PASS BAND TRANSMISSION AND BINARY PHASE SHIFT KEYING

Types of transmission of digital signals

1) **Baseband data transmission** : The digital data is transmitted over the channel directly. There is no carrier or any modulation. This is suitable for transmission over short distances.

2) **Passband data transmission** : The digital data modulates high frequency sinusoidal carrier. Hence it is also called digital CW modulation. It is suitable for transmission over long distances.

Types of Passband Modulation

1) **Phase shift keying (PSK)** : In this technique, the digital data modulates phase of the carrier.
2) **Frequency shift keying (FSK)** : In this technique, the digital data modulates frequency of the carrier.
3) **Amplitude shift keying (ASK)** : In this technique, the digital data modulates amplitude of the carrier.

Advantages of Passband Transmission over Baseband Transmission

1. Long distance transmission.
2. Analog channels, can be used for transmission.
3. Multiplexing techniques can be used for bandwidth conservation.
4. Problems such as ISI and crosstalk are absent.
5. Passband transmission can take place over wireless channels also.
6. Large number of modulation techniques are available.

Drawbacks of Passband Modulation

1. Modulation and demodulation equipments, transmitting/receiving antennas, interference problems make the system complex.
2. It is not suitable for short distance communication.

Binary Phase Shift Keying (BPSK)

Principle of BPSK

In binary phase shift keying (BPSK), binary symbol '1' and '0' modulate the phase of the carrier. Let the carrier be,

$$s(t) = A \cos(2\pi f_0 t)$$

'A' represents peak value of sinusoidal carrier. In the standard 1Ω load register, the power dissipated will be,

$$P = \frac{1}{2} A^2$$

$$A = \sqrt{2P}$$

When the symbol is changed, then the phase of the carrier is changed by 180 degrees (π radians).

for symbol '1' $\Rightarrow$ $s_1(t) = \sqrt{2P}\cos(2\pi f_0 t)$

Symbol '0' $\Rightarrow$ $s_2(t) = \sqrt{2P}\cos(2\pi f_0 t + \pi)$

Since $\cos(\theta + \pi) = -\cos\theta$, we can write above equation as,

$$s_2(t) = -\sqrt{2P}\cos(2\pi f_0 t)$$

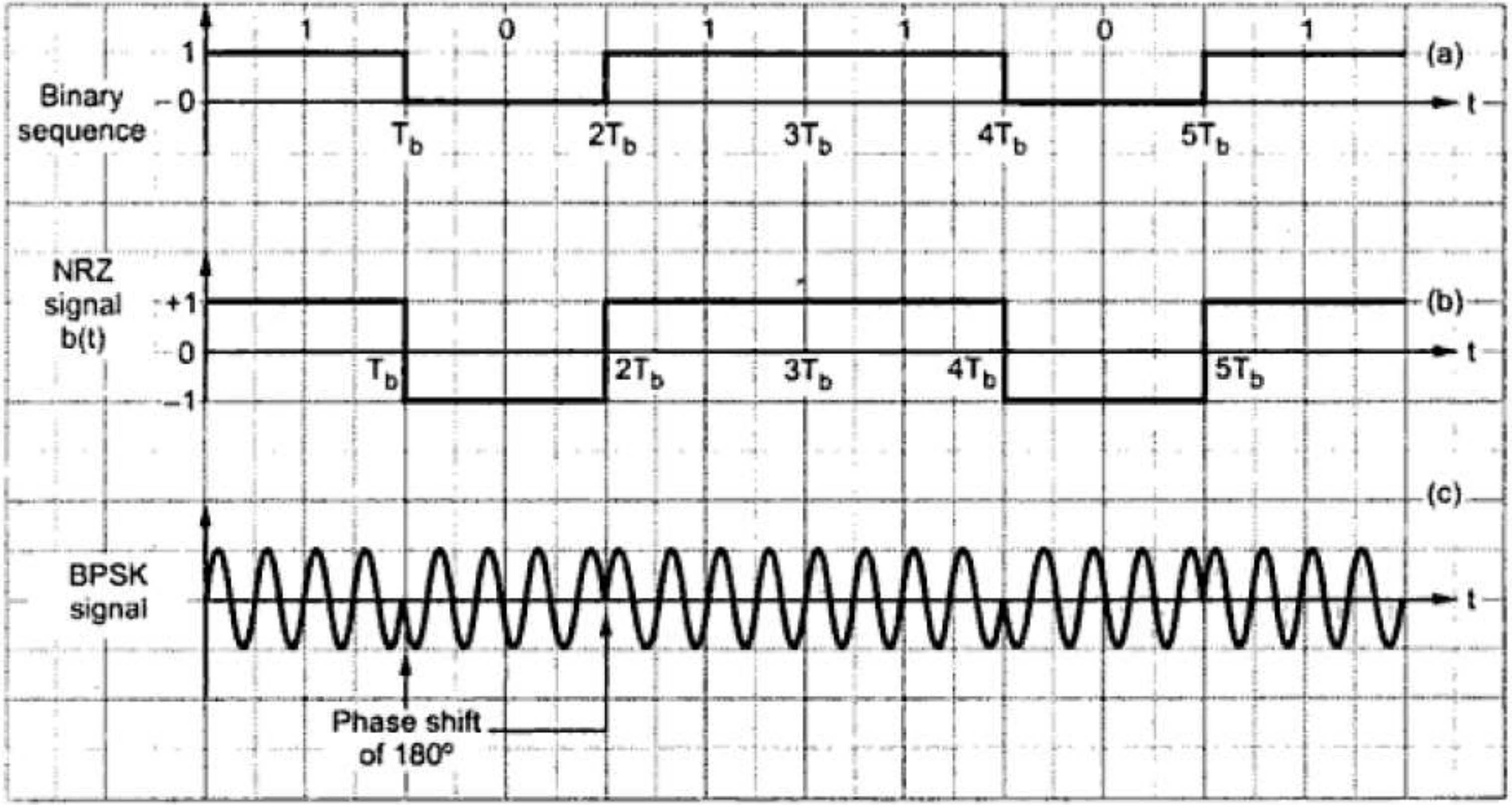
With the above equation we can define BPSK signal combinely as,

$$\boxed{s(t) = b(t)\sqrt{2P}\cos(2\pi f_0 t)}$$

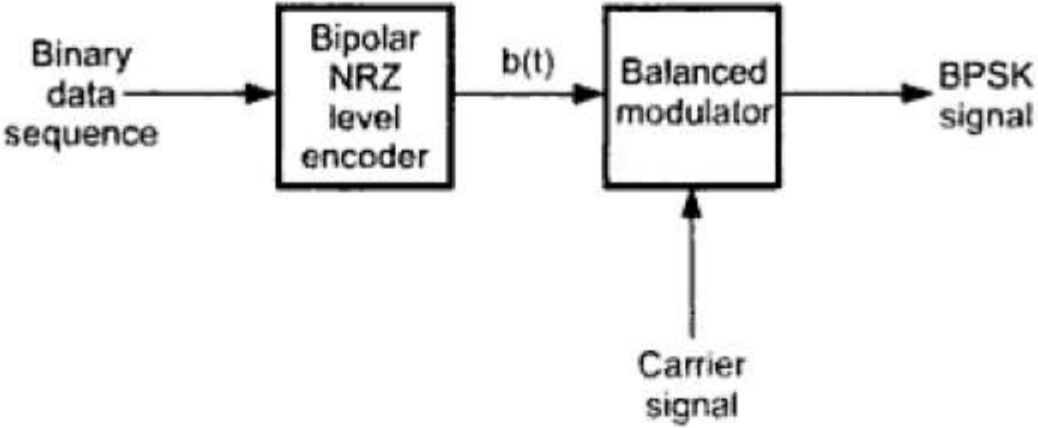
Here $b(t) = +1$ when binary '1' is to be transmitted

$= -1$ when binary '0' is to be transmitted

Graphical Representation of BPSK Signal



Generator of BPSK Signal



- The BPSK signal can be generated by applying carrier signal to the balanced modulator.
- The baseband signal $b(t)$ is applied as a modulating signal to the balanced modulator. Fig. 3.2.2 shows the block diagram of BPSK signal generator.
- The NRZ level encoder converts the binary data sequence into bipolar NRZ signal.

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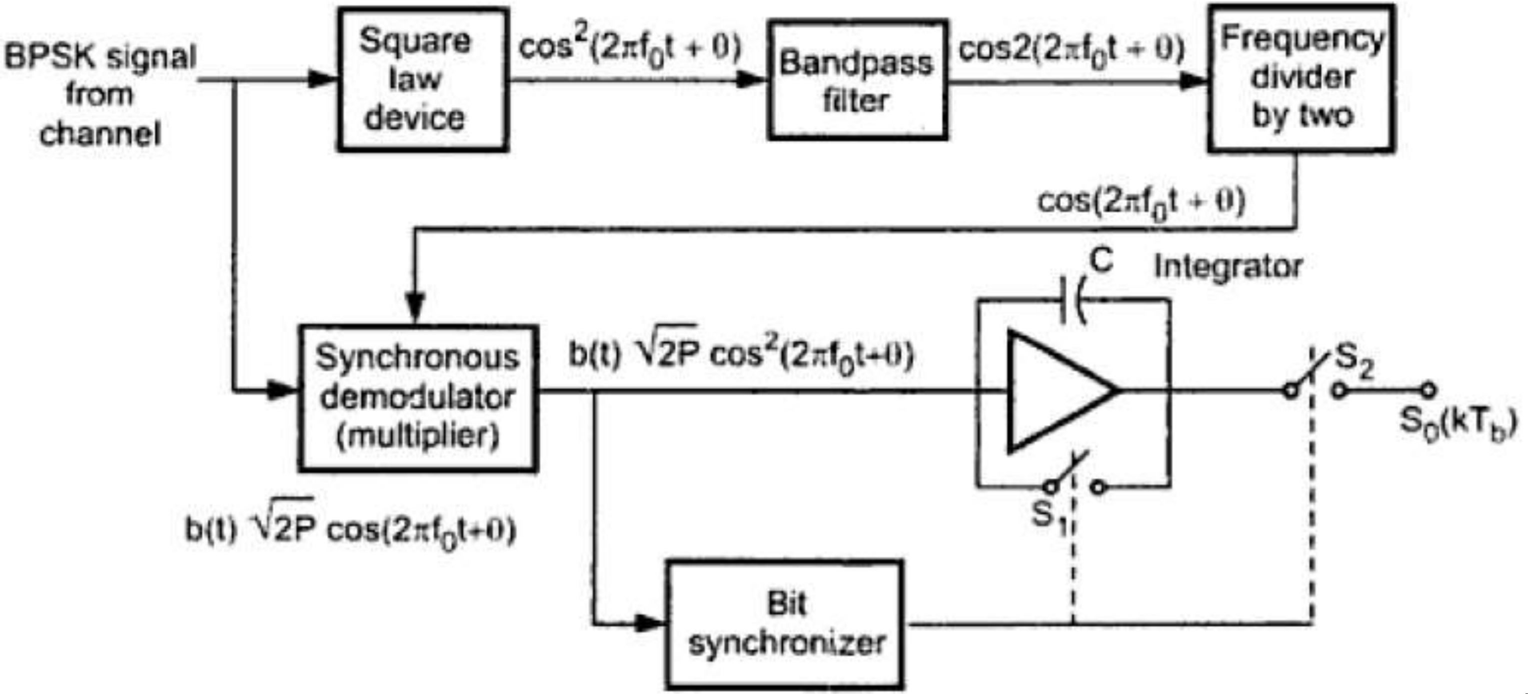
Reception of BPSK Signal

Fig. shows the block diagram of the scheme to recover baseband signal from BPSK signal.

The transmitted BPSK signal is,

$$s(t) = b(t)\sqrt{2P}\cos(2\pi f_0 t)$$



1) **Phase shift in received signal :**

The signal at the input of the receiver is

$$s(t) = b(t)\sqrt{2P}\cos(2\pi f_0 t + \theta)$$

2) **Square law device :** The received signal is passed through a square law device. At the output of the square law device the signal is

$$\cos^2(2\pi f_0 t + \theta)$$

$$\cos^2\theta = \frac{1 + \cos 2\theta}{2}$$

$$\therefore \quad \cos^2(2\pi f_0 t + \theta) = \frac{1 + \cos 2(2\pi f_0 t + \theta)}{2}$$

$$= \frac{1}{2} + \frac{1}{2}\cos 2(2\pi f_0 t + \theta)$$

3) **Bandpass filter :** Bandpass filter removes the DC level of $\frac{1}{2}$ and at its output we get

$$\cos 2(2\pi f_0 t + \theta) \qquad \text{(signal of frequency } 2f_0\text{)}$$

4) **Frequency divider** : The above signal is passed through a frequency divider by two. Therefore at the output of frequency divider we get a carrier signal whose frequency is f_0 i.e. $cos\,(2\pi f_0\,t+\theta)$.

5) **Synchronous demodulator** : The synchronous (coherent) demodulator multiplies the input signal and the recovered carrier. Therefore at the output of multiplier we get,

$$b(t)\sqrt{2P}\,cos\,(2\pi f_0\,t+\theta)\times cos\,(2\pi f_0\,t+\theta) = b(t)\sqrt{2P}\,cos^2\,(2\pi f_0\,t+\theta)$$

$$= b(t)\sqrt{2P}\times\frac{1}{2}[1+cos\,2\,(2\pi f_0\,t+\theta)]$$

$$= b(t)\sqrt{\frac{P}{2}}\,[1+cos\,2\,(2\pi f_0\,t+\theta)]$$

6) **Bit synchronizer and integrator** : The above signal is then applied to the bit synchronizer and integrator. The integrator integrates the signal over one bit period. The bit synchronizer takes care of starting and ending times of a bit.

At the end of bit duration T_b, the bit synchronizer closes switch S_2 temporarily. This connects the output of an integrator to the decision device.

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