

Frequency modulation

Wireless communication

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Abstract: In the modulation process the base band signal such as voice, radio etc. modifies another high frequency signals called the carrier. The carrier is usually a sine wave i.e. higher in frequency than highest base band frequency. There are mainly two types of modulation techniques: analog and digital In this paper I am going to present a brief description about the FM (frequency modulation) which is a analog modulation technique. In FM the instantaneous frequency of the radio frequency carrier wave is varied in accordance with the modulating signal, while the amplitude of the RF (radio frequency) wave is held constant.

I. INTRODUCTION

Frequency modulation is a process in which the frequency of the carrier signal is varied in accordance with the amplitude of the modulating signal. Keeping amplitude and phase of the carrier signal constant.

The range of modulating frequency 30 Hz to 15kHz for wideband FM and 30Hz to 3kHz for narrow band FM .The wideband FM is used where the purpose is to transmit high fidelity signal such as FM broadcasting and TV sound.

II. EASE OF USE

A. Resilient to noise :-

One of the main advantages of frequency modulation that has been utilized by the broadcasting industry is the reduction in noise as most noise is amplitude based ,this can be removed by running the signal through the limiter so that frequency variation appear.

B.Does not require linear amplifiers in the transmitter :-

As only frequency changes are required to be carried ,any amplifier in the transmitter do not need to be linear.

C.Unables greater efficiency than many other modes :-

The use of non linear amplifier e.g. class C, etc means that transmitter efficiency levels will be higher - linear amplifier are inherently insufficient.

III. MODULATION INDEX

1.The modulation index of FM is defined as,

$M_f = \frac{\delta}{f_m}$ = frequency deviation/modulating frequency

$M_f = \delta / f_m$

2. The modulation index(m_f) is very important in FM because the bandwidth of the FM wave.

3. Modulation index also decides the number of sidebands having significant amplitude.

4. In AM the maximum value of the modulation index is 1, but in FM the modulation index can be greater than 1.

IV. METHODS FOR GENERATION OF FM

There are 2 methods of generation of FM:

A.Direct method:

1. If L or C of tuned circuit of an oscillator is changed in accordance with the amplitude of modulating signal ,it gives FM signal.

2. The reactance of device is varied proportional to modulating signal voltage ,this will vary the frequency of oscillator to produce FM.

3. The device used are FET, transistor or varactor diode.

4. There are two methods:

(i)FET Reactance modulator

(ii)Varactor diode modulator .

(i)FET Reactance

1. FET here is a three terminal reactance that may be connected across the tank circuit of the oscillator to be frequency modulated.
2. The value of this reactance is proportionally to the transductance of the device ,which further depends on the gate bias and its variations.

(ii) VARACTER diode modulator

1. The varacter diode FM modulator is shown in figure below.
2. A varacter diode is semiconductor diode whose junction capacitance varies linearly with the applied bias.
3. The varacter diode must be reverse biased.
4. The diode is first reverse biased by the negative voltage $-V_b$. Due to reverse bias the junction capacitance effect is provided.
5. Modulating voltage is applied in series with negative do bias. Hence , bias applied across varacter with modulating voltage.
6. This will vary junction capacitance of the diode causing oscillator frequency to vary accordingly.
7. The RFC will connect the dc and modulating signal to the varacter diode but it offers a vary high oscillator circuit is isolated from dc bias and modulating signal.
8. This is simplest reactance modulator and used for automatic frequency control and remote tuning.

B. Indirect method :

1. Direct method of FM generation uses LC oscillator but LC oscillator are not stable for communication and broadcast purpose.
2. Alternative method is indirect method are called as "Armstrong method" of FM generation.
3. In this method FM is obtained through phase modulation.
4. A crystal oscillator can be used hence frequently stability is very high.
5. This method is widely used in practice.

(i)Armstrong method

Direct method of FM generation uses LC oscillators but LC oscillators are not stable for communication and broadcast purpose, this method allows the use of crystal oscillator to generate FM through phase modulation.

Operation of the Armstrong method :

1. The crystal oscillator generates the carrier at low frequency typically at 1MHz.this is applied to the combining network and 90deg phase shifter.

2. The modulating signal is passed through an audio equalizer to boost low modulating frequencies. The modulating signal is then applied to a balanced modulator.
3. The balanced modulator produces two sideband such that their resultant is 90deg phase shifted with respect to understand carrier.
4. The un-modulated carrier and 90° shifted sidebands are added in combining network.
5. The output of combining network is FM is FM wave with low carrier frequency f_c and low value of modulation index m_f .
6. The carrier frequency and modulation index are then raised by passing through first group of multipliers. The carrier frequency is hen raised by using a mixer and then f_c and m_f both are raised high values using the second group of multipliers.
7. The FM signal with high f_c and high m_f is then passed through a class C power amplifier to raise the level of the FM signal.

V. ADVANTAGES OF FM OVER AM

1. An FM system provides a better signal to noise ratio then the AM system put simply this means it has a less noise .
2. During its transmission(prapogation) a frequency modulated wave will be subject to noise and interference voltages the effect of this unwanted voltage is to vary the amplitude and phase of the FM wave.
3. The deviation ratio used in amateur communication(narrow band FM)is 5/3or 1.66the signal to noise ratio advantages over AM.

VI. DISADVANTAGES OF FM OVER AM

1. FM has a greater bandwidth requirement than AM. Narrow band FM occupies 16kHz space of spectrum compared to AM's 6kHz.
2. FM system generally have a much wider bandwidth than AM system .This makes FM more pron to selective fading amplifies ti hf prapogation .

VII. REFFRENCES

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