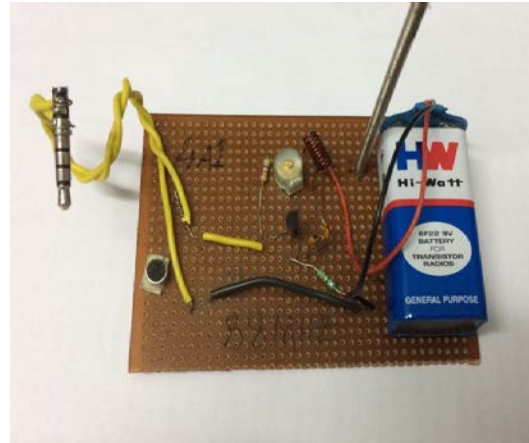
Fig. 2. Circuit diagram of F.M Transmitter using BJT

The oscillator is required in FM Transmitter Circuit in order to generate the radio frequency carrier waves. The energy for the oscillation is stored as it is a derived from the (inductor and capacitor) LC circuits. So the transmitter circuit is capable of storing energy. The base band signal obtained from the microphone or 3.5mm jack is passed through the base terminal of the transistor in order to modulate with the output signal of the LC circuit in FM (frequency modulation wave) Form.

In order to obtain best FM signal frequency band the resonant frequency can be changed by varying the value of capacitor in trimmer capacitance. The modulated signal is then transmitted or

radiated with the help of antenna with the frequency of FM frequency range. The antenna is nothing but a piece of good conductor, in our application we have used an antenna from a RF controlled remote car circuit, and the length of the antenna however must be significant.

5. HARDWARE MODEL



6. CONCLUSION

An FM transmitter has been proposed which is intended to work completely based on a single transistor. Advanced features such as a high range or long distance transmission is currently subject of further improvements.

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