Aim ↬ To perform line coding techniques [RZ, NRZ, Manchester] using trainer kit.

Apparatus Required ↬ CM8 Panel [Data formatting and reformatting experiment panel], DSO and connecting wires.

Theory ↬

Line coding is a method used in digital communication to convert binary data into specific voltage levels or pulses for transmission. Line coding helps ensure reliable data transmission and can affect factors like synchronization and bandwidth usage. Each technique has its advantages and trade-offs, making them suitable for different communication scenarios. The main techniques include:

RZ [Return-to-Zero] ↪ In this method, each bit is represented by a voltage level that returns to zero within the bit period. A '1' is a high voltage, and a '0' is a low voltage, with the signal returning to zero between each bit.

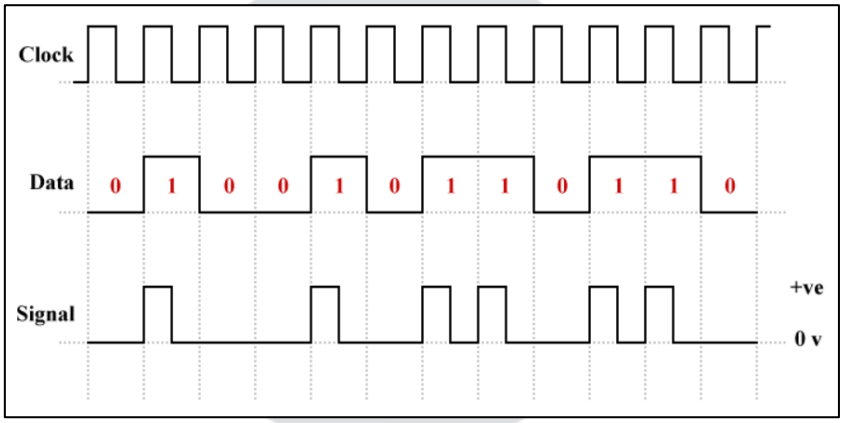

Fig. i) RZ line coding technique

NRZ [Non-Return-to-Zero] ↪ Here, the signal does not return to zero during the bit period. In NRZ-L (Level), a '1' is a high voltage, and a '0' is a low voltage. In NRZ-I (Inverted), a transition at the start of the bit period represents a '1'.

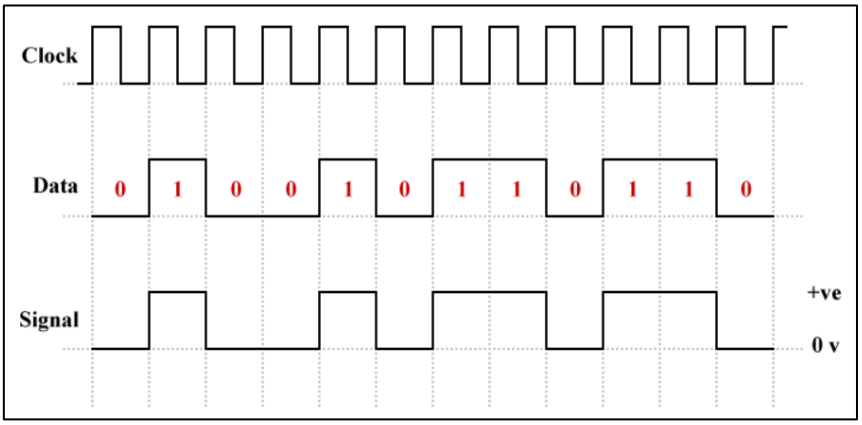

Fig. ii) NRZ line coding technique

Manchester coding ↪ This technique combines the clock and data into one signal, where a '1' is shown by a transition from low to high and a '0' by a transition from high to low within the bit period.

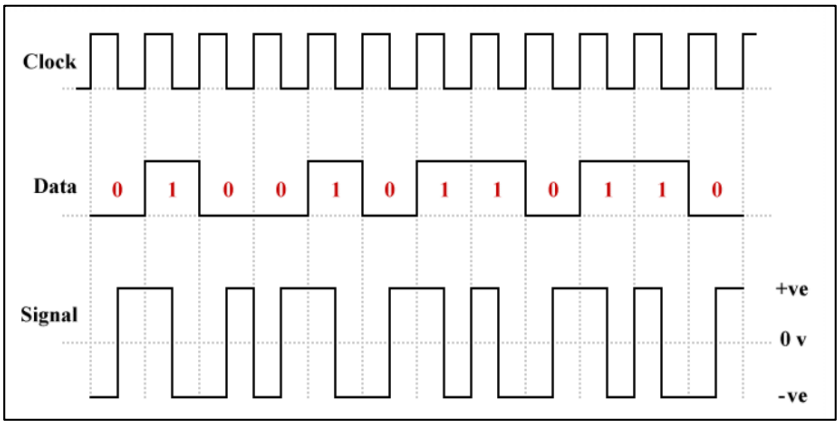

Fig. iii) Manchester line coding technique

The CM8 Data Formatting and Reformatting Experiment Panel allows users to practice these techniques, helping to understand their behavior and impact on communication systems.

Procedure ↬

i. Connect +12V to Socket 1 and GND to Socket 2 of the CM8 panel.
ii. Observe a 250 KHz signal at Socket 8 and a 32 KHz signal at Socket 4 using the CRO.
iii. Set SW6 to 250KHz Mode (Down position), then connect Socket 8 to Socket 11 (250 KHz-TX CLK) and Socket 11 to the I/P CLK of PRBS [NGLPF]. Turn the PRBS switch to ON (Up position).
iv. Connect PRBS Data from NGLPF to Socket 14. Then connect Socket 18 to Socket 9 (Encoded output - Decoded input) and Socket 9 to Socket 7 (Decoder input - input [PLL]).
v. Connect TX CLK & Recovered CLK to CHI & CH II of the CRO. Set time/div to 2µs, volt/div to 2V, and CRO to Dual mode. Adjust VR3 [FC] for stable waveforms, then connect Socket 13 to Socket 12 (Recovered CLK - RX CLK) and observe the encoded output at Socket 18 and the detected output (original PRBS data) at Socket 20.

Output ↬

Fig. iv) DSO output of RZ line coding

Fig. v) DSO output of NRZ line coding

Fig. vi) DSO output of Manchester line coding

Result ↬

The experiment successfully demonstrated RZ, NRZ, and Manchester line coding techniques using the CM8 panel. The waveforms for each coding method were correctly observed and verified.

Conclusion ↬

The experiment illustrated the practical effects of each line coding technique on digital signal transmission, confirming their impact on synchronization and bandwidth.

Precautions ↬

- Ensure proper connections and settings as per the procedure to avoid incorrect results.
- Verify signal levels and timings to ensure accurate waveform observation.
- Adjust VR3 [FC] carefully to maintain stable waveforms on the CRO.