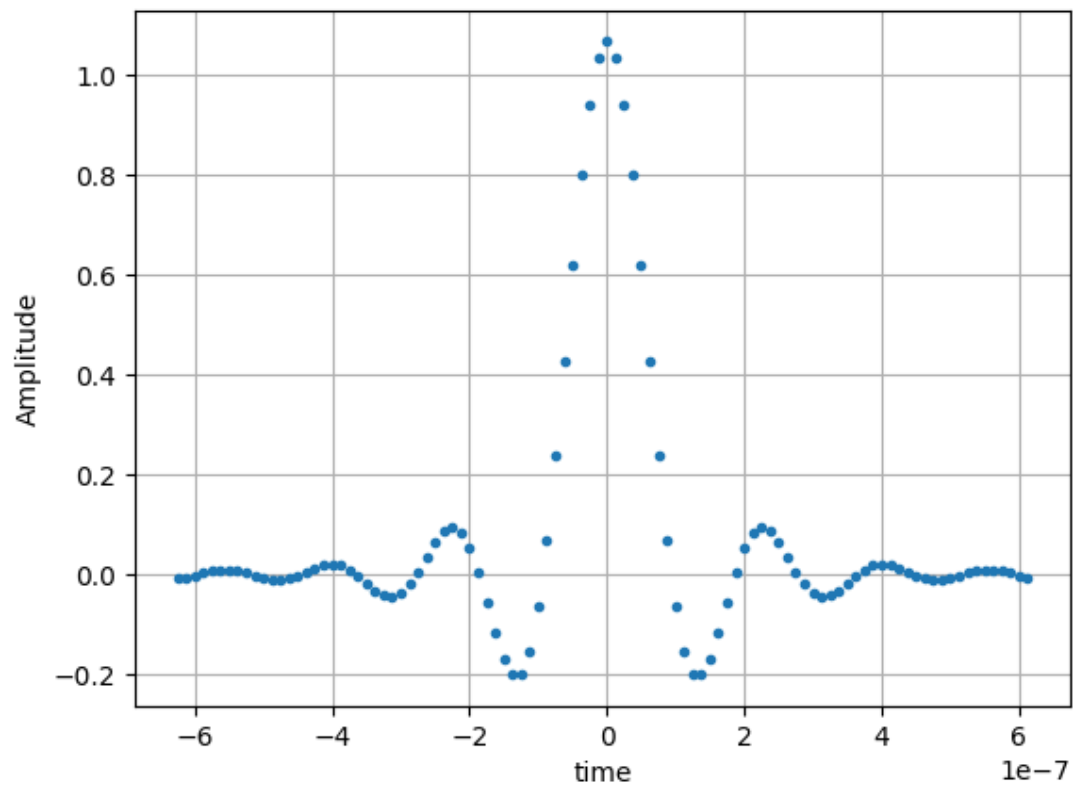
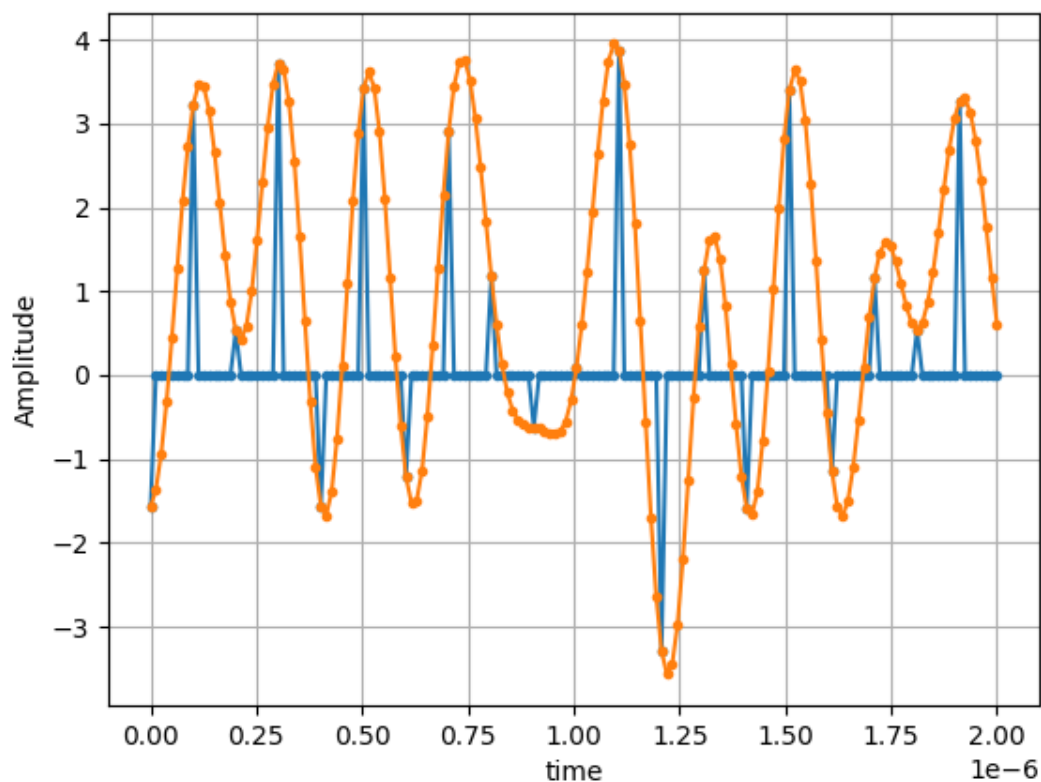


Symbols Generated random in nature – changes with each run of program



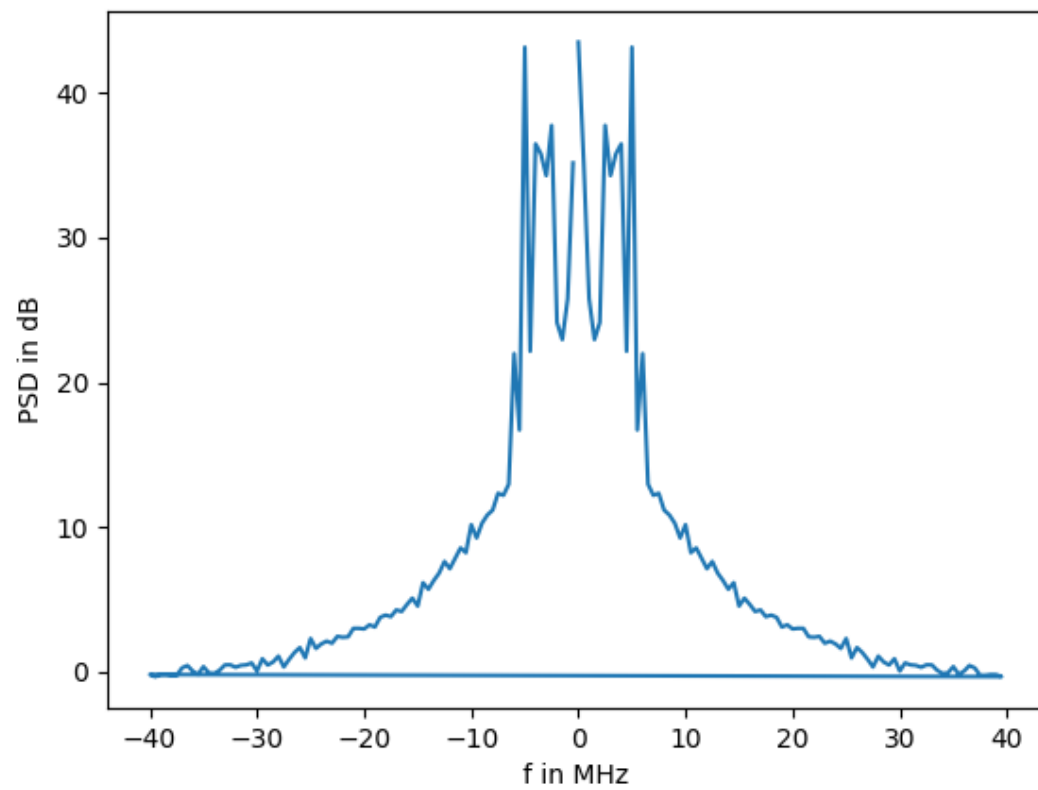
Impulse response of a pulse shaping filter – RRC (Root Raised Cosine)



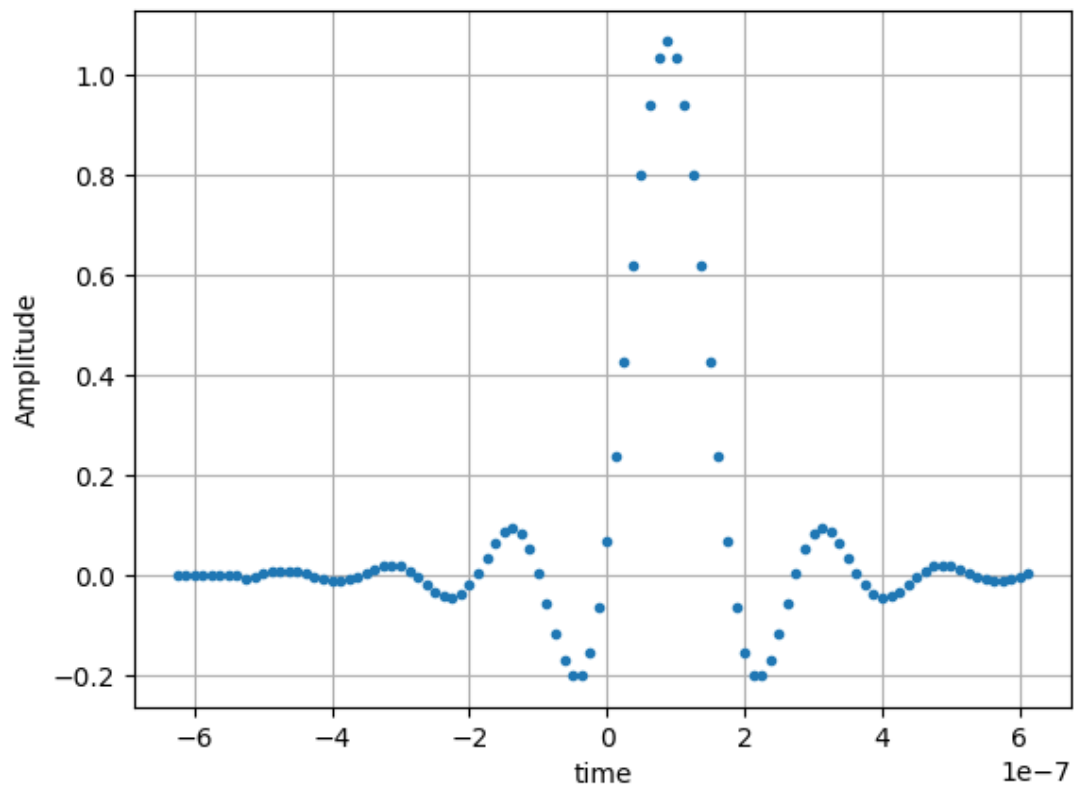
Orange color curve shows RRC pulse when convolved with padded Symbol Stream. Blue color plot marks the instances when symbol was sent that is $k \cdot T_s$ where k is integer and T_s (symbol duration) is 0.1 micro seconds that helps to get desired 20 Mbps speed.

2 bits in 0.1 micro seconds that in 1 seconds $1/(0.1 \cdot 10^{-6})$ pulses and each pulse transmit 2 bits hence in second 20 megabits, hence transmission rate is 20Mbps.

We can observe we are not getting the accurate symbol value in transmitted signal at time when time stamps when symbol was sent this is because RRC is not zero at T_s hence resulting in Inter Symbol Interference (ISI).

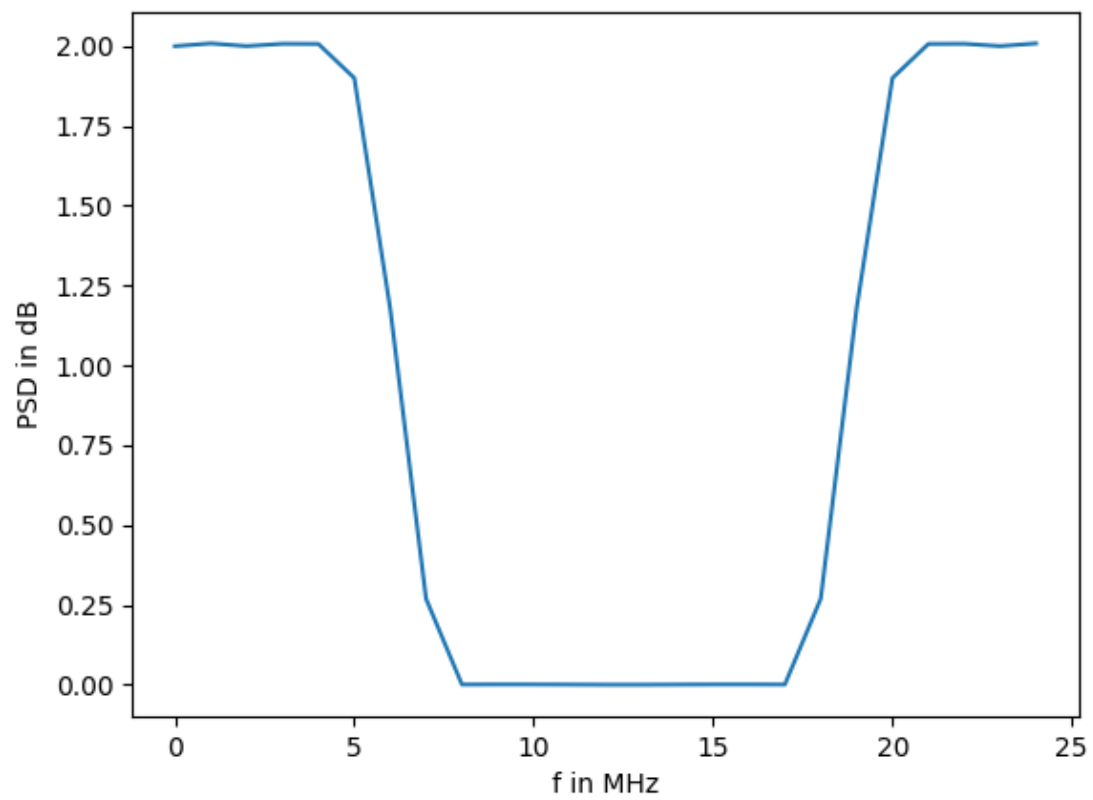


Spectrum of a modulated (transmitted) signal

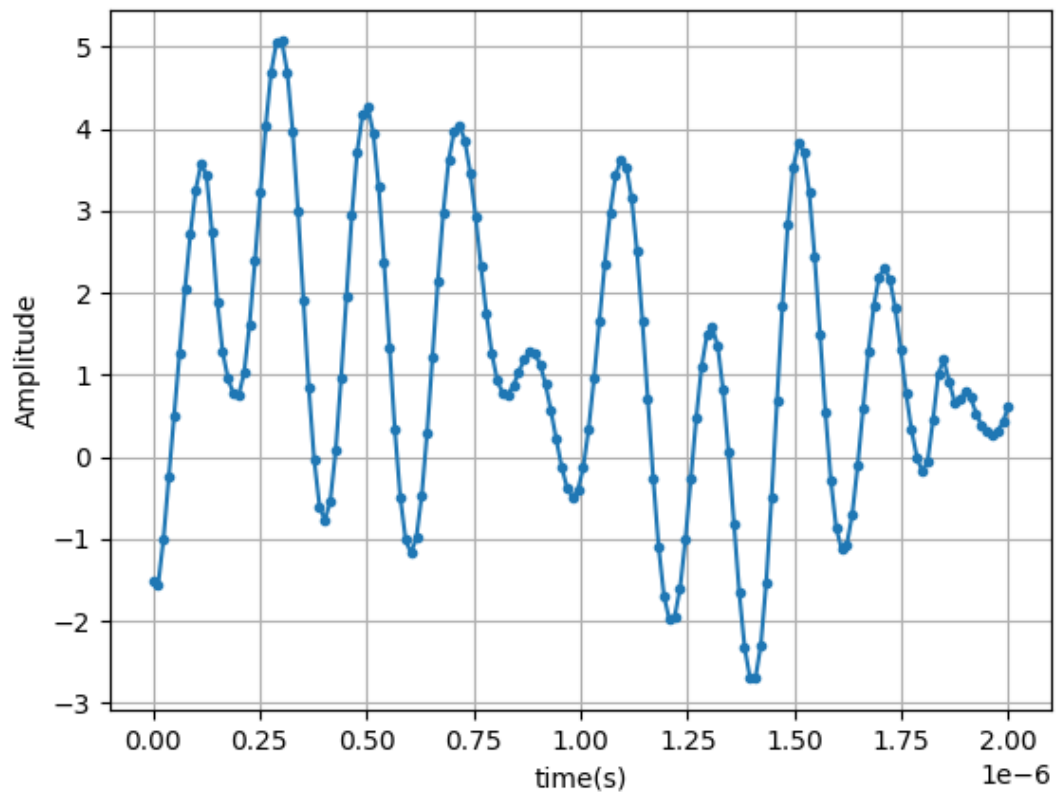


Impulse response of a matched filter ($h(T_s - t)$) for maximum SNR

Spectrum of low pass filter



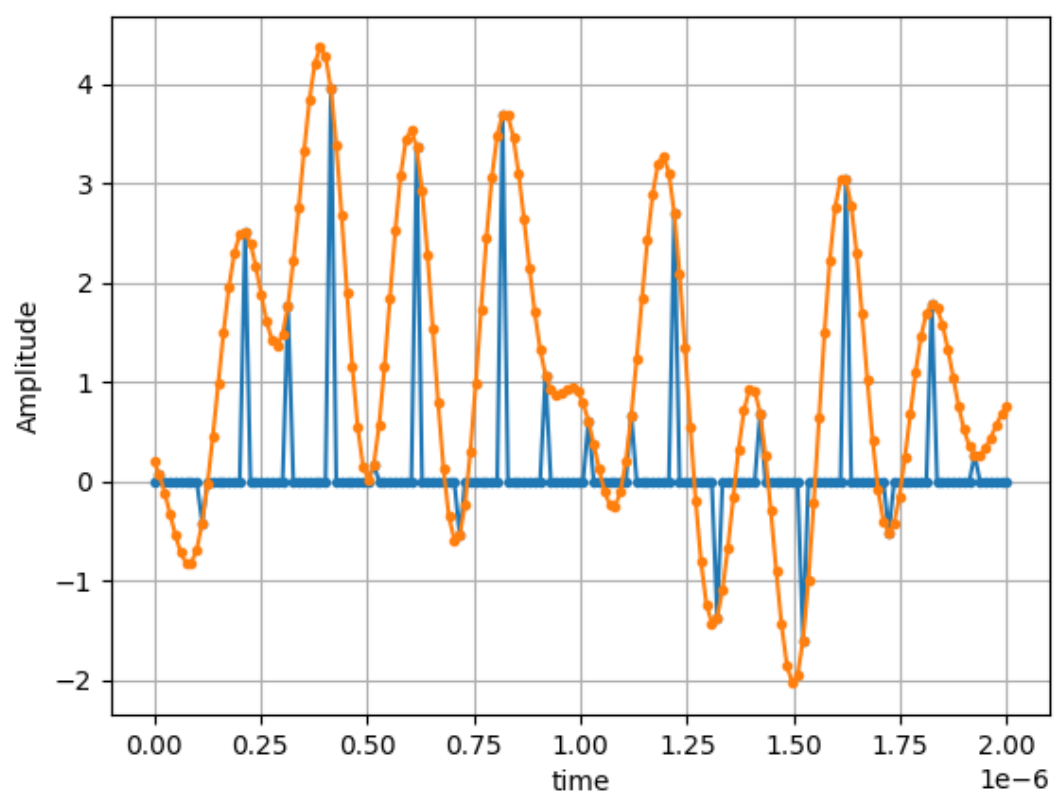
Now after passing through low pass filter the pass band signal the recovered signal which will be given to low pass filter is

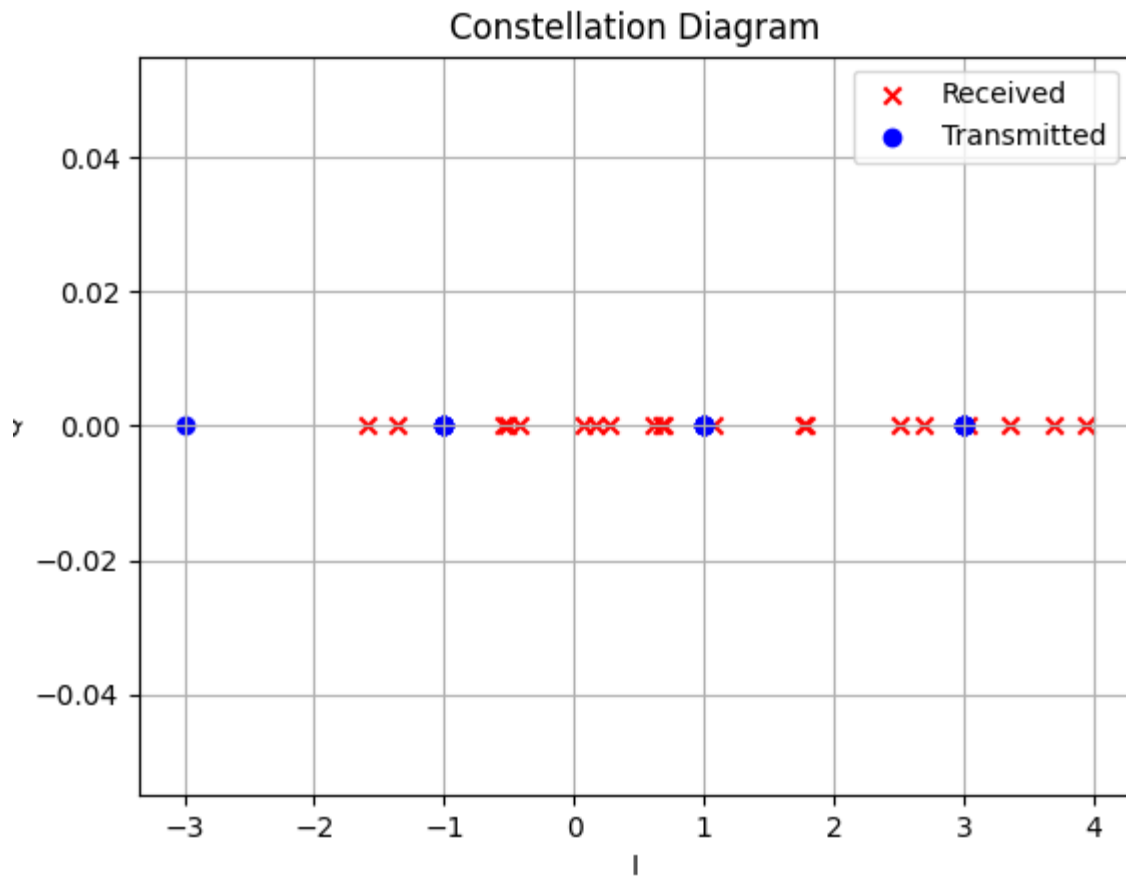


The signal has less transition due to removal of high frequency component

Recovered signal after passing through Match Filter given below

MatchFilter response to transmitted Signal and instants where we transmitted Symbols



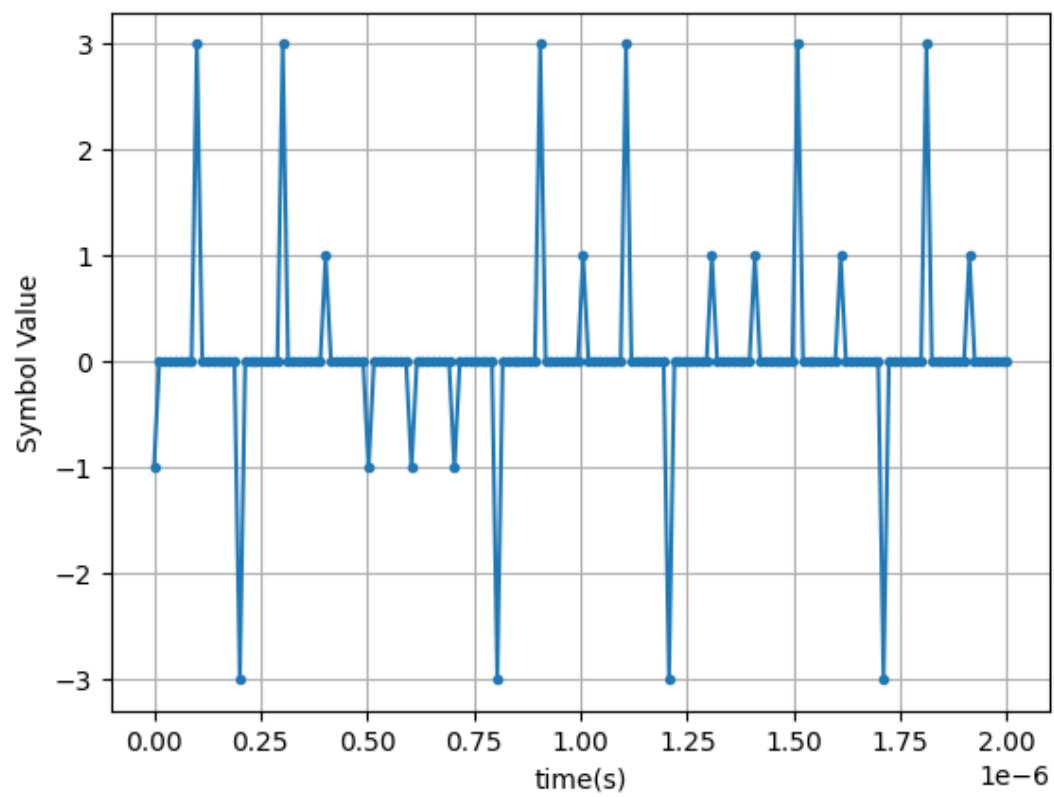


Constellation Diagram

The constellation diagram is bad due to ISI and removal of high frequency.

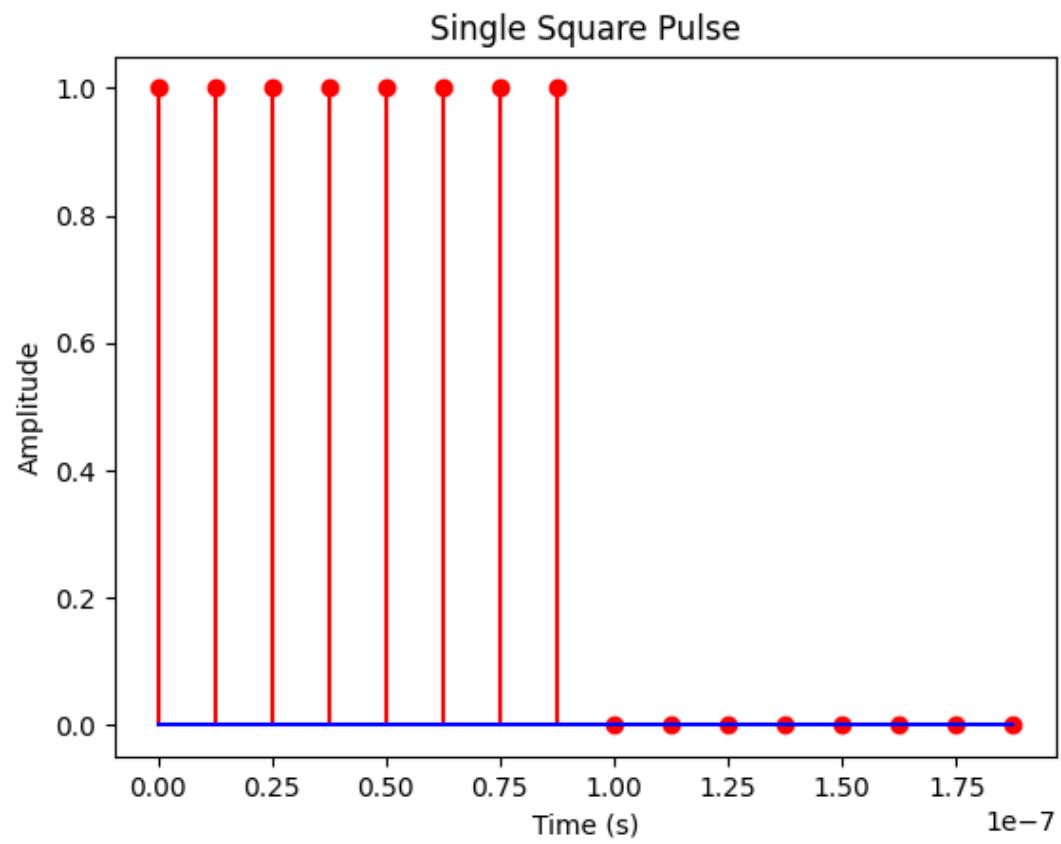
Case 2 When Impulse Response of filter is square pulse

Note pulse duration is $T_s = 0.1 \times 10^{-6}$ seconds (0.1 micro seconds)

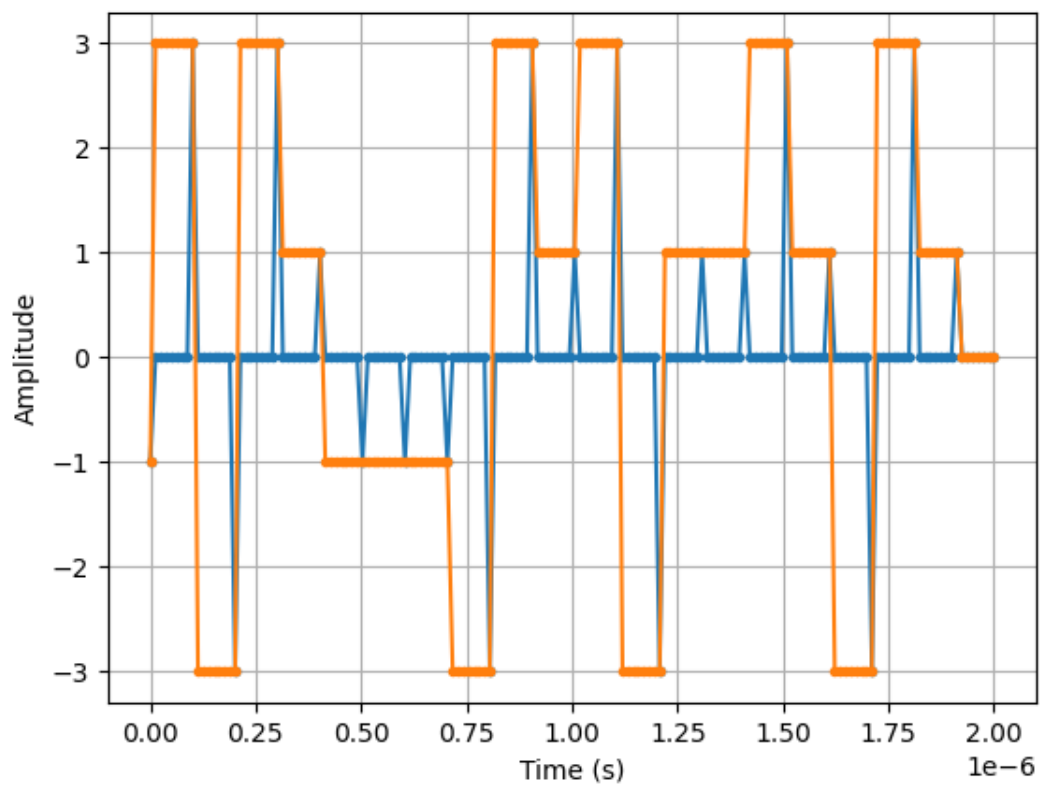


Symbols Generated random in nature – changes with each run of program

Figure 1

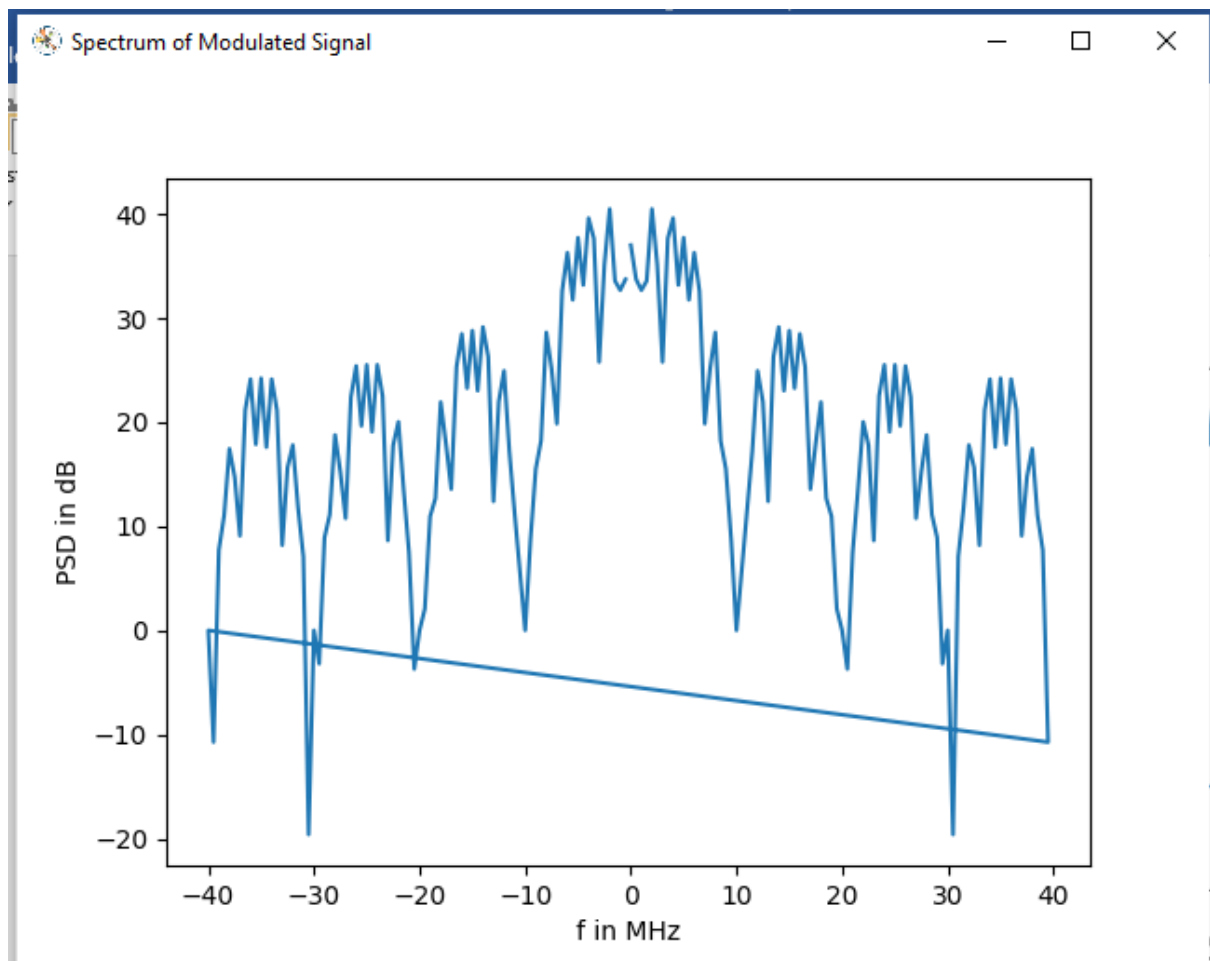


Impulse response of a pulse shaping filter – Square Pulse



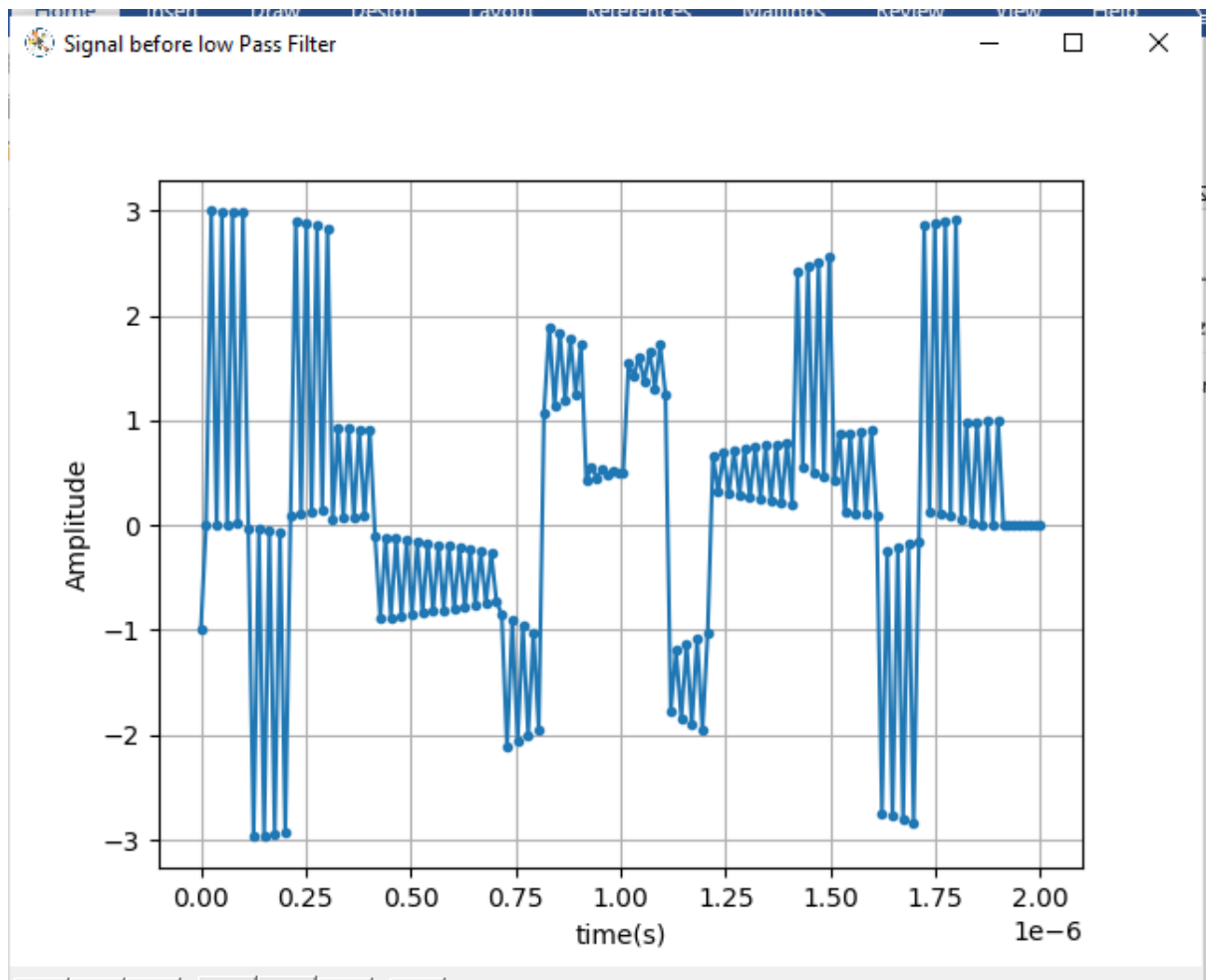
Orange color curve shows square pulse when convolved with padded Symbol Stream. Blue color plot marks the instances when symbol was sent that is $k \cdot T_s$ where k is integer and T_s (symbol duration) is 0.1 micro seconds that helps to get desired 20 Mbps speed.

No ISI observed

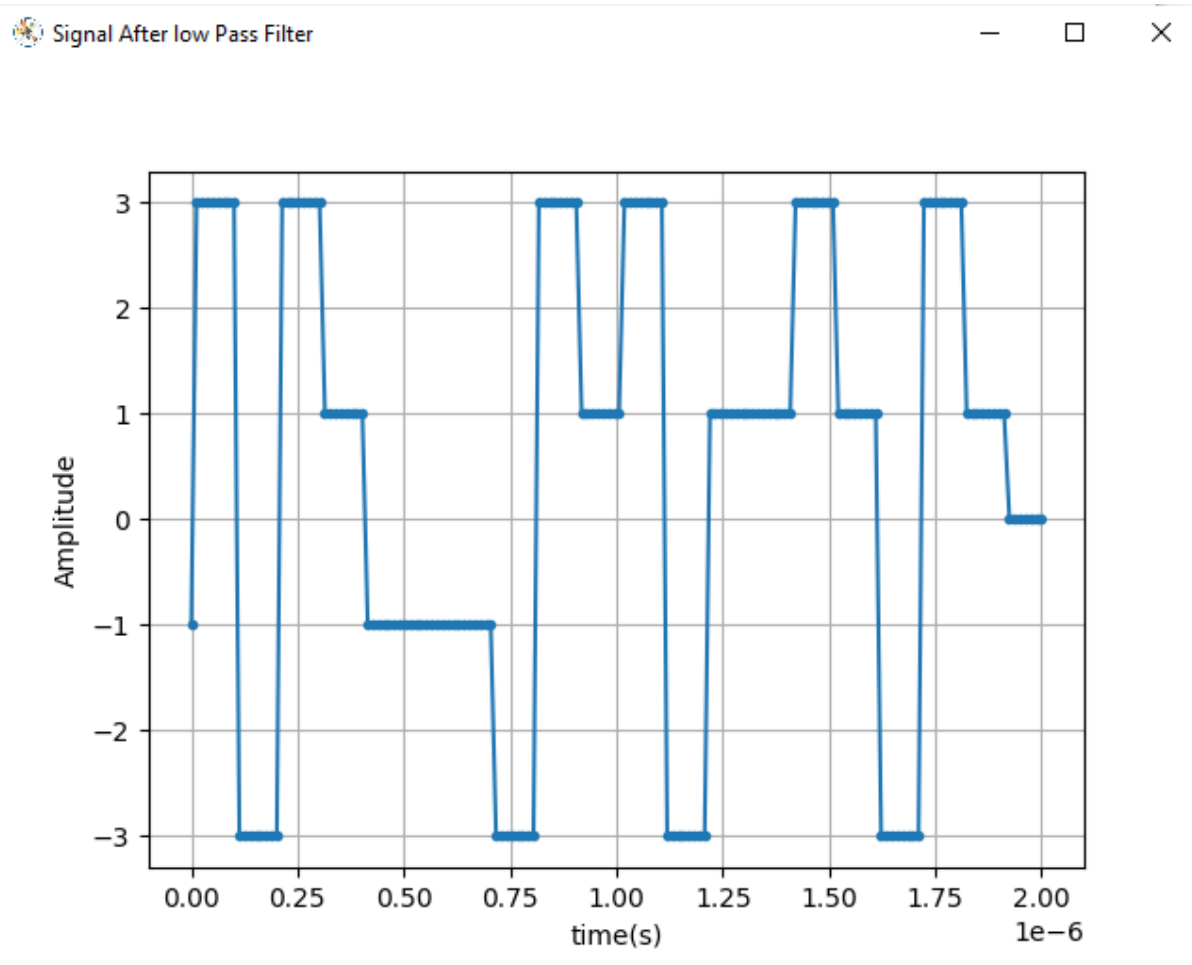


Spectrum of a modulated (transmitted) signal

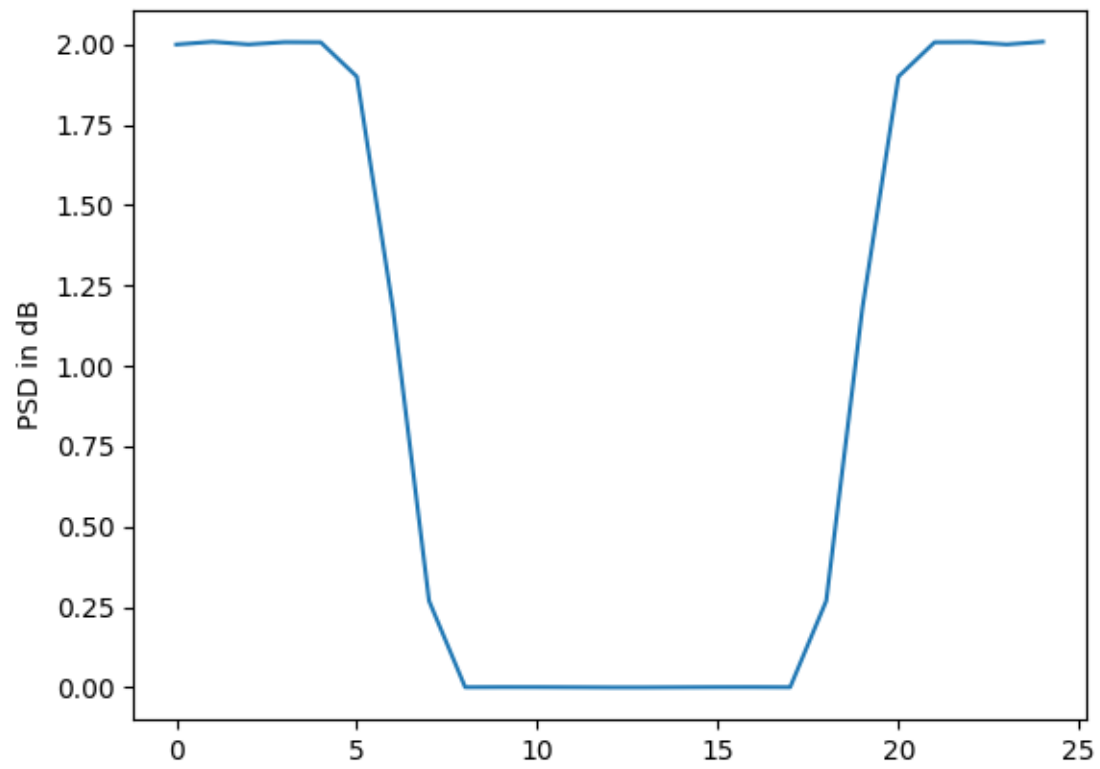
Passband signal before low pass filtering below

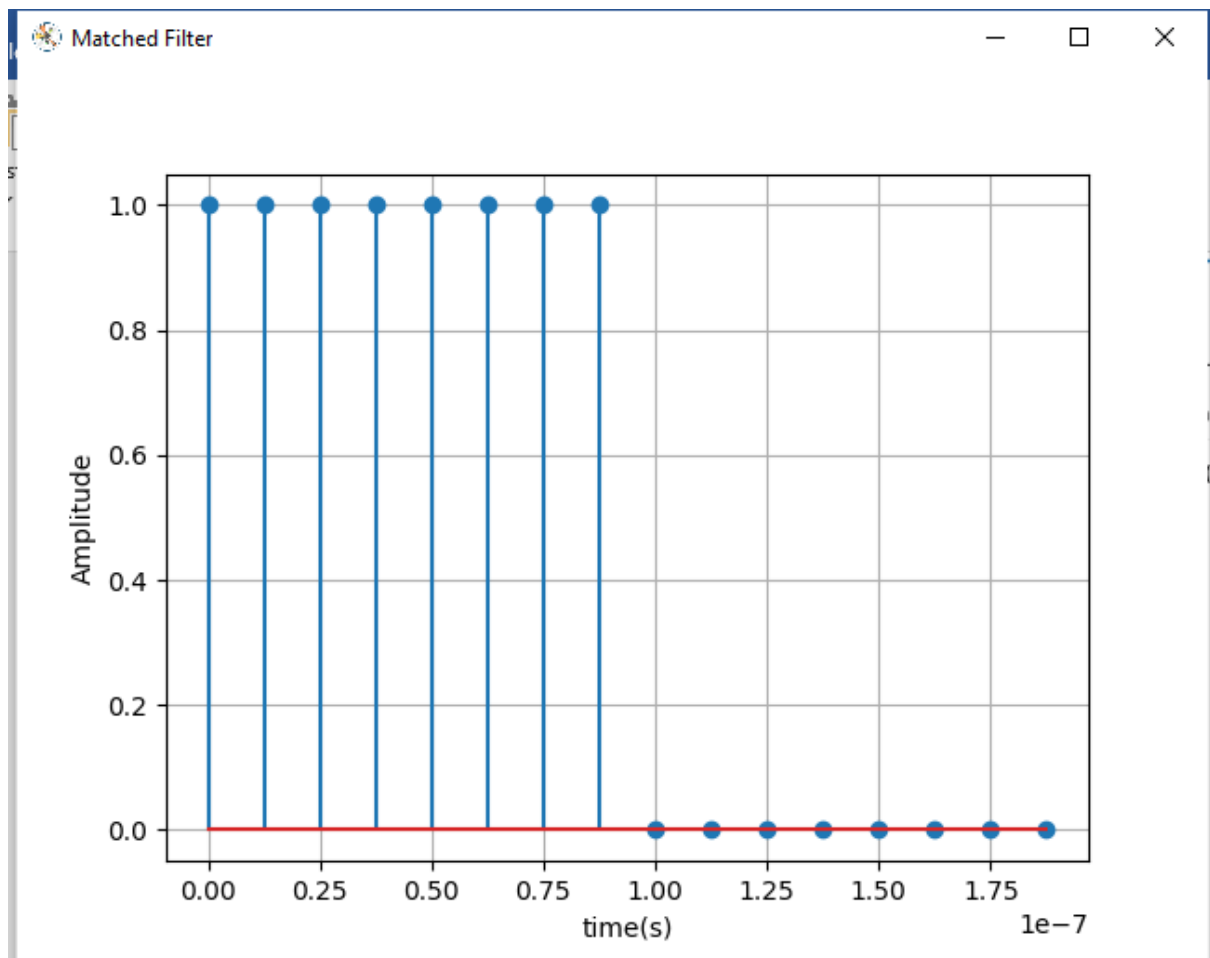


Signal after low pass filtering and which will be given to match filter given below

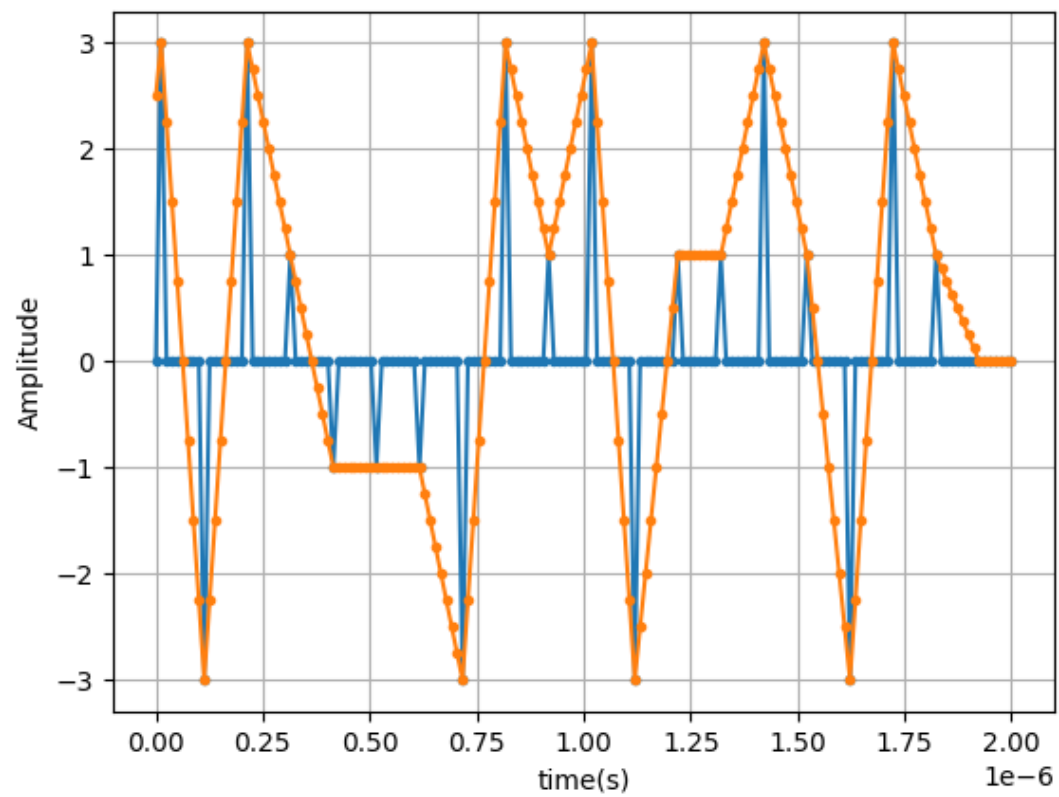


Filter response (Low pass filter)



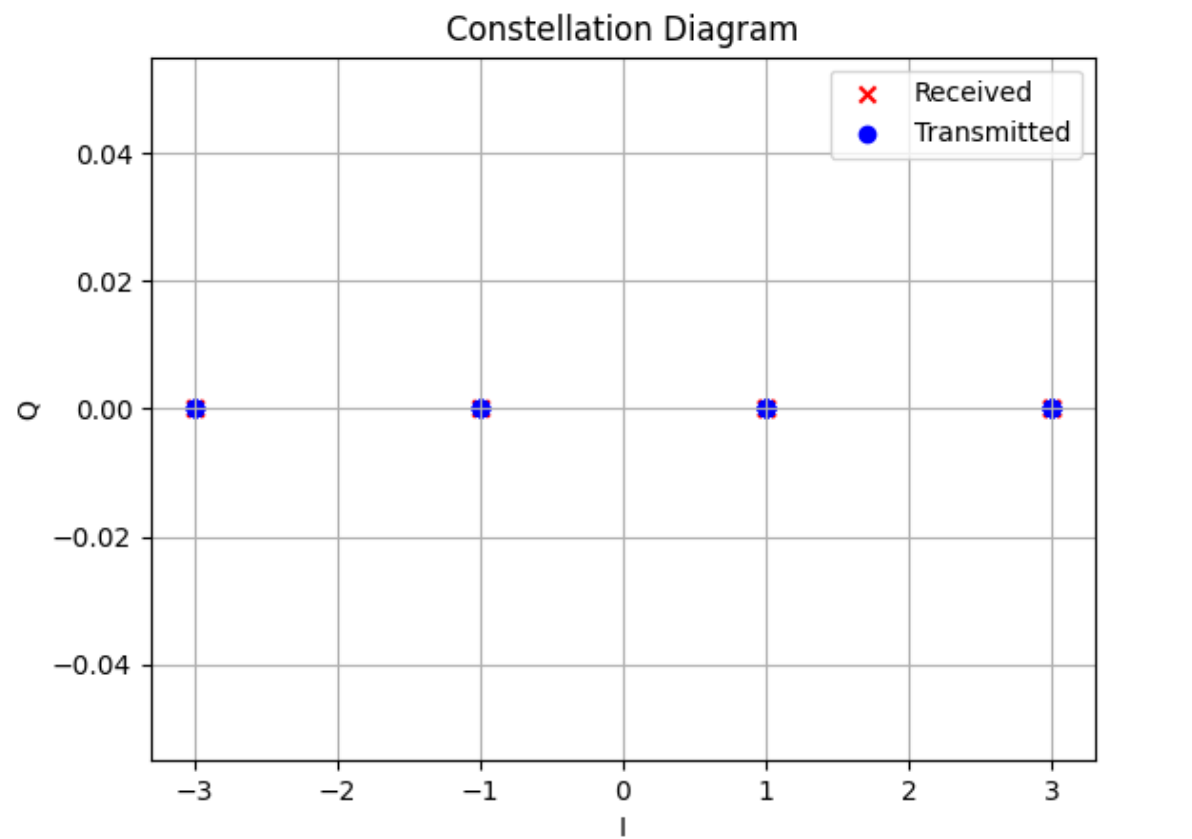


Impulse response of a matched filter same as pulse shaping filter



Orange color plot show signal after passing matched filter

Figure 3



Constellation Diagram

Receive exactly what I am transmitting.