FM Modulation

Topic	Student Name	Date	Course Leader
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This laboratory exercise expands the characteristics of the FM (frequency modulation).

Introduction

Below please find a block diagram of a balanced FM modulator.

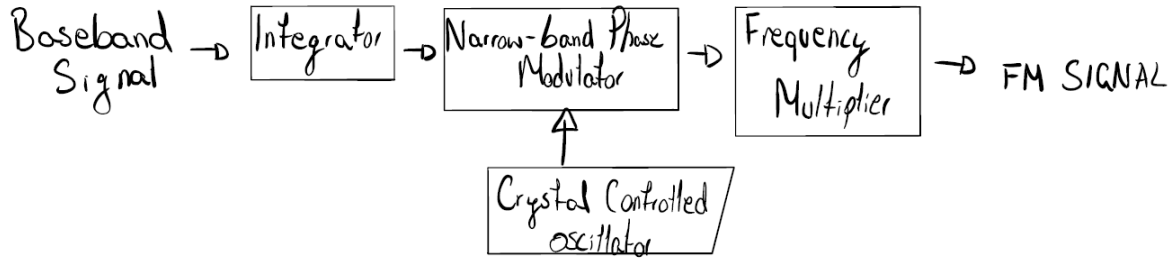

Figure 1 Presents a block diagram of a frequency modulated signal

Measurements

All measurements for this experiment were simulated using the program TINA TI. The equation for the FM signal is:

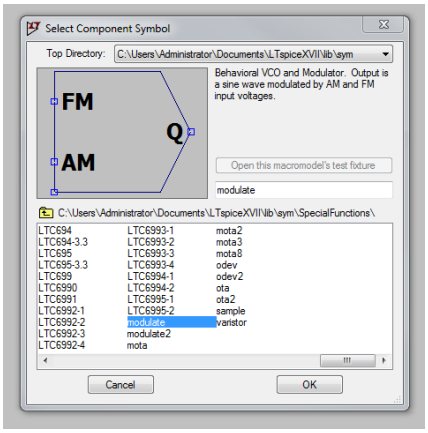

Figure 2.1 Presents a screengrab of options and steps made in order to achieve final results

This is the circuit used to generate my signal, using the given parameters for the modulator

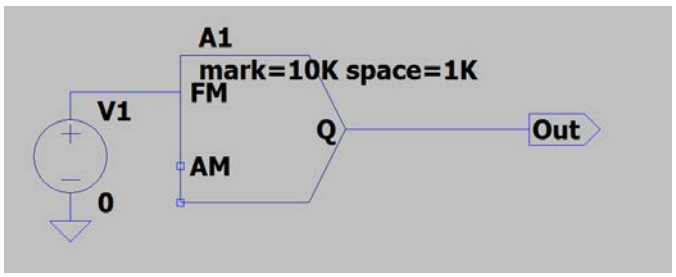

Figure 2.2 Presents a screengrab of options and steps made in order to achieve final results

Below is the output sine wave received from use of that circuit in transient analysis simulation

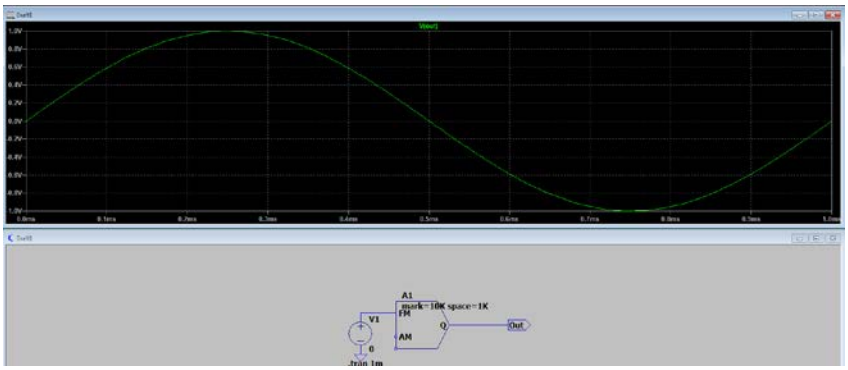

Figure 2.3 Presents the output graph with use of following circuit

Below please find enclosed an exported graph from figure 2.3.

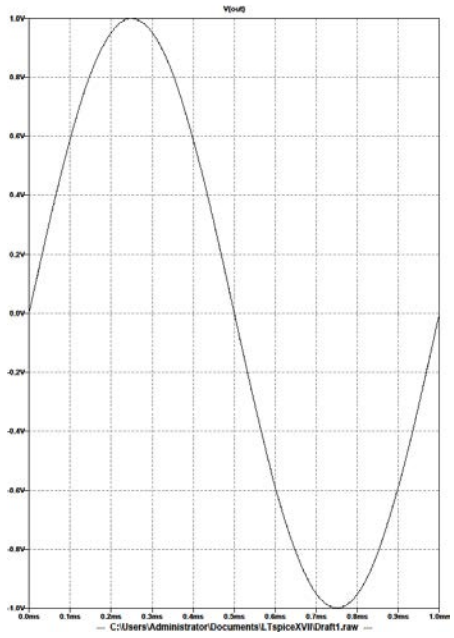

Figure 2.4 Presents an export of graph from figure 2.3

Below please find the frequency information read from the cursors, this presents data from 0 – 1 V.

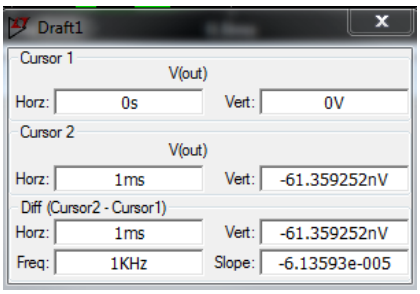

Figure 3.1 Presents value at 0V

Voltage Level [V]	Frequency [Hz]
0	1000.00
0.1	1900.24
0.2	2799.28
0.3	3701.42
0.4	4607.67
0.5	5500.00
0.6	6401.64
0.7	7299.07
0.8	8199.50
0.9	10000.00
1.0	10013.00

Figure 3.2 Presents final results ranging from 0 – 1 V.

With use of values from figure 3.2 I have generated a Frequency Voltage graph as seen below (figure 3.3).

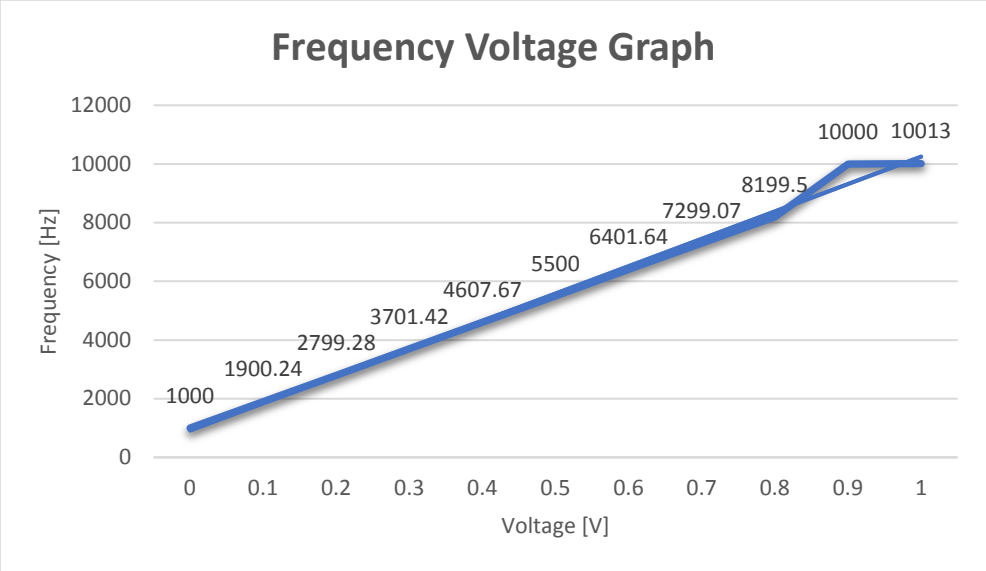

Figure 3.3 Presents obtained results from the datasheet in figure 3.2

Below please find an exported version of the graph.

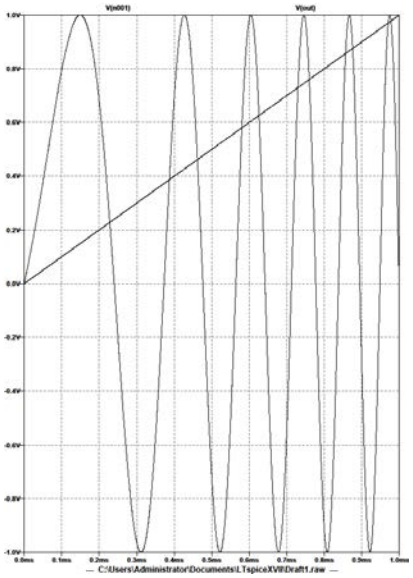

Figure 3.4 Presents an export of graph from point 19

I have then changed the values of my voltage source to sine as per instruction stated.

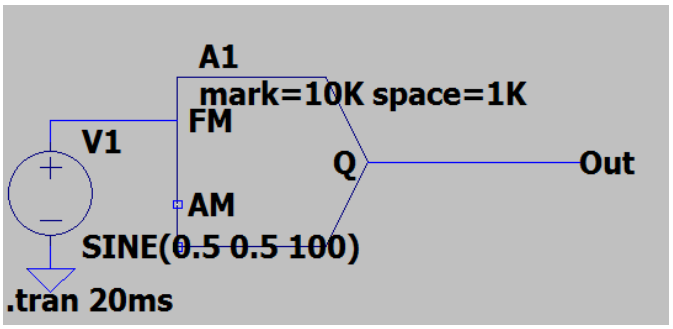

Figure 4.1 Presents a screengrab of options and steps made in order to achieve final results

Below please find the graph resulting from the circuit above figure 4.1

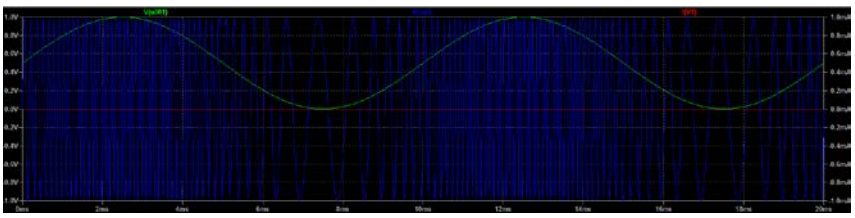

Figure 4.2 Presents the output graph with use of following circuit in figure 4.1

Below please find the FFT diagram with 10 000 data points.

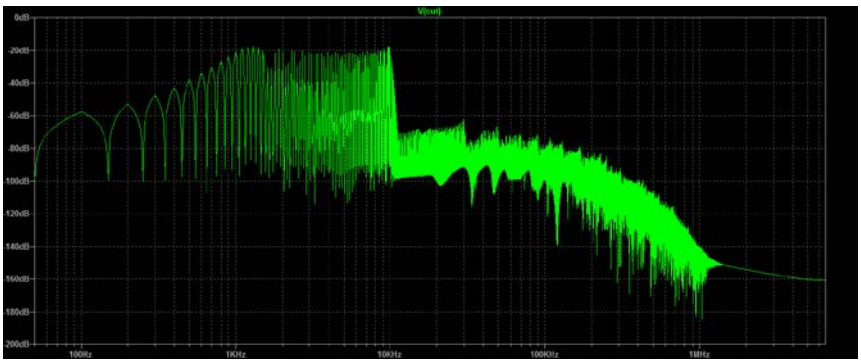

Figure 4.3 Presents FFT diagram with 10000 data points.

Below please find an exported version of graph 4.3

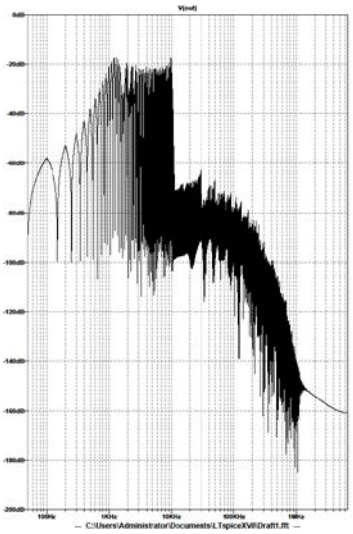

Figure 4.4 Presents an export of graph from figure 3.3

To calculate the bandwidth we use Carson's Method of calculating bandwidth; please find the following equation and calculation showing this.

$$\text{Bandwidth} = 2(\Delta f + fm) = 2*(3.80 + 100\ \text{Hz}) = 207.60\ \text{Hz}$$

Square wave:

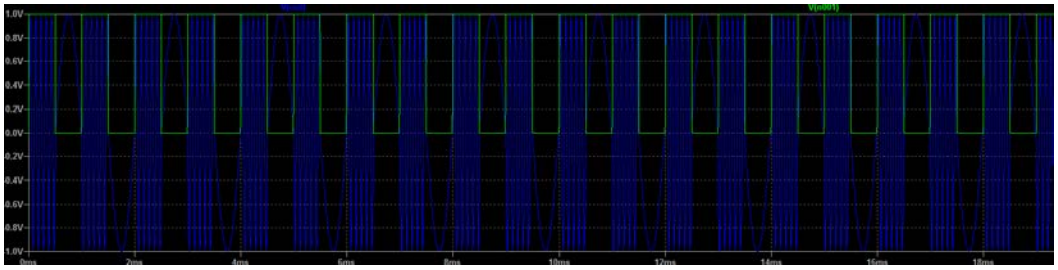

Figure 5.1 Presents square wave simulation

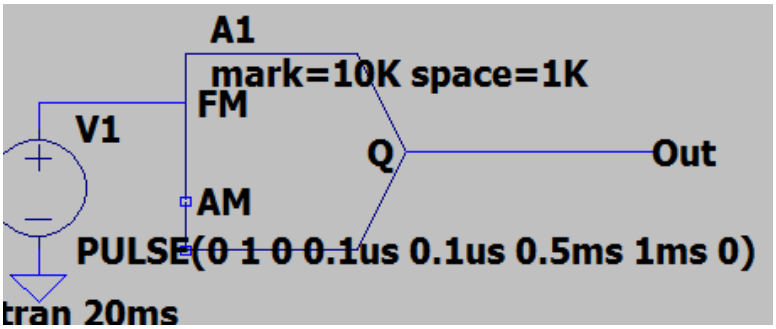

Figure 5.2 Presents circuit used to generate square wave

Triangle Wave:

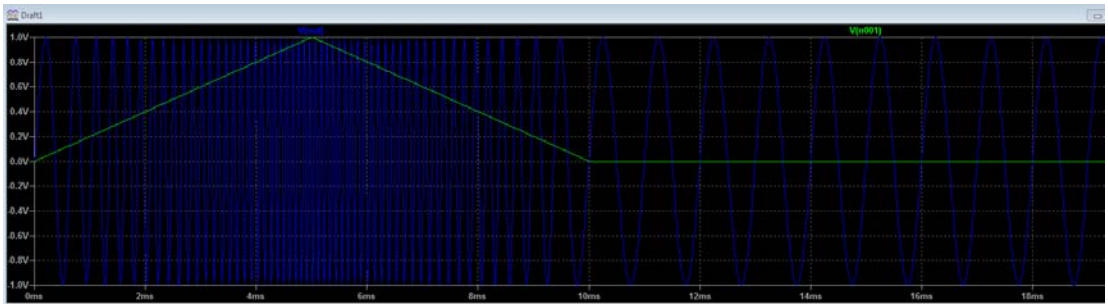

Figure 6.1 Presents square wave simulation

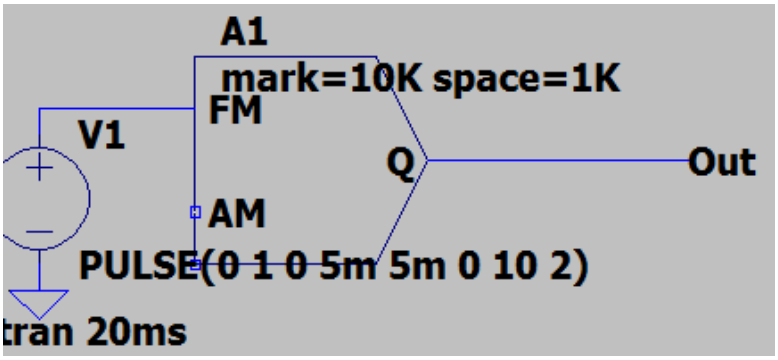

Figure 6.2 Presents circuit used to generate square wave