Chapter Two

Layout: **10 Hrs.**

1. Line Coding (or Pulse Modulation)

Lecture Eight

Line Coding (or Pulse Modulation)

Digital to digital signal converting (DDC)

Objective of Lecture:

Understand the way by which we convert the analog signal to binary bits.

Behavioral goals:

- Student will be able to convert bit sequences into electrical pulse signal.
- Choose appropriate line coding waveform.
- Differentiate between line coding waveform.

This lecture answers important questions which are:

What is Line Coding?

Why Line Coding is important?

How is Line Coding done?

Where can you exploit Line Coding?

What are the problems in Line Coding?

1.1. Introduction to Line Coding

In this chapter, we show the schemes and techniques that we use to transmit bits over guided medium or baseband channel (such as coaxial cable) by converting the signal into electrical pulses. This technique called Line coding or pulse modulation (some time is called digital data to digital signals conversion).

Line coding consists of representing the digital signal to be transported, by a waveform that is appropriate for the specific properties of the physical channel (and of the receiving equipment). The pattern of voltage, current or photons used to represent the digital data on a transmission link is called line encoding. The common types of line encoding are:

1.2. Common Line Coding Waveform

Generally, line codes are divided into three groups, which are:

1. Non Return to zero Group (NRZ)
    a. NRZ – Level (ON-OFF signal)
    b. NRZ – Mark
    c. NRZ - Space
2. Return to zero group (RZ)
3. Phase encoded waveform
    a. Biphase – L (Manchester coding)
    b. Biphase – M
    c. Biphase - S

1.2.1. Non return Zero NRZ Group

NRZ – L Procedure: Non return to zero level. This is the standard positive logic signal format used in digital circuits.

1. **1** forces a high level

2. **0** forces a low level

NRZ – M Procedure:

1. Initial, **1** is high and **0** is low
2. Then, **1** forces a transition
3. **0** does nothing (keeps sending the previous level)

NRZ – S Procedure:

1. Initial, 0 is high and 1 is low
2. 1 does nothing (keeps sending the previous level)
3. 0 forces a transition

NRZ – Polar Procedure:

1. 1 is represented by positive $+V$
2. 0 is represented by positive $-V$

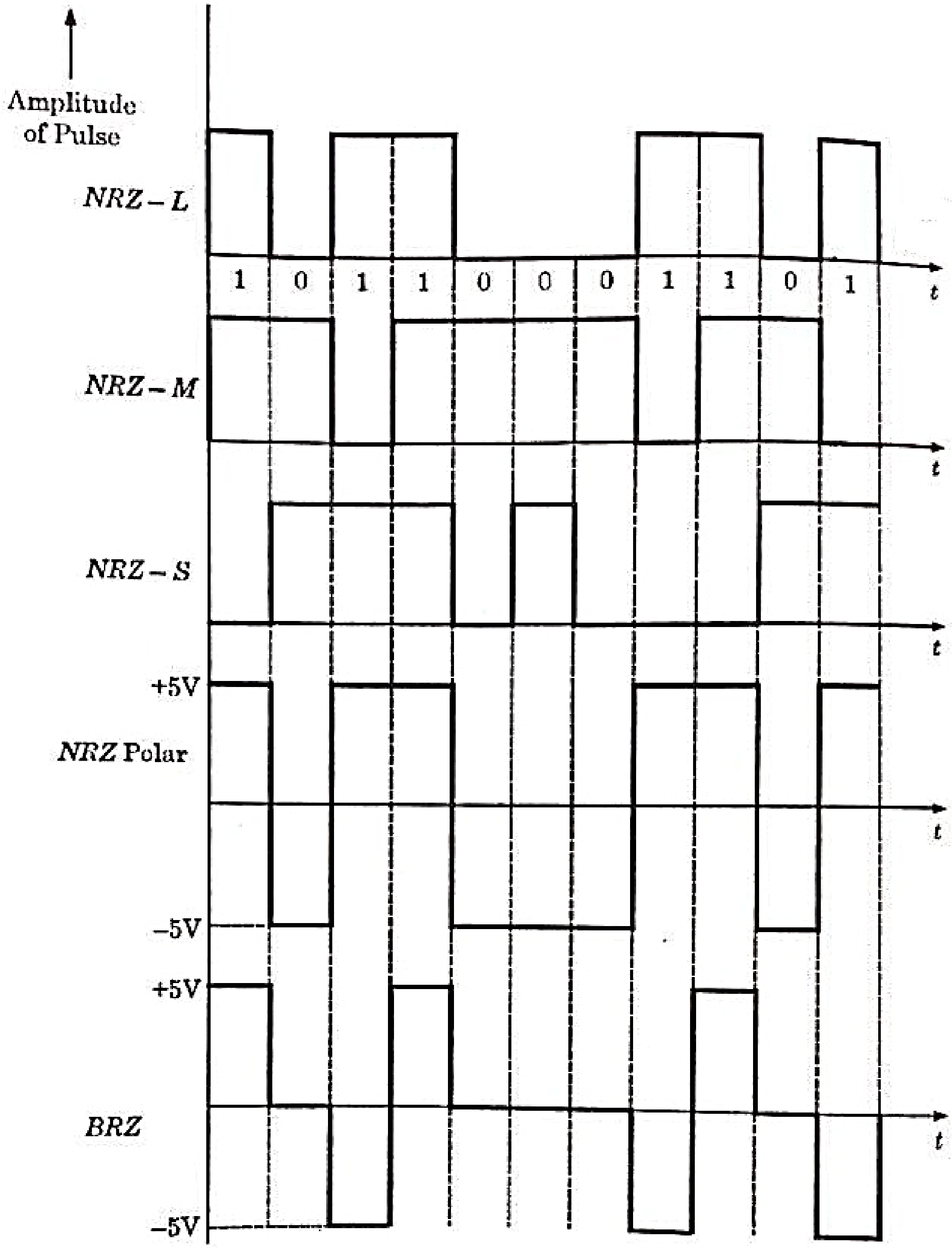

Figure 1.1: NRZ Groups

1.2.2. Return Zero (RZ) Group

Unipolar RZ Procedure:

1. 1 goes high for half the bit period and returns to low
2. 0 stays low for the entire period

Bipolar RZ Procedure:

1. 1 goes high for half the bit period and returns to low in $+V$
2. 0 goes high for half the bit period and returns to low in $-V$

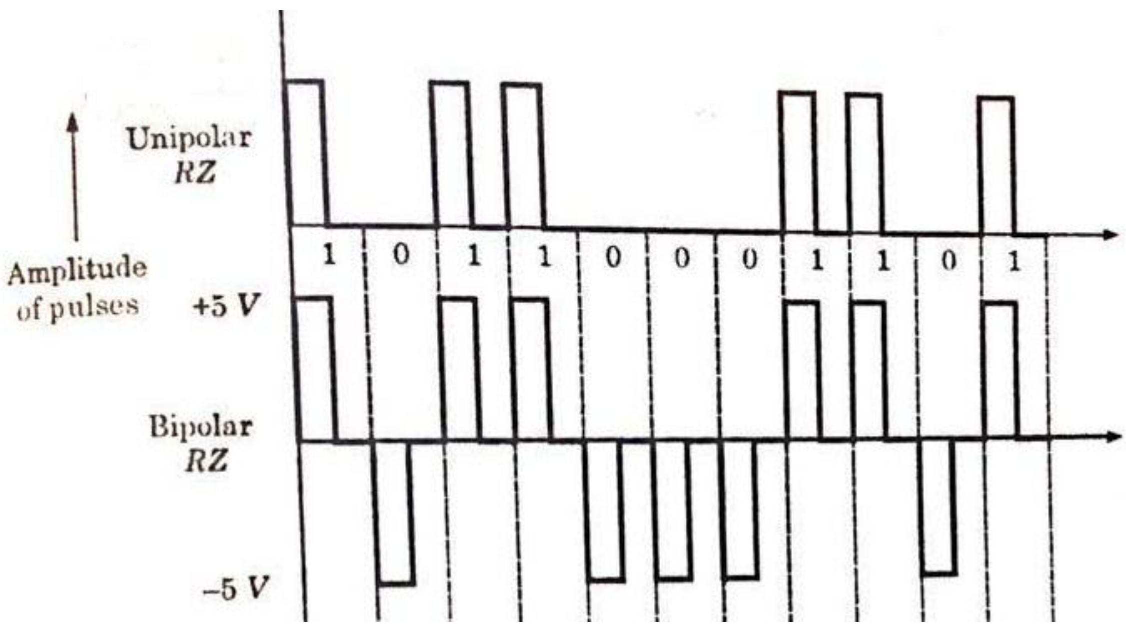

Figure 1.2. RZ groups

1.2.3. Return Zero (RZ) Group

Biphase – L (Manchester):

1. Two consecutive bits of the same type force a transition at the beginning of a bit period.

2. 1 forces a negative transition in the middle of the bit
3. 0 forces a positive transition in the middle of the bit

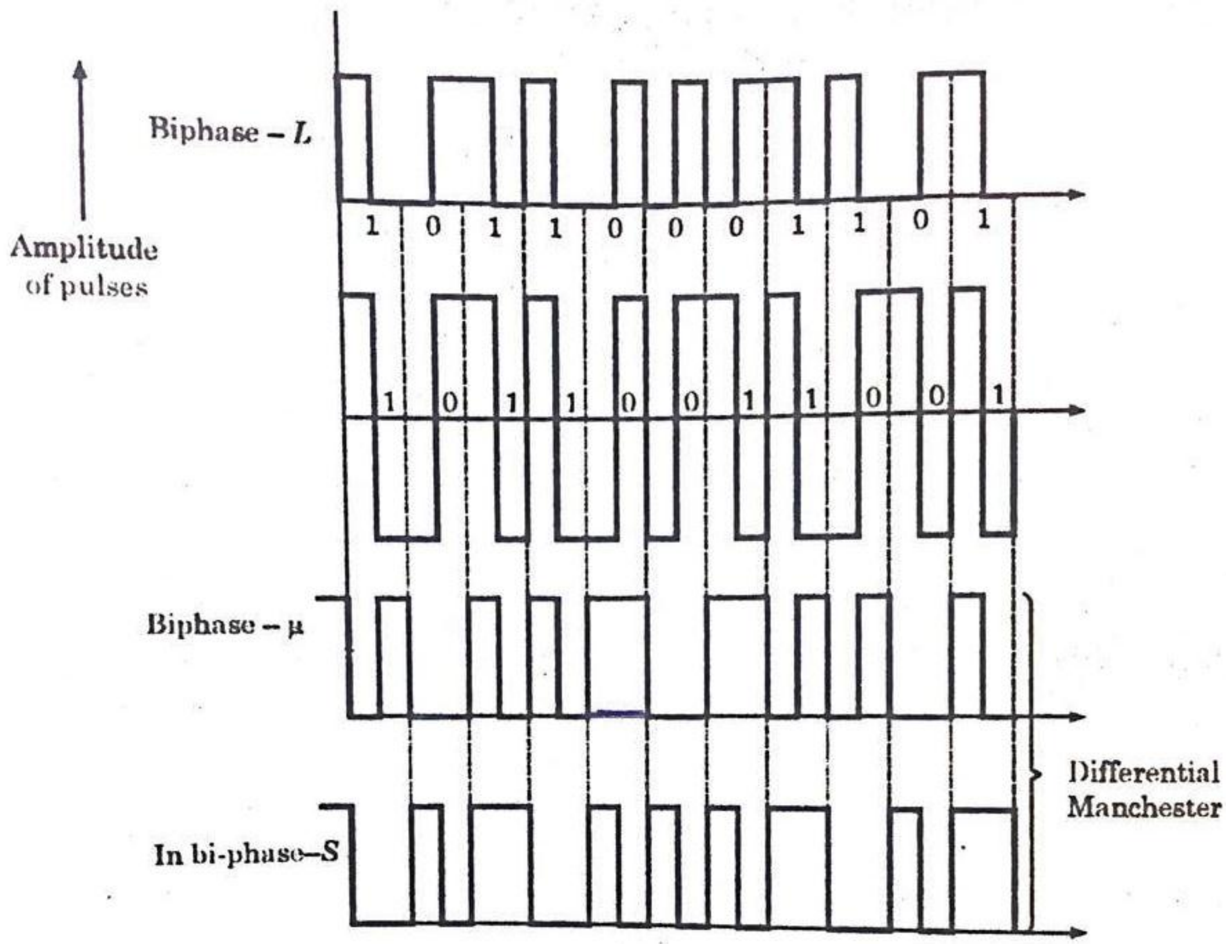

Figure 1.3. Biphase Groups

Biphase – M Procedure:

1. Initial, 1 is half low then high, 0 is low space
2. 1 forces a transition but opposite to previous
3. 0 keeps level constant but opposite to previous

In Biphase – S Procedure:

1. Initial, 1 is low space, 0 is half then high
2. 0 forces a transition but opposite to previous
3. 1 keeps level constant but opposite to previous