



## Experiment No. 2 : Generating Amplitude modulated signal

### Objective :

The aim of this experiment is to generate the AM signal using simulation in MATLAB.

### Theory:

Analog Communication is an information transmitting mechanism, i.e. music, voice, and video using broadcast radio, walkie-talkies, or cellular radio, and broadcast television. The significant invention made by Marconi in 1895 was a radio. Later, the foundation of Trans-Atlantic Communication Systems had been taken place. Although digital communications systems are much more efficient, cost-saving, more reliable, some communication systems are still analog.

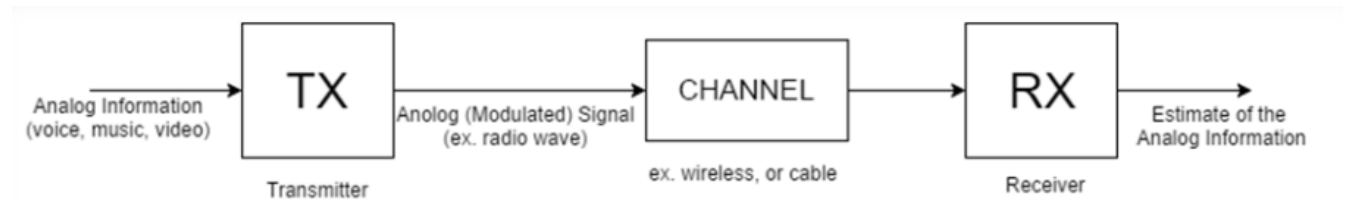


Figure 1: Basics of Analog Communications

Analog communication techniques can be summarized as:

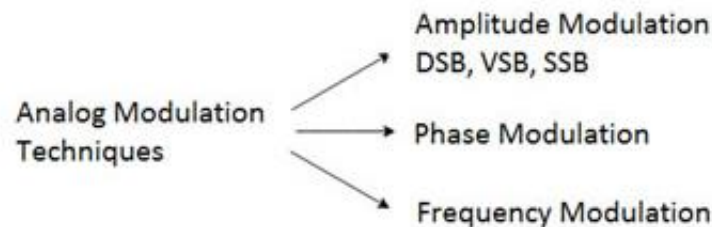


Figure 2: Analog Modulation Techniques



Advantages of modulation:

- Size of the antenna reduces when a signal is modulated by a larger frequency of a carrier.

$$\text{Antenna size} = L = \lambda = \frac{c}{f_c}, \text{ where } c = \text{speed of the light} = 3 \times 10^8 \text{ m/s}$$

- Using modulation to transmit the signal through space to long distances. Therefore, Wireless Communication techniques has raised our standards considerably.
- Modulation allows us to transmit multiple signals in the same medium (i.e. Frequency Division Multiplexing, FDMA)

### Amplitude Modulation and Demodulation

Let  $\omega_c = 2\pi f_c$  be the carrier frequency in radians per second where  $f_c \gg W$ . Then the amplitude modulated signal  $s(t)$  can be expressed as:

$$s(t) = A_C [1 + \mu m(t)] \cos(2\pi f_c t)$$

$$s(t) = A_C \cos(2\pi f_c t) + A_c \mu m(t) \cos(2\pi f_c t)$$

, where  $\mu$  is the modulation index defined in  $0 < \mu < 1$

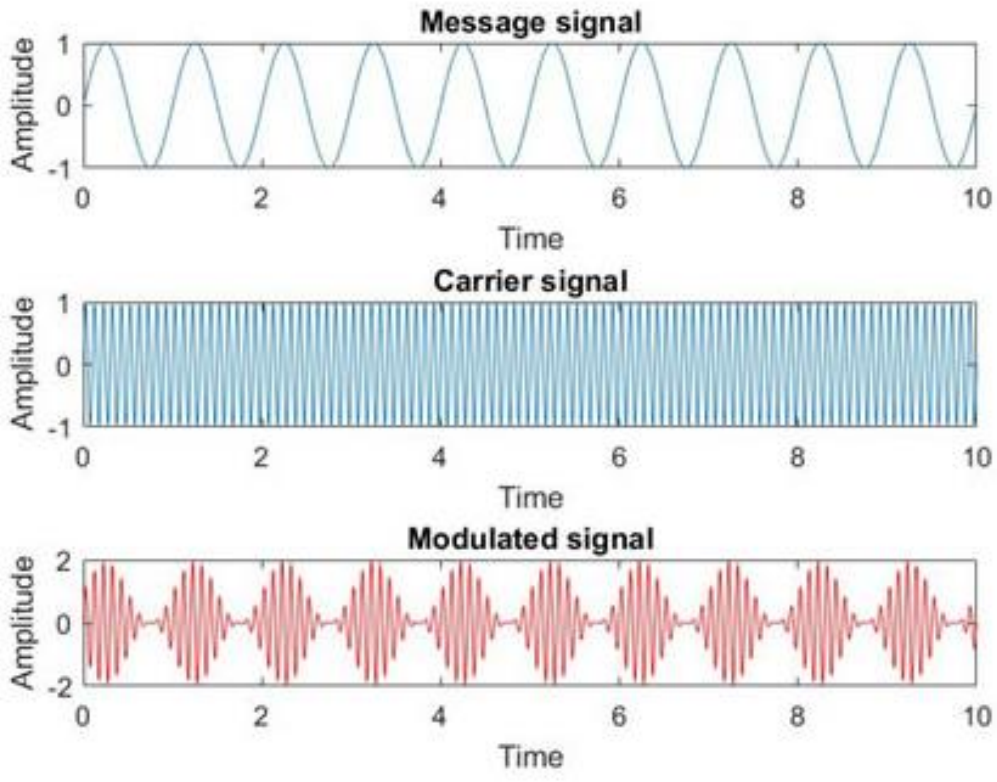
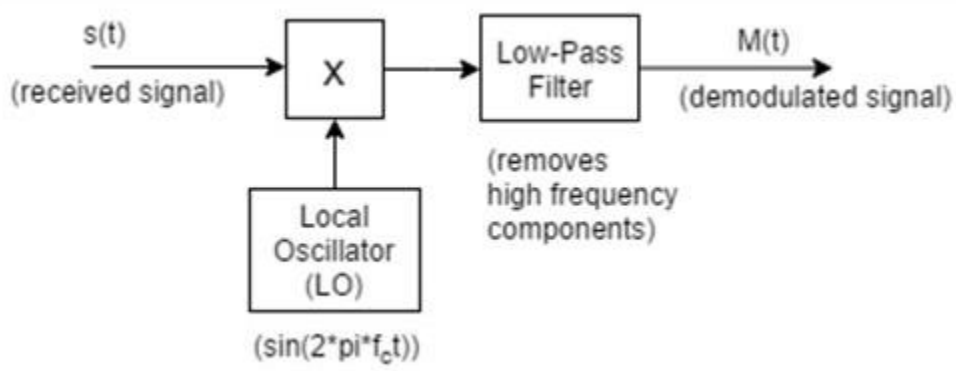


Figure 3: AM Waveforms

**Demodulator:**

The block diagram of synchronous demodulator is as shown





In order for the low-pass to detect the information envelope, the frequency of the carrier must be as high as possible. However, as you can imagine the noise from the nature (i.e. white noise) cannot be filtered/removed perfectly in such analog transmissions (AM, or FM).

$$s(t) = \sin(2\pi f_c t) + \frac{m(t)}{2} \sin(2\pi f_c t - 2\pi f_m t) - \frac{m(t)}{2} \sin(2\pi f_c t + 2\pi f_m t)$$

After the multiplication of  $s(t) \times \sin(2\pi f_c t)$

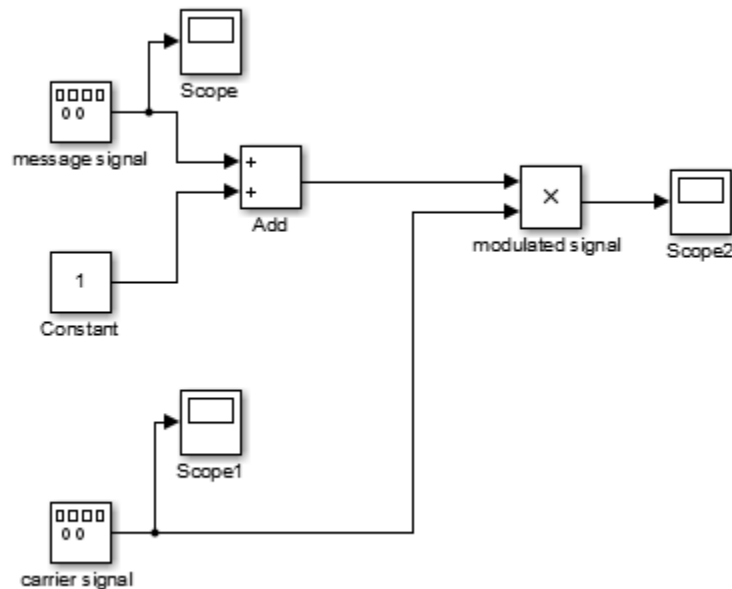
$$= -\frac{m(t)}{2} \sin(2\pi f_m t) - \frac{1}{2} \sin(2\pi f_c t) - \frac{m(t)}{2} (4\pi f_c t - 2\pi f_m t) + \frac{m(t)}{4} \sin(2\pi f_c t + 2\pi f_m t)$$

Then, the low-pass filter removes the higher frequency components, so we can recover  $m(t)$ .



## Procedure :

## Modulation:



1- Drag the following blocks from Simulink library:

Block	Library
Signal generator	sources
Constant	Commonly used blocks
Add	Math operations
Product	Math operations
Scope	sinks

2- Connect the blocks

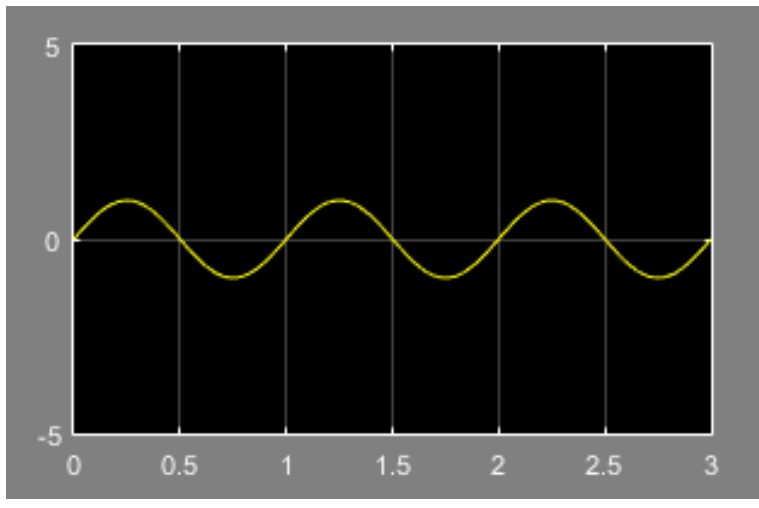
3- Run the program



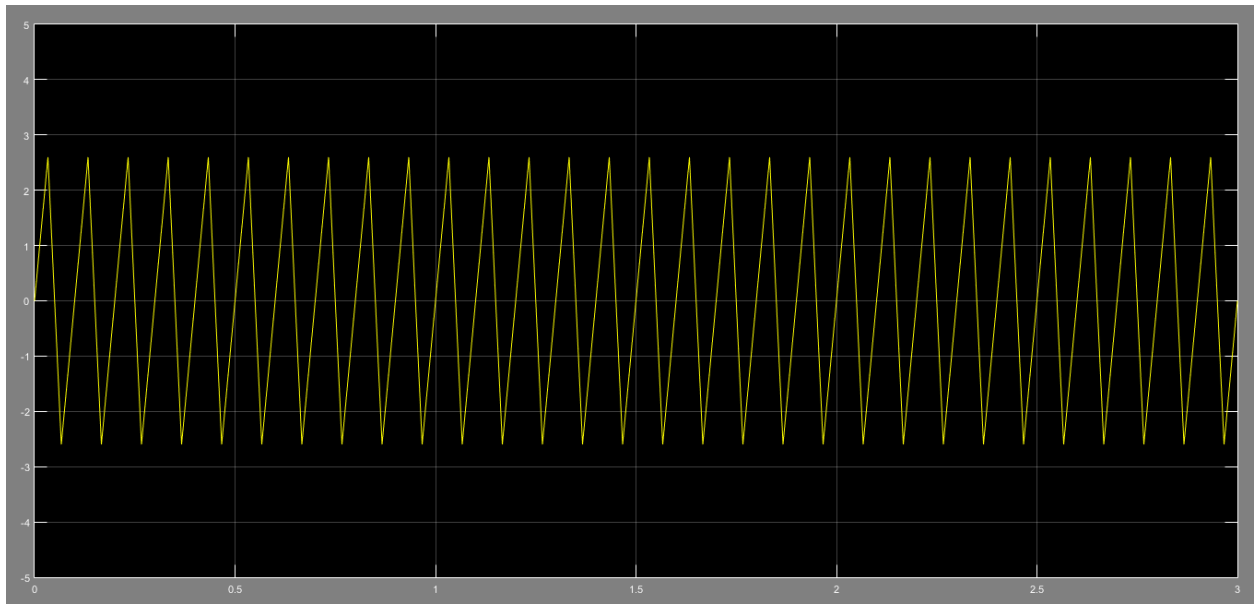
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**Results :**

**Modulating signal :**

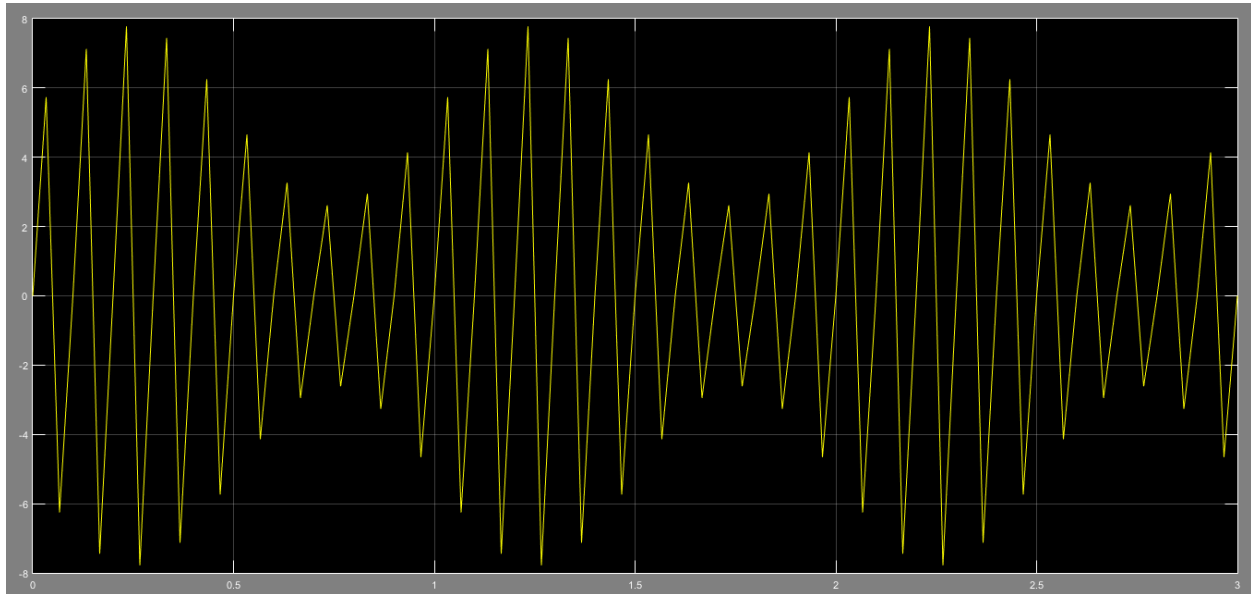


**Carrier signal :**





## Modulated signal:



## Procedure 2:

For demodulation of AM signal the following steps will be applied:

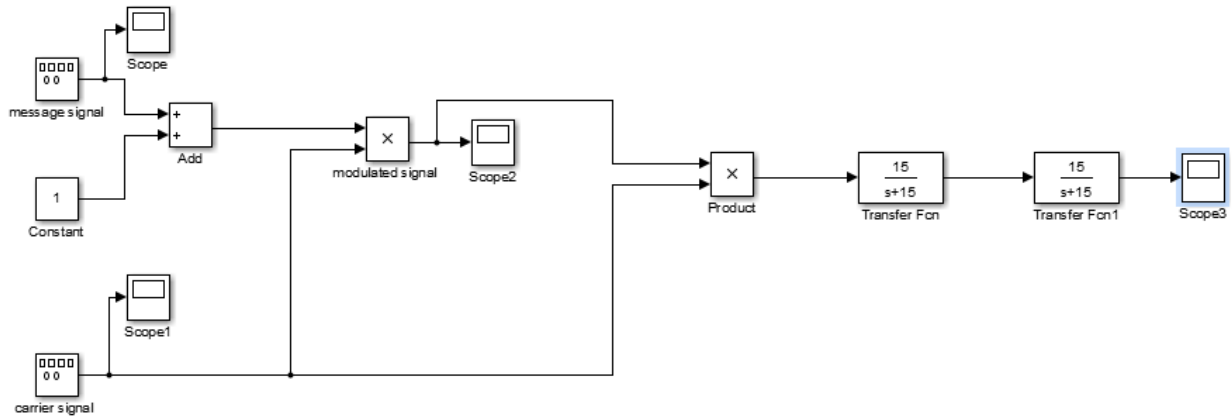
- 1- To the previous modulating circuit , we will add the following blocks:

Blocks	Library
Product	Math operations
Transfer function	Continuous
Scope	sinks

- 2- connect the items
- 3- run the program



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## Results :

From scope , the output signal will appear and this signal is the information

