Abu Dhabi University

EEN 335 - Introduction to Communication Systems

Lab Report 2
AM Modulation and Demodulation.

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Section 1

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Contents

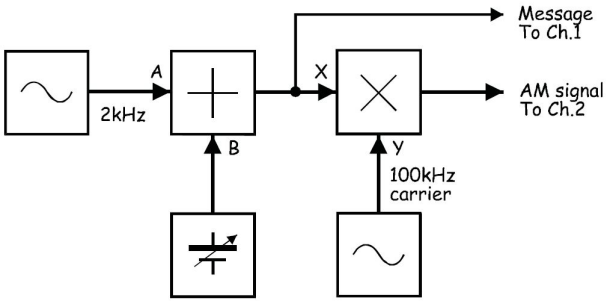
Abstract

In this lab experiment, we are going to first generate Amplitude modulated signals by DSB-LC, DSB-SC, and SSB-SC and then try different techniques on how to demodulate these signals.

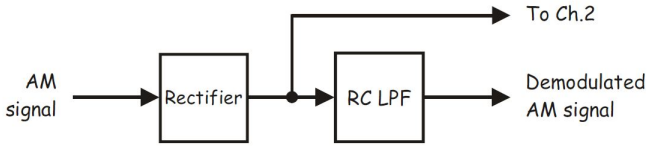
1 Introduction

In this lab we are going to perform AM Modulation and Demodulation. Demodulation is recovering the original message signal from a modulated carrier signal. Telecommunication receivers are made for the purpose of demodulation of a specific or different types of signals.

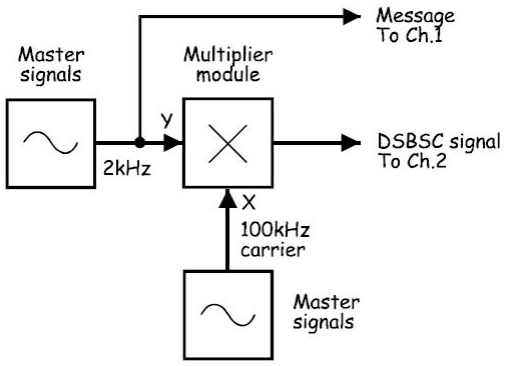
DSB-LC Modulation A Double Side Band Suppressed carrier signal is generated by first shifting the message signal to some value by adding DC voltage to it and then multiplying the result with the carrier signal.



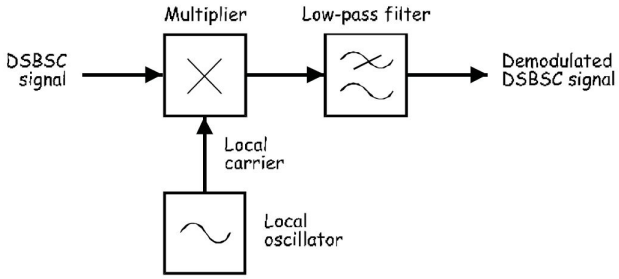
DSB-LC Demodulation A Double Side Band Large carrier signal is demodulated using a simple envelope detector which includes a diode and a capacitor.



DSB-SC Modulation A Double Side Band Suppressed carrier signal is generated by simply multiplying the message signal with the carrier signal.

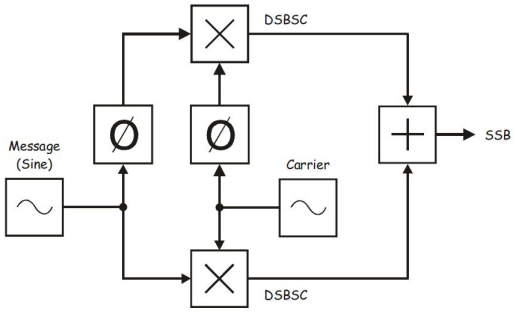


DSB-SC Demodulation A Double Side Band Suppressed carrier signal is demodulated using a multiplier at the receiver side, multiplying the incoming signal with the carrier of the same frequency and then applying a low pass filtering.

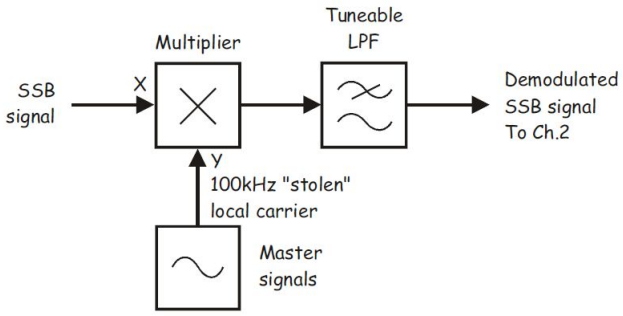


SSB-SC Modulation As we can see from the name SSBSC transmits only one sideband of the two, it does not matter which side band is transmitted as both have the information. SSB needs half of the bandwidth that of the DSB which is a good advantage.

One of the methods to make a SSB is to make a DSBSC and then filter it so that we are left with only one sideband. This method is known as filter method. In this case good filters are to be used which can be very expensive. Other alternative method to make and SSB is using the phase method, this uses phase discrimination technique which leaves us with only one sideband.



SSB-SC Demodulation A Single Side Band Suppressed carrier signal is demodulated using a multiplier at the receiver side, multiplying the incoming signal with the carrier of the same frequency and then applying a low pass filtering.



2 Experiment Set-up

2.1 DSB-LC

For generating DSB-LC we followed the same basic technique and connected the apparatus as shown below:-

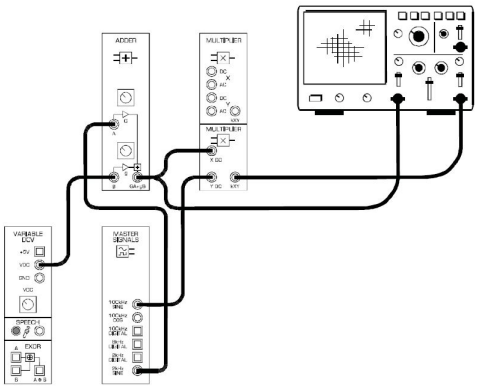


Figure 1: This is how we setup the circuit for generating DSB-LC Signal

2.2 DSB-SC

For generating DSB-SC we followed the multiplier technique and connected the apparatus as shown below:-

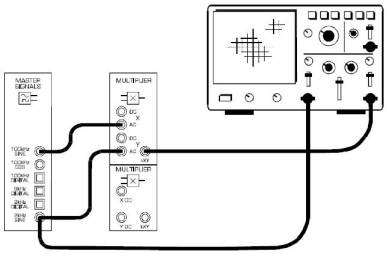


Figure 2: This is how we setup the circuit for generating DSB-SC Signal

2.3 SSB-SC

For generating SSB-SC we followed the phase shifted technique and connected the apparatus as shown below:-

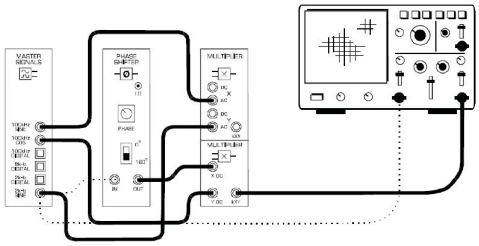


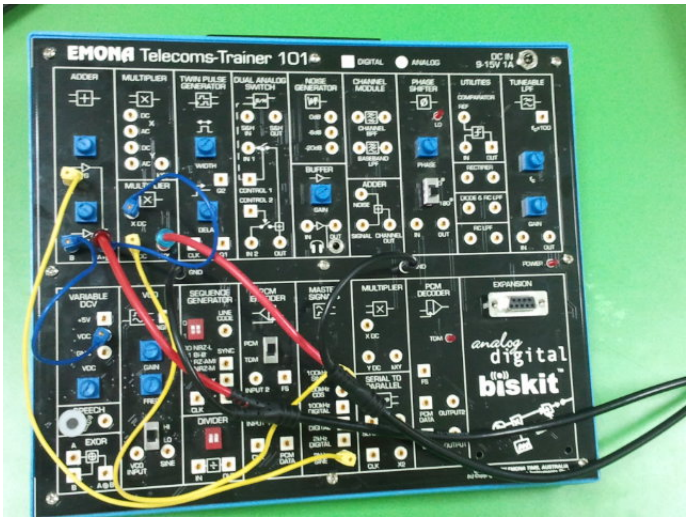
Figure 3: This is how we setup the circuit for generating SSB-SC Signal

3 List of Equipment used

- Communication Biskit Training Module.
- Connector Wires.
- Oscilloscope.
- 5V Voltage Power Supply.

4 Procedure

4.1 DSB-LC



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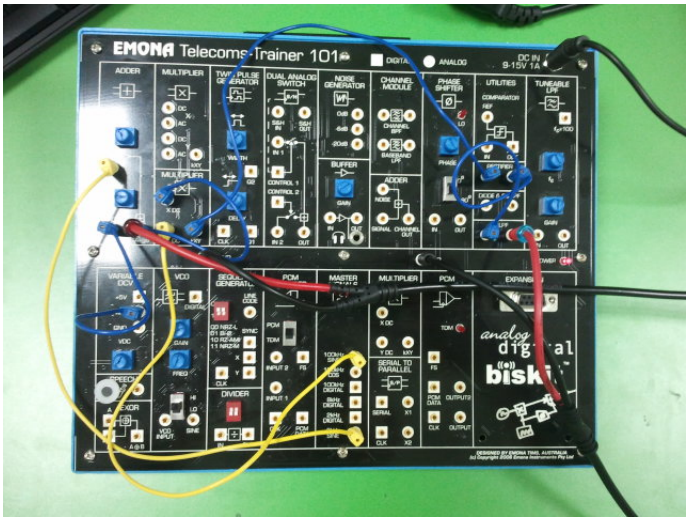
As seen in the figure, we connected the oscilloscope channel 1 to the adder output and channel 2 to the multiplier output. This generated for us the DSB-LC signal.



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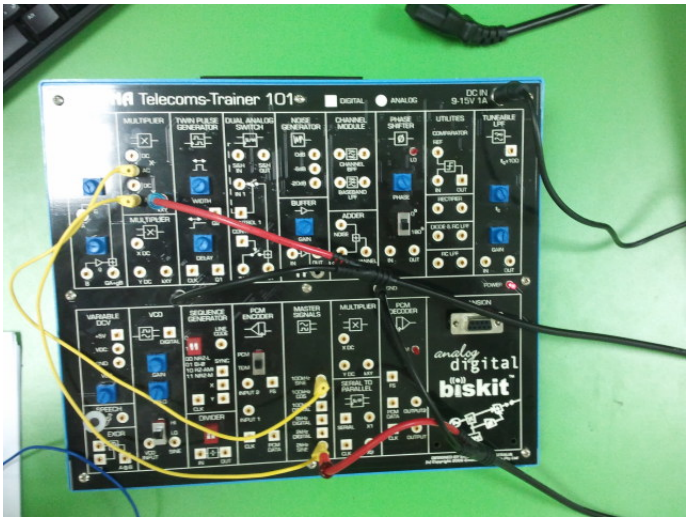
After generating AM signal, we connected the circuit to demodulate the signal. As seen in the figure, we connected the oscilloscope channel 1 to the adder output and channel 2 to the output of Low Pass Filter. This recovered for us the original signal from DSB-LC signal.

4.2 DSB-SC



< – – –
As seen in the figure, we connected the oscilloscope channel 1 to the original message signal which is the low frequency sinusoidal and channel 2 to the multiplier output. This generated for us the DSB-SC signal.

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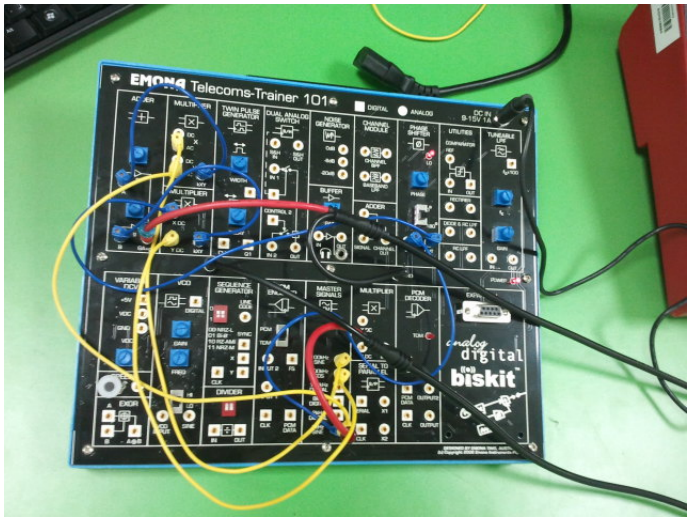
After generating DSB-SC signal, we connected the circuit to demodulate the signal. As seen in the figure, we connected the oscilloscope channel 1 to the original message signal which is a low frequency sinusoidal and channel 2 to the output of Low Pass Filter. This recovered for us the original signal from DSB-LC signal.

4.3 SSB-SC



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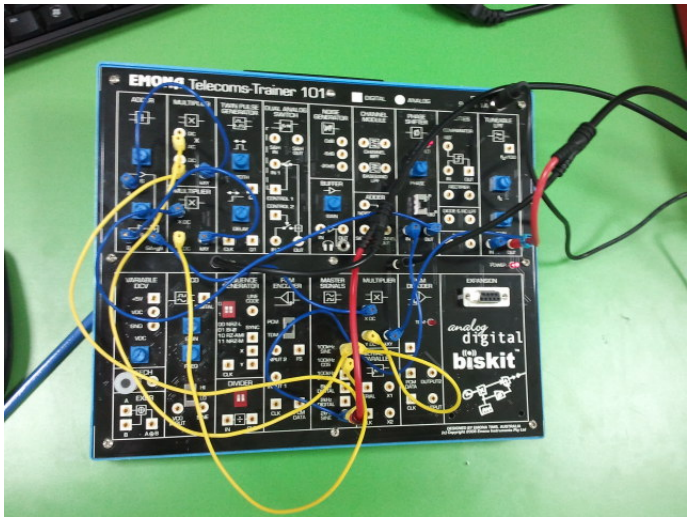
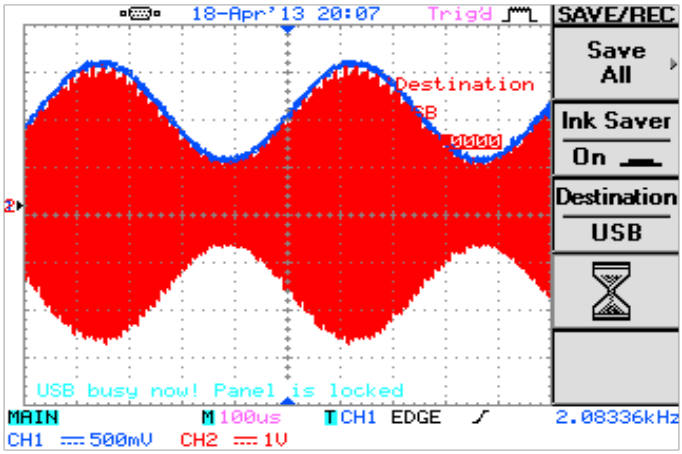
As seen in the figure, we connected the oscilloscope channel 1 to the original message signal which is the low frequency sinusoidal and channel 2 to the adder output. This generated for us the SSB-SC signal.



$<---$
After generating SSB-SC signal, we connected the circuit to demodulate the signal. As seen in the figure, we connected the oscilloscope channel 1 to the original message signal which is a low frequency sinusoidal and channel 2 to the output of Low Pass Filter. This recovered for us the original signal from DSB-SC signal.

5 Results and Discussions



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The blue signal is channel 1 which shows the shifted message signal and the red signal is this message signal multiplied by the high frequency carrier wave called DSB-LC.

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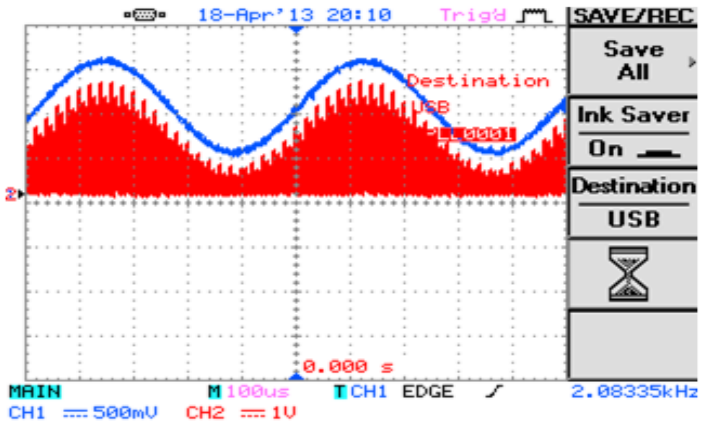

$<---$
The blue signal is channel 1 which shows the shifted message signal and the red signal is this output from the diode where as we can see the diode has cut-off the negative part of the signal.

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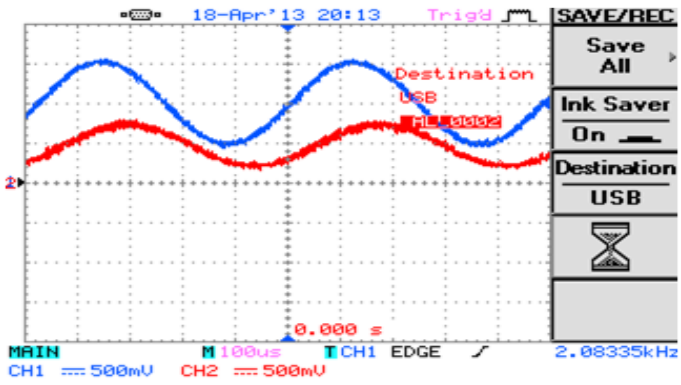

The blue signal is channel 1 which shows the shifted message signal and the red signal is this output from the envelope detector where as we can see that first the diode has cut-off the negative part of the signal and then the capacitor has smoothed out the signal. Also, we can see that the red signal is lagging the blue signal, this is because of the capacitor.

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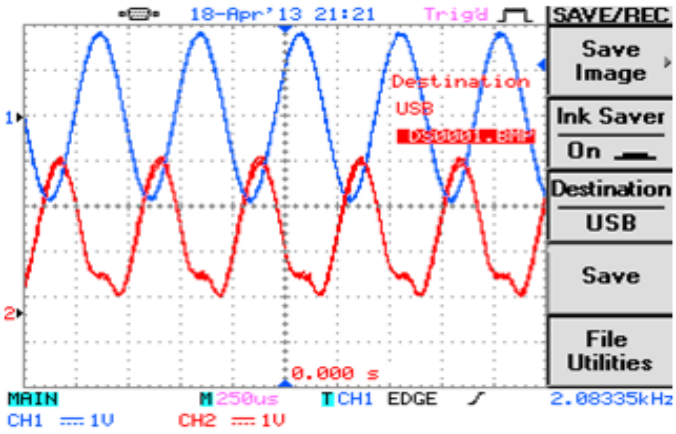

The blue signal is channel 1 which shows the shifted message signal but we have increased the modulation index to greater than one and the red signal is this output from the envelope detector where as we can see that the recovered signal is distorted. Also, we can see that the red signal is lagging the blue signal, this is because of the capacitor.

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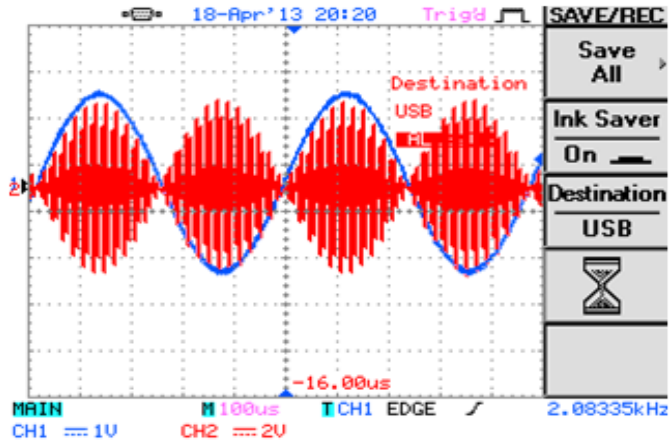

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The blue signal is channel 1 which shows the message signal and the red signal is this output from the multiplier and it is DSB-SC.

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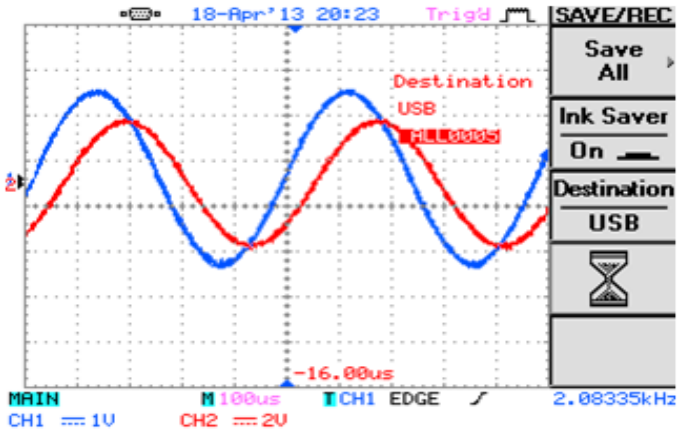

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The blue signal is channel 1 which shows the message signal and the red signal is the output from the multiplier of the demodulation circuit.

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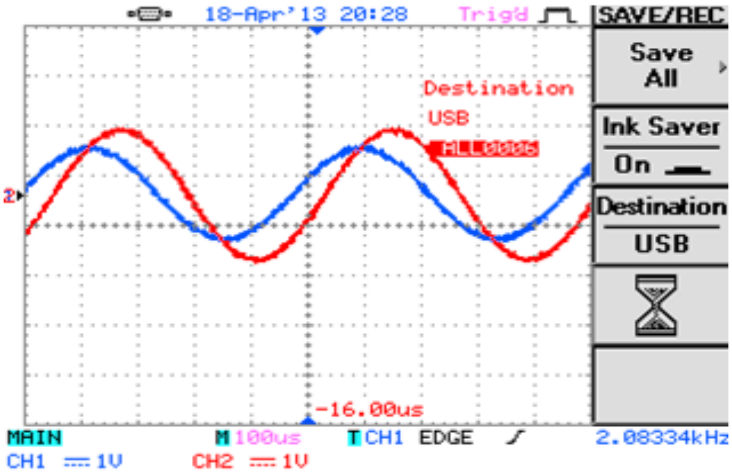

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The blue signal is channel 1 which shows the message signal and the red signal is the output from the multiplier of the demodulation circuit. We are increasing the amplitude of the signal to see what effect it has on the demodulation.

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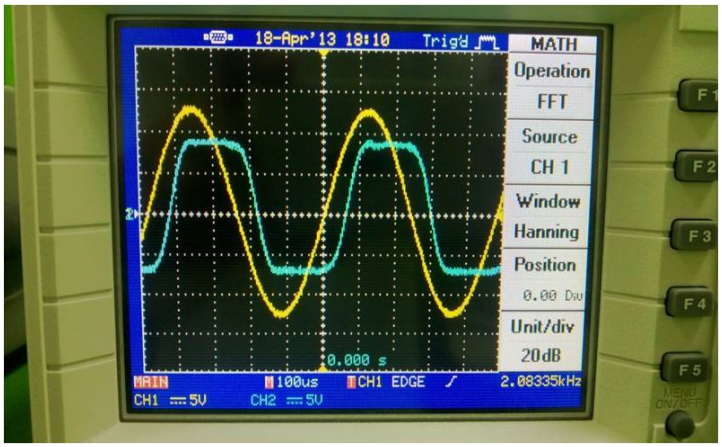

$<---$
And sure enough, the demodulated signal becomes distorted after reaching some maximum amplitude. This is because the message signal has more amplitude than the supply voltage in the multiplier.

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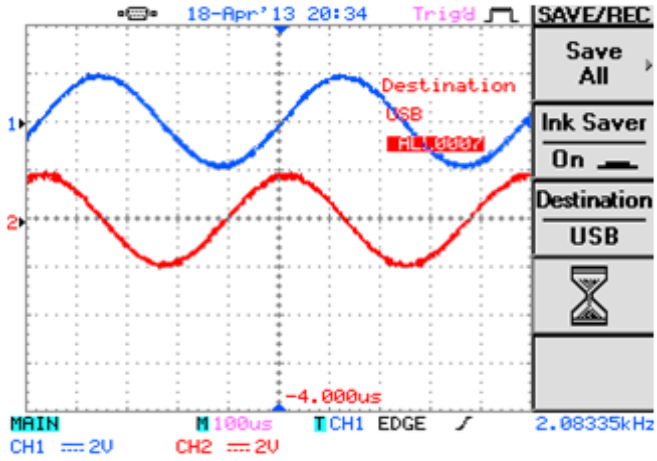

$<---$
The channel 1 in blue shows the original message signal whereas, the channel 2 in red shows the phase shifted signal which will be used to make the SSB-SC signal.

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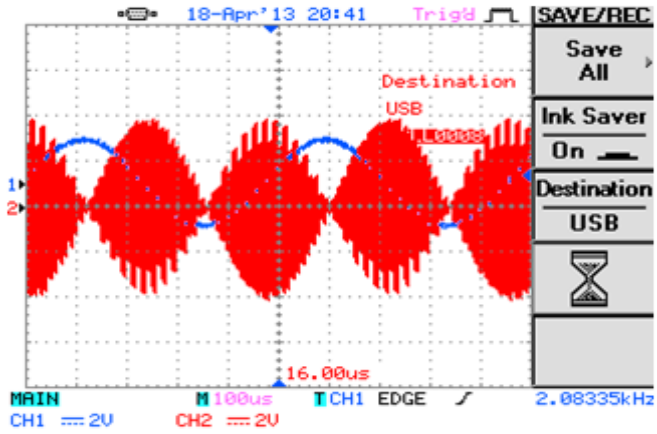

$<---$
The channel 1 in blue shows the original message signal whereas, the channel 2 in red shows the SSB-SC signal.

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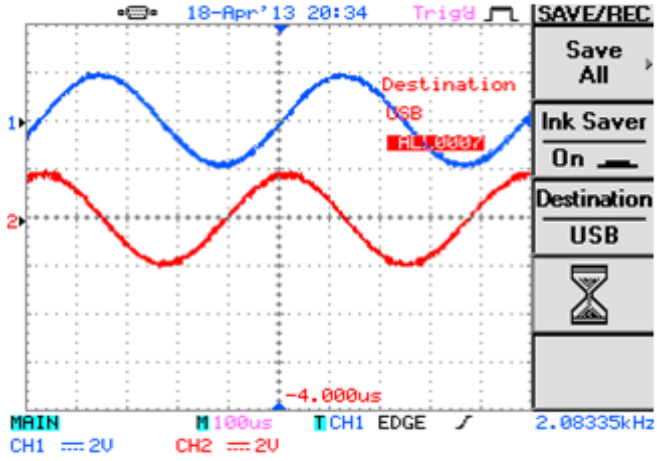

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The channel 1 in blue shows the original message signal whereas, the channel 2 in red shows the demodulated SSB-SC signal.

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6 Conclusion

- The DSB-SC and SSB-SC can be demodulated using the same demodulation technique and equipment, but SSB-SC has a bandwidth advantage over DSB-SC such that SSB-SC uses half the bandwidth compared to DSB-SC.
- The SSB-SC demodulated signal is phase shifted to about 90 Degrees.
- Changing the amplitude of the original message signal can cause the demodulated signal to distort because the modulation index is changed when we change the amplitude.
- The best type of AM modulation is SSB-SC as it uses half the frequency of the DSB-LC or DSB-SC.
- Meanwhile DSB-LC allows the use of very easy-to-make and cheap receiver which is very ideal in many situations where there are many receivers and limited transmitters. One example is Radio Receiver/Transmitter.

7 Team Dynamics

Part and Member	**Weight Grade**	**Muhammad Obaidullah**	**Bilal Arshad**
Abstract	10%	50%	50%
Introduction	15%	50%	50%
Procedure Part 1	15%	50%	50%
Procedure Part 2	15%	50%	50%
Results Part 1	15%	50%	50%
Results Part 2	15%	50%	50%
Conclusion	15%	50%	50%
Total	100%	50%	50%