COMMUNICATIONS LAB. Experiment #4: ASK Modulation / Demodulation

OBJECTIVES
Introduction to Amplitude Shift Keying modulation and demodulation and understanding the waveforms in ASK.

GENERAL INFORMATION on Amplitude Shift Keying Modulation/Demodulation
ASK is the digital version of Amplitude Modulation (AM). That is, the baseband message signal modulating a carrier is not continuous-analog but a signal that assumes finite number of values. For practical reasons, the number of possible values is 2^b where b is a positive integer. Each value (representing a particular symbol/sub-message) appears in the signal for a finite amount of preset constant duration, for practical purposes again. The experiment you will be doing involves binary symbols (b=2), meaning that we have only two message signal values resulting in two carrier amplitudes in the end.

General block diagram for an ASK modulator is no different than that of AM;
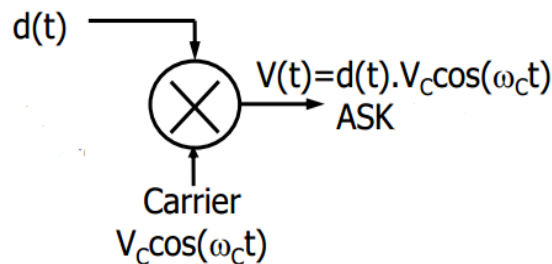
where d(t) is the digital message signal and $V_C \cos(\omega_C t)$ is the carrier signal. Then, for a message signal given as consecutive +A or 0 pulses, resulting ASK signal is shown below along with the message signal.
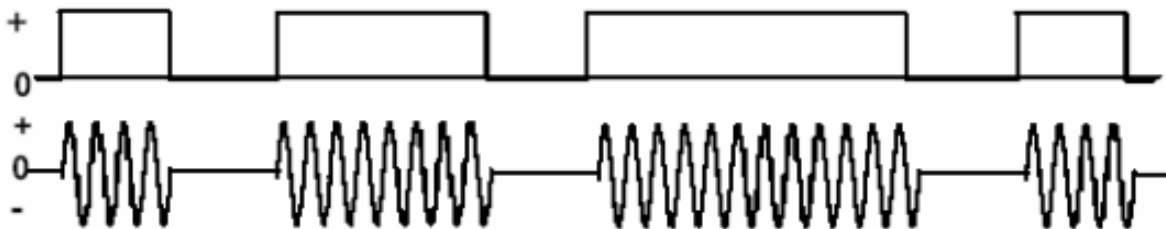
It is easy to note that the two values (+A and 0) actually represent two binary values 0 and 1.
ASK signals have well defined envelope. Thus, it is possible to demodulate ASK (recover the information signal at the receiver) using an envelope detector. A synchronous demodulator would also be appropriate. However, envelope detection circuitry is simple, while the synchronous demodulation requires a phase-locked local carrier and therefore a carrier acquisition circuitry. Note that the example ASK signal given above has "no signal" periods in it, presenting a challange for the carrier acquisition.

EXPERIMENT

1. **Amplitude Shift Keying Modulation**

a)   Connect Q0 of Logic-Switches to DATA IN for ASK Module input.

b)   Generate sinusoidal carrier signal (100kHz/6.5Vpp) using "FG1" and connect this signal to "Vc" and observe this signal on the oscilloscope's CH1 channel.

c)   Apply logic-0 to DATA IN and obtain 0V on CH2 by adjusting VC2 potentiometer. Draw the resulting signal in your report..

d) Apply logic-1 to DATA IN and obtain 5Vpp on CH2 by adjusting VC1 potentiometer. Draw the resulting signal in your report.

e) Note down your comments; Explain the purposes of VC2 and VC1 potentiometers.
   Important: Do not change the potentiometers in the following steps of the experiment.

f) Disconnect Logic-switch. Generate a 10kHz square signal by using the Square output of the FG2 function generator. Connect this signal to both DATA IN and CH1 of the oscilloscope.

g) See the ASK output signal by connecting it to CH2 of the scope. Draw the signal in your report and note down your comments.

h) Disconnect Square signal from the modulator. Connect Logic-Switches to Serializer. That is, connect Q0 to D0, Q1 to D1, … , Q7 to D7. Adjust Logic-Switches module to the ASCII code of the letter A which is $(01000001)_2$. Select Pin switch position (on the Serializer) to load parallel data and connect S_{out} output of the Serializer to DATA IN and observe the serialized data signal on the CH1 of the scope.

i) Observe ASK output on the CH2 of the scope. Draw it in your report and note down your comments.

2. **Amplitude Shift Keying Demodulation**

j) Demodulate the modulated ASK signal by connecting ASK Modulation output to ASK Demodulation input. Make sure that the serialized message signal is on CH1 and the demodulated ASK signal is on CH2. Draw both signals in your report and comment; Did you get what you have transmitted? What are the differences?

k) Disconnect Logic-Switches and Serializer connections on the training kit and use a 1kHz square signal as the message signal, like you did in step f.

l) Repeat step j, noting down your comments again.

m) Change the frequency of the square message signal reasonably until you see an interesting demodulated signal. Draw both message and demodulated ASK signals in your report and note down your comments.