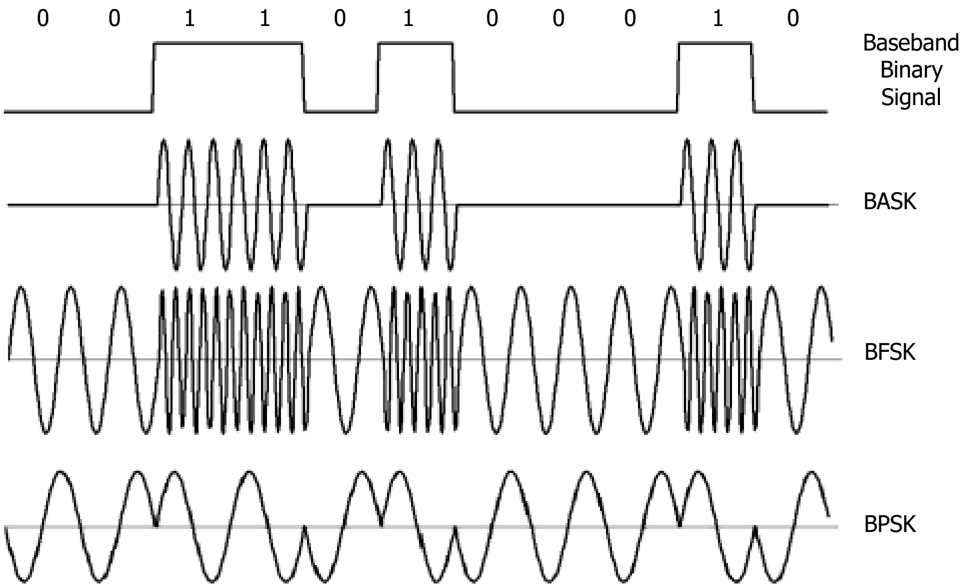
Part 2 DIGITAL MODULATION

2.1 BINARY DIGITAL MODULATION

Since pulse-modulated signals consist of "low" frequencies, they cannot be efficiently transmitted through a channel with band-pass characteristics. Hence, for communication systems employing band-pass channels, it becomes advantageous to modulate a carrier signal with the digital data stream prior to transmission. Three basic forms of digital modulation corresponding to AM, FM & PM are known as Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), and Phase Shift Keying (PSK).



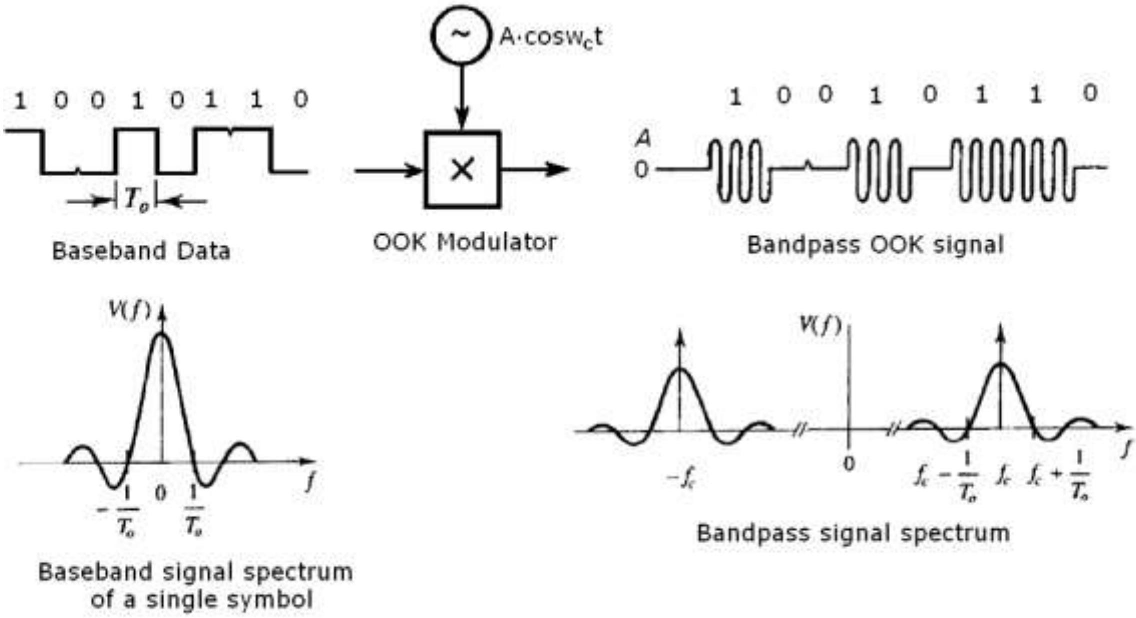
2.2 BINARY AMPLITUDE SHIFT KEYING (BASK)

In BASK, the amplitude of a high-frequency carrier is switched between two values, ON-OFF Keying (OOK):

$$x(t) = \begin{cases} A\cos(\omega_c t) & \text{for logic 1} \\ 0 & \text{for logic 0} \end{cases}$$

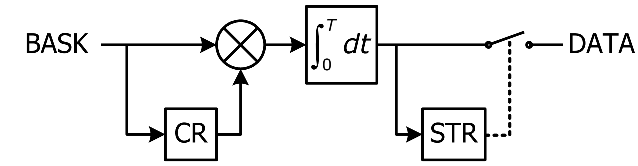
The bandwidth of BASK signal = ?

2.2.1 Generation

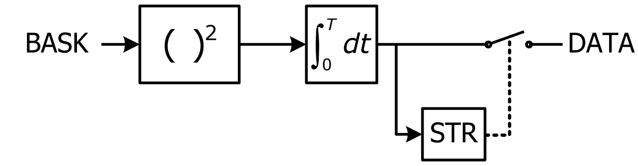


2.2.2 Demodulation

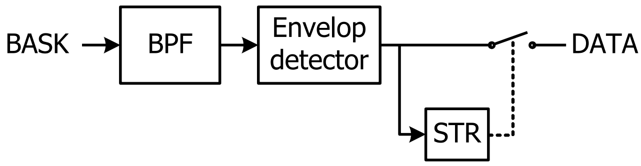
Coherent Correlation Receiver



Quasi-Coherent Square-law Receiver



Incoherent Envelop Receiver



2.2.3 Probability of Error in BASK

The receiver must decide based on two possibilities:

$$y(t) = \begin{cases} A\cos(\omega_c t) + n_0(t) & \text{for logic 1} \\ n_0(t) & \text{for logic 0} \end{cases}$$

Where $n_0(t)$ is the input noise to the decision maker.

As mentioned earlier, for $p_0(v_n) = p_1(v_n) = \frac{1}{2}$, the optimum decision threshold is set at $E_1/2$, (E_1= received signal energy for logic bit 1, when $E_0 = 0$). So, with the Gaussian distributed noise, the probability of error is:

$$P_E = \text{Erfc}\left(\sqrt{\frac{E_{\text{Avg}}}{\eta}}\right)$$

since $S = \dfrac{E_{\text{Avg}}}{T_0}$ and $N = \eta B \Rightarrow P_E = \text{Erfc}\left(\sqrt{T_0 B \dfrac{S}{N}}\right)$

Where: S = average received signal power,

E_{Avg} = average received signal energy $= \dfrac{(E_0 + E_1)}{2} = \dfrac{E_1}{2}$

R_b = binary data rate $= \dfrac{1}{T_0}$

T_0 = Binary bit interval.

B = Decision maker bandwidth.

$$P_E = \text{Erfc}\left(\sqrt{\frac{E_1}{2\eta}}\right)$$

$$P_E = \text{Erfc}\left(\sqrt{\frac{S}{N}}\right) \qquad \text{Coherent Detection at } T_0 B = 1$$

$$P_E \approx \frac{1}{2}\exp\left(\frac{-E_{AV}}{2\eta}\right) \qquad \text{Incoherent Detection}$$