GENERATION BINARY PHASE SHIFT KEYING (BPSK):

The distinguishing feature of BPSK is that it eliminates the need for synchronizing the receiver to the transmitter by combining two basic operations at the transmitter:

- *Binary encoding* of the input binary sequence and
- *PSK* of the encoded sequence, from which the name of this new binary signaling scheme

high or low state of the previous element. This DPSK technique doesn't need a reference oscillator.

In BPSK (BinaryPhase Shift Keying) the phase of the modulated signal is shifted relative tothe previous signal element. No reference signal is considered here. The signal phase follows the

The following figure represents the model waveform of BPSK.

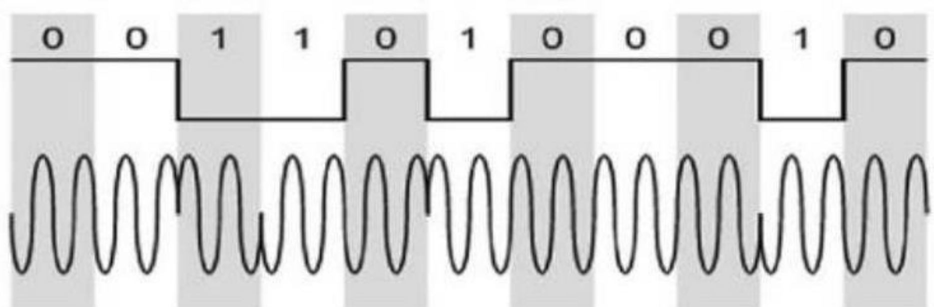


Fig: Represents the model waveform of BPSK.

Source: Brainkart

It is seen from the above figure that, if the data bit is LOW i.e., 0, then the phase of the signal is not reversed, but is continued as it was. If the data is HIGH i.e., 1, then the phase of the signal is reversed, as with NRZI, invert on 1 (a form of differential encoding).

If we observe the above waveform, we can say that the HIGH state represents an **M** in the modulating signal and the LOW state represents a **W** in the modulating signal.

The word binary represents two-bits. **M** simply represents a digit that corresponds to the number of conditions, levels, or combinations possible for a given number of binary variables.

This is the type of digital modulation technique used for data transmission in which instead of one- bit, two or **more bits are transmitted at a time**. As a single signal is used for multiple bit transmission, the channel bandwidth is reduced.

BPSK TRANSMITTER.:

Figure 2-37a shows a simplified block diagram of a *differential binary phase-shift keying* (DBPSK) transmitter. An incoming information bit is XNORed with the preceding bit prior toentering the BPSK modulator (balanced modulator).

For the first data bit, there is no preceding bit with which to compare it. Therefore, an initial reference bit is assumed. Figure 2-37b shows the relationship between the input data, the XNOR output data, and the phase at the output of the balanced modulator. If the initial reference bit is assumed a logic 1, the output from the XNOR circuit is simply the complement of that shown.

In Figure 2-37b, the first data bit is XNORed with the reference bit. If they are the same, the XNORoutput is a logic 1; if they are different, the XNOR output is a logic 0. The balanced modulator operates the same as a conventional BPSK modulator; a logic I produces +sin ct at the output, and A logic 0 produces sin ct at the output.

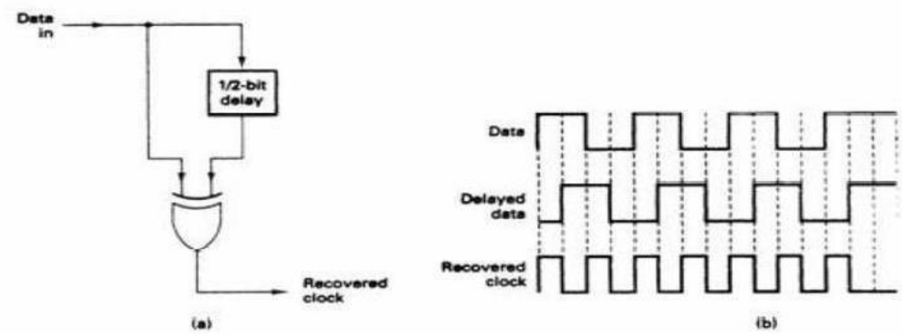


FIGURE 9-40 (a) Clock recovery circuit; (b) timing diagram

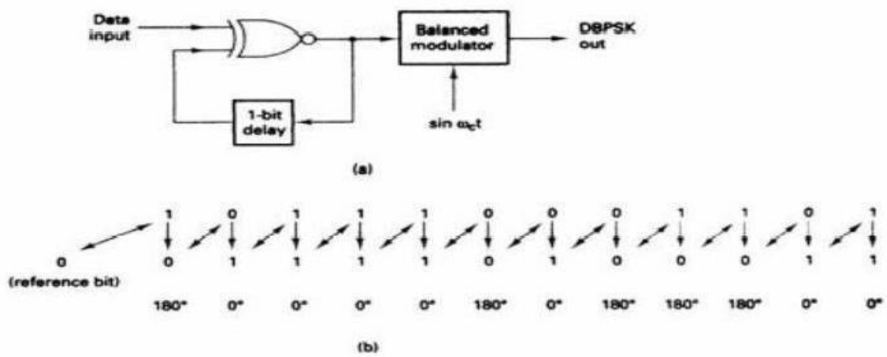
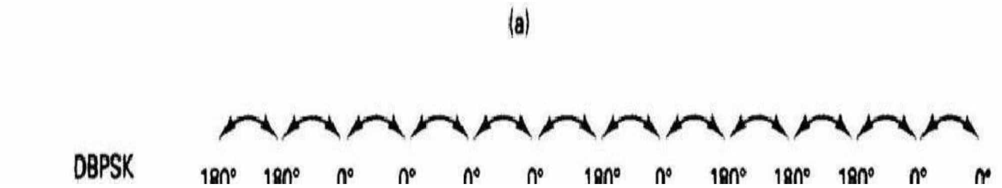


FIGURE 2-37 DBPSK modulator (a) block diagram (b) timing diagram
(Source: S. Haykin, ―Digital Communications‖, John Wiley, 2005-Page-414)

BPSK RECEIVER:

Figure 9-38 shows the block diagram and timing sequence for a DBPSK receiver. The received signal is delayed by one bit time, then compared with the next signaling element in the balanced modulator. If they are the same. J logic 1(+ voltage) is generated. If they are different, a logic 0 (- voltage) is generated. [f the reference phase is incorrectly assumed, only the first demodulated bit is in error. Differential encoding can be implemented with higher-than-binary digital modulation schemes, although the differential algorithms are much more complicated than for DBPS K.

The primary advantage of DBPSK is the simplicity with which it can be implemented. With DBPSK, no carrier recovery circuit is needed. A disadvantage of DBPSK is, that it requires between 1 dB and 3 dB more signal-to-noise ratio to achieve the same bit error rate as that of absolute PSK.



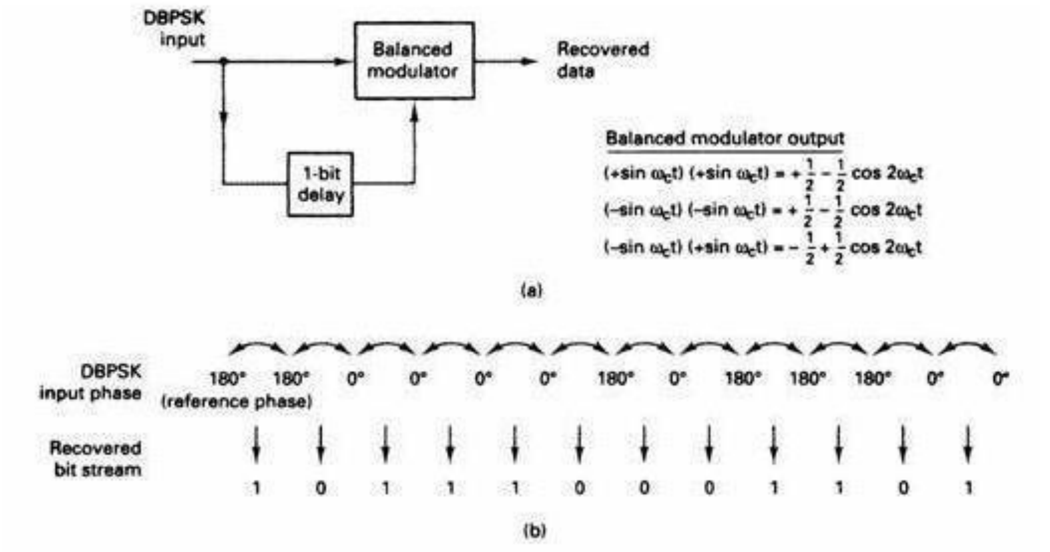


FIGURE 2-38 DBPSK demodulator: (a) block diagram;(b) timing sequence

(Source: S. Haykin, ―Digital Communications‖, John Wiley, 2005-Page-415)

Error Probability of BPSK

Basically, the DPSK is also an example of noncoherent orthogonal modulation whenits behavior is considered over successive two-bit intervals; that is, $0 \le t \le 2T_b$. To elaborate, let the transmitted DPSK signal be for the first-bit interval $0 \le t \le T_b$, which corresponds to symbol 1. Suppose, then, the input symbol for the second-bit interval $T_b \le t \le 2T_b$ is also symbol 1. According to part 1 of the DPSK encoding rule, the carrier phase remains unchanged, thereby yielding the DPSK signal

$$s_1(t) = \begin{cases} \sqrt{\dfrac{2E_b}{T_b}}\cos(2\pi f_c t), & \text{symbol 1 for} \quad 0 \le t \le T_b \\ \sqrt{\dfrac{2E_b}{T_b}}\cos(2\pi f_c t), & \text{symbol 0 for} \quad T_b \le t \le 2T_b \end{cases}$$

Suppose, next, the signaling over the two-bit interval changes such that the symbol at the transmitter input for the second-bit interval T_b □ t □ $2T_b$ is 0. Then, according to part 2 of the DPSK encoding rule, the carrier phase is shifted by □ radians (i.e., 180°), thereby yielding the new DPSK signal

$$s_2(t) = \begin{cases} \sqrt{\dfrac{2E_b}{T_b}}\cos(2\pi f_c t), & \text{symbol 1 for} \quad 0 \le t \le T_b \\ \sqrt{\dfrac{2E_b}{T_b}}\cos(2\pi f_c t + \pi), & \text{symbol 1 for} \quad T_b \le t \le 2T_b \end{cases}$$

We now readily see from (7.246) and (7.247) that $s1(t)$ and $s2(t)$ are indeed orthogonal over the two-bit interval 0 □ t □ $2T_b$, which confirms that DPSK is indeed a special form of

noncoherent orthogonal modulation with one difference compared with the case of binary FSK: for BPSK, we have $T = 2T_b$ and $E = 2E_b$. Hence, using (7.227), we find that the

BERfor BPSK is given by

$$P_e = \frac{1}{2}\exp\left(-\frac{E_b}{N_0}\right)$$