

AMPLITUDE MODULATION TRANSMITTER

Amplitude modulation is a form of modulation in which information is carried in the envelope of the carrier. There are different types of amplitude modulation (i) Amplitude Modulation Suppressed Carrier (AM-SC) (ii) Amplitude Modulation with Carrier (AM-C) (iii) Amplitude Modulation with Single Sideband (AM-SSB). For the suppressed carrier schemes the receiver must generate a carrier in frequency and phase synchronism with the carrier at the transmitter. This makes the receiver complex and increases its cost. Regular Amplitude Modulation transmitter is inefficient but the receiver design is simplified. Hence in terrestrial broadcast radio Amplitude Modulation is used which can be handled with a very inexpensive receiver. Mathematically, the regular amplitude modulation can be expressed as:

$$y(t) = (A + \mu m(t)) \cos(2\pi f_c t)$$

Where A is the maximum amplitude of $m(t)$, f_c is the carrier frequency and μ is the modulation index. Figure 5.1 below shows a segment of modulating signal and its corresponding amplitude modulated signal.

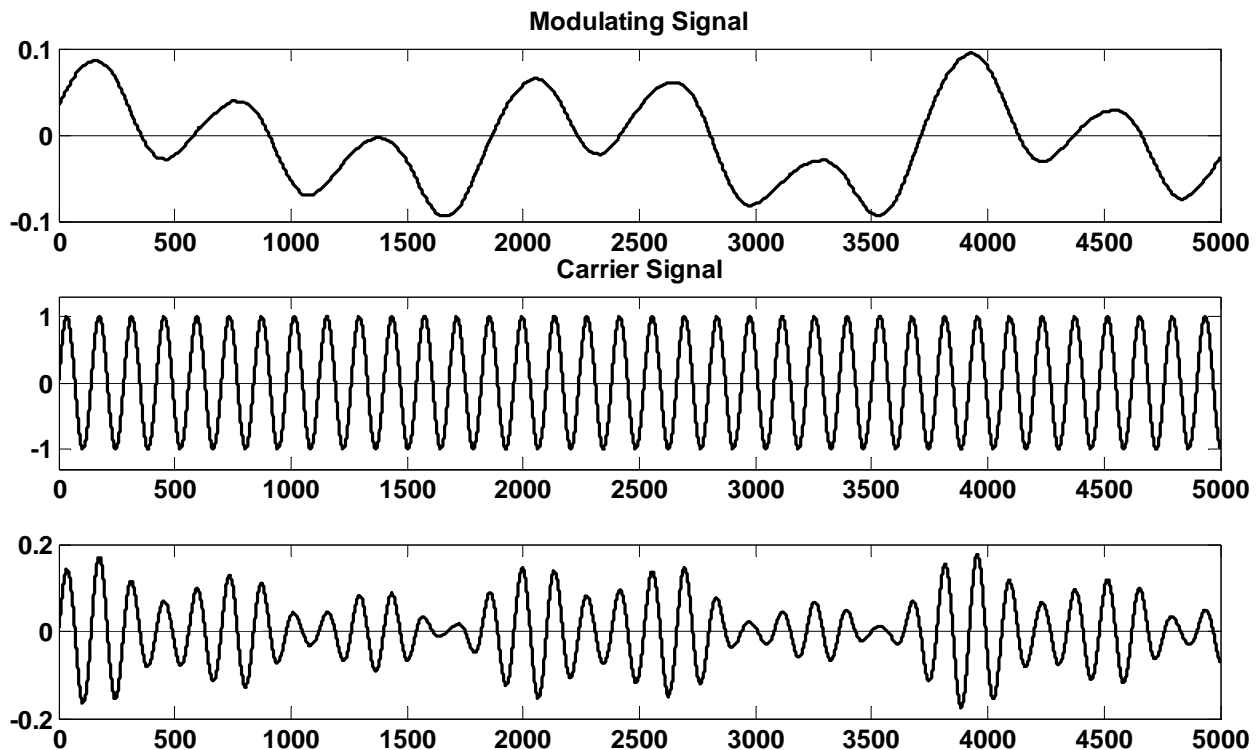


Figure 5.1: Amplitude modulation

There are two important parameters in amplitude modulation; frequency of the carrier and the modulation index or modulation depth.

Modulation index

The modulation depth or modulation index represents the ratio of peak value of modulating signal and the DC bias which represents the amplitude of the carrier. For amplitude modulation, modulation index is defined as:

$$\mu = \frac{\text{Peak value of the modulating signal}}{\text{Amplitude of the carrier}}$$

Therefore if $\mu = 0.5$, the carrier strength is twice the peak amplitude of the modulating signal. Figure 5.2 shows two modulated signals with different modulation indices.

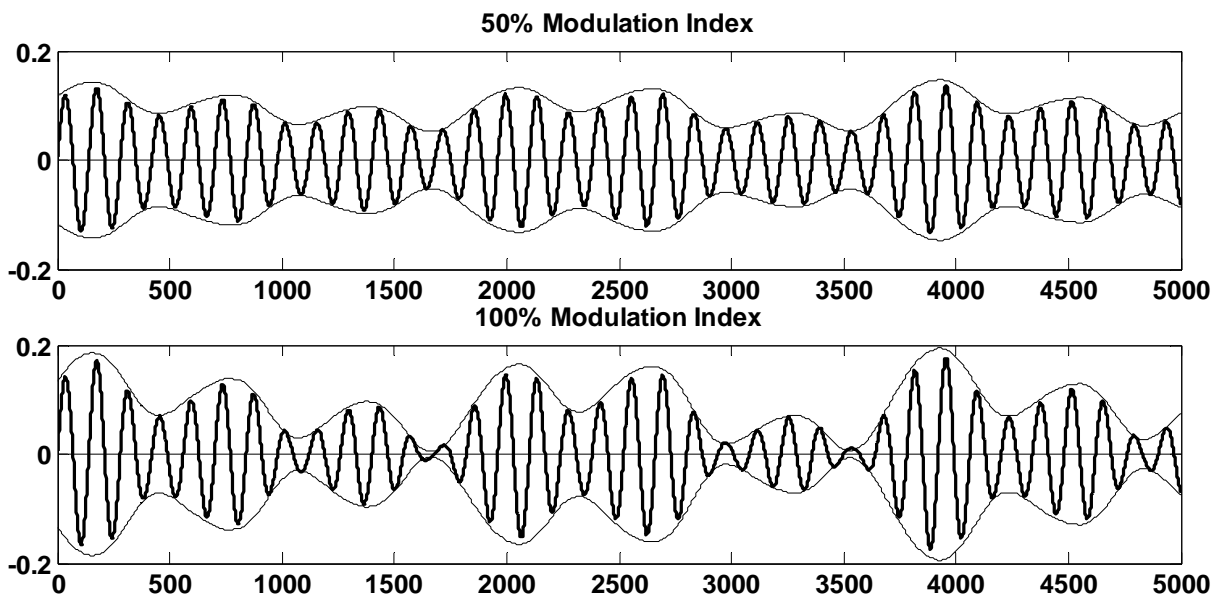


Figure 5.2: Effect of modulation index in amplitude modulation

Amplitude modulation can be implemented on the FlexTrainer. Select the experiment of amplitude modulation on the FlexTrainer. Connect the signal generator to the input channel-A of the FlexTrainer. Connect output channel-A of the FlexTrainer to the oscilloscope to observe the amplitude modulated signal. Figure 5.3 shows the arrangement of circuit for this experiment.

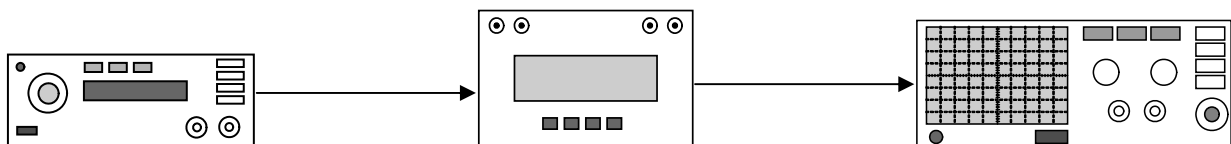
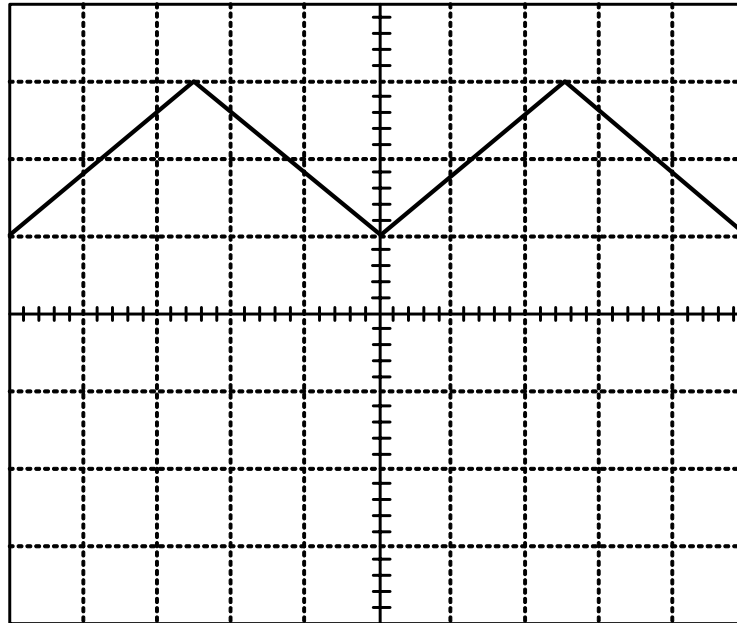


Figure 5.3: Circuit layout

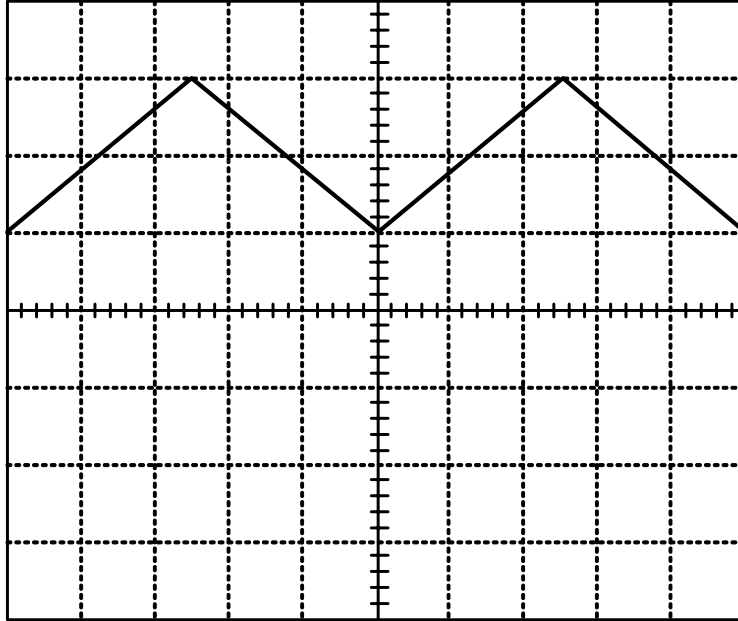
Select the frequency of internally generated carrier to be 1000 Hz. Set the modulation index to 60%. Select a periodic triangular waveform with a frequency of approximately 200 Hz on

signal generator. The diagram below shows the modulating signal. The time-base of oscilloscope is set at 1 mSec/division. Set the oscilloscope to display both the modulating and modulated signals. Sketch the waveform of the modulated signal below the modulating signal.



To see the effect of change in carrier frequency on the modulated signal, change the carrier frequency over its entire range of 500Hz-8000Hz and again observe the modulated signal. Describe the effect of change in carrier frequency on the modulated signal.

Select carrier frequency to be 1000 Hz and change the modulation index from 60% to 100%. Draw the modulated signal below the modulating signal. Observe the effect of change in modulation index on the modulated signal.



Vary the value of modulation index over its entire range of 10% - 100% and see how it affects the modulated signal. Write down your observations about the effect of change of modulation index.

Now we will see the effect of change in amplitude of modulating signal on the modulated signal. As modulation index is the ratio of amplitudes of the signal and the amplitude of the carrier, a change in amplitude of the modulating signal requires a corresponding change in the strength of the carrier so that the modulation index remains the same. Select modulation index to be 80%. Slowly change the amplitude of the modulating signal and see the effect on the modulated signal. Write down your observations below.

Select a carrier frequency of 1000 Hz and a triangular modulating signal with a frequency of 200 Hz. Now connect the output channel-A of this FlexTrainer to input channel-A of another FlexTrainer. Configure the second FlexTrainer as a spectrum analyzer. Select X-Y mode on the oscilloscope. Observe the spectrum on the oscilloscope. Change the carrier frequency to 1500 Hz and 2000 Hz. Observe the spectrum and write down your observations.

Select a carrier frequency of 1000 Hz and a triangular modulating signal with a frequency of 200 Hz. Now vary the modulation index from 10% to 100% and observe the spectrum of the modulated signal on the oscilloscope. Write down the effect of change in modulation index on the modulated signal spectrum.

Select a carrier frequency of 1000 Hz and a triangular modulating signal with a frequency of 200 Hz. Vary the amplitude of modulating signal from the signal generator and observe the effect on the spectrum. Write your observations below.

Select a carrier frequency of 1000 Hz and a sinusoidal modulating signal of 100 Hz from the signal generator and observe the spectrum on the oscilloscope. Change the sinusoidal signal

to triangular and then to square waveforms. Observe the change in the spectrum on the oscilloscope. Write your observations below.
