Report – FM Radio Transmitter

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OBJECTIVE

To construct an FM Transmitter using a 2n3904 NPN Transistor in the frequency range of 88MHz-102MHz and receive it in mobile radio.

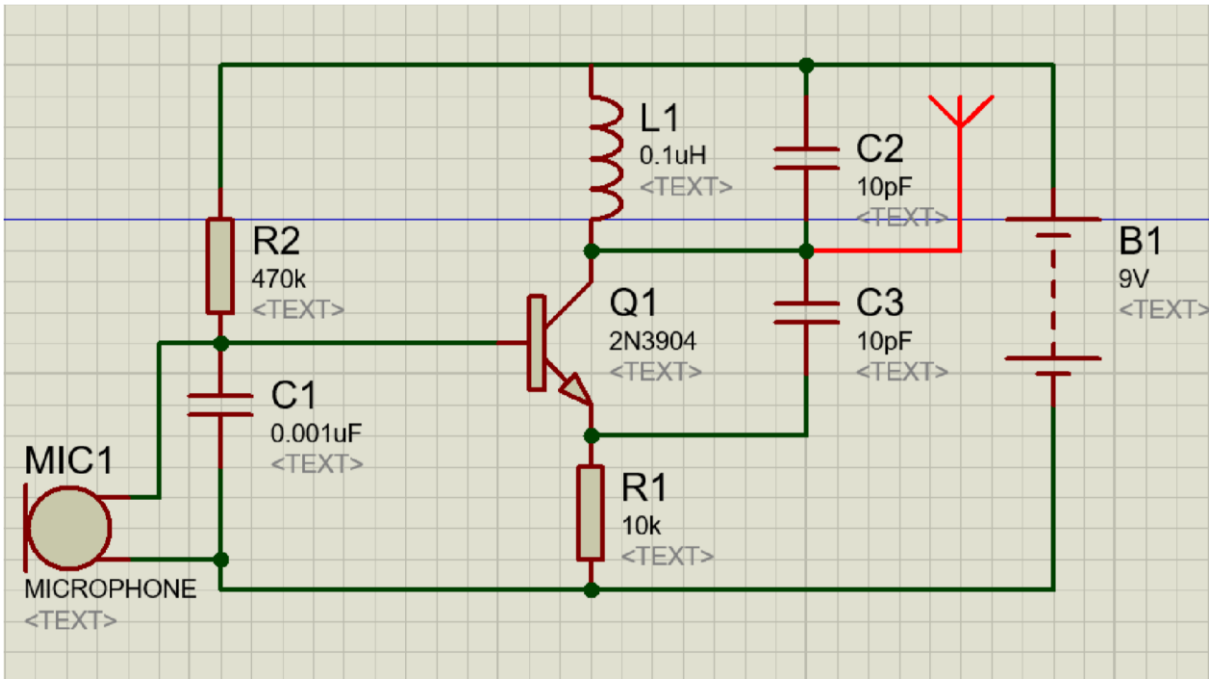
ABSTRACT:

The FM transmitter is a low-power transmitter and it uses Frequency Modulated waves for transmitting the sound, this transmitter transmits the audio signals through the carrier wave by the difference of frequency. The carrier wave frequency is equivalent to the audio signal of the amplitude and the FM transmitter produces a VHF band of 88 to 108MHZ. Frequency modulation (FM) transfers the information by varying the frequency of the carrier wave according to the message signal. Generally, the FM transmitter uses VHF radio frequencies of 87.5 to 108.0 MHz to transmit & receive the FM signal. This transmitter accomplishes the most excellent range with less power. The performance and working of the wireless audio transmitter circuit depend on the induction coil & variable capacitor.

COMPONENTS REQUIRED:

- Breadboard
- 2n3904 NPN Transistor
- Resistor 470ohm
- Resistor 10k ohm
- Capacitor 10pF x2
- Capacitor 1nF
- Capacitor 10nF
- Condenser mic
- Copper wire (as an inductor)
- Connecting wires

CIRCUIT DIAGRAM:



DESCRIPTION:

Although computers may be the most important outworking of electronics in the modern world, wireless communications aren't far behind. You may have wondered, for instance, how your cell phone or GPS device can send or receive information from distant sources--all invisibly.

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 mic penetrated the base of the transistor, which modulates the LC tank circuit carrier frequency in FM format. The capacitor in parallel with the inductor is used to change the resonant frequency for fine modification to the FM frequency band. The modulated signal from the antenna is radiated as radio waves at the FM frequency. In this circuit, the length of the antenna should be significant, and here 10 cm long copper wire of the antenna is used.

FM is divided into two broad categories:

Wideband FM (WFM)

Narrowband FM (NBFM)

The primary difference between the two types of FM is the number of sidebands in the modulated signal. Wideband FM has a large number (theoretically infinite) number of sidebands. Narrowband FM has only a single pair of significant sidebands.

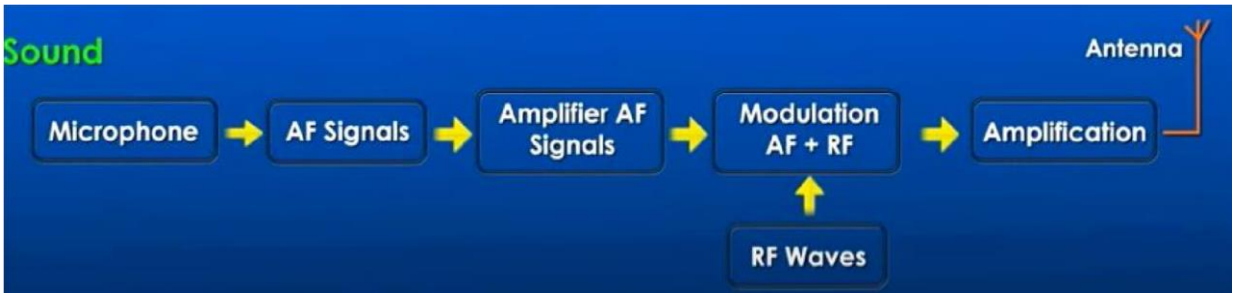
Commercial WBFM broadcasts occur in the VHF range, between 88 and 108 MHz. The carrier frequencies start at 88.1 MHz and are separated by 200 kHz intervals. The maximum audio bandwidth allowed is 15 kHz and the deviation is limited to +/- 75 kHz. limiting the deviation to this value leaves a 25 kHz guard band at each end of the channel that limits inter-channel interference. The DR for commercial FM broadcasting is 75/15 = 5.0. This is a wideband FM signal. **NBFM** is widely used in business and public service communications. The DR for NBFM is restricted to values between 0.5 and 1.0. By holding the DR to such small values, only the carrier and the first sideband are of significant amplitude. When only one sideband and the carrier are transmitted, the NBFM signal occupies the same bandwidth as an AM signal. This overcomes one of the drawbacks of wideband FM, the large bandwidth required. The FCC permits the bandwidth of NBFM signals to be from 10 to 30 kHz, depending on the assigned carrier frequency and the type of operation authorized.

OUTCOME:

With the help of a condenser microphone, the voice is converted into electrical signals at the capacitor C1 and the capacitor C2 is used for noise reduction/canceling. The electrical signals from the microphone are comparatively weak to be used to transmit and hence 2N3904 NPN transistor is used to amplify the signal. Furthermore, the signal is superimposed with the carrier signal which is generated from the tank circuit. The inductor and capacitor which are parallel to each other are the ones that make up the tank circuit. On the contrary, the carrier wave generated by the tank circuit is damped that is it will decay over time. This is prevented by the same transistor 2n3904. the capacitor connecting the collector and emitter junctions of the transistor forms the feedback to the circuit. The message signal and the carrier wave signal are superimposed at the base terminal of the 2n3904 transistor. The output signal is transmitted with the help of the antenna.to conclude the range of frequency

in which the output signal is transmitted is due to the inductor and the capacitor which are in parallel.

The range of electromagnetic waves is 7-10 meters i.e. if the receiver goes beyond the range, only noise will be received. The designed circuit has a bandwidth of 88102 MHz.



- Sound waves are converted into electrical signals called Audio Frequency Waves(AF).
- Microphones convert the vibrations into audio frequency.
- Audio Frequency Waves cannot travel too long, so electromagnetic waves of 1 meter to 1 kilometer as transport vehicles for Audio Frequency Waves signals.
- EM waves carrying AF signals are called carrier waves or radio frequency waves (RF).
- Radiofrequency waves are generated by the tank circuit(Oscillator circuit byL2 AND C2).
- These modulated waves are transmitted to the antenna and that is transmitted to space.

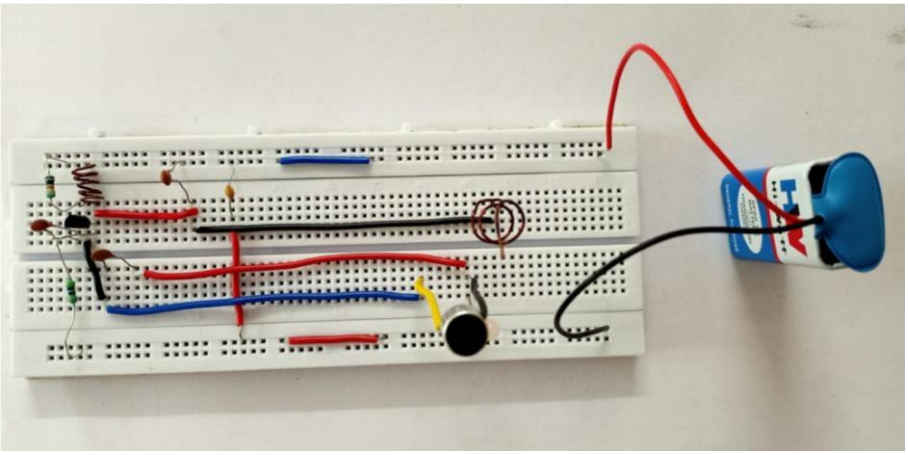
FORMULA FOR CALCULATING THE TRANSMITTED FREQUENCY:

$$F= 1/2\pi\sqrt{L2C2}$$

L2 = 0.001H (8 cm of copper wire and a radius of 0.35 cm)

C2= 10 pF

- F ranges from 88MHz-102MHz



FUTURE SCOPE :

- This smaller version of the FM Transmitter can act as a spy bug and must strictly not be used to invade the privacy of the public/people.
- The FM transmitters are used in the homes like sound systems in halls to fill the sound with the audio source.
- The correctional facilities have used FM transmitters to reduce the prison noise in common areas.
- The FM transmitters still play a major role in the mode of communication in the military, air force, navy, etc. of each country even though the world is moving towards digitalization.
- It can also be used as a bug and several random taps on the microphone synchronously produce morse code.
- One of the most widely used applications is SONAR, which is still developing to increase its range.
- It also has found application in video broadcasting and recording, sound synthesis, medicine, data transmission, both analog and digital, telemetry, military surveillance, and detection systems, and, to a smaller degree, in many other fields.

REFERENCES

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