ECE 4705 Lab
Experiment 4 – OOK Modulation
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ECE4705L_04

ECE 4705L **EXPERIMENT 4**

OOK MODULATION

OBJECTIVE

The objective of this experiment is to understand OOK modulation.

LAB REPORT

Before we begin talking about ON OFF Keying (OOK) modulation, we should get an understandng of the concept of modulation itself first. As a general definition, modulation can be defined as the process of modifying the amplitude, frequency or phase of a high frequency carrier signal in order to represent a desired lower frequency message signal to be sent. Modulation can can be applied to both analog and digital carriers to represent either analog or digital data being sent. Some forms of analog modulation include Single Sidedband Amplitude and Double Sideband with Single Carrier modulation. However, in this report we will be focusing on three main types of digital modulation which are Phase Shift Keying modulation, Frequency Shift Keying modulation, and Amplitude Shift Keying modulation. The use of these different types of modulation differs based on what is required of an application.

The first type of modulation which will be covered is Phase Shift Keying (PSK) modulation. PSK modulation is done by changing the phase of the carrier signal to represent a digital message that is being sent. Essentially, when working in the digital world and there is a change in digital data, either from binary high '1' to binary low '0' or vice versa, there will be a phase shift of 180° in the carrier signal. This is used to help demodulate the carrier signal from the demodulator in order to obtain the original digital message being sent from the transmitter. The figrure below depicts time and frequency

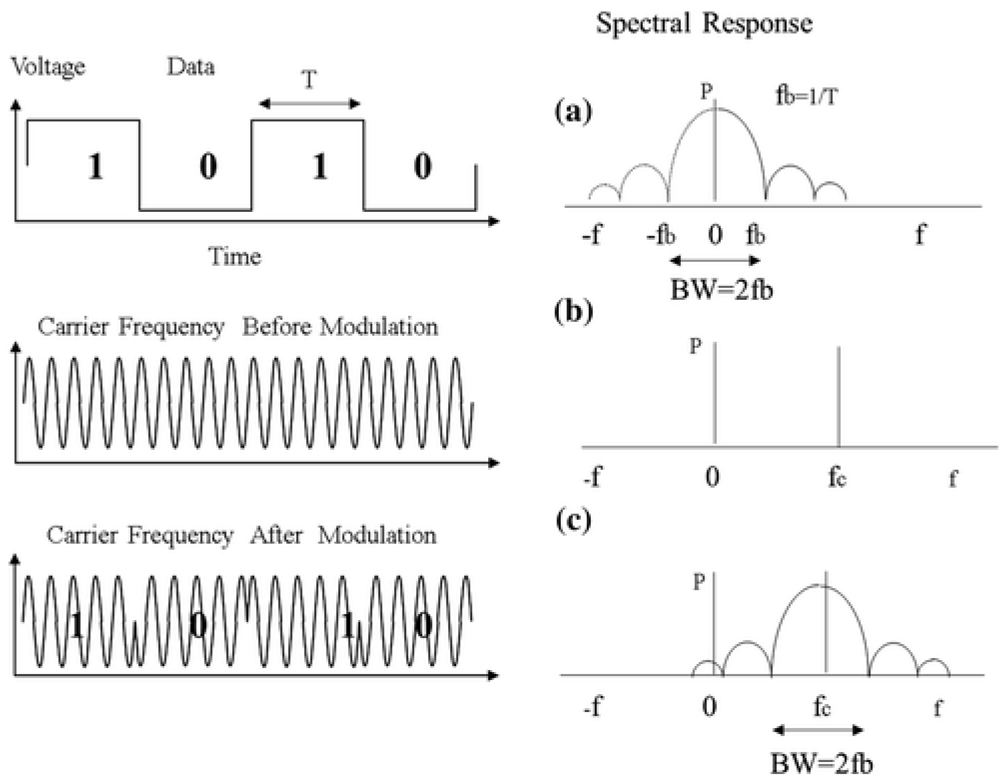

Figure (1): Phase Shift Keying Modulation in Time and Frequency Domain

For Frequency Shift Modulation, instead of there being a 180° phase shift in the carrier signal when the message switches states, FSK either reduces the frequency or reduces the frequency of the carrier signal. When the message signal is a low ‘0’, there is a reduction of frequency and when the message signal is a high, ‘1’ there is an increase in frequency of the carrier signal (f_c). This increase or decrease is equal to the carrier frequency(f_c) plus or minus the message frequency (f_b).

The last kind of modulation we will go over is Amplitude Shift Keying modulation. This modulation modifies the amplitude of the carrier signal based on the current state of the message. If the message signal is in a low state ‘0’ the amplitude of the carrier signal is reduced but when the message signal is in a high state ‘1’ then the amplitude of the carrier signal will be increased.

By knowing what modulation is and what types of modulations are available we can better understand just what OOK modulation is. On-Off Keying modulation, or OOK modulation, is a commonly used variant of ASK modulation. It is used to represent digital data just as ASK modulation does through amplitude changes, but instead of changing the amplitude we are changing whether or not the carrier signal is present. For On-Off Keying modulation, when a digital message signal is in a high state ‘1’ then the carrier signal will be present but when the signal is in a low state ‘0’ the carrier signal will be completely absent. This simpler variant of the ASK modulation is more efficient from a spectral standpoint in comparison to FSK modulation and consumes less power when transmitting the message signal compared to ASK modulation. Although OOK seems to be a more efficient way to carry message signals, it is far more susceptible to outside noise. OOK modulation is typically used to send Morse code via radio frequencies and may sometimes be used to transfer data from computer to computer through ISM radio bands. On-Off Keying modulation works by first being able to identify the message signal that is being sent. Since OOK is a type of digital modulation technique, it works almost like a Digital to Analog conversion. The message that is being identified is a digital signal or a binary bitstream that is then modulated with a carrier signal which is typically a high frequency analog signal. Once the two signals have been multiplied or modulated, the transmitter is then able to send this information to be identified by a desired receiver. The receiver obtains the modulated signal and uses a demodulator in order to obtain the original digital signal being sent. Usually the demodulated signal is not entirely the same as the message signal because of outside noise, but it is similar enough to be able to recover the message.

APPENDIX

Figures and Equations

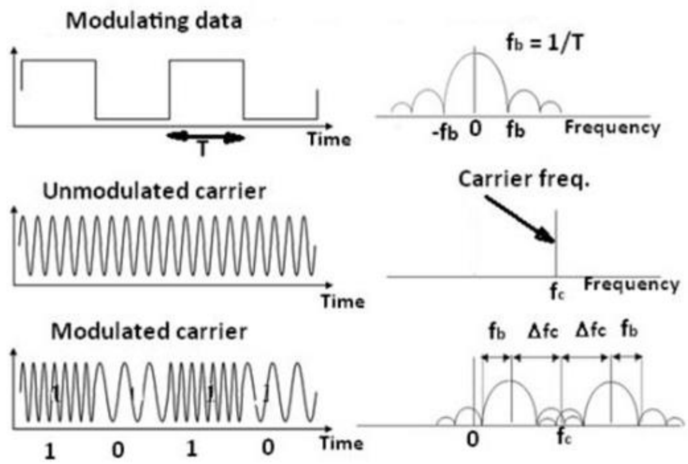

Figure (2): Frequency Shift Keying Modulation in Time and Frequency Domain

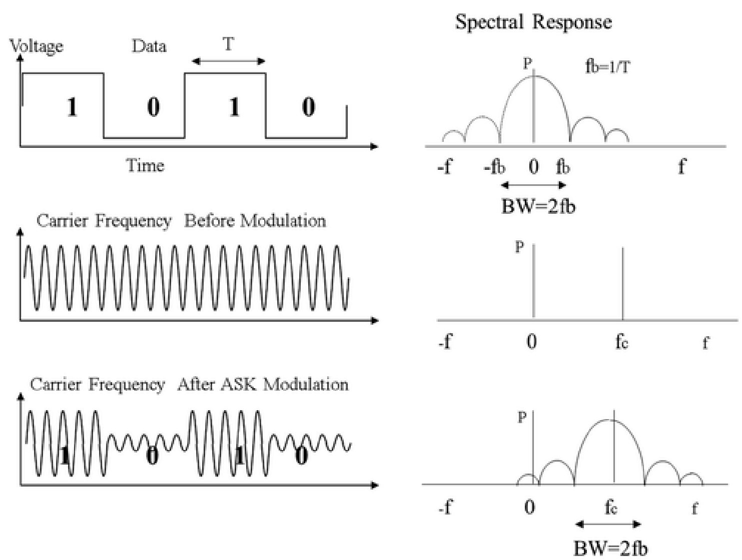

Figure (3): Amplitude Shift Keying Modulation in Time and Frequency Domain

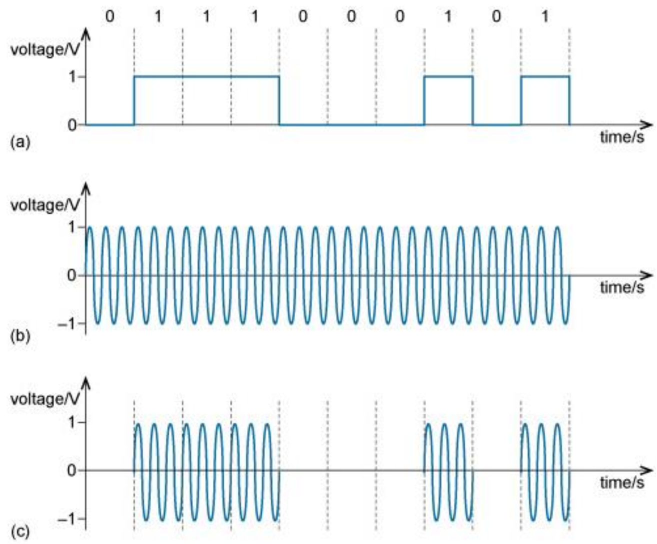

Figure (4): On-Off Keying Modulation in Time Domain

$$V_{OOK}(t) = A_c Cos(2\pi f_c t)\,; High\ State\ (Binary\ 1)$$
$$V_{OOK}(t) = 0\,; Low\ State\ (Binary\ 0)$$

Figure (5): Equations for OOK Modulation in Time Domain

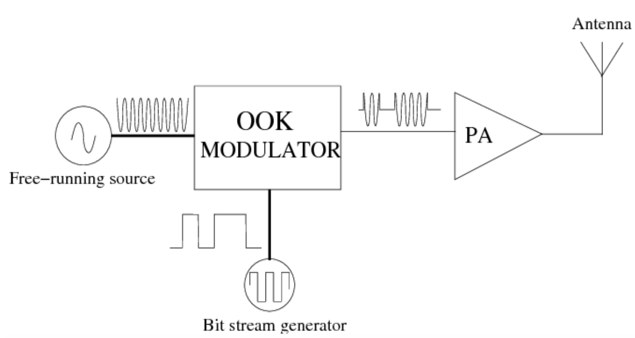

Figure (6): On-Off Key Modulator Block Diagram

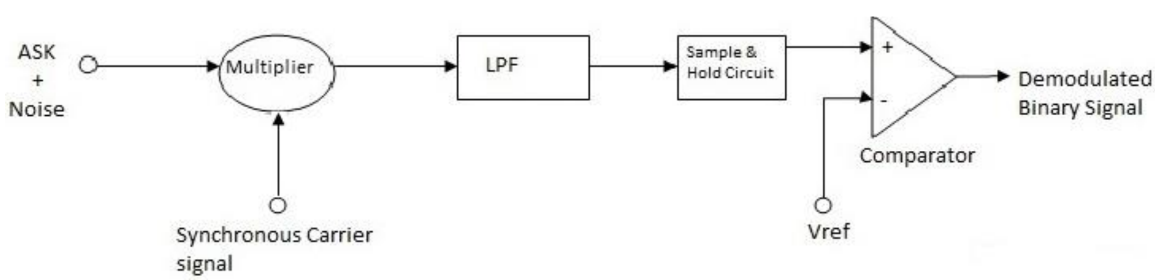

Figure (7): On-Off Key Demodulator Block Diagram