Experiment No.: 7 **Date:**

Aim:

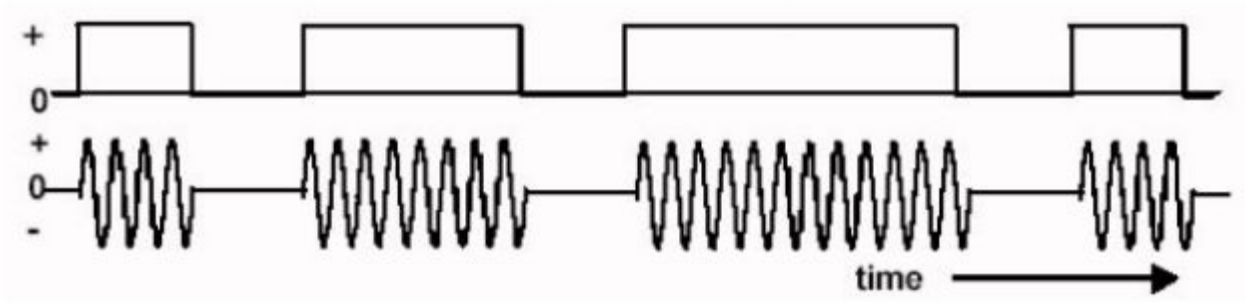
To Generate and demodulate an amplitude shift keying (ASK) signal.

Theory:

Amplitude Shift Keying (ASK) is the digital modulation technique. In amplitude shift keying, the amplitude of the carrier signal is varied to create signal elements. Both frequency and phase remain constant while the amplitude changes. In ASK, the amplitude of the carrier assumes one of the two amplitudes dependent on the logic states of the input bit stream. This modulated signal can be expressed as:

$$x_o(t) = \begin{cases} 0 & \text{symbol "0"} \\ A\cos\omega_c t & \text{symbol "1"} \end{cases}$$

Amplitude shift keying (ASK) in the context of digital signal communications 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. Thus the modulated waveform consists of bursts of a sinusoid. Figure 1 illustrates a binary ASK signal (lower), together with the binary sequence which initiated it (upper). Neither signal has been band limited.

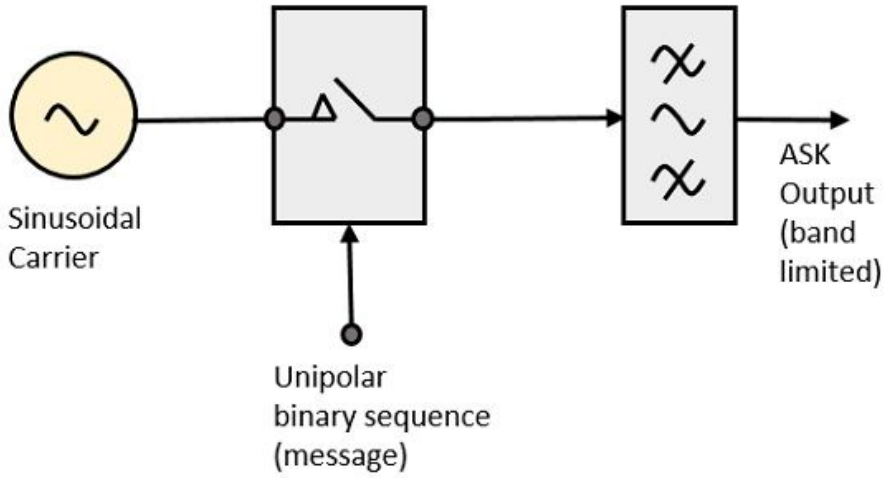


Message Signal & ASK Signal

There are sharp discontinuities shown at the transition points. These result in the signal having an unnecessarily wide bandwidth. Band limiting is generally introduced before transmission, in which case these discontinuities would be 'rounded off'. The band limiting may be applied to the digital message, or the modulated signal itself. The data rate is often made a sub-multiple of the carrier frequency.

ASK Modulator:

The ASK modulator block diagram comprises of the carrier signal generator, the binary sequence from the message signal and the band-limited filter. Following is the block diagram of the ASK Modulator.



The carrier generator, sends a continuous high-frequency carrier. The binary sequence from the message signal makes the unipolar input to be either High or Low. The high signal closes the switch, allowing a carrier wave. Hence, the output will be the carrier signal at high input. When there is low input, the switch opens, allowing no voltage to appear. Hence, the output will be low.

The band-limiting filter shapes the pulse depending upon the amplitude and phase characteristics of the band-limiting filter or the pulse-shaping filter.

ASK Demodulator:

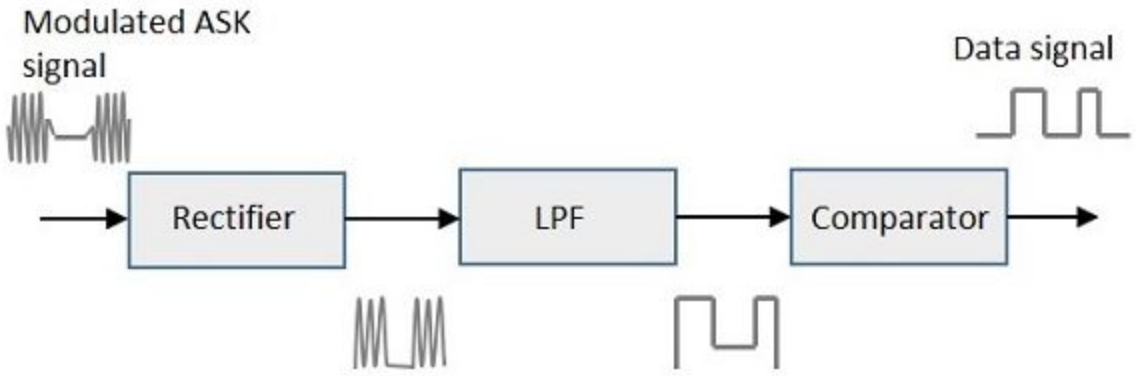
There are two types of ASK Demodulation techniques.

- Asynchronous ASK Demodulation/detection
- Synchronous ASK Demodulation/detection

The clock frequency at the transmitter, when matches with the clock frequency at the receiver, it is known as a Synchronous method, as the frequency gets synchronized. Otherwise, it is known as Asynchronous.

Asynchronous ASK Demodulator:

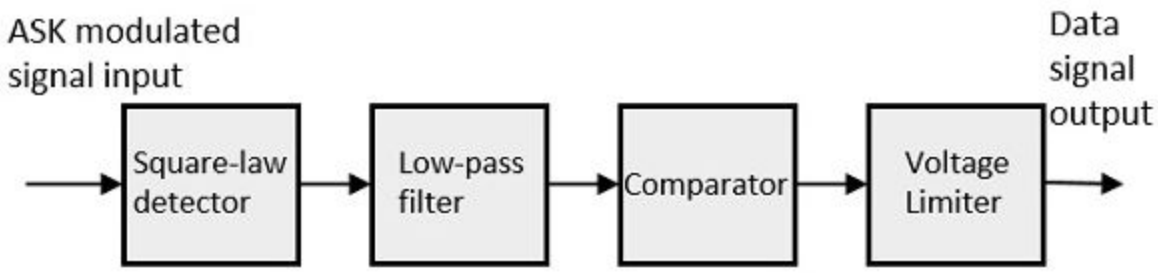
The Asynchronous ASK detector consists of a half-wave rectifier, a low pass filter, and a comparator. Following is the block diagram for the same.



The modulated ASK signal is given to the half-wave rectifier, which delivers a positive half output. The low pass filter suppresses the higher frequencies and gives an envelope detected output from which the comparator delivers a digital output.

Synchronous ASK Demodulator:

Synchronous ASK detector consists of a Square law detector, low pass filter, a comparator, and a voltage limiter. Following is the block diagram for the same.



The ASK modulated input signal is given to the Square law detector. A square law detector is one whose output voltage is proportional to the square of the amplitude modulated input voltage. The low pass filter minimizes the higher frequencies. The comparator and the voltage limiter help to get a clean digital output.

Algorithm to implement ASK modulation & demodulation on MATLAB:

ASK Modulation:

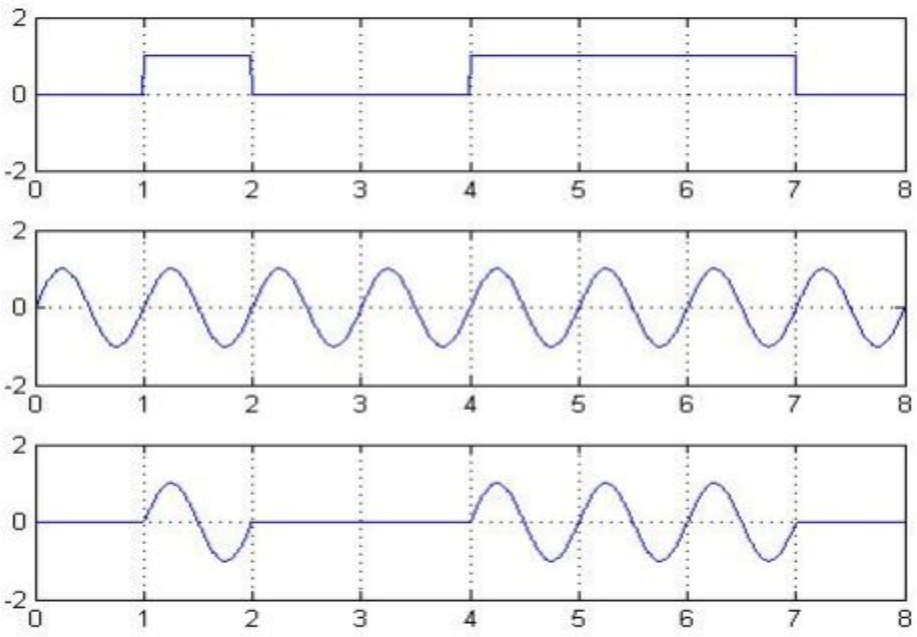
1. Generate a carrier signal of frequency fc.
2. Start a FOR Loop.
3. Generate a binary sequence, a message signal.
4. Generate ASK modulated signal, which will transmit carrier signal for logic 1 and zero signal for logic 0.
5. Plot message signal and ASK modulated signal.
6. End FOR Loop.
7. Plot binary data and carrier.

ASK Demodulation:

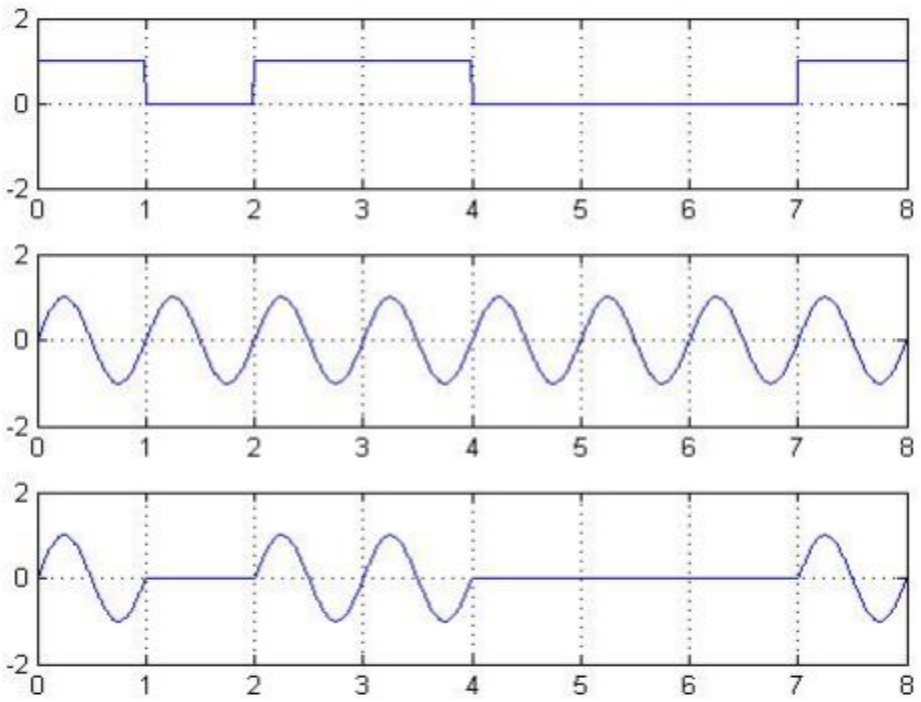
1. Start FOR Loop.
2. Perform correlation of ASK signal with carrier to get decision variable.
3. Make decision to get demodulated binary data. If x > 0, choose '1' else choose '0'.
4. Plot the demodulated binary data.

Expected Result:[1. Message signal 2. Carrier signal 3. ASK signal]

- Observation waveform for the bit stream [0 1 0 0 1 1 1 0]



- Observation waveform for the bit stream [1 0 1 1 0 0 0 1]

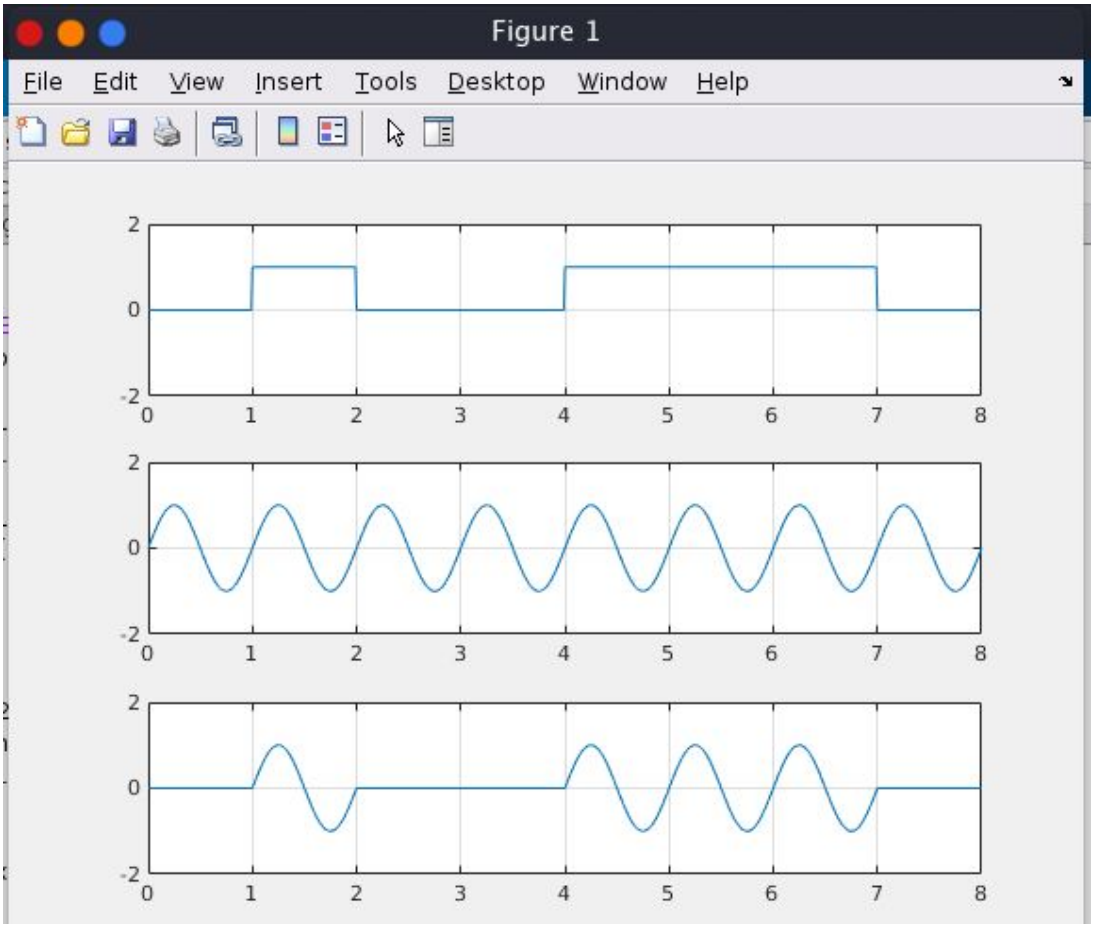


MATLAB Code:

```
clc

clear all

b = input('Enter the Bit stream \n ');

n = length(b);

t = 0:.01:n;

x = 1:1:(n+1)*100;

for i = 1:n

      for j = i:.1:i+1

            bw(x(i*100:(i+1)*100)) = b(i);

      end

end
```

```
bw = bw(100:end);

sint = sin(2*pi*t);

st = bw.*sint;

%Plotting all using subplot

subplot(3,1,1)

plot(t,bw)

grid on ; axis([0 n -2 +2])

subplot(3,1,2)

plot(t,sint)

grid on ; axis([0 n -2 +2])

subplot(3,1,3)

plot(t,st)

grid on;

axis([0 n -2 +2])
```

Result:



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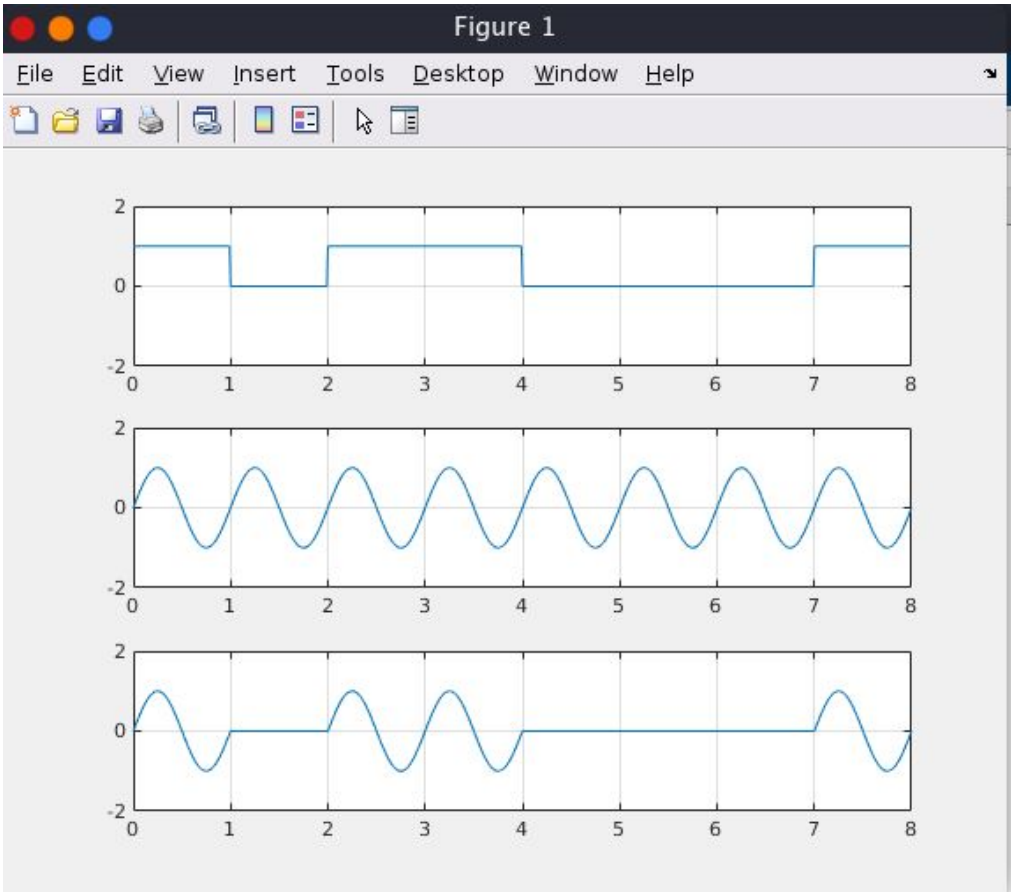

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Application of ASK:

- Low-frequency RF applications
- Home automation devices
- Industrial networks devices
- Wireless base stations
- Tire pressuring monitoring systems

References:

1. ASK Basics, waveforms, introduction to modulation & demodulation:

https://www.youtube.com/watch?v=ucrZlde8vtk

2. ASK Modulation:

https://www.youtube.com/watch?v=AmRjVzHFBAk

3. ASK Demodulation:

https://www.youtube.com/watch?v=_uf3j5Y2sNs

4. ASK on Kit:

https://www.youtube.com/watch?v=NDvRg-R8Mwo

5. ASK on MATLAB:

https://www.youtube.com/watch?v=x7mjVGFKnk8

Conclusion:

In this experiment we learnt how to generate and demodulate amplitude shift keying signals using ***MATLAB.***

Signature **Remarks**