PRINCIPLE OF AM AND FM DEMODULATION

Demodulation is the process of recovering the signal intelligence from a modulated carrier wave. This process, also called detection, is the reverse process of modulation. The wireless signal consists of radio frequency (high frequency) carrier wave modulated by audio frequency (low frequency). The diaphragm of a telephone receiver or a loud speaker cannot vibrate with high frequency. Moreover, this frequency is beyond the audible range of human ear. So, it is necessary to separate the audio frequencies from radio- frequency carrier waves.

Types of Demodulation

Corresponding to different types of modulation processes, there are different types of demodulation.

1. AM Demodulation

In order that a modulated wave is audible, it is necessary to change the nature of modulated wave. This is accomplished by a circuit called detector. In amplitude demodulation a simple diode detector is used. A detector circuit performs the following two functions:

(i) It rectifies the modulated wave i.e. negative half of the modulated wave is eliminated. A modulated wave has positive and negative halves exactly equal. Therefore, average current is zero and speaker cannot respond. If the negative half of this modulated wave is eliminated as shown in, the average value of this wave will not be zero since the resultant pulses are now all in one direction. Therefore, the diaphragm will have definite displacement corresponding to the average value of the wave. It may be seen that shape of the average wave is similar to that of the modulation envelope. As the signal is of the same shape as the envelope, therefore, average wave shape is of the same form as the signal.

(ii) It separates the audio signal from the carrier. The rectified modulated wave contains the audio signal and the carrier. It is desired to recover the audio signal. This is achieved by a filter circuit which removes the carrier frequency and allows the audio signal to reach the load i.e.speaker.

2. FM Demodulation

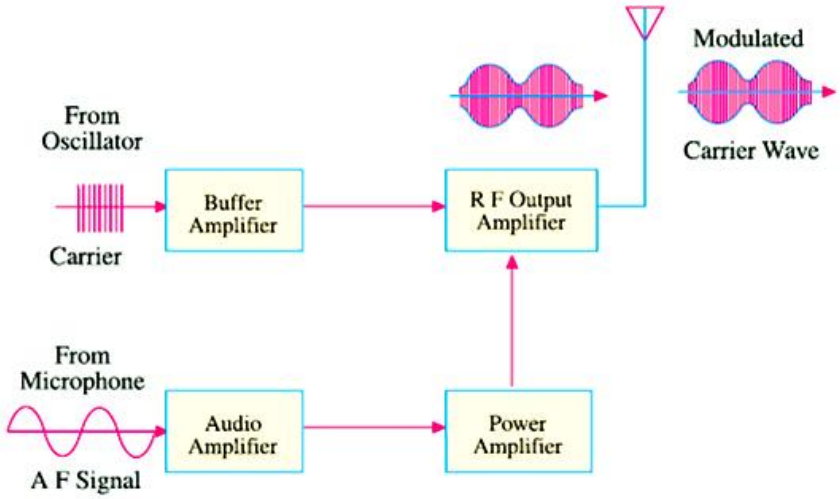
An FM carrier signal contains information (or intelligence we wish to convey) in the form of frequency variations above and below the centre frequency of the carrier. For recovering the information, we must first convert the FM signal in such a way that it appears as a modulated RF voltage across the diode. A simple method of converting frequency variations into voltage variations is to make use of the principle that reactance (of coil or capacitor) varies with frequency. When an FM signal is applied to an inductor, the current flowing through it varies in amplitude according to the changes in frequency of the applied signal. Now, changes in frequency of the FM signal depend on the amplitude of the modulating AF signal. Hence, the current in the inductor varies as per the amplitude of the original modulating signal. In this way, frequency changes in FM signal are converted into amplitude changes in current. These changes in current when passed through a resistor produce corresponding changes in voltage. Hence, we find that, ultimately, frequency variations in FM signal are converted into voltage changes. Also, there exists a linear relation between the two – something essential for distortion-less demodulation.

There are a number of circuits that can be used to demodulate FM such as slope FM detector, ratio detector, Foster-Seeley FM detector, phase locked loop FM demodulator, quadrature FM demodulator and coincidence FM demodulator.

BLOCK DIAGRAM OF AN AM TRANSMITTER

The following figure shows the block diagram of a typical transmitter. The carrier wave is supplied by a crystal-controlled oscillator at the carrier frequency. It is followed by a tuned buffer amplifier and an RF output amplifier.

The source of AF signal is a microphone. The audio signal is amplified by a low level audio amplifier and, finally, by a power amplifier. It is then combined with the carrier to produce a modulated carrier wave which is ultimately radiated out in the free space by the transmitter antenna as shown.



BLOCK DIAGRAM OF FM TRANSMITTER

The FM transmitter mainly consists of pre-amplifier, FM modulator, oscillator, frequency multiplier and power amplifier. Basically common FM transmitter contains following functional blocks.

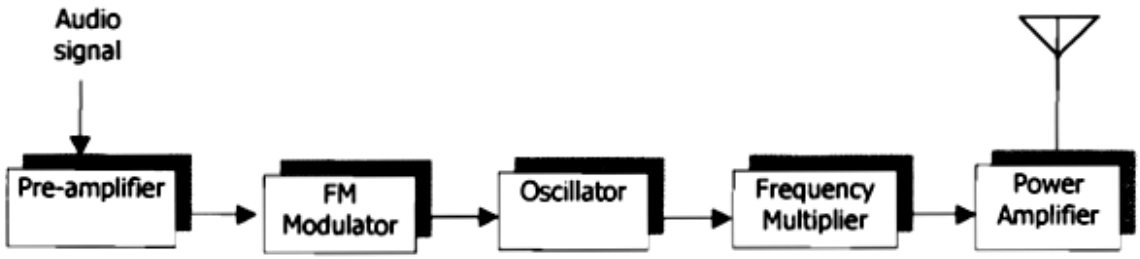


Figure 3.1: Block diagram of standard FM transmitter.

The pre-amplifier boosts the audio signal levels from several milli-volts to higher enough stage for feeding into the modulator. Usually a high pass filter network is added between pre-amplifier and modulator stage. This high pass filter acts as pre-emphasis network to improve the signal to noise level of FM transmission at higher frequency. The pre-emphasis network is optional. However, the receiver will suffer from distortion at higher frequency of audio signal if this stage is ignored. With the carrier signal generated from oscillator, the modulator modulates the carrier with input signal from pre-amplifier stage.

The operating frequency of the generated FM output is still not high enough to be transmitted through free space. Thus, several stages of frequency multiplier are put to increase the operating frequency. After going through a number of multipliers, the attenuation of signal level is compensated by the final stage power amplifier. Power amplifier restored the FM signal strength to the desired level.