COMM.SYS.300 COMMUNICATION THEORY

Project Work:

Experimenting an Elementary Single-Carrier M-QAM-based Digital Communication Chain

Author's details

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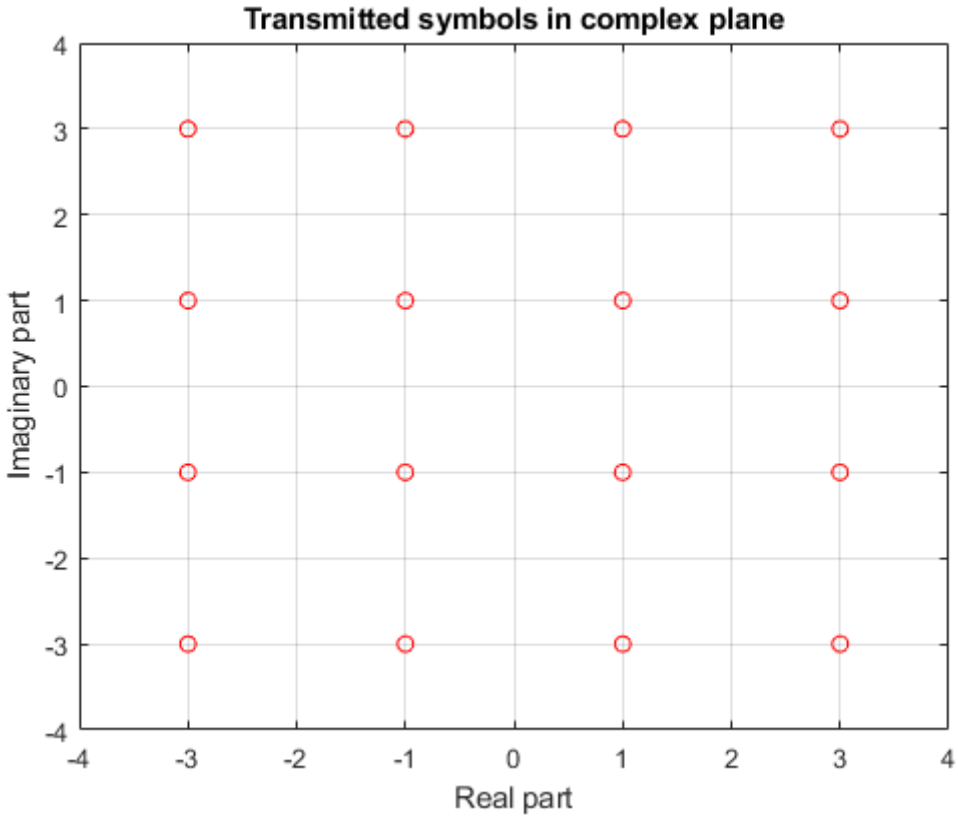
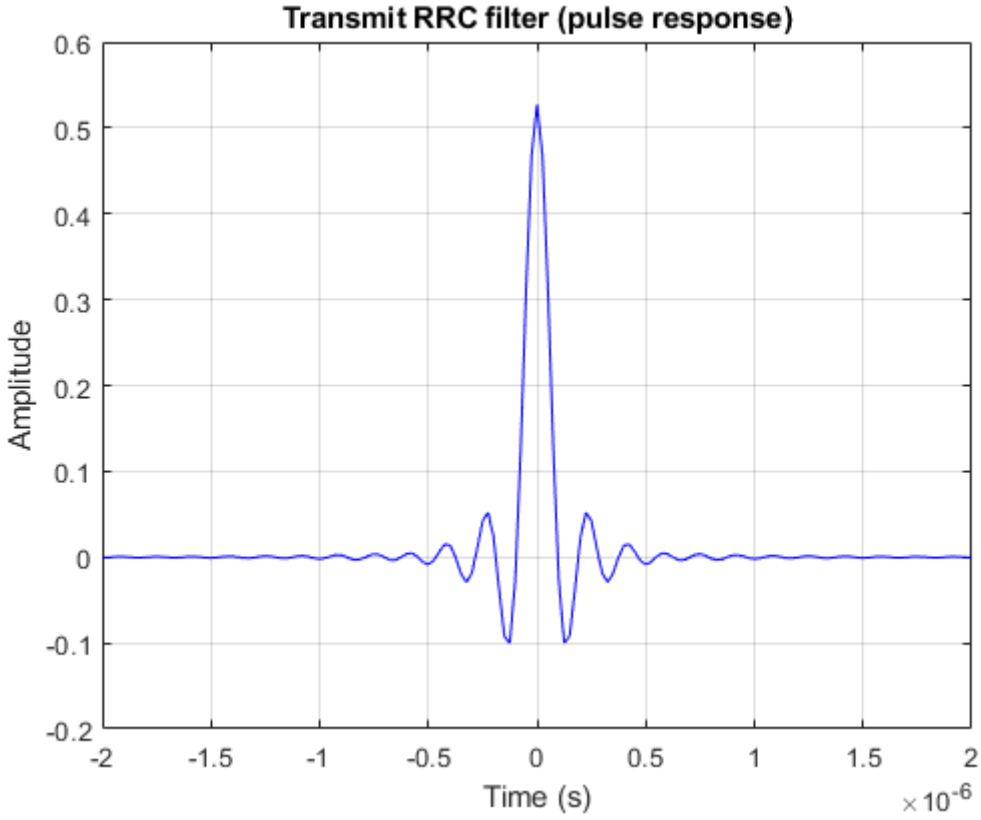
Task 1

- Plot the relevant responses and explain what you observe.

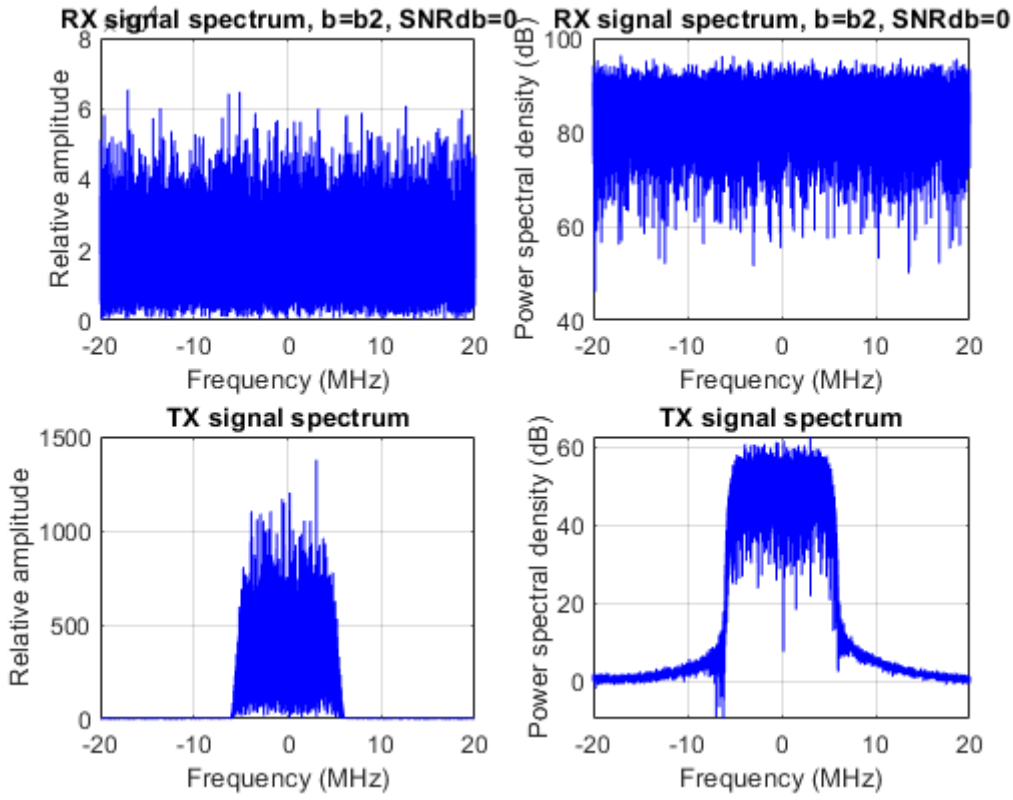


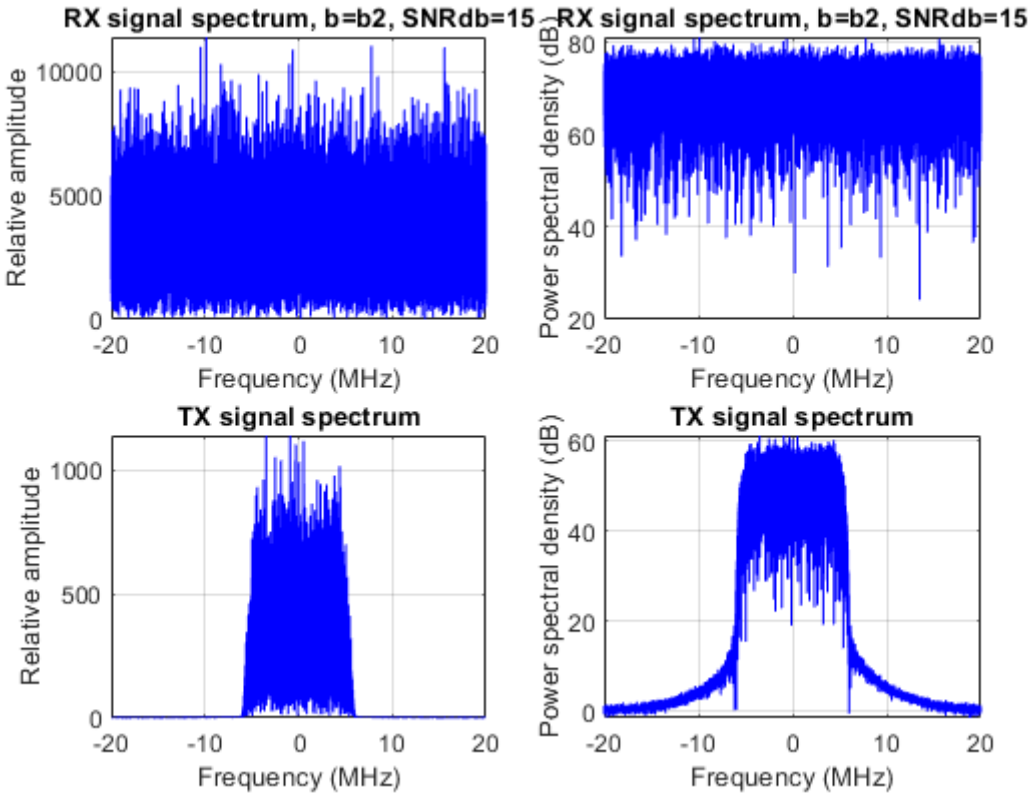


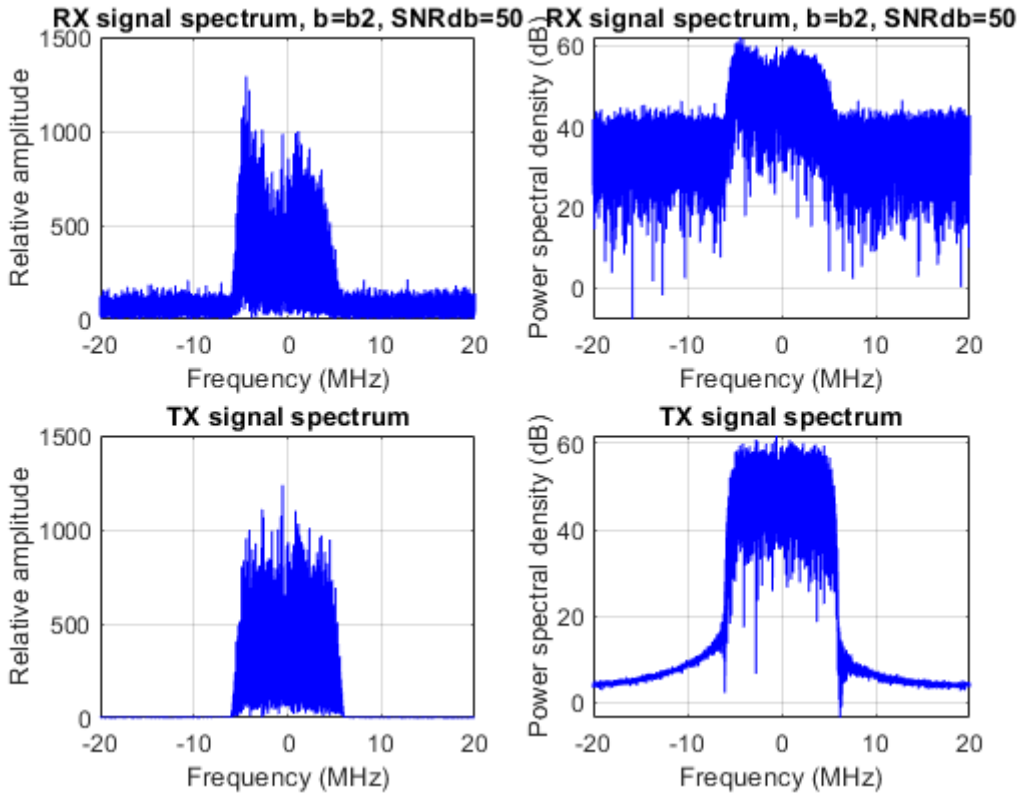
TX Spectrum

Task 2

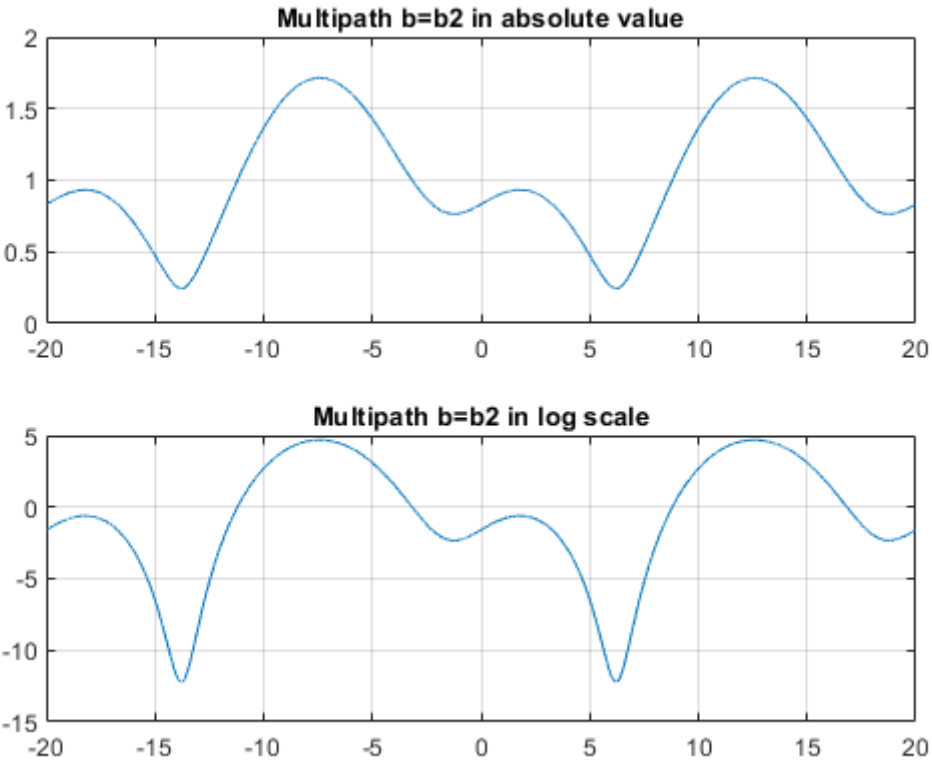
- Vary the SNRdB value e.g. few values between 0 . . . 50, and see how that impacts the RX signal spectrum. Provide relevant spectral examples and explain what you observe.



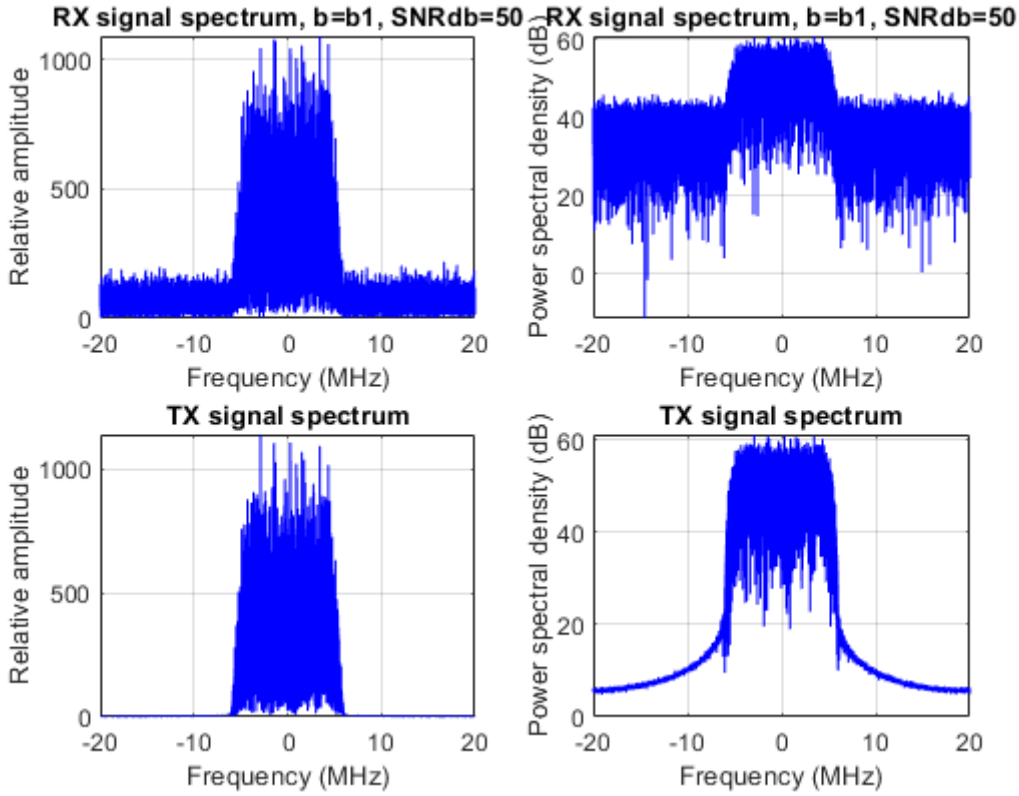


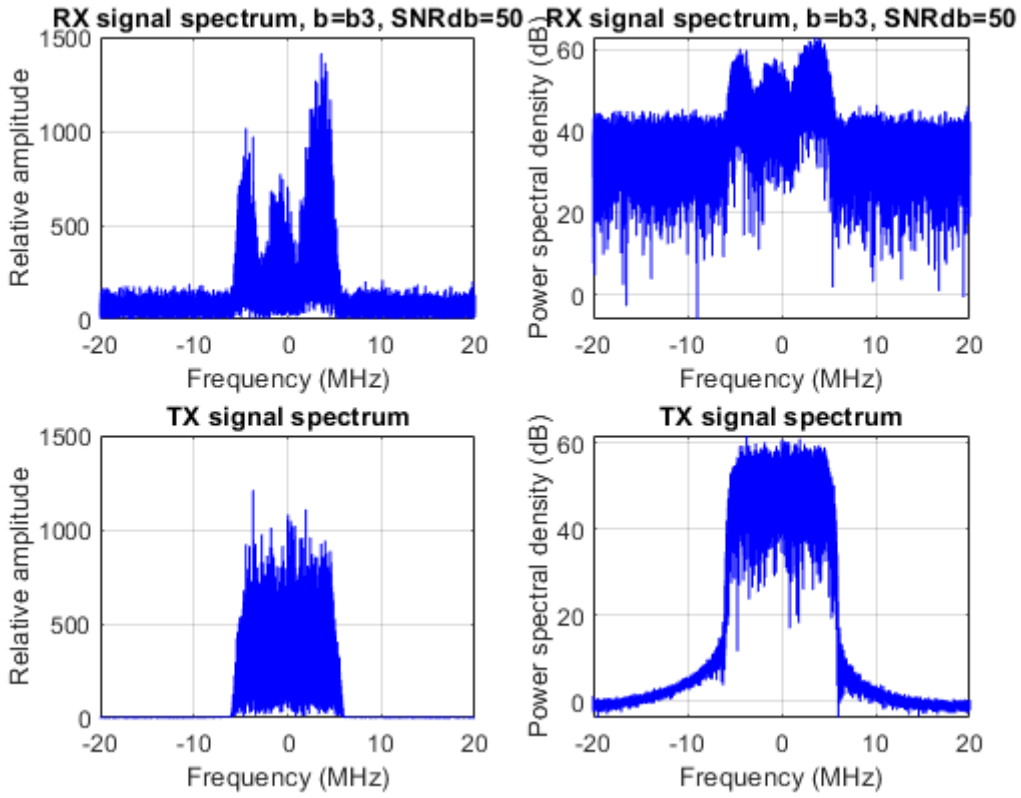


- Explain also the effects of multipath, why does the RX signal spectrum have clear fading notches inside the passband ? To address the issue, plot the amplitude response of the multipath channel on a separate figure.



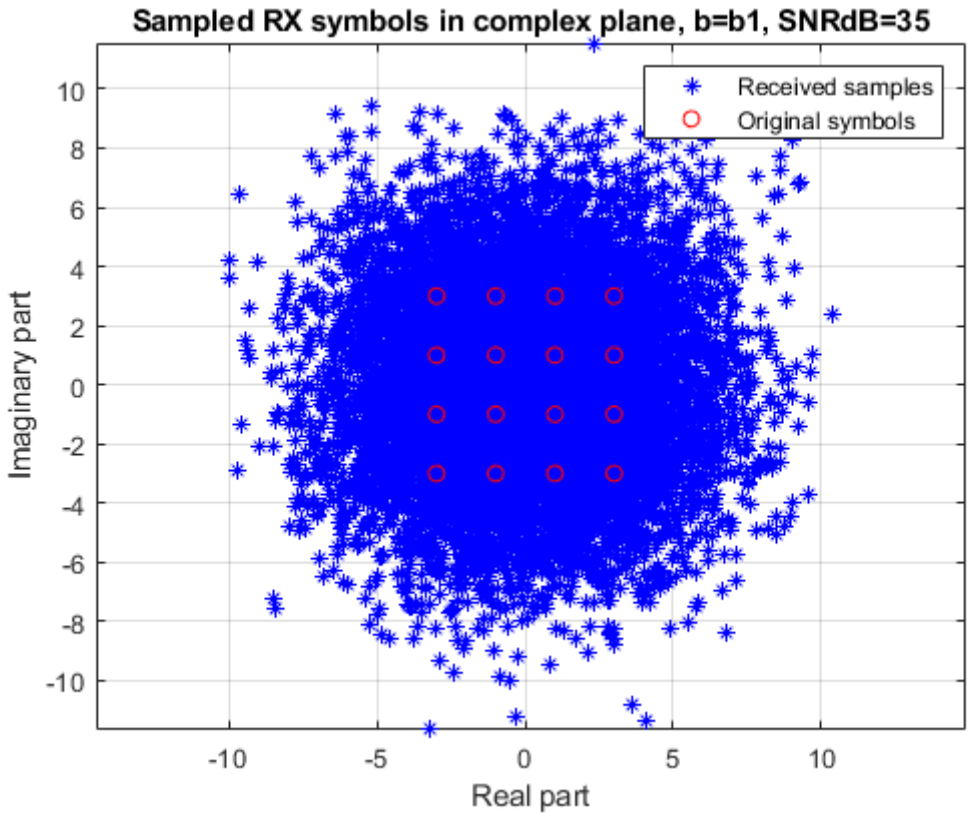
- Vary also the multipath channel profile between the channels b1, b2, b3 and explain what you observe (in terms of the RX signal spectrum).



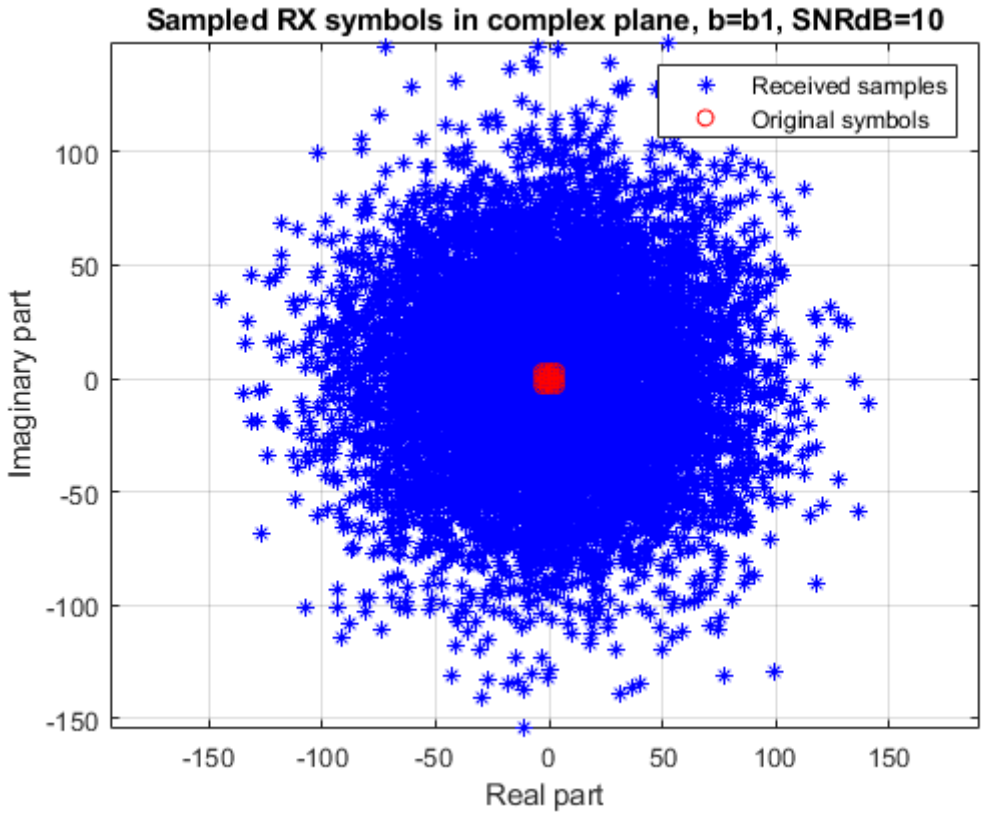


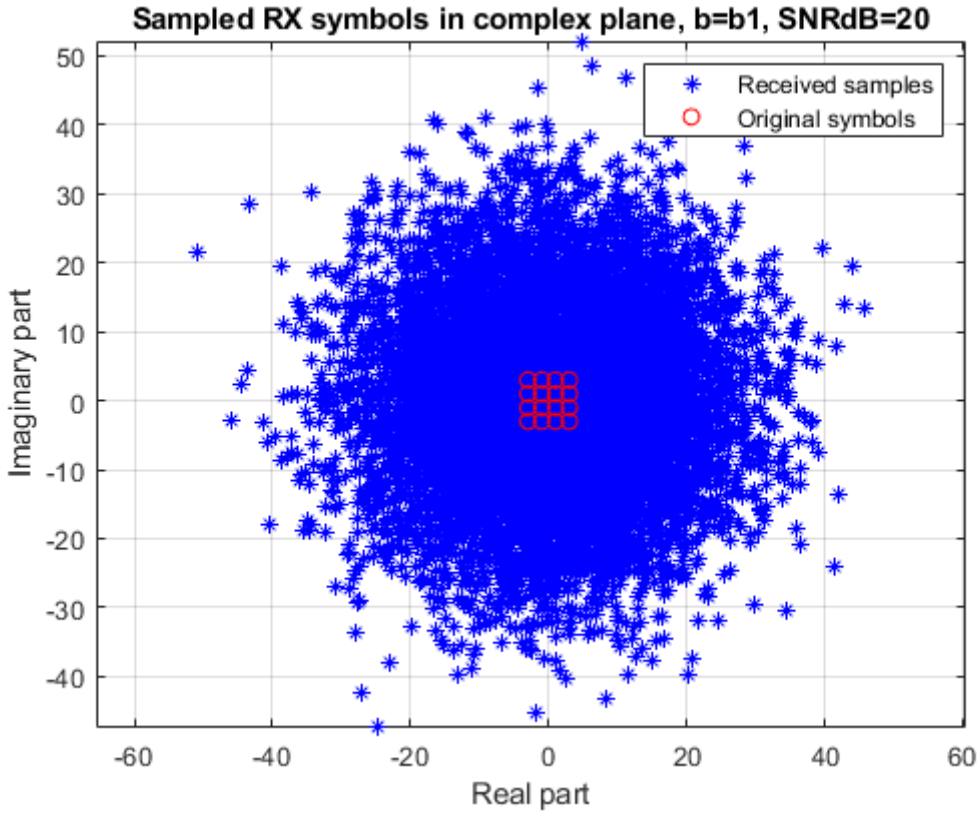
Task 3

- First momentarily omit the multipath (i.e. use the channel b1) and set SNR to 35 dB. Plot the RX signal constellation and explain what you see.

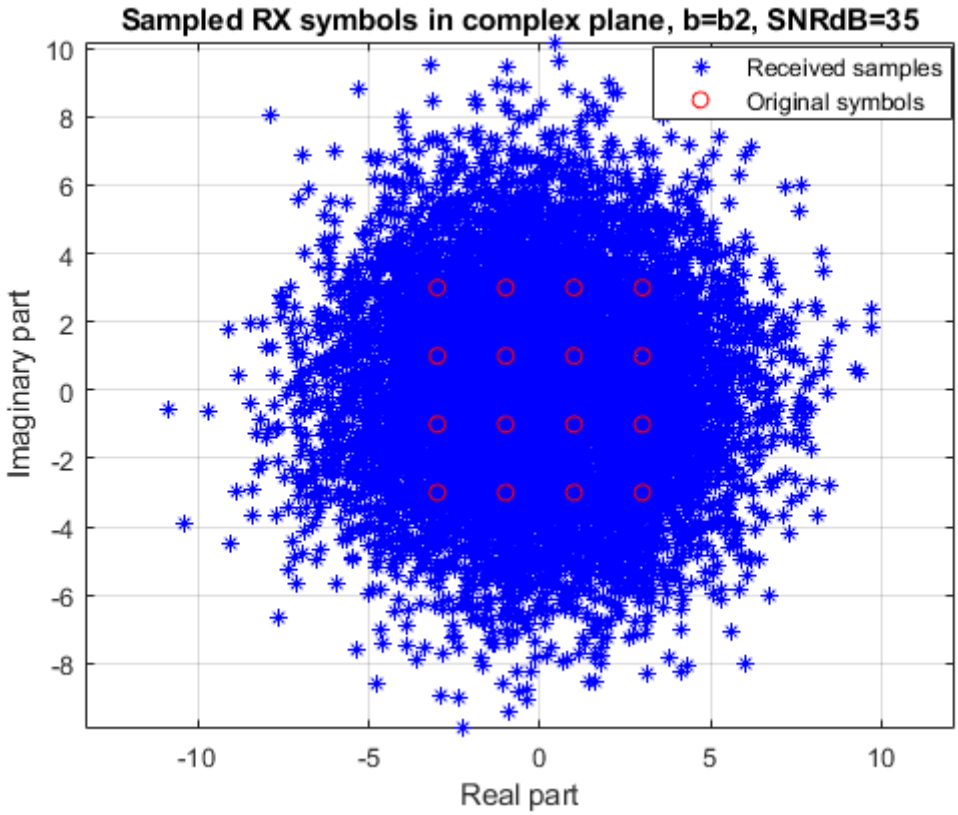


- Then repeat by changing the SNR to 10 dB and 20 dB and plot and comment again the RX signal constellation. Would the RX still be able to reliably decode/detect the received signal ?

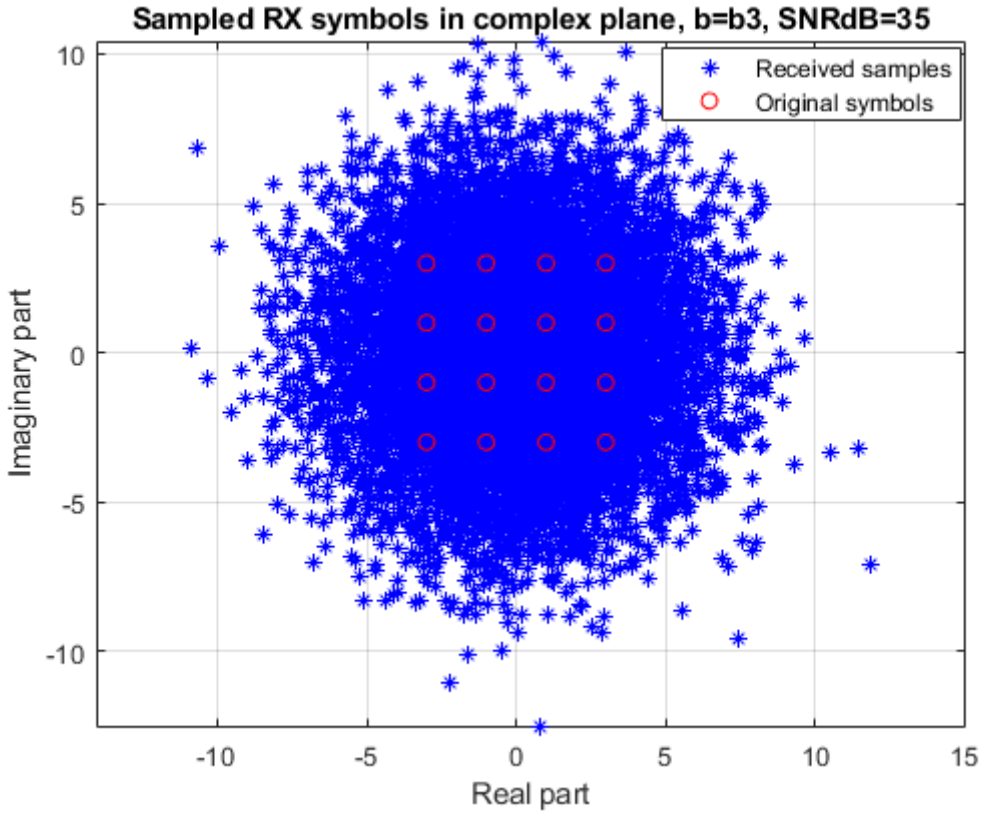




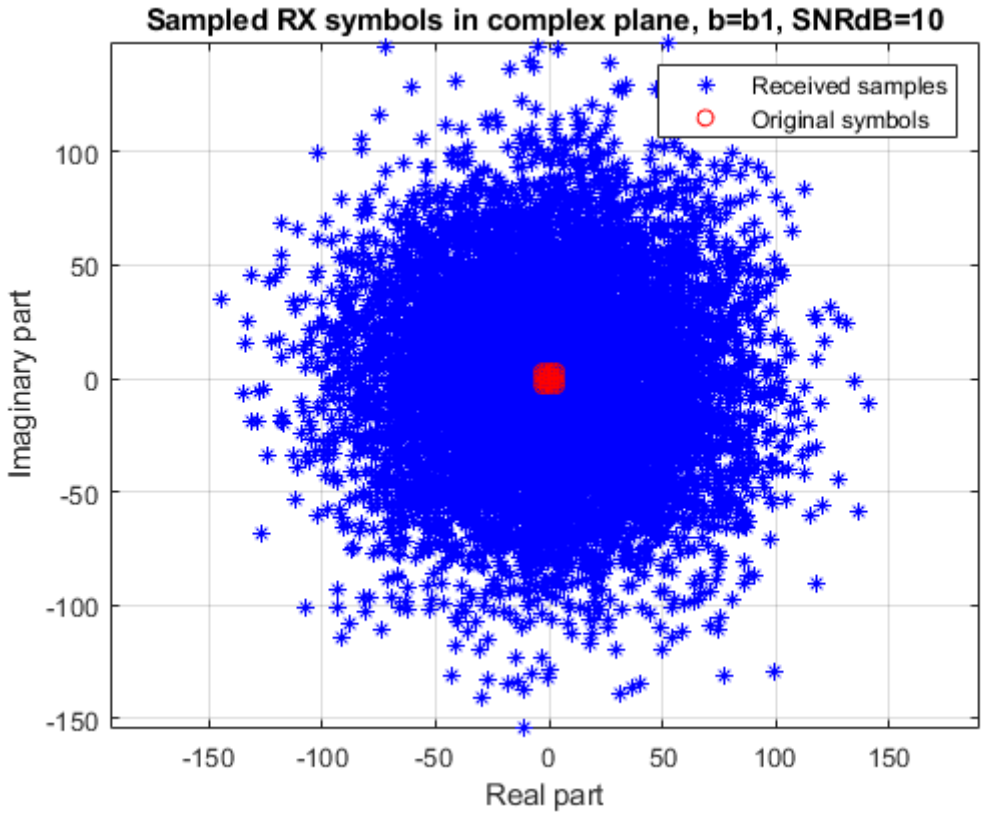
- Then repeat by setting SNR back to 35 dB but now turning on the multipath channel. Experiment with both multipath channels b2 and b3. Plot always the RX signal constellation and try to explain what you

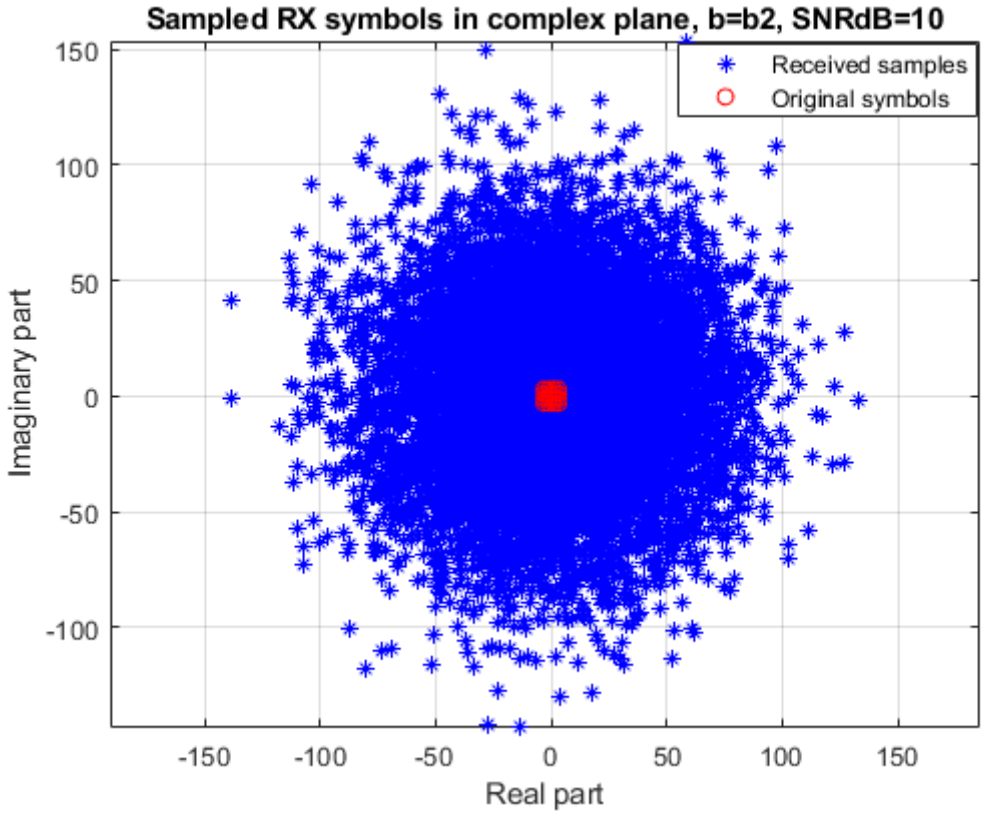


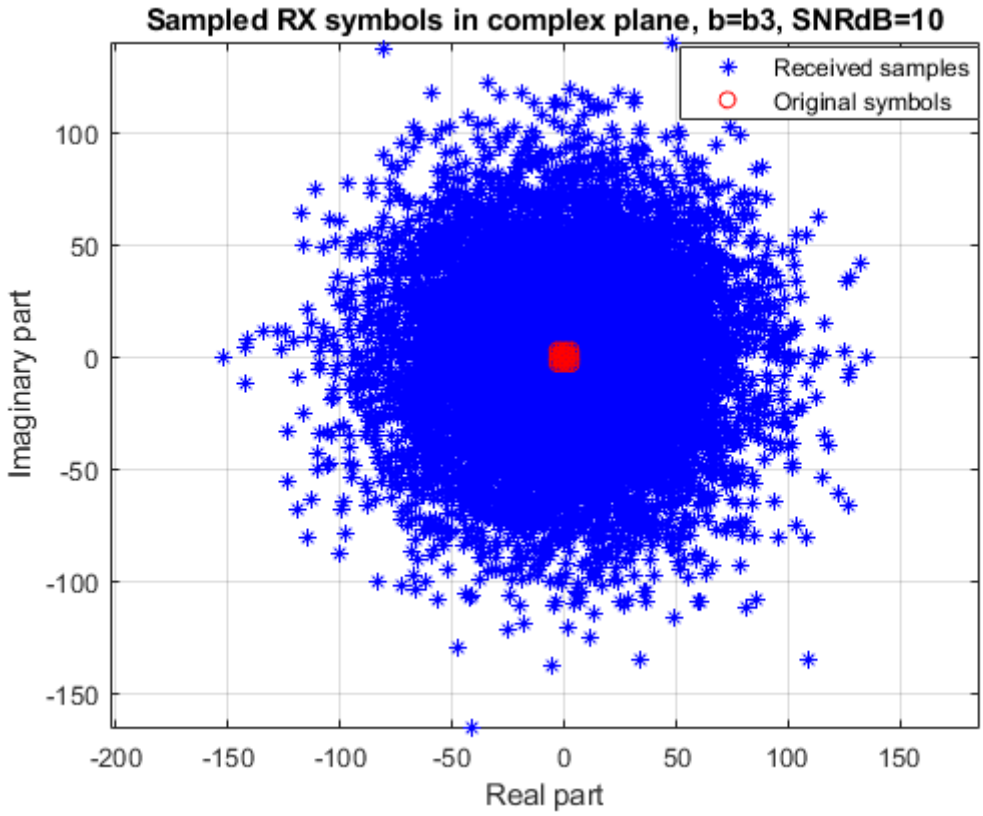
see.



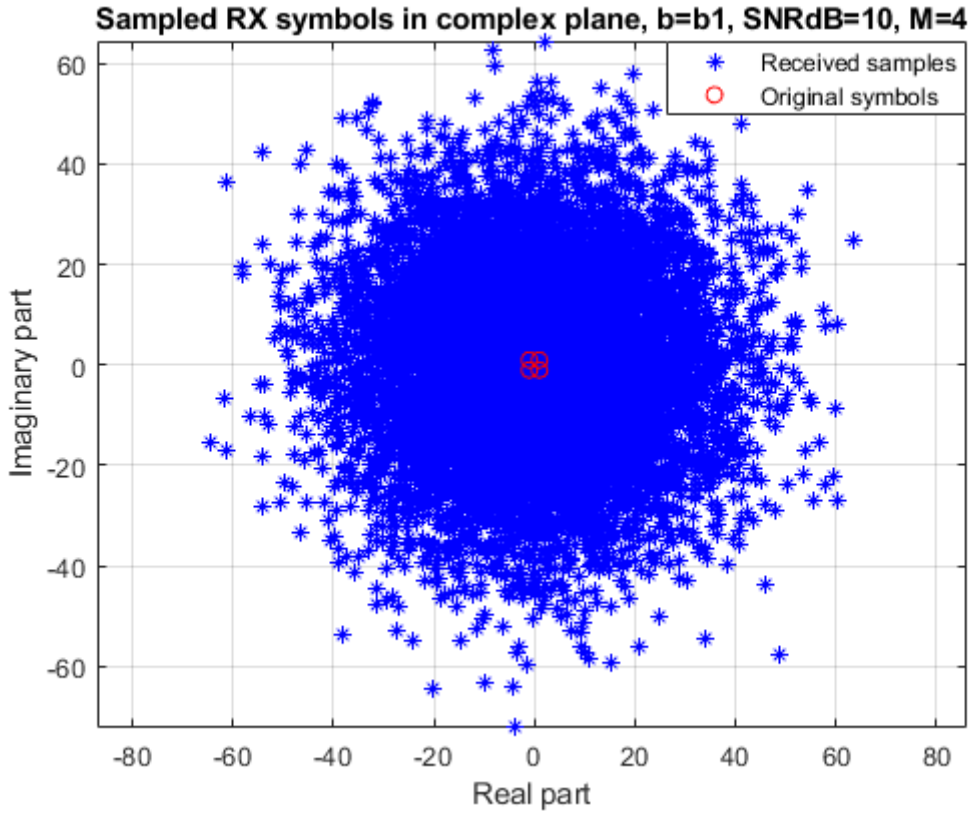
- Then lower the SNR down to 10 dB. Again plot the RX signal constellations with all (multipath) channels b1, b2 and b3 and explain what you see.

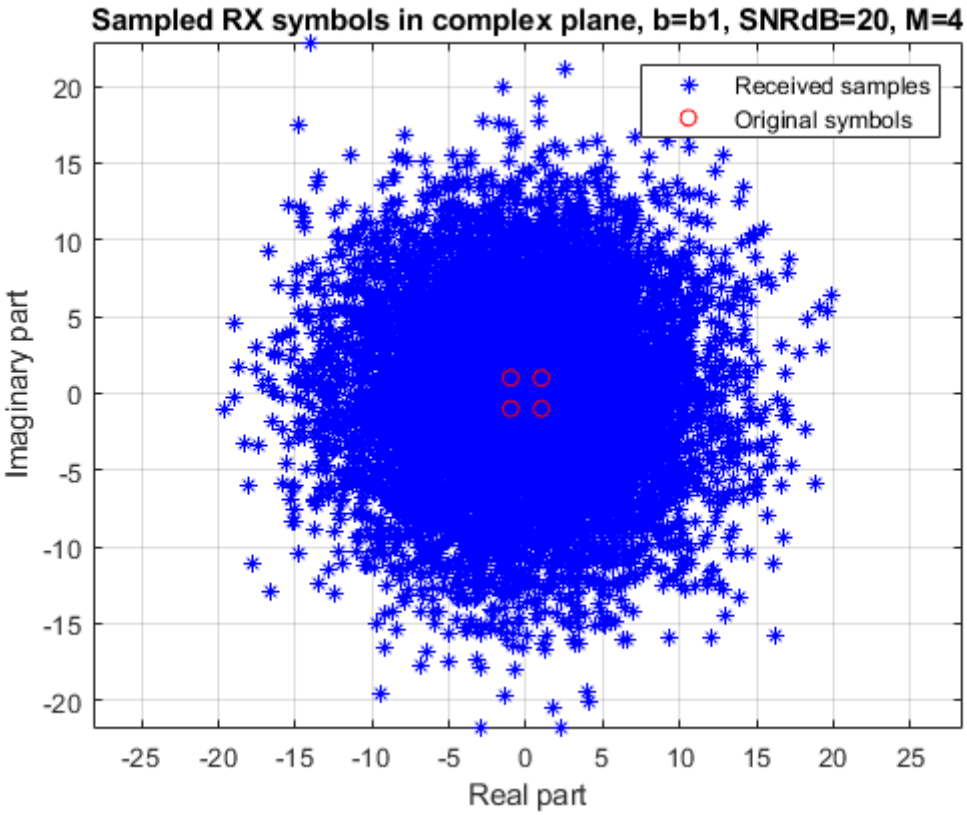

Sampled RX symbols in complex plane, b=b1, SNRdB=10
Received samples
Original symbols
Imaginary part
Real part
100
50
0
-50
-100
-150
-150
-100
-50
0
50
100
150

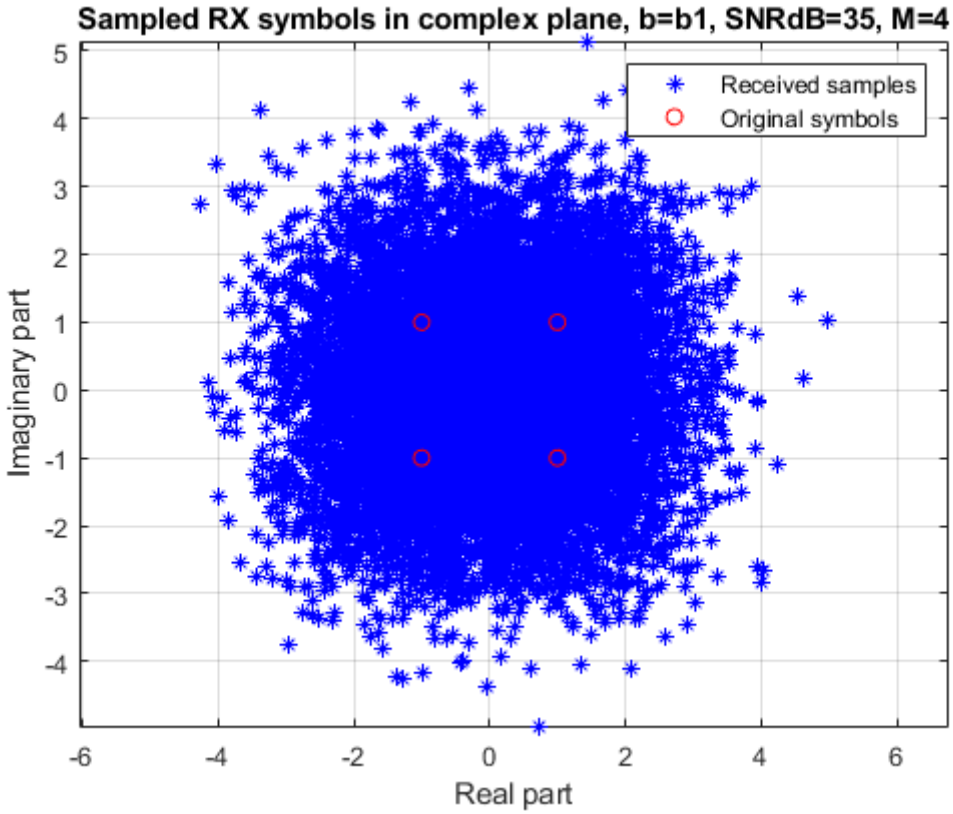

Sampled RX symbols in complex plane, b=b2, SNRdB=10
Received samples
Original symbols
Imaginary part
Real part
150
100
50
0
-50
-100
-150
-100
-50
0
50
100
150

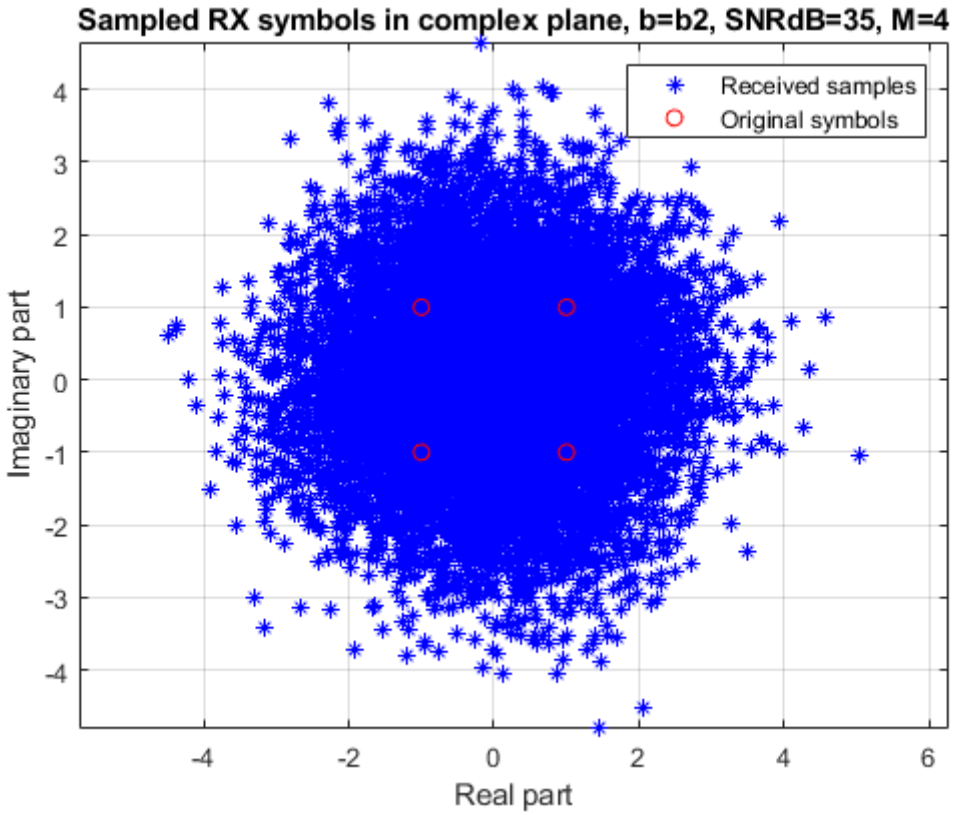


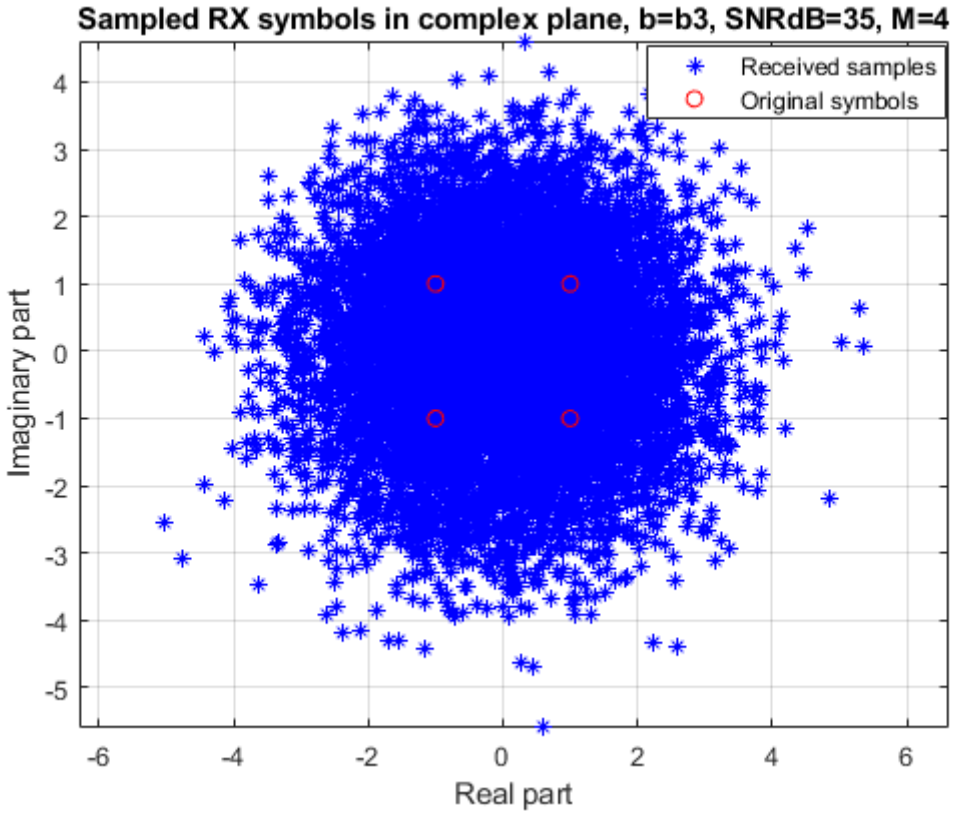
- Next, change the modulation order to M = 4, and repeat the above steps shortly. Comment on the differences.



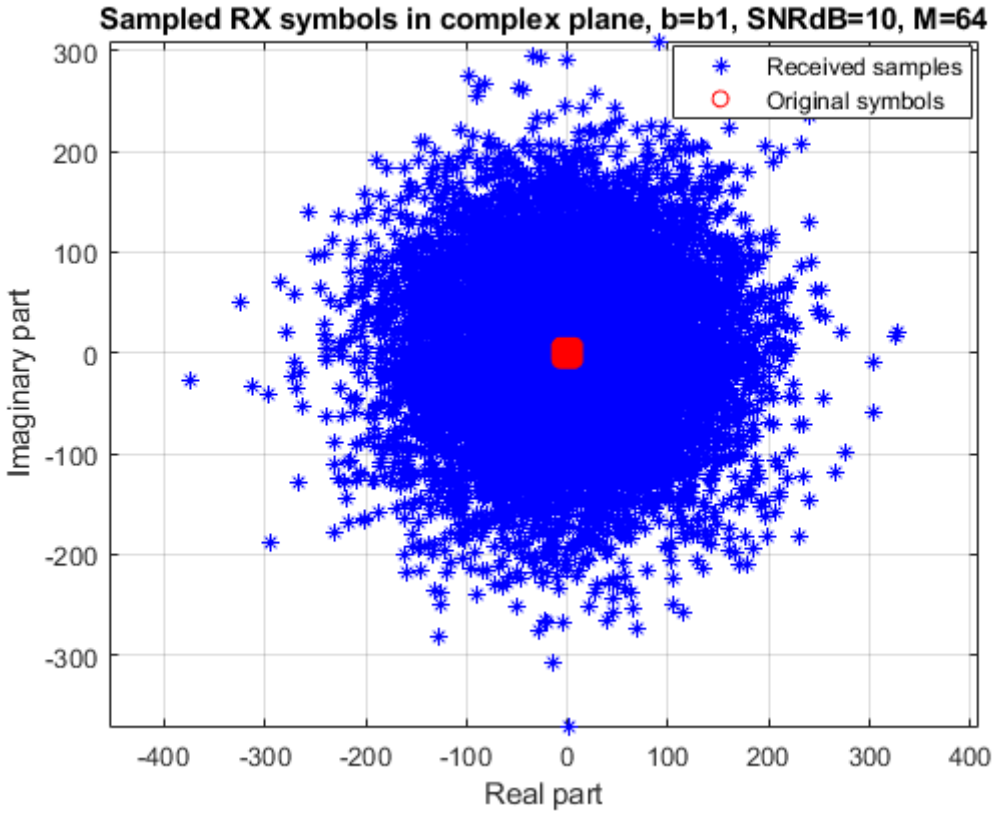

Sampled RX symbols in complex plane, b=b1, SNRdB=20, M=4
Received samples
Original symbols
Imaginary part
Real part
20
15
10
5
0
-5
-10
-15
-20
-25
-20
-15
-10
-5
0
5
10
15
20
25

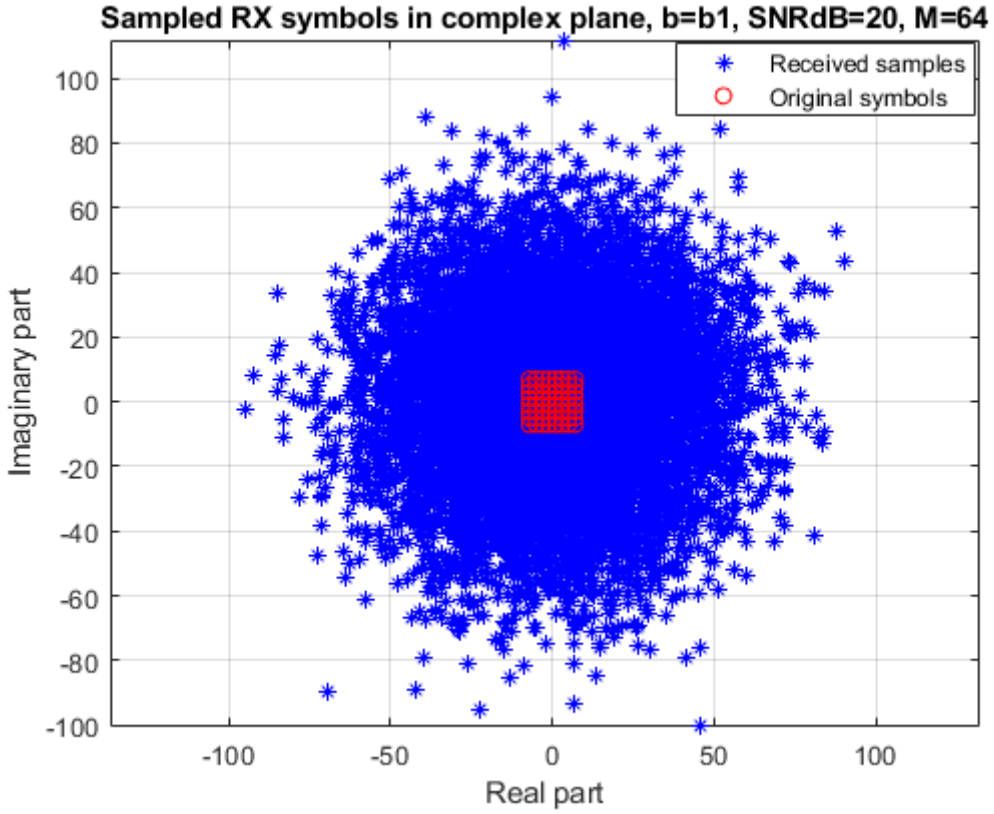

Sampled RX symbols in complex plane, b=b1, SNRdB=35, M=4
Received samples
Original symbols
Imaginary part
Real part
5
4
3
2
1
0
-1
-2
-3
-4
-6
-4
-2
0
2
4
6

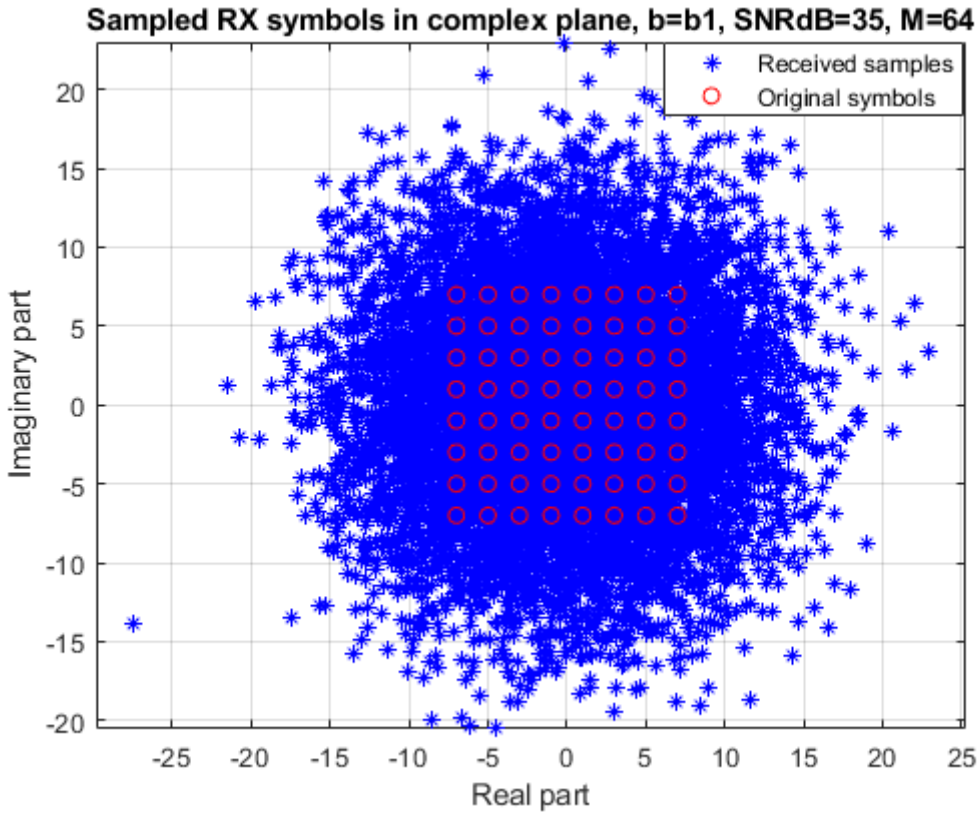

Sampled RX symbols in complex plane, b=b2, SNRdB=35, M=4
Received samples
Original symbols
Imaginary part
Real part
4
3
2
1
0
-1
-2
-3
-4
-4
-2
0
2
4
6

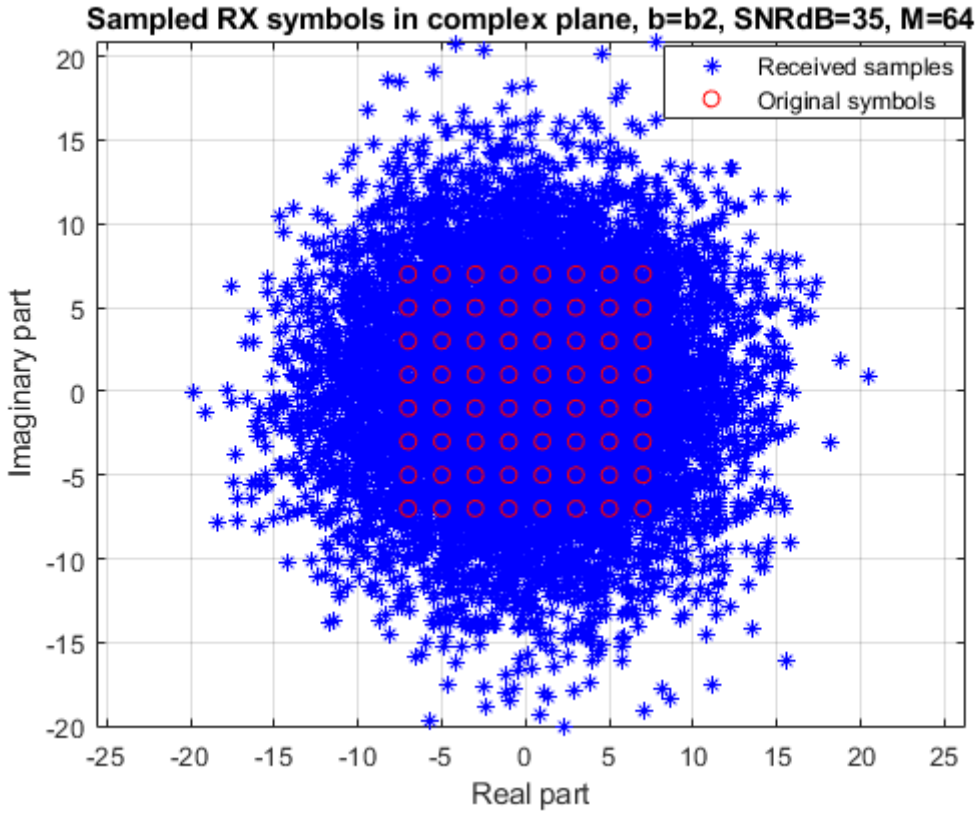

Sampled RX symbols in complex plane, b=b3, SNRdB=35, M=4
Received samples
Original symbols
Imaginary part
Real part
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-4
-2
0
2
4
6

- Finally, change the modulation order to M = 64, and repeat the above steps shortly. Comment on the differences.






Sampled RX symbols in complex plane, b=b1, SNRdB=35, M=64
Received samples
Original symbols
Imaginary part
Real part
20
15
10
5
0
-5
-10
-15
-20
-25
-20
-15
-10
-5
0
5
10
15
20
25


Sampled RX symbols in complex plane, b=b2, SNRdB=35, M=64
Received samples
Original symbols
Imaginary part
Real part
20
15
10
5
0
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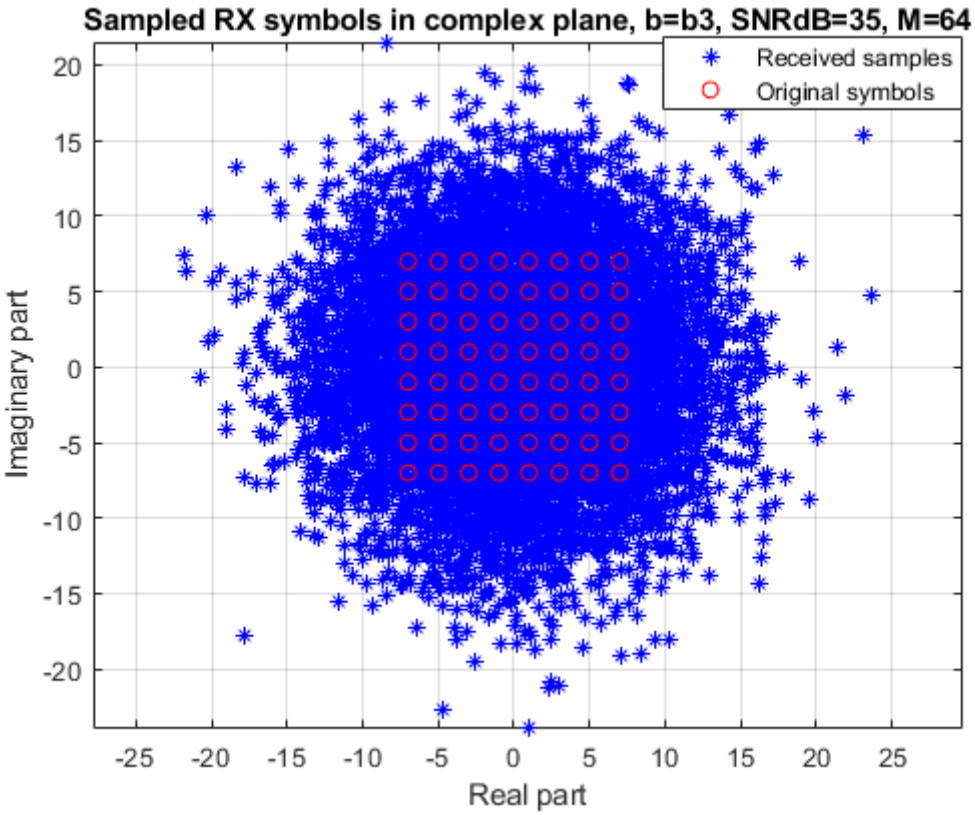
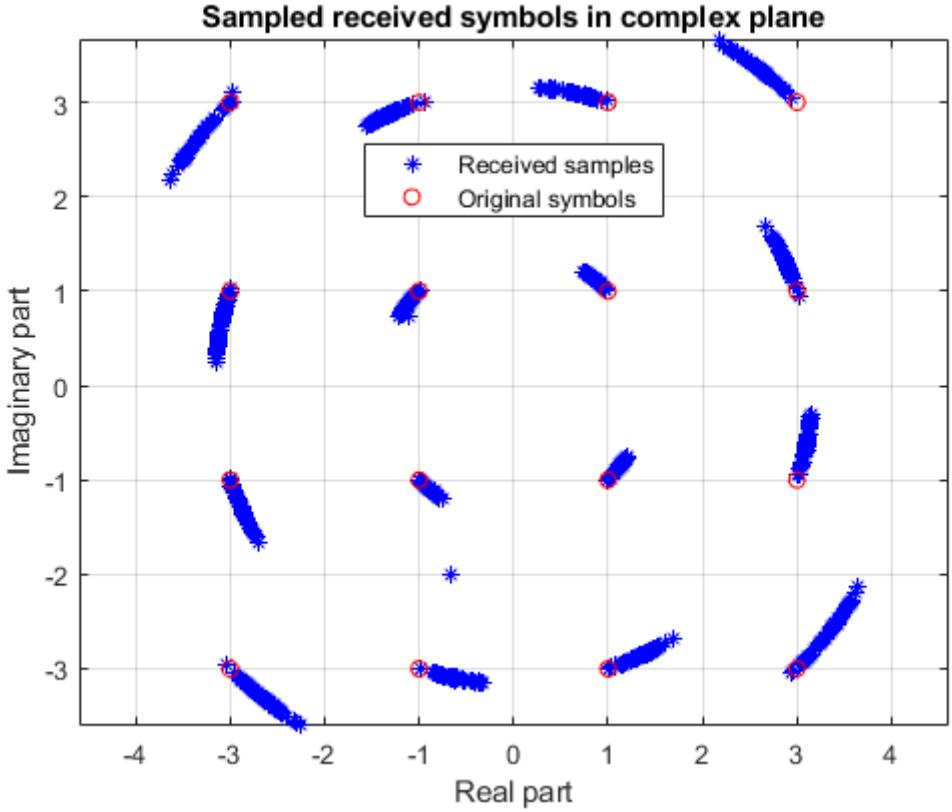
-10
-15
-20
-25
-20
-15
-10
-5
0
5
10
15
20
25

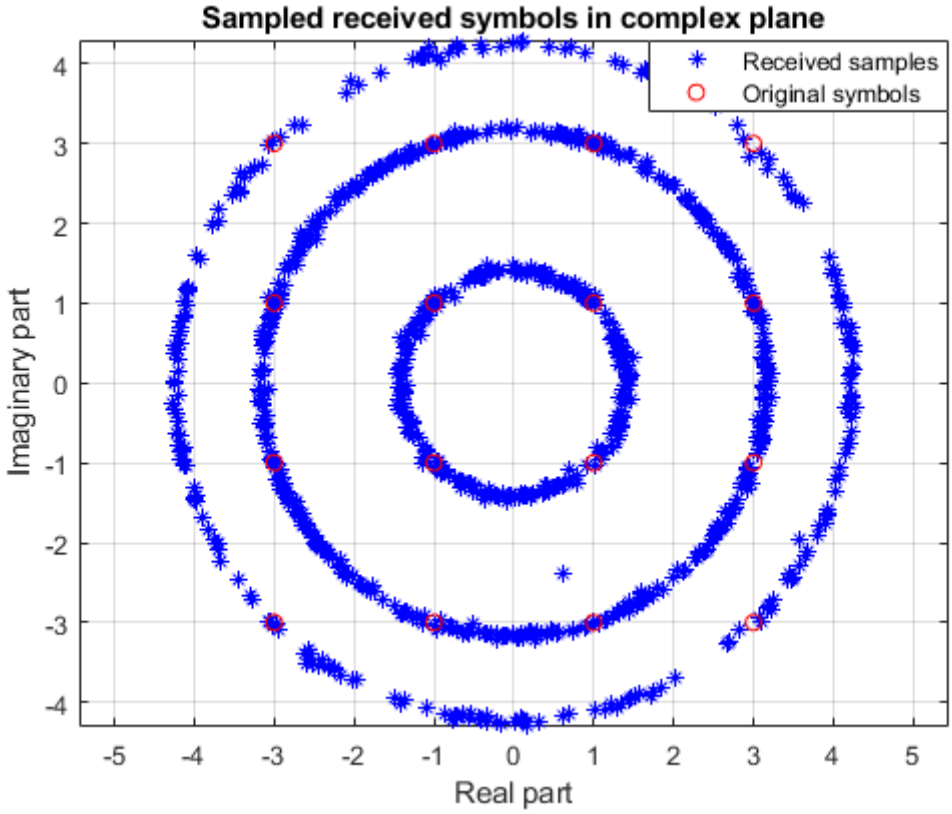


Task 4

- First set Beta = 100 and plot the RX signal constellation and explain what you see.



- Then repeat by changing the Beta = 5000 and plot and comment again the RX signal constellation. Would the RX still be able to reliably decode/detect the received signal?


Sampled received symbols in complex plane
Received samples
Original symbols
Imaginary part
Real part
4
3
2
1
0
-1
-2
-3
-4
-5
-4
-3
-2
-1
0
1
2
3
4
5