

EXPERIMENT NUMBER - 5

EXPERIMENT NAME - BINARY PHASE SHIFT KEYING (BPSK)

DATE - 21/11/2022, MONDAY

\* AIM:

To perform PSK (Phase Shifting Keying) to a digital signal and to verify output of the signal.

\* SOFTWARE REQUIRED:

- ① Oracle VM VirtualBox 6.1.38, Oracle Corporation
- ② Ubuntu 22.04 (64-bit) Operating System
- ③ GNU Radio Companion Application, v3.10.1  
(sudo apt-get install gnuradio)

\* THEORY:

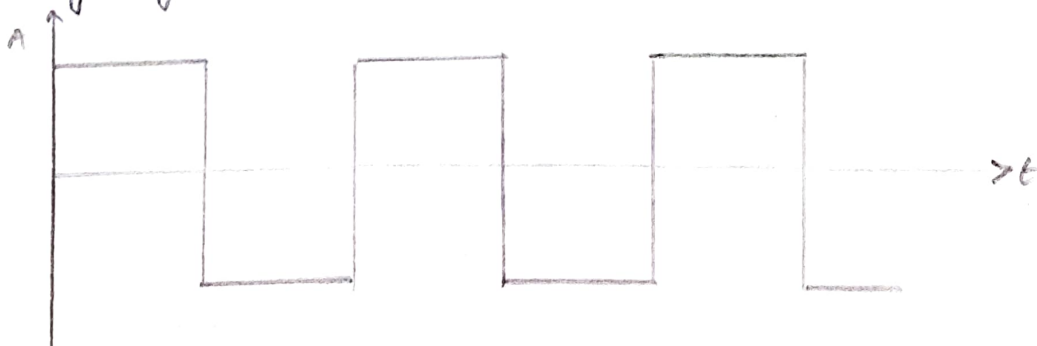
I. Phase Shift Key (PSK) -

PSK is a digital modulation scheme technique in which phase of the carrier signal is changed by varying the sine and cosine input in a particular time. PSK is widely used in wireless LAN, wireless operation along with RFID and Bluetooth communication.

II. Binary Phase Shift Keying (BPSK) -

BPSK is called two phase PSK or phase reversal keying in which sine wave could take two phase reversal,  $0^\circ$  and  $180^\circ$ .

Message signal



## FSK modulated signal



The output of the sine wave of the modulated signal will be a direct input carrier or the inverted input carrier which is a function of data signal.

When the carrier signal is cosine, then the modulated signal will have a phase shift of  $180^\circ$ .

Band pass representation is -

$$s_m(t) = \text{Re} \{ s_{m,1}(t) e^{j2\pi f_c t} \}$$

$$= \text{Re} \left\{ g(t) e^{j\left(\frac{2\pi}{M}(m-1)\right)} e^{j2\pi f_c t} \right\}$$

$$\therefore s_m(t) = g(t) \cos\left(\frac{2\pi}{M}(m-1) + 2\pi f_c t\right)$$

$$\Rightarrow g(t) \cos(2\pi f_c t) \cos\left(\frac{2\pi}{M}(m-1)\right) - g(t) \sin(2\pi f_c t) \sin\left(\frac{2\pi}{M}(m-1)\right)$$

where  $M$  is number of symbol  
and  $m$  is bits.

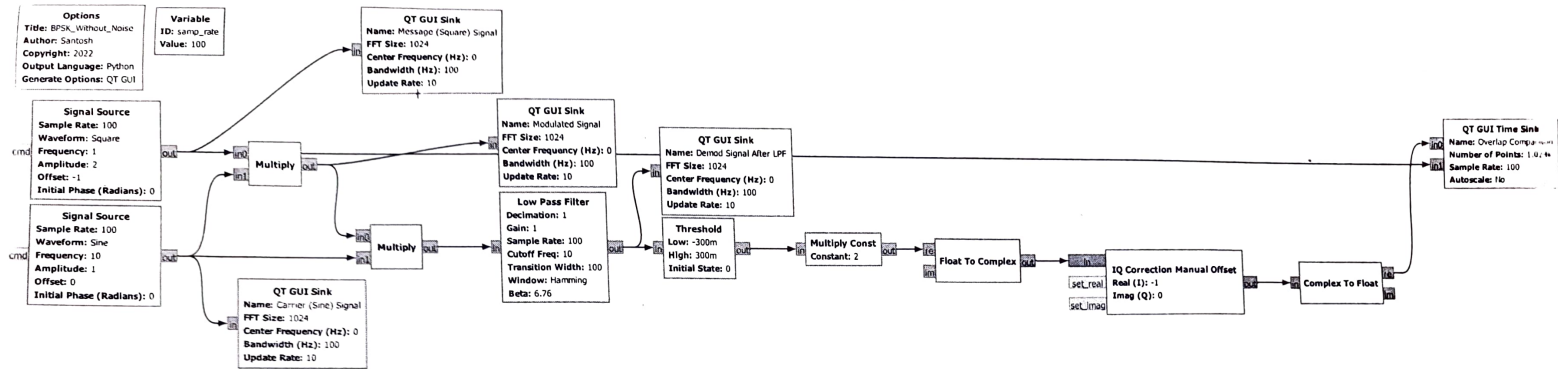
If represented using orthogonal representation,

$$s_m(t) = \sqrt{\frac{E_g(t)}{2}} \phi_1(t) \cos\left(\frac{2\pi}{M}(m-1)\right) - \sqrt{\frac{E_g(t)}{2}} \phi_2(t) \sin\left(\frac{2\pi}{M}(m-1)\right)$$

Euclidean distance can be found by -

$$\sqrt{E_g \left(1 - \cos\left(\frac{2\pi}{M}(m-1)\right)\right)}$$

# A. BPSK without Noise



\* OUTPUTS:

1. BPSK Without Noise

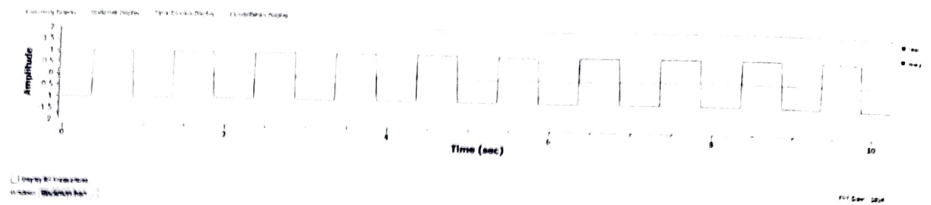


Figure 1 - message (square) signal

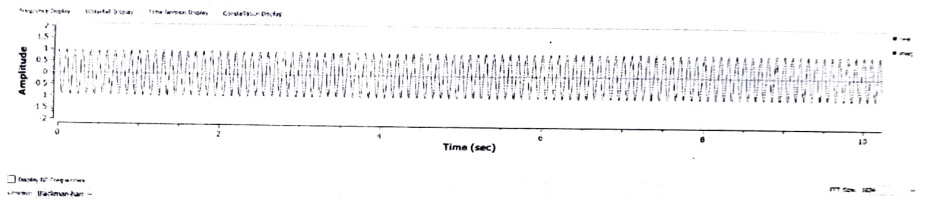


Figure 2 - carrier (sine) signal

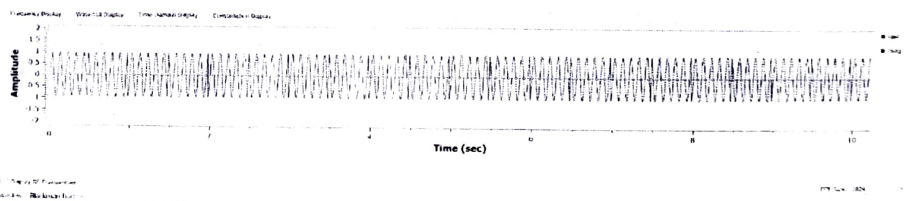


Figure 3 - modulated signal

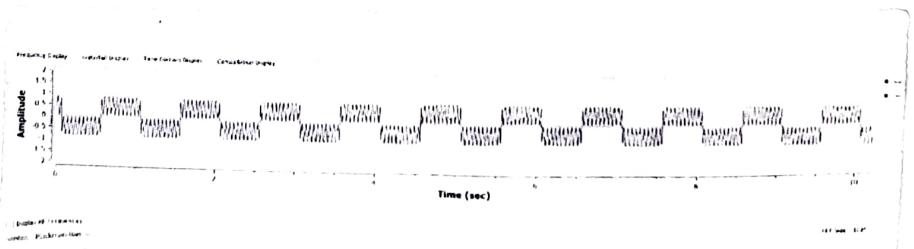
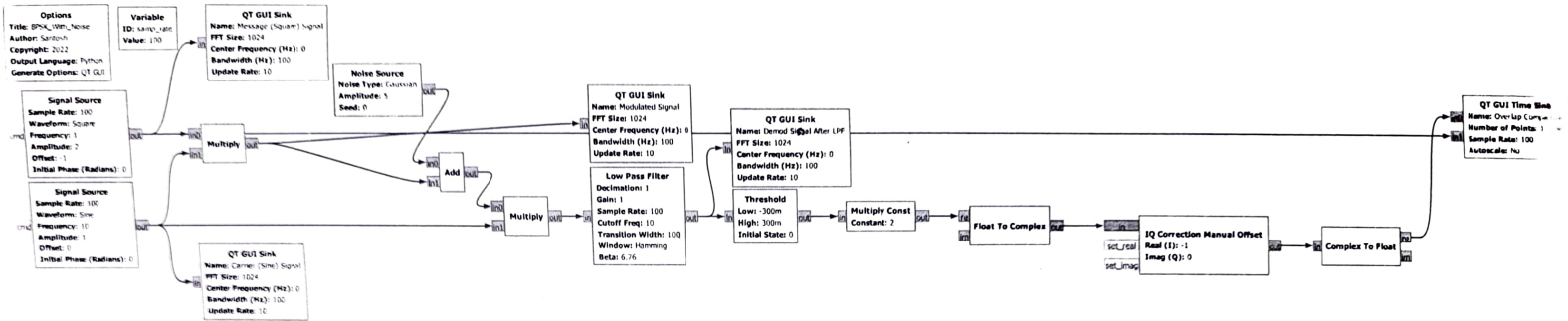


Figure 4 - Demodulated signal  
After Passing through  
low Pass Filter

# B. BPSK with Noise



### 3 BPSK with Noise -

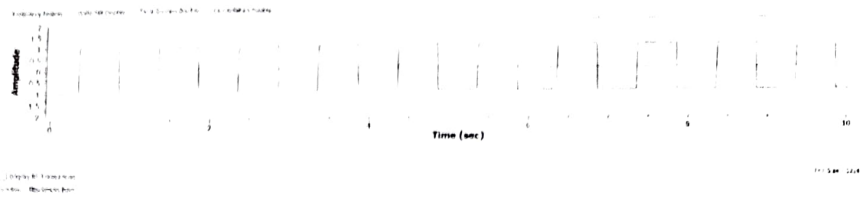


Figure 1 - Message (Square) Signal

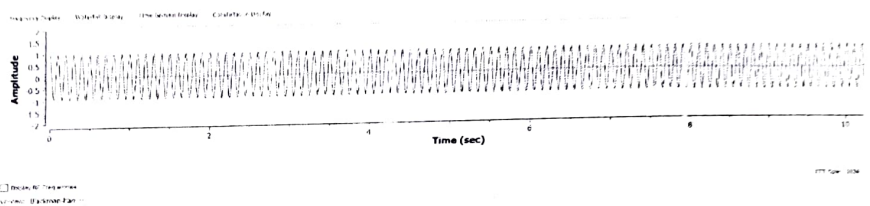


Figure 2 - Carrier (Sine) Signal

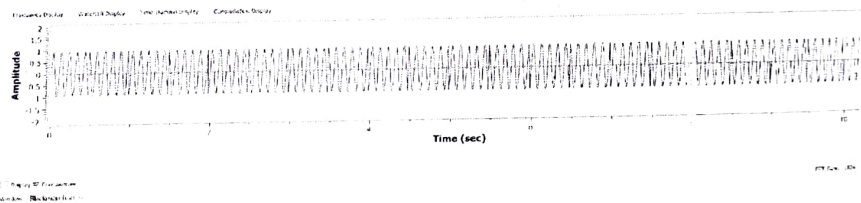


Figure 3 - Modulated Signal

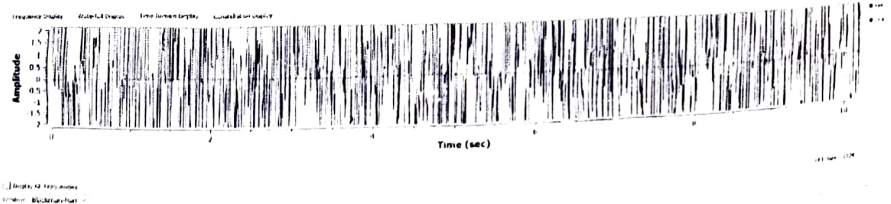


Figure 4 - Demodulated Signal  
after Passing Through  
Low Pass Filter



When external noise is added to the system, threshold should be selected approximately to regenerate the signal.

\* RESULT :

Thus, phase shift keying is done to modulate the input to a bandpass signal and outputs are verified successfully.

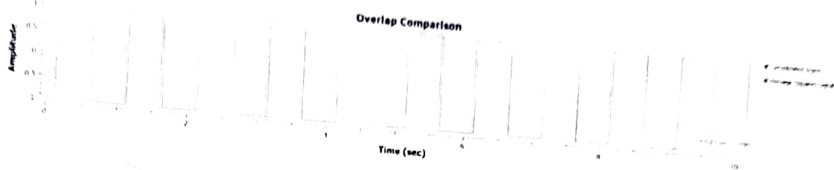


Figure 1 - overlap comparison for BPSK without noise

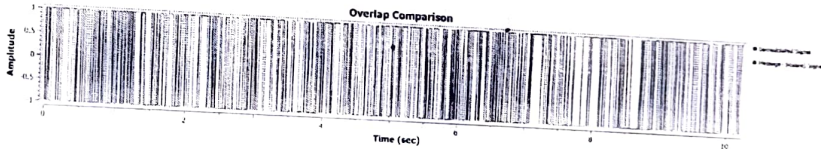


Figure 2 - overlap comparison for BPSK with noise