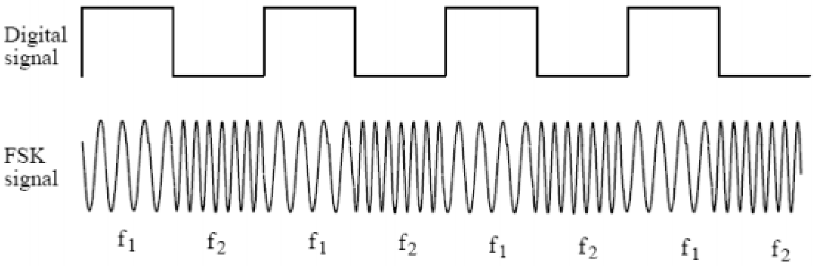
COMMUNICATIONS LAB. Experiment #5: FSK Modulation / Demodulation

OBJECTIVES

Introduction to Frequency Shift Keying modulation and demodulation.

GENERAL INFORMATION on Frequency Modulation/Demodulation

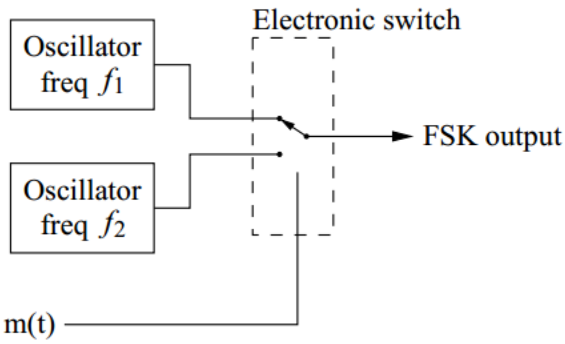
In wireless transmission, wider communication bandwidth is almost always the key to better reception and signal recovery. Frequency modulation types can therefore show better performance on received signal quality. In digital data transmission, this corresponds to Frequency Shift Keying (FSK). FSK is a type of FM where the modulating signal assumes discrete values and shifts the output frequency to a set of predetermined discrete frequency values. If the information consists of only two values (binary), they are sometimes referred as the mark and space frequencies. An example binary information signal and FSK modulated signal are shown in the following figure.



In frequency shift keying, the signals transmitted for spaces (binary zeros) and marks (binary ones) are

$$s_0(t) = A\cos(2\pi f_0 t + t_0)\,, \quad 0 < t \le T_b$$
$$s_1(t) = A\cos(2\pi f_1 t + t_0)\,, \quad 0 < t \le T_b$$

respectively, where t_0.is an arbitrary initial phase. This is called a discontinuous phase FSK system, since the sinusoidals are generated independently and therefore the modulated signal is discontinuous at the switching times. A signal of this form can be generated by the following system:



Demodulation of FSK signal can be done by converting FSK to ASK by a filter whose ascending/descending slope is centered between two FSK frequencies, followed by an ASK demodulator. Similar to synchronous demodulators, these two discrete frequencies can also be replicated at the receiver (via PLLs) and a synchronous demodulation can be performed.

(The methods mentioned in the following note are yet to be discussed in the lecture.)

Note: Contrary to the common belief, use of matched filters is either difficult or too limiting to realize here, since in reality, these discrete frequencies are very close to each other and therefore bit period starts and ends must be determined very precisely. Instead a synchronous demodulator synchronized to one of the carriers is easier for binary FSK, considering that binary FSK is the sum of two ASK-modulated signals with different carriers. In that case, one cannot benefit from the wider bandwidth however. It would be better to synchronously demodulate two ASKs and apply decision criterion afterwards. (Question: How?)

<u>COMMUNICATIONS LAB. Experiment #5: FSK Modulation / Demodulation</u>

<u>EXPERIMENT</u>

1. Frequency Shift Keying Modulation

a) Connect Q0 of Logic-Switches to DATA IN of FSK Module input. Connect this signal to CH1 of the scope and observe to make sure that it works.

b) Connect otput of the FSK module to CH2 of the scope. Set Q0 to logic-0. Adjust f_L potentiometer to see an 16kHz carrier signal on CH2. Draw what you see on the scope in your report.

c) Set Q0 to logic-1. Adjust f_H to obtain a 32kHz signal on CH2. Draw the signal in your report.

d) State the purposes of f_L and f_H potentiometers in your report.
Important: Do not change the potentiometers in the following steps.

e) Disconnect Logic-switch from DATA IN. Connect the output of FG1 signal generator to both DATA IN and CH1 of the scope. Generate a 1kHz square signal on FG1 and observe.

f) CH2 was already connected to FSK output. Draw both CH1 and CH2 signals in your report, making sure that you see about 3-4 periods of the square signal on the scope.

g) Disconnect FG1 and connect DATA IN and CH1 to the output of the Serializer.
Connect Serializer inputs to Logic-Switches outputs (Q0...Q7 to D0...D7).
Adjust Logic-Switches to ASCII code of the letter A (01000001).
Select Pin switch position (on the Serializer) to load parallel data.
Connect Sout output of the Serializer to DATA IN of FSK module.
Observe both serialized data and FSK signal on CH1 and CH2 respectively.

h) Make sure that you observe entire seralized 8 bit signal on scope. Draw both signals in your report.

2. Frequency Shift Keying Demodulation

i) Demodulate the modulated signal by connecting FSK Modulation output to FSK Demodulation input. While doing this, observe the original message signal on the CH1 of the oscilloscope and observe the FSK demodulation output signal on the CH2 of the oscilloscope. Draw the result observed on the screen to your report and note down your comments.
Hint: You may need to adjust "PLL Frequency" to observe a proper result, like you did in the previous FM experiment.

j) Change the message signal by disconnecting Logic-Switches and Serializer connections on the training kit and connecting a 1kHz square signal to DATA IN, like you did in the step-e.

k) Observe the square signal on CH1 and demodulated signal on CH2. Draw the signals observed on the scope in your report and note down your comments.
Hint: You may need to adjust "PLL Frequency" to observe a proper result, like you did in the previous FM experiment.

l) Change the frequency of the square message signal by some reasonable amount and observe the changes on the scope. Draw the signals in your report and note down your comments.