Faculty of Engineering and Technology
Electrical and Computer Engineering Department
Communication Laboratory
ENEE4113
Prelab Exp 2 DSB-SC and SSB-SC

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Section: 6

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Software Prelab (Simulink Matlab)

Message signal:

$$m(t) = 0.85\cos(2\pi(1000)t)$$

Carrier signal:

$$c(t) = 1\cos(2\pi(15k)t)$$

Figure 1 Information of Signals

Double Sideband Suppressed Carrier (DSB-SC) Modulation and Demodulation

DSB-SC Modulation Simulink :

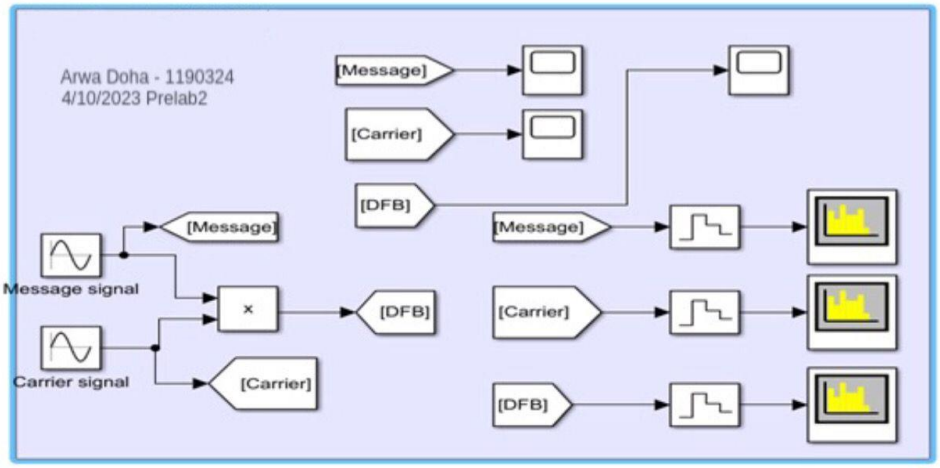

Figure 2 DSB-SC Modulation Simulink

Message signal :

The message signal's amplitude stands at 0.85, a critical factor in determining the extent of modulation. It is imperative to maintain a modulation depth below 1 to prevent any potential distortion from occurring.

Message signal in time domain

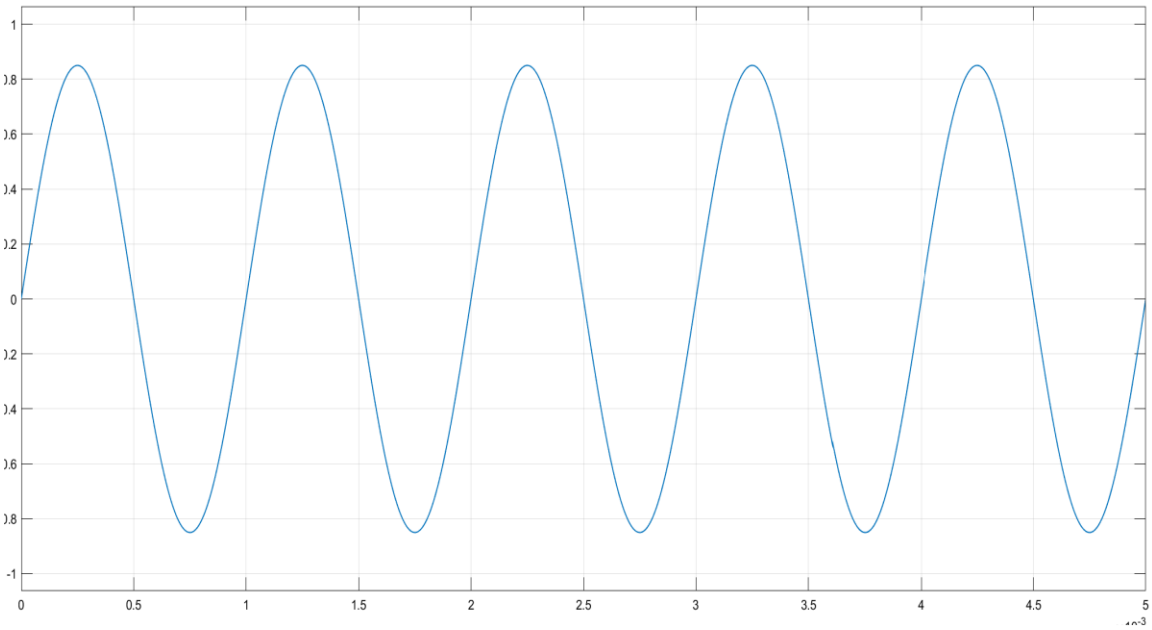

Figure 3 Message signal (DSB-SC) in time domain

Message signal in frequancy domain:

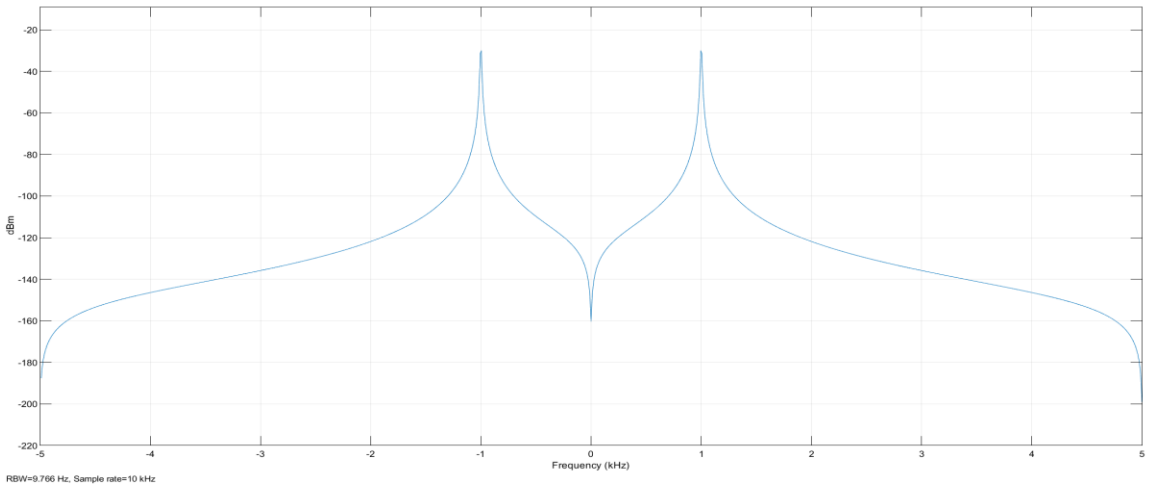

Figure 4 Message signal (DSB-SC) in freq domain

Carrier Signal

The carrier frequency, set at 15 kHz, is notably higher than the frequency of the message signal, which is 1 kHz. This frequency difference serves the purpose of elevating the message signal to a more efficient transmission and modulation range.

Carrier signal in time domain:

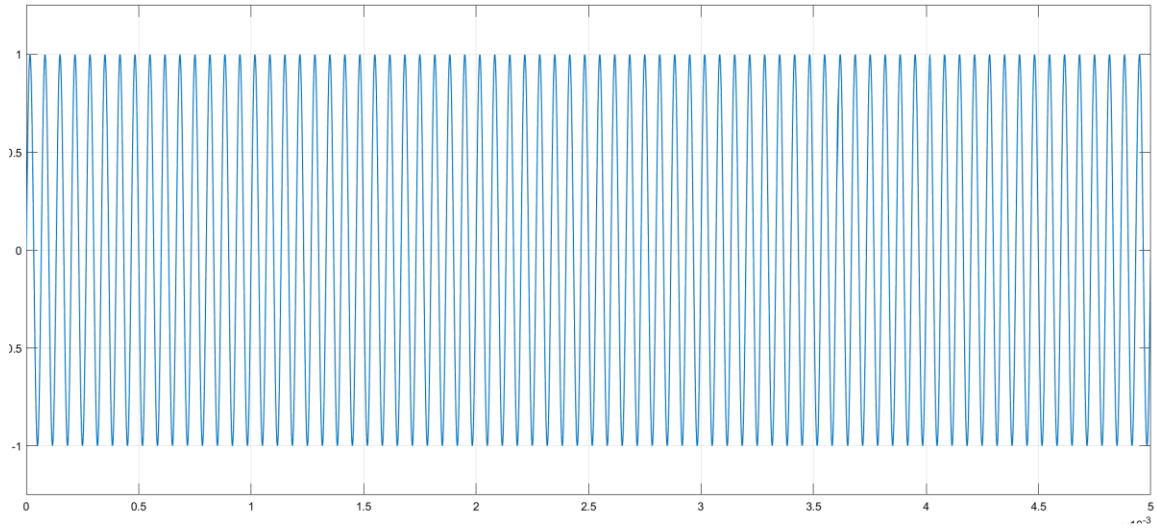

Figure 5 Carrier signal (DSB-SC) in time domain

Carrier signal in frequancy domain:

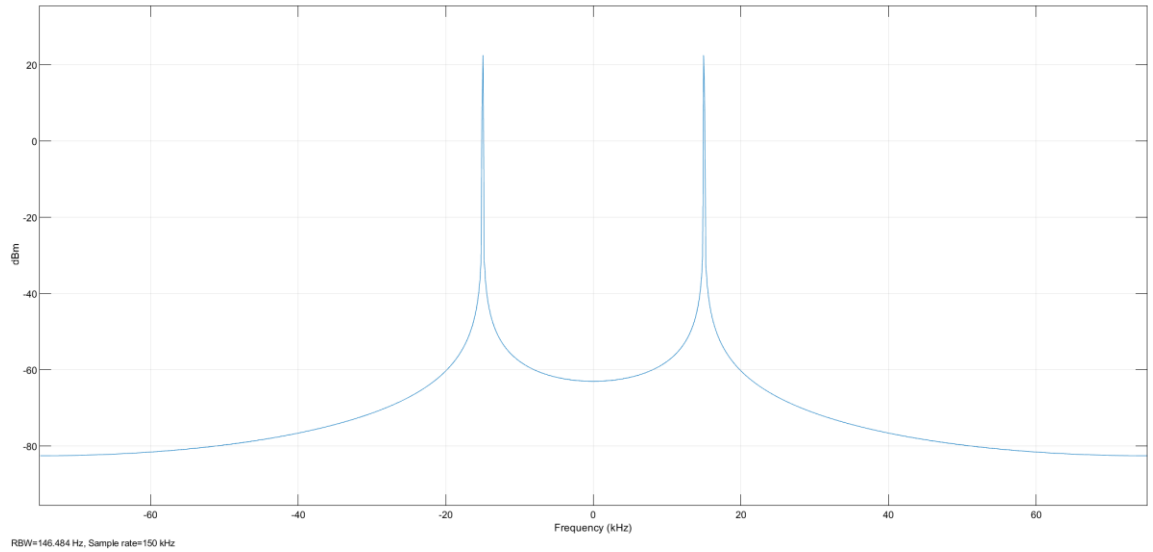

Figure 6 Carrier signal (DSB-SC) in freq domain

Modulated signal s(t):

The carrier signal undergoes modulation by the message signal through a multiplication process. Consequently, the outcome is a Double Sideband Suppressed Carrier (DSB-SC) modulated signal, encompassing both upper and lower sidebands, while the carrier signal itself is eliminated or suppressed.

Modulated signal in Time Domain :

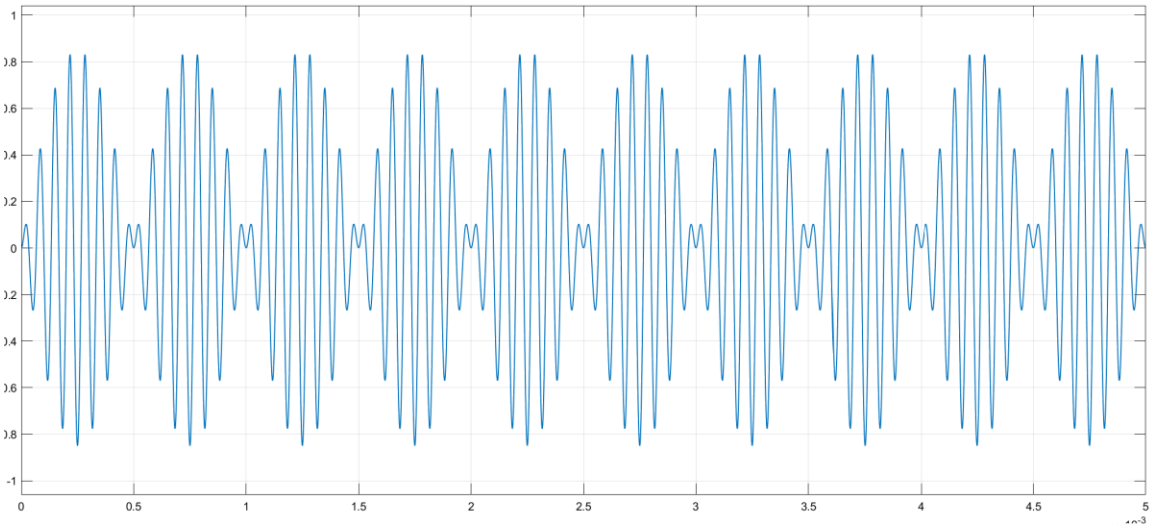

Figure 7 S(t) in time domain in DSB

Modulated signal in Frequency Domain :

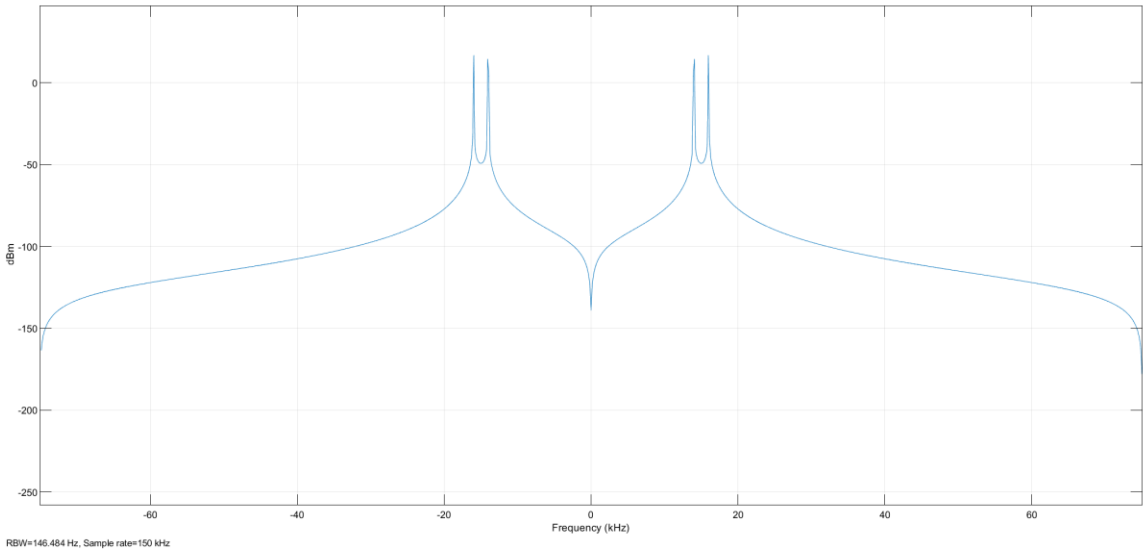

Figure 8 S(t) in freq domain in DSB

Parameters:

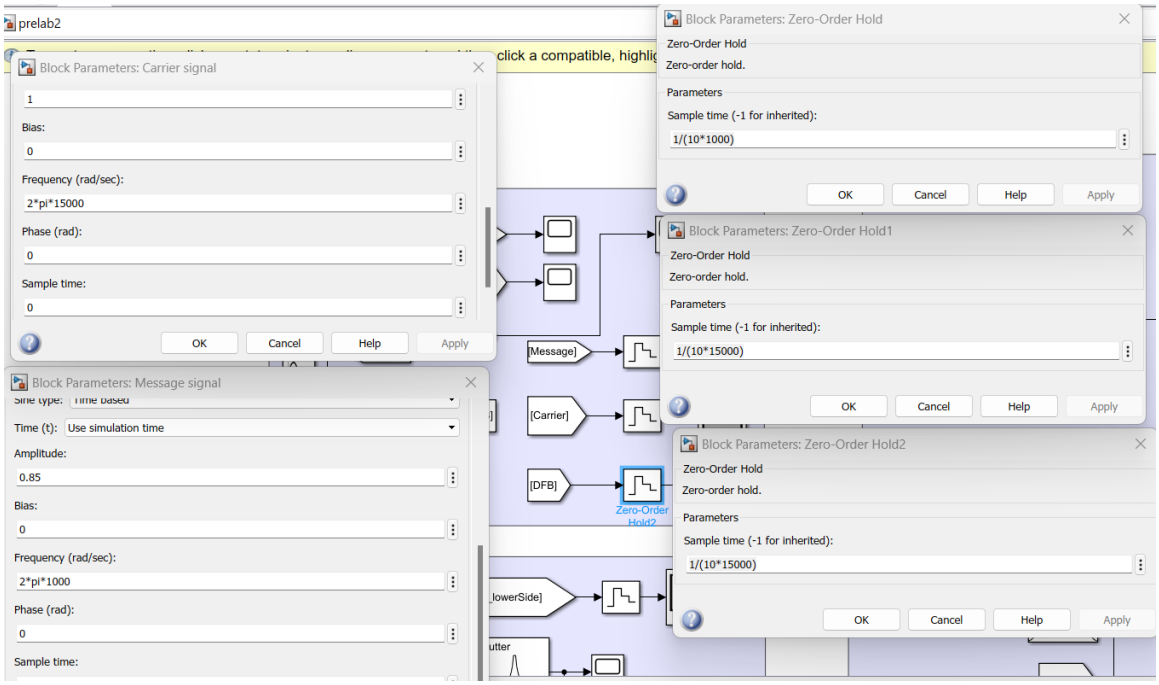

Figure 9 parameters used in DSB-SC Modulation Simulink

Demodulation:

Demodulating a DSB-SC signal entails the extraction of the original message signal by removing the carrier component from the modulated signal.

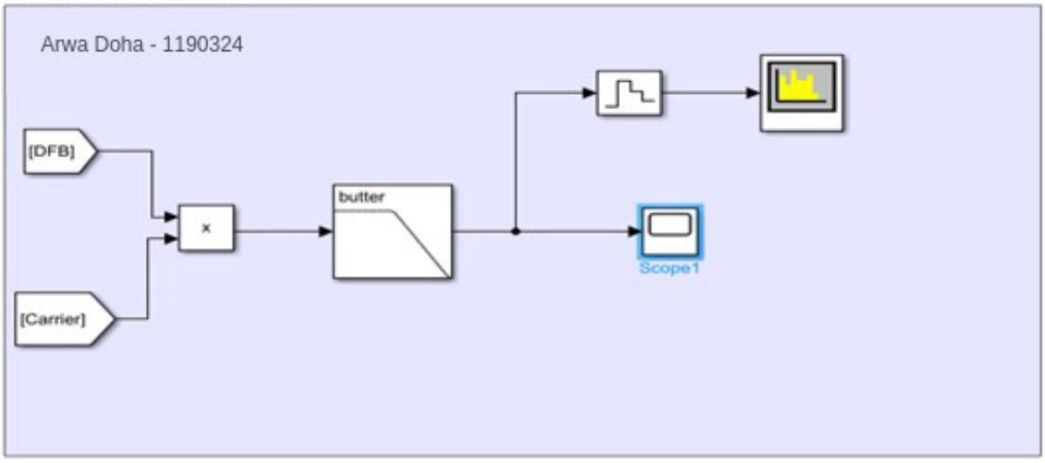

Figure 10 DSB-SC Demodulation Simulink

Demodulation in frequency domain :

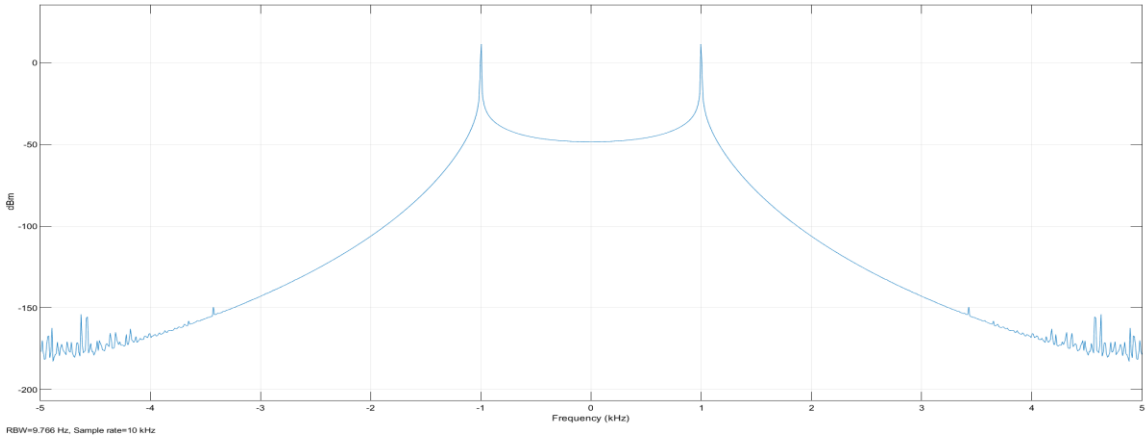

Figure 11 DSB-SC Demodulation frequency domain

Demodulation in time domain

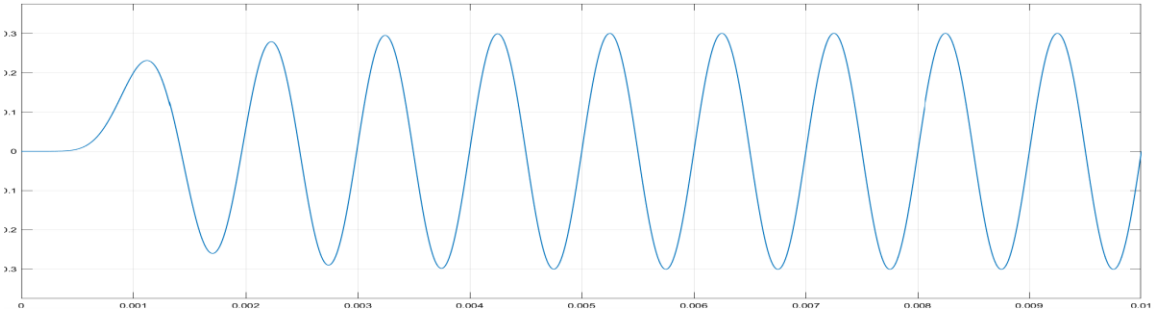

Figure 12 DSB-SC Demodulation in time domain

During the demodulation process of DSB-SC, the carrier is effectively removed, thereby revealing the original message signal. This phenomenon is evident in both the time domain, as illustrated in Figure 12, and the frequency domain, as depicted in Figure 11 representations.

Parameters:

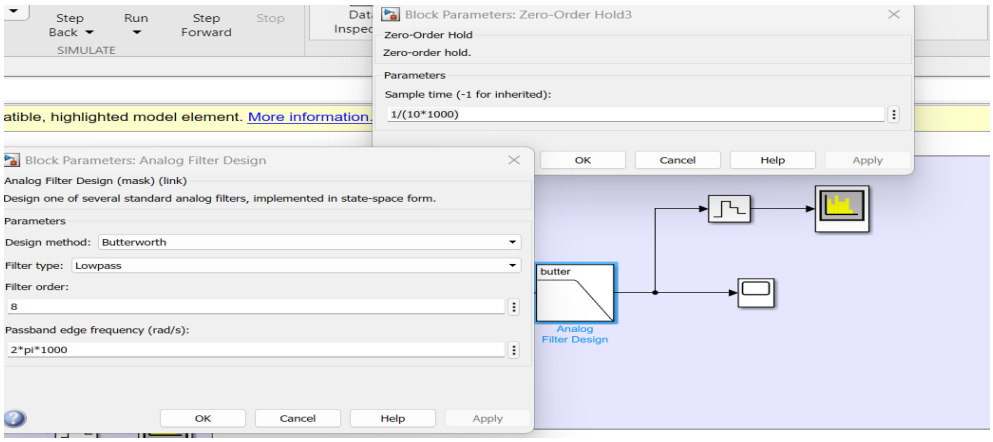

Figure 13 parameters used in DSB-SC Demodulation Simulink

Single SideBand Suppressed Carrier (SSB-SC) Modulation and Demodulation

SSB-SC Modulation → Method1: lower Side

The modulation process involves the message signal modulating the carrier signal, akin to DSB-SC modulation. However, in the lower sideband scenario, both the upper sideband and the carrier are suppressed, resulting in only the lower sideband being present in the modulated signal.

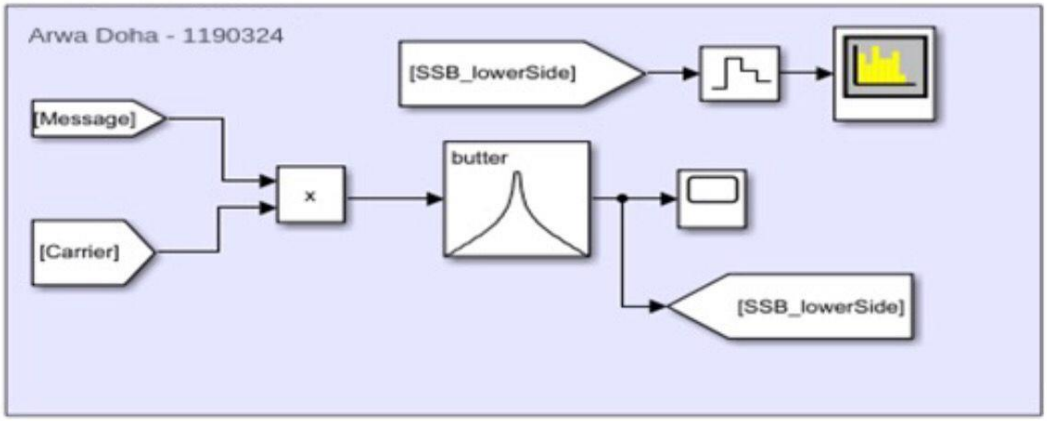

Figure 14 SSB-SC Modulation lower Side lower Side

Time domain in SSB-SC Modulation method1:

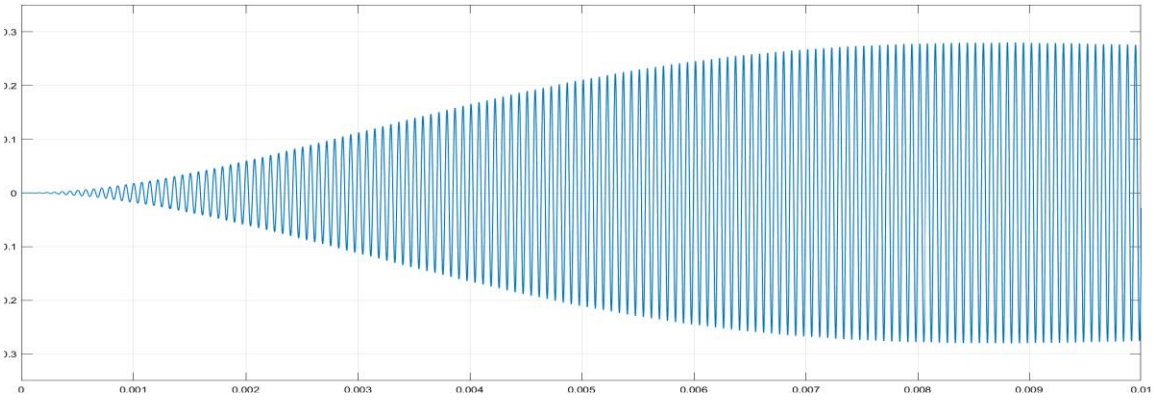

Figure 15 Time domain in SSB-SC Modulation method 1

Frequency domain in SSB-SC Modulation method1:

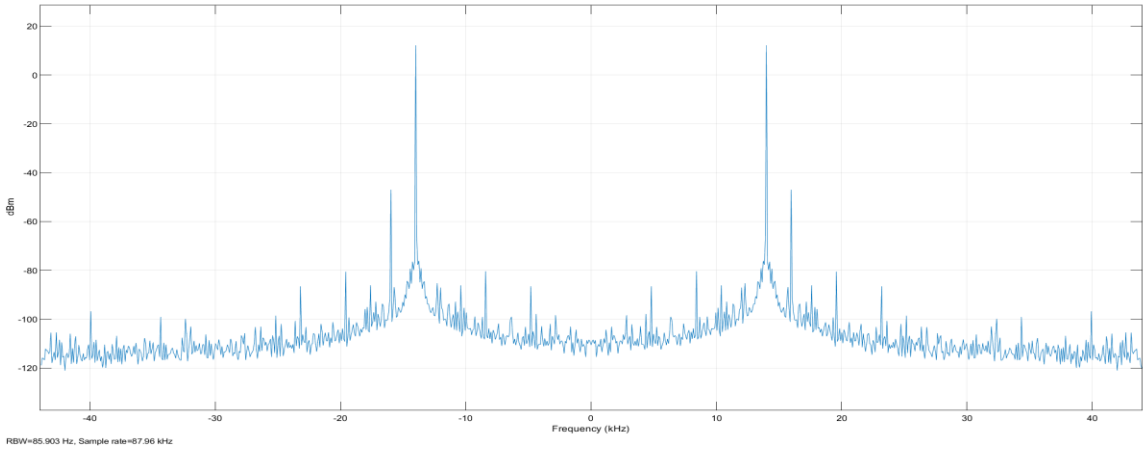

Figure 16 Frequency domain in Single suppressed carrier Modulation method 1

In the case of single suppressed carrier modulation (lower sideband), the message signal modulates the carrier signal in a manner similar to DSB-SC modulation. However, in this specific scenario, both the upper sideband and the carrier are suppressed, leading to the transmission of only the lower sideband.

This modulation process is visually depicted in Figure 14. The time domain representation is observable in Figure 15, whereas Figure 16 illustrates the frequency domain representation of this modulation technique.

Parameters

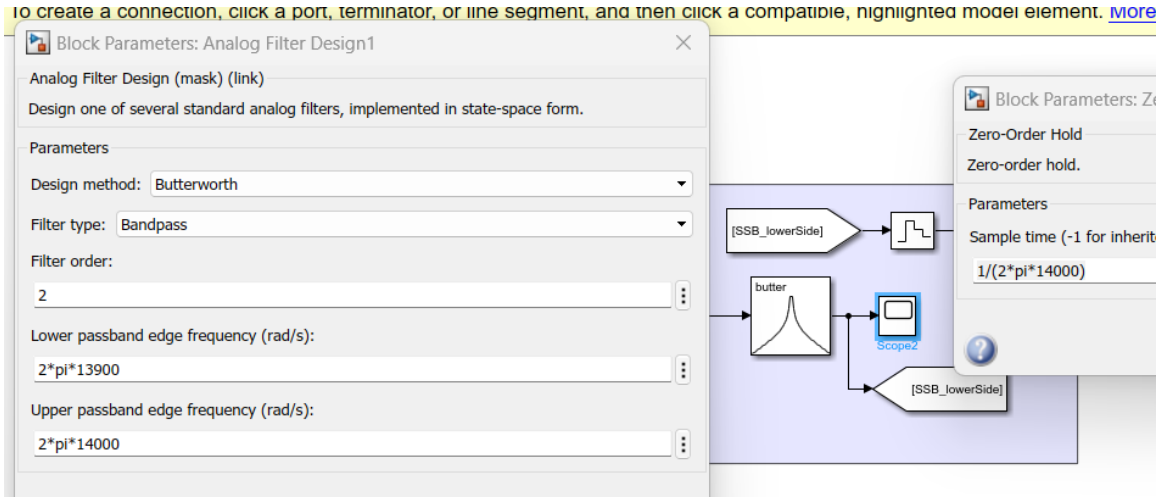

Figure 17 Parameters used in SSB-SC Modulation lower Side simulink

SSB-SC Demodulation lower sideband

Demodulating the lower sideband of (SSB-SC) signal involves the reconstruction of the original message signal from the received signal. This process allows for the extraction of the original information carried by the lower sideband.

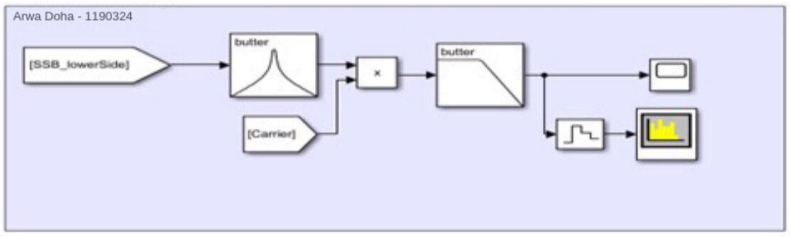

Figure 18 SSB-SC DeModulation lower Side lower Side simulink

Time domain of SSB-SC DeModulation lower sideband:

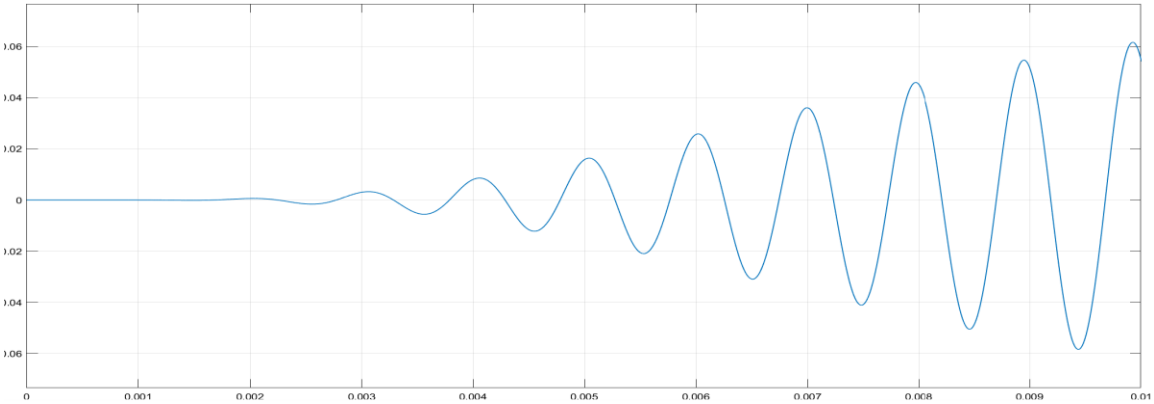

Figure 19 Time domain of SSB-SC DeModulation lower sideband

Frequancy domain of SSB-SC DeModulation lower sideband

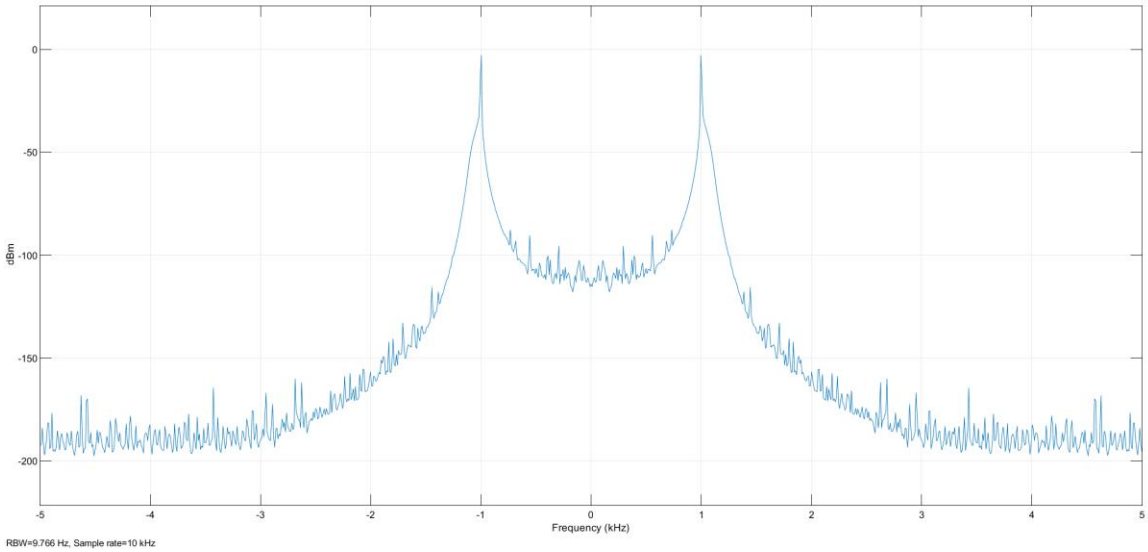

Figure 20 SSB-SC Demodulation LS in freq domain

During the demodulation process of the Single Suppressed Carrier Modulation Method 1 (lower side), the primary objective is to reconstruct the original message signal from the received signal. This demodulation process aims to recover the original information contained within the lower sideband.

The demodulation process is visually represented in Figure 18. The time domain depiction of the demodulation can be observed in Figure 19, and Figure 20 displays the frequency domain representation of the demodulated signal for Method 1 of single suppressed carrier modulation (lower side).

Parameters:

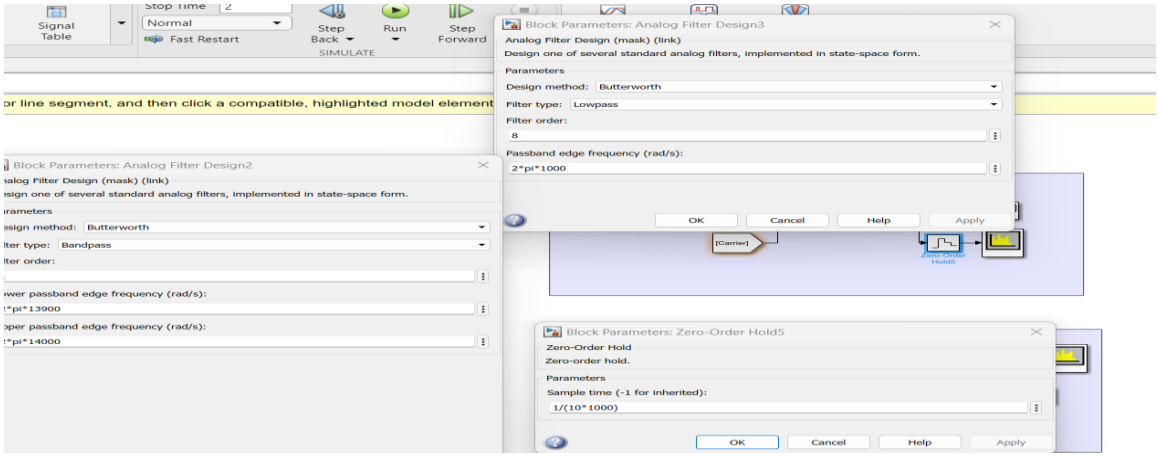

Figure 21 Parameters used in SSB-SC DeModulation LS simulink

SSB-SC Modulation→ Method2: lower Side

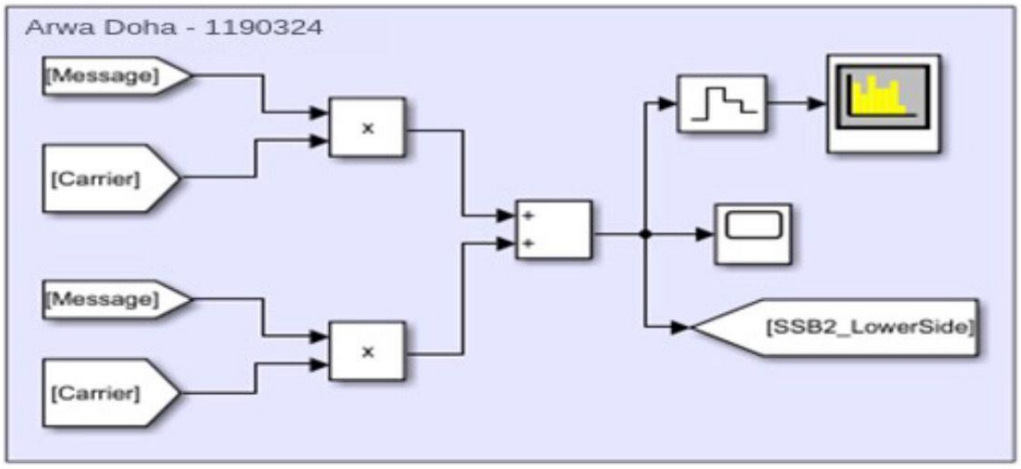

Figure 22 SSB-SC Modulation Method2(lower Side)

SSB-SC Modulation in Time Domain :

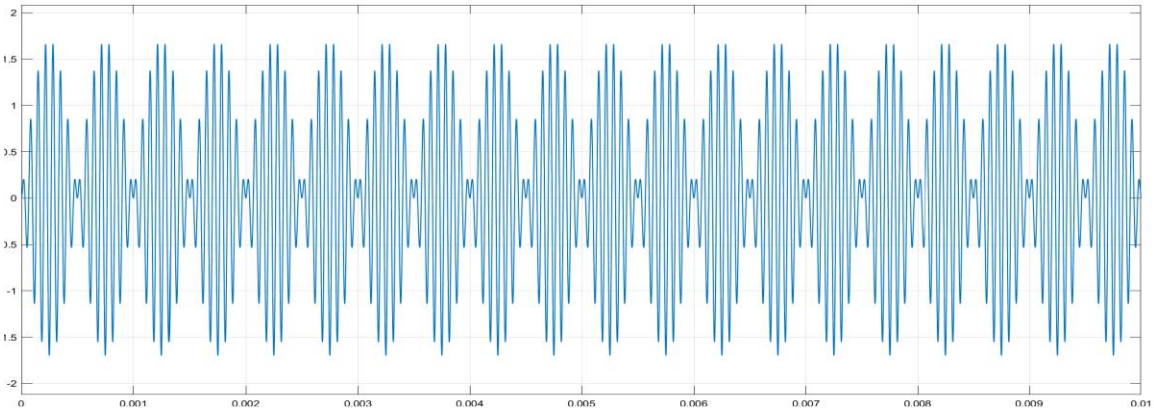

Figure 23 SSB-SC Modulation in time domin

SSB-SC Modulation in frequency Domain :

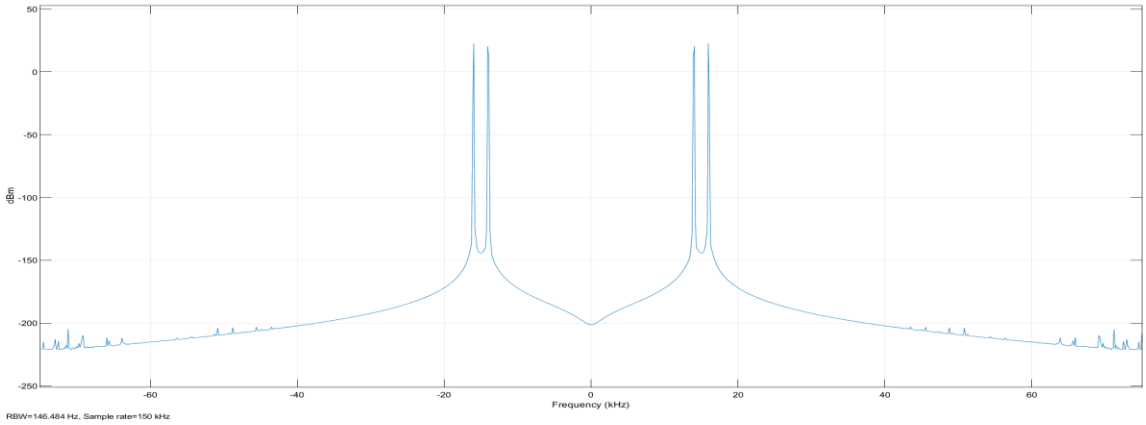

Figure 24 SSB-SC Modulation in frequency Domain

Parameters

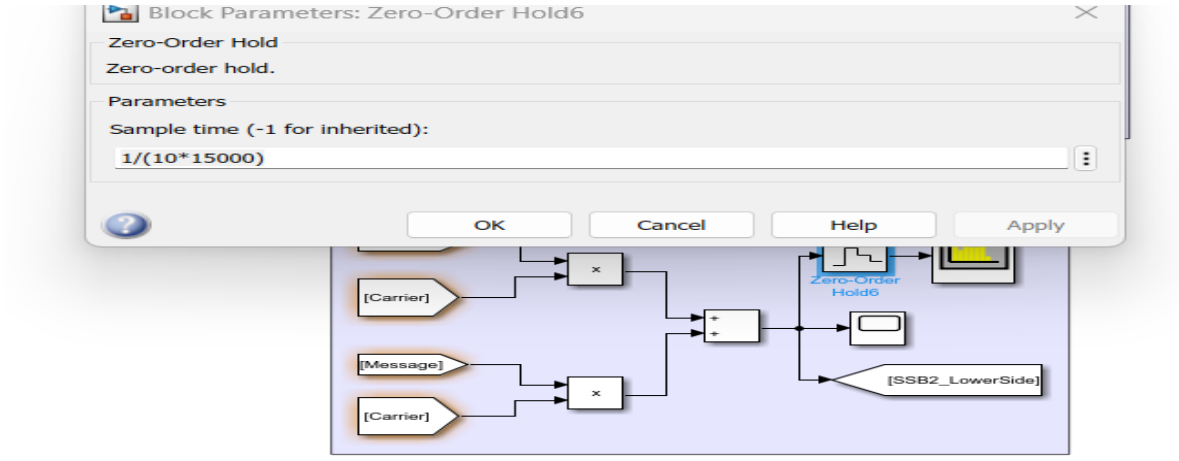

Figure 25 Parameters used in SSB-SC Modulation simulink

SSB-SC Demodulation Method2

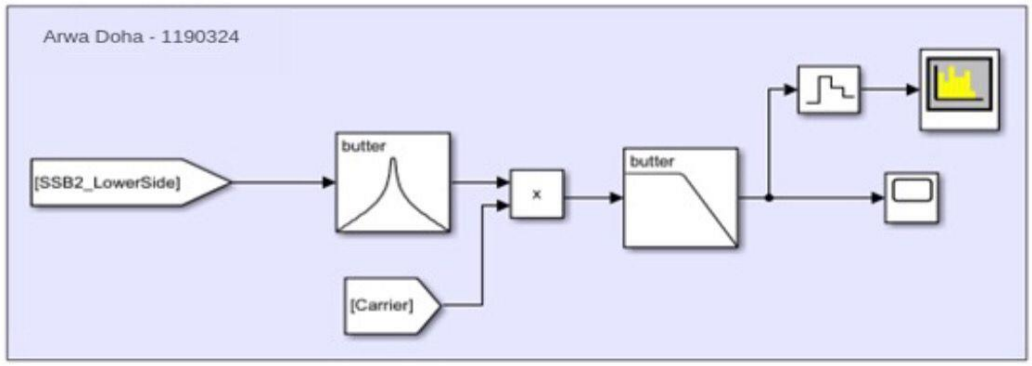

Figure SSB-SC Demodulation(Method2) simulink

SSB-SC Demodulation in Time Domain :

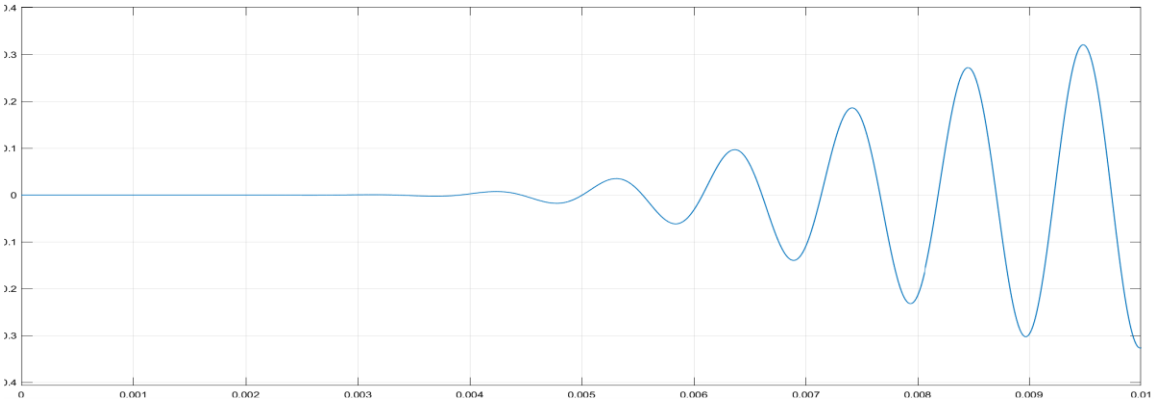

Figure 26 Ttime domain of SSB-SC Demodulation

SSB-SC Demodulation in Freq Domain :

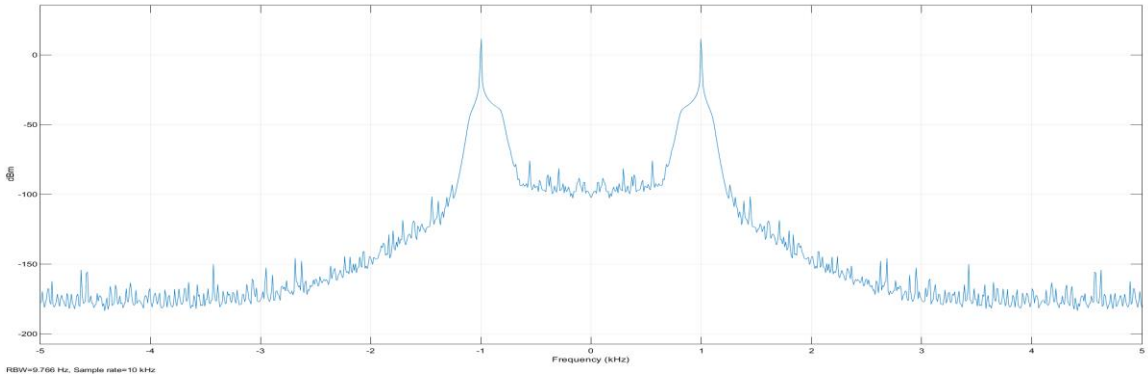

Figure 27 Frequency Domain of SSB-SC Demodulation

Parameters

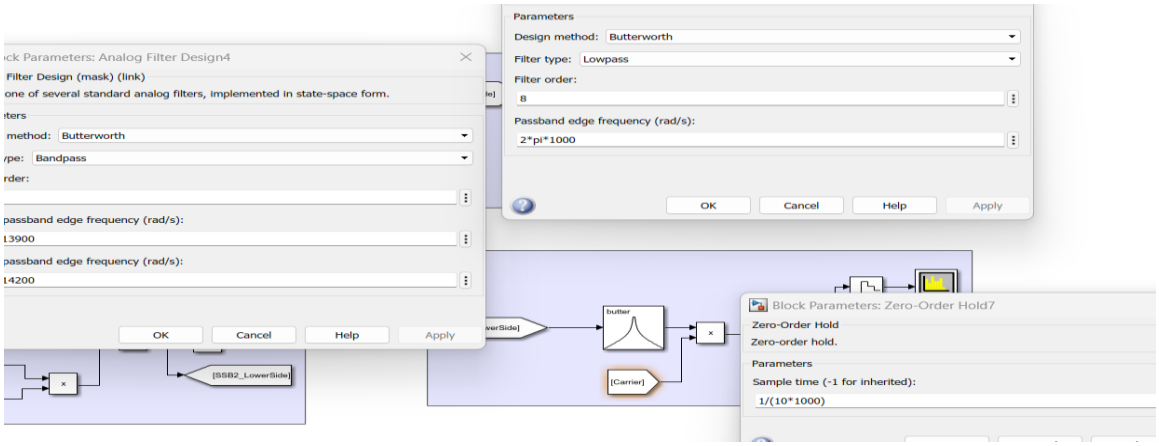

Figure 28 Parameters used in SSB-SC Demodulation

In the context of single suppressed carrier modulation Method 2 (lower side), the modulation process involves the message signal modulating the carrier signal, which is similar to the DSB-SC modulation.

This modulation technique is depicted in Figure 22. The time domain representation of this modulation process can be observed in Figure 23, and Figure 24 displays the frequency domain representation of the modulated signal.

In the demodulation process of the single suppressed carrier using Method 2, the objective is to extract the original message signal from the received signal. This process allows for the recovery of the original information carried by the signal.

The demodulation process is visually illustrated in Figure 26. To further analyze the demodulation, you can refer to Figure 27 for the time domain response, and Figure 28 offers a depiction of the frequency domain characteristics of the demodulated signal.