Lab 9

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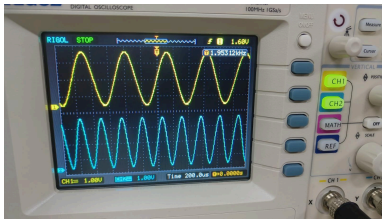
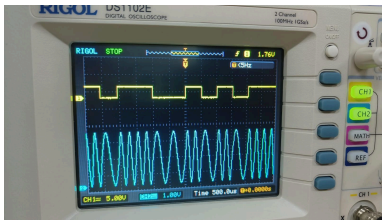
Frequency Shift Key:

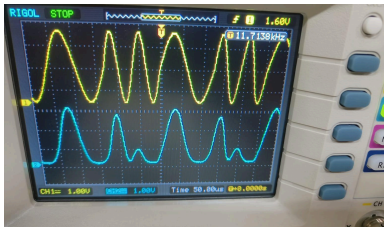
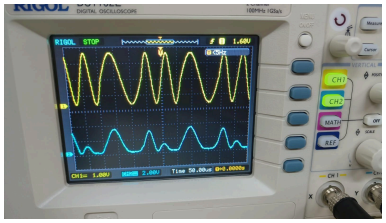
Experiment. 19:

Input Data Type	Clock Frequency	Channel	Output
8 Bit	2 Khz	CH1: Input Data (TP2) CH2: Encoded Input Data(TP28)	
8 Bit	2 Khz	CH1: Carrier signal F1(TP30) CH2: Carrier Signal F2 (TP29)	
8 Bit	2 Khz	CH1: Encoded Input Data (TP28) CH2: FSK Output (TP31)	

Conclusion:

1. The FSK modulator switches between two frequencies for binary 1 and 0.
2. Clear frequency changes at TP29 and TP30 correspond to logic 0 and 1.
3. FSK modulation is suitable for long-distance and low-noise data transmission.

Experiment. 20:

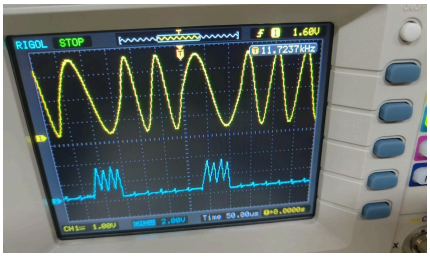
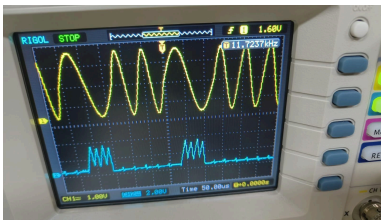
Input Data Type	Clock Frequency	Channel	Output
8 Bit	8 Khz	CH1: FSK output (TP31), CH2: multiplier out (TP34)	
8 Bit	8 Khz	CH1: FSK output (TP31), CH2: multiplier out (TP35)	

Conclusion:

1. The complex multiplier accurately modulates input data into FSK signals at different frequencies.
2. The multiplier output at TP34 and TP35 confirms the frequency modulation of binary data.

3. The process ensures effective frequency shifting based on the input data pattern.

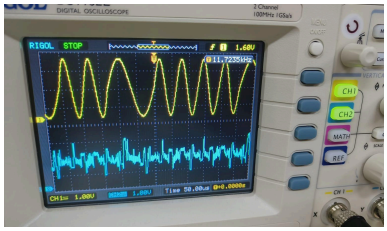
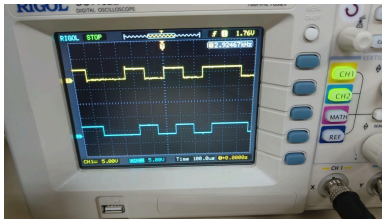
Experiment. 21:

Input Data Type	Clock Frequency	Channel	Output
8 Bit	8 Khz	CH1: FSK output (TP31), CH2: Integrator out (TP36)	
8 Bit	8 Khz	CH1: FSK output (TP31), CH2: Integrator out (TP37)	

Conclusion:

1. The integrator block successfully smooths the FSK signal by filtering out high-frequency noise.
2. Outputs at TP36 and TP37 verify the integration process.
3. This is essential for recovering clean signals before demodulation.

Experiment.22:

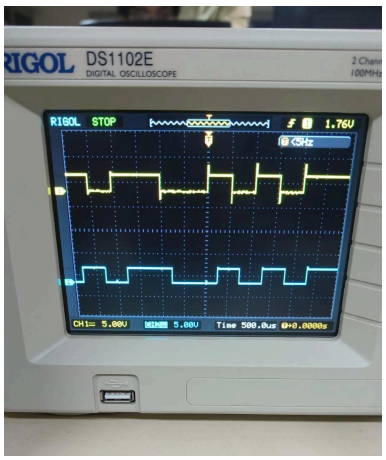
Input Data Type	Clock Frequency	Channel	Output
8 Bit	2 Khz	CH1: FSK output (TP31), CH2: Sigma out (TP38)	
8 Bit	8 Khz	CH1: input data(TP28), CH2: Comparator out (TP39	

Conclusion:

1. The comparator accurately recovers binary data from the integrated FSK signal by comparing the output against a threshold.
2. The output at TP39 confirms the comparison of the FSK signal.
3. The comparator plays a crucial role in finalizing the data recovery process.

Experiment. 23:

Input Data Type	Clock Frequency	Channel	Output
8 Bit	2 Khz	CH1: input data (TP28), CH2: demodulator out (TP39)	

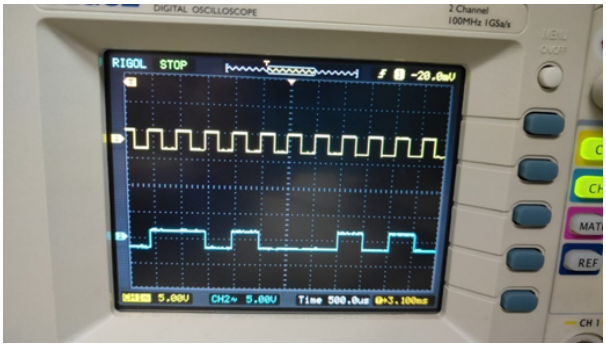
8 Bit	8 Khz	CH1: input data (TP28), CH2: demodulator out (TP39)	

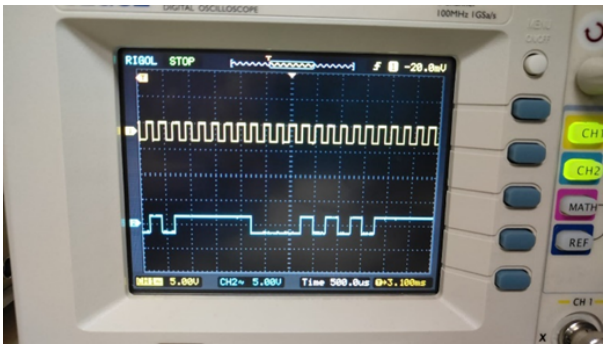
Conclusion:

1. The FSK demodulator successfully recovers binary data from frequency-shifted signals.
2. Outputs at TP27 demonstrate the accurate demodulation of FSK signals.
3. FSK demodulation is robust for low-noise, long-distance communication.

Quadrature Phase Shift Keying (QPSK):

Experiment 1:

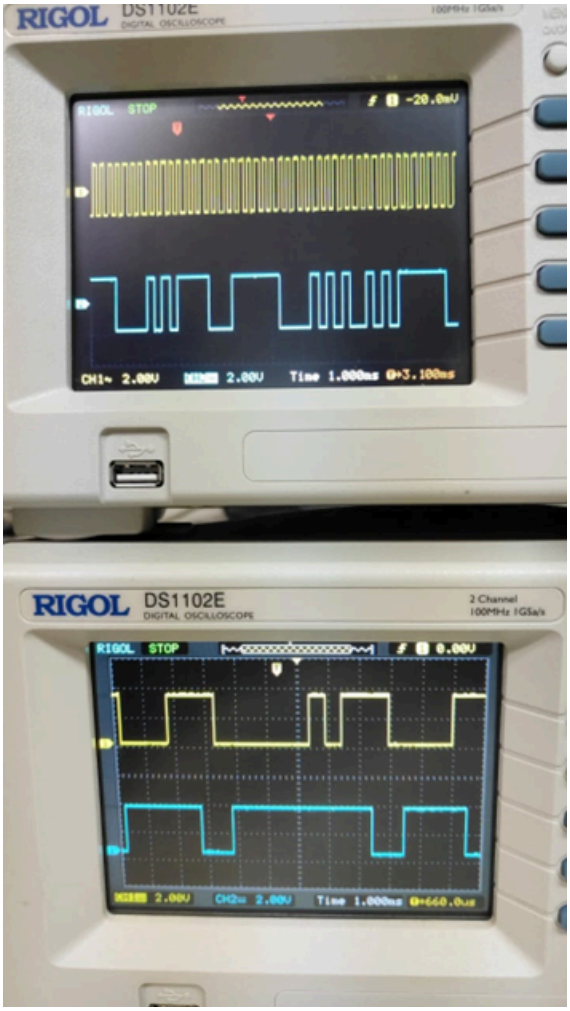
Data Bit	Data Rate	Channel	DSO Results
16 Bit	4KHz	D1: TP1 D7: TP2	
32 Bit	2KHz	D1: TP1 D7: TP2	

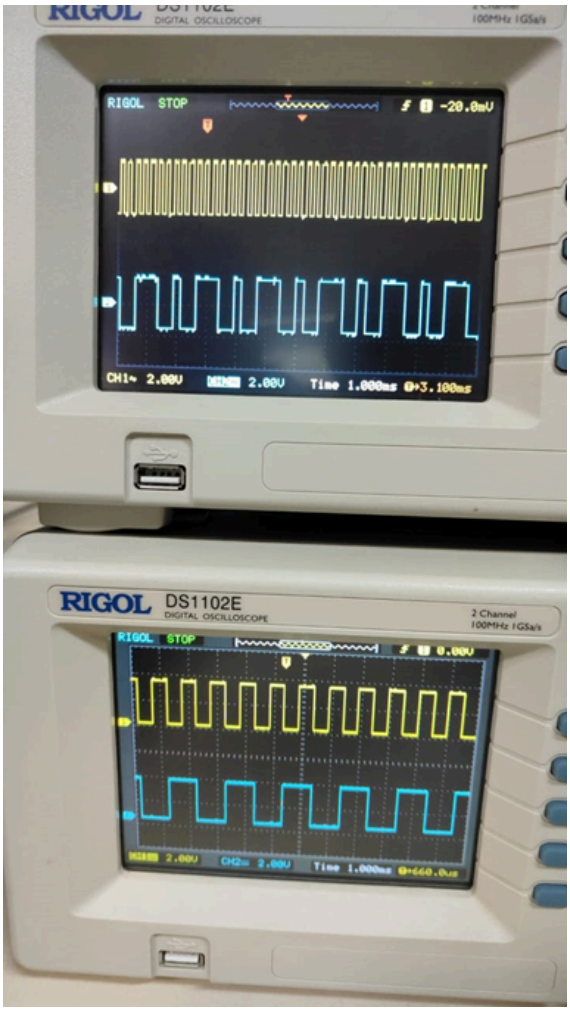
64 Bit	8KHz	D1: TP1 D7: TP2	

Conclusion:

1. Observed the selected bit pattern and data rate at test points TP1 and TP2.

Experiment 2:

Data Bit	Data Rate	Channel	DSO Results
16 Bit	4KHz	D1: TP1 D7: TP2 D10:TP19 D15: TP20	

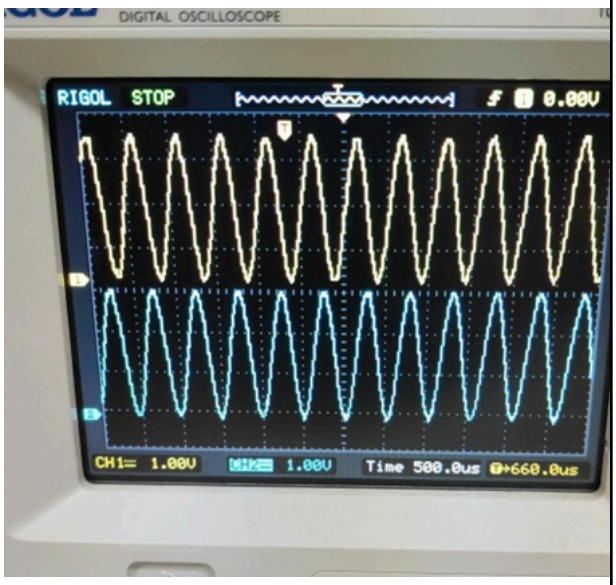
32 Bit	2KHz	D1: TP1 D7: TP2 D10:TP19 D15: TP20	

64 Bit	8KHz	D1: TP1 D7: TP2 D10:TP19 D15: TP20	

Conclusion:

1. Successfully demonstrated QPSK modulation and understood the 2-bit encoding process by observing the I-Channel and Q-Channel at TP3 and TP4.

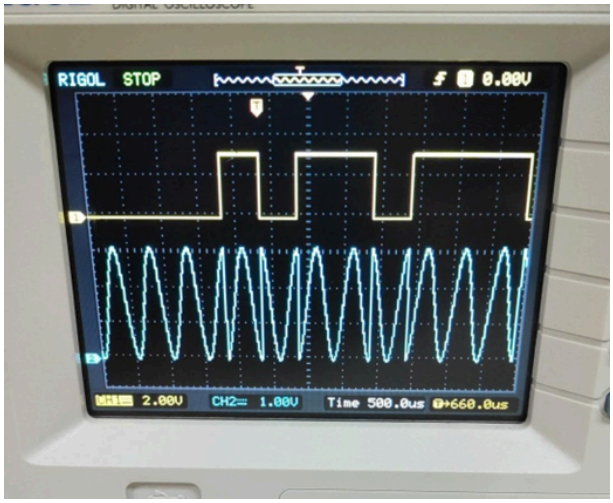
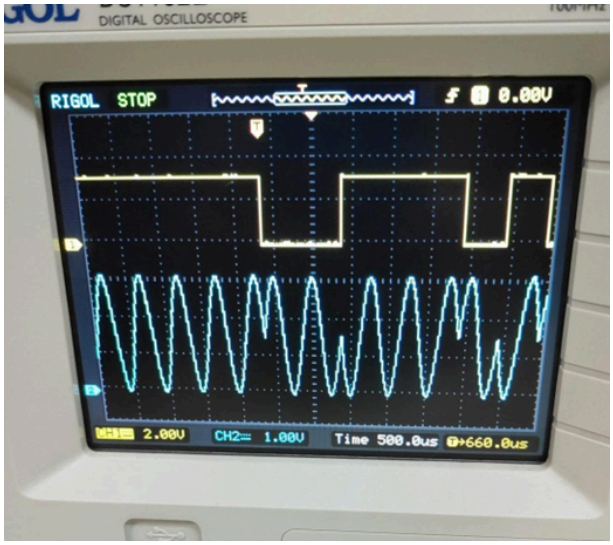
Experiment 3:

Channel	DSO Results
CH1: TP5 CH2: TP6	

Conclusion:

1. Successfully observed the I-Channel, Q-Channel, and carrier signals (sine and cosine).

Experiment 4:

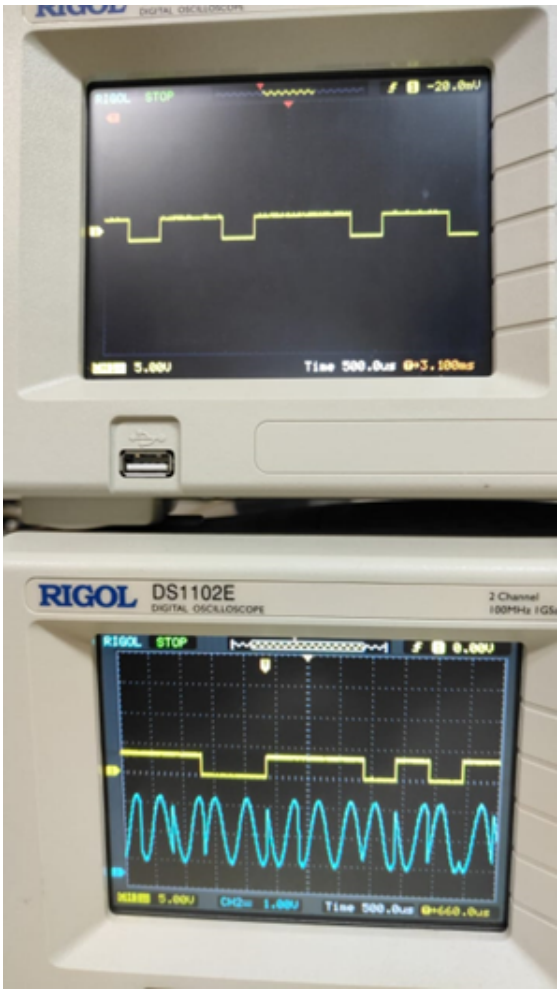
Data Bit	Data Rate	Channel	DSO Results
32 Bit	4KHz	CH1: TP3 CH2: TP7	
32 Bit	4KHz	CH1: TP4 CH2: TP8	

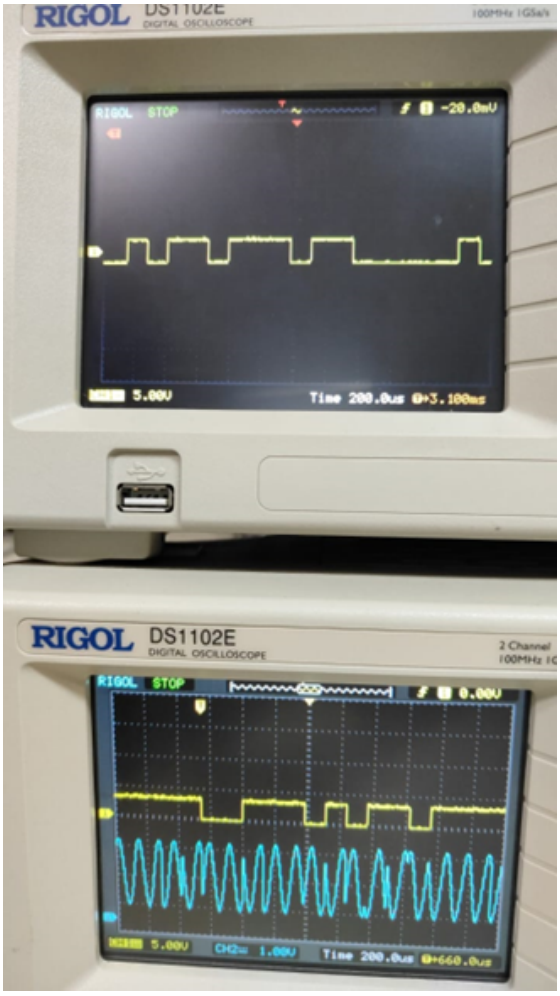
Conclusion:

1. I-Channel and Q-Channel modulation were successfully observed.
2. Modulated signals are influenced by both bit patterns and data rate changes.

Experiment 5:

Data Bit	Data Rate	Channel	DSO Results
8 Bit	16KHz	D1:TP3 D7:TP4 CH2:TP9	

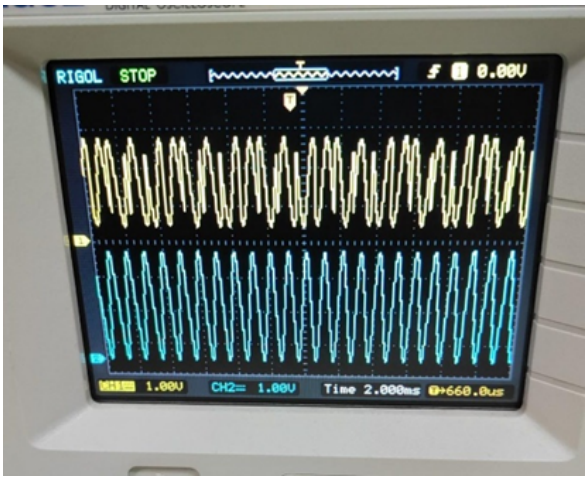
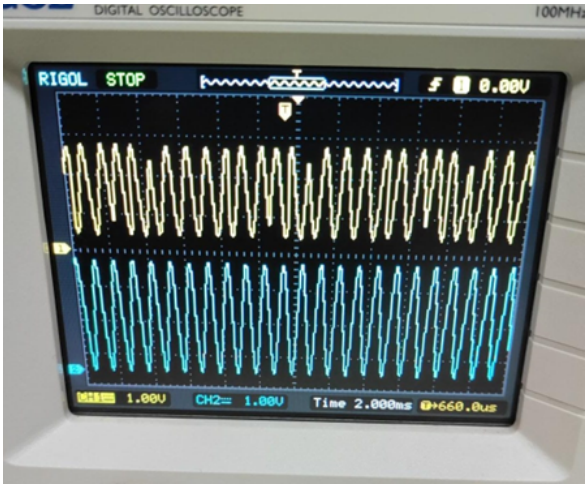
32 Bit	4KHz	D1:TP3 D7:TP4 CH2:TP9	

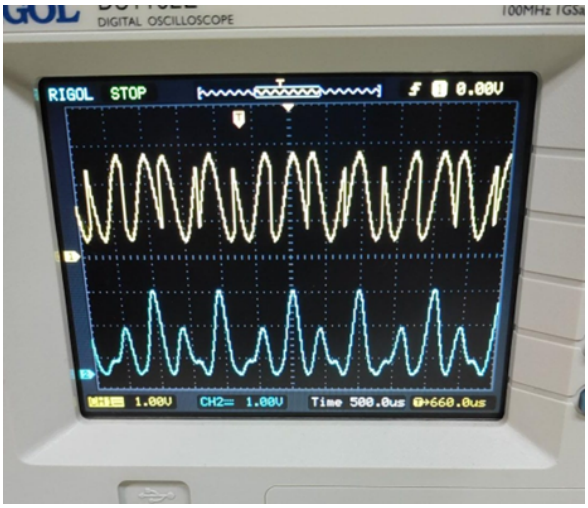
32 Bit	16KHz	D1:TP3 D7:TP4 CH2:TP9	

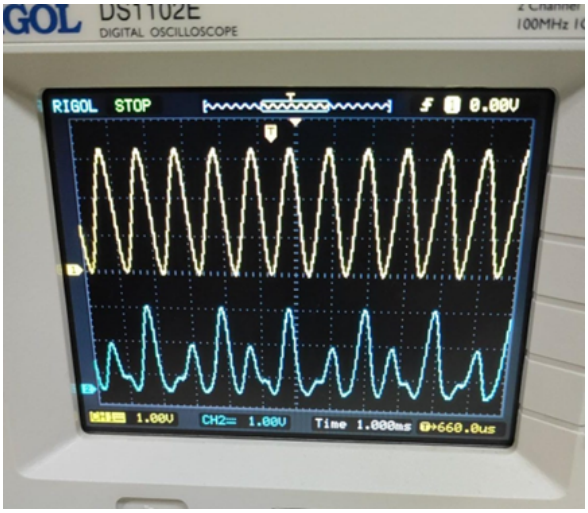
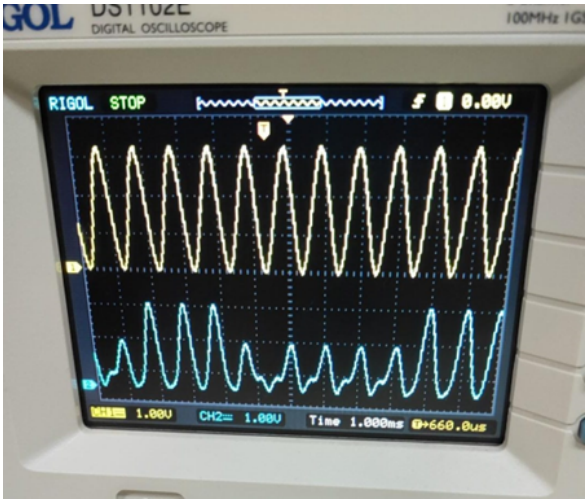
Conclusion:

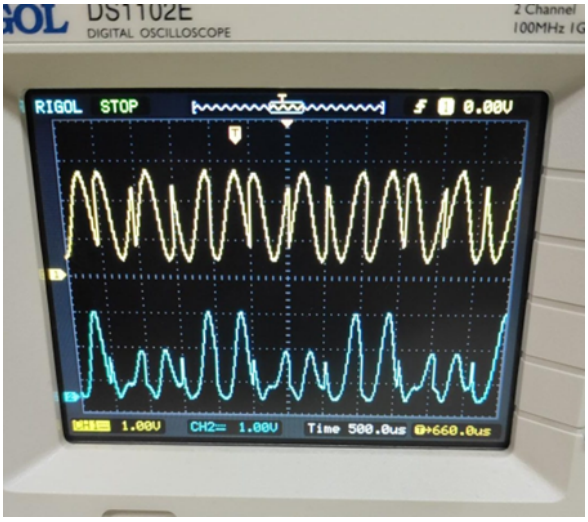
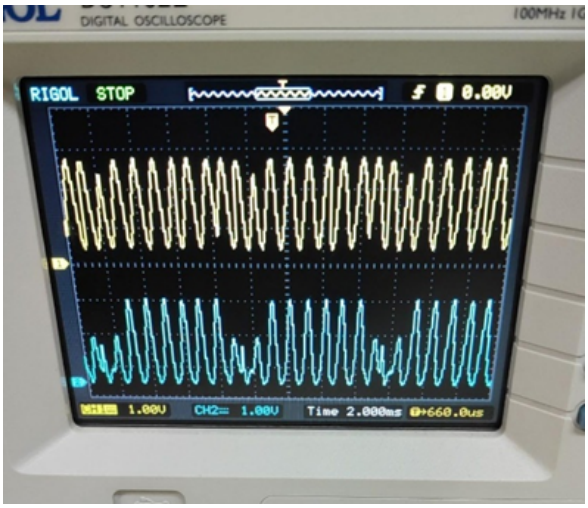
1. The QPSK modulated signal was successfully observed.
2. The frequency of the modulated signal varied with different data rates.

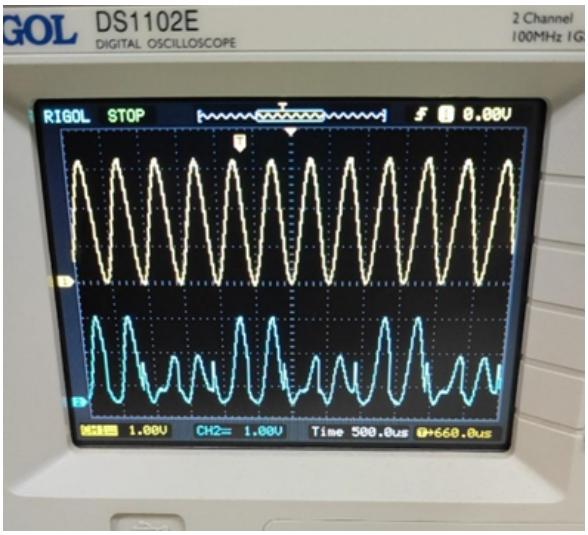
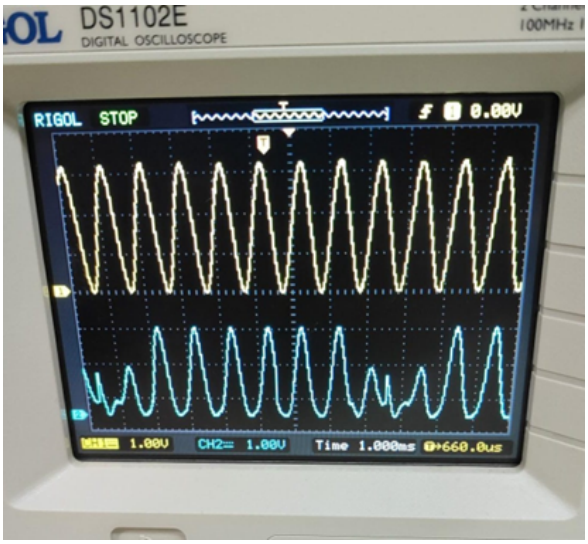
Experiment 6:

Data Bit	Data Rate	Channel	DSO Results
8 Bit	2KHz	CH1: TP9 CH2: TP10	
16 Bit	2KHz	CH1: TP9 CH2: TP11	

8 Bit	4KHz	CH1: TP9 CH2: TP12	
16 Bit	2KHz	CH1: TP9 CH2: TP12	

8 Bit	2KHz	CH1: TP10 CH2: TP12	
16 Bit	2KHz	CH1: TP10 CH2: TP12	

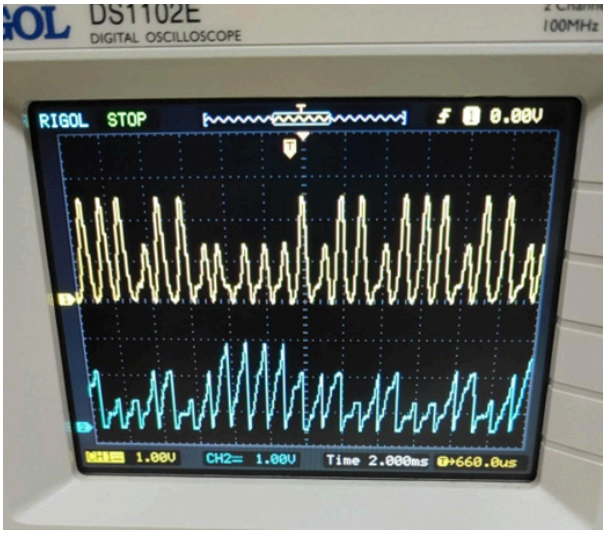
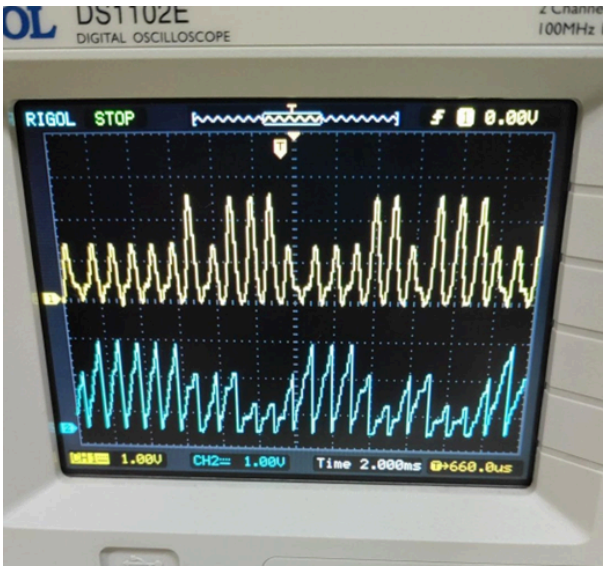
8 Bit	4KHz	CH1: TP9 CH2: TP13	
16 Bit	2KHz	CH1: TP9 CH2: TP13	

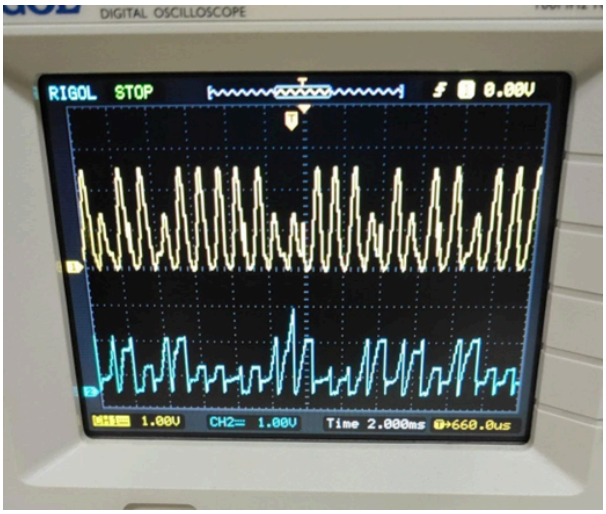
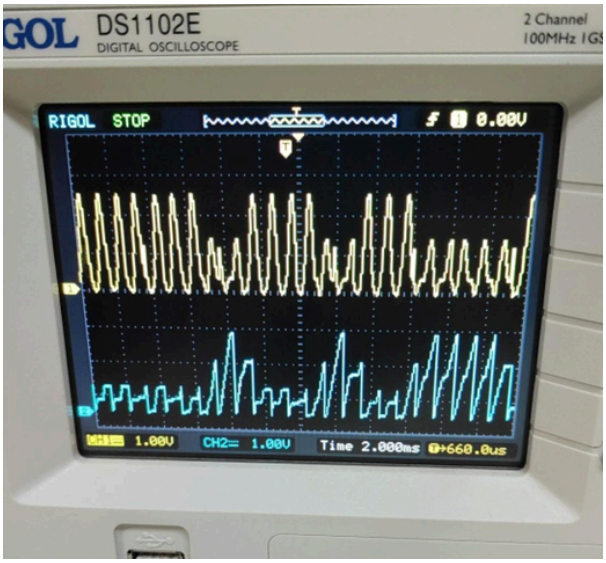
8 Bit	4KHz	CH1: TP11 CH2: TP13	
16 Bit	2KHz	CH1: TP11 CH2: TP13	

Conclusion:

1. Multiplied output signals for QPSK and carrier signals were observed.
2. The signal is a result of multiplication between the QPSK signal and cosine/sine waves.

Experiment 7:

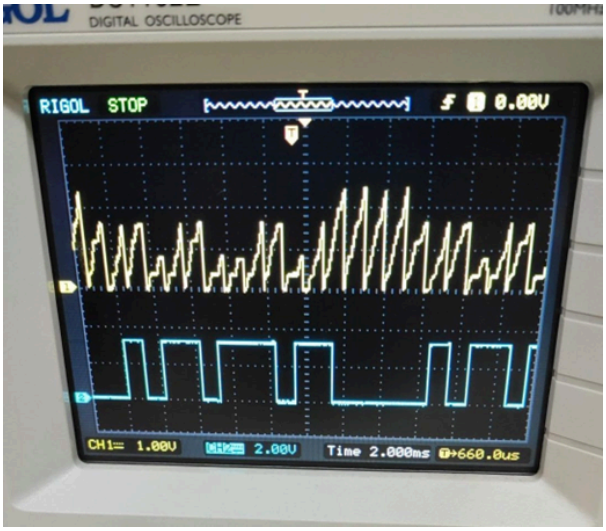
Data Bit	Data Rate	Channel	DSO Results
32 Bit	2KHz	CH1: TP12 CH2: TP14	
64 Bit	2KHz	CH1: TP12 CH2: TP14	

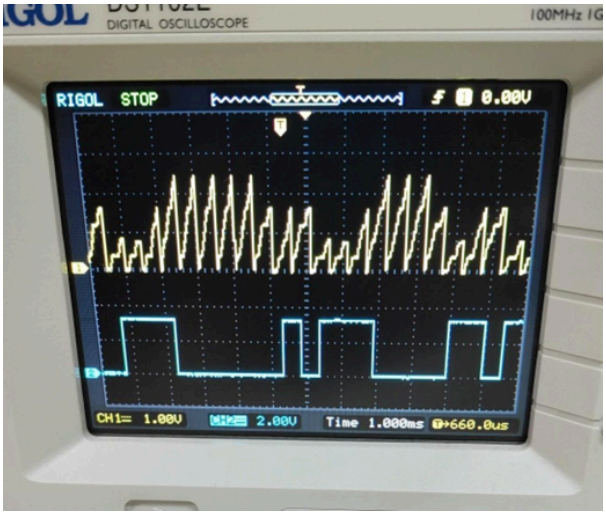
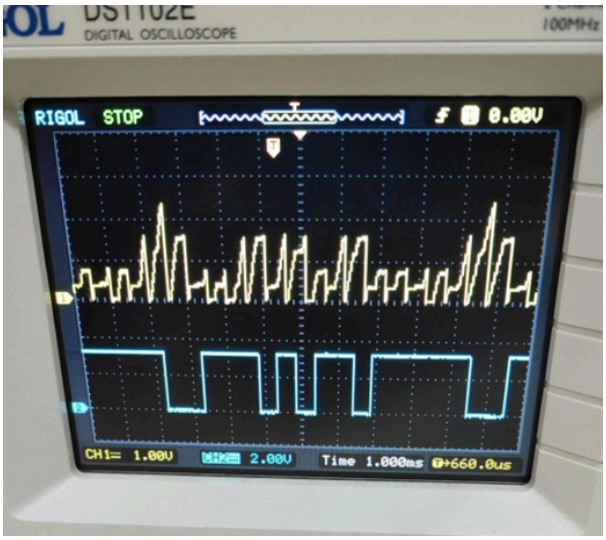
32 Bit	2KHz	CH1: TP13 CH2: TP15	
64 Bit	2KHz	CH1: TP13 CH2: TP15	

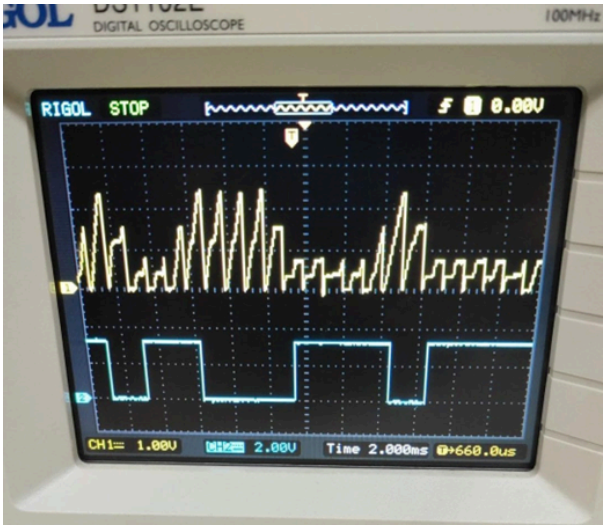
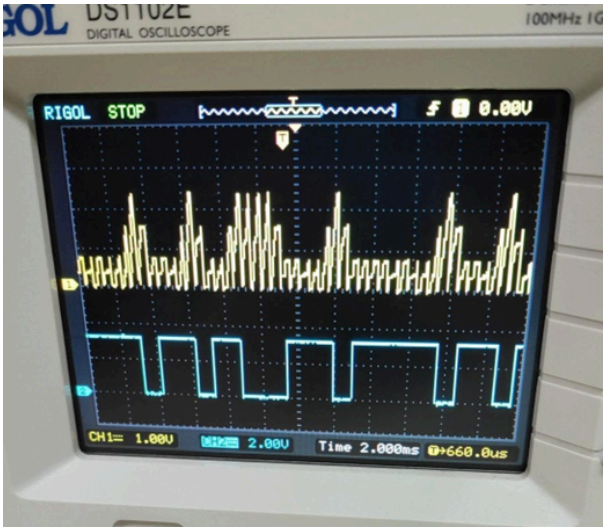
Conclusion:

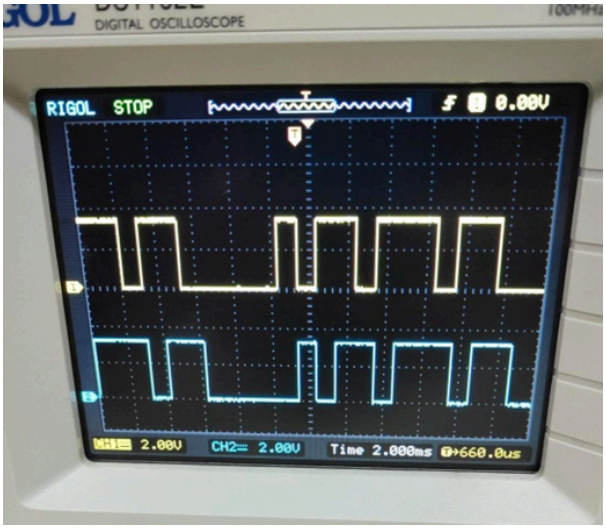
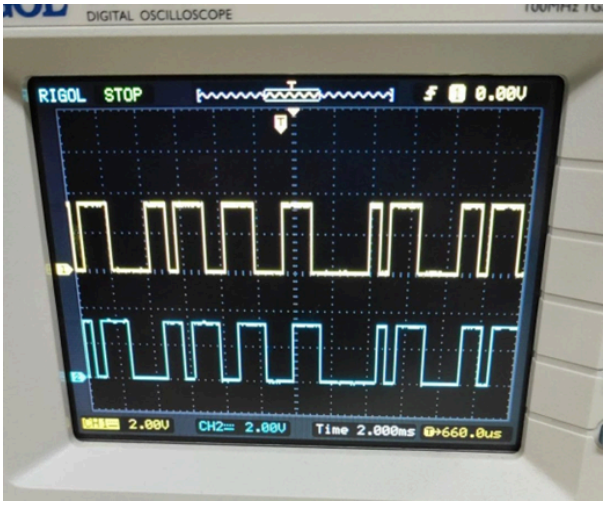
1. The integrated output for I-Channel and Q-Channel was successfully observed.
2. The integration smooths out the multiplied signals, making them suitable for further processing.

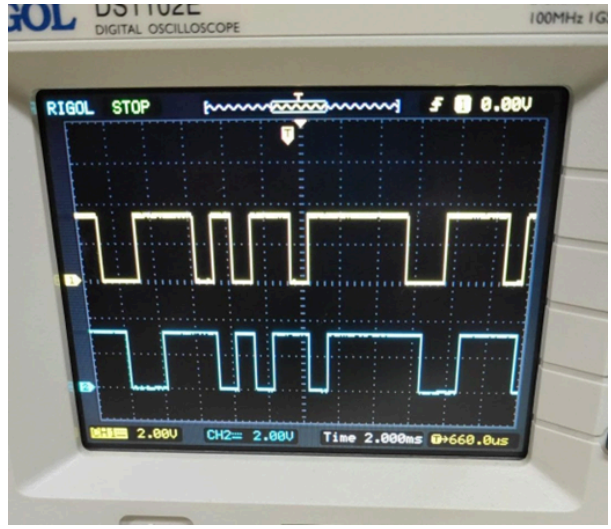
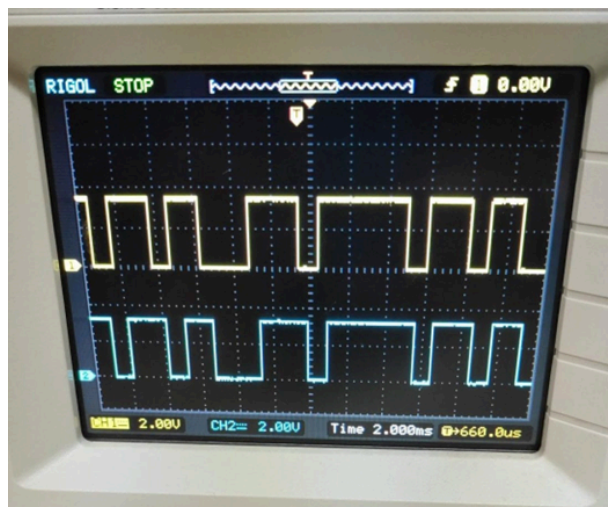
Experiment 8:

Data Bit	Data Rate	Channel	DSO Results
32 Bit	2KHz	CH1: TP14 CH2: TP16	
64 Bit	2KHz	CH1: TP14 CH2: TP16	

64 Bit	4KHz	CH1: TP14 CH2: TP16	
32 Bit	4KHz	CH1: TP15 CH2: TP17	

64 Bit	2KHz	CH1: TP15 CH2: TP17	
64 Bit	4KHz	CH1: TP15 CH2: TP17	

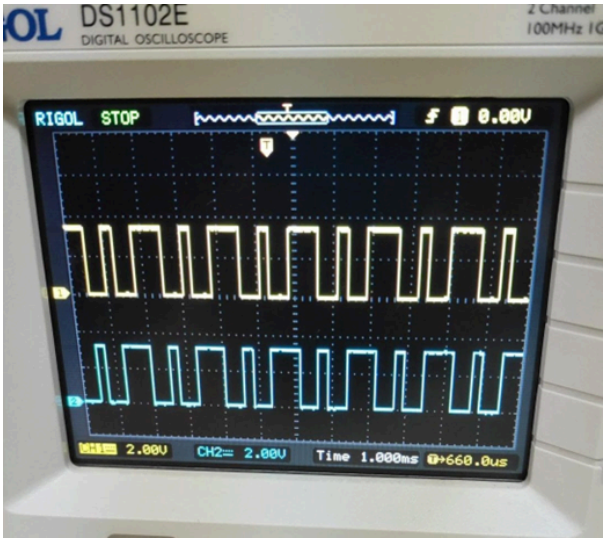
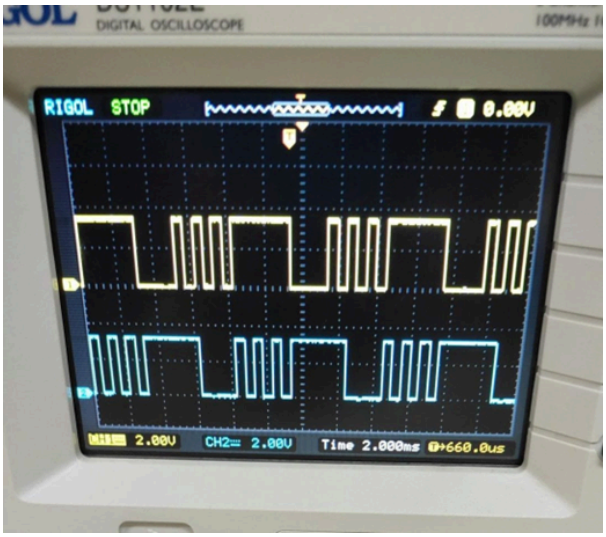
32 Bit	2KHz	CH1: TP3 CH2: TP16	
64 Bit	4KHz	CH1: TP3 CH2: TP16	

32 Bit	2KHz	CH1: TP4 CH2: TP17	
64 Bit	4KHz	CH1: TP4 CH2: TP17	

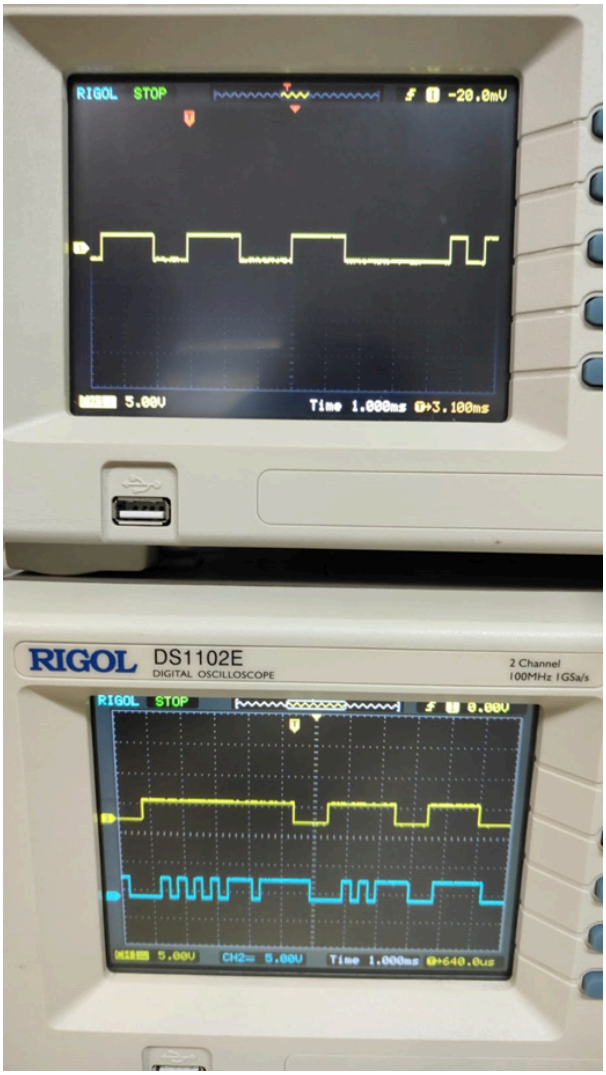
Conclusion:

1. The comparator output correctly matches the original input with a delay.
2. The comparator refines the signals for accurate data recovery

Experiment 9:

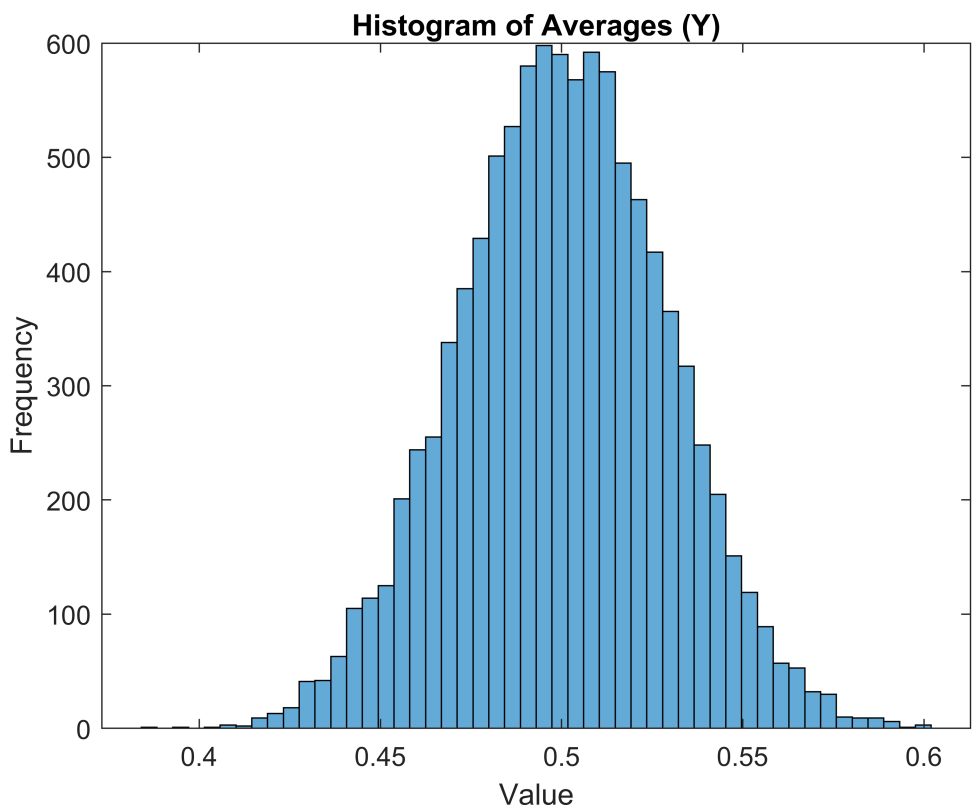
Data Bit	Data Rate	Channel	DSO Results
8 Bit	4KHz	CH1: TP2 CH2: TP18	
16 Bit	2KHz	CH1: TP2 CH2: TP18	

32 Bit	2KHz	D1: TP16 D7: TP17 D10:18	

64 Bit	4KHz	D1: TP16 D7: TP17 D10:18	

Conclusion:

1. The demodulated QPSK signal was successfully recovered.
2. The demodulated signal is in sync with the input bit pattern and data rate.

MATLAB Exercise Lab 9

```
% (a) Generate uniform random variables
n = 1e6;
x = rand(1, n);

% (b) Calculate the average of every 100 elements
m = 100;
y = zeros(1, n/m);
for i = 1:n/m
    y(i) = mean(x((i-1)*m + 1:i*m));
end

% (c) Plot the histogram of y
figure;
histogram(y, 50);
title('Histogram of Averages (Y)');
xlabel('Value');
ylabel('Frequency');
```