SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution

Coimbatore-35

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

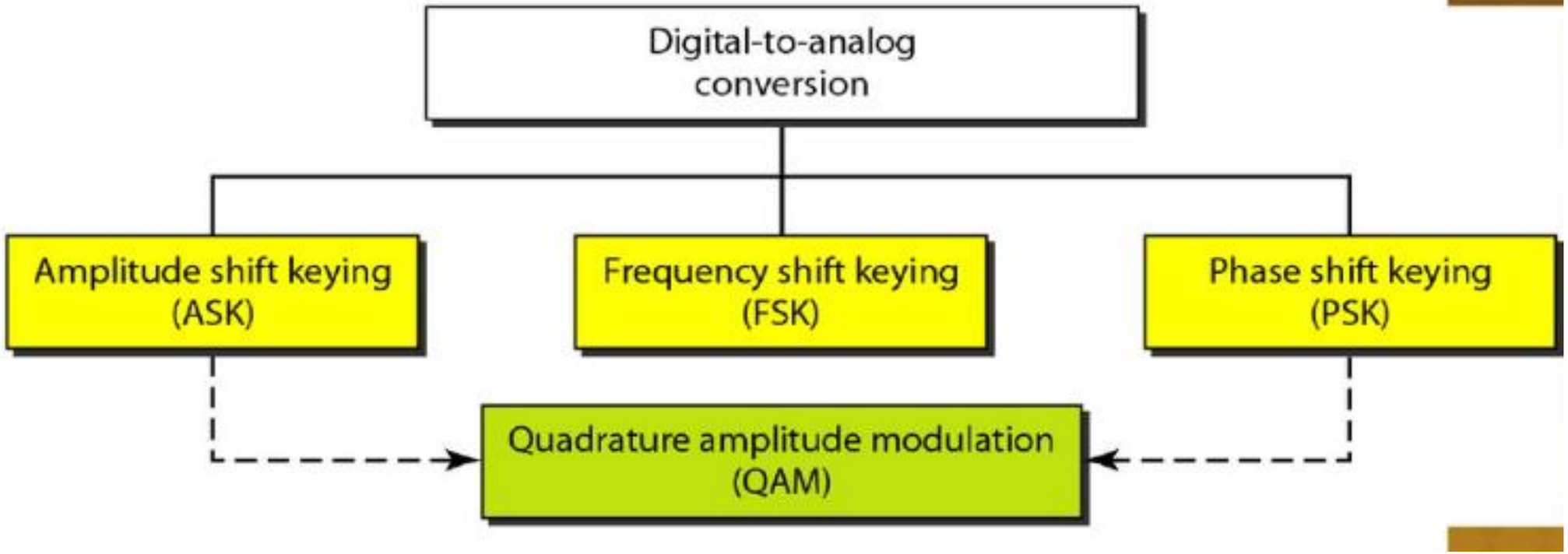
19ECB301-ANALOG AND DIGITAL COMMUNICATION

III YEAR/ V SEMESTER

UNIT 4 – DIGITAL MODULATION TECHNIQUES

TOPIC – **Frequency Shift Keying (FSK)**

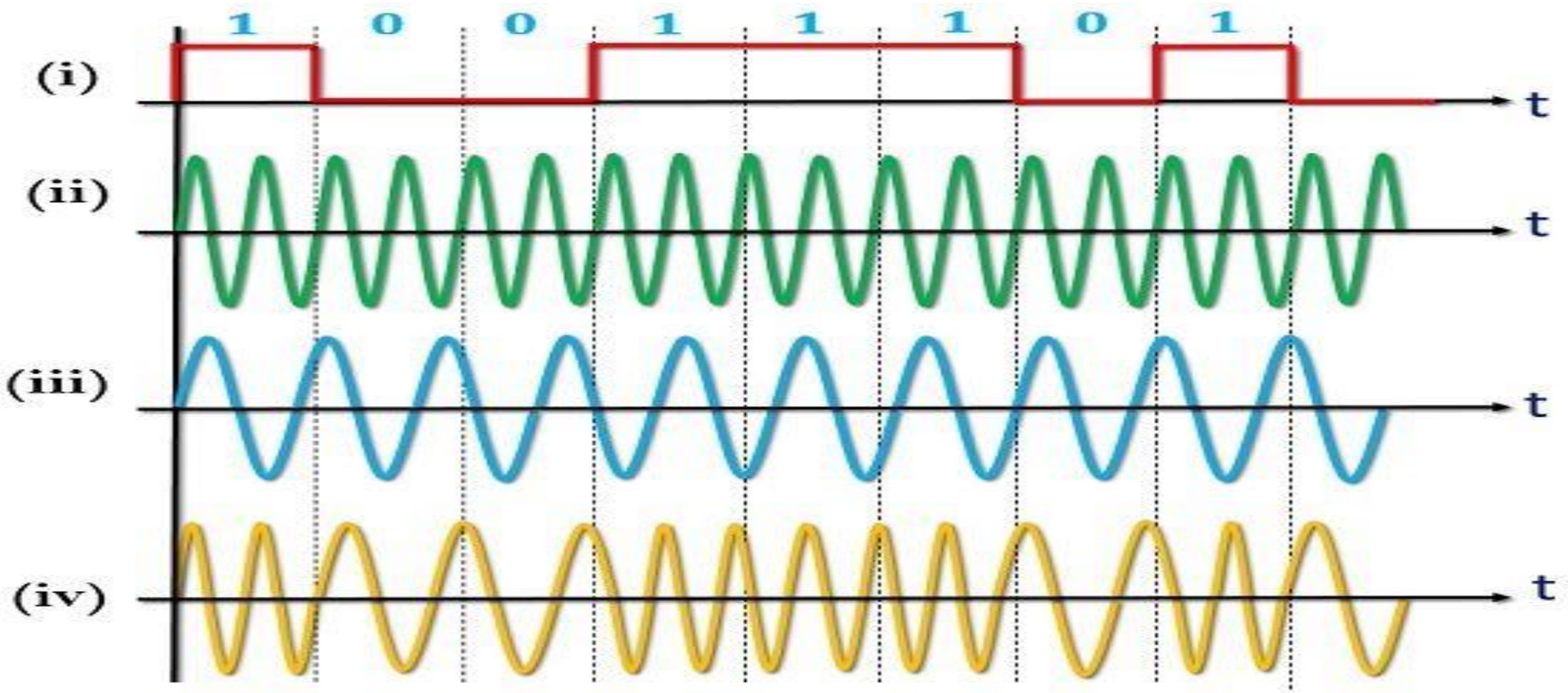
OUTLINE


Digital-to-analog conversion
Amplitude shift keying (ASK)
Frequency shift keying (FSK)
Phase shift keying (PSK)
Quadrature amplitude modulation (QAM)

Frequency Shift Keying (FSK) – Definition

- A digital modulation technique that allows data transmission by changing the frequency of the carrier wave according to the digital modulating signal is known as **frequency shift keying (FSK)**.

FSK – Waveform Representation



(i) Digital bitstream
(ii) High frequency carrier wave
(iii) Low frequency carrier wave
(iv) FSK modulated wave

Electronics Coach

If $b(t) = '1'$; $s_H(t) = \sqrt{2P_s}\cos(2\pi f_0 + \Omega)t$ ...(4.6.1)

If $b(t) = '0'$; $s_L(t) = \sqrt{2P_s}\cos(2\pi f_0 - \Omega)t$ ...(4.6.2)

Thus there is increase or decrease in frequency by Ω. Let us use the following conversion table to combine above two FSK equations.

$b(t)$ Input	$d(t)$	$P_H(t)$	$P_L(t)$
1	+1 V	+1 V	0 V
0	−1 V	0 V	+1 V

Table 4.6.1 Conversion table for BPSK representation

We can write equation (4.6.1) and equation (4.6.2) combinely as,

$$s(t) = \sqrt{2P_s}\cos\left[(2\pi f_0 + d(t)\,\Omega)\,t\right] \quad \text{... (4.4.4)}$$

Thus when symbol '1' is to be transmitted, the carrier frequency will be $f_0 + \left(\frac{\Omega}{2\pi}\right)$. If symbol '0' is to be transmitted, the carrier frequency will be $f_0 - \left(\frac{\Omega}{2\pi}\right)$. i.e.,

$$f_H = f_0 + \frac{\Omega}{2\pi} \quad \text{for symbol '1'} \quad \text{... (4.6.4)}$$

$$f_L = f_0 - \frac{\Omega}{2\pi} \quad \text{for symbol '0'} \quad \text{... (4.6.5)}$$

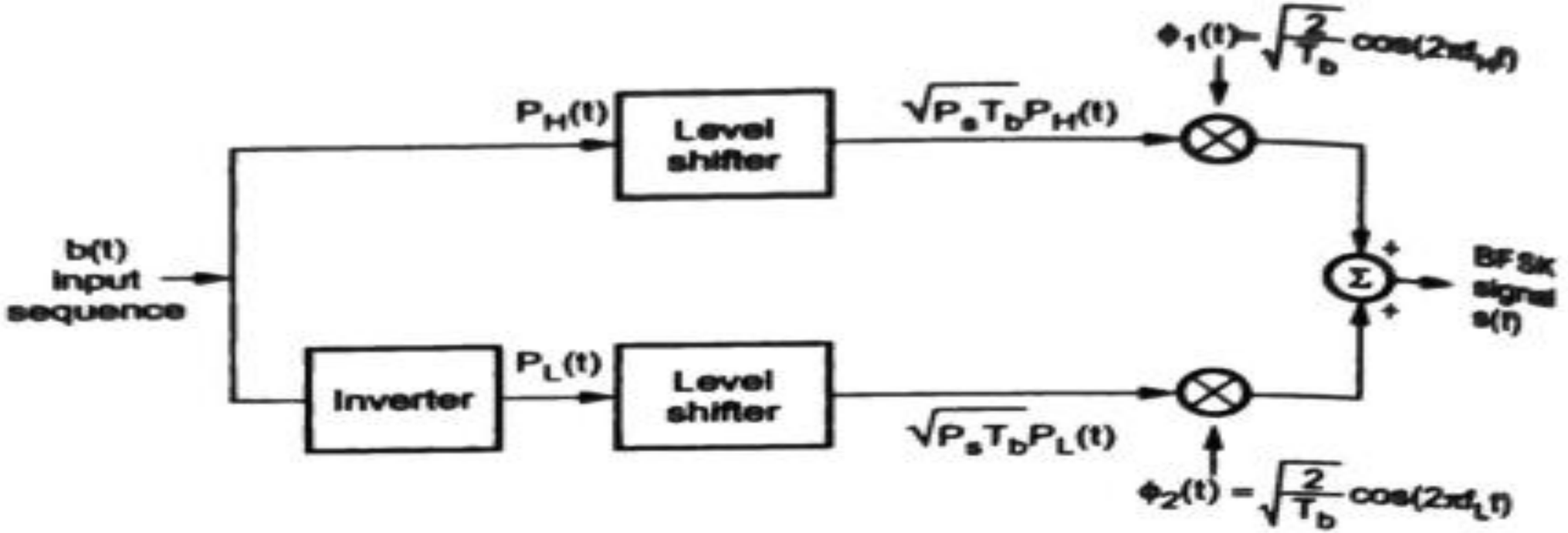


Fig. 4.6.1 Block diagram of BFSK transmitter

Therefore the modulated signal has continuous phase. Such BFSK signal is shown in Fig. 4.6.2. The adder then adds the two signals.

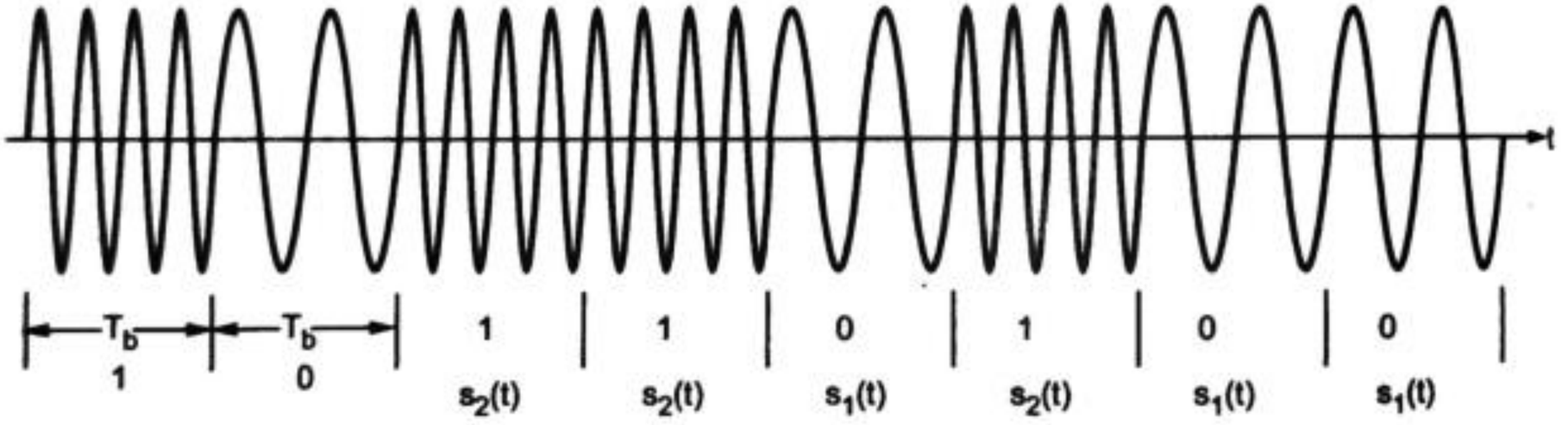


Fig. 4.6.2 BFSK signal

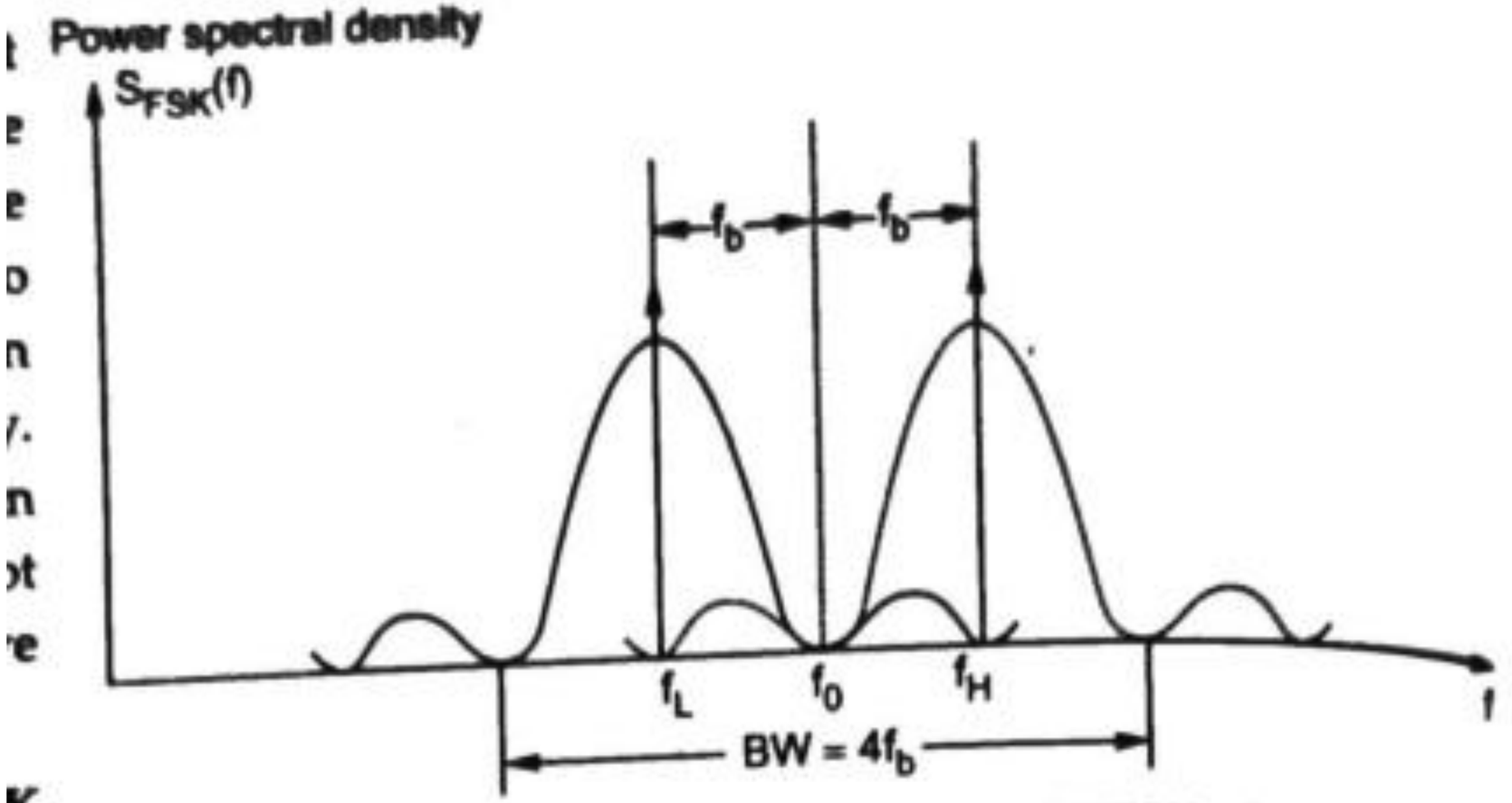


Fig. 4.6.3 Power spectral density of BFSK signal

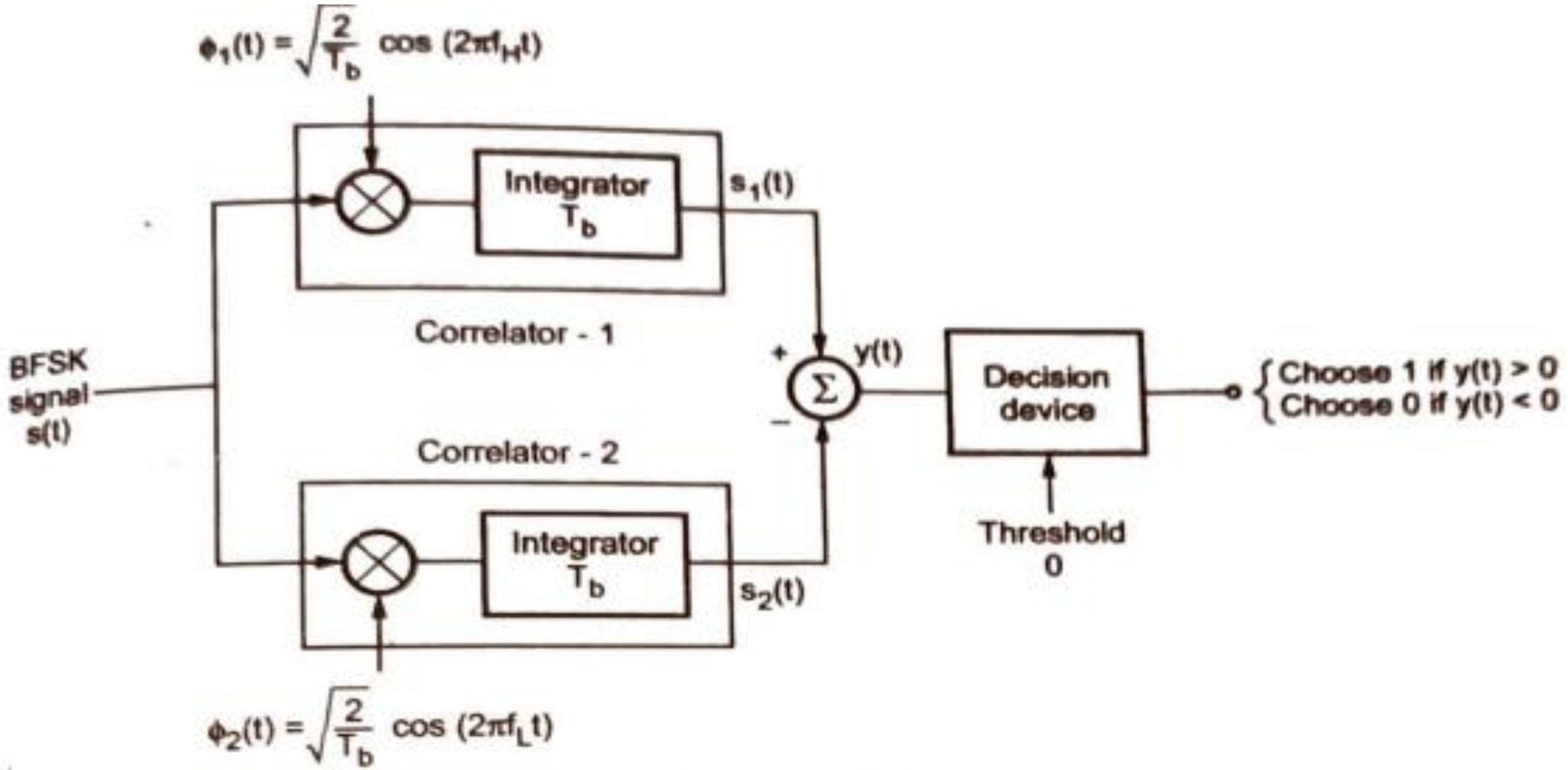


Fig. 4.6.4 Coherent BFSK reciever

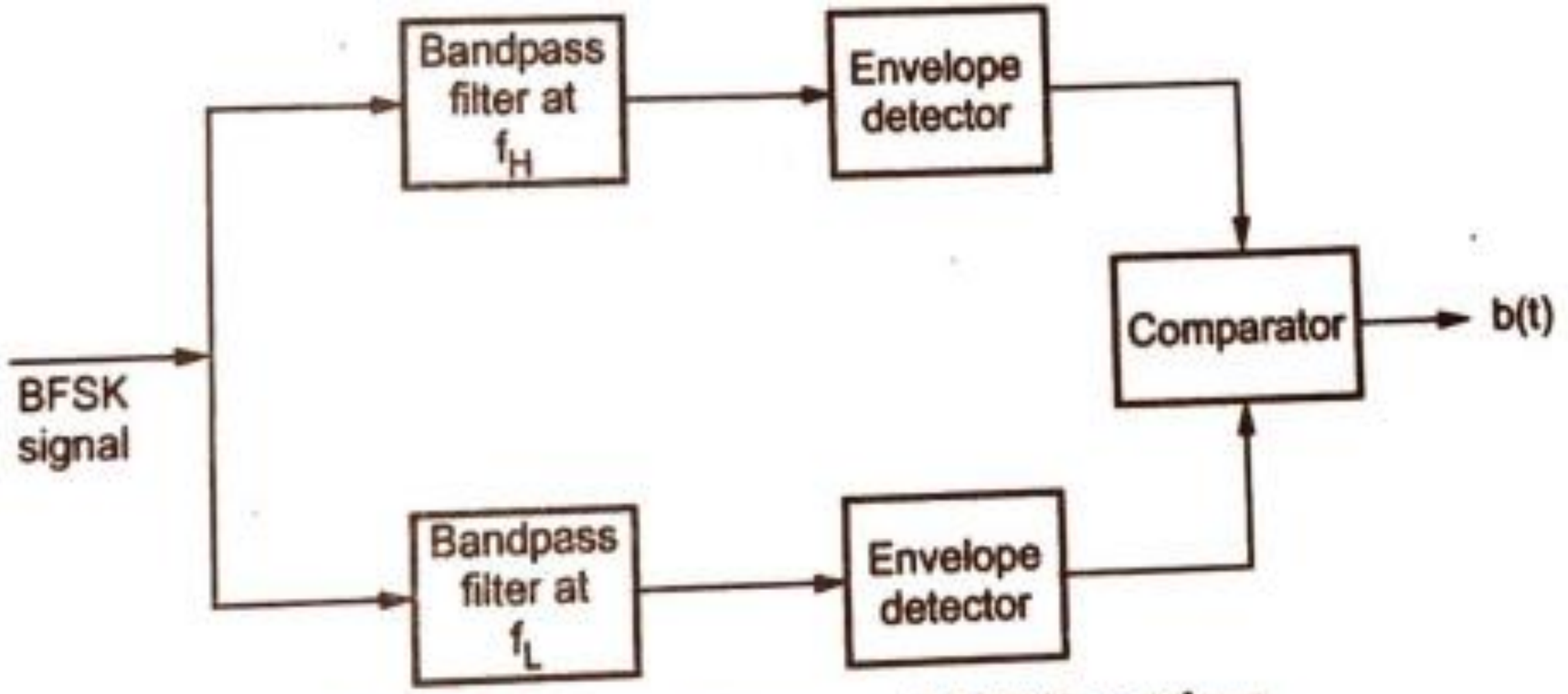


Fig. 4.6.5 Block diagram of BFSK receiver

... (4.6.19)

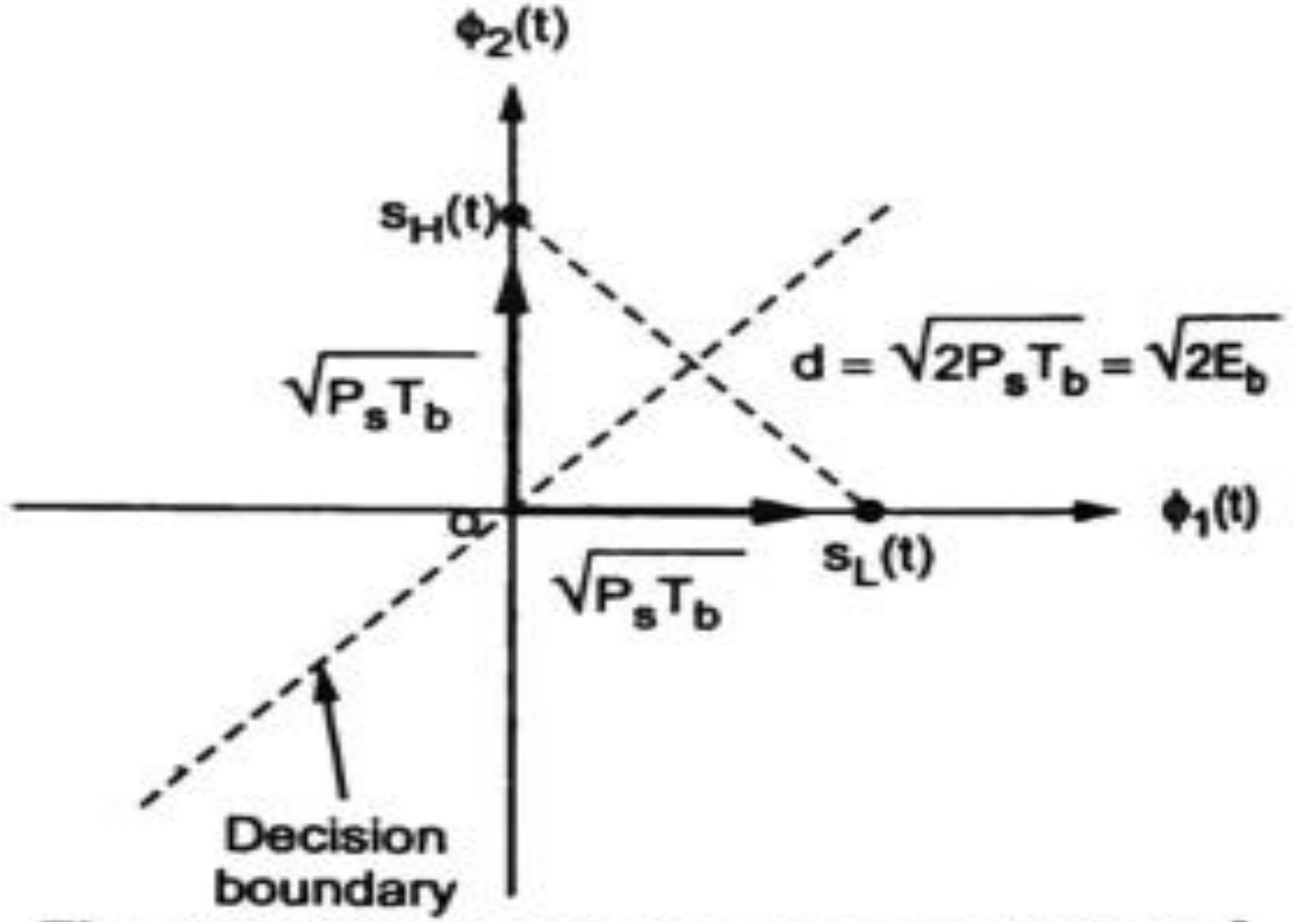


Fig. 4.6.6 Signal space representation of orthogonal BFSK

Frequency Shift Keying (FSK) – Advantages

- FSK provides better noise immunity.
- The signal transmission through FSK is quite simple.
- It is suitable for long-distance data transmission.
- Bit error rate performance is better than ASK.

Frequency Shift Keying (FSK) – Disadvantages

- It utilizes more bandwidth as compared to ASK and PSK thus is not bandwidth efficient.
- Detection of the signal at the receiver is somewhat complex

Frequency Shift Keying (FSK) – Applications

- The technique is used in the high-frequency data transmission system.
- Extensively used in low-speed modems.

THANK YOU