PartB: DSB-SC Modulation Report

Abdelateef Khaled 202001344
Seif Raslan 202000797

1 Introduction

In this report, we explore the Double Sideband Suppressed Carrier (DSB-SC) modulation technique using MATLAB simulations. We generate two message signals, $m_1(t)$ and $m_2(t)$, and modulate them using DSB-SC modulation. The resulting signals are then analyzed and plotted.

2 Signal Generation

The message signals $m_1(t)$ and $m_2(t)$ are generated using MATLAB. $m_1(t)$ is a piecewise linear function, while $m_2(t)$ is a step function as described in the provided code. These signals are plotted in Figures 1 and 2 as shown below.

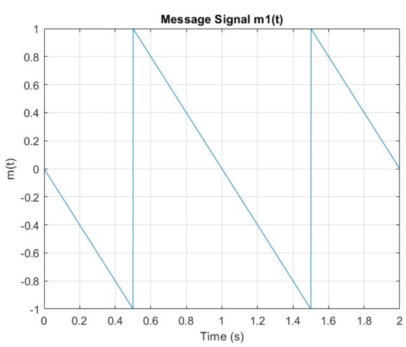

Figure 1: Message Signal $m_1(t)$

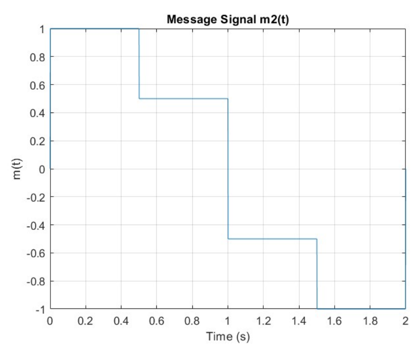

Figure 2: Message Signal $m_2(t)$

3 Modulation and Signal Processing

The DSB-SC modulation is performed using the provided MATLAB code. The modulated signal $s(t)$ is generated using a carrier wave of 1-volt amplitude and 10KHz frequency as following

$$s(t) = m_i(t)\cos\left(2\pi f_c t\right), \quad for i = 1,2$$

3.1 The Modulated signal

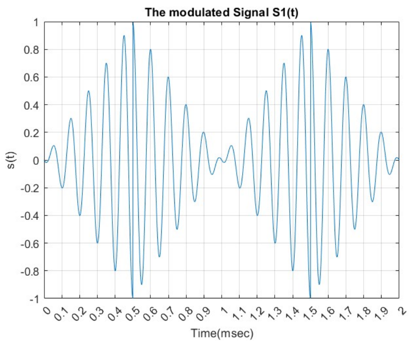

Figure 3: Modulated Signal $s_1(t)$

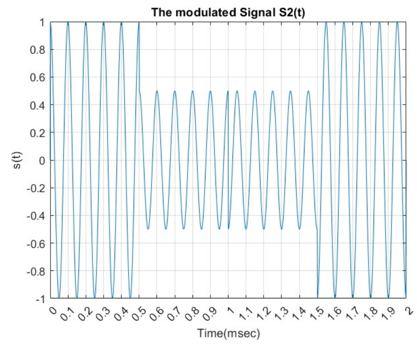

Figure 4: Modulated Signal $s_2(t)$

As shown above, the figures depict the modulated signals of the messages after multiplication with a cosine carrier wave. This is evident as the message signals take on the shape of sinusoidal waves.

3.2 Signal after multiplied with wave carrier

Next, the modulated signals are multiplied by the carrier wave again to obtain the massages and wave carrier with double frequency summing to each other. The resulting signals are then plotted and shown in the Figures below

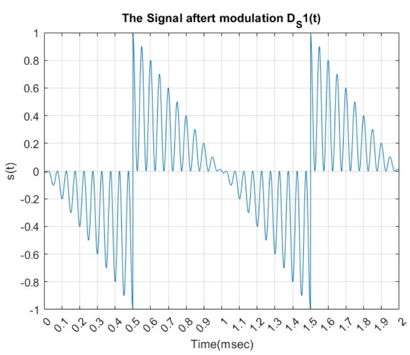

Figure 5: Multiplied Signal $D_{s1}(t)$

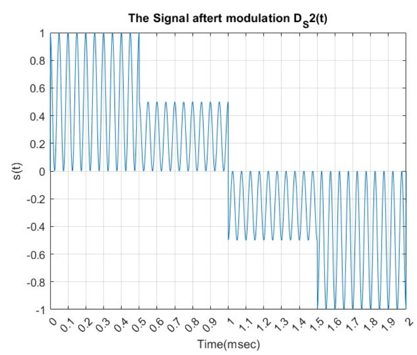

Figure 6: Multiplied Signal $D_{s2}(t)$

In the above figure, we observe that the demodulated modulated signal $D_s(t)$ results from the multiplication of $s(t)$ with a cosine carrier wave. This results in a waveform where the message signal is added to the carrier wave cosine with double f_c.

3.3 Signal after passing on low pass filter

Finally, the integrated signals are obtained by passing the modulated signals through a low-pass filter. The integrated signals $F_{D_s1}(t)$ and $F_{D_s2}(t)$ are plotted in Figures below

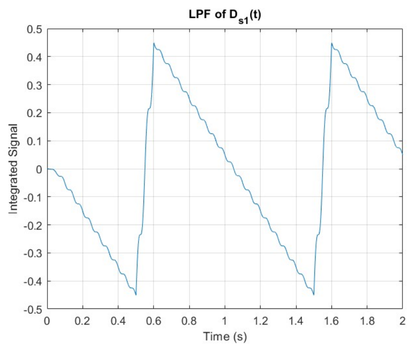

Figure 7: Integrated Signal $F_{D_s1}(t)$

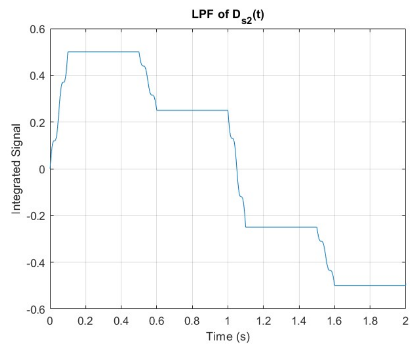

Figure 8: Integrated Signal $F_{D_s2}(t)$

The figures above closely resemble the shape of the message signals $m_1(t)$ and $m_2(t)$, both of which experience a reduction in amplitude. This reduction occurs when the modulated signal $s(t)$ is multiplied by the cosine carrier wave. Specifically, the reduction arises from the multiplication of $\cos(f_c t)$ with another $\cos(f_c t)$, resulting in $\frac{1}{2}(1 + \cos(2f_c t))$. Subsequently, when passing through a low-pass filter, high-frequency components are eliminated, leading to the messages having halved amplitude.

4 Conclusion

In this report, we investigated the Double Sideband Suppressed Carrier (DSB-SC) modulation technique through MATLAB simulations. By generating and modulating two message signals, $m_1(t)$ and $m_2(t)$, we observed the effects of DSB-SC modulation on the signals.

Through the analysis of the modulated signals $s_1(t)$ and $s_2(t)$, we observed that the message signals were effectively multiplied to a cosine carrier wave. Then, we performed demodulation by multiplying the modulated signals again with cosine, resulting in $D_{s_1}(t)$ and $D_{s_2}(t)$. After passing them through a low-pass filter, we obtained the two message signals $m_1(t)$ and $m_2(t)$ with halved amplitude.

Overall, our study provides insights into the behavior of DSB-SC modulation and its signal-processing implications.