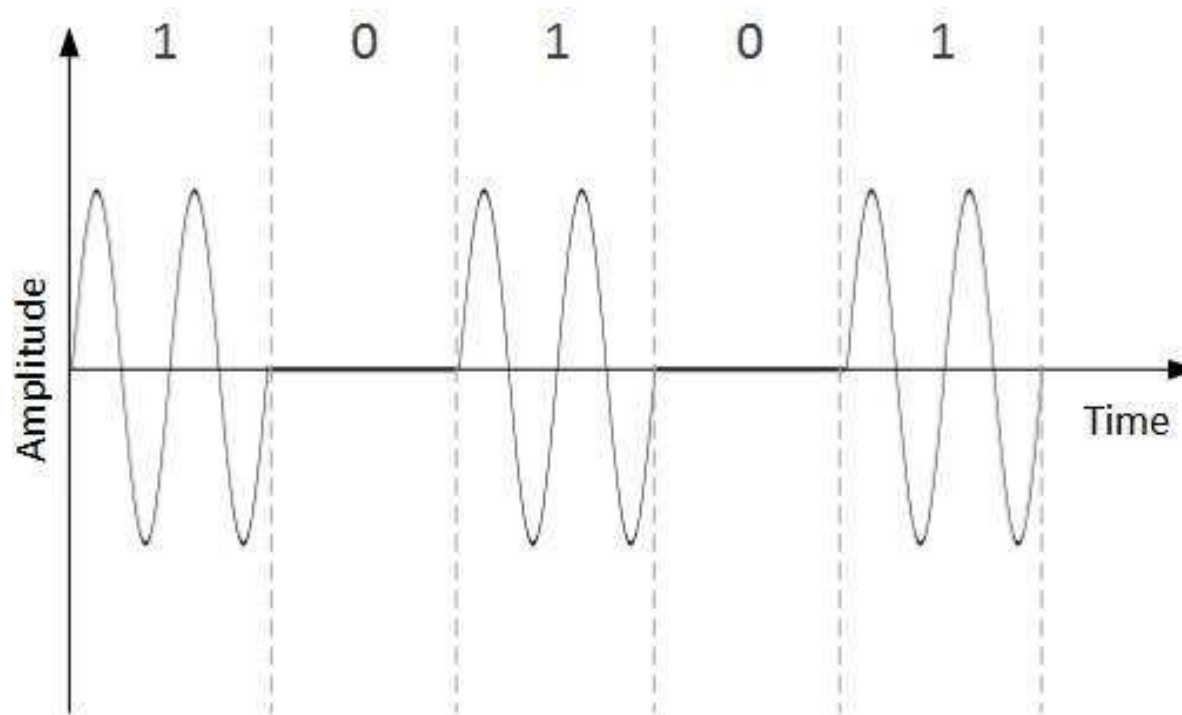


Chapter 5

Analog Transmission

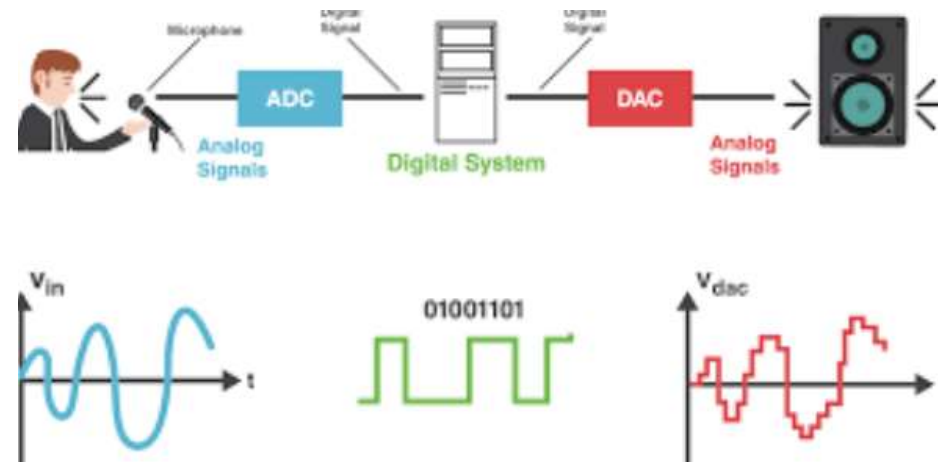


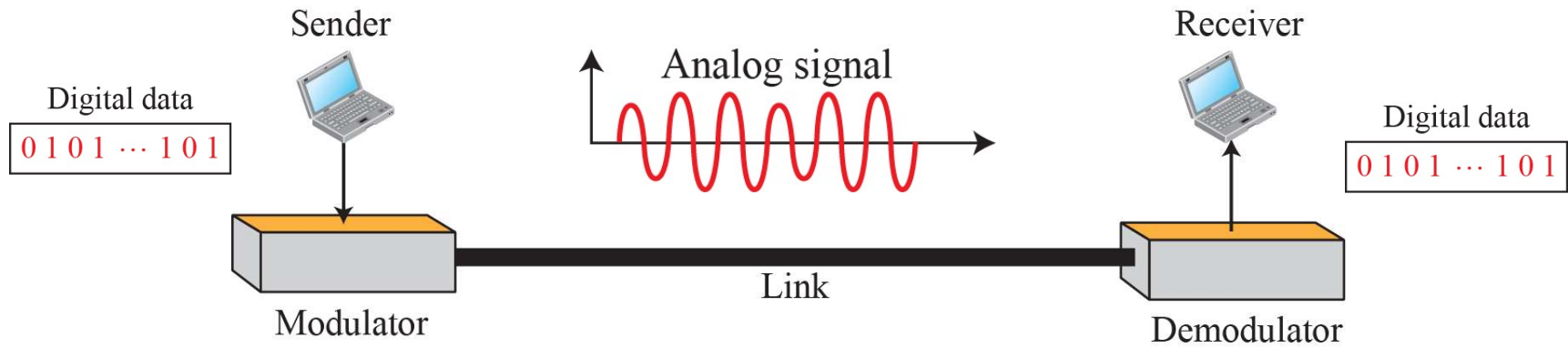
Objective

- Digital-to-analog conversion.
- Amplitude shift keying (ASK), Frequency shift keying (FSK), Phase shift keying (PSK).
- Analog-to-analog conversion.
- Amplitude modulation (AM), Frequency modulation (FM), Phase modulation (PM)

DIGITAL-TO-ANALOG CONVERSION

- Digital-to-analog conversion is the process of changing one of the characteristics of an analog signal based on the information in digital data.
- Next figure shows the relationship between the digital information, the digital-to-analog modulating process, and the resultant analog signal.

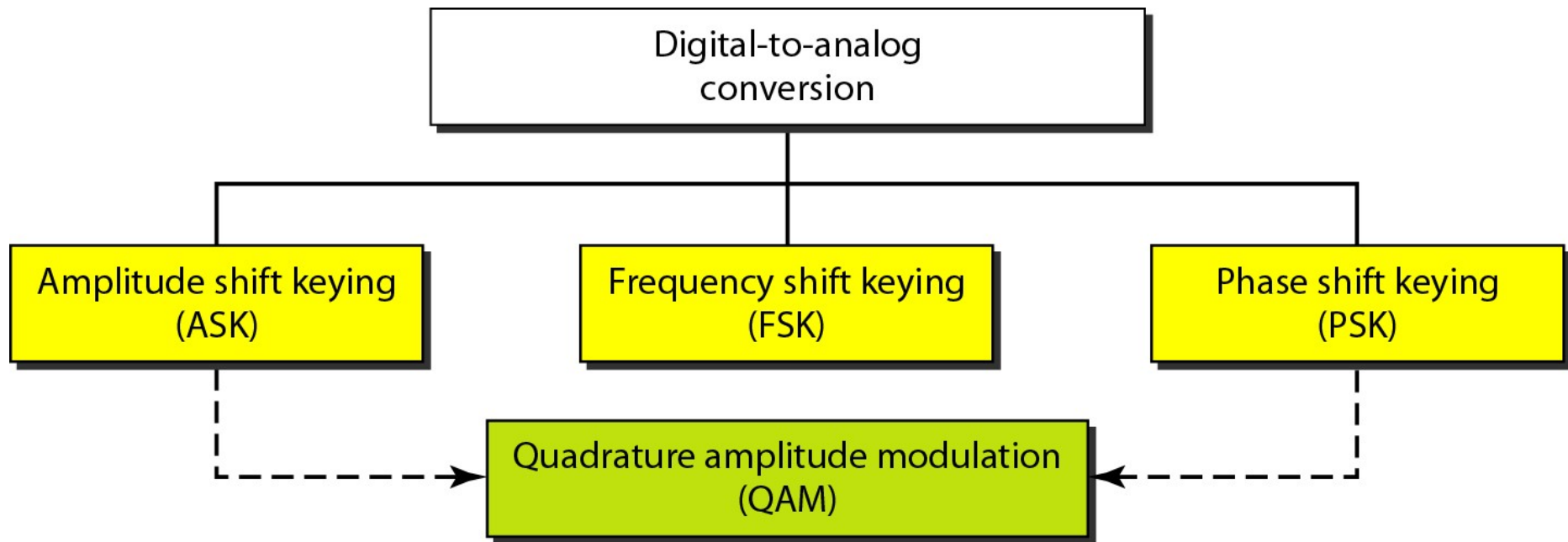




Digital-to-analog conversion

Aspects of Conversion

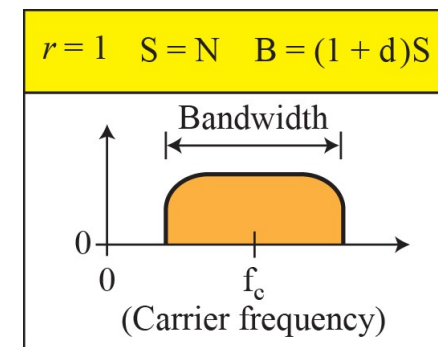
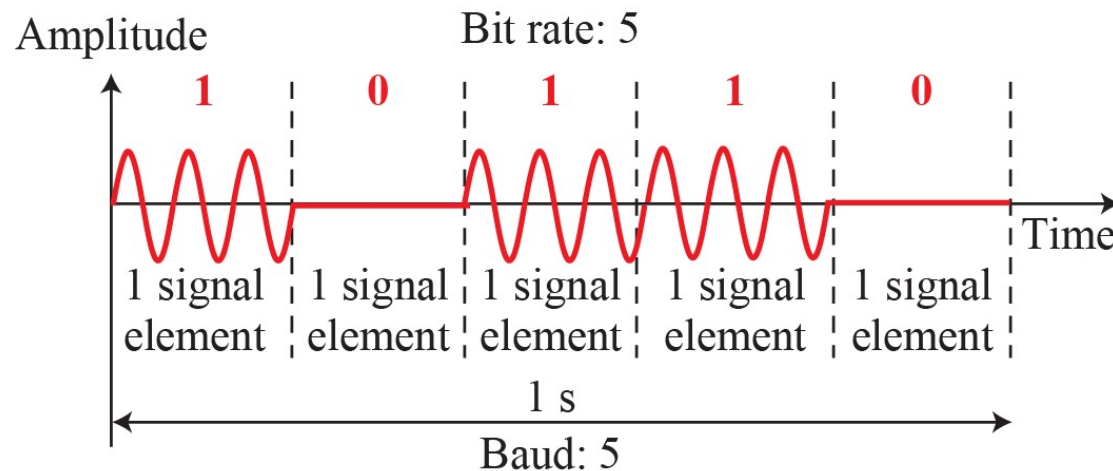
- **Baud rate**, also known as symbol rate and modulation rate, is the number of symbol changes, waveform changes, or signaling events across the transmission medium per time unit.
- A **carrier signal** or **carrier frequency** is a transmitted electromagnetic pulse or wave at a steady base frequency of alternation on which information can be imposed by increasing signal strength, varying the base frequency, varying the wave phase, or other means.



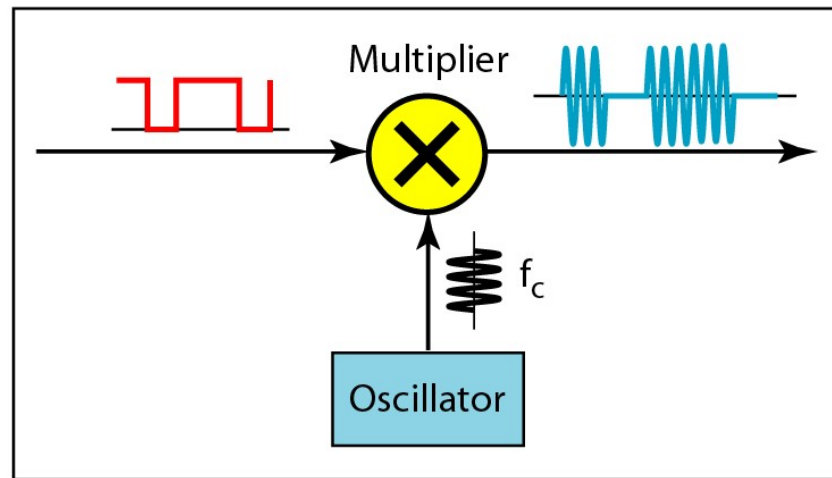
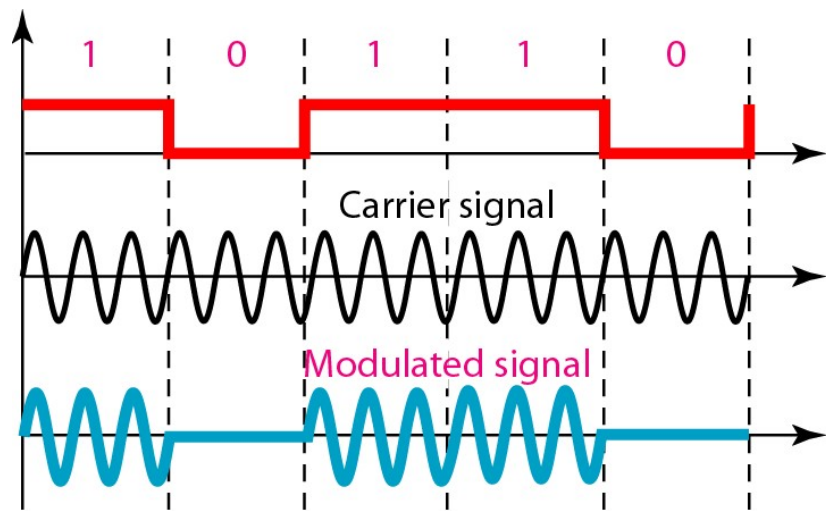
Types of digital to analog conversion

Amplitude Shift Keying

- In amplitude shift keying, the amplitude of the carrier signal is varied to create signal elements. Both frequency and phase remain constant while the amplitude changes.



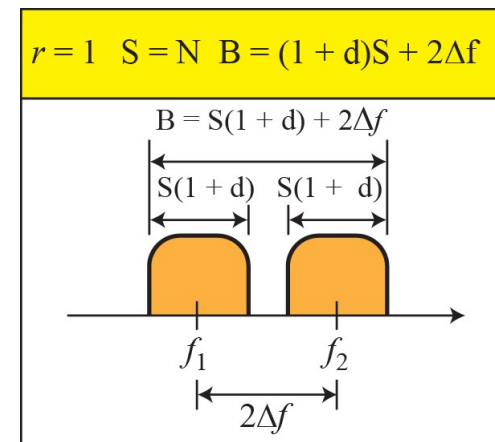
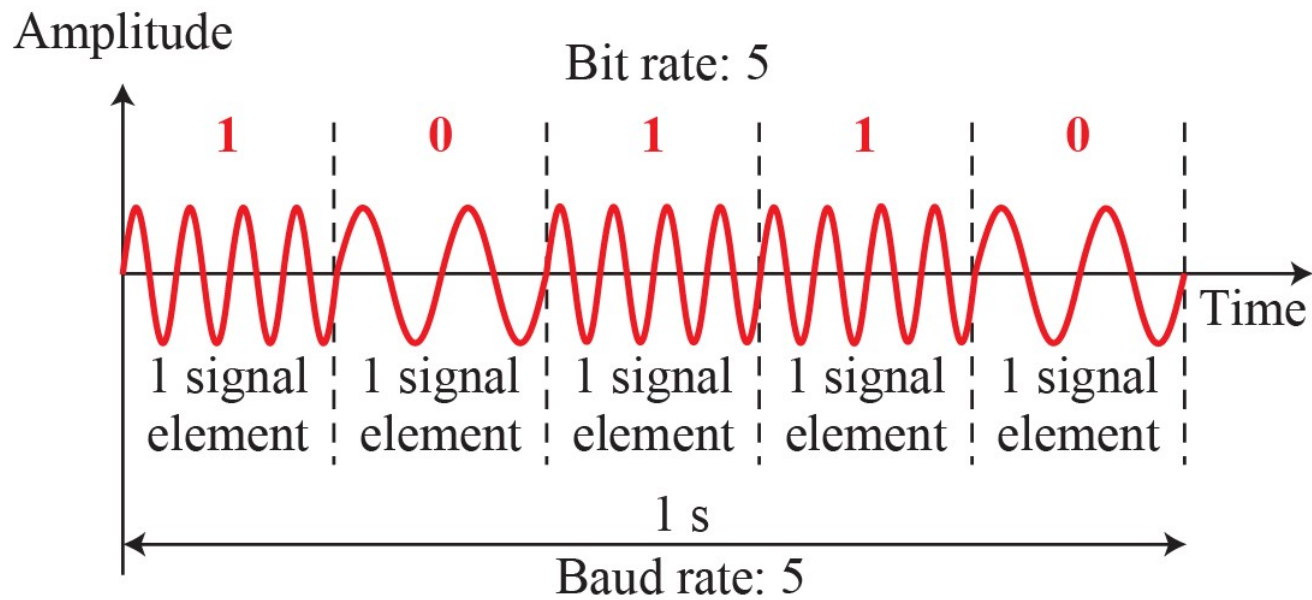
Binary amplitude shift keying



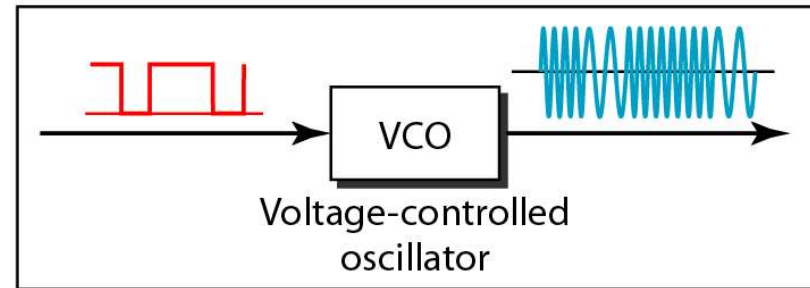
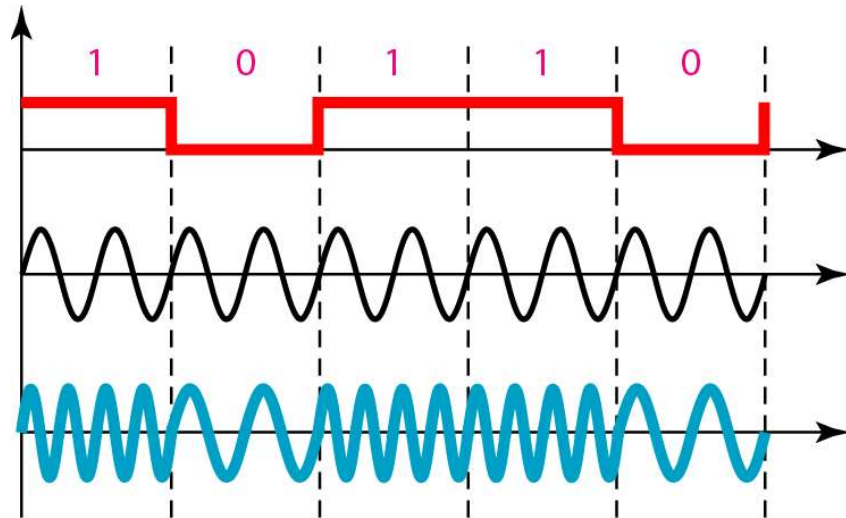
Implementation of binary ASK

Frequency Shift Keying

- In frequency shift keying, the frequency of the carrier signal is varied to represent data.
- The frequency of the modulated signal is constant for the duration of one signal element, but changes for the next signal element if the data element changes.
- Both peak amplitude and phase remain constant for all signal elements.



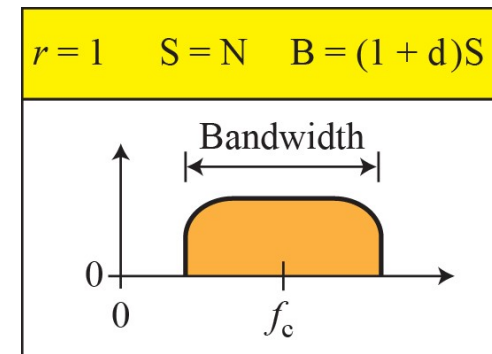
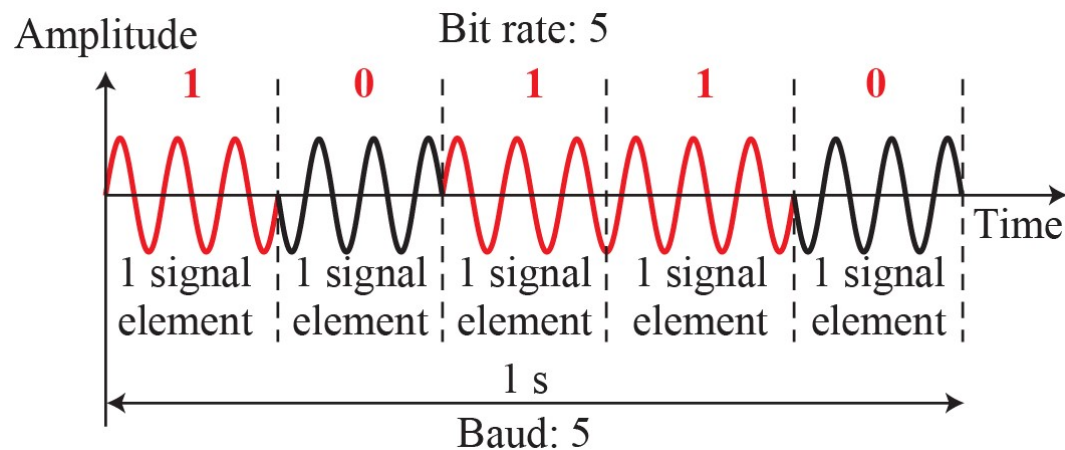
Binary frequency shift keying



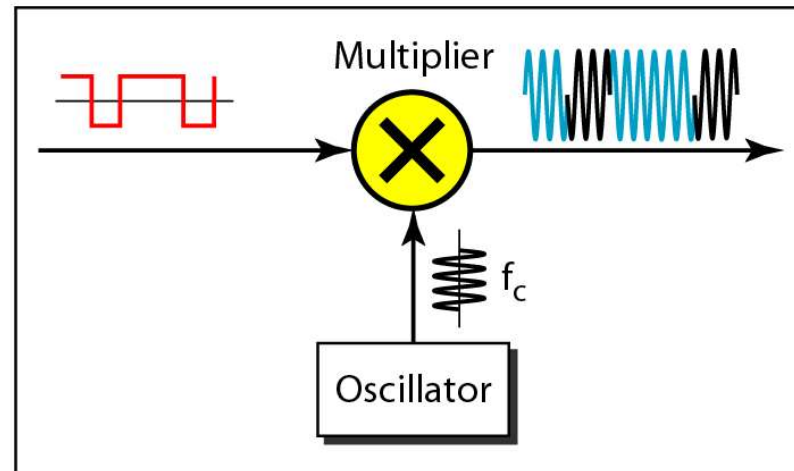
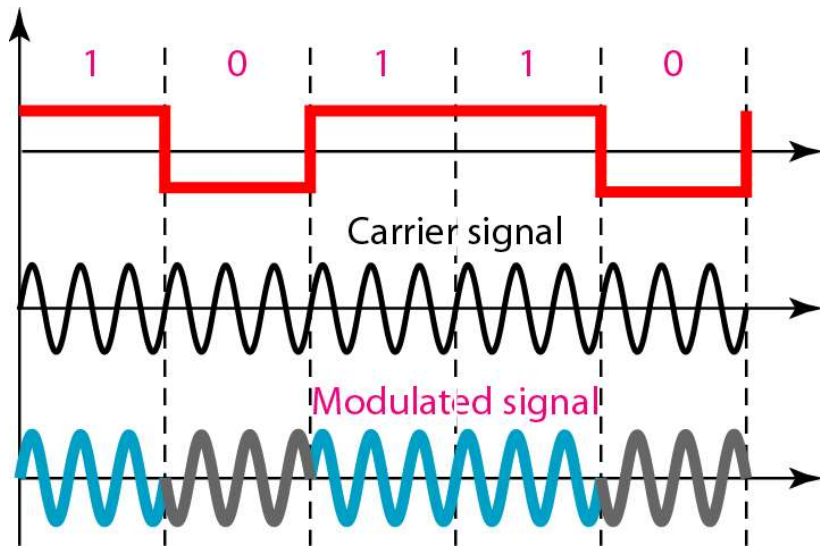
Implementation of BFSK

Phase Shift Keying

- In phase shift keying, the phase of the carrier is varied to represent two or more different signal elements. Both peak amplitude and frequency remain constant as the phase changes.



Binary phase shift keying



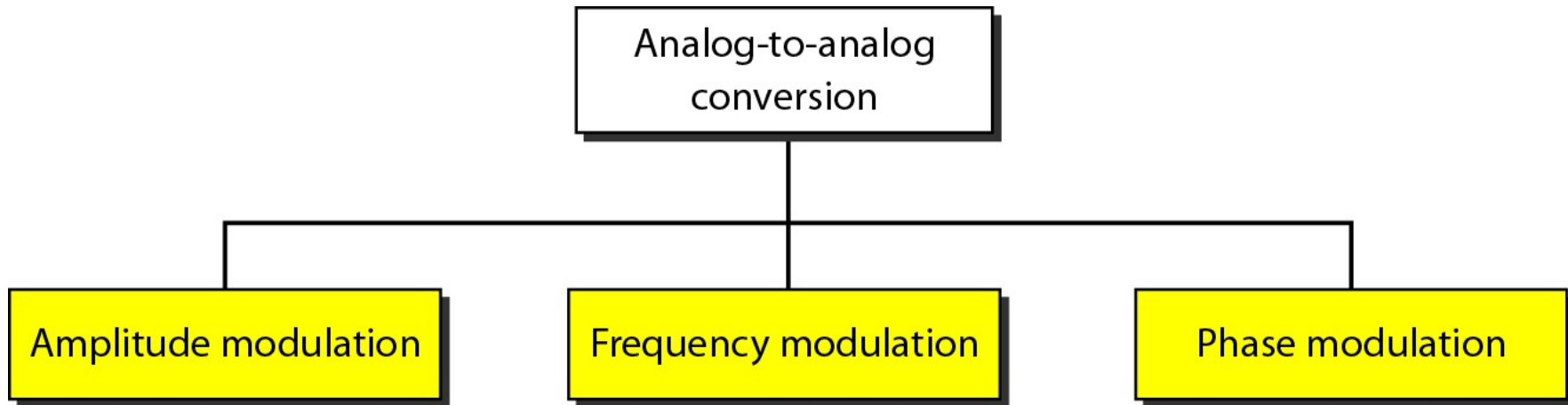
Implementation of BPSK

Quadrature Amplitude Modulation

- Today, PSK is more common than ASK or FSK. However, we will see shortly that QAM, which combines ASK and PSK, is the dominant method of digital-to-analog modulation.
- QAM is a form of modulation that uses two carriers—offset in phase by 90 degrees—and varying symbol rates (i.e., transmitted bits per symbol) to increase throughput.

ANALOG-TO-ANALOG CONVERSION

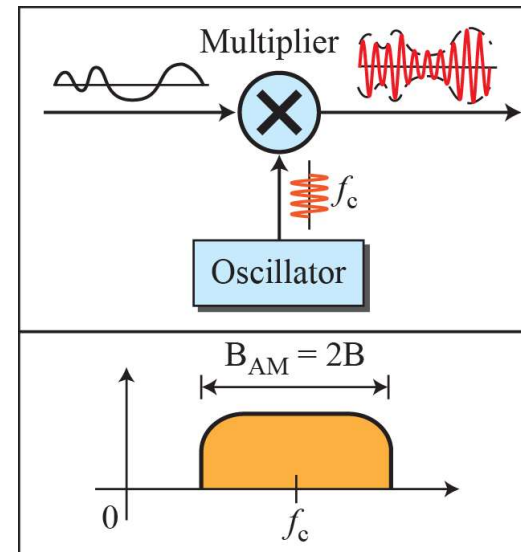
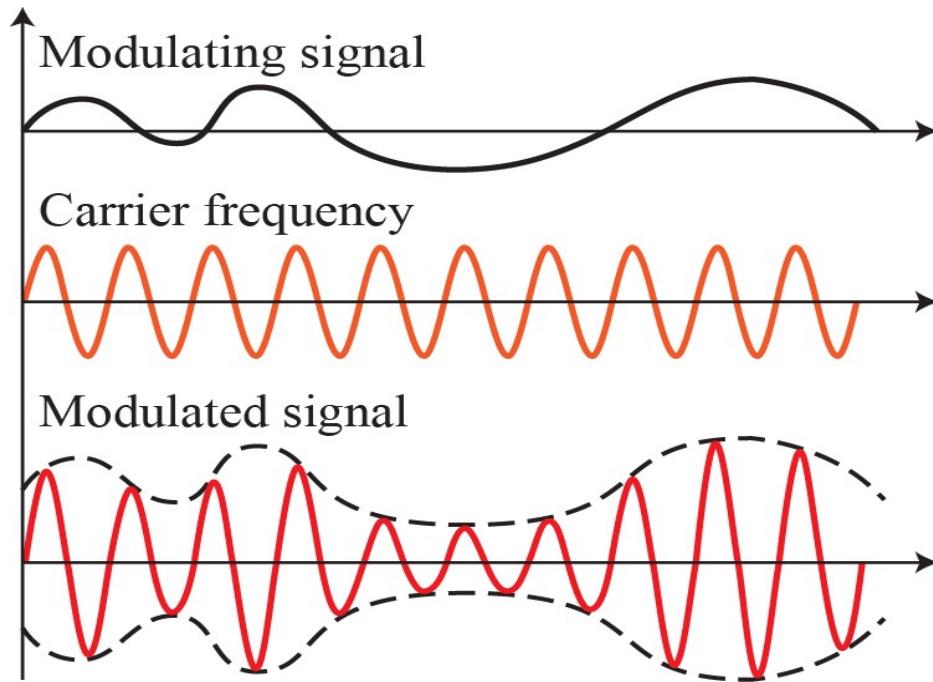
- Analog-to-analog conversion, or analog modulation, is the representation of analog information by an analog signal.
- Modulation is needed if the medium is bandpass in nature or if only a bandpass channel is available to us.
- Analog-to-analog conversion can be accomplished in three ways: AM FM and PM.



Types of analog-to-analog modulation

Amplitude Modulation (AM)

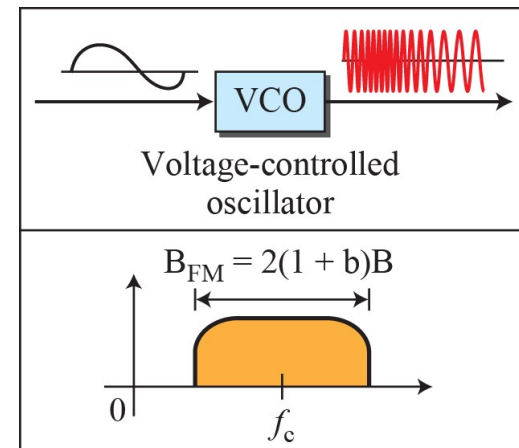
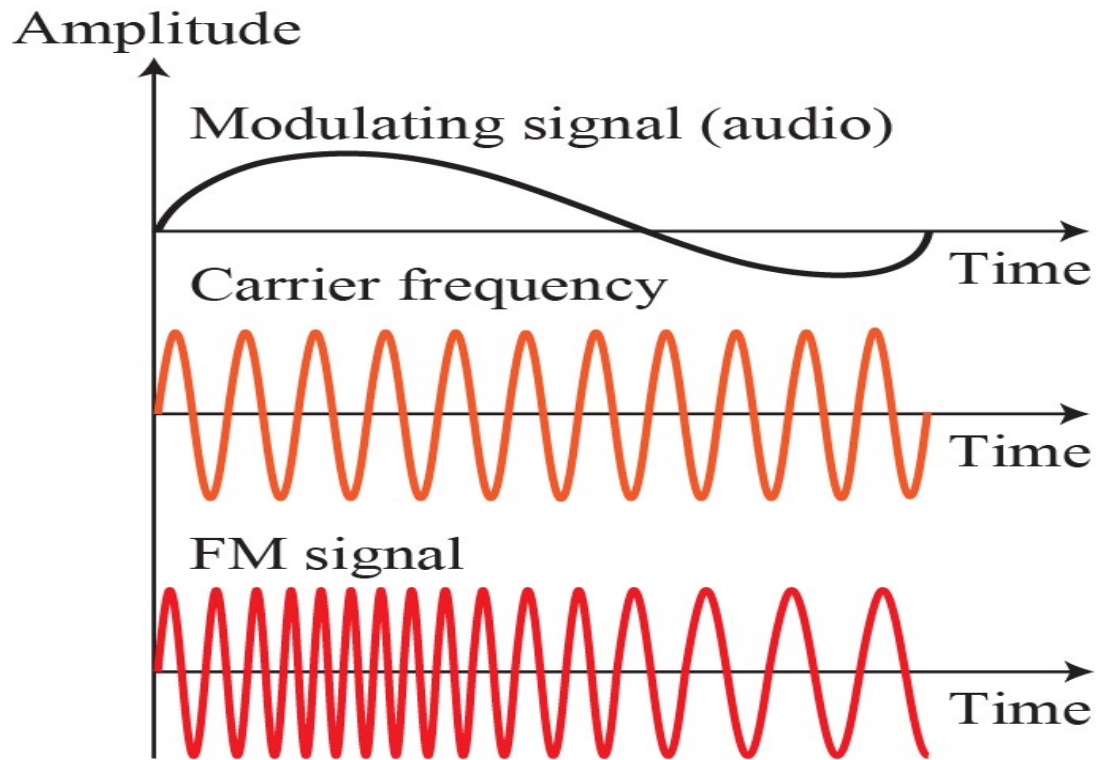
- In AM transmission, the carrier signal is modulated so that its amplitude varies with the changing amplitudes of the modulating signal.
- The frequency and phase of the carrier remain the same; only the amplitude changes to follow variations in the information.
- **The modulating signal is the envelope of the carrier.** AM is normally implemented by using a simple multiplier because the amplitude of the carrier signal needs to be changed according to the amplitude of the modulating signal.



Amplitude modulation

Frequency Modulation (FM)

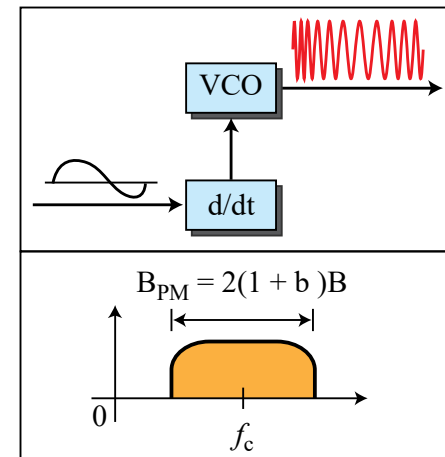
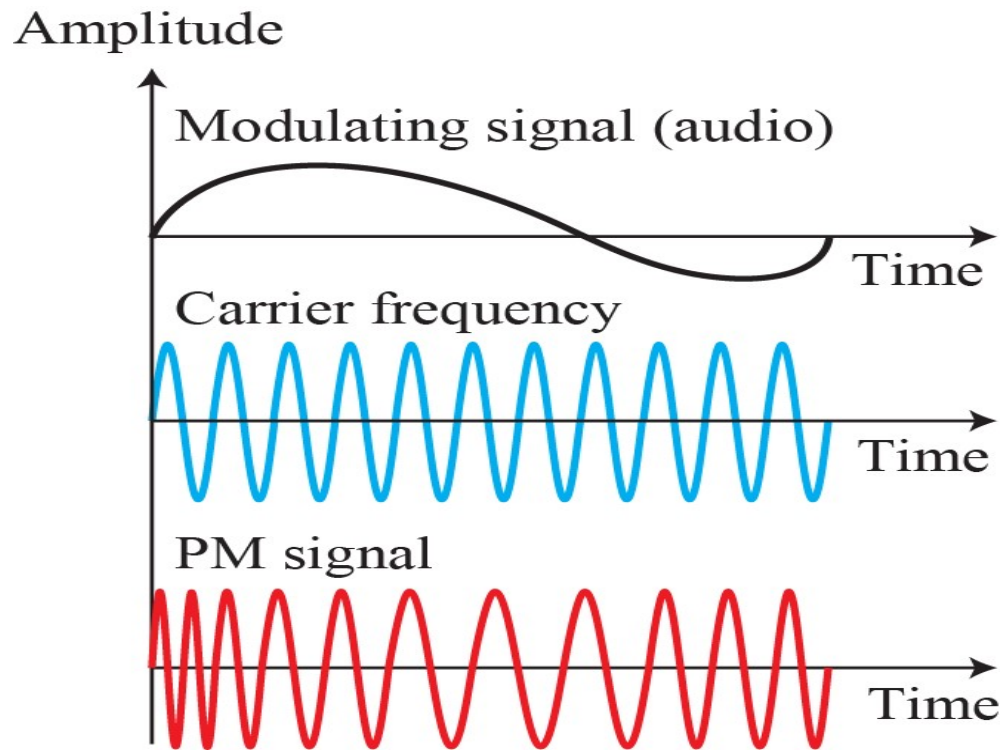
- In FM transmission, the frequency of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal.
- The peak amplitude and phase of the carrier signal remain constant, but as the amplitude of the information signal changes, the frequency of the carrier changes correspondingly.



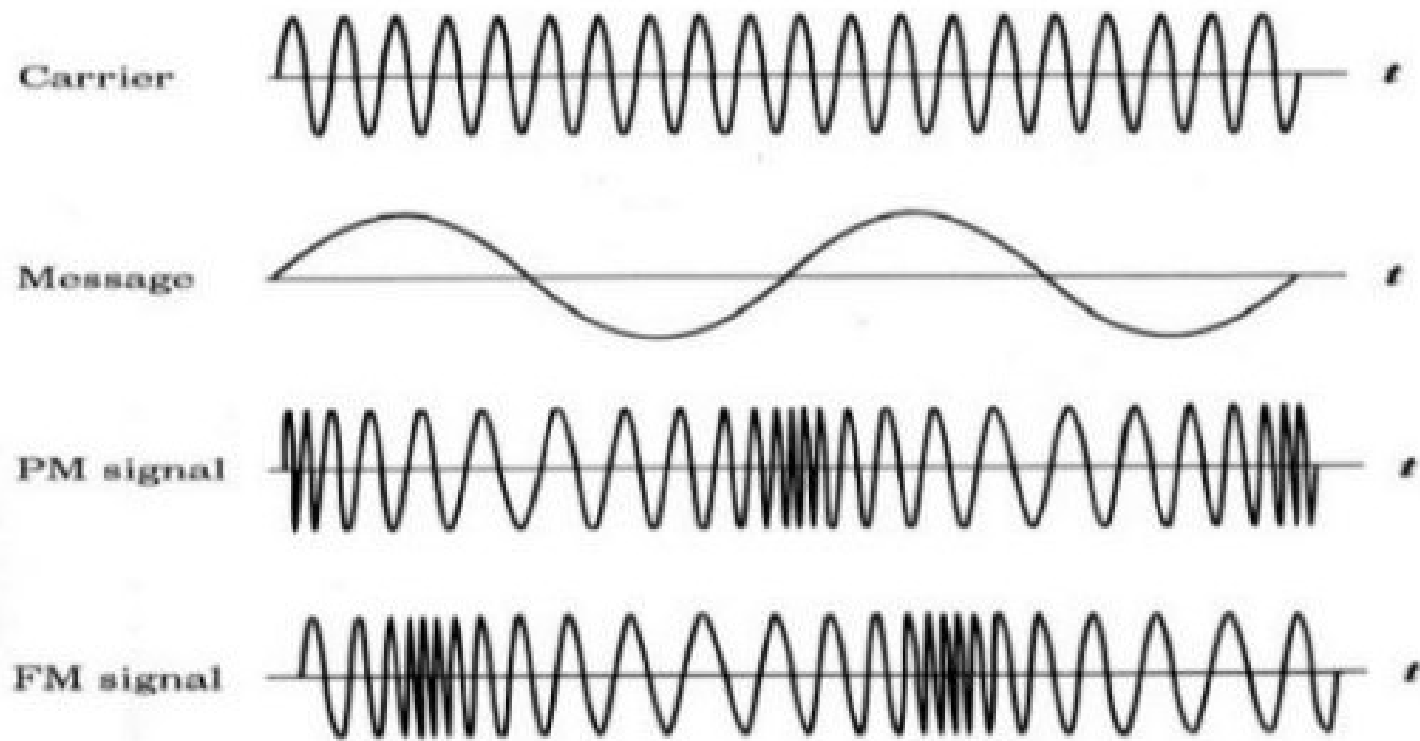
Frequency modulation

Phase Modulation (PM)

- In PM transmission, the phase of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal.
- The peak amplitude and frequency of the carrier signal remain constant, but as the amplitude of the information signal changes, the phase of the carrier changes correspondingly.



Phase modulation



- s1 그림에서 밑에 2가지만 보면 어느것이 FM이고, 어느것이 PM인지 알수 없음. 하지만 입력신호와 비교하면 보면 입력신호가 +로 높을때 캐리어 주파수가 높고, 입력신호가 낮을때 캐리어 주파수가 낮게 나오는 것이 FM변조임. 반면에 Phase 변조의 경우 입력신호의 기울기에 따라 결정됨. 즉 입력신호가 Low -> High로 상승할때 캐리어 주파수가 높아지고, High -> Low로 내려올때 캐리어 주파수가 낮아짐.

swkim, 2021-09-08