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The LNM Institute of Information Technology

The LNM Institute of Information Technology
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Signal System and Communication Laboratory

Session 2020-21
Experiment No. 07

1 Aim

1) To generate amplitude modulated signals (= 0.3, 0.5 and 1) and Demodulate the modulated wave.
2) To implement a Double Side Band - Suppressed Carrier (DSB-SC) modulator using a sampler (switch) and a band-pass filter and recover the modulating signal.

2 Hardware & Software Required

* Desktop/Laptop
* MATLAB

3 Theory

3.1 AM Modulation

In Amplitude Modulation the amplitude of high frequency sine wave (carrier) is varied in accordance with the instantaneous value of the modulating signal.

$$m(t) = A_m cos(2 f_m t) \quad \text{(modulating signal)} \tag{1}$$

$$c(t) = A cos(2\pi f_c t) \quad \text{(carrier signal)} \tag{2}$$

$$s_{AM}(t) = [A_c + A_m cos(2\pi f_m t)]\ cos(2\pi f_c t) \quad \text{(equation of Amplitude Modulated wave)} \tag{3}$$

Where;

A_m: Amplitude of modulating signal

A_c: Amplitude of carrier signal

f_m: Frequency of modulating signal

f_c: Frequency of carrier signal

Therefore, above is the derivation of Amplitude Modulation.

3.1.1 Modulation index

Modulation index is also known as modulation depth is defined for the carrier wave to describe the modulated variable of carrier signal varying with respect to its unmodulated level. It is represented as follows:

$$\text{Modulation index } (\mu) = \frac{m_p}{A} = \frac{V_{max} - V_{min}}{V_{max} + V_{min}} \tag{4}$$

where;
m_p is the peak value of modulating signal and A is the carrier amplitude, V_{max} and V_{min} are maximum and minimum values of the envelope.

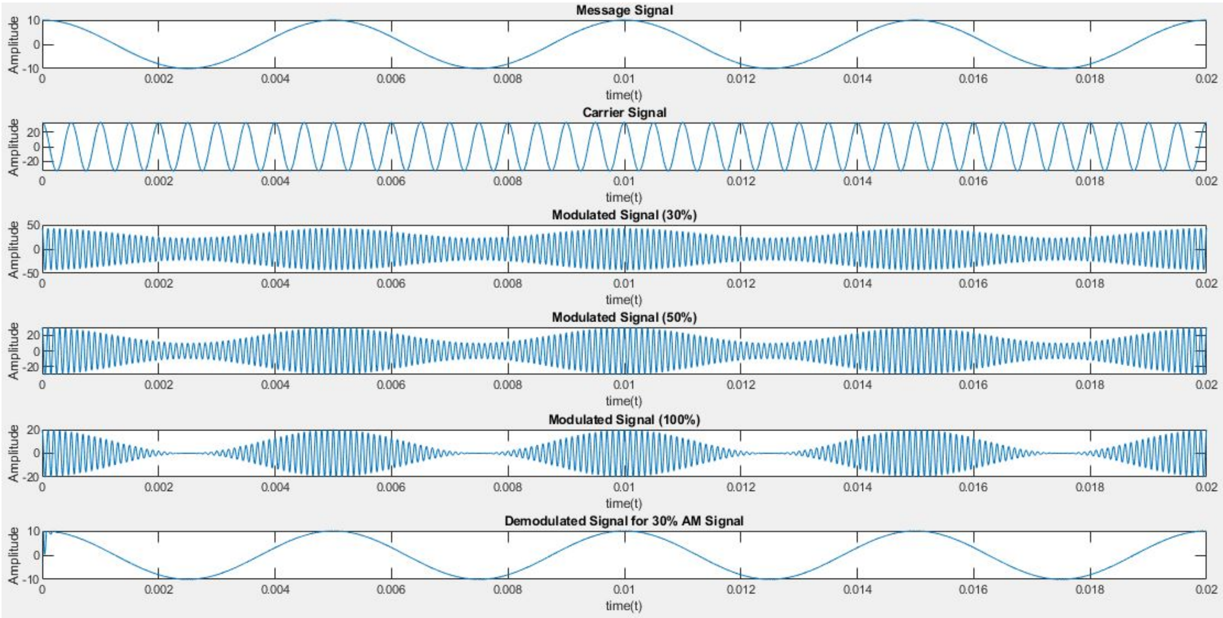

Figure 1: AM Modulation and Demodulation waveforms

3.2 DSB-SC Modulation

Double-sideband suppressed carrier modulation is the same as AM, except there is no carrier component. The basic transmit signal for DSB-SC is

$$s_{DSB-SC}(t) = m(t)\ cos(2\pi f_c t). \tag{5}$$

where f_c is the carrier frequency. The Fourier transform $S(f)$ the modulator output is related to the Fourier transform $M(f)$ of the message signal by

$$S(f) = \frac{1}{2}M(f - f_c) + \frac{1}{2}M(f + f_c) \tag{6}$$

3.2.1 DSB-SC Demodulation

Demodulation is recovering the message signal back from the modulated signal. Demodulation has two basic types.

1. Non Coherent or Envelop Detection
2. Coherent or Product Detection

Former type is mainly reserved for Double Side Band (DSB) and Vestigial Side Band (VSB) type modulation. On the other hand, later can be used in every AM type. Keeping the efficiency and cost parameters in mind, coherent detection technique is utilized here. In Coherent Detection modulated signal at receiving end is multiplied with the carrier of same frequency as was at sending end because of which this technique is called as synchronous demodulation. The signal is then passed through low pass filters to recover the original signal back. In this experiment we have used simple 1st order filters to analyze their performance.

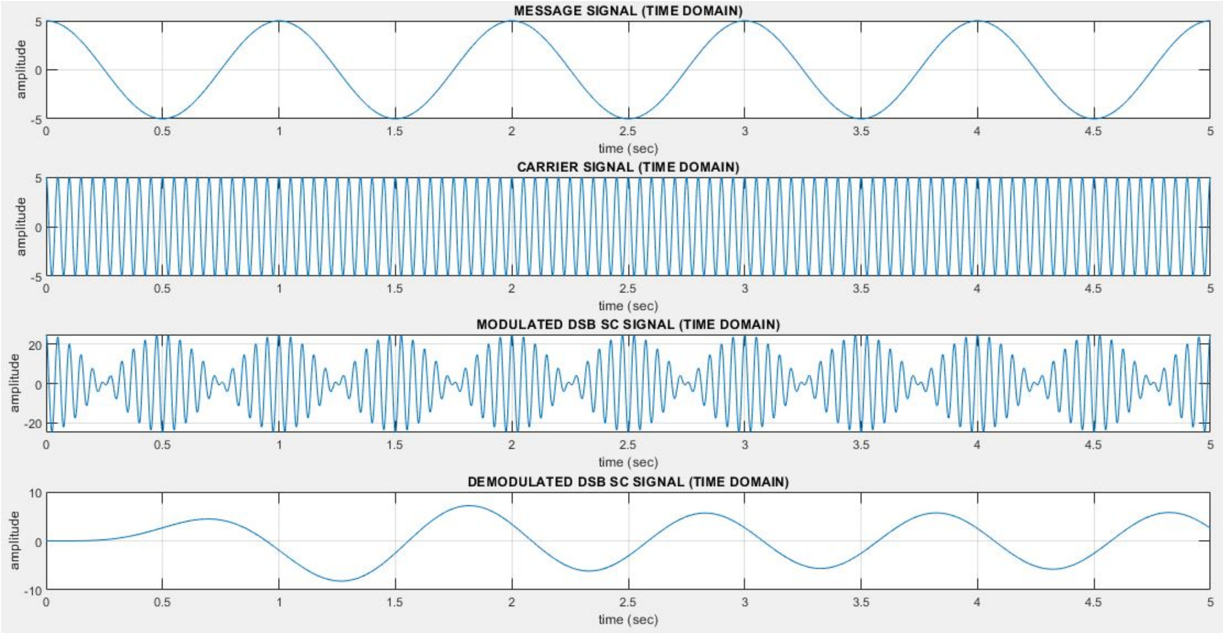

Figure 2: DSB-SC Modulation and Demodulation waveforms

4 Exercises

1. Generate AM wave forms in time domain and frequency domain with 30%, 50% and 100% depth of modulation. $[A_m = 10V;\ f_m = 200Hz$ and $f_c = 2000Hz]$
2. Study the effect of over modulation in AM waveform.
3. Generate DSB-SC wave forms in time domain and frequency domain. $[A_m = 5V;\ A_c = 5V;\ f_m = 1Hz$ and $f_c = 20Hz]$
4. Compare the spectrum of DSB-SC with DSB-FC signal for same set of modulating frequency and Carrier frequency.