Lab 4

EYE PARTTERNS

INTRODUCTION:

In this experiment yon will be introduced to some important aspects of pulse transmission which are relevant to digital and data communication applications. Issues of interest include:

In the 1920s Harry Nyquist proposed a clever method now known as Nyquist's first criterion, that makes possible the transmission of telegraphic signals over channels with limited bandwidth without degrading signal quality. This idea has withstood the test of time. It is very useful for digital and data communications. The method relies on the exploitation of pulses that look like sin(x)/x - see the Figure opposite. The trick is that zero crossings always fall at equally spaced points. Pulses of this type are known as 'Nyquist I' (there is also Nyquist II and I).

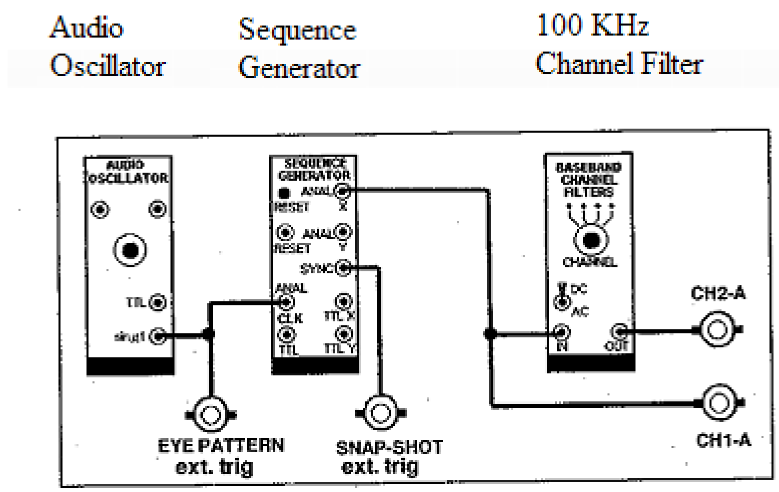
In practical communication channels distortion causes the dislocation of the zero crossings of Nyquist pulses, and results in intersymbol interference ISI. Eye patterns provide a practical and very convenient method of assessing the extent of IS1 degradation. A major advantage of eye patterns is that they can he used 'on-line' in real-time. There is no need to interrupt normal system operation.

The effect of IS1 becomes apparent at the receiver when the incoming signal has to be 'read' and decoded; ie., a detector decides whether the value at a certain time instant is, say, 'HI' or 'LO' (in a binary decision situation). A decision error may occur as a result of noise. Even though IS1 may not itself cause an error in the absence of noise, it is nevertheless undesirable because it decreases the margin relative to the decision threshold, ie., a given level of noise, that may be harmless in the absence ISI, may lead to a high error rate when ISI is present.

Another issue of importance in the decision process is timing jitter. Even if there is no IS1 at the nominal decision instant, timing jitter in the reconstituted bit clock results in decisions being made too early or too late relative to the ideal point. As you will discover in this experiment, channels that are highly bandwidth efficient are more sensitive to timing jitter.

STEPS:

EXTRA MODULES: 100 KHZ CHANNEL FILTER,



1. A convenient rate to start with 2KHz. Select CHANNEL#1. Select a short sequence.
2. Synchronize the oscilloscope to the 'start-of-sequence' synchronizing signal from the SEQUENCE GENERATOR, set the sweep speed to display between 10 and 20 sequence pulses. This is the 'snap shot' mode. Both traces should be displaying the same picture, since CHANNEL#1 is a 'straight through' connection.
3. Adjust 100KHz CHANNEL FILTER for Channel #1, #2, #3
4. For the Channel #4, using a sinusoidal output from an AUDIO OSILLATOR as a test input:
   Set the TUNE and GAIN control of the TUNEABLE LPF fully clockwise. Select the NORM bandwidth mode.
   Set the AUDIO OSILLATOR to a frequency of 1KHz . This is well within the current filter passband.
   Note the output amplitude on the oscilloscope.
   Increase the frequency of the TUNEABLE LPF until the output amplitude fall 100 times.
   This is a 40 dB reduction relative to the passband gain.
5. **Record your assessment of the maximum practical data rate through each of the four channels . Figure1. from CHANNEL #1. Figure2. from CHANNEL #2 Figure3. from CHANNEL #3. Figure4. from CHANNEL #4, and describe what you observe.**
6. Change the oscilloscope synchronize signal from the start-of –sequence SYNC output of the SEQUENCE GENERATOR to the sequence bit clock. Increase the sequence length. Make sure the oscilloscope is set to pass DC.
   There are no difference if try AC coupling.

7. Select CHANNEL#2, Use a data rate of about 2 KHz. You should have a display on CH-2A similar to that of “Figure 3” below. **Check and print the output as Figure 3 and describe what you observe.**
8. Increase the data rate until the sys starts to close. “Figure 4” shows an eye not nearly as clearly defined as that of Figure 3. **Check and print the output as Figure 4 and describe what you observe.**
9. Take some time to examine the display, and consider what it is you are looking at.
10. Determine the highest data rate for which you consider you would always be able to make the correct decision. Note that the actual moment to make decision will be the same for each of the fore filters.

ACHIEVEMENTS:

Understanding the Nyquist 1 criterion; transmission rate via bandlimited channels; comparison of the ‘snap-shot’ display with the ‘eye patterns’.

Reference: D1-02-4 on Volume D1 Fundamental Digital Experiment

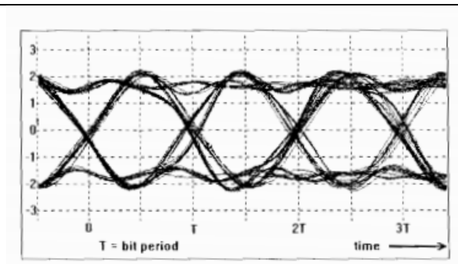


Figure 3: a ‘good’ eye pattern

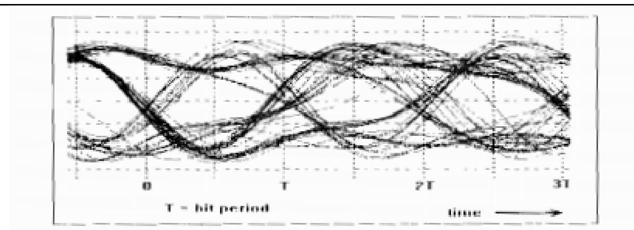


Figure 4: compare with Figure 3; a faster data rate

Certification: I hereby certify that performance of the experiment above and the writing of this report was entirely by me (or by me and my lab partner). I understand that if this certi fication is false, I am in violation of Academic Honesty rules and may be subject to serious penalty in accordance with those rules.

Signature ______________________________________Date______________