Experiment No.: 4

Title: Experimental study of PSK modulation and demodulation.

Roll No.: _________ Batch: __________
Date of Performance: _________________
Date of Assessment: ___________________

Particulars	Marks
Attendance (05)	
Journal (05)	
Performance (05)	
Understanding (05)	
Total (20)	
Signature of Staff Member	

Experiment No: 4

Title: Experimental study of PSK modulation and demodulation.

Aim: To study and analyze the working of a BPSK (Binary Phase Shift Keying) transmitter and receiver using a suitable communication trainer kit or software.

Prerequisites:

- Basic Digital Communication Concepts.
- Function of signal generators, oscilloscopes, and modular/demodulator circuits.
- Use of communication trainer kits and connection of blocks.

Objectives:

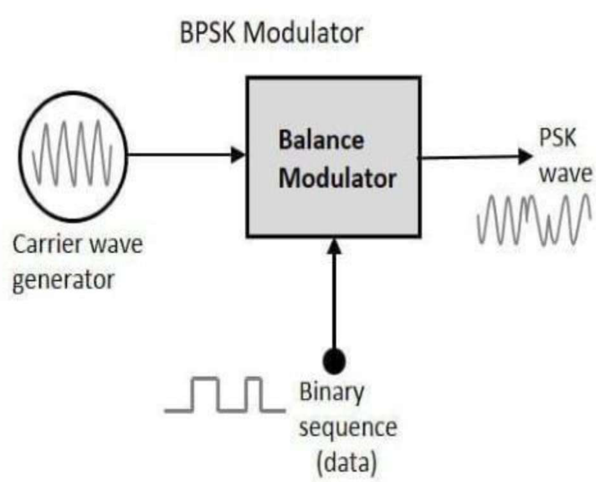
- To understand the principle and working of Binary Phase Shift Keying.
- To generate BPSK signals using a transmitter circuit/module.
- To observe and analyze the transmitted and received waveforms.

Theory:

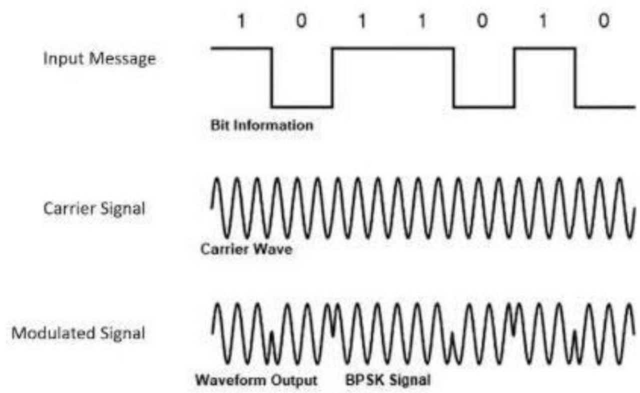
The trainer has been designed with a view to provide practical/experiment knowledge of binary phase shift keying Modulation/Demodulation technique as practically implemented in digital communication systems on a SINGLE P.C.B.

Binary Phase – Shift Keying:

The simplest form of PSK is binary phase-shift keying (BPSK), where N = 1 and M = 2. Therefore, with BPSK, two phases ($2^1 = 2$) are possible for the carrier. One phase represents a logic 1, and the other phase represents a logic 0. As the input digital signal changes state (i.e., from a 1 to a 0 or from a 0 to a 1), the phase of the output carrier shifts between two angles that are separated by 180 degrees.



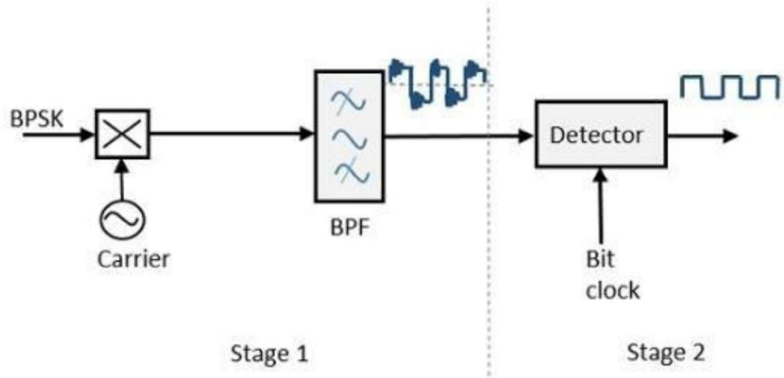
Hence, other names for BPSK are phase reversal keying (PRK) and biphase modulation. BPSK is a form of square-wave modulation of a continuous wave (CW) signal.



Consider a sinusoidal carrier. If it is modulated by a hipolar hit stream according to the scheme illustrated in figure below, its polarity will be reversed every time the bit stream changes polarity. This, for a sine wave, is equivalent to a phase reversal (shift). The multiplier output is a BPSK signal. The information about the hit stream is contained in the changes of phase of the transmitted signal. Asynchronous demodulator would be sensitive to these phase reversals. The appearance of a BPSK signal in the time domain is shown in below Figure (lower trace). The upper trace is the binary message sequence. There is something special about the waveform of above figure. The wave shape is 'symmetrical' at each phase transition. This is because the bit rate is a submultiples of the carrier frequency (ω/2*pi). In addition, the message transitions have been timed to occur at a zero-crossing of the carrier. Whilst this is referred to as 'special', it is not uncommon in practice. It offers the advantage of simplifying the bit clock recovery from a received signal. Once the carrier has been acquired then the bit clock can be derived by division. The basic BPSK generated by the simplified arrangement illustrated in 1st figure will have a bandwidth, in excess of that considered acceptable for efficient communications. If you can calculate the spectrum of the binary sequence then you know the bandwidth of the BPSK itself. The BPSK signal is a linearly modulated DSB, and so it has a bandwidth twice that of the baseband data signal from which it is derived 2. In practice there would need to be some form of bandwidth control. Band limiting can be performed either at baseband or at carrier frequency. It will be performed at baseband in this experiment.

Demodulation of BPSK:

Demodulation of a BPSK signal can be considered a two stage process:



1. Translation back to baseband, with recovery of the bandlimited message waveform
2. Regeneration from the bandlimited waveform back to the binary message bit stream.

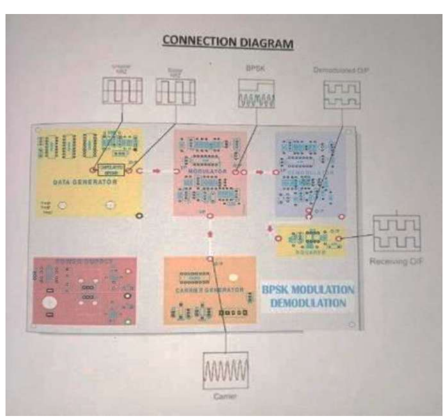
   Translation back to baseband requires a local, synchronized carrier. **Stage 1:**

   Translation back to baseband is achieved with a synchronous demodulator. This requires a local synchronous carrier. In this experiment, a stolen carrier will be used. Carrier acquisition will be investigated in the experiment entitled DPSK – carrier acquisition and BER (within volume 02 – further and advanced digital experiments)

   Stage 2:

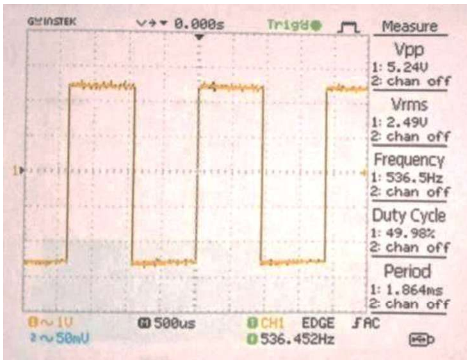
   The translation process does not reproduce the original binary sequence, but a bandlimited version of it. The original binary sequence can be regenerated with a detector. This requires information regarding the bit clock rate. If the bit rate is a sub-multiple of the carrier frequency then bit clock regeneration is simplified. In TIMS the DECISION MAKER module can be used for the regenerator, and in this experiment the bit clock will be a submultiple of the carrier.

Connection diagram:



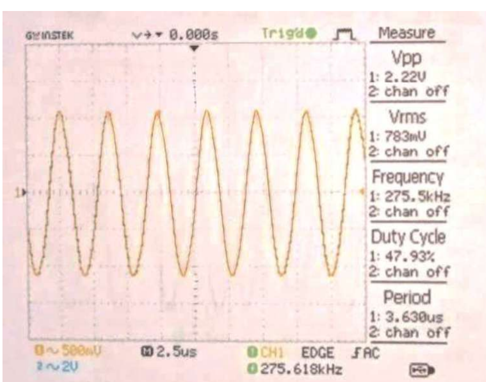
Procedure:

1. Connect the CRO channel 1- to unipolar NRZ signal to observe the waveform



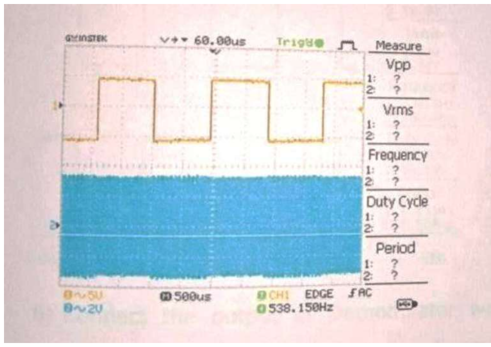
2. Connect the CRO channel 2- to observe the polar NRZ waveform

3. Connect the CRO to observe the carrier signal at carrier generator block



4. Connect the NRZ polar data to the input of modulator and observe the NRZ polar and modulated BPSK signal respectively by triggering NRZ data channel.

i]



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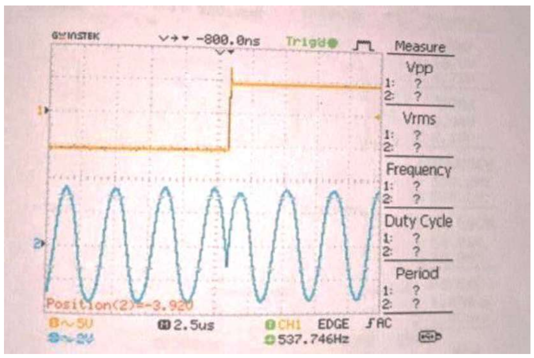
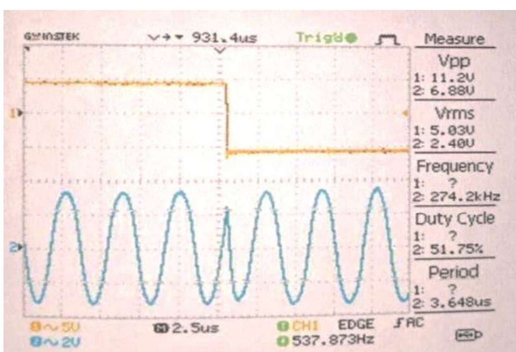
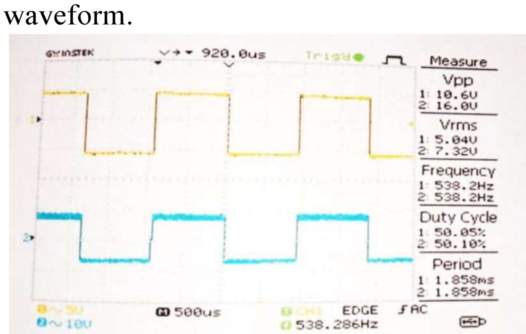


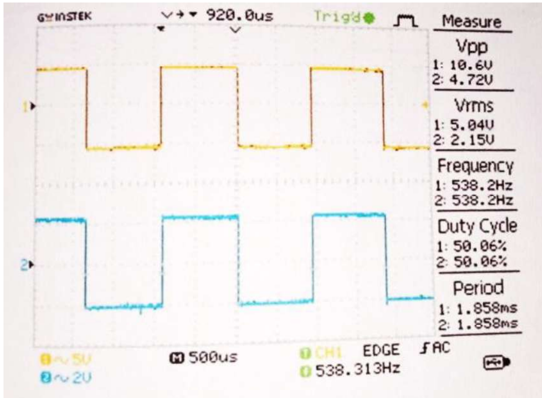
iii]



5. Connect the carrier and modulated data to the coherent demodulator and observe the waveform.



6. Connect the output of demodulator waveform to the squarer and comparator and observe the waveforms.



Using MATLAB:
Program:

```
clc;
clear all;
close all;

f = 2;                                %frequency of sine wave
fs = 100;                             %sampling period of the sine wave
t = 0:1/fs:1;                         %splitting time into segments of 1/fs

%setting the phase shifts for the different BPSK signals
p1 = 0;
p2 = pi;                              %getting the number bits to be modulated
N = input('enter the number of bits to be modulated: N = '); %generating the random signal
bit_sequence=round(rand(1,N));        %allocating the dynamic variables
time = [];
digital_signal = [];
PSK = [];
carrier_signal = [];                  %GENERATING THE SIGNALS
for ii = 1:1:N %the original digital signal is
   if bit_sequence(ii) == 0
      bit = zeros(1,length(t));
   else bit = ones(1,length(t));
   end
   digital_signal = [digital_signal bit]; %Generating the BPSK signal
   if bit_sequence(ii) == 0
      bit = sin(2*pi*f*t+p1);
   else bit = sin(2*pi*f*t+p2);
   end
   PSK = [PSK bit];                   %Generating the carrier wave
   carrier = sin(2*f*t*pi);
   carrier_signal = [carrier_signal carrier];
   time = [time t];
   t = t + 1;
end
```

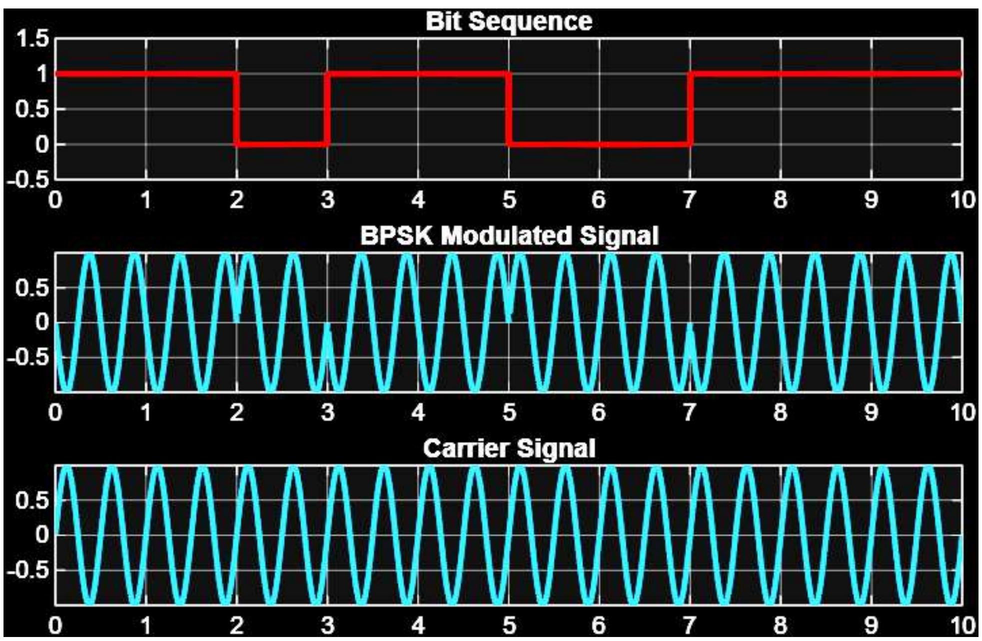
```
subplot(3,1,1);
plot(time,digital_signal,'r','linewidth',2);
grid on;
axis([0 time(end) -0.5 1.5]);
title('Bit Sequence')

subplot(3,1,2);
plot(time,PSK,'linewidth',2);
grid on;
axis tight;
title('BPSK Modulated Signal')

subplot(3,1,3);
plot(time,carrier_signal,'linewidth',2);
grid on;
axis tight;
title('Carrier Signal')
```

Output:

Enter the number of bits to be modulated: **N = 10**



Conclusion:

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