# EEE341

Introduction to Communication Engineering Laboratory

## Lab – Report

BRAC UNIVERSITY

Inspiring Excellence

Section: 02

Experiment no. 03

Name of the experiment:

*Modulation Index*

*Prepared by:*

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***Other Group members:***

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Additional comments (if any):

## Introduction:

Changes the signal/carrier according to the intensity of intelligence signal (message signal) is called modulation. The modulation index or the percentage of modulation is an important part of the modulation process.

$$m_a = \frac{amp.change\ of\ carrier\ wave}{amp.of\ carrier\ wave} = \frac{(A_c + m(t)|max) - A_c}{A_c} = \frac{A_m}{A_c}$$

The modulation index can be determined from the envelope itself which will be displaced on the oscilloscope. As the amplitude of the message signal is increased, extra lobes appear in the envelope. These lobes indicate over modulation. As the amplitude of the message signal is decreased below 100% modulation, measurements of the maximum and minimum envelope amplitude yield modulation index.

Modulation index or the percentage of modulation:

$$\frac{Vmax - Vmin}{Vmax + Vmin} * 100\% \qquad or \qquad \frac{Am}{Ac} * 100\%$$

## Objectives:

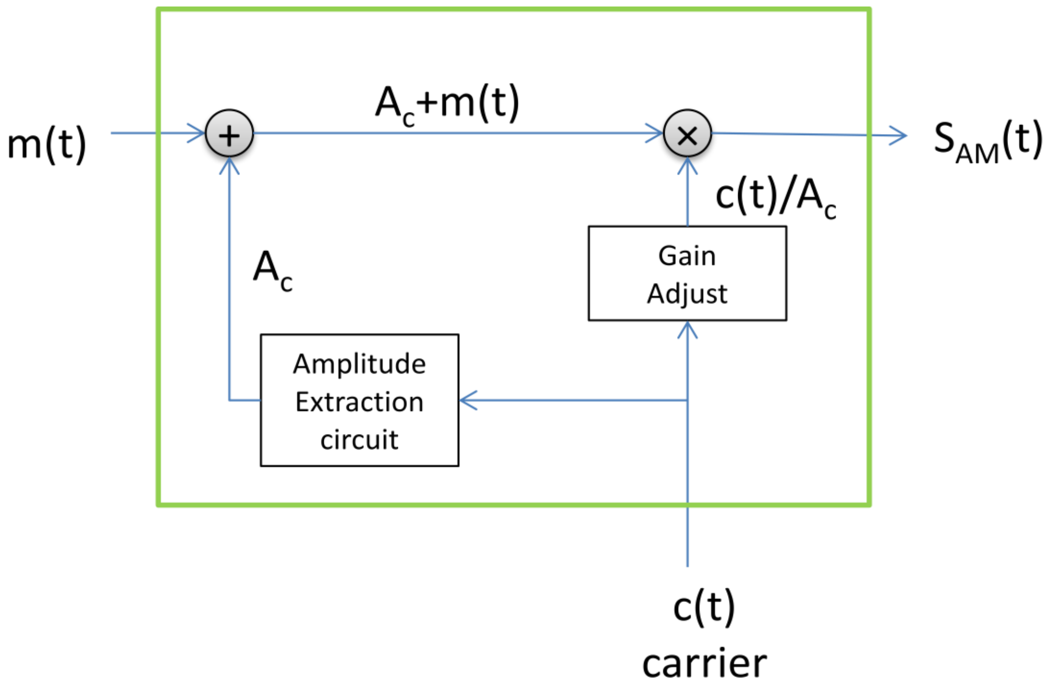
1. To understand the characteristic of Amplitude Modulation.
2. To examine and measure the percentage of Amplitude Modulation.

## Equipment:

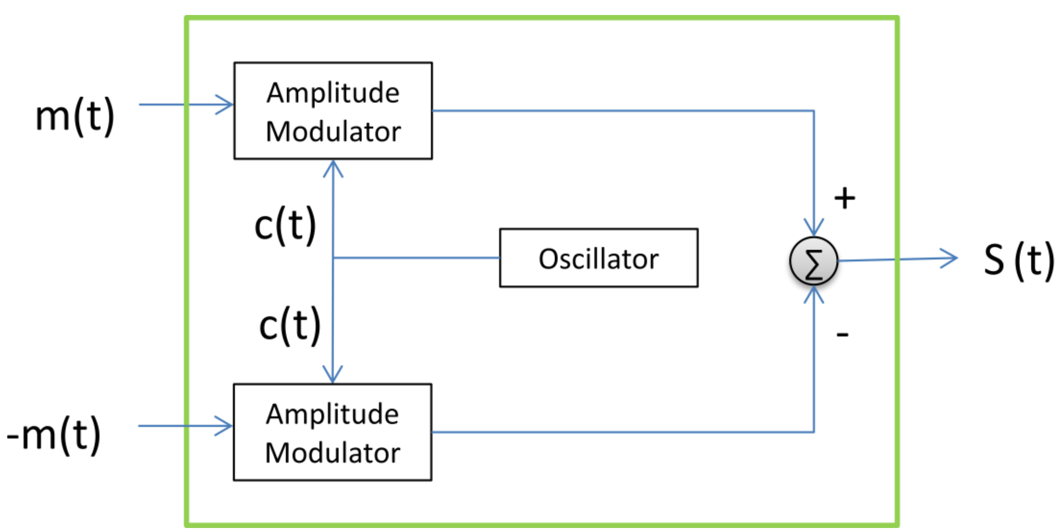
1. ANACOM 1/1 module
2. Power sources +12Vdc,-12Vdc
3. Connecting wires
4. Oscilloscope

## Block Diagram:

### AM Generation DSB:




### AM Generation DSB-SC:



# Results (Experimental):

**Input Message Signal:** We have uesd a MODICOM 1 board for this experiment. The internal analog input signal of the board is 2.34kHz.

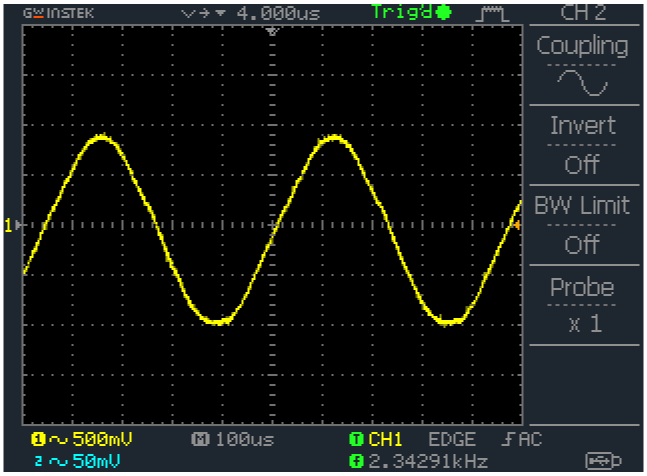



Figure 1: Input message signal

**Carrier Signal:** The internal analog carrier signal of the board is 9.63MHz. The frequency of carrier signal is much greater than the input message signal.

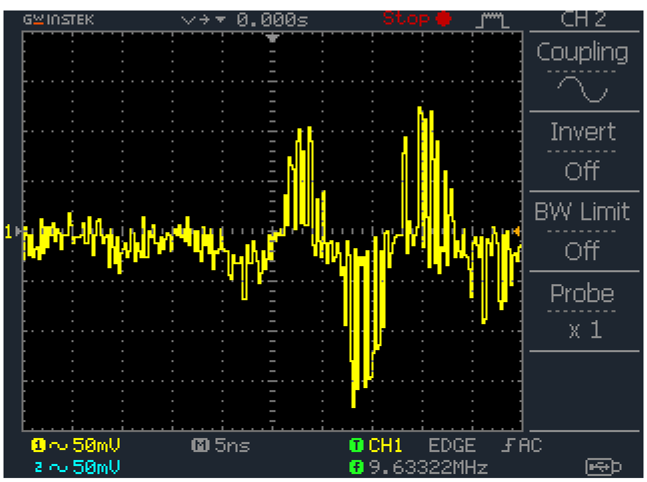



Figure 2: Carrier Signal

A complementary figure to modulation index is also used for amplitude modulation signals. Known as the modulation depth,it is typically the modulation index expressed as a percentage.

**100% Modulation:** When the amplitude of the signal after modulation reaches 2, a modulation depth of 100%, the carrier level falls to zero and rise to twice its non-modulated level.

At 100% Modulation, Am=Ac

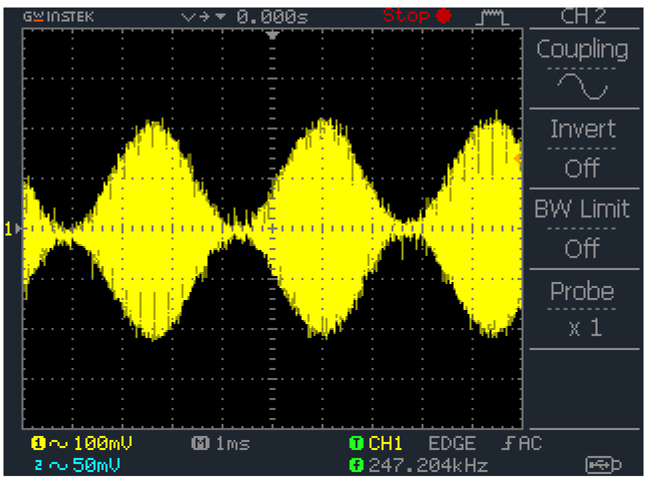



Figure 4: 100% Modulation

**Under Modulation 50%:** For modulation index 0.5, the modulation causes the signal to increase by a factor of 0.5 and decrease to 0.5 of its original level. Thus a modulation index of 0.5 would be expressed as a modulation depth of 50%.
50% Modulation,
Ac>Am
Am/Ac= (2/3)*100%= 66.66%

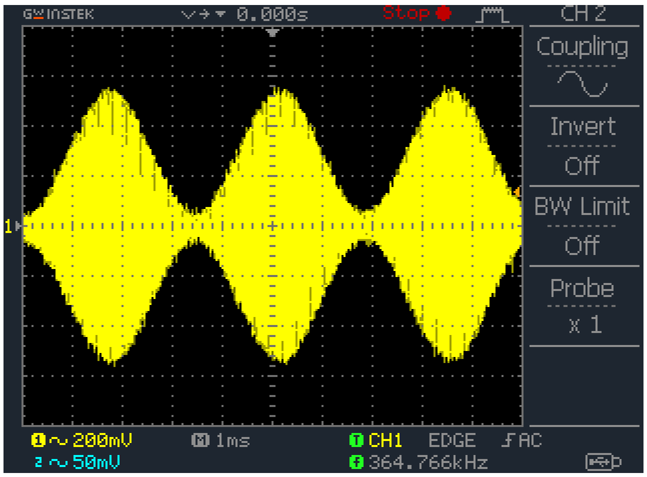



Figure 5: Under Modulation (50%)

**Over Modulation 150%:** Any increase of the modulation index above 1 is called as over modulation. For this experiment we measured modulation index of 1.5 which is 150%.

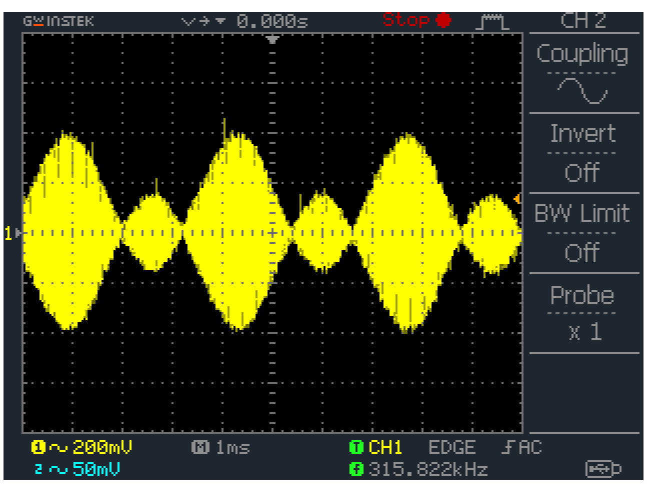
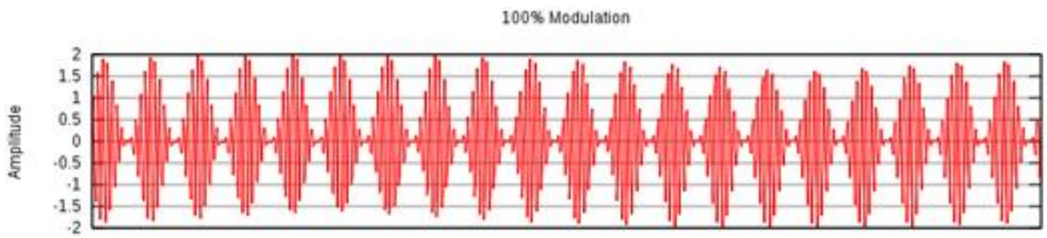



Figure 3: Over modulation(150%)

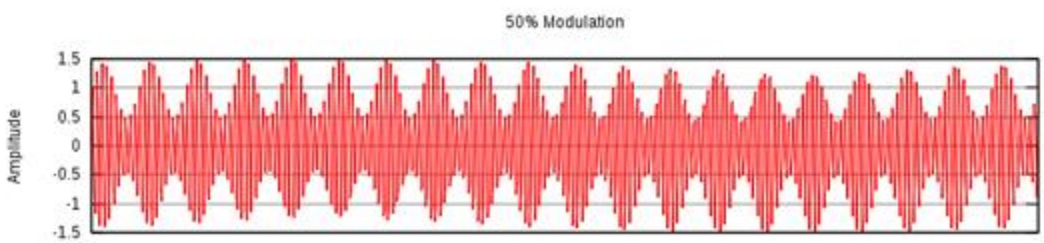
Am>Ac
Am/Ac= (3/2)*100%= 150%

## Results (Theoretical):

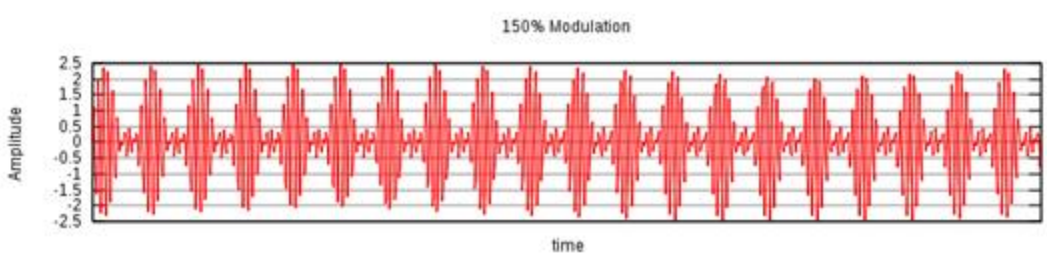
100% Modulation, Am=Ac




50% Modulation,
Ac>Am
Am/Ac= (2/3)*100%= 66.66%
Under modulation




Am>Ac
Am/Ac= (3/2)*100%= 150%
Over modulation



## Discussion:

MI determines the strength and quality of transmitted signal. If MI is bigger, the signal will be stronger. If MI is greater than 1 the signal will be distorted. Under modulated AM signal is not an efficient means of transmitting information due to power considerations. At a modulation index of 1 both the upper and lower sidebands have amplitudes which are half of that of the carrier amplitude. Over modulation occurs with a modulation index of greater than 1. Over modulation causes distortion at the receiver as well as interference with other stations due to the undesired sideband frequencies that are generated. The frequency of carrier signal will be much greater than the message signal. The carrier experiences 180 degree phase reversals for over modulation where the carrier level would try to go below the zero point. This phase reversals give rise to additional sidebands resulting from the phase reversals that extend out in theory to infinity. This can cause serious interference to other users if not filtered.