Lab Manual 6

Carrier Modulation and Demodulation

AMPLITUDE SHIFT KEYING

Aim: To modulate and demodulate amplitude shift keyed (ASK) signal using MATLAB

Theory:

Generation of ASK Amplitude shift keying - ASK - is a modulation process, which imparts to a sinusoid two or more discrete amplitude levels. These are related to the number of levels adopted by the digital message. For a binary message sequence there are two levels, one of which is typically zero. The data rate is a sub-multiple of the carrier frequency. Thus the modulated waveform consists of bursts of a sinusoid.

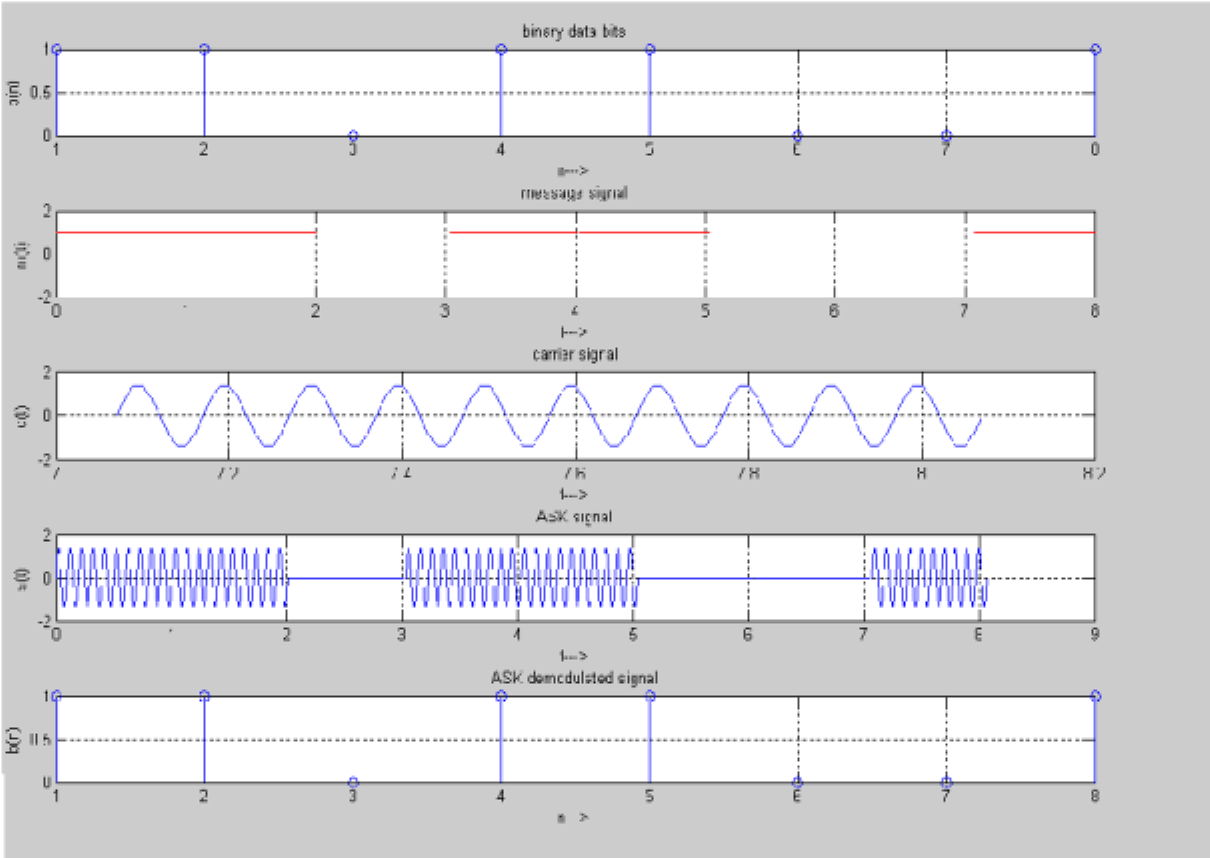
Demodulation ASK signal has a well-defined envelope. Thus it is amenable to demodulation by an envelope detector. Some sort of decision-making circuitry is necessary for detecting the message. The signal is recovered by using a correlator and decision making circuitry is used to recover the binary sequence.

Algorithm Initialization commands ASK modulation

1. Generate carrier signal.
2. Start FOR loop
3. Generate binary data, message signal(on-off form)
4. Generate ASK modulated signal.
5. Plot message signal and ASK modulated signal.
6. End FOR loop.
7. Plot the binary data and carrier.

ASK demodulation

1. Start FOR loop
2. Perform correlation of ASK signal with carrier to get decision variable
3. Make decision to get demodulated binary data. If x>0, choose ‘1’ else choose ‘0’
4. Plot the demodulated binary data.



The program for ASK modulation and demodulation generated by following the given algorithm has been simulated in MATLAB and necessary graphs are plotted.

PHASE SHIFT KEYING

Aim: To modulate and demodulate phase shift keyed (PSK) signal using MATLAB

Generation of PSK signal

PSK is a digital modulation scheme that conveys data by changing, or modulating, the phase of a reference signal (the carrier wave). In PSK bits 1 and 0 will be assigned different phases. PSK uses a finite number of phases, each assigned a unique pattern of binary digits. Usually, each phase encodes an equal number of bits. Each pattern of bits forms the symbol that is represented by the particular phase.

The demodulator, which is designed specifically for the symbol-set used by the modulator, determines the phase of the received signal and maps it back to the symbol/bit it represents, thus recovering the original data.

In a coherent binary PSK system, the pair of signal S1(t) and S2 (t) used to represent binary symbols 1 & 0 are defined by

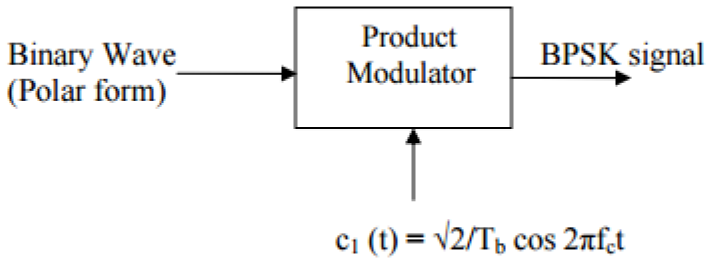
- $S1(t) = \sqrt{2Eb/Tb} \cos 2\pi fct$
- $S2(t) = \sqrt{2Eb/Tb} \cos(2\pi fct + \pi) = -\sqrt{2Eb/Tb} \cos 2\pi fct$ where $0 \le t < Tb$
- and Eb = Transmitted signed energy for bit

- The carrier frequency fc =n/Tb for some fixed integer n.

Antipodal Signal:

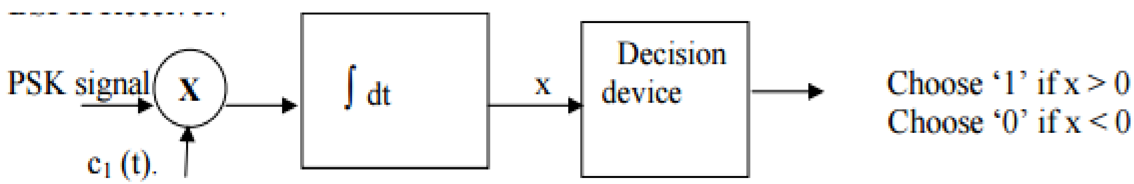
The pair of sinusoidal waves that differ only in a relative phase shift of 180° are called antipodal signals.

BPSK Transmitter:



The input binary symbols are represented in polar form with symbols 1 & 0 represented by constant amplitude levels V & -V. This binary wave is multiplied by a sinusoidal carrier in a product modulator. The result in a BSPK signal.

BSPK Receiver:



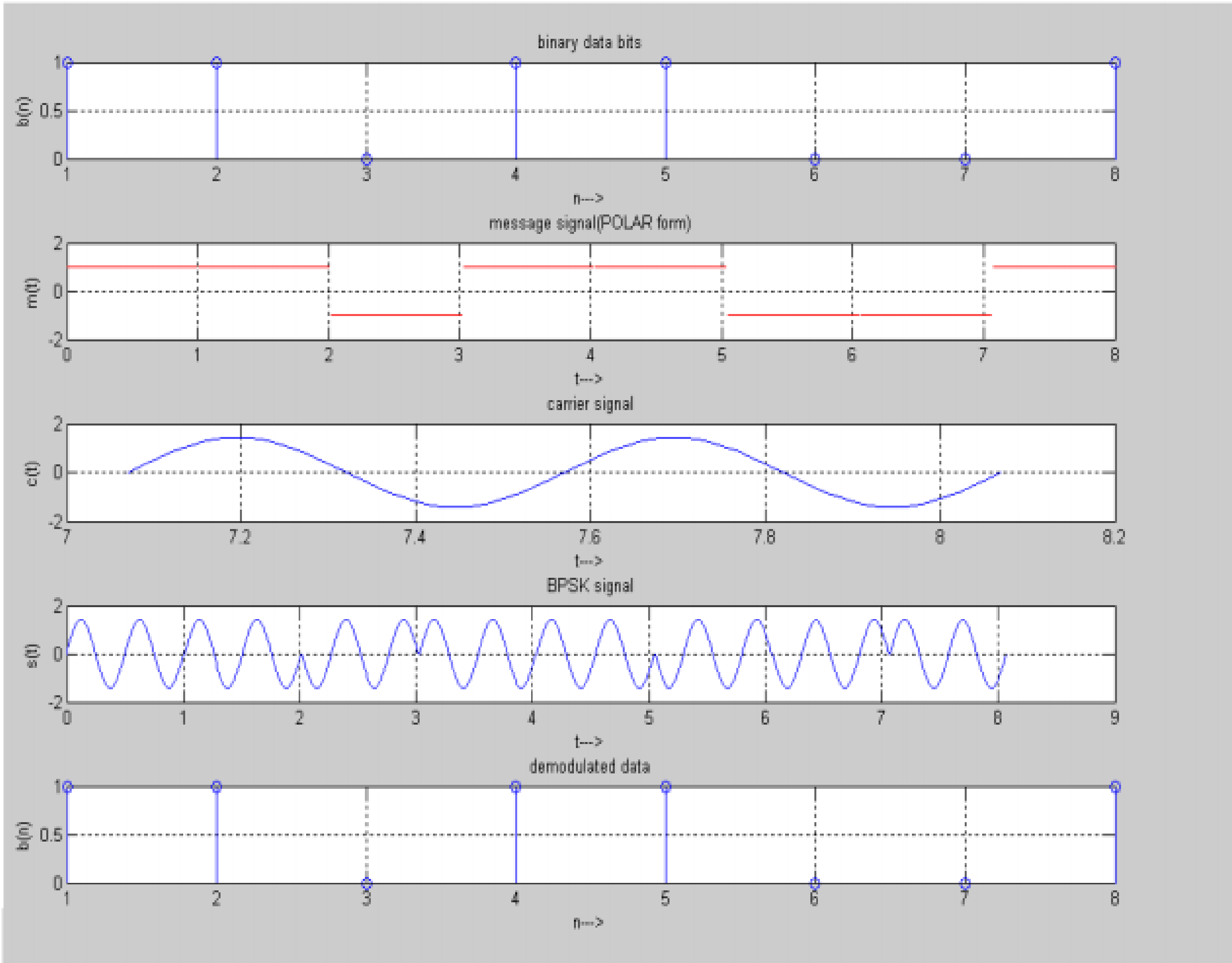
The received BPSK signal is applied to a correlator which is also supplied with a locally generated reference signal c1 (t). The correlated o/p is compared with a threshold of zero volts. If x> 0, the receiver decides in favour of symbol 1. If x< 0, it decides in favor of symbol 0.

Algorithm Initialization commands PSK modulation

1. Generate carrier signal.
2. Start FOR loop
3. Generate binary data, message signal in polar form
4. Generate PSK modulated signal.
5. Plot message signal and PSK modulated signal.
6. End FOR loop.
7. Plot the binary data and carrier.

PSK demodulation

1. Start FOR loop Perform correlation of PSK signal with carrier to get decision variable
2. Make decision to get demodulated binary data. If x>0, choose '1' else choose '0'
3. Plot the demodulated binary data.



Result The program for PSK modulation and demodulation has been simulated in MATLAB and necessary graphs are plotted.

FREQUENCY SHIFT KEYING

Aim: To modulate and demodulate frequency shift keyed (FSK) signal using MATLAB

Theory

Generation of FSK

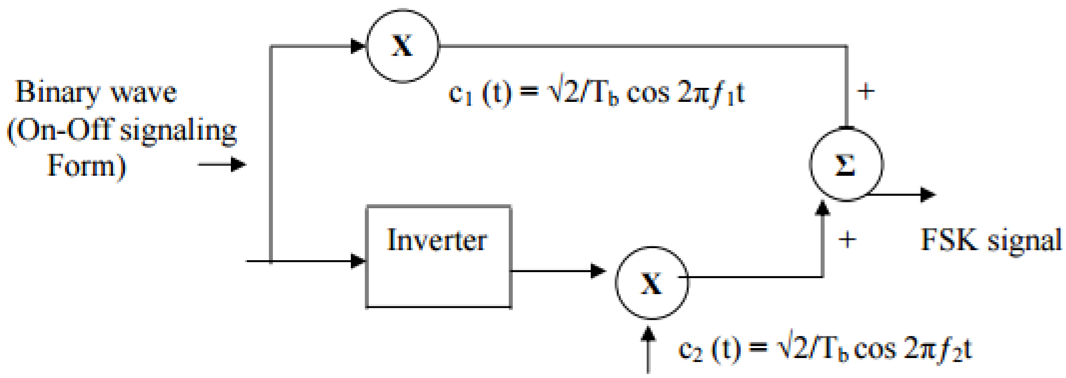
Frequency-shift keying (FSK) is a frequency modulation scheme in which digital information is transmitted through discrete frequency changes of a carrier wave. The simplest FSK is binary FSK (BFSK). BFSK uses a pair of discrete frequencies to transmit binary (0s and 1s) information. With this scheme, the "1" is called the mark frequency and the "0" is called the space frequency. In binary FSK system, symbol 1 & 0 are distinguished from each other by transmitting one of the two sinusoidal waves that differ in frequency by a fixed amount.

$S_i(t) = \sqrt{2E/T_b} \cos 2\pi f_1 t \qquad 0 \le t \le T_b$

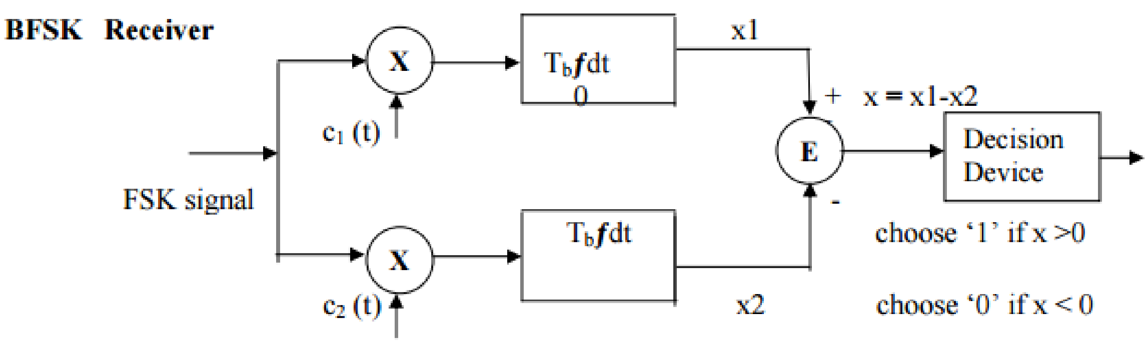
$\qquad 0 \qquad\qquad\qquad$ elsewhere

Where i=1, 2 & Eb=Transmitted energy/bit
Transmitted freq= ƒi = (nc+i)/Tb, and n = constant (integer), Tb = bit interval
Symbol 1 is represented by S1 (t)
Symbol 0 is represented by S0 (t)

BFSK Transmitter:



The input binary sequence is represented in its ON-OFF form, with symbol 1 represented by constant amplitude V with & symbol 0 represented by zero volts. By using inverter in the lower channel, we in effect make sure that when symbol 1is at the input, The two frequency f1& f2 are chosen to be equal integer multiples of the bit rate 1/Tb. By summing the upper & lower channel outputs, we get BFSK signal.



The receiver consists of two correlators with common inputs which are supplied with locally generated coherent reference signals c1(t) and c2 (t).

The correlator outputs are then subtracted one from the other, and the resulting difference x is compared with a threshold of zero volts. If x >0, the receiver decides in favour of symbol 1 and if x <0, the receiver decides in favour of symbol 0.

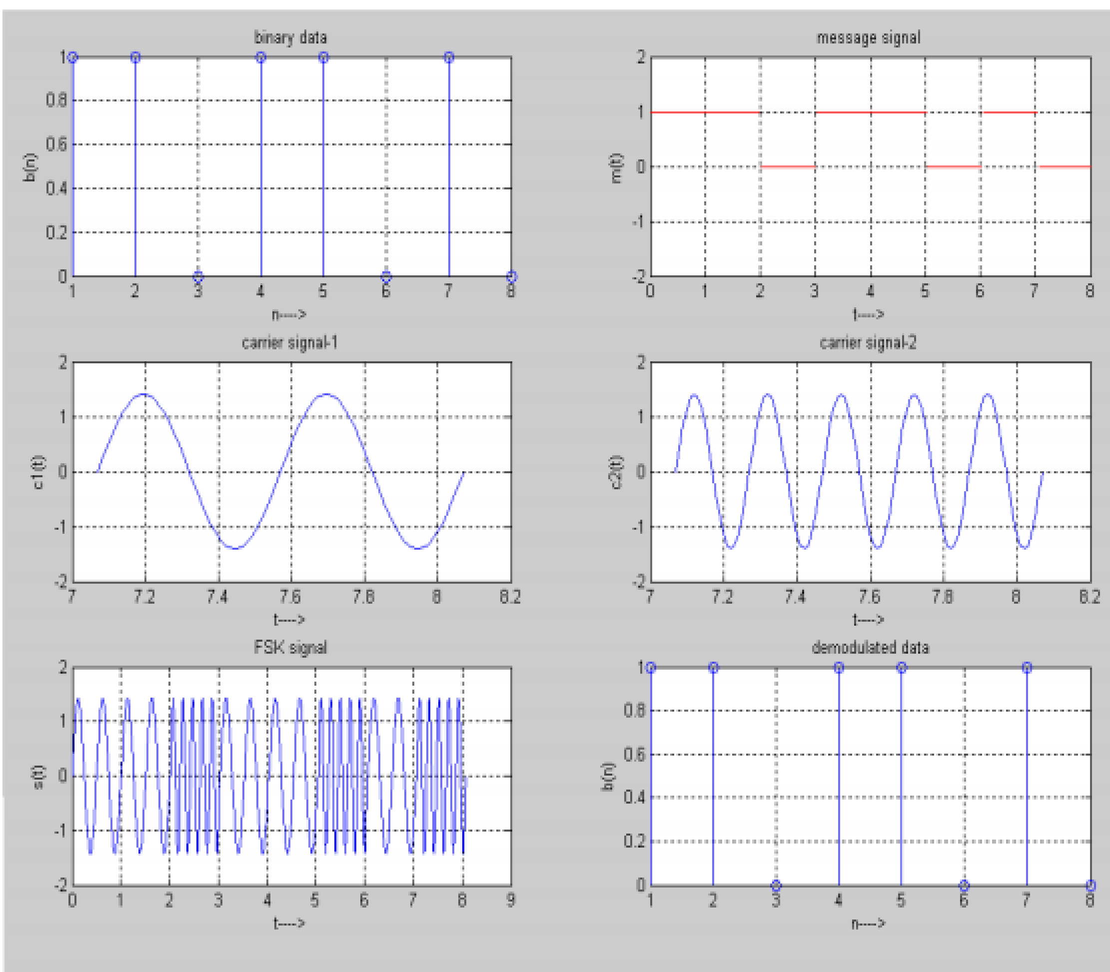
Algorithm

Initialization commands FSK modulation

1. Generate two carriers signal.
2. Start FOR loop
3. Generate binary data, message signal and inverted message signal
4. Multiply carrier 1 with message signal and carrier 2 with inverted message signal
5. Perform addition to get the FSK modulated signal
6. Plot message signal and FSK modulated signal.
7. End FOR loop.
8. Plot the binary data and carriers.

FSK demodulation

1. Start FOR loop
2. Perform correlation of FSK modulated signal with carrier 1 and carrier 2 to get two decision variables x1 and x2.
3. Make decision on x = x1-x2 to get demodulated binary data. If x>0, choose ‘1’ else choose ‘0’.
4. Plot the demodulated binary data.



Result The program for FSK modulation and demodulation has been simulated in MATLAB and necessary graphs are plotted.

TASKS :

Task1: Write Matlab code to apply all Modulation and demodulation Techniques on given binary data.

X=[1 1 0 1 0 0 1 0 1 1 1 1 1 0 0 0 0 1 0 1 0 1 0 0 0 1 1 0 1];