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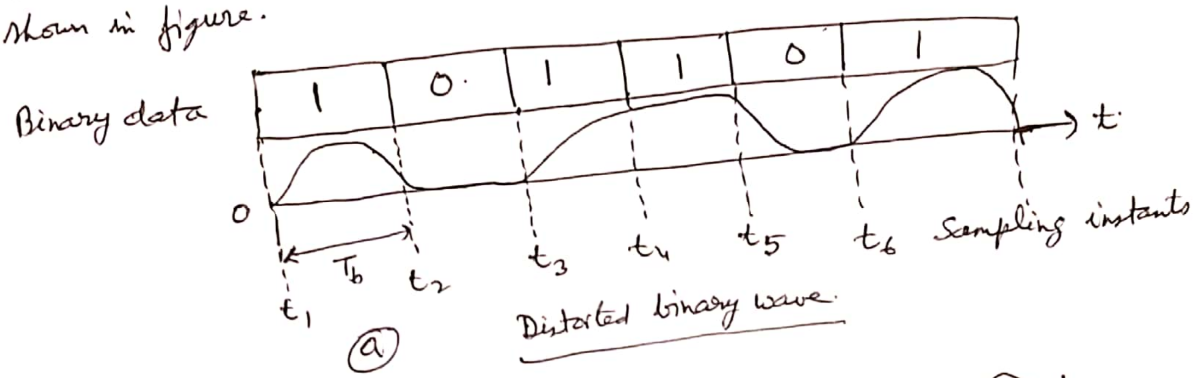
Eye Pattern Technique.

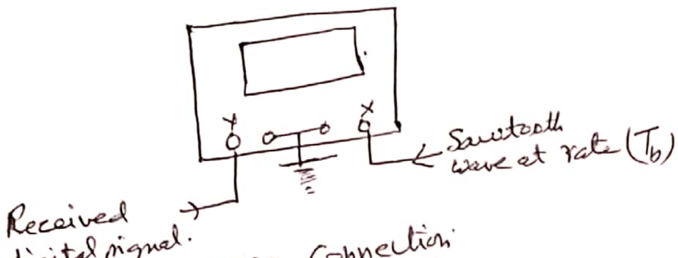
Eye Pattern Technique :- Eye pattern is a pattern displayed on the screen of a CRO. The shape of this pattern resembles with the shape of human eye. Hence, it is known as eye pattern. Eye pattern is a practical way to study the intersymbol interference (ISI) and its effects on a PCM or data communication system. The eye-pattern technique is a simple but powerful measurement method for assessing the data-handling ability of a digital transmission system. This method has been used extensively for evaluating the performance of wire systems. and can also be applied to optical fiber data links.

The eye-pattern measurement are made in the time domain and allow the effects of waveform distortion to be shown immediately on an CRO.

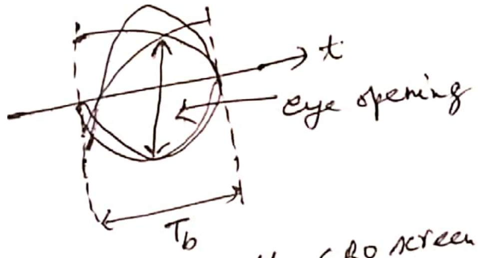
The eye pattern is obtained on the CRO interference by applying the received signal to vertical deflection plate (Y-plates) of the CRO and a sawtooth wave at the transmission symbol rate i.e. $(\frac{1}{T_b})$ to the horizontal deflection plates (X-plates) as shown in figure.



Distorted binary wave



CRO Connection



(c) Eye-pattern seen on the CRO screen.

The received digital signal and the corresponding oscilloscope display have been shown in figure (a). The resulting oscilloscope display shown in figure (c) is called as the eye pattern. The interior region of the eye pattern is known as the eye opening.

Some key features of this pattern include the following:

(1) The opening (height) and width of the eye

(2) The 20-to-80 percent rise and fall times

(3) Overshoot on logic one and zeros.

(4) Undershoot on a logic zero.

(5) Jitter (eye jitter) in the eye pattern

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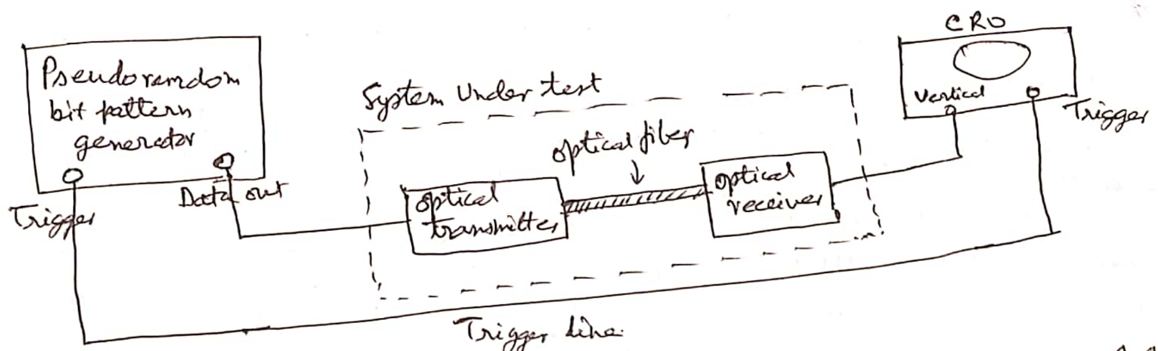

The word Pseudorandom means that the generated combination or sequence of ones and zeros will eventually repeat but that it is sufficiently ~~rando~~ random for test purposes.

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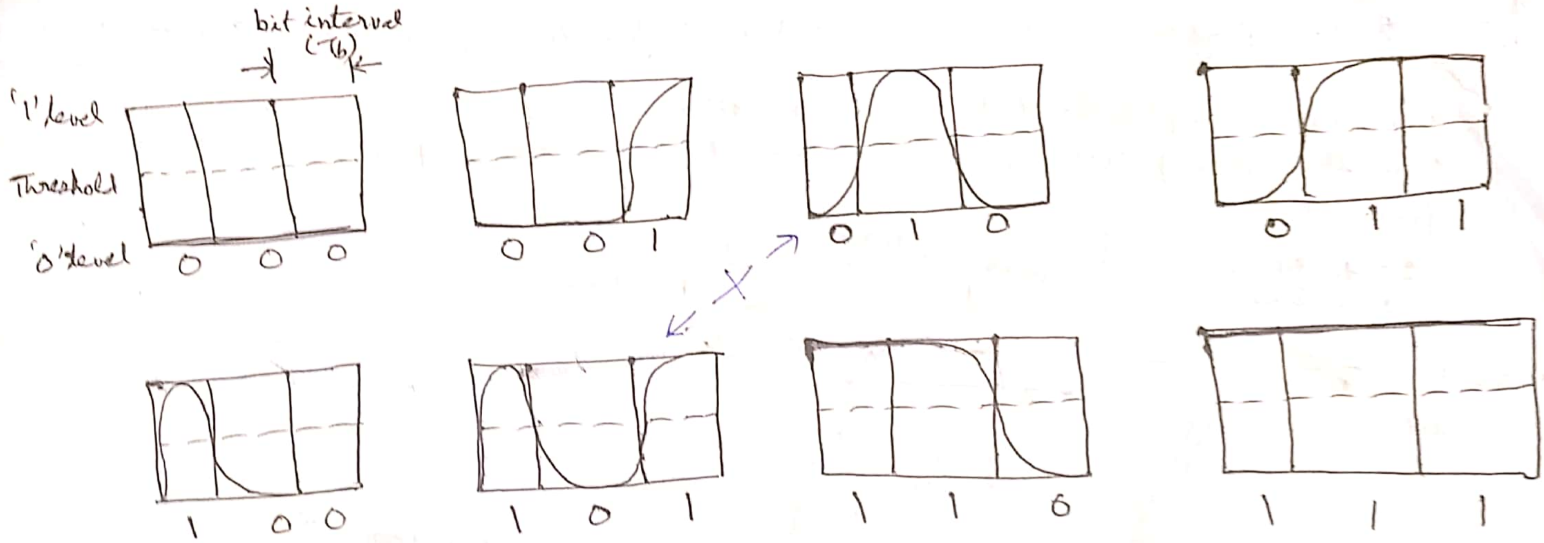
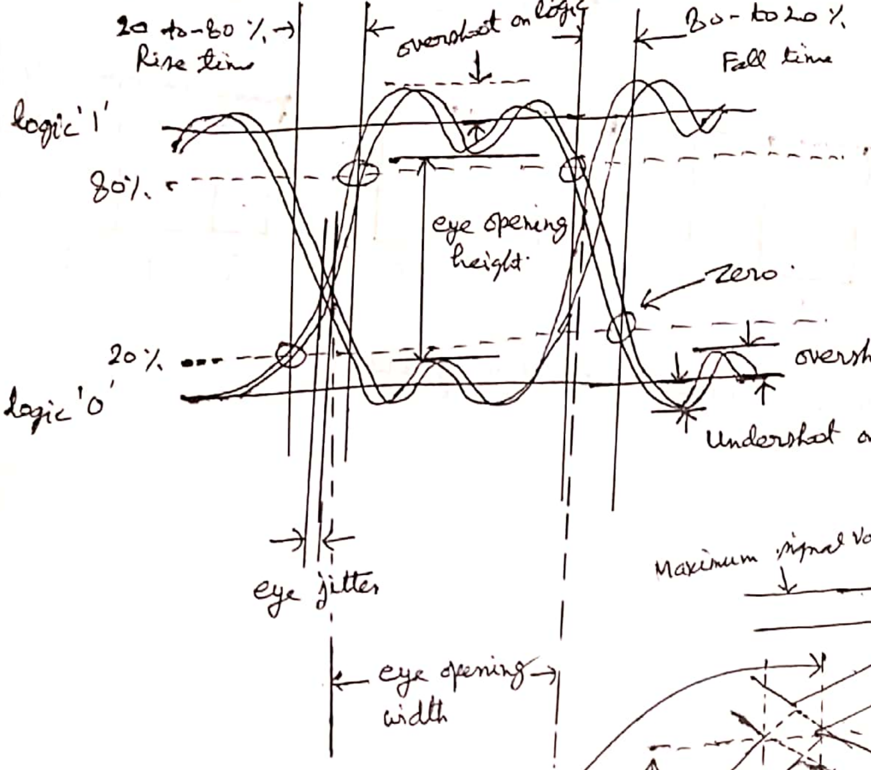
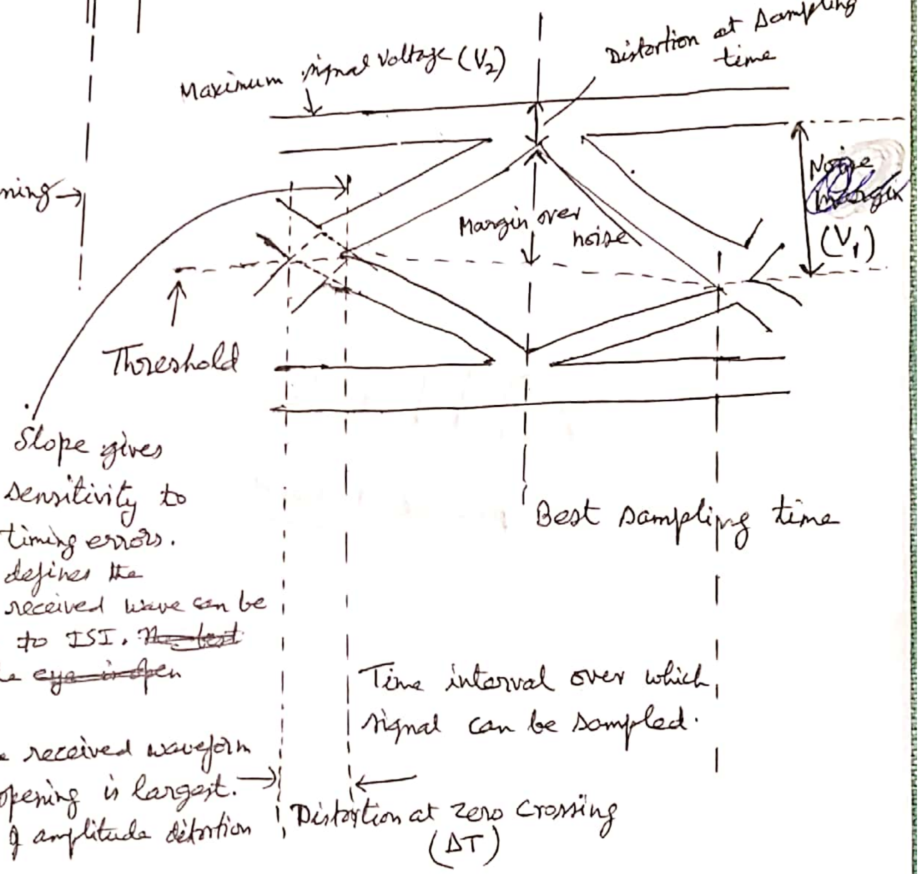


Eight possible 3-bit long NRZ combination of pulses.

System performance information obtained from the eye pattern :- The following information regarding the (1) signal amplitude distortion (2) timing jitter and (3) system rise time can be derived from the eye pattern shown in figure ( ) and the simplified drawing shown in figure ( ).





(1) The width of the eye opening defines the time-interval over which the received wave can be sampled, without an error due to ISI. ~~The best time for sampling is when the eye is open widest~~.

(2) The best time to sample the received waveform is when the height of the eye opening is largest. This height is reduced as a result of amplitude distortion in the data signal.

(3) The vertical distance between the top of the eye opening and the maximum signal level gives the maximum distortion.

(4) The more the eye closes, the more difficult it is to distinguish between ones and zeroes in the signal.

(5) When the effect of ISI is severe, the eye is completely closed and it is impossible to avoid errors due to the combined presence of ISI and noise in the system.

(6) Noise margin is the percentage ratio of the peak signal voltage for an alternating bit sequence (defined by the height of the eye opening) to the maximum signal voltage V_2 as measured from the threshold level, i.e.

$$\text{Noise margin } (\%) = \frac{V_1}{V_2} \times 100\ \%.$$

increase in the BER.

(7) The height of eye opening at a specified sampling time defines the margin over noise. Closing of the eye is a measure of degradation in receiver performance and is associated with a corresponding

(8) ~~In this scheme, the laser~~ The sensitivity of the system to the timing error is determined by the rate of closure of the eye as the sampling rate is varied.

(9) Timing jitter or edge jitter or phase distortion in an optical fiber system arises from noise in the receiver and pulse distortion in the optical fiber. If the signal is sampled in the middle of the time interval (i.e midway between the times when the signal crosses the threshold level), then the amount of distortion ΔT at the threshold level indicates the amount of jitter. Timing jitter is thus given by

$$\text{Timing jitter}(\%) = \frac{\Delta T}{T_b} \times 100\ \%$$

where T_b is a bit interval.

(10) The rise-time is defined as the time interval between the point where the rising edge of the signal reaches 10% to 90% of its final amplitude.

However, when measuring optical signals, these points are often obscured by noise and jitter effect. Thus, the more distinct values at the 20% and 80% threshold points are normally measured.

To convert from the 20 to 80 percent rise time to a 10-to-90 percent rise time, the relationship are given by

$$\boxed{T_{10-90} = 1.25\ T_{20-80}}$$

Similarly, we can determine the fall time.

(11) Any nonlinearities of the channel transfer characteristics will create an asymmetry in the eye pattern.

If a purely random data stream is passed through a purely linear system, all the eye openings will be identical and symmetrical.

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