COMMUNICATIONS LAB. Experiment #2: Amplitude Modulation / Demodulation

OBJECTIVES

Introduction to amplitude modulation and demodulation.

GENERAL INFORMATION on Amplitude Modulation/Demodulation

Modulation is a process of controlling a quantity with another quantity. In communication it should be understood as controlling one or more property of a signal (carrier) with an information signal since transmitting an information signal in the form of a modulated carrier is either necessary or has certain benefits over transmitting the bare information signal;

- Radiating baseband information signal through an antenna has technical difficulties (very long antenna requirement)
- Using RF carriers opens the way to band sharing (frequency division mux) with other transmitters.
- Certain modulation techniques may help improve the quality of the reception.

Carrier is primarily a HF sinusoidal signal due to its wave propagation properties and is in general in the form of $y(t) = Acos(2\pi f_C t + \phi)$ where A is the amplitude, f_C is the frequency and ϕ is the angle of the sinusoidal. We are to replace the amplitude A in AM to $A(t)$ (or $x(t)$) to notify that it is the information signal we are trying to transmit and it varies with time (eg: voice signal). In AM, f_C and ϕ are constant. Amplitude modulation is primarily used for commercial/conventional broadcasting.

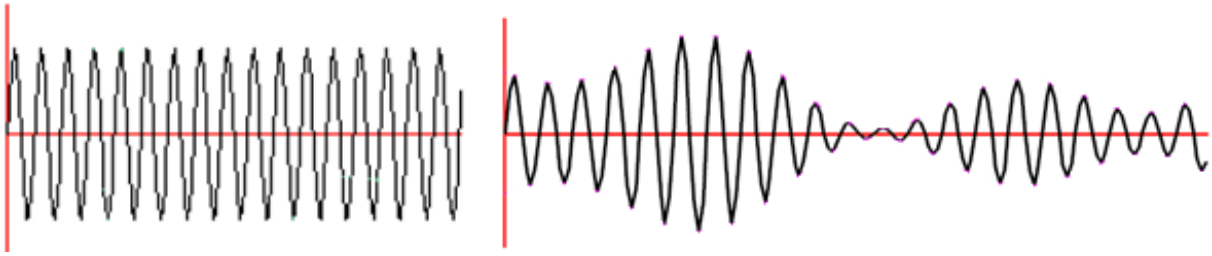

Figure 1 *Unmodulated and amplitude modulated carrier example*

The process of extracting the message from a modulated signal is called demodulation or detection. For AM, demodulation can be accomplished by;

- Using a diode + RC circuit (envelope detection)
- Using a synchronous detector (requiring exact original carrier at the receiver)

We have synchronous demodulators in the lab.

EXPERIMENT

1. The Amplitude Modulation

a) Generate 40kHz and 1,5Vpp carrier signal (*Vc*) by using the "*FG1*" function generator and observe this signal by "*Channel 1*" of the oscilloscope.

b) Generate 1kHz and 7Vpp message signal (*Vm*) by using the "*FG2*" function generator and observe this signal by "*Channel 2*" of the oscilloscope while "*Channel 1*" is still connected to "*FG1*". You may need to change the trigger source to *Channel 2*, in order to have stable display of the signal.

c) Observe both channels at the same time. Draw the result observed on the screen to your report. You need to see 40 periods of one signal against 1 period of the other. Signals' phase/frequency may flactuate slightly. You can keep at least one of them stable on the screen using trigger function of the scope.

d) Make required connections to generate the AM modulated signal. Required connections are given in Figure 2.

e) Connect the "*Channel 1*" of the oscilloscope to the "*AM*" output of the AM module.

f) Observe the modulated signal at the "*AM*" output. Draw the result observed on the screen to your report and note down your comments.

g) Observe the output frequency spectrum using the "*FFT*" function on the oscilloscope.
Hint: "FFT" analyzer can be found by pushing the "Math" button on the oscilloscope.

h) Change the frequency and the amplitude of the carrier signal while "*FFT*" function is still available (**Do not change the frequency and the amplitude of the message signal) and observe the effects of the changes. Take notes. Draw the result observed on the screen in your report.
i) Change the frequency and the amplitude of the message signal while "*FFT*" function is still available. Take notes. Draw the result observed on the screen in your report.
j) Exit "*FFT*" function. Then, find an example for an ideally modulated signal and over modulated signal. Draw both of the results observed on the screen to your report and note down your comments. When ideal, positive envelope of the AM signal is just over 0V.
Hint: Modulation index of an ideally modulated signal is 1, modulation index of an overmodulated signal index value is greater than 1.

2. The Amplitude Demodulation

k) Generate 40kHz – 1,5Vpp carrier signal by using the "*FG1*" function generator.
l) Generate 1kHz - 7Vpp message signal by using the "*FG2*" function generator.
m) Make connections on the training kit to set up the AM demodulator as shown in Fig. 3.
n) Connect the "*Channel 1*" of the oscilloscope to the "*Vm*" input of the AM modulator.
o) Connect the "*Channel 2*" of the oscilloscope to the "*Vo*" output of the AM demodulator.
p) Observe the "*Vo*" and "*Vm*" at same time. Draw the result observed on the screen to your report and note down your comments. Is there any difference between "*Vm*" and "*Vo*"?
q) Change the frequency and the amplitude of the message signal, observe the result and take notes. Draw the result observed on the screen to your report at each different result.

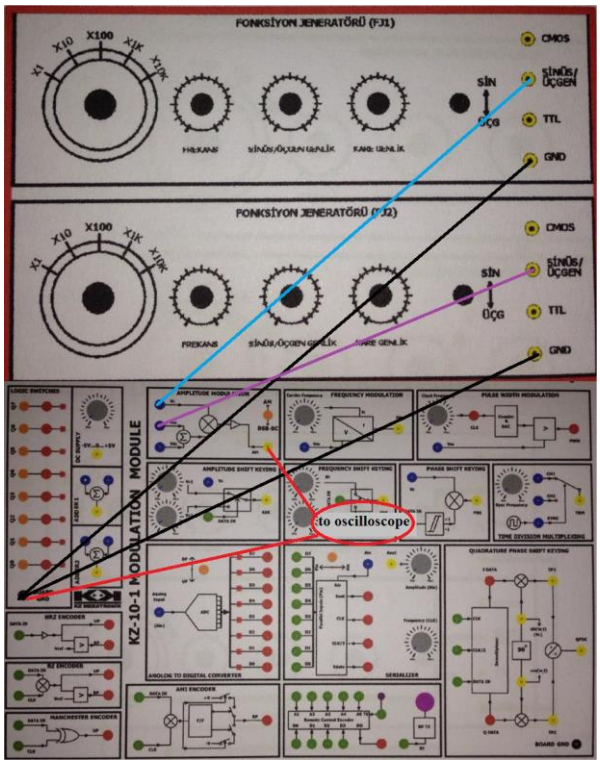

Figure 2 *Module connections for AM modulation*

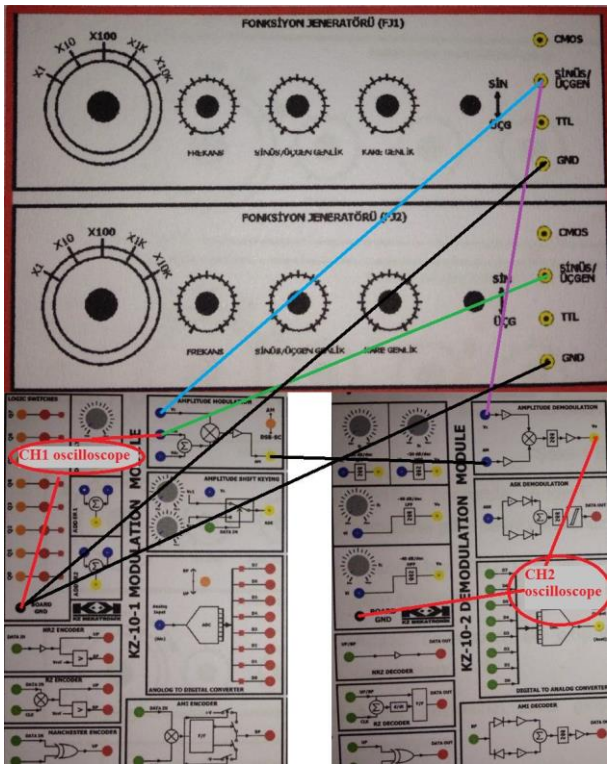

Figure 3 *Module connections for AM demodulation*