AmplitudeModulation -- Overview

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Generation of Amplitude Modulated Wave

Objective:

- To generate the Amplitude modulated signal.
- To determine the percentage of modulation with various amplitude and frequency of message and carrier signals respectively.

Components Required:

1.	BJT	BC 147	1
2.	Resistor	10KΩ 22KΩ, 1KΩ	3 1 each
3.	Capacitor	0.1μf 0.01μf 0.001μf	2 1
4.	Bread board	-	1
5.	Function Generator	-	2
6.	VRPS	(0-30)V	1
7.	CRO	Dual trace	1

Pre - Lab Questions:

- Why we want to do modulation?
- What is base band signal and pass band signal?
- What is amplitude modulation?
- Why carrier signal frequency should be more than modulating signal frequency?
- Draw the Fourier Transform of AM signal?

Theory:

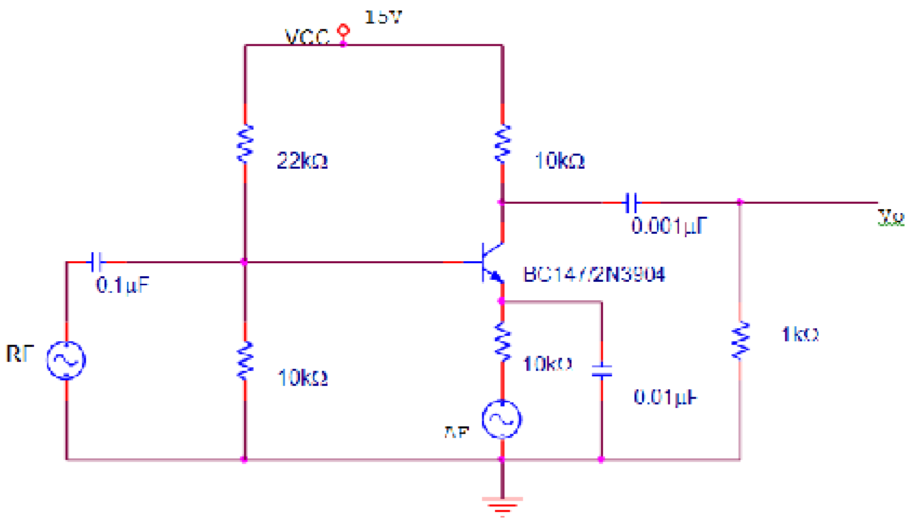
- In amplitude modulation, the instantaneous amplitude of a carrier wave is varied in accordance with the instantaneous amplitude of the modulating signal.

- Main advantages of AM are small bandwidth and simple transmitter and receiver designs.
- Amplitude modulation is implemented by mixing the carrier wave in a nonlinear device with the modulating signal. This produces upper and lower sidebands, which are the sum and difference frequencies of the carrier wave and modulating signal.
- The carrier signal is represented by c(t) = A cos(wct)
- The modulating signal is represented by m(t) = B sin(wmt)
- Then the final modulated signal is

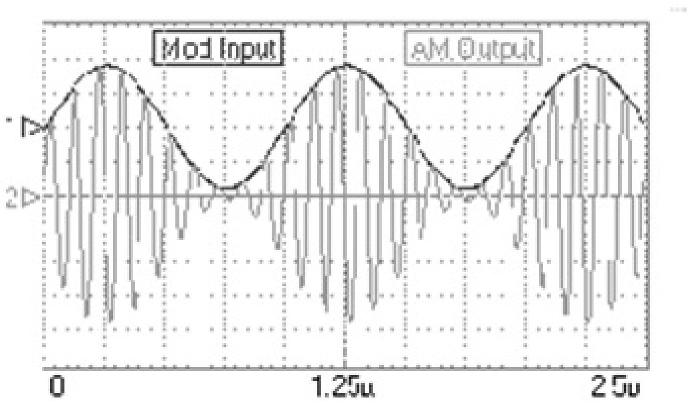
[1 + m(t)] c(t) = A [1 + m(t)] cos(wct)
= A [1 + B sin(wmt)] cos(wct)
= A cos(wct) + A m/2 (cos((wc+wm)t)) + A m/2 (cos((wc-wm)t))

- Because of demodulation reasons, the magnitude of m(t) is always kept less than 1 and the frequency much smaller than that of the carrier signal.
- Note that the modulated signal has frequency components at frequencies wc, wc+wm and wc-wm.

Circuit Diagram:



Model Graph:



Tabulation:

Message Signal		Carrier Signal		AM Output	
Frequency	Voltage	Frequency	Voltage	Vmax	Vmin

Calculation:

Modulation index is found using the formula

$$m = \frac{2V_{max} - 2V_{min}}{2V_{max} - 2V_{min}} = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

Inference:

- Thus the Amplitude Modulated wave is generated.
- Modulation index also is found and verified with theoretical formula.

AmplitudeModulation -- Procedures

Step 1

Connections are made as per the circuit diagram.

Step 2

The message signal of 1 KHz and the carrier signal of approximately 100 KHz are set on signal generator

Step 3

The output is observed on Oscilloscope and the AM wave is captured.

Step 4

The required graph is plotted showing the whole process of modulation.

Step 5

On the AM output waveform, add MAXIMUM (Vmax) and MINIMUM (Vmin) measurements - to compute the modulation index.

Step 6

The modulation index is calculated using the formula

$$m = \frac{2V_{max} - 2V_{min}}{2V_{max} - 2V_{min}} = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

from the graph.

Step 7

Post Lab Questions:

- Name some AM stations and what frequency range they are operating?
- In AM spectrum what do side bands signify?
- Derive the Power Transmitted equation of AM?
- Is there any power wastage in the AM transmission?
- What is the bandwidth of AM signal?