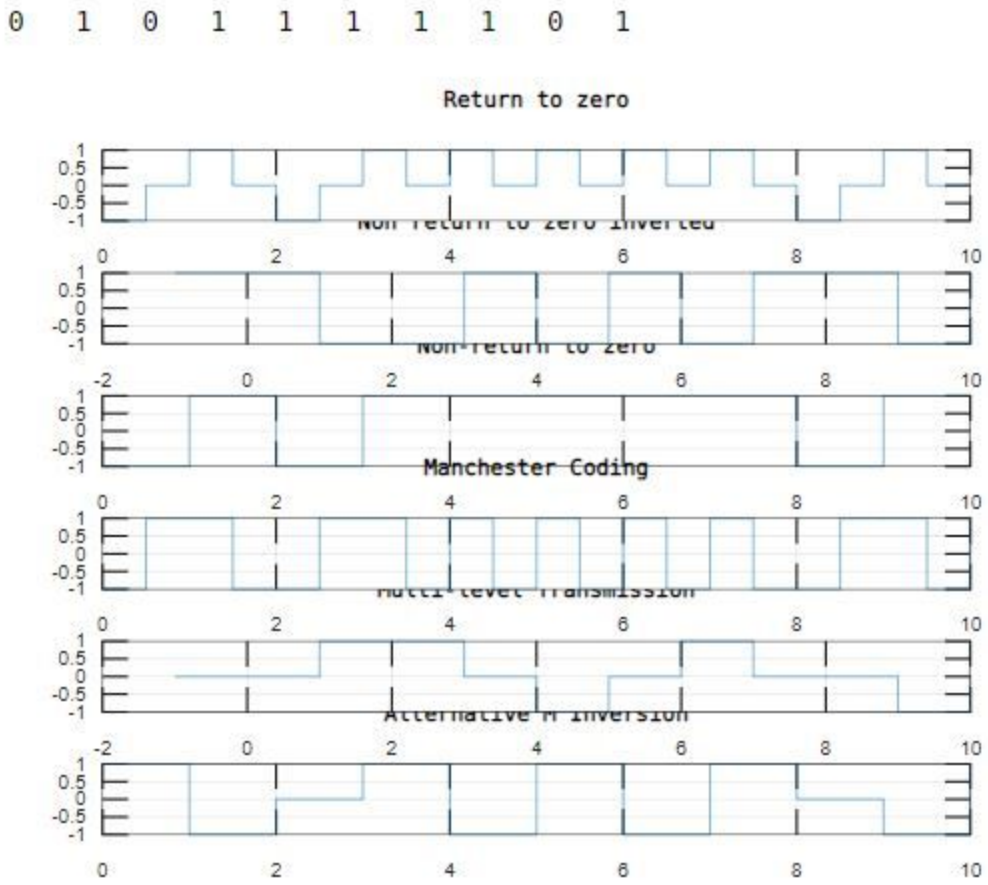
* **Figures**



* **Which type of signal has the highest bandwidth? Comment?**

Manchester codes requires the highest bandwidth of all the line codes, Manchester codes say that every single bittime will have a transition in the middle of the bit time, so that a receiver could find that transition, and "lock on" to the signal again, if it started to stray away from center.

* **Mention the advantages and disadvantages of each line code?**

Unipolar Non-Return to Zero (NRZ)

Advantages

- It is simple.
- A lesser bandwidth is required.

Disadvantages

- No error correction done.
- Presence of low frequency components may cause the signal droop.
- No clock is present.
- Loss of synchronization is likely to occur (especially for long strings of 1s and 0s).

Unipolar Return to Zero (RZ)

Advantages

- It is simple.
- The spectral line present at the symbol rate can be used as a clock.

Disadvantages

- No error correction.
- Occupies twice the bandwidth as unipolar NRZ.
- The signal droop is caused at the places where signal is non-zero at 0 Hz.

Polar NRZ

Advantages

- It is simple.
- No low-frequency components are present.

Disadvantages

- No error correction.
- No clock is present.
- The signal droop is caused at the places where the signal is non-zero at 0 Hz.

Polar RZ

Advantages

- It is simple.
- No low-frequency components are present.

Disadvantages

- No error correction.
- No clock is present.
- Occupies twice the bandwidth of Polar NRZ.
- The signal droop is caused at places where the signal is non-zero at 0 Hz.

Bipolar Signaling

Advantages

- It is simple.
- No low-frequency components are present.
- Occupies low bandwidth than unipolar and polar NRZ schemes.
- This technique is suitable for transmission over AC coupled lines, as signal drooping doesn't occur here.
- A single error detection capability is present in this.

Disadvantages

- No clock is present.
- Long strings of data causes loss of synchronization.

Signal	Comments
NRZ–L	Non-return to zero level. This is the standard positive logic signal format used in digital circuits. 1 forces a high level 0 forces a low level
NRZ–M	Non return to zero mark 1 forces a transition 0 does nothing
NRZ–S	Non return to zero space 1 does nothing 0 forces a transition
RZ	Return to zero 1 goes high for half the bit period 0 does nothing
Biphase–L	Manchester. Two consecutive bits of the same type force a transition at the beginning of a bit period. 1 forces a negative transition in the middle of the bit 0 forces a positive transition in the middle of the bit
Biphase–M	There is always a transition at the beginning of a bit period. 1 forces a transition in the middle of the bit 0 does nothing
Biphase–S	There is always a transition at the beginning of a bit period. 1 does nothing 0 forces a transition in the middle of the bit
Differential Manchester	There is always a transition in the middle of a bit period. 1 does nothing 0 forces a transition at the beginning of the bit
Bipolar	The positive and negative pulses alternate. 1 forces a positive or negative pulse for half the bit period 0 does nothing

*** Mention the advantages and disadvantages of 2 other line codes?**

CDI

The CDI(Conditioned Diphase Interface) bipolar line code is actually a slightly different form of the original FM line coding used in single-density disk drives and audio cassette tapes. Marks are encoded as alternate polarity full period pulses. Spaces are encoded by half a period at the negative voltage and half period at the positive voltage. This coding scheme has the advantage that it requires less logic to implement than HDB3.

Differential Manchester

Differential Manchester encoding, also called biphase mark code (BMC) or FM1, is a line code in which data and clock signals are combined to form a single 2-level self-synchronizing data stream. It is a differential encoding, using the presence or absence of transitions to indicate logical value. It has the following advantages over some other line codes:

- A transition is guaranteed at least once every bit, allowing the receiving device to perform clock recovery.
- Detecting transitions is often less error-prone than comparing against a threshold in a noisy environment.
- Unlike with Manchester encoding, only the presence of a transition is important, not the polarity.

- Differential coding schemes will work exactly the same if the signal is inverted (wires swapped). (Other line codes with this property include NRZI, bipolar encoding, coded mark inversion, and MLT-3 encoding).
- If the high and low signal levels have the same voltage with opposite polarity, coded signals have zero average DC voltage, thus reducing the necessary transmitting power and minimizing the amount of electromagnetic noise produced by the transmission line.

Code