CHAPTER 4

RESULTS & DISCUSSION

4.1.1 Results & Discussion

This chapter includes prototype interface and discussion of the result being done throughout the process. This will also include the data calculation and waveform being derived in lab. Future recommendation of the project and its effectiveness towards infrared transmission will also be discussed.

4.1.2 Infrared transmission

In this project data transmission is being conduct using infrared in PWM (Pulse Width Modulation).Infrared signal generated is immune to electromagnetic wave but vulnerable to any light source that contain infrared component. The on off process of the photodiode will determine data being transmitted.

4.1.3 Pulse Width Modulation (infrared)

The process is called pulse duration modulation or pulse length modulation, as the width of a constant amplitude pulse is varied proportional to the amplitude of the analog signal at the time the signal is sampled. The maximum analog signal amplitude produces the widest pulse and the minimum analog signal amplitude produces the narrowest pulse. All pulse have the same amplitude.

4.2 Pulse Width Modulation (infrared) Mouse derive from Oscilloscope

Figure 4.2.1: Mouse Transmitter/Receiver waveform vertical angle movement

Transmitter Receiver

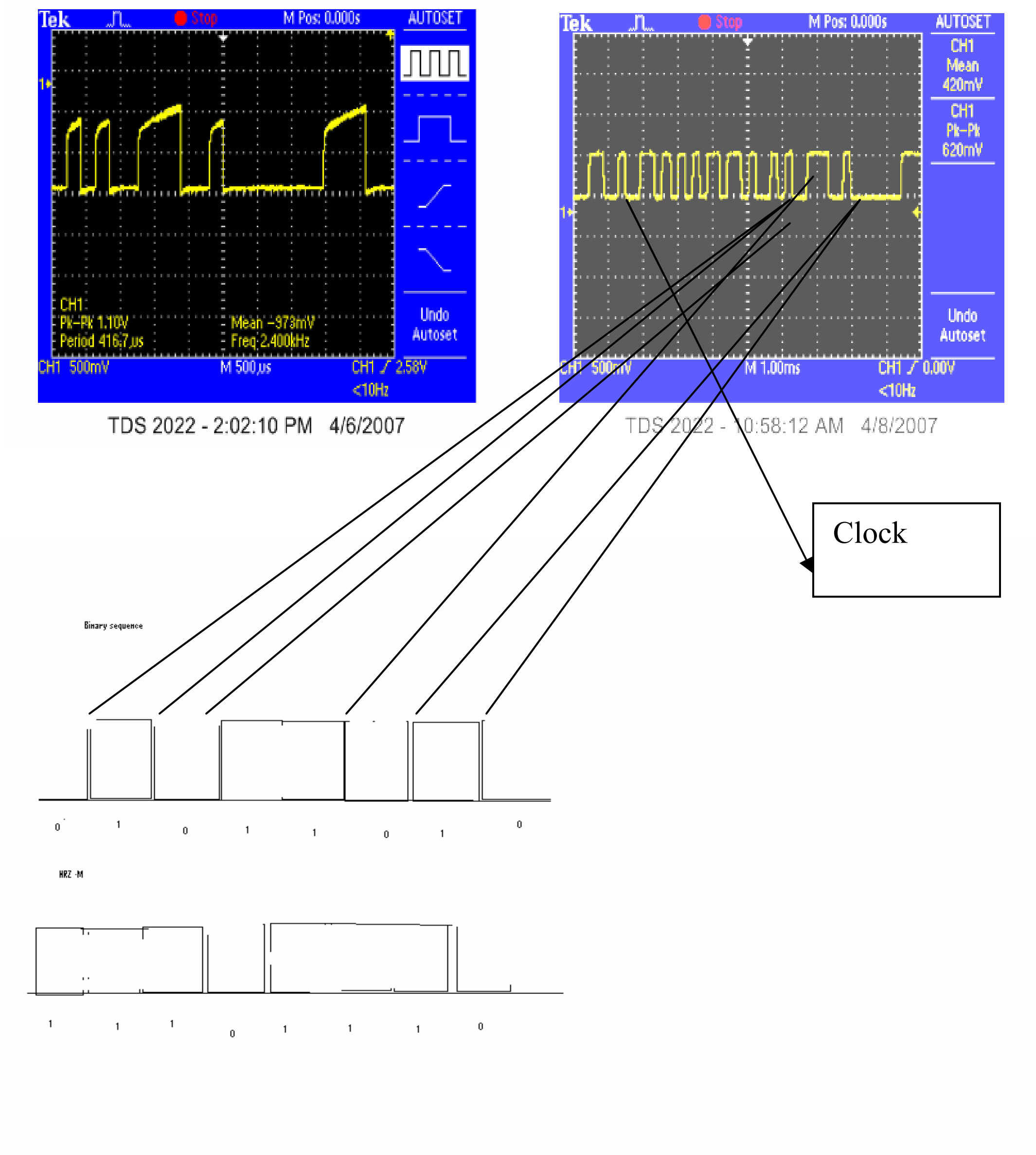


Figure 4.2.2: Mouse Transmitter/Receiver theoretical waveform vertical angle movement. .Top represents the binary, bottom represent NRZ-M

4.2 Pulse Width Modulation (infrared) Mouse derive from Oscilloscope

Figure 4.2.3: Mouse Transmitter/Receiver waveform right movement

Transmitter Receiver

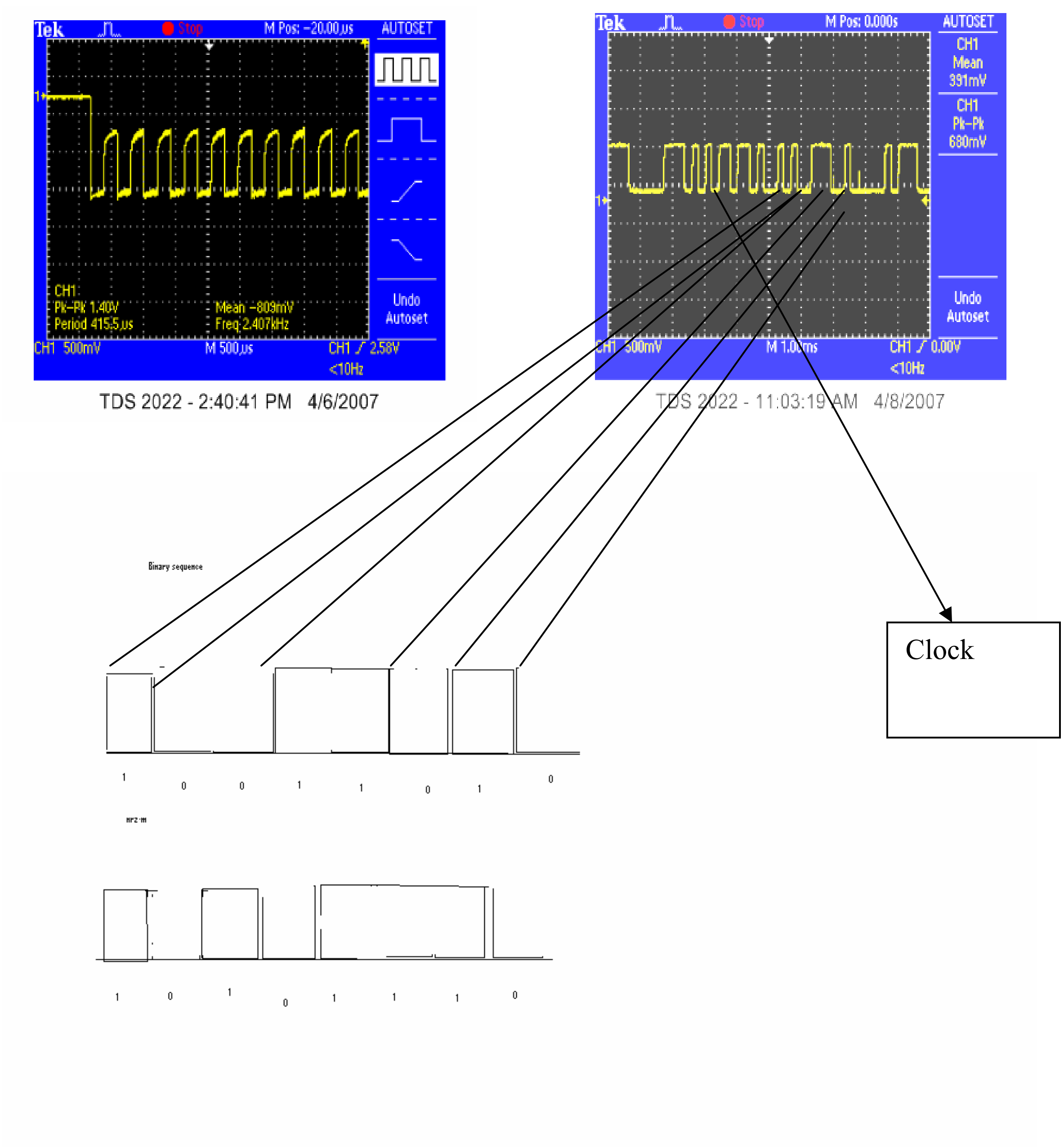


Figure 4.2.4: Mouse Transmitter/Receiver theoretical waveform right movement. Top represents the binary, bottom represent NRZ-M

4.2 Pulse Width Modulation (infrared) Mouse derive from Oscilloscope

Figure 4.2.5: Mouse Transmitter/Receiver waveform backward movement

Transmitter Receiver

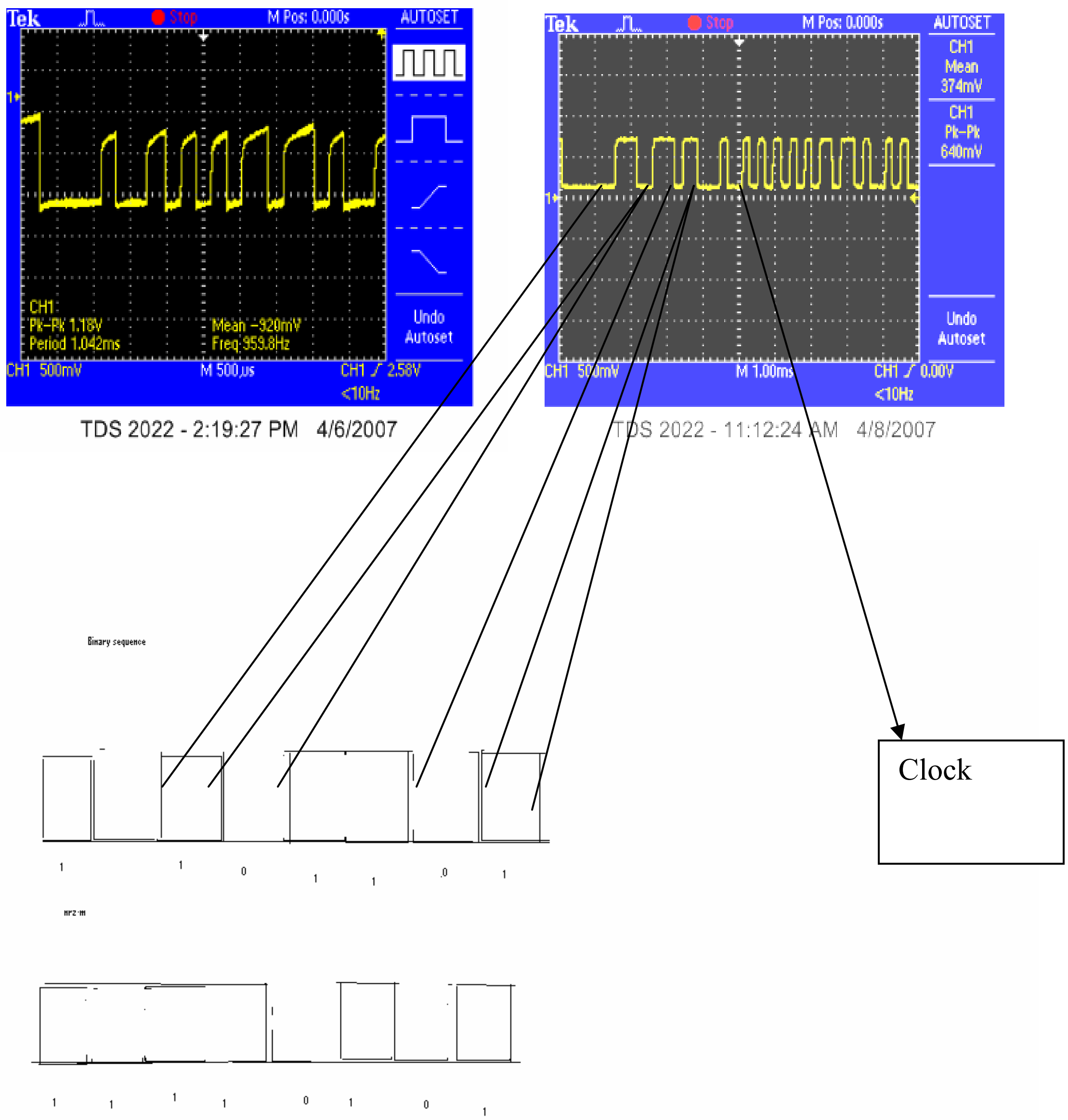


Figure 4.2.6: Mouse Transmitter/Receiver theoretical waveform backward movement. Top represents the binary, bottom represent NRZ-M

4.2 Pulse Width Modulation (infrared) Mouse derive from Oscilloscope

Figure 4.2.7: Mouse Transmitter/Receiver right click.

Transmitter   Receiver

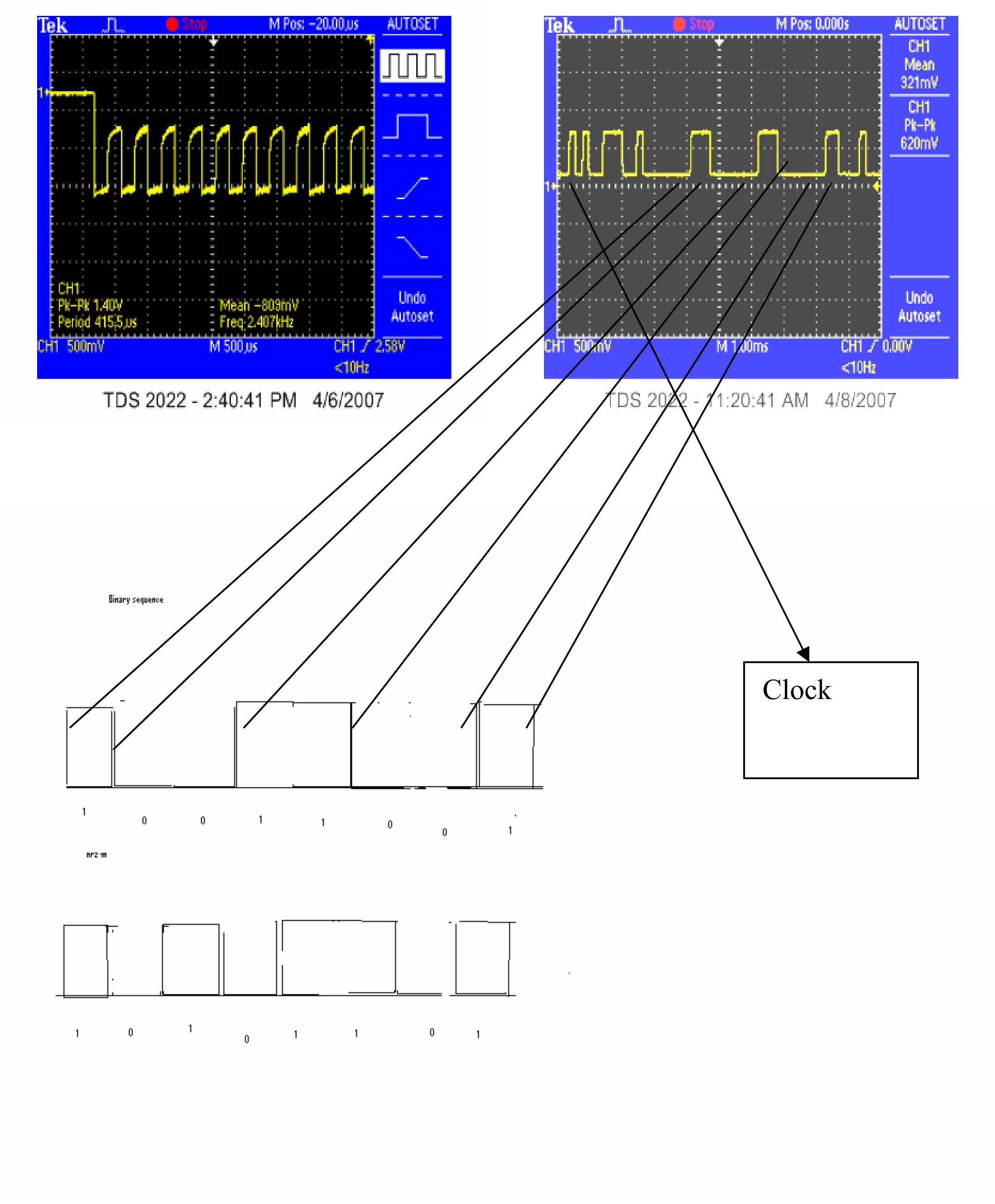


Figure 4.2.8: Mouse Transmitter/Receiver theoretical waveform right click movement. Top represents the binary, bottom represent NRZ-M

4.2.2 Data Conclusion for Mouse Waveform

Data conclusion The data received by the receiver will then be amplified by the direct amplifier by a gain of two. As through observation of the oscillator the peak to peak voltage of the receiver is half of the transmitter.

The current of the transmitter and the receiver is too small to be measured as it is estimated to be 0.0 something mili amperes

The transfer rate of the photodiode is estimated to 1.6 ms per bit. This is done by observing the time cycle of the oscilloscope .Estimation is started when the pattern of the graph first appear and ended when the pattern disappear and remains the normal rate clock pulse.

4.3 Pulse Width Modulation (infrared) Keyboard derive from Oscilloscope

Note: **Yellow waveform represents the transmitter waveform**
Blue waveform represents the receiver waveform

Figure 4.3.1: Letter L

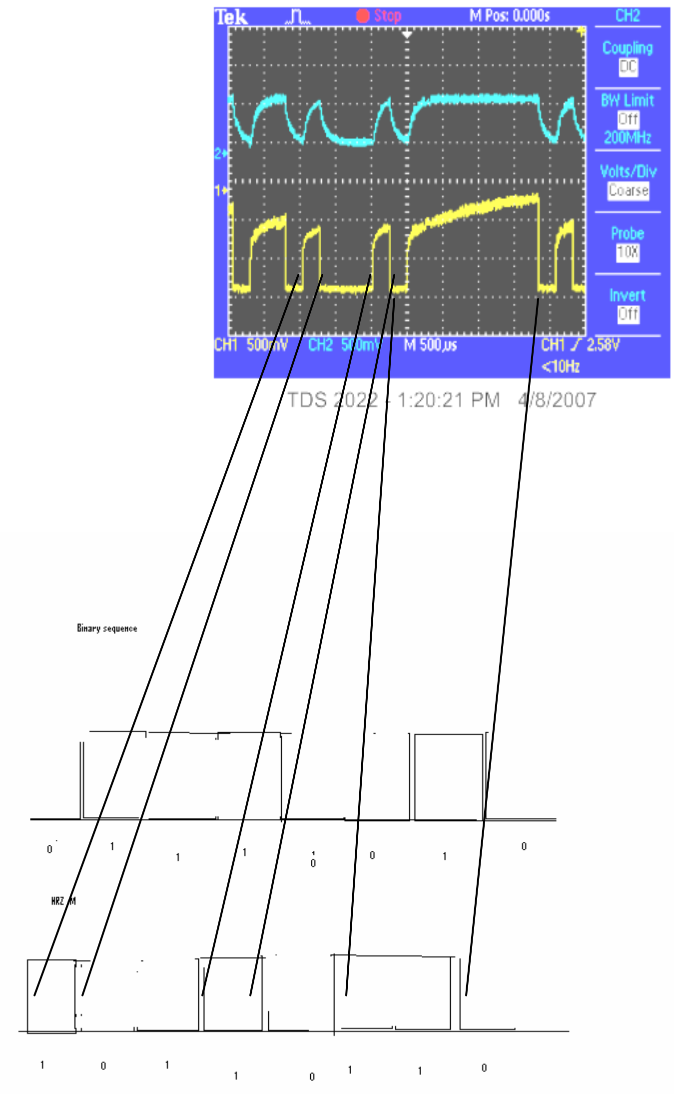


Figure 4.3.2: Letter L
Top represents the binary, bottom represent NRZ-M

4.3 Pulse Width Modulation (infrared) Keyboard derive from Oscilloscope

Note: **Yellow waveform represents the transmitter waveform**
Blue waveform represents the receiver waveform

Figure 4.3.3: Letter k

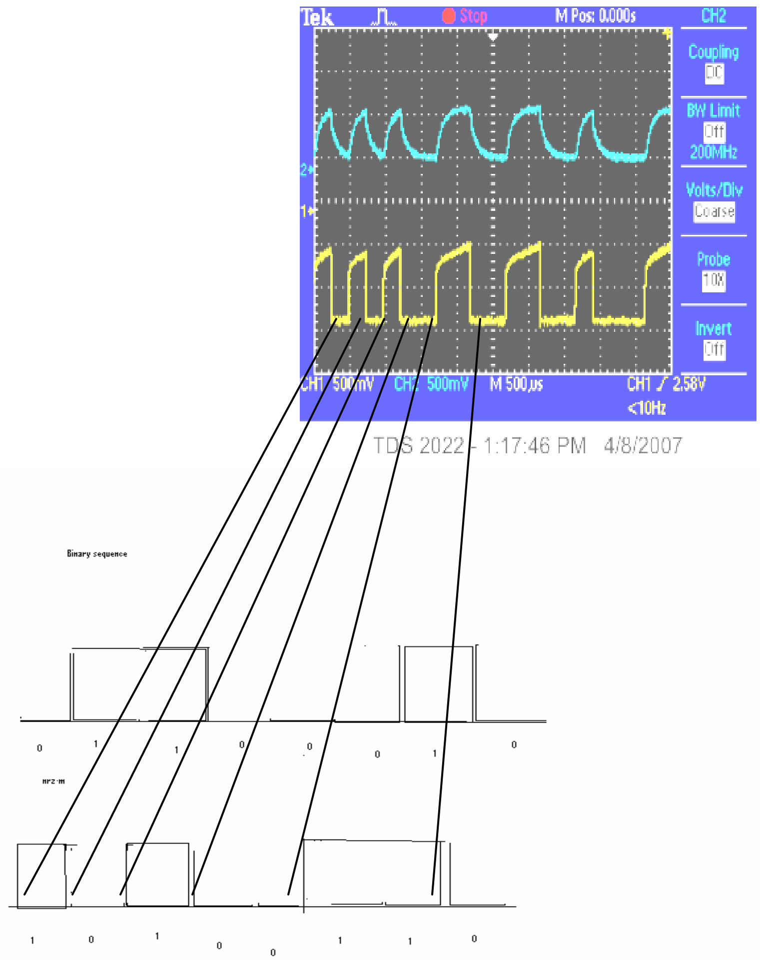


Figure 4.3.4: Letter k
Top represents the binary, bottom represent NRZ-M

4.3 Pulse Width Modulation (infrared) Keyboard derive from Oscilloscope

Note: **Yellow waveform represents the transmitter waveform**
Blue waveform represents the receiver waveform

Figure 4.3.5: Letter d

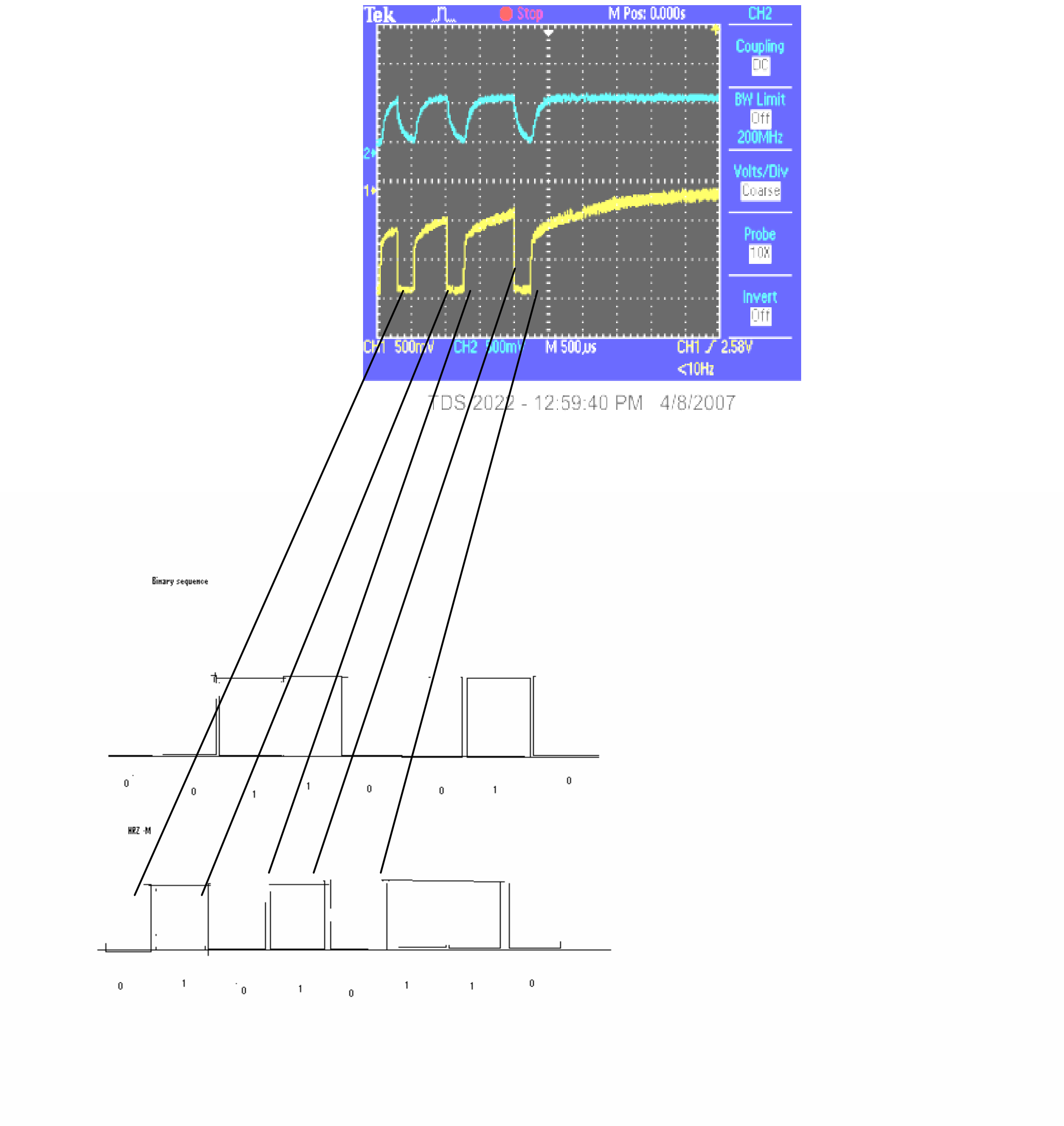
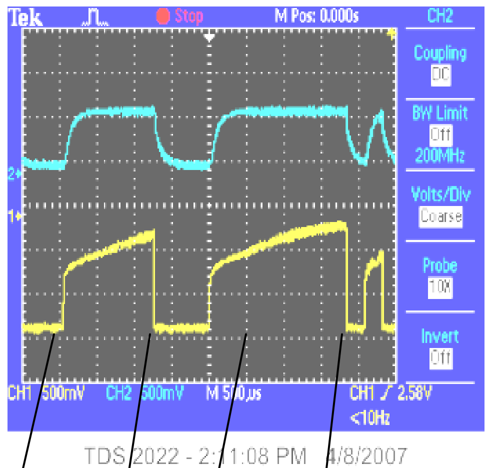


Figure 4.3.6: Letter d
Top represents the binary, bottom represent NRZ-M

4.3 Pulse Width Modulation (infrared) Keyboard derive from Oscilloscope

Note: **Yellow waveform represents the transmitter waveform**
Blue waveform represents the receiver waveform

Figure 4.3.7: Number 3



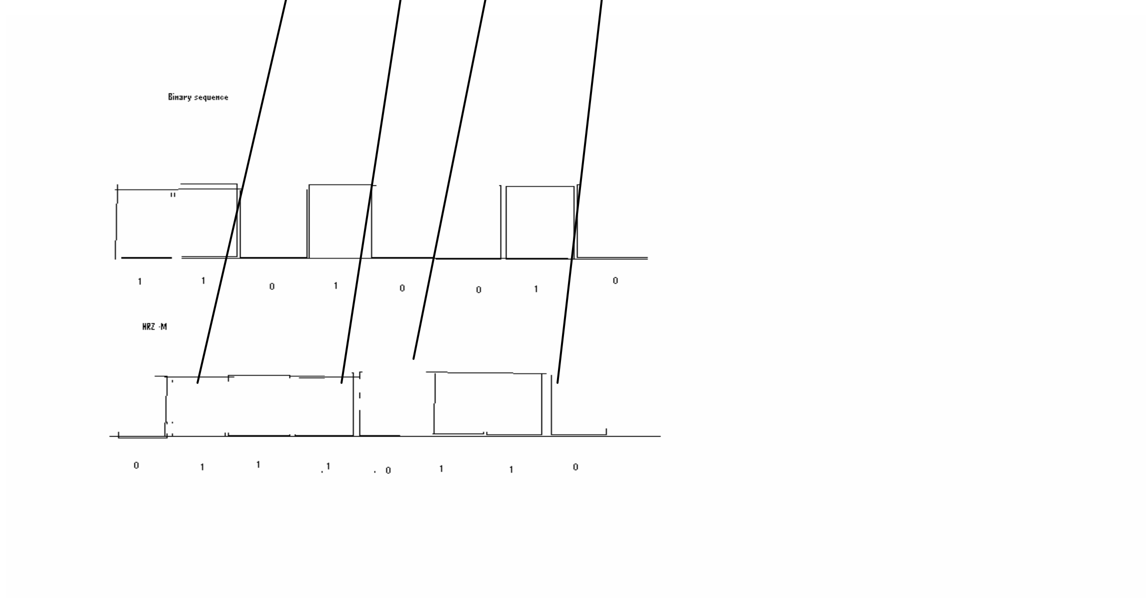
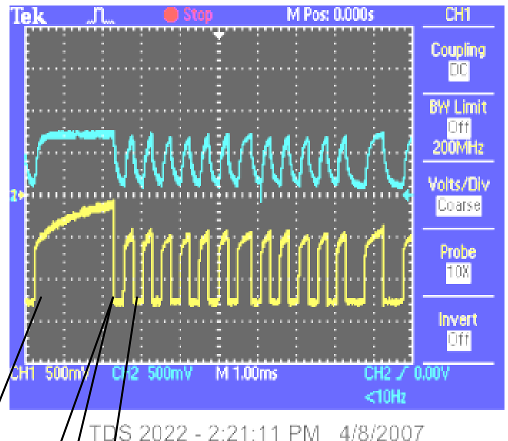


Figure 4.3.8: Letter 3
Top represents the binary, bottom represent NRZ-M

4.3 Pulse Width Modulation (infrared) Keyboard derive from Oscilloscope

Note: **Yellow waveform represents the transmitter waveform**
Blue waveform represents the receiver waveform

Figure 4.3.9: Number 7



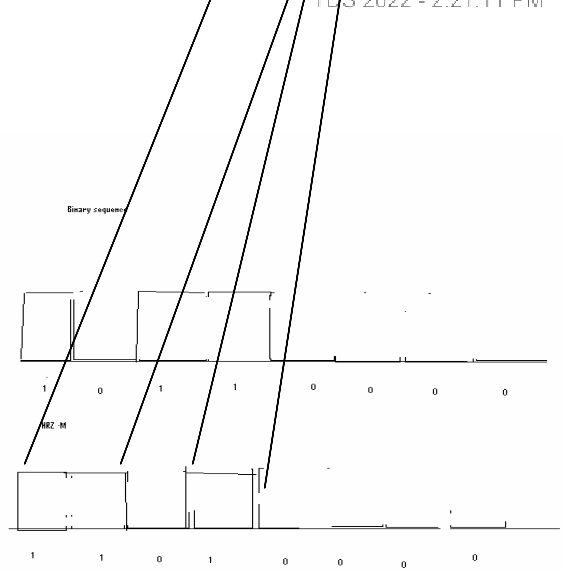


Figure 4.3 .10: Letter 7
Top represents the binary, bottom represent NRZ-M

4.3 Pulse Width Modulation (infrared) Keyboard derive from Oscilloscope

Note: **Yellow waveform represents the transmitter waveform**
Blue waveform represents the receiver waveform

Figure 4.3.11: CTRL

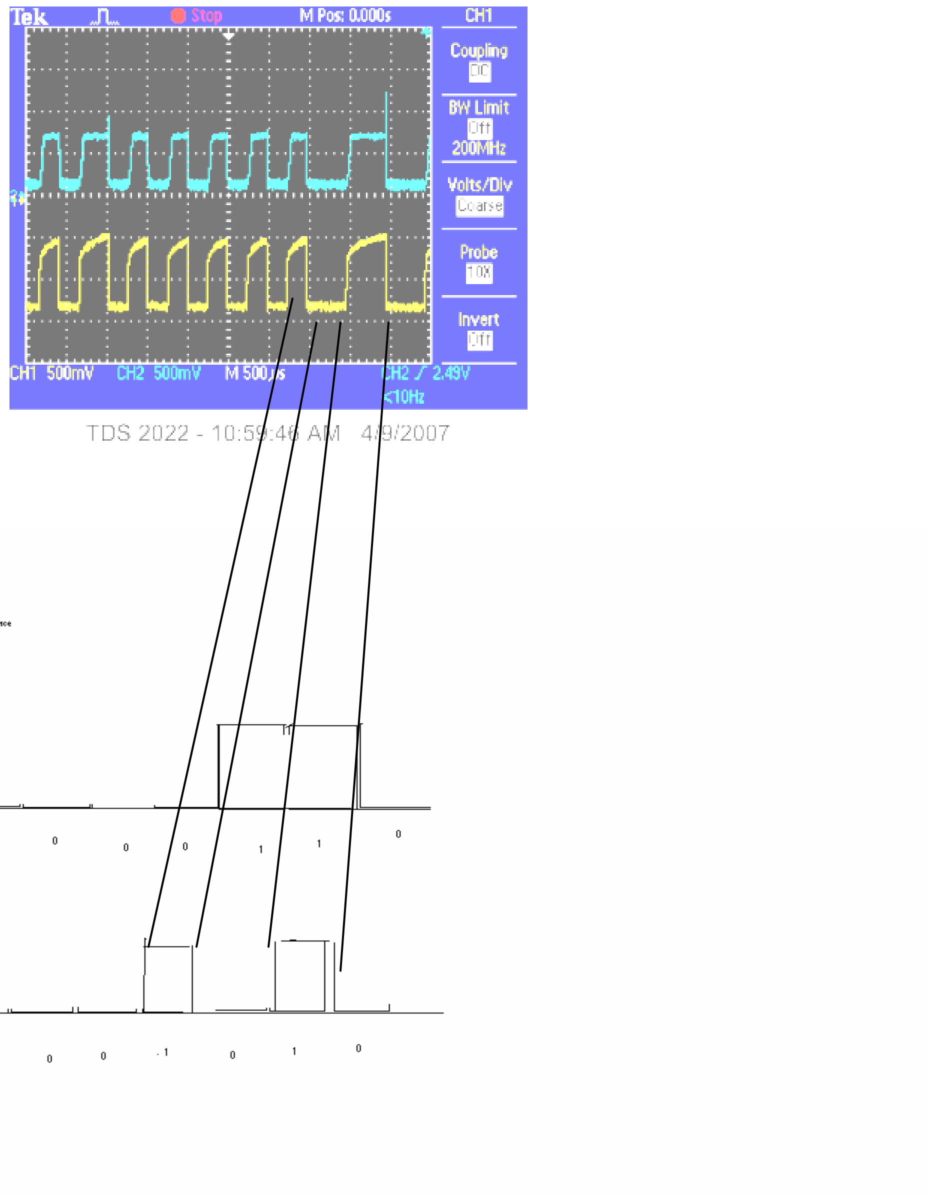
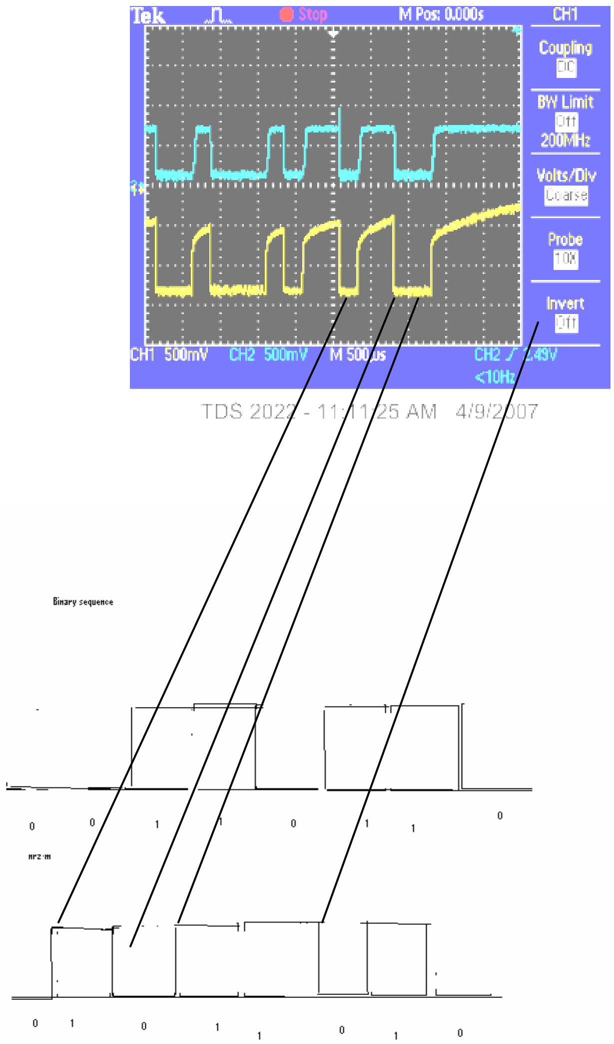


Figure 4.3 .12: CTRL
Top represents the binary, bottom represent NRZ-M

4.3 Pulse Width Modulation (infrared) Keyboard derive from Oscilloscope

Note: **Yellow waveform represents the transmitter waveform**
Blue waveform represents the receiver waveform

Figure 4.3.13: F2



: Figure 4.3 .14: F2

Top represents the binary, bottom represent NRZ-M

4.3 Noise which causes inaccurate data and distortion

Through the observation, overall of the graph present in the oscilloscope has spark and drizzling plots. These can be known as noise associated with the operation of the photodiode. There are two type of noise associated with infrared one is the flicker noise and the other is the shot noise .The two component o0f current that contribute to this noise are junction current and leakage current.

Through observation, the junction current causes shot noise while the leakage current causes thermal noise from the leakage resistance and flicker noise. After having measured the photodiode using the function generator when the device is in idle mode, derived that the thermal noise of the photodiode is 19 Hz

When the frequency of the function generator is increase more than 19Hz, the shot noise manipulate the signal. The S/N ratio of the infrared is defined as the ratio of photocurrent versus the number of electrons Signal rises linearly with the area of the photodiode, while vary at the square root of the area. Noise equivalent power occurs when the S/N ratio is equal to 1 and the band width is narrow between 1-10 Hz. The NEP varies inversely with the responsitivity of the photodiode. Thus NEP will be minimum at the peak wavelength and will increase slightly as the wavelength of the proton and electrons increase or decreases.

4.4 Transmission length for both keyboard and mouse

Transmission length of the keyboard being measured mechanical with an assistance of a wooden block is 19.4cm.

Transmission wavelength measure using the spectrum analyzer by pressing an arbitrary key of the keyboard is 790 nm

Reponses time of the photodiode is 0.05 ns (IRDA standard) for infrared photodiode .The value varies according to the infrared photodiode used and the kind of data being pressed.

Thus the rise time and fall time gap referring to the oscilloscope is approximated to 15µs fort any which is arbitrary press .Then the speed of the infrared is 790nm x 0.05ns,will equal 15800 m/per second .

The exact transmission length of the keyboard should be 15800 m/per second x 15µs equal to 0.237m

Comparison between the measured value mechanically for the keyboard 0.194m and mouse 0.235m and the calculated value 0.237m, the mean for both mouse and keyboard is 0.2145m .The value calculated is approximate to the value measured mechanically.