EXPERIMENT NUMBER 1

Amplitude Modulation & Demodulation

AIM: To perform amplitude modulation and demodulation and calculate the modulation index for various modulating voltages and plot the relevant waveforms.

LEARNING OBJECTIVE:

- To provide a familiarization to generate an amplitude-modulated (AM) signal, with an adjustable modulation factor (m).
- To examine both time & frequency displays of an AM signal.
- To measure the percentage modulation (m %), and the percentage of total power in both sidebands and in the carrier versus the modulation index (m).
- To investigate the use (& limitation) of envelope detection in demodulating AM signals.

PRIOR CONCEPTS: Modulation and its types, Frequency and Amplitude variance, Sampling Theorem.

EQUIPMENT REQUIRED

Equipment	Range	Quantity
CRO	(0-20)MHz	1
Function Generator	(0-1)MHz	2
Experiment Kit		1
Power Supply	(0-30)V	1

COMPONENTS REQUIRED

Components	Value	Quantity
Transistor	BC107	1
Capacitor	0.01µF	2
	0.1µF	1
	10µF	1
Resistor	10kΩ	1
	1KΩ	1
	2.2kΩ	1
	1.2KΩ	3
Diode	IN4001	1

THEORY: Modulation is defined as the process by which some characteristics of a carrier signal is varied in accordance with a modulating signal. The base band signal is referred to as the modulating signal and the output of the modulation process is called as the modulated signal. Amplitude modulation is defined as the process in which is the amplitude of the sinusoidal carrier wave is varied in accordance with the base band signal. The envelope of the modulating wave has the same shape as the base band signal provided the following two requirements are satisfied.

1. The carrier frequency fc must be much greater than the highest frequency components fm of the message signal m (t) i.e. $f_C >> f_m$.

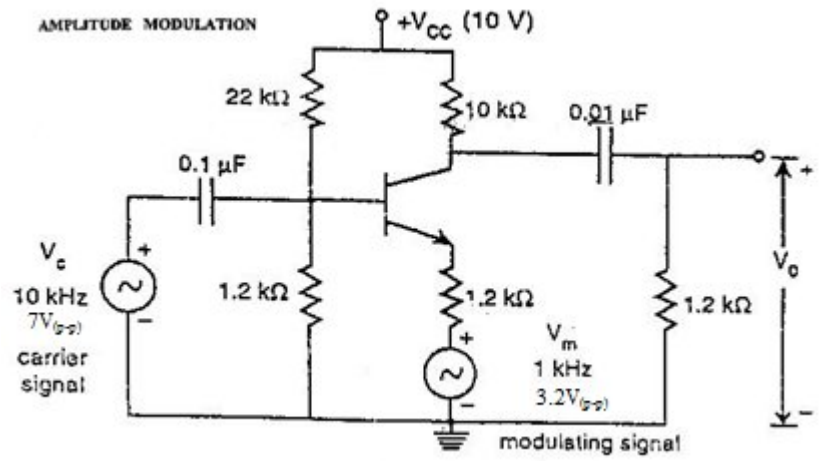
2. The modulation index must be less than unity. If the modulation index is greater than unity, the carrier wave becomes over modulated.

PROCEDURE

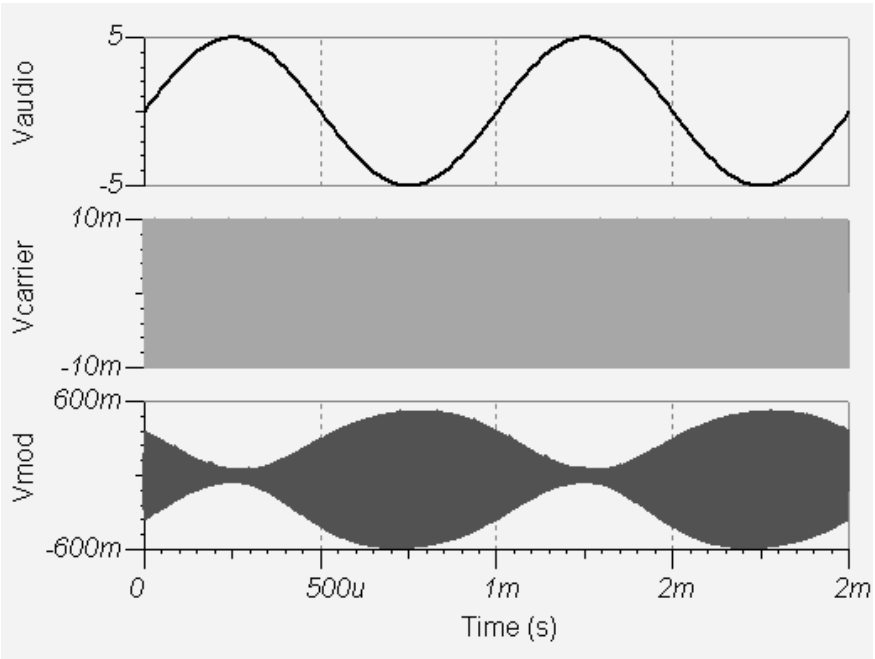
1. Connections are made as shown in the circuit diagram.
2. The power supply is connected to the collector of the transistor.
3. Modulated Output is taken from the collector of the transistor.
4. Carrier signal is set to 3.2V $_{(p\text{-}p)}$, 10 KHz using function generator.
5. Modulating signal is set to around 3.2V $_{(p\text{-}p)}$, 1 KHz (with a +2V dc - offset) and amplitude is varied around the carrier voltage.
6. Calculate F_{max} and F_{min} from the output waveform.
7. Calculate the modulation index using the formula

$$f_{\text{pulsed}} = \frac{F_{\max} - F_{\min}}{F_{\max} + F_{\min}},$$

CIRCUIT DIAGRAM



WAVEFORM



Lab Report

The AM Broadcast station technical standards specify that the % modulation be maintained @ 85 - 95%; comment on any possible disadvantages [based on your experimental results] that will occur by ignoring this specification.

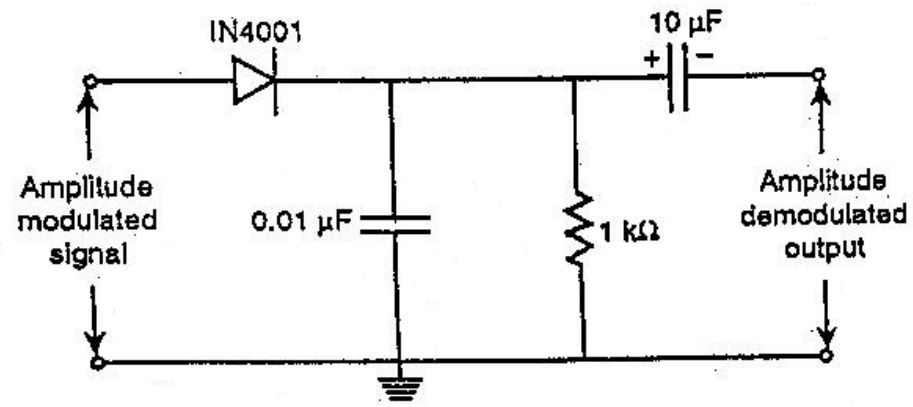
Amplitude Demodulation

The process of detection provides a means of recovering the modulating Signal from demodulating signal. Demodulation is the reverse process of modulation. The detector circuit is employed to separate the carrier wave and eliminate the side bands. Since the envelope of an AM wave has the same shape as the message, independent of the carrier frequency and phase, demodulation can be accomplished by extracting envelope.

PROCEDURE

1. Connections are made as shown in the circuit diagram.
2. The amplitude modulated signal from AM generator is given as input to the circuit
3. The demodulated output is observed on the CRO.
4. Various values of modulating voltage signal frequency corresponding to demodulated voltage and frequency are noted and the readings are compared (both must be same in all parameters).

CIRCUIT DIAGRAM AND OPERATING PRINCIPLE



The detection of AM signals is accomplished by means of a diode rectifier which may be either a vacuum tube or a semiconductor diode. The demodulator must meet three requirements: (1) It must be sensitive to the type of modulation applied at the input, (2) it must be nonlinear, and (3) it must provide filtering. Because the semiconductor is a nonlinear device, it conducts in only one direction. This eliminates the negative portion of the RF carrier and reproduces the signal.

WAVEFORM