Student No / Name :	Group:
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Experiment 2: Observations of AM and DSBSC signals in the frequency domain

1. Turn on the NI ELVIS power switch at the back then turn on its Prototyping Board Power switch at the front.
2. Launch the NI ELVIS software.
3. Launch the DATEx soft front-panel (SFP). From Step-4 to Step-10 it is aimed to setting 1V DC voltage and 1Vp-p 10kHz sine signal.
4. Launch the Variable Power Supplies (VPS) VI. Adjust the VPS negative output about -6V. Minimize VPS, **but dont't close it.**
5. Locate the Adder module on the DATEx SFP and turn its soft G and g controls fully anti-clockwise.
6. Connect the set-up shown in Figure 1 below.

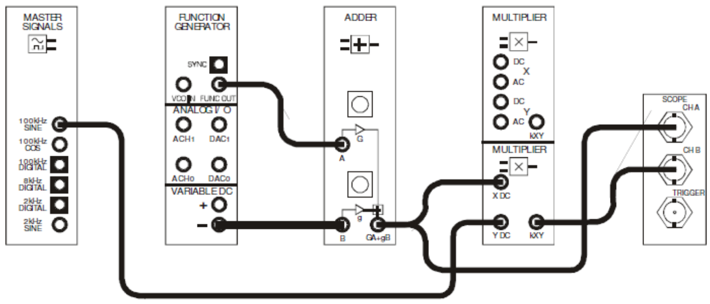


Figure 1

7. Launch the NI ELVIS DMM VI. Set up the DMM VI for measuring DC voltages. Connect the Adder module's output to the DMM's HI input and adjust the module's soft g control to obtain a 1V DC output. *In previous experiment we did the same things.* **Close the DMM VI**.

8. Launch the Function Generator's VI. Adjust the Function Generator using its soft controls for an output with the following specifications:
   - Waveshape: Sine
   - Frequency: 10kHz exactly
   - Amplitude: 4Vp-p
   - DC Offset: 0V

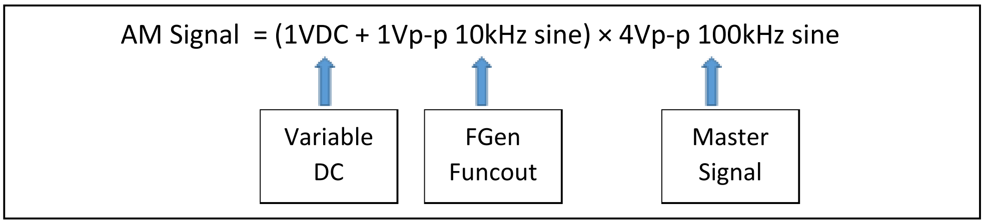
   You'll be using the Function Generator VI again later but minimise its window for now.

9. Launch the NI ELVIS Oscilloscope VI. Set up the scope the procedure with the following changes:
   - Trigger Source control- Immediate
   - Channel 0 Coupling control - AC
   - Channel 0 Scale control - the 500mV/div position
   - Timebase control - the 50µs/div position

10. Adjust the Adder module's soft G control to obtain a 1Vp-p sinewave. Set the scope's Channel 0 Coupling Control to DC. Set the scope's Trigger Source control to CH 0 and set its Trigger

Level control to 1V. Activate the scope's Channel 1 input to view both the message and the modulated carrier.

If your setup and adjustment are right, you must obtain signal at the multiplier output as below. (You should notice that the master signal modules output generates approximately 3,6Vp-p.)



Question 1: *For the given inputs to the Multiplier module, what are the frequencies of the three sinewaves on its output? (6p)*

Question 2: *Use this information to calculate the modulating and modulated signal bandwidth? (5p)*

11. Launch the NI ELVIS Dynamic Signal Analyzer. Adjust the Signal Analyzer's controls as follows:

General

Sampling to Run

Input Settings

- *Source Channel* to *Scope CHB*
- Voltage Range to ±10V

FFT Settings

- *Frequency Span* to *150,000*
- *Resolution* to *400*
- *Window* to *7 Term B-Harris*

Averaging

- *Mode* to *RMS*
- *Weighting* to *Exponential*
- *# of Averages* to *3*

Triggering

- *Triggering* to *FGEN SYNC_OUT*

Frequency Display

- *Units* to *dB*
- *RMS/Peak* to *RMS*
- *Scale* to *Auto*
- *Markers* to *OFF* (for now)

Activate the Signal Analyzer's markers by pressing the Cursors (Markers) button. Using C1 cursor measure LSB ,Carrier and USB frequencies, using both C1 and C2 cursors measure Bandwidth. Fill in the Table1. *Please write the values that you measure with the DSA, not theoritical values.* Plot the DSA spectrum of AM signal.

(15p)

Table1. AM Modulation DSA frequencies (KHz) (8p)

LSB	
Carrier	
USB	
Bandwidth	

Question 3: How do the measured values in Table 1 compare with your theoretically predicted values (see Questions 1 and 2)? Explain any differences. (5)

12. Maximise the Function Generator's VI and firstly increase its output frequency to 20KHz thend secondly 30KHz. Use the Signal Analyzer's two markers to find the AM signal's new bandwidth. Record this in Table 2 below. *As previosly please write the values that you measure with the DSA, not theoritical values.*

Table 2. Bandwidth for different mesage frequencies (6p)

Bandwidth for fm=20KHz	
Bandwidth for fm=30KHz	

Question 4: What's the relationship between the message signal's frequency and the AM signal's bandwidth?(5p)

13. Return the Function Generator's output frequency to 10kHz. Wait until the Signal Analyzer's frequency domain display has fully updated then disconnect the banana plug to the Multiplier module's X input. Observe the changings on the DSA spectrum.

Question 5: *What is this signal? What's missing and why? (10p)*

14. Reconnect the banana plug to the Multiplier module's X input. Disconnect the banana plug to the Multiplier module's Y input.

Question 6: *What is this signal? Why are the sidebands missing when there's a message? (10p)*

15. Disassemble the current set-up. Close the Signal Analyzer's VI. Maximise the Function Generator VI and check that its output frequency is has been returned to 10kHz. Set the Function Generator's output to 1Vp-p.

16. Connect the set-up shown in Figure 2 below.

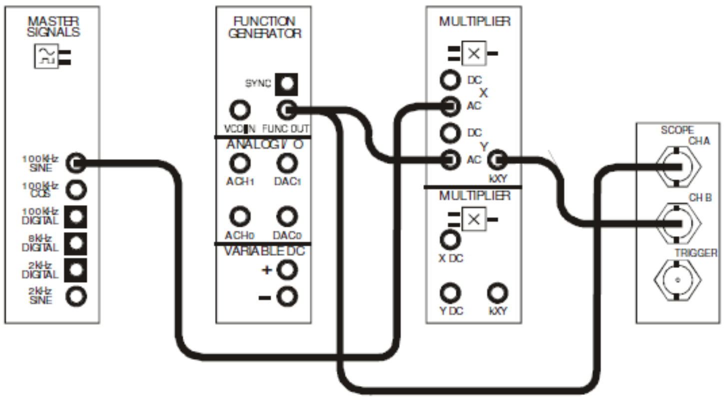


Figure 2

This set-up implements the equation : DSBSC = 1Vp-p 10kHz sine × 4Vp-p 100kHz sine

17. Launch the NI ELVIS Oscilloscope virtual instrument (VI). Set up the scope per the procedure with the following changes:

- Trigger Source control- Immediate
- Channel 0 and Channel 1 Coupling control - DC
- Channel 0 Scale control - the 2V/div position, Channel 1 Scale control - the 2V/div position
- Timebase control - the 50μs/div position

Question 6: For the given inputs to the Multiplier module, what are the frequencies of the two sinewaves on its output?(4p)

Question 7: *Use this information to calculate the DSBSC signal's bandwidth.(5p)*

18. Close the scope's VI.Launch the NI ELVIS Dynamic Signal Analyzer VI and adjust its controls per Step 12. Activate the Signal Analyzer's markers by pressing the Cursors (Markers) button. Using C1 cursor measure LSB and USB frequencies, using both C1 and C2 cursors measure Bandwidth. Fill in the Table1. *Please write the values that you measure with the DSA, not theoritical values.* Plot the DSA spectrum of DSBSC signal.

(15p)

Table3. DSBSC Modulation DSA frequencies (KHz) (6p)

LSB	
USB	
Bandwidth	

Question 8*: Compare the DSBSC signal's bandwidth with the bandwidth for the AM signal with a 10kHz message (in Table 1). What can you say about the bandwidth requirements of AM and DSBSC signals?(10)*