

# Principles of Communication (BEC-28)

## Unit-4

### Pulse Modulation and Digital Transmission of Analog Signal

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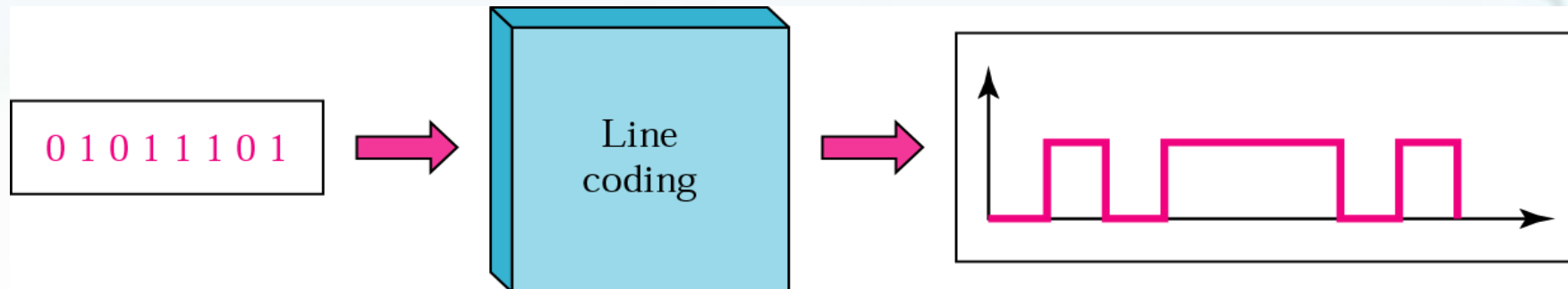
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## **Content of Unit-IV**

**Pulse Modulation and Digital Transmission of Analog Signal:** Sampling Theorem and its applications, Concept of Pulse Amplitude Modulation, Pulse width modulation and pulse position modulation, PCM, Pulse Time Modulation, TDM and FDM. **Line Coding**, Quantizer, Quantization Noise, Compounding multiplexer.

# ➤ *What is LINE CODING ?*

- *The process of converting digital data to digital signals*



# ➤ **Need Of Line Coding:**

- Various Techniques
- Other Way: From Computers
- Information: Inherently discrete in nature
- Transmitted over band-limited channel: Signal gets Dispersed
- Causes: Overlap and Distortion
- Distortion: Inter-symbol Interference(ISI)

# Properties of Line Coding

- **Transmission Bandwidth:** as small as possible
- **Power Efficiency:** As small as possible for given BW and probability of error
- **Error Detection and Correction capability.**
- **Adequate timing content:** Extract timing from pulses
- **Transparency:** Prevent long strings of 0s or 1s

```
graph TD; A[ ] --- B[Unipolar]; A --- C[Polar]; A --- D[Bipolar];
```

**Unipolar**

**Polar**

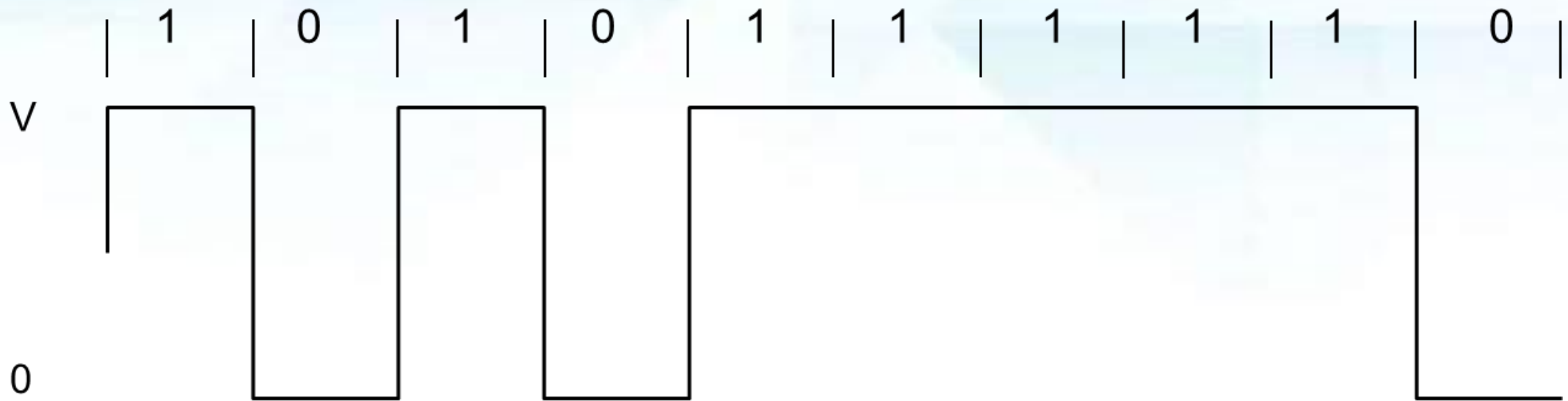
**Bipolar**

1. Not-Return to Zero (NRZ)

2. Return to Zero (RZ)

## ■ Unipolar NRZ:

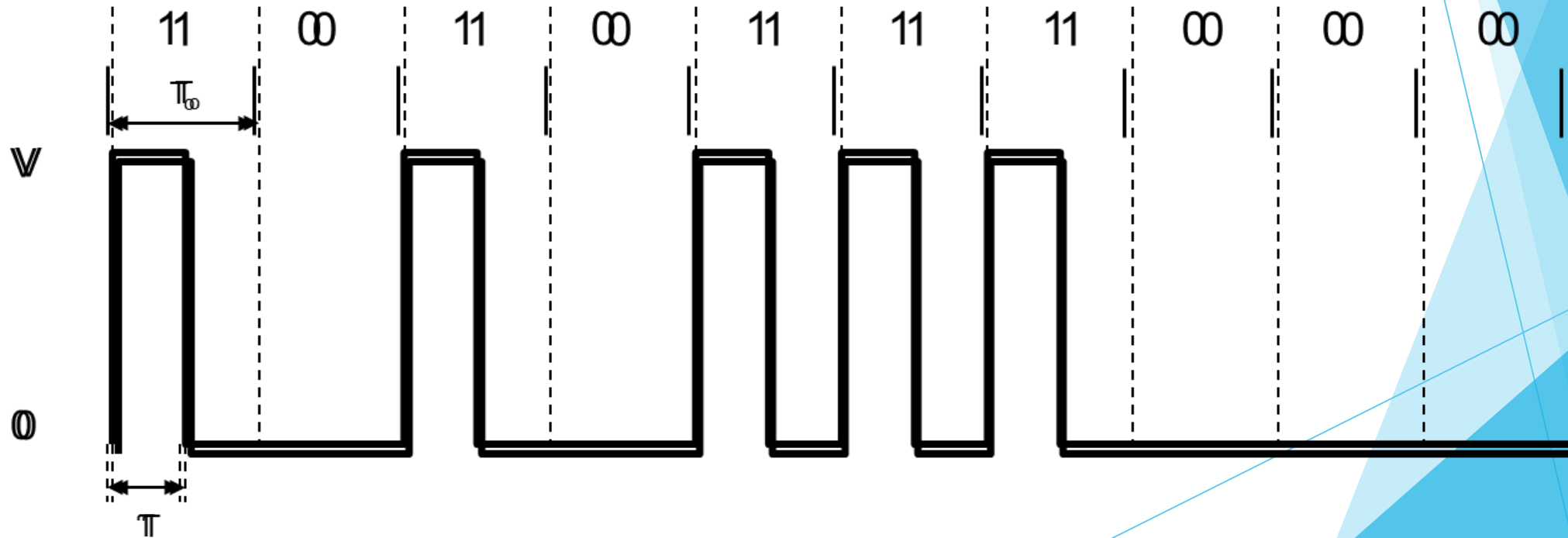
- Pulse 0: Absence of pulse
- Pulse 1 : Presence of pulse





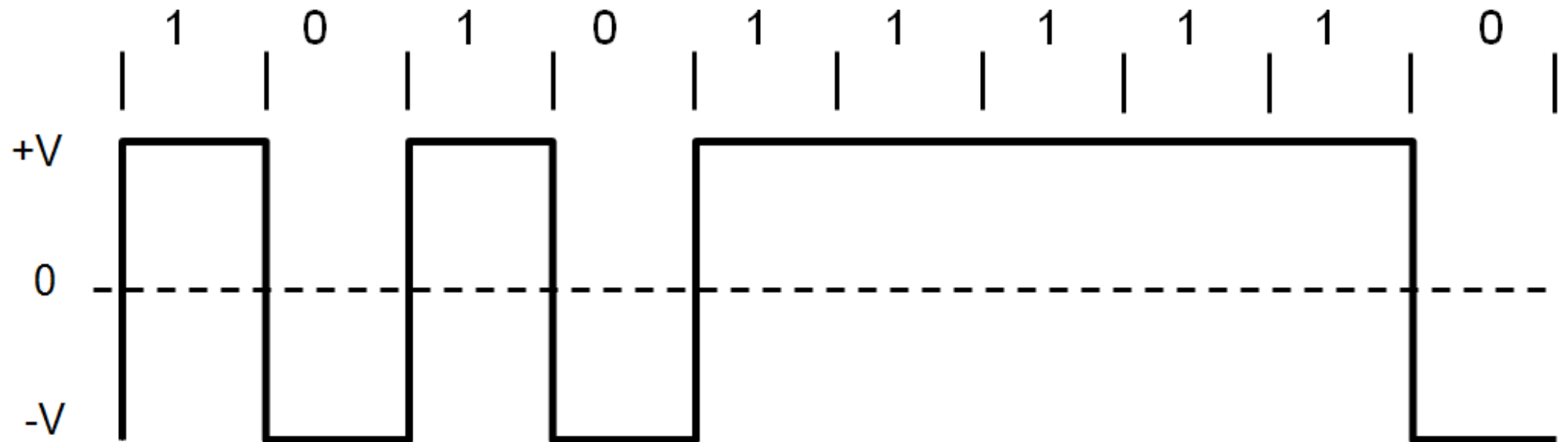
# ■ Unipolar RZ:

- Pulse 0: Absence of pulse
- Pulse 1 : Presence of pulse



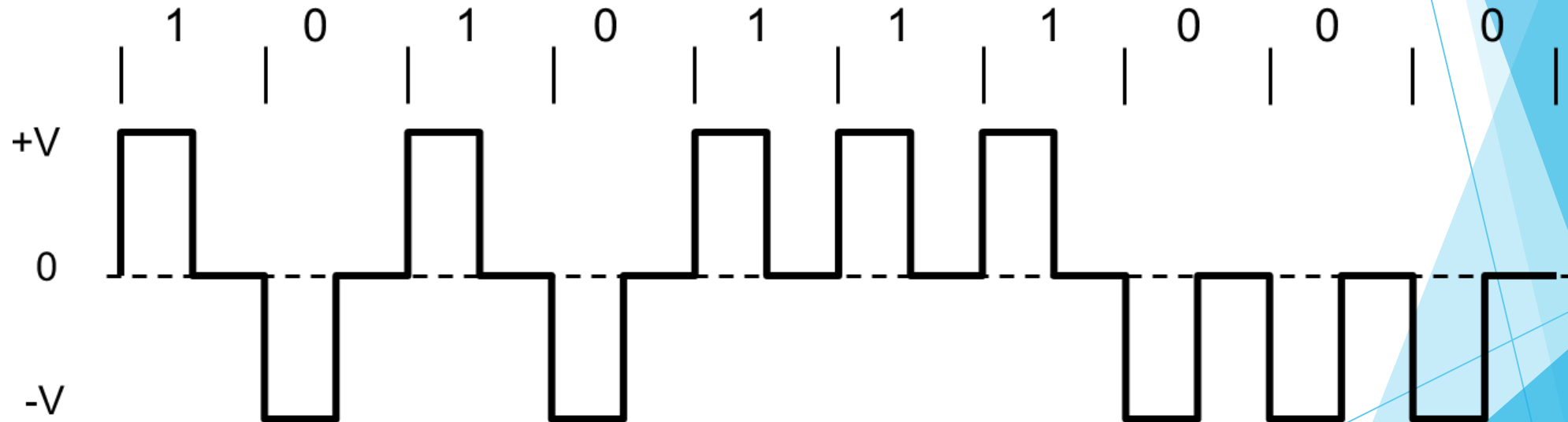
## ■ Polar NRZ:

- Pulse 1 : Presence of pulse
- Pulse 0: Opposite of pulse



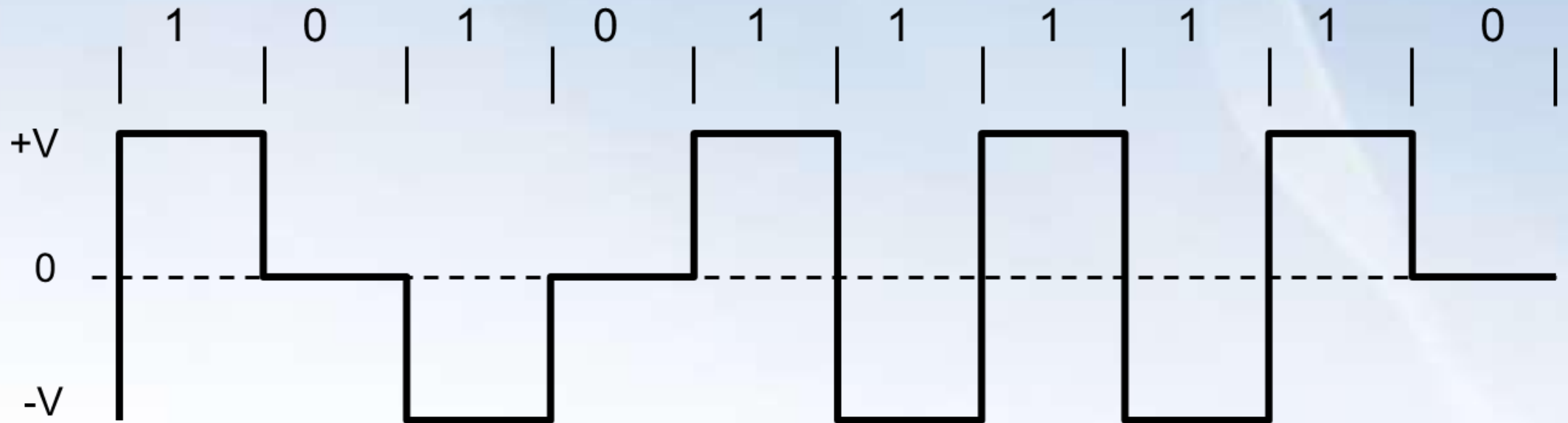
## ■ Polar RZ:

- Pulse 1 : Presence of pulse
- Pulse 0: Opposite of pulse



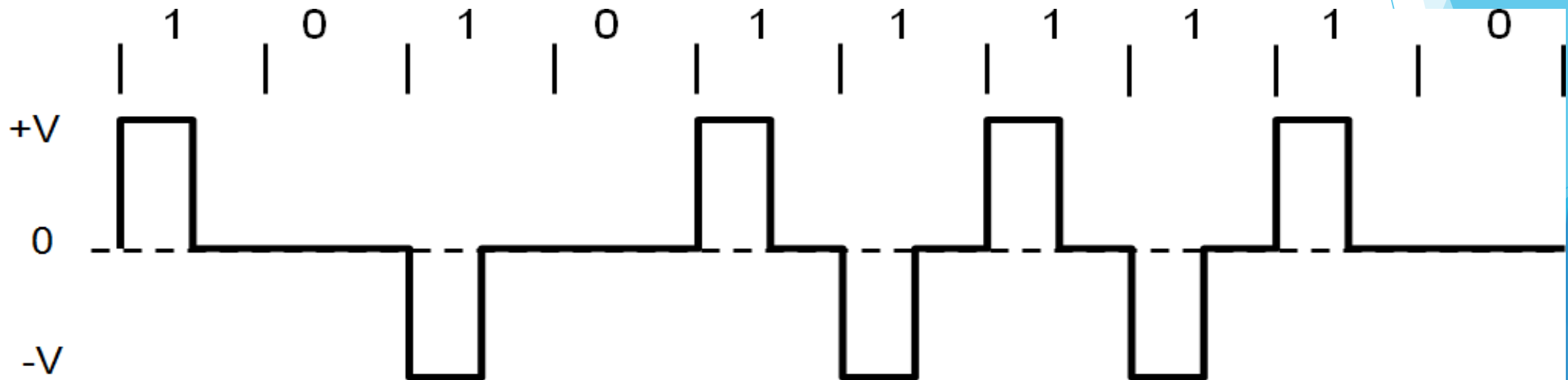
## ■ Bipolar NRZ:

- Pulse 1 : Alternating voltage levels
- Pulse 0: Absence of pulse



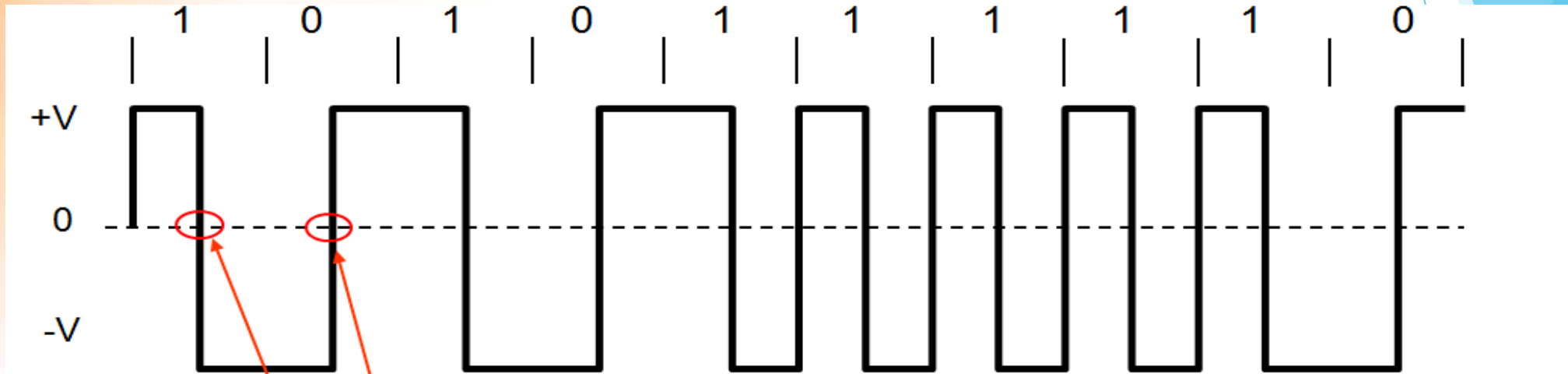
## ■ Bipolar RZ:

- Pulse 1 : Alternating voltage levels
- Pulse 0: Absence of pulse



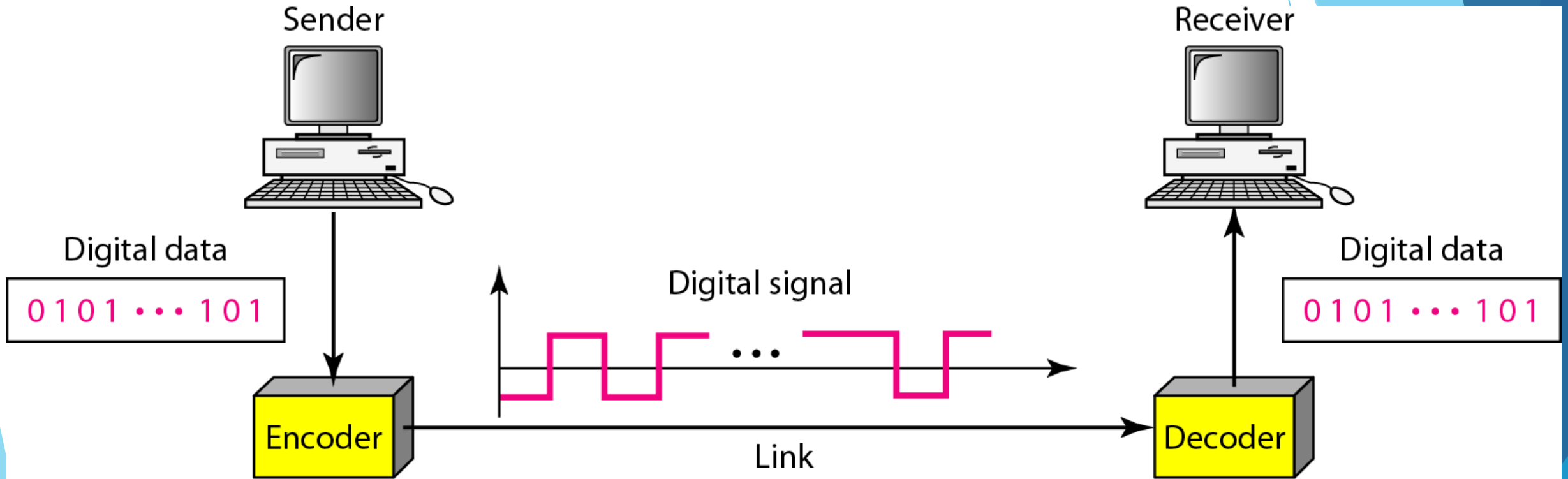
# Manchester Coding:

- Pulse 1 : +ve in 1<sup>st</sup> half and -ve in 2<sup>nd</sup> half
- Pulse 0: -ve in 1<sup>st</sup> half and +ve in 2<sup>nd</sup> half



**Note:** There is always a transition at the centre of bit duration.

# ➤ Line coding and decoding





Thank You