Date : 31- 11-‘22
Experiment No. : 04

Experiment Name : Study of Amplitude Modulation and Demodulation.

Theory :

Modulation :

A message carrying signal has to get transmitted over a distance and for it to establish a reliable communication, it needs to take the help of a high frequency signal which should not affect the original characteristics of the message signal.

The characteristics of the message signal, if changed, the message contained in it also alters. Hence it is a must to take care of the message signal. A high frequency signal can travel up to a longer distance, without getting affected by external disturbances. We take the help of such high frequency signal which is called as a carrier signal to transmit our message signal. Such a process is simply called as Modulation.

Modulation is the process of changing the parameters of the carrier signal, in accordance with the instantaneous values of the modulating signal.

Message Signal : The signal which contains a message to be transmitted, is called as a message signal. It is a baseband signal, which has to undergo the process of modulation, to get transmitted. Hence, it is also called as the modulating signal.

Carrier Signal: The high frequency signal which has a certain phase, frequency, and amplitude but contains no information, is called a carrier signal. It is an empty signal. It is just used to carry the signal to the receiver after modulation.

Modulated signal : The resultant signal after the process of modulation, is called as the modulated signal. This signal is a combination of the modulating signal and the carrier signal.

Types of Modulation :There are many types of modulations. Depending upon the modulation techniques used, they are classified as shown in the following figure.

Types of Modulation

There are many types of modulations. Depending upon the modulation techniques used, they are classified as shown in the following figure.

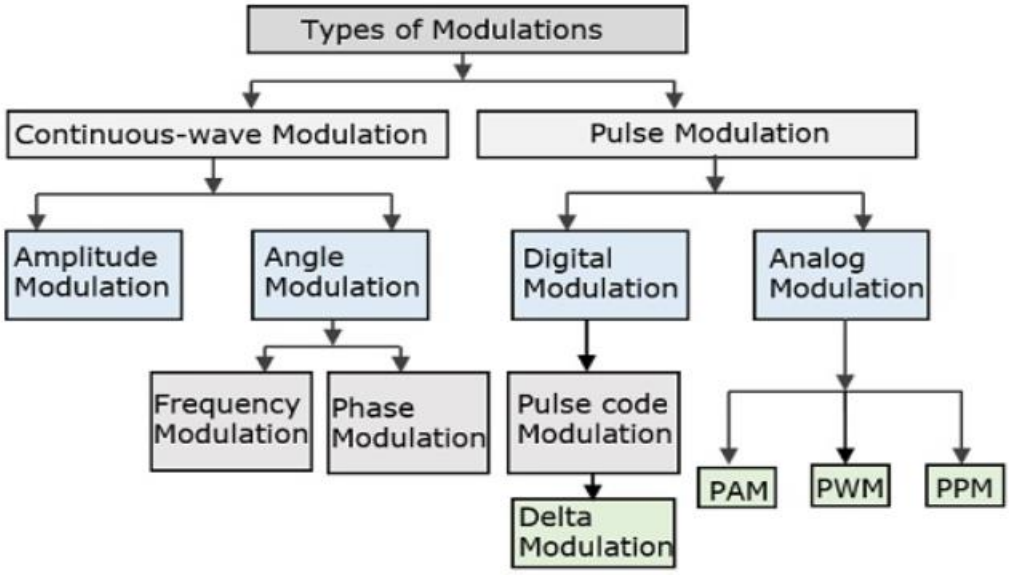


Figure 4.1 : Types of Amplitude Modulation.

Amplitude Modulation :

Amplitude modulation is a process by which the wave signal is transmitted by modulating the amplitude of the signal. It is often called AM and is commonly used in transmitting a piece of information through a radio carrier wave. Amplitude modulation is mostly used in the form of electronic communication.

Types of Amplitude Modulation : There are three main types of amplitude modulation. They are;

- Double sideband-suppressed carrier modulation (DSB-SC).
- Single Sideband Modulation (SSB).
- Vestigial Sideband Modulation (VSB).

Message Signal : $v_m = V_m Sin\,(\omega_m t)$
Carrier Signal : $v_c = V_c Sin\,(\omega_c t)$
So, Modulated signal will be , $v = (v_m + V_c) Sin\,(\omega_c t)$

$$
\begin{aligned}
v &= (v_m + V_c) Sin\,(\omega_c t) \\
&= (V_m Sin\,(\omega_m t) + V_c) Sin\,(\omega_c t) \\
&= V_m Sin\,(\omega_m t) Sin\,(\omega_c t) + V_c Sin\,(\omega_c t) \\
&= V_c \left[Sin\,(\omega_c t) + \frac{V_m}{V_c} Sin\,(\omega_m t) Sin\,(\omega_c t) \right] \\
&= V_c \left[Sin\,(\omega_c t) + \frac{m}{2} \cos(\omega_m - \omega_c)\, t - \frac{m}{2} \cos\,(\omega_m + \omega_c) t \right]
\end{aligned}
$$

$$= V_c Sin\,(\omega_c t) + \frac{mV_c}{2}\cos(\omega_m - \omega_c)\,t - \frac{mV_c}{2}\cos\,(\omega_m + \omega_c)t$$

Here, $V_c Sin\,(\omega_c t)$ is the carrier Signal
$\frac{mV_c}{2}\cos(\omega_m - \omega_c)\,t$ is the lower band side
$\frac{mV_c}{2}\cos\,(\omega_m + \omega_c)t$ is the upper band side

Process of Modulation :
we have to generate the carrier signal and message signal.Here we have a device named DSB AM reception. Where it generates amplitude modulation signal or message signal and a local oscillator which generates a high frequency signal which is nothing but carrier signal.Then we pass this who signal into a mixer which will add two signal frequency and then divides it by two.If message signal has frequency of fm and local oscillator signal has fo then output of the mixer will be (fm+fo)/2.Then this signal is passed by amplifier 1 and amplifier 2 for amplification.So this is the modulation process and here we will get our modulated signal.

Demodulation:
Demodulation is extracting the original information-bearing signal from a carrier wave.
A demodulator is an electronic circuit (or computer program in a software-defined radio) that is used to recover the information content from the modulated carrier wave.

Ways of Demodulation :
There are several ways of demodulation depending on how parameters of the base-band signal such as amplitude, frequency or phase are transmitted in the carrier signal. For example, for a signal modulated with a linear modulation like AM (amplitude modulation), we can use a synchronous detector. On the other hand, for a signal modulated with an angular modulation, we must use an FM (frequency modulation) demodulator or a PM (phase modulation) demodulator. Different kinds of circuits perform these functions.

Given below are various techniques used for demodulation.
1 . Diode rectifier envelope detector:
In this process, the Amplitude modulated wave is detected and demodulated
The diode rectifies the incoming wave and allows only a half-wave.
Then the capacitor removes any unnecessary radio frequency signals leaving the original form of the wave.
2. Product Detector:
The term "product detector" comes from the fact that SSB (single sideband suppressed carrier) demodulation requires an output that is a product of the inputs. A mixer/product detector's job is to create a product or multiply the value of the inputs, while the phrase "product detector" was first used in the early days of SSB usage and is still in use today. Demodulation is done using a product detector and with a local beat frequency oscillator or a carrier injection oscillator.

3 . Synchronous Detector:

It is the most optimum method. It has a product detector or a mixer with a local oscillator. The local oscillator is synchronized to the incoming signal.

A simple diode rectifier is the most basic type of amplitude modulated signal detection. Synchronous demodulation is a type of demodulation that may be utilized to produce better performance.

Process of Demodulation :

for demodulation we have an envelope detector.Which is nothing but a diode with capacitor.We know that this type of circuit is works as filter.So if we give the modulated signal as a input of this envelope circuit then we will get the demodulated signal as it will only pass the positive or negative portion.It will mainly detect the envelope of the positive portion of our signal or negative portion.This is how we do the demodulation process.

Circuit Diagram :

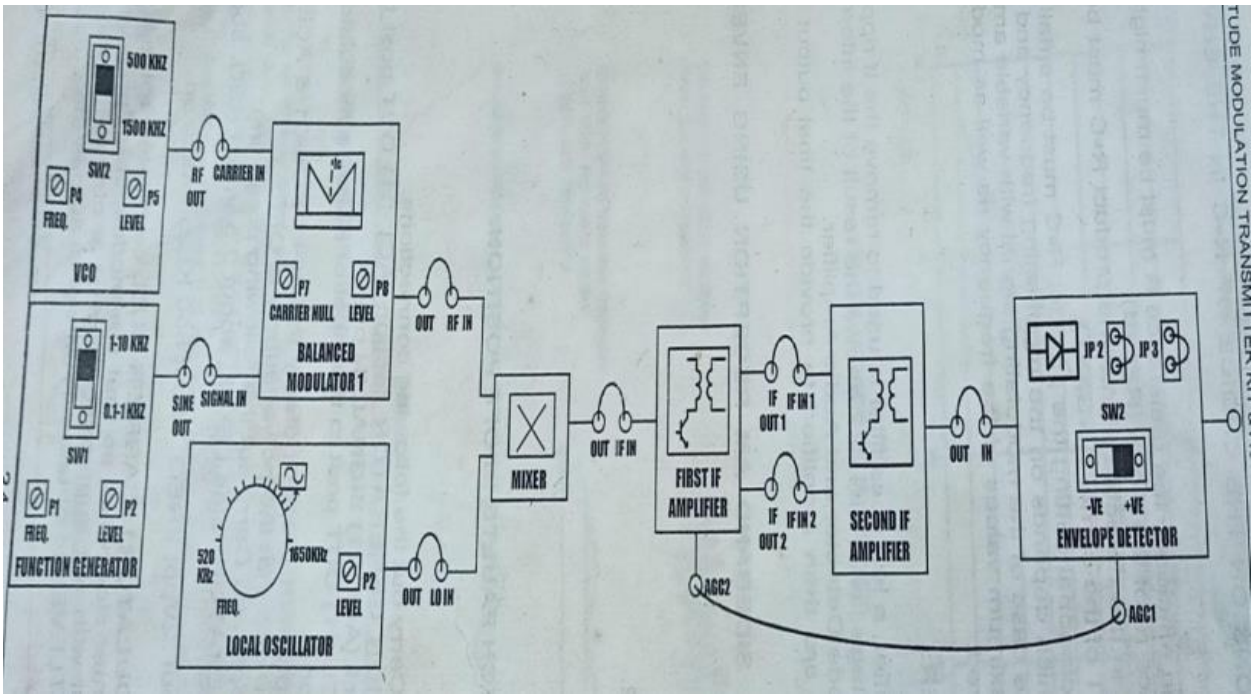


Figure 4.2 : Block Diagram of DSB AM Reception Using Envelope Detector

Output :

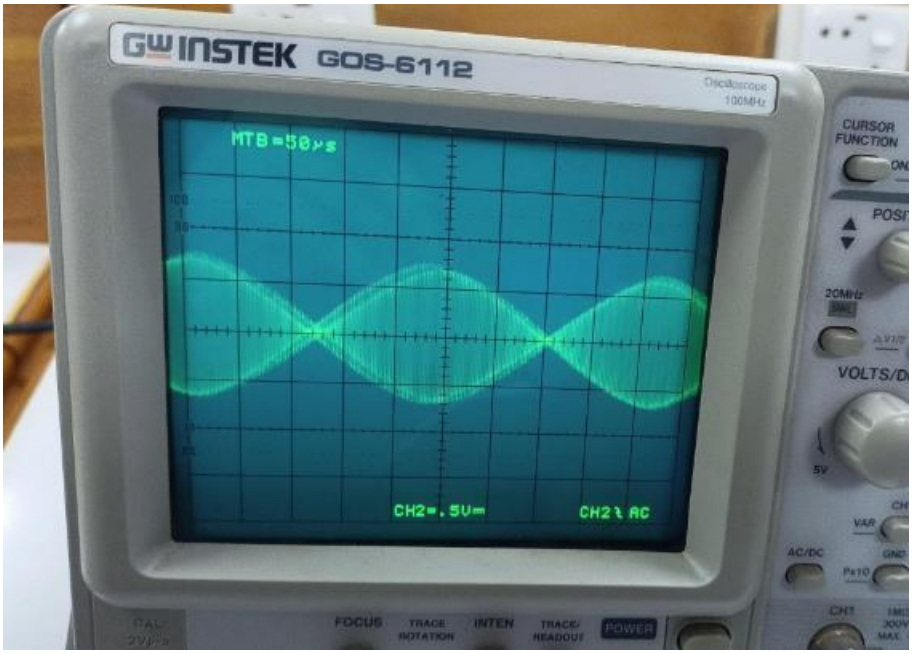


Figure 4.3 : Output of Modulated Signal in Oscilloscope.

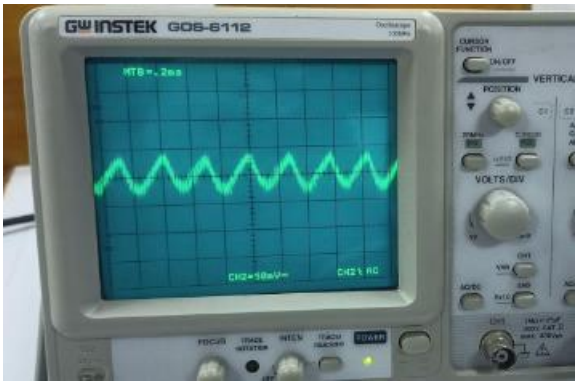


Figure 4.4 : Output of Demodulated Signal in Oscilloscope.

Discussion :

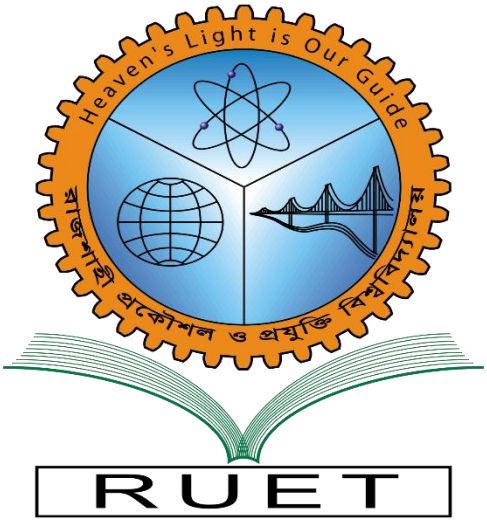
In this experiment we have done Amplitude Modulation and Demodulation . First of all we have generated two signal from the DSB AM reception. One of the signal one of the signal is of high frequency which is called the carrier signal, and the other one is of low frequency which is called message signal. We used a mixer to modulate the signal and then we have use two amplifier to lower its frequency. The reason behind this is that if the if the frequency is high then deviation of modulated signal will be low and output will be more sinusoidal.Then we use an envelope detector circuit with a diode and capacitor which passes the only positive or negative envelop only which is our message signal after demodulation.

Conclusion:

In this experiment , the modulation process was smooth and we got the expected output .But in demodulation the signal we get was distorted.Maybe be it was because of internal problem of the signal generator or circuit connection.

Rajashahi University of Engineering and Technology

Department of Electrical and Computer Engineering



Submission Date : 14-11-'22

Course No: ECE 3208

Course Title: Communication Engineering Sessional

Submitted By :	**Submitted To:**
Tamim Hasan Roll : 1810044 Session : 2018-19 Department of ECE, RUET	Milton Kumar kundu Assistant Professor , Department of ECE RUET