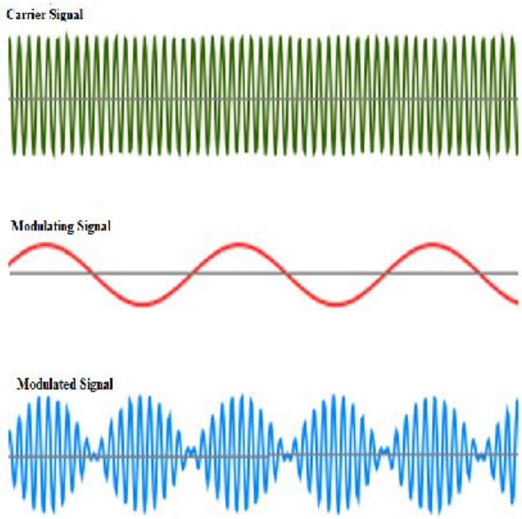
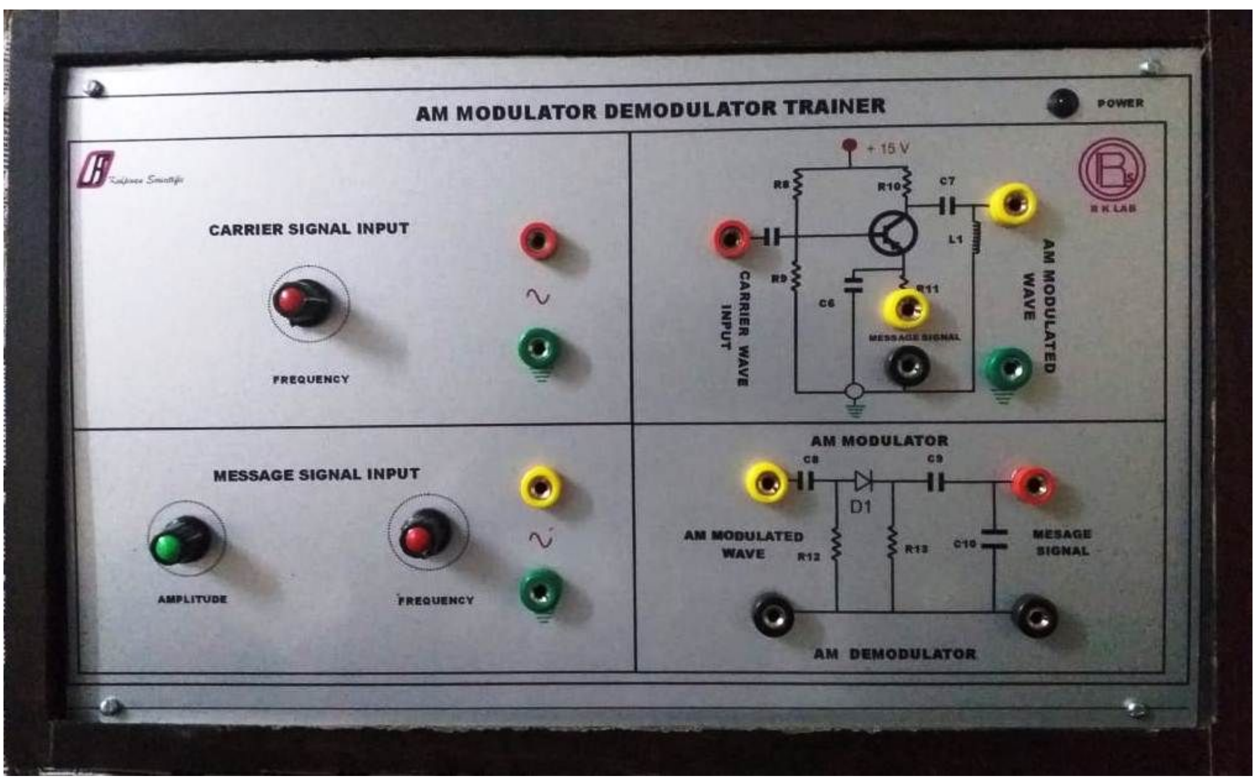
TO DESIGN AN AMPLITUDE MODULATOR USING TRANSISTOR





AIM:

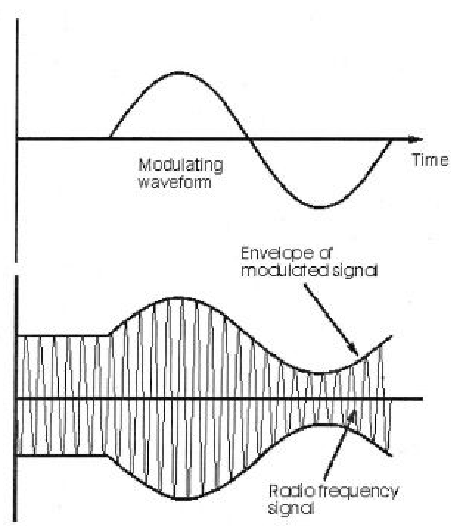
1. **Calculate the modulation index and observe the am envelope.**
2. **Demodulation of AM and observe message signal**

APPARATUS USED:

(i) AM Trainer Kit (ii) CRO with connecting probes (iii) Connecting cords

THEORY:

In order that a radio signal can carry audio or other information for broadcasting or for two way radio communication, it must be modulated or changed in some way. Although there are a number of ways in which a radio signal may be modulated, one of the easier, and one of the first methods to be used was to change its amplitude in line with variations of the sound. The basic concept surrounding what is amplitude modulation, AM, is quite straightforward. The amplitude of the signal is changed in line with the instantaneous intensity of the sound. In this way the radio frequency signal has a representation of the sound wave superimposed in it. In view of the way the basic signal "carries" the sound or modulation, the radio frequency signal is often termed the "carrier".



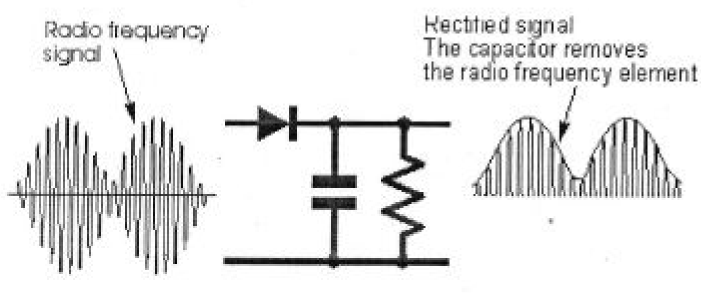
Amplitude Modulation (AM)

When a carrier is modulated in any way, further signals are created that carry the actual modulation information. It is found that when a carrier is amplitude modulated, further signals are generated above and below the main carrier. To see how this happens, take the example of a carrier on a frequency of 1 MHz which is modulated by a steady tone of 1 kHz. The process of modulating a carrier is exactly the same as mixing two signals together, and as a result both sum and difference frequencies are produced. Therefore when a tone of 1 kHz is mixed with a carrier of 1 MHz, a "sum" frequency is produced at 1 MHz + 1 kHz, and a difference frequency is produced at 1 MHz - 1 kHz, i.e. 1 kHz above and below the carrier.

If the steady state tones are replaced with audio, like that encountered with speech of music, these comprise many different frequencies and an audio spectrum with frequencies over a band of frequencies is seen. When modulated onto the carrier, these spectra are seen above and below the carrier. It can be seen that if the top frequency that is modulated onto the carrier is 6 kHz, then the top spectra will extend to 6 kHz above and below the signal. In other words the bandwidth occupied by the AM signal is twice the maximum frequency of the signal that is used to modulate the carrier, i.e. it is twice the bandwidth of the audio signal to be carried.

Amplitude Modulation

Amplitude Modulation, AM, is one of the most straightforward ways of modulating a radio signal or carrier. The process of demodulation, where the audio signal is removed from the radio carrier in the receiver is also quite simple as well. The easiest method of achieving amplitude demodulation is to use a simple diode detector. This consists of just a handful of components: - a diode, resistor and a capacitor.



AM Diode Detector

In this circuit, the diode rectifies the signal, allowing only half of the alternating waveform through. The capacitor is used to store the charge and provide a smoothed output from the detector, and also to remove any unwanted radio frequency components. The resistor is used to enable the capacitor to discharge. If it was not there and no other load was present, then the charge on the capacitor would not leak away, and the circuit would reach a peak and remain there.

Advantages of Amplitude Modulation (AM): There are several advantages of amplitude modulation, and some of these reasons have meant that it is still in use today:

- It is simple to implement
- It can be demodulated using a circuit consisting of very few components
- AM receivers are very cheap as no specialized components are needed.

Disadvantages of amplitude modulation: Amplitude modulation is a very basic form of modulation, and although its simplicity is one of its major advantages, other more sophisticated systems provide a number of advantages. Accordingly it is worth looking at some of the disadvantages of amplitude modulation.

- It is not efficient in terms of its power usage.
- It is not efficient in terms of its use of bandwidth, requiring a bandwidth equal to twice that of the highest audio frequency.
- It is prone to high levels of noise because most noise is amplitude based and obviously AM detectors are sensitive to it.

PROCEDURE

FOR MODULATION

- Connect the carrier signal output to carrier signal input.
- Connect modulating signal output (From function generator) (1 KHz) to modulating signal input.
- Connect oscilloscope channel "A" with the Modulated signal input socket.
- Connect the oscilloscope "B" with the Modulated signal output socket.
- Keep the amplitude control at minimum position
- Switch 'ON' the instrument using ON/OFF switch.
- Adjust oscilloscope time base and vertical gain. A band will appear upon the screen Position at the center of the screen
- Trace out the pattern of the modulated wave and measure amplitudes in Vpp .
- Increase modulating input to successive levels and note amplitude "A and B" for each increment. Calculate modulation factor for each input. Draw a plot between input signal (AF) modulation factors. The curve of the graph shows the modulation process.

Calculation:

Modulation factor for above AM modulation.

$$Mf = \frac{Vmax - Vmin/2}{Vmax + Vmin/2}$$

Example readings

Vmax = 4V

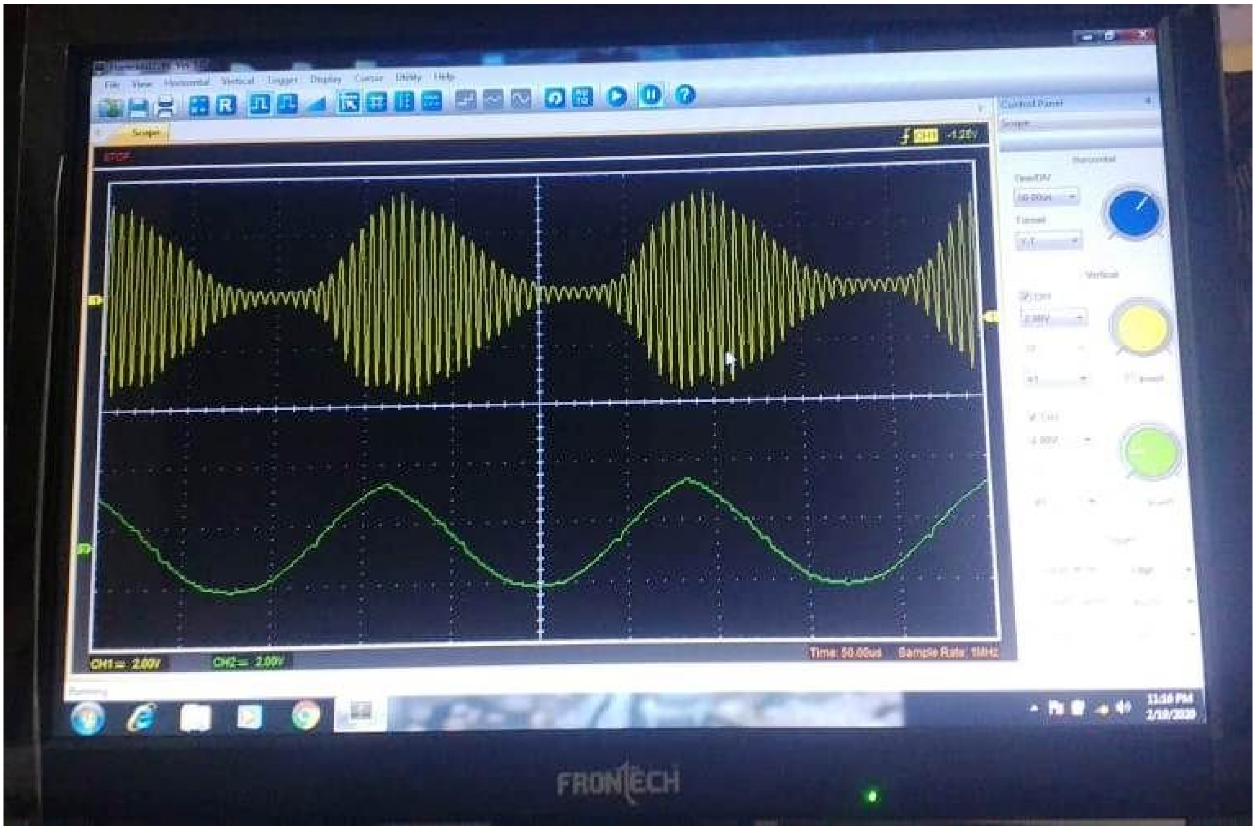
V min = 1V

Mf = 0.6 = 60%

FOR DEMODUTATION

- Connect the modulated signal output to the input of demodulated circuit.
- Connect oscilloscope channel "A" with the Demodulated signal output. Now connect the oscilloscope "B" with the Modulated signal input.

Sample graphs:



PRECAUTIONS:

- Switch off the experimental kit during making connections.
- Use the CRO carefully.