Coding Techniques for different Data Formats and FSK - Modulation and Demodulation

Object:- (a) Encode the given binary data into the following Formats using the given Trinity kit model CS-1223Tx :-

1) Non-Return to Zero Formats: NRZ-L, NRZ-M and NRZ-S
2) Phase Encoded Formats : Biphase-L, Biphase-M and Biphase-S
3) Alternate Mark Inversion Format : AMI

(b) Use the encoded data format NRZ-L as the modulating signal, generate the FSK signal.

(c) Recover the Data from the FSK signal generated above by demodulation using the Trinity CS-1223 Rx kit.

Apparatus Used :- 1. Trinity Data Format Trainer Kits model 1223 Tx and Rx.
2. A Dual Trace CRO (20 MHz)

Brief Description of the Kit, CS-1223 Tx :-

The kit CS-1223 Tx consists of the following six sections:-

1 **Clock and Data Generator Section**, providing Clock-S and Data-S at its outputs.
2 **Data Formats Generator Section** having two inputs CLK-In and DATA-In, and six outputs for different Data formats. (NRZ-M & NRZ-S are available at NRZ-M/S output, selected by the two-way switch SW-1).
3 **Carrier Generator Section**, providing three sinusoidal signals:2 MHz, 1 MHz (0^o) and 1 MHz (180^o), to be used as carrier signals for different modulation schemes such as FSK, etc.
4 **Carrier Modulation Section** having three inputs (control input for modulating signal, Input-1 and Input-2 for carrier) and one output providing the modulated signal.
5 **Unipolar to Bipolar converter**, and
6 **Bipolar to Unipolar converter**

The kit **CS-1223 Rx** is for decoding of the encoded formats and demodulation of the FSK .

THEORY:-

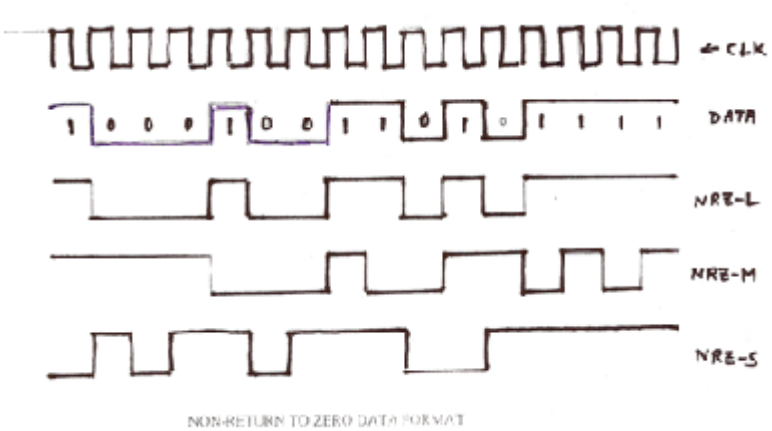
1. The Non-Return to Zero Formats:

a) NRZ-L :- Here all ‘ones’ are represented by high and all ‘zeroes’ by low levels.

b) NRZ-M :- All ‘ones’ are marked by the change in level, and all zeroes by no transition.

c) NRZ-S :- All ‘ones’ by no transition, and all zeroes by change in level.

The above encoded signals in Non Return to Zero Formats are shown in the following figure:-



NON-RETURN TO ZERO DATA FORMAT

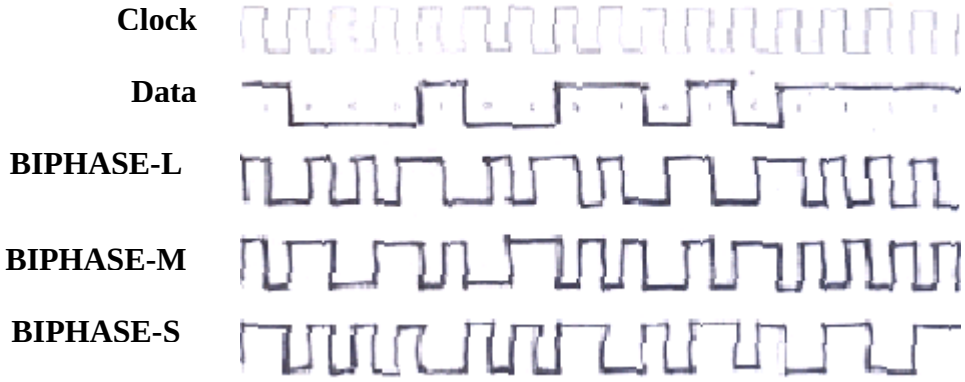
2. Phase Encoded Formats :-

Biphase-L:- 'One is represented by half bit wide pulse positioned during the first half of the bit interval and a 'zero' by half bit wide pulse positioned during the second half of the bit interval. This type of coding is also known as Manchester coding.

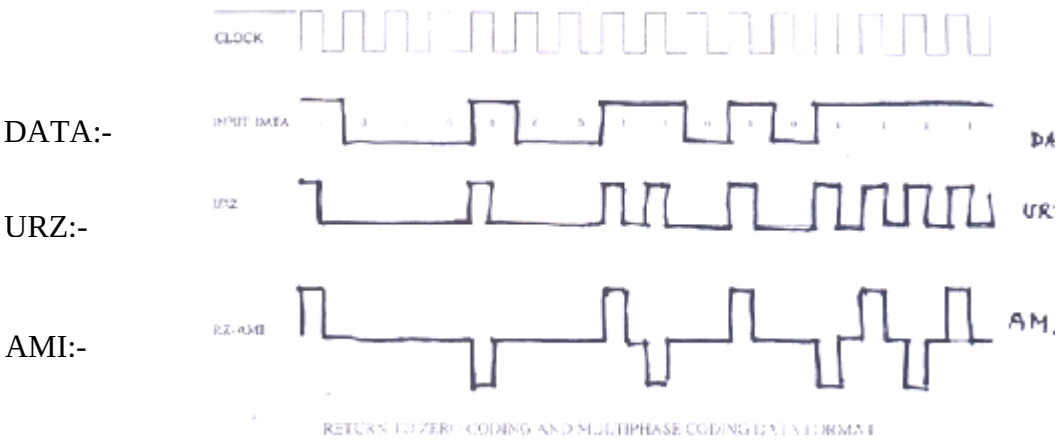
Biphase-M:- In this type of coding, a transition occurs at beginning of every bit interval, and a 'one' is represented by a second transition at half bit later, whereas a 'zero' has no second transition.

Biphase-S :- Here also, a transition occurs at beginning of every bit interval, but a 'zero' is marked by a second transition occurring at one half bit later and 'one' has no second transition.

The waveforms for this type of coding are shown in the following figure:-

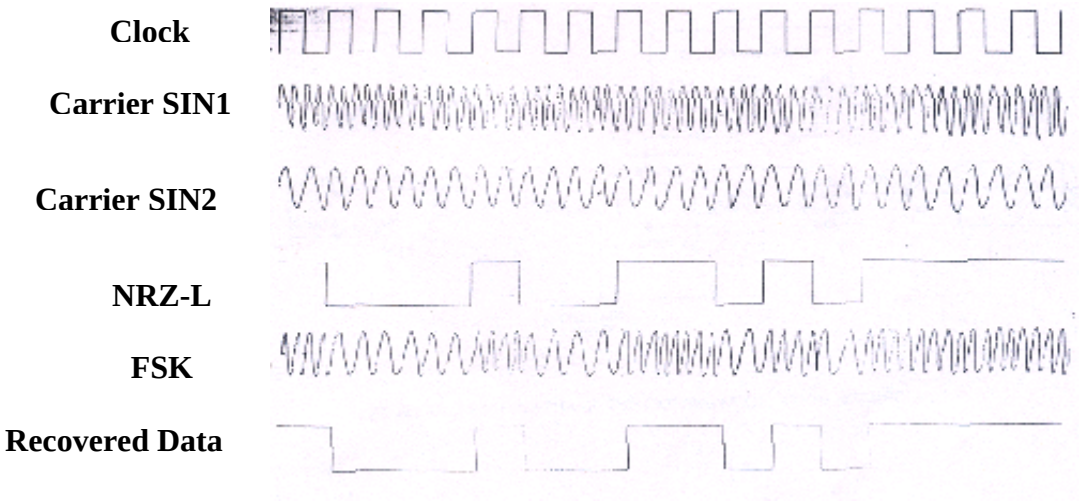


3. Alternate Mark Inversion Format, AMI :- This is a multi-level coding technique, in which the binary digits 'ones' and 'zeroes' are represented by three or more voltage levels, instead of the normal two levels 'High' and 'Low'. In this technique 'ones' are represented by equal amplitudes of alternating pulses, which alternate between a +5 V and -5V. These alternating pulses return to 0 volt, after every half bit interval. The 'zeroes' are represented by absence of pulses. This technique of data encoding finds its application in Telemetry. The following figure shows the waveforms for AMI :-



4. FSK and its Demodulation:-

FSK (frequency shift keying), is a technique of modulation in which the frequency of the carrier shifts to some other value on the occurrence of the 'High' level of binary modulating signal, and returns to its original value on the occurrence of the 'Low' level of the binary modulating signal. By demodulation, the data is recovered. The FSK waveforms are shown in the following figure:-



PROCEDURE :-

(a) For Data coding techniques:-

After turning ON the kit, Observe the Clock and the data on CRO, connect them to their corresponding inputs in "Data Formats Generator Section".

Observe NRZ-L, AMI, Biphase-L at the terminals marked with their names.

Observe NRZ-M and NRZ-S at the terminal marked NRZ-M/S and select M & S by the switch, SW-1.

Similarly observe Biphase-M and Biphase-S at the terminal marked Biphase-M/S and select M & S by the switch, SW-1.

(b) For FSK:-

Connect NRZ-L to the control input of Carrier modulation section, and view it on one-channel of CRO.

Connect 2 MHz carrier to Input-1 and 1 MHz (0^o) carrier to Input-2 of the Carrier modulation section.

Observe FSK signal at the FSK output, and note the appearance of the two frequencies corresponding to the High and Low levels on the CRO screen. Trace the FSK waveform.

(b) Recovery of Data from FSK:-

Use another kit CS-1223 Rx and connect the grounds of both the kits together.

Connect the FSK from Tx kit to FSK IN input terminal in the FSK Demodulator section on the Rx kit.

Observe the recovered Data (NRZ-L) at the demodulator output terminal and view it on one channel of the CRO, whereas view the modulating signal (NRZ-L on Tx kit) on the other channel of the CRO..

Trace the two signals.

Note that a small phase lag exists between the modulating data and the recovered data because of the limitation of the tracking ability and the time response of the PLL (used in the demodulator section in the Rx kit).

Report:- Discuss the decoding techniques for different coded data formats. Comment on your results and give reasons for justification of any assumption or argument.