SSB Modulation

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This laboratory exercise expands the characteristics of the SSB linear modulation.

Introduction

SSB, else known as Single – Sideband Modulation (SSB-SC – Single – Sideband Modulation Suppressed Carrier) modulation is commonly used for audio / radio transmission. For example SSB-AM is a popular modulation type that is commonly detected by a product detector – it is very commonly used by radio enthusiasts as well as the military (in *HF communication systems). This is very interesting as the bandwidth is the same as the modulating signal itself, to be more precise this is an exact half of a DSB – SC or AM signal.

***HF-** High frequency

Measurements

All measurements for this experiment were simulated using the program TINA TI.

In Transient Analysis:
As seen in the figure below, I have added a controlled source as requested in the instruction manual. According to the given instructions and parameters I have set the expression as CS1 = V(N1)*V(N2) and number of voltages to two entries, later I proceeded to insert the generator with given VG1 and VG2 parameters.

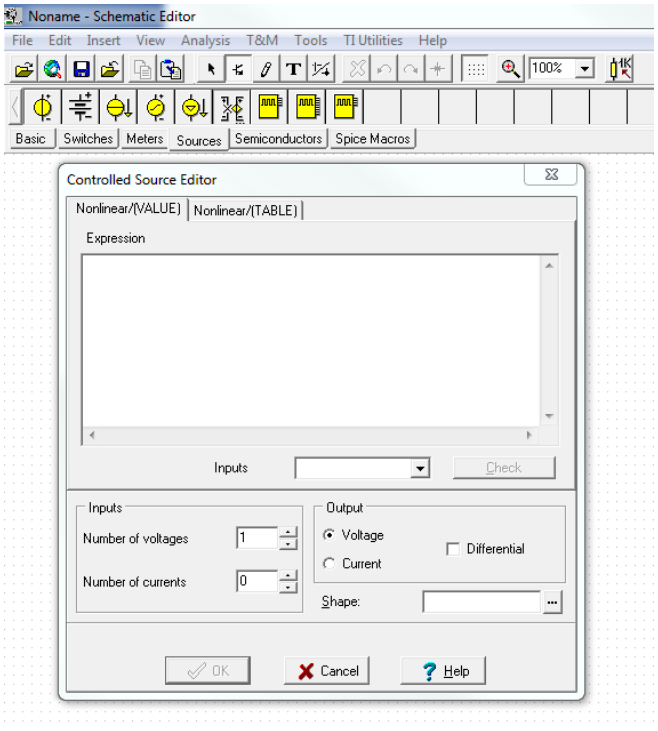

Figure 1.1 – Presents the process of specifying controlled sources.

Below please find the parameters that have been provided into the simulation for the voltage generators as given in instructions.

VG1 – Set to sine wave; amplitude of 1V; frequency 10 kHz (carrier)

VG2 – Set to sine wave; amplitude of 1V; frequency 1 kHz (message)

VG3 – Set to cos wave; amplitude of 1V; frequency 10 kHz (carrier)

VG4 – Set to cos wave; amplitude of 1V; frequency 1 kHz (message)

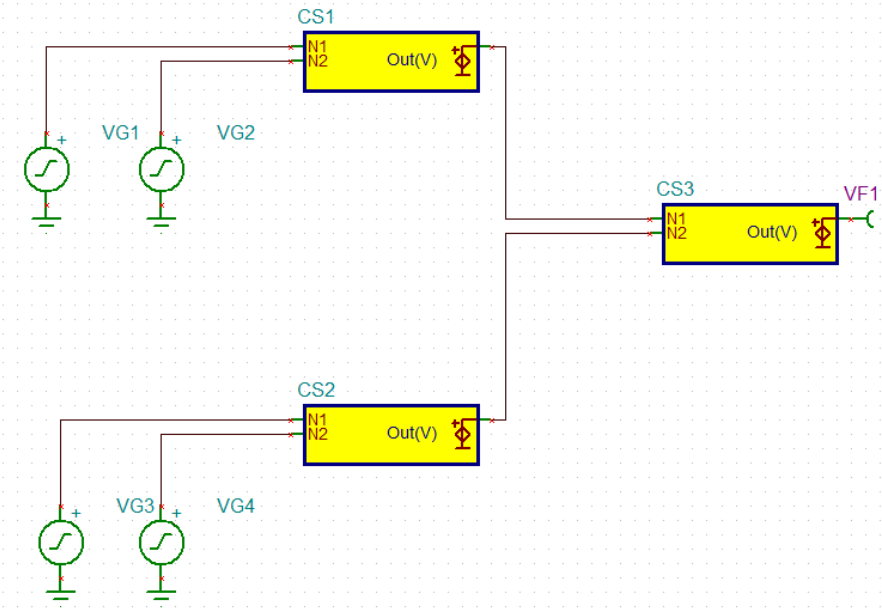

Figure 1.2 – Presents the generated voltage generator according to parameters provided. Three controlled source and four voltage generators

In the below please notice an exported version of the graph drawn by our graph with use of the Transient analysis mode set to 2ms as stated in instructions. As we can see we have an output signal generated that has amplitude of 1V. Simulation environment: 2ms.

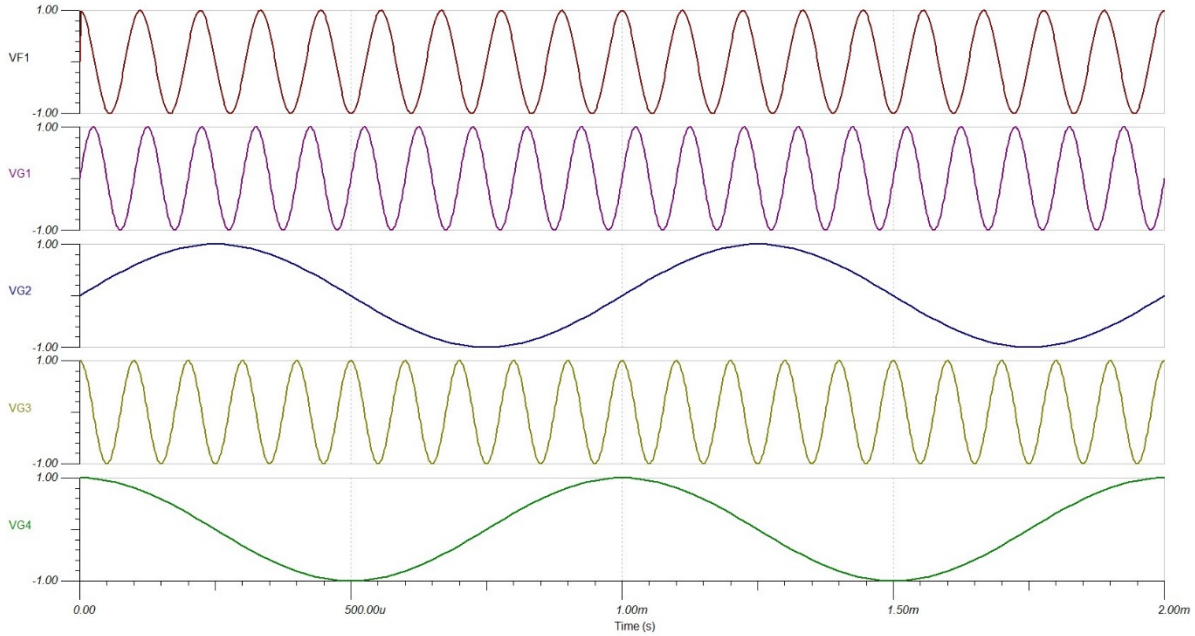

Figure 1.3 – Presents results of the transient state set according to provided parameters.

In the below please find a figure that presents the Fourier series parameters used for calculation process. After changed parameters select calculate, once processed selected draw.

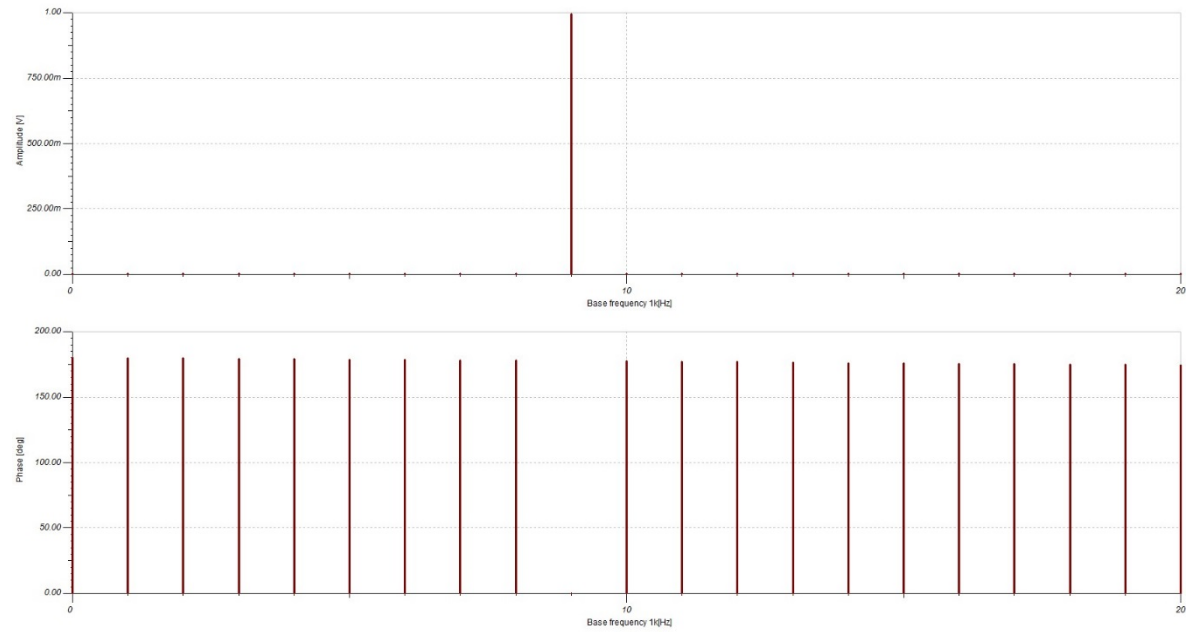

Figure 2.1 Presents Fourier Series parameters used for calculations process

Amplitude of VG4 has been changed to 3V, simulation has been re-run as seen below:

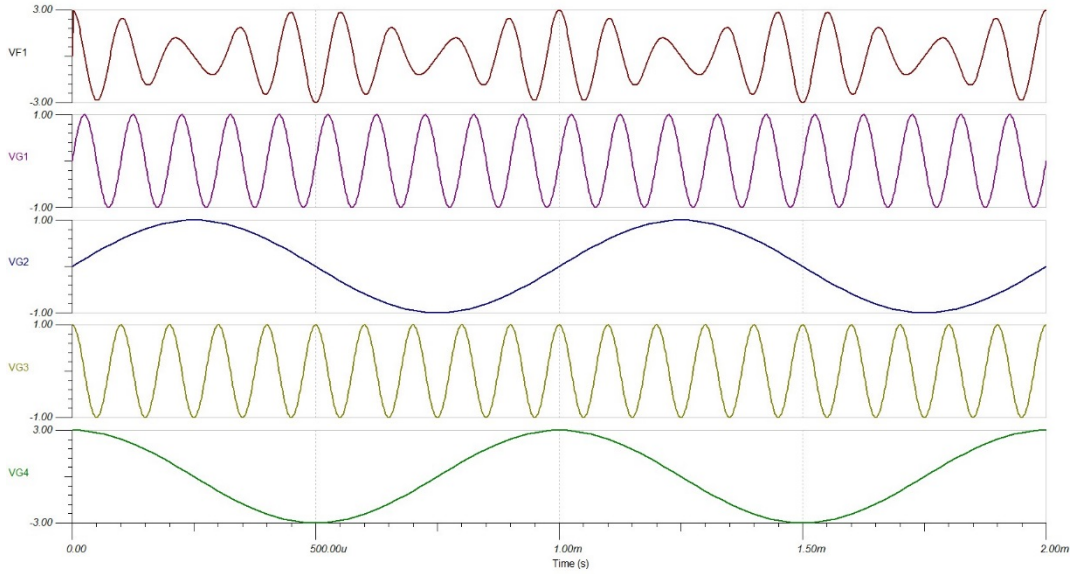

Figure 3.1 Presents results of the transient state set according to new provided parameters

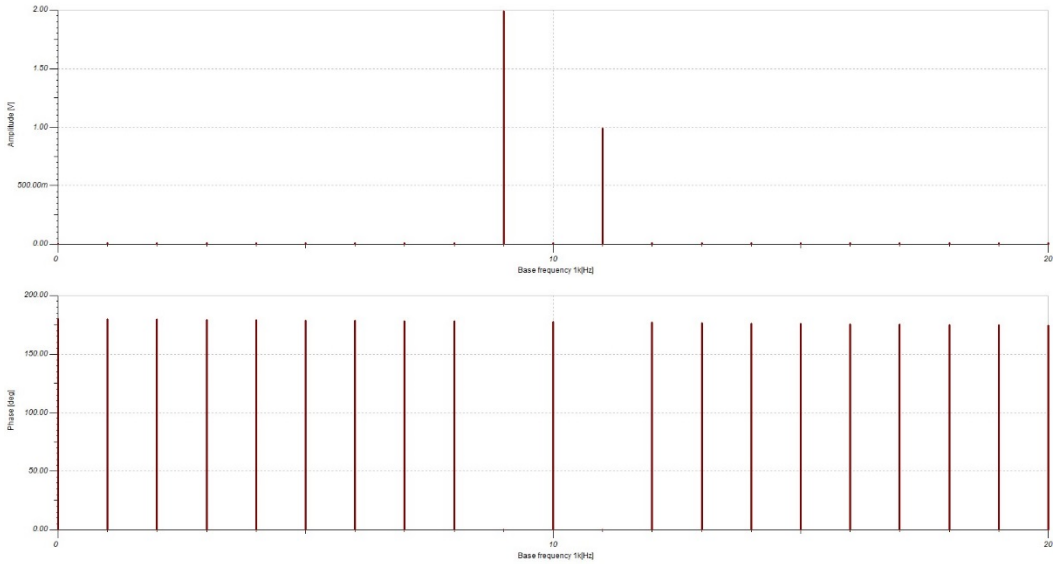

Figure 3.2 Presents graphed calculations of Fourier Series analysis

With frequency set to 1.1kHz for VS VG4

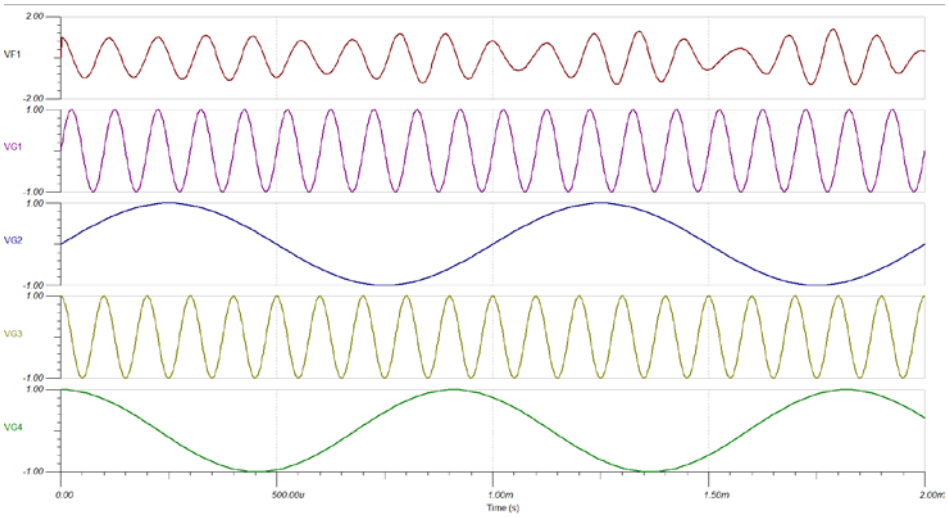

Figure 4.2 Presents results of the transient state set according to new provided parameters.

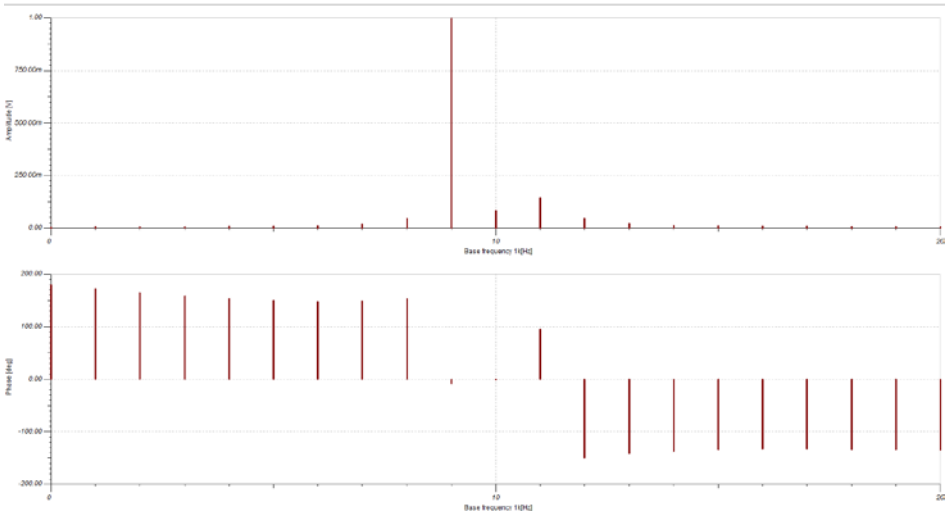

Figure 4.3 Presents graphed calculations of Fourier Series analysis.

Below please find the re-run simulation three times with different parameters. Parameters used are in the figure description.

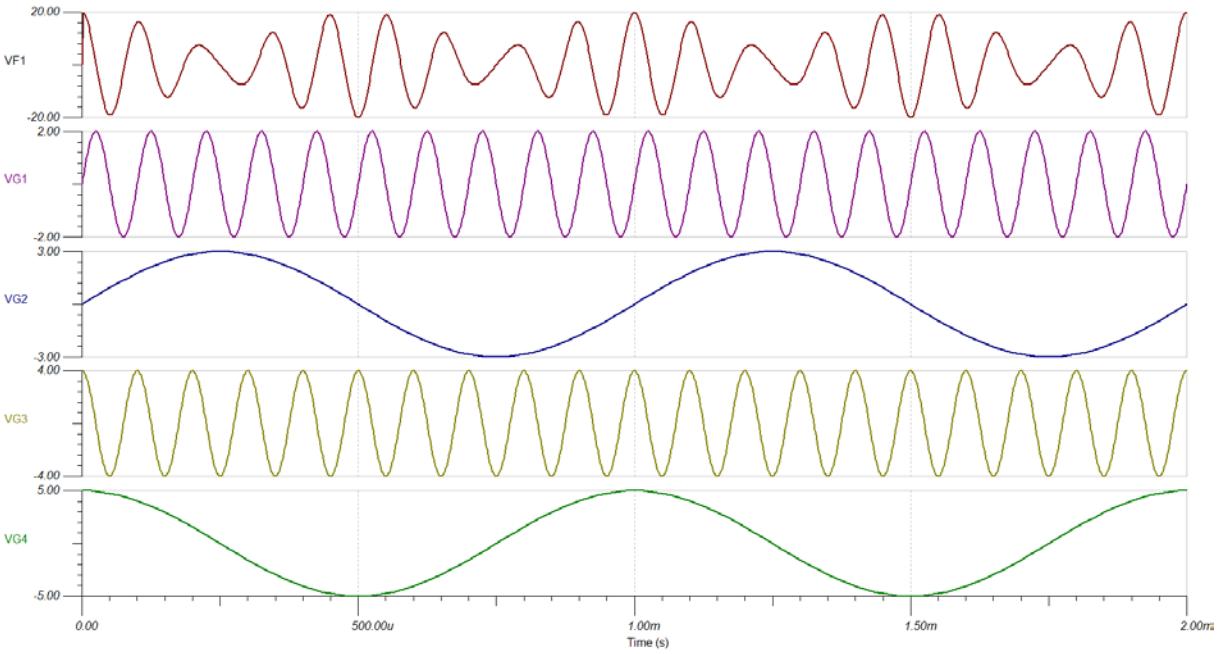

Figure 5.1 Presents results of the transient state set according to new provided parameters; VG1 =2V; VG2 =3V; VG3 = 4V; VG4=5V.

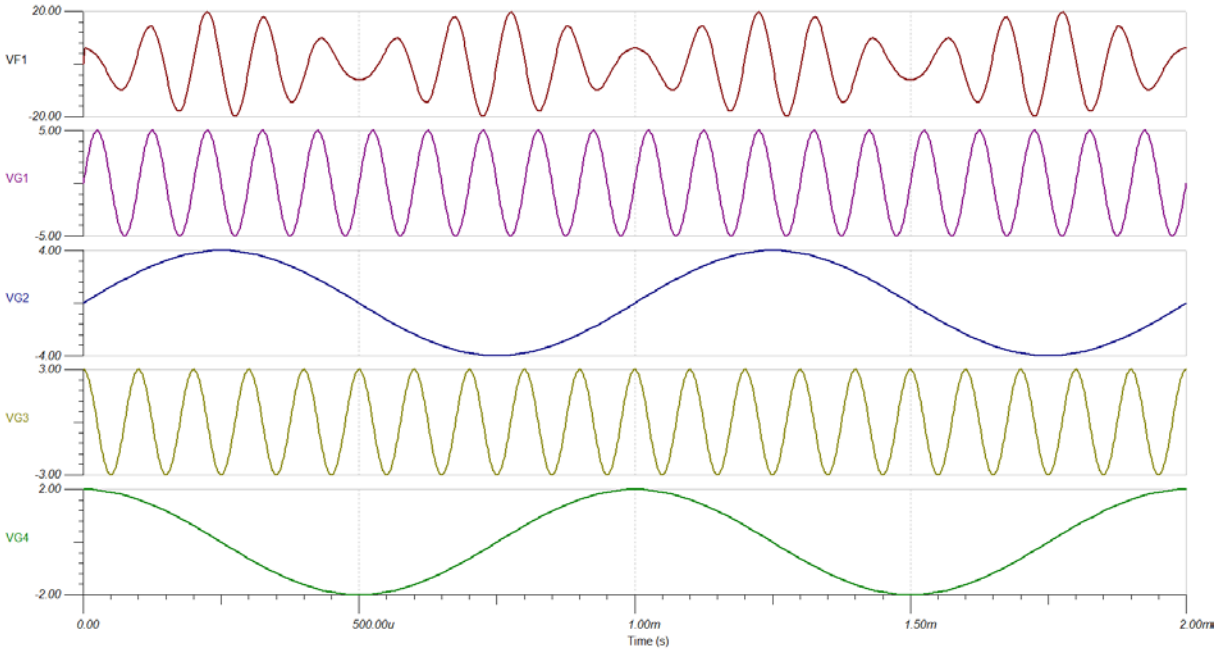

Figure 5.2 Presents results of the transient state set according to new provided parameters; VG4 =2V; VG3 =3V; VG2 = 4V; VG1=5V.

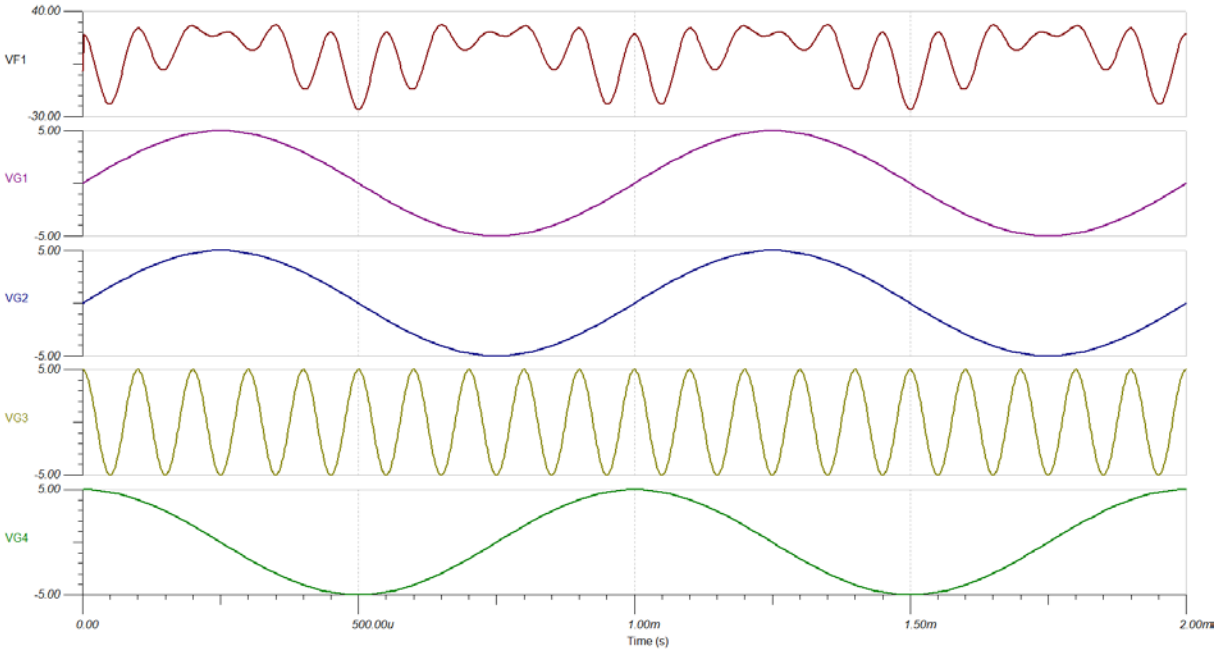

Figure 5.3 Presents results of the transient state set according to new provided parameters; VGX =5V

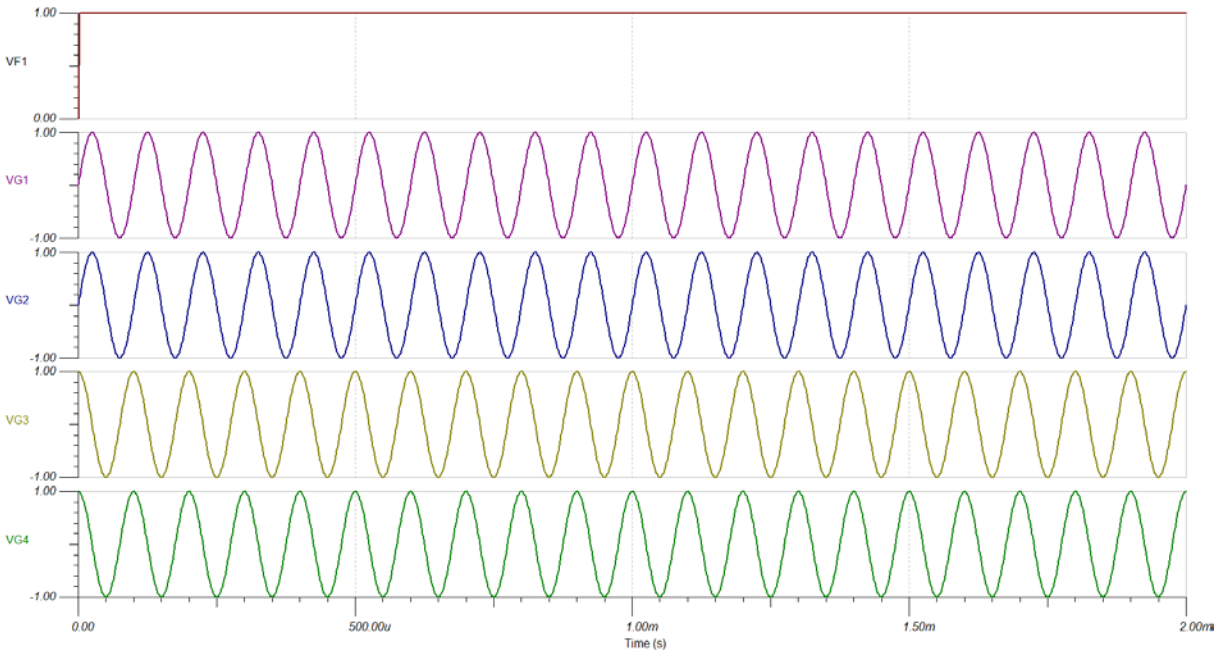

Figure 5.4 Presents results of the transient state set according to new provided parameters; VGX =1V;and all equal to 10kHz frequency.

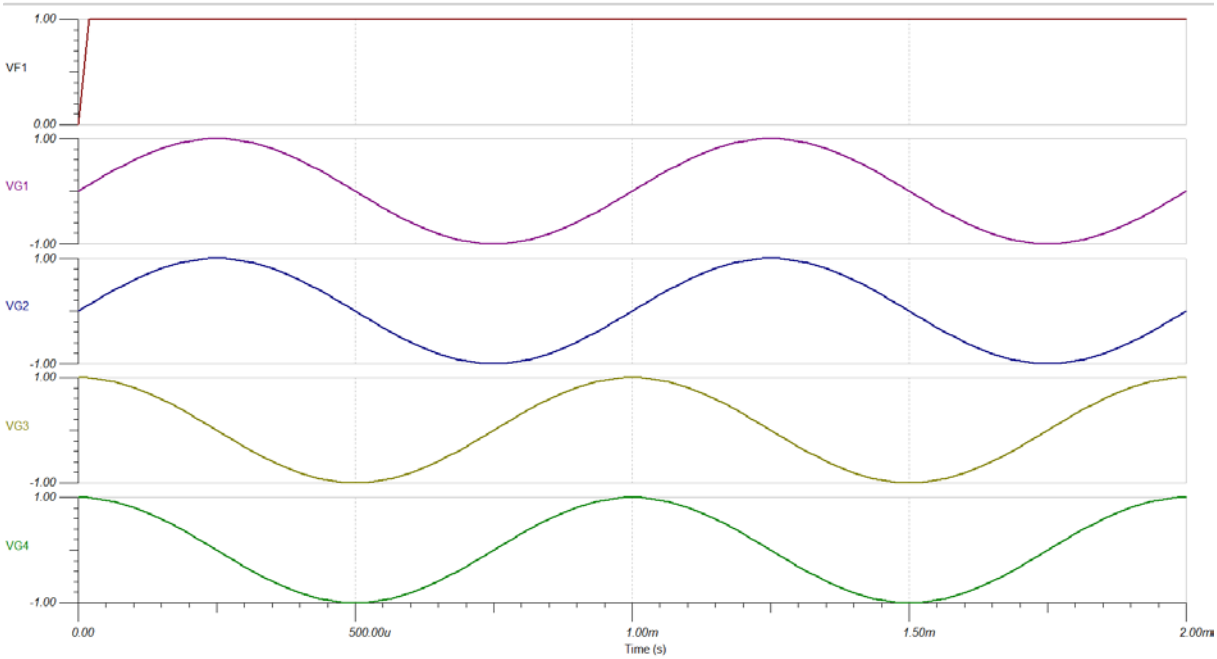

Figure 5.5 Presents results of the transient state set according to new provided parameters; VGX =1V;and all equal to 1kHz frequency.

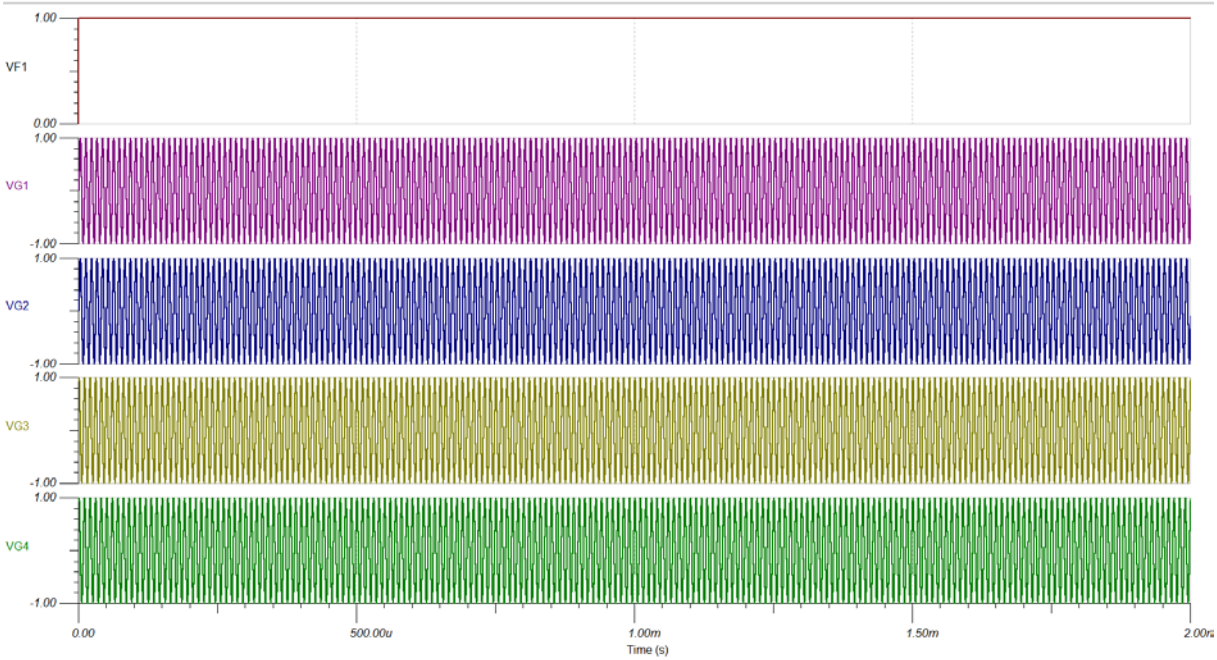

Figure 5.6 Presents results of the transient state set according to new provided parameters; VGX =1V;and all equal to 100kHz frequency.

CS3 changed to V(N1)-V(N2):

VG 1-4 set to 1V. VG 1 & 3 = 10k; VG 2 & 4 = 1k

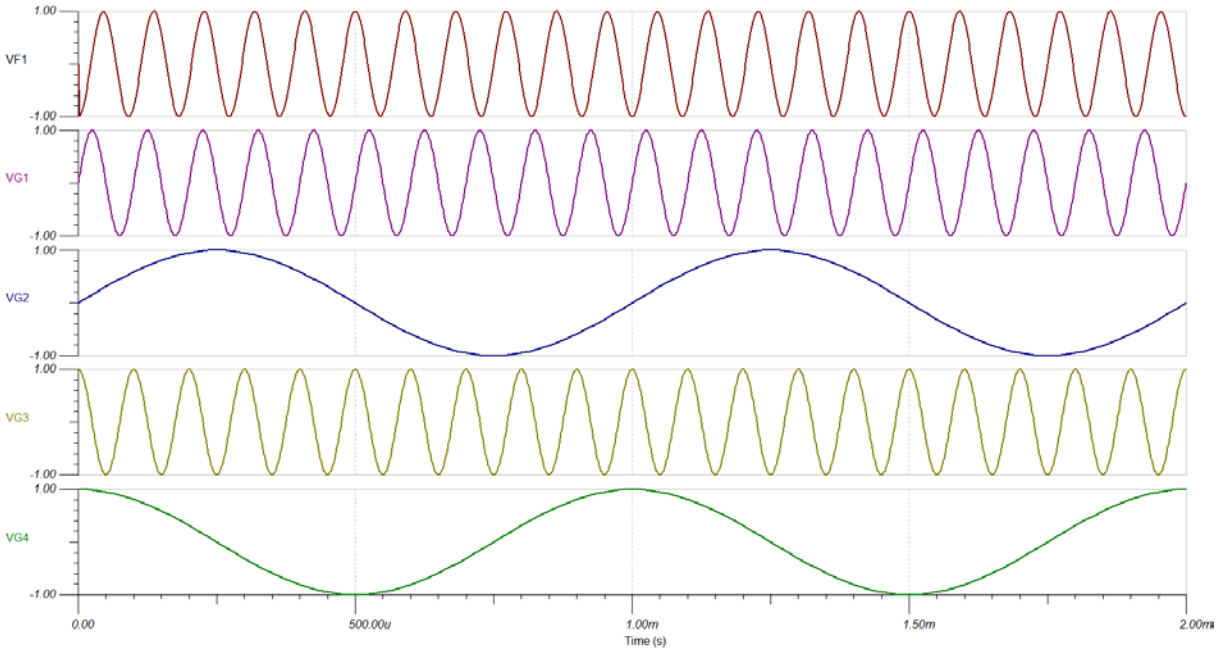

Figure 6.1 Presents results of the transient state set according to new provided parameters.

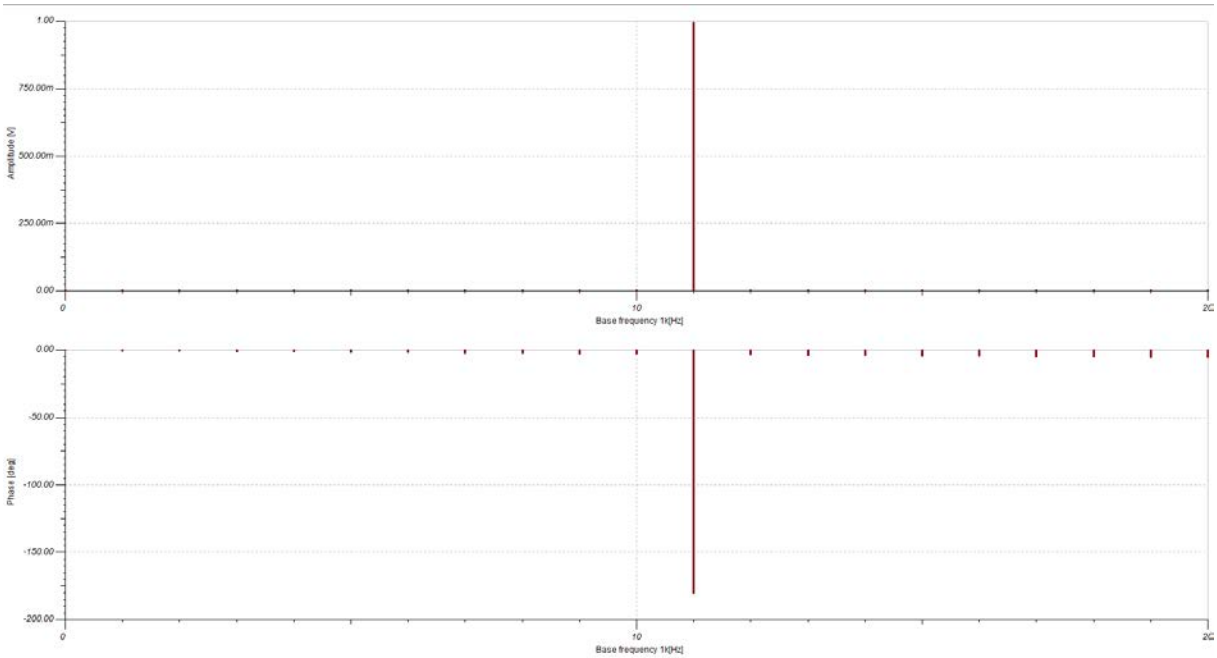

Figure 6.2 Presents graphed calculations of Fourier Series analysis.