Lab 7 – Project

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EEL4515 Fundamental of Digital Communications

Prof. Dr. George Atia - Section 0012

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1.0 Experiment Objective

Understand the principles of Binary Phase Shift Keying (BPSK) digital modulation scheme, its error performance through simulation and hardware implementation of BPSK modulation.

2.0 About Laboratory Day and Equipment List

The laboratory session took place on the Thursday section between 9:00am and 11:50am on March 28th, 2024. My lab partner was Isiah. The equipment for the is experiment is listed below,

1. MATLAB
2. Rohde & Schwarz RTM 3034 Oscilloscope
3. Function Generator
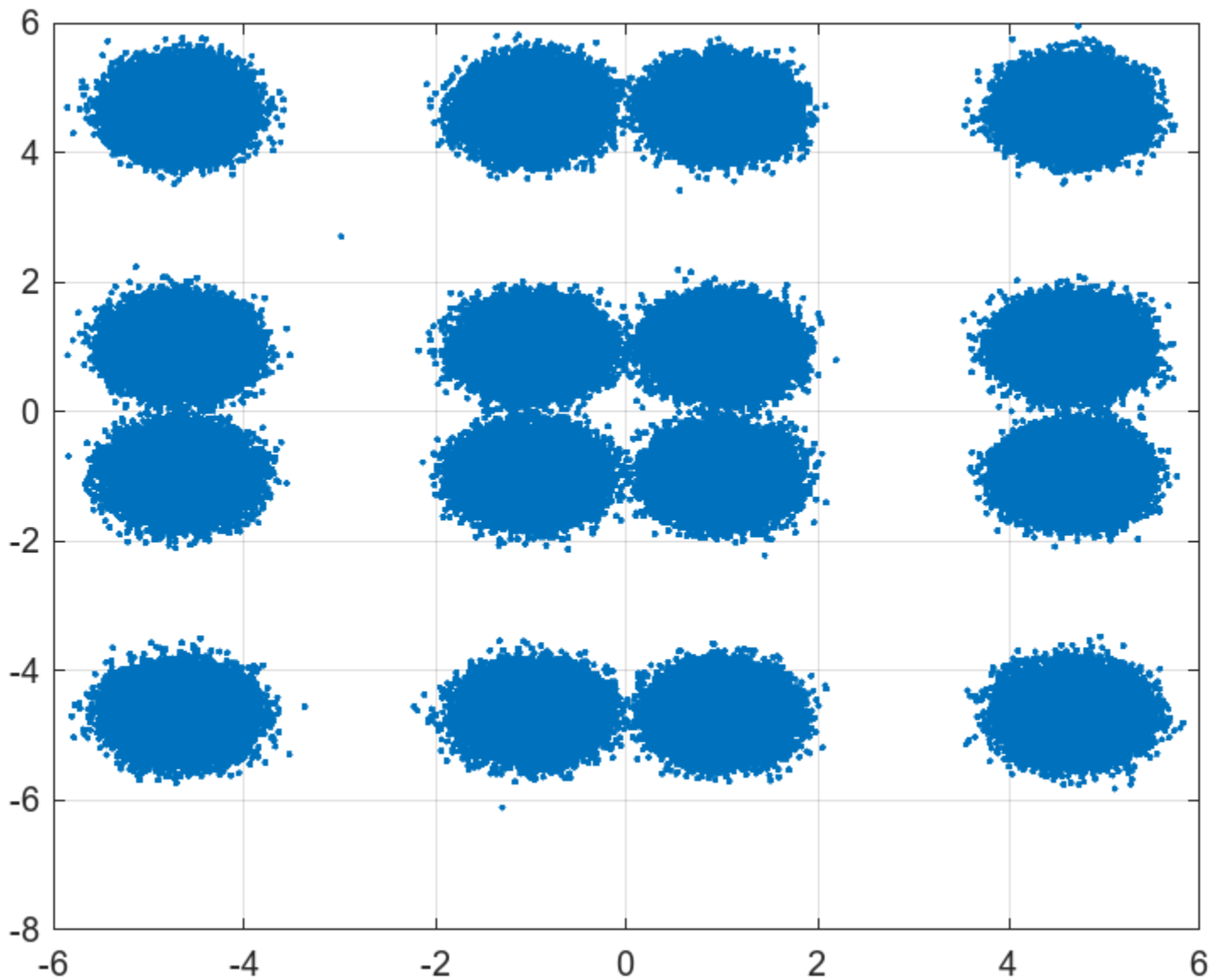4. 2N4392 NMOS
5. LF351N Operational Amplifier

3.0 Simulation
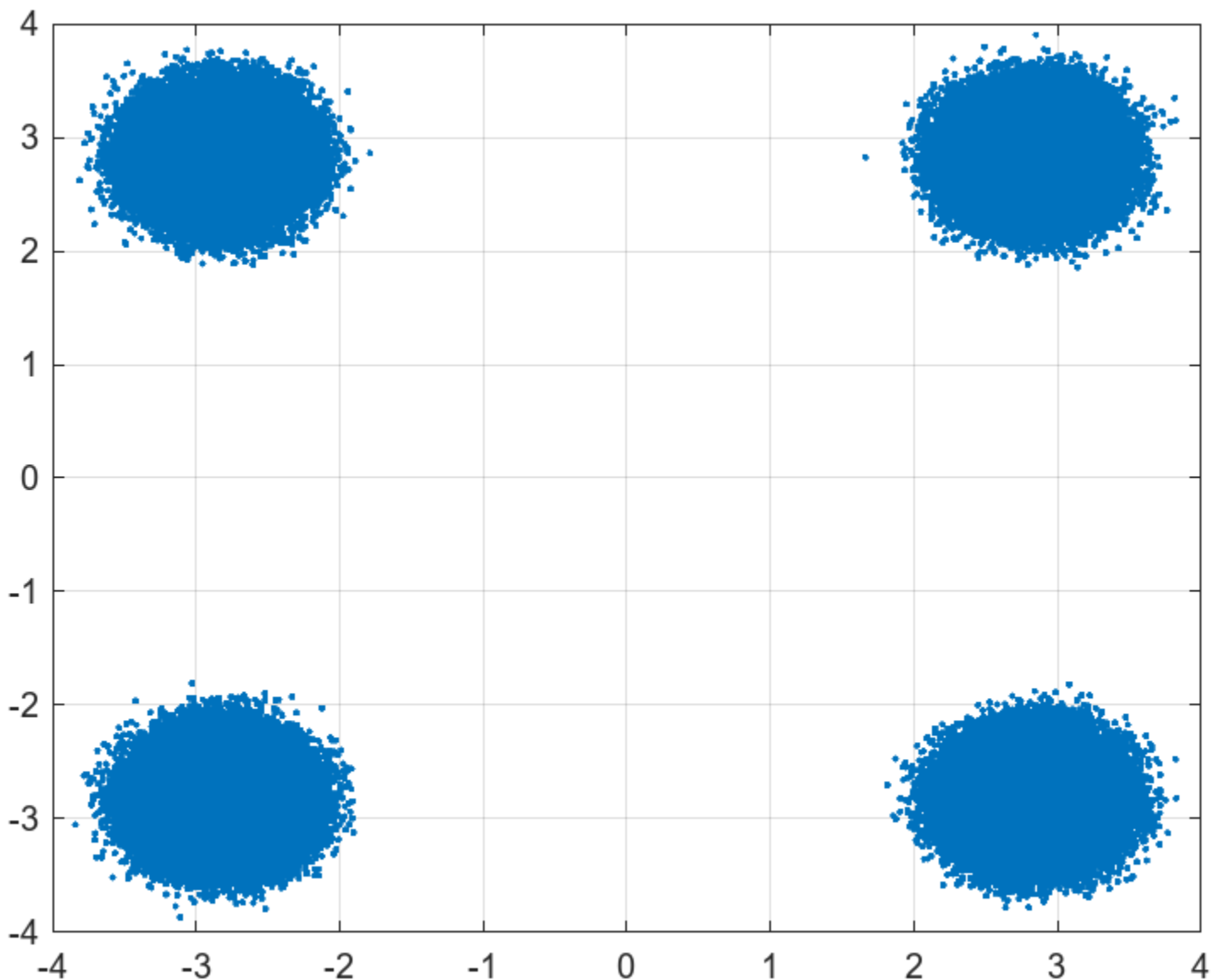
Constellation Diagram of Input Message with Noise
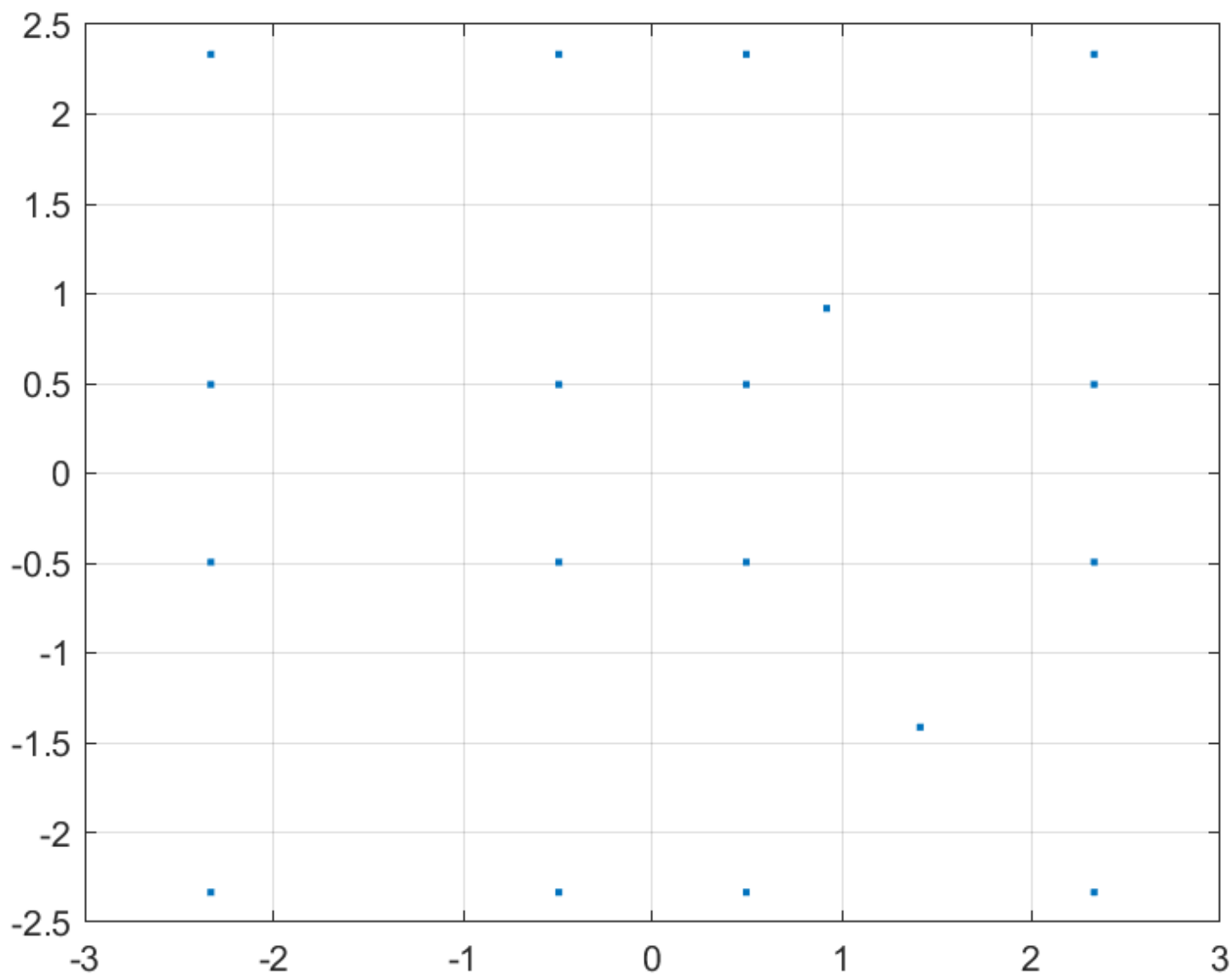
Constellation Diagram of Channel Effects

Received Message with Channel Effects and Noise

3.0 MATLAB Code

Used to generate figure(s)

```
clear all
close all
clc
A = sqrt(2);

data = zeros(1, 1e4);
qpsk_symbols = [(1-1j), (1+1j), (-1-1j), (-1+1j)];
for i=1:1:length(data)
    data(i) = A * qpsk_symbols(randi(length(qpsk_symbols)));
end

plot(real(data), imag(data), '.');
grid on;

figure;
g = [1 0 0 0.65];
AWGN = awgn(data, 12, 2, 'dB');
```

```
ych = conv(data, g, 'same');
y = ych + AWGN;

plot(real(ych), imag(ych), '.');

grid on;
hold off;

figure

plot(real(y), imag(y), '.');
```

4.0 Learned Objectives
- BPSK Modulation
- Channel Effects
- MATLAB Simulation

5.0 Conclusion
In this lab we saw how we can modulate an m-array signal using QBSK, where we send the message using 4 symbols. In this 4-array scheme, we send the symbols with the same amplitude but with 4 equally spaced symbols. We saw the effects of channel which would make demodulation impossible unless we invert the channel effect. Also, we noticed that the noise (to a lesser extent) also affects reception of the signal. If the noise is lower, we can potentially have a higher m-array signal because there would a wider error margin. Overall, this lab helped form a better understanding of theoretical analysis of BPSK and general QAM siganls.