DSB-SC Modulation

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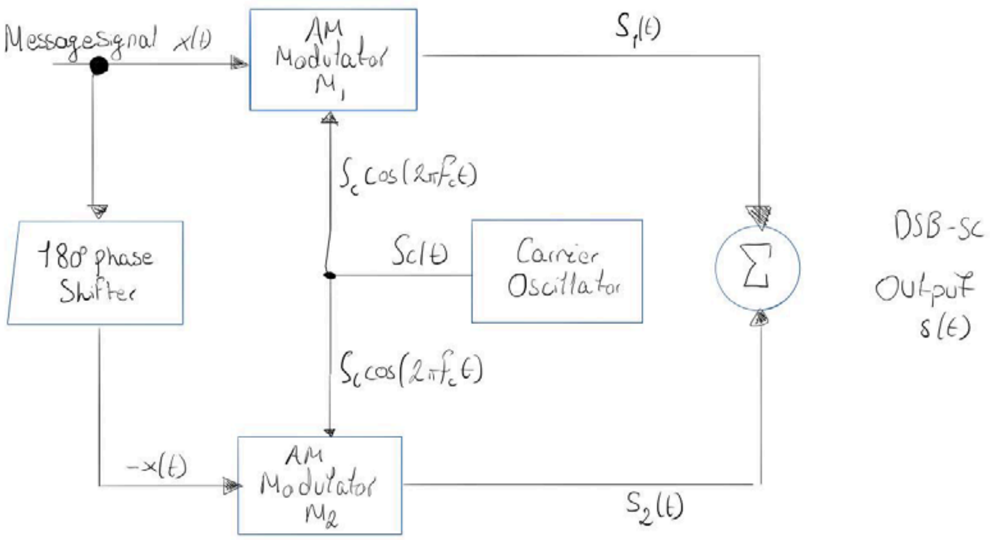
This laboratory exercise expands the characteristics of the DSB (double-sideband) linear modulation. Modulation is performed consistently to its requirements in order to achieve an accurate synchronization with the oscillating carrier.

Introduction

Electrical signals can be found in almost all devices we all use ranging from telephones, TV's to radio broadcasts and so on. Therefore, within communication systems all of this information is being transmitted from one spot to another with the use of said electrical signals. Commonly message signals are not ideal to be transmitted, for example due to propagation qualities – note: only for a large wavelength. Usually most of these signals are at a similar frequency range therefore we must ensure that all of these transmissions are done at a different frequency in order to avoid any broadcast signal interference. We commonly use linear modulation, that translates the spectrum of message signal to a higher frequency, then this spectrum that is already translated is modified before it's transmission resulting in linear modulation schemes. Usually there are four, AM, DSB-LC, SSB, VSB and **DSB**. In this experiment we will simulate and examine the characteristics of DSB modulation.

Below please find a block diagram of a balanced DSB modulator using AM modulator modulator.



Measurements

All measurements for this experiment were simulated using the program TINA TI. The equation describing the DSB signal wave - $s(t) = A_m A_c \cos(2\pi f_m t)\cos(2\pi f_c t)$ and is used to assemble the circuit to generate our DSB signal.

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.

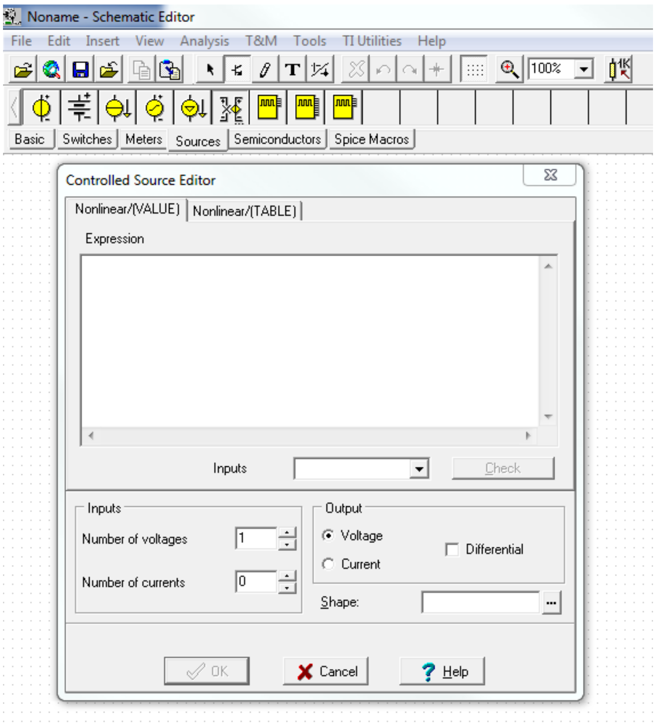


Figure 1.1 – Presents the process of specifying controlled sources.

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 5V; frequency 10 kHz (carrier)

VG2 – Set to sine wave; amplitude of 5V; frequency 1 kHz (message)

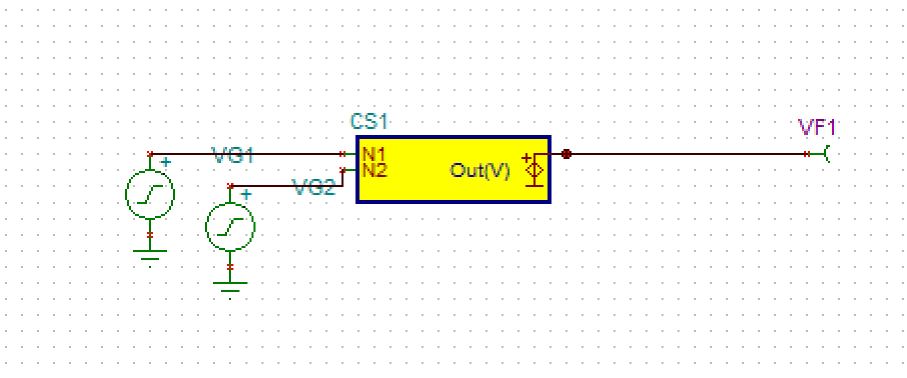


Figure 1.2 – Presents the generated voltage generator according to parameters provided. One controlled source and two voltage generators

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 equivalent to estimately 30V.

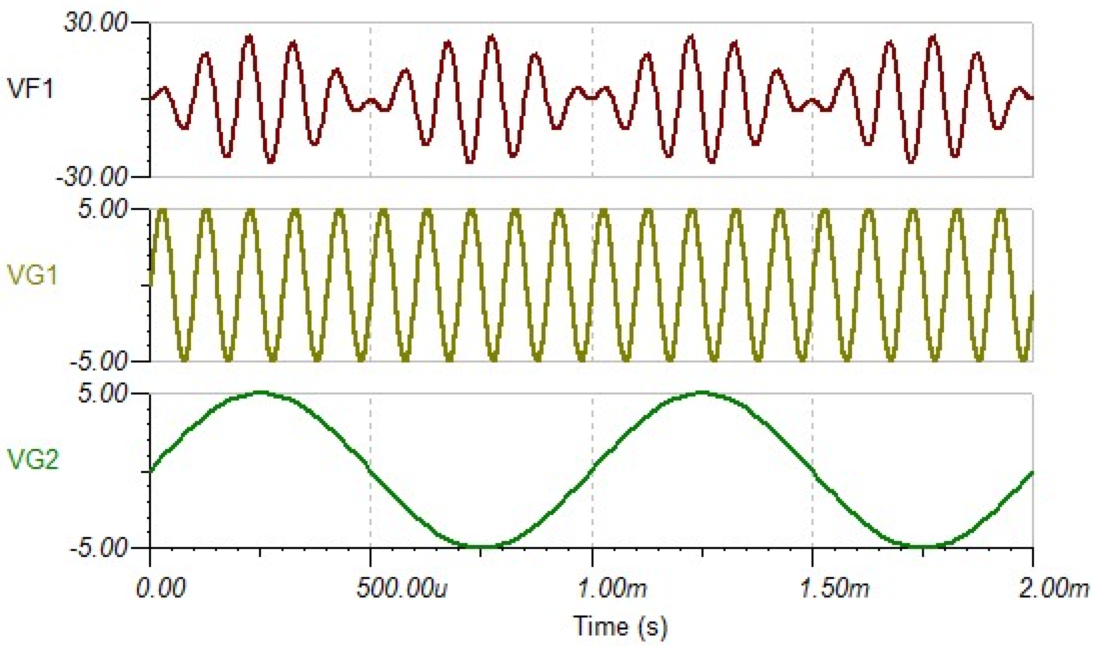


Figure 1.3 – Presents results of the transient state set according to provided parameters.

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.

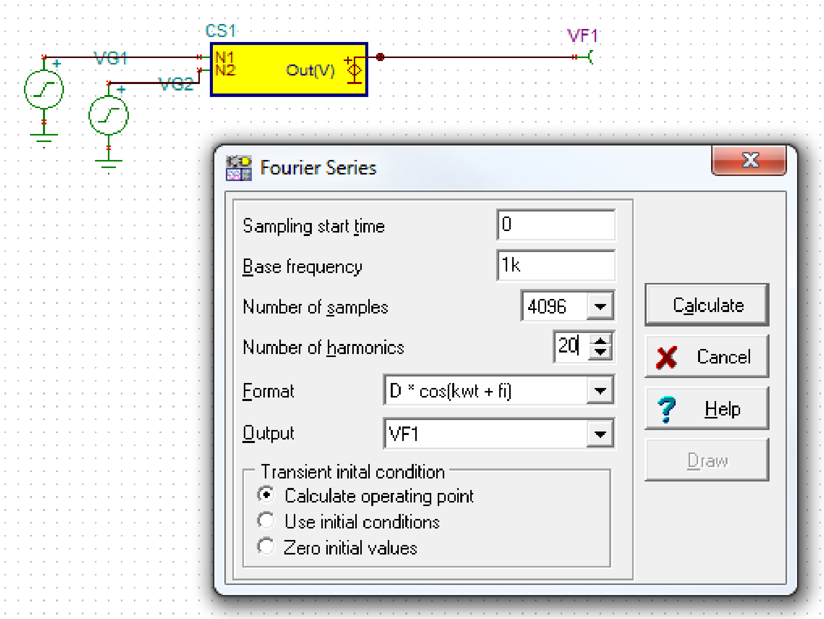


Figure 2.1 Presents Fourier Series parameters used for calculations process

Below please see figure 2.2, which shows the Fourier analysis. We see our 20 harmonics, and are able to notice an impulse response of the two dirac delta impulses which make a gate shape. We can also notice that our phase is constantly changing and isn't linear.

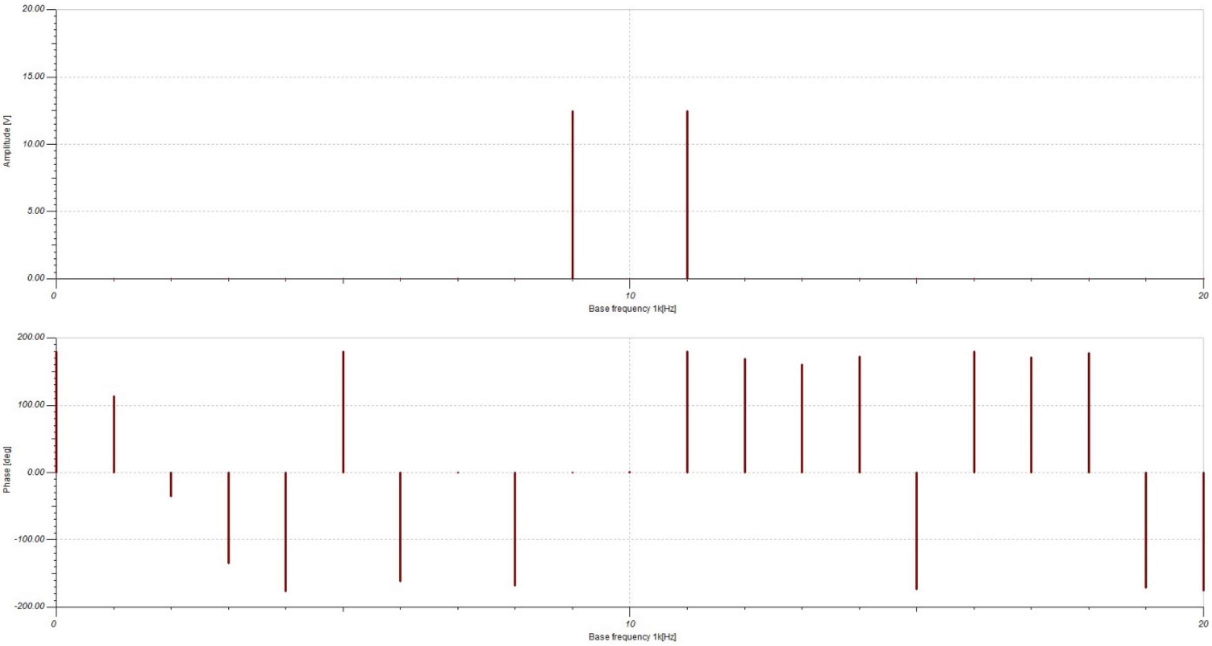


Figure 2.2 Presents graphed calculations of Fourier Series analysis.

DC level has been changed to 2V at VG2 and simulation has been repeated, as seen in figures below.

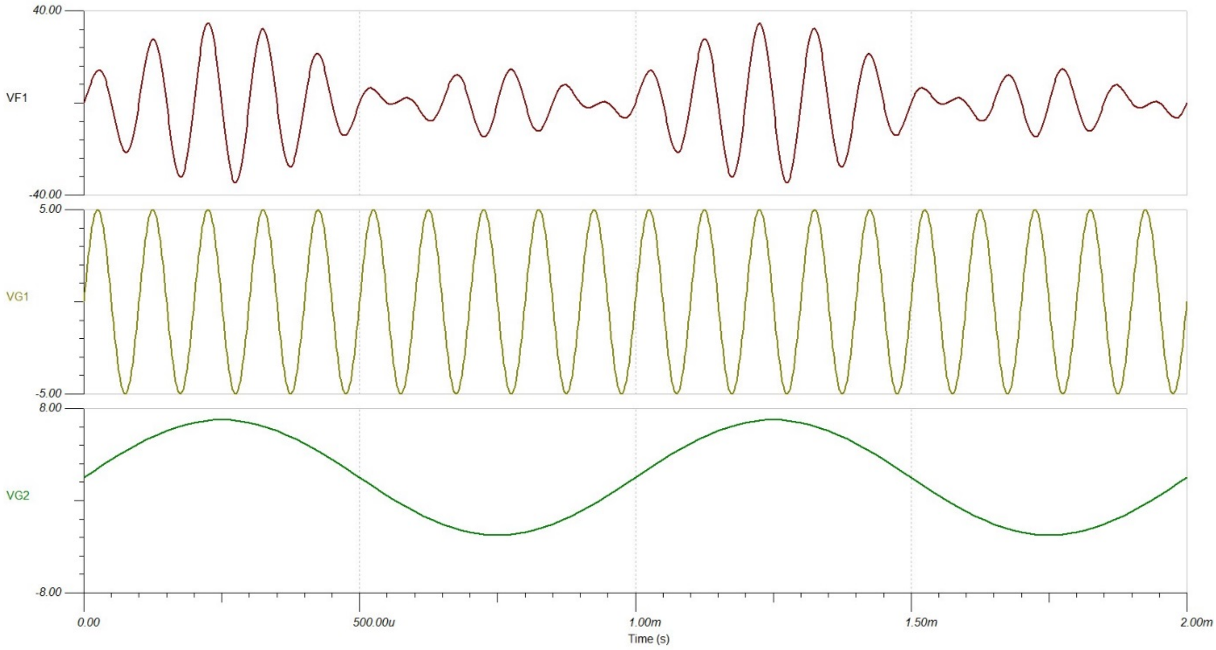


Figure 3.1 Presents results of the transient state set according to new provided parameters

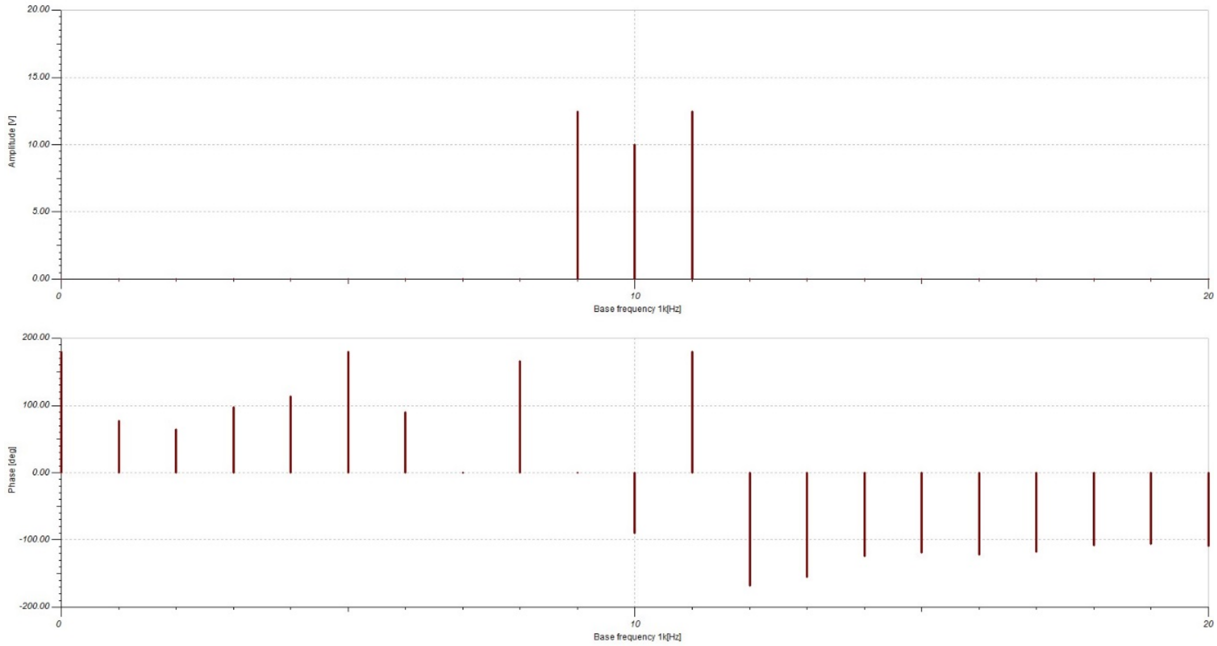


Figure 3.2 Presents graphed calculations of Fourier Series analysis

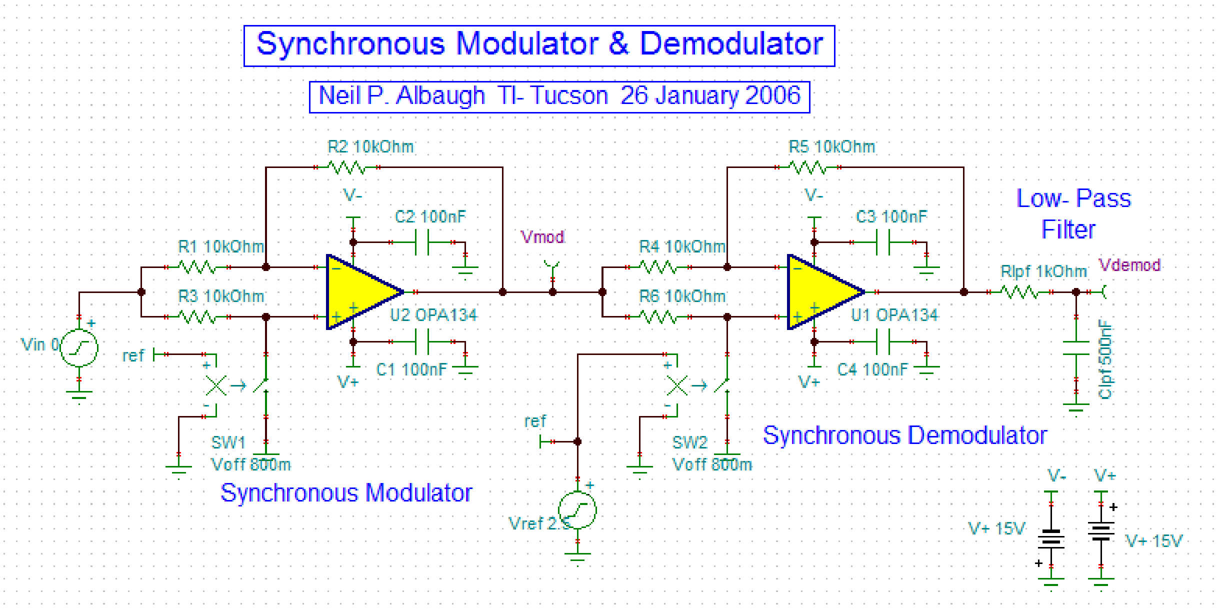


Figure 4.1 Presents a Synchronous Demodulator Signal Process Example.

Simulation repeated by using Sine signal parameters, amplitude and frequency provided:

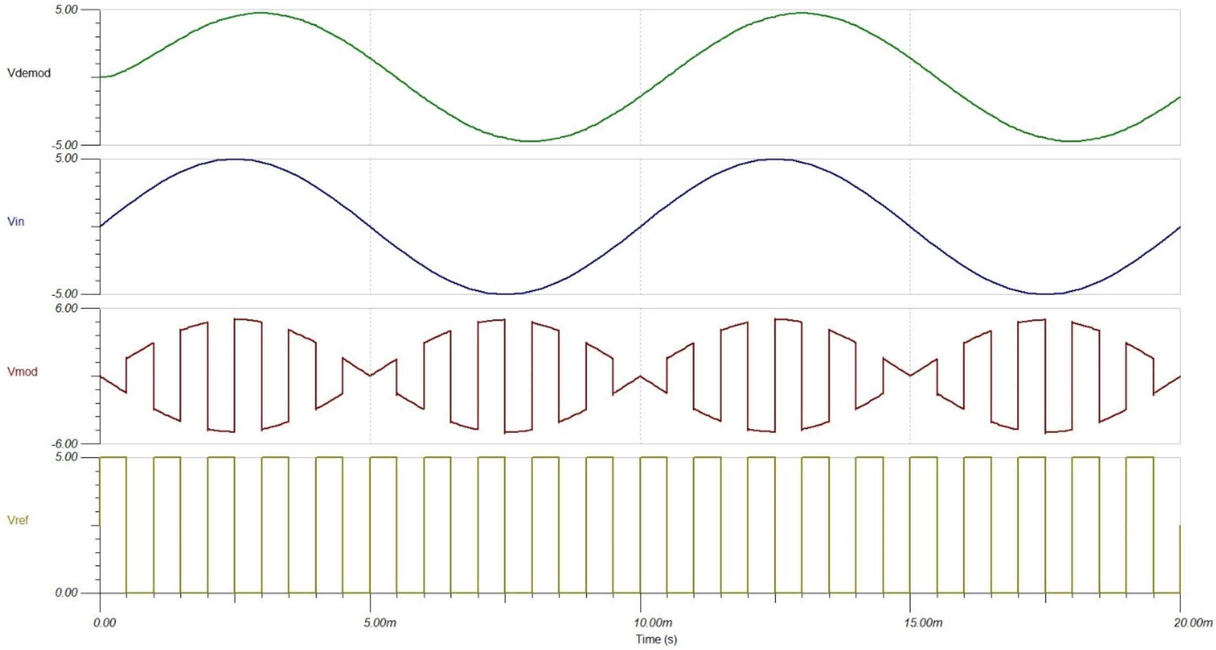


Figure 4.2 Presents results of the transient state set according to new provided parameters.

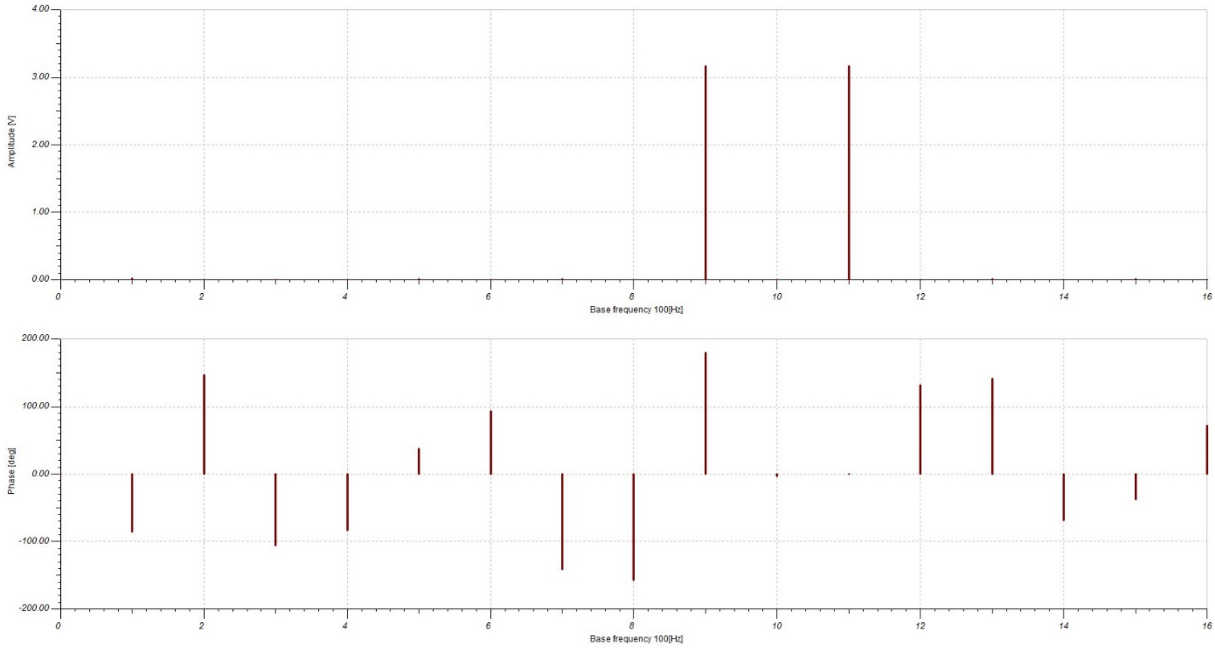


Figure 4.3 Presents graphed calculations of Fourier Series analysis.

Simulation repeated by using Square signal parameters, amplitude and frequency provided:

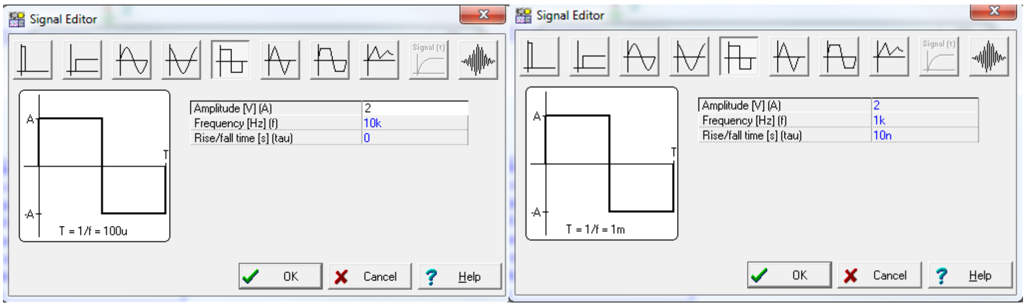


Figure 5.1 Presents presets and parameters of signal generated.

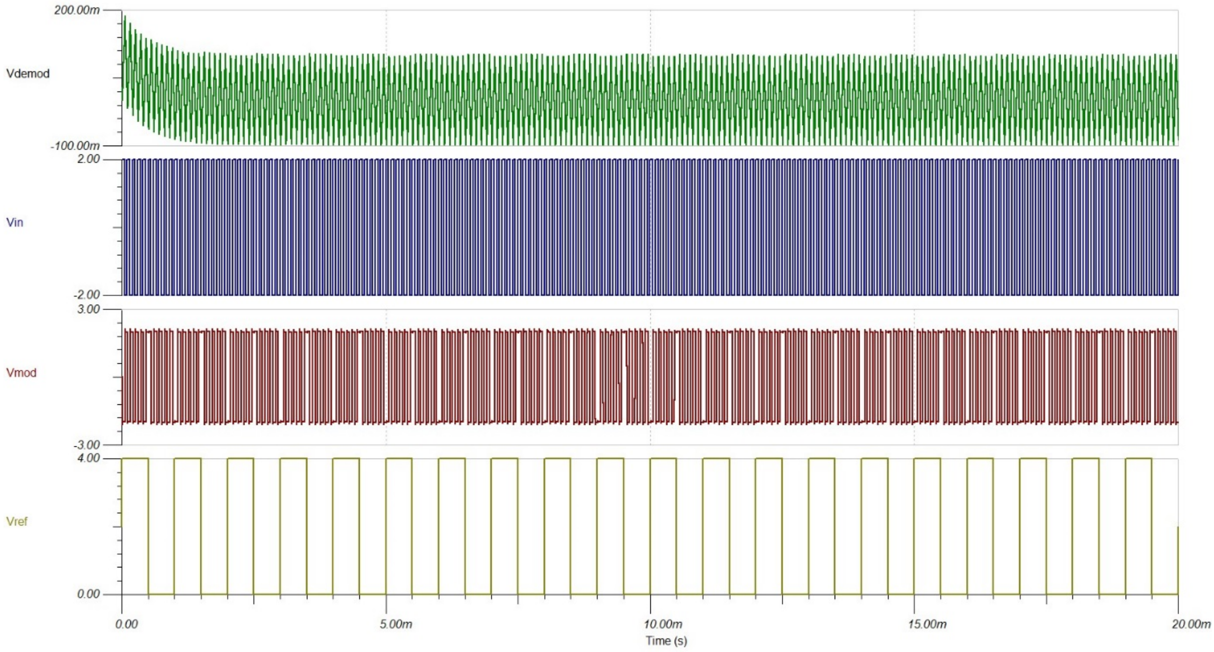


Figure 5.2 Presents results of the transient state set according to new provided parameters.

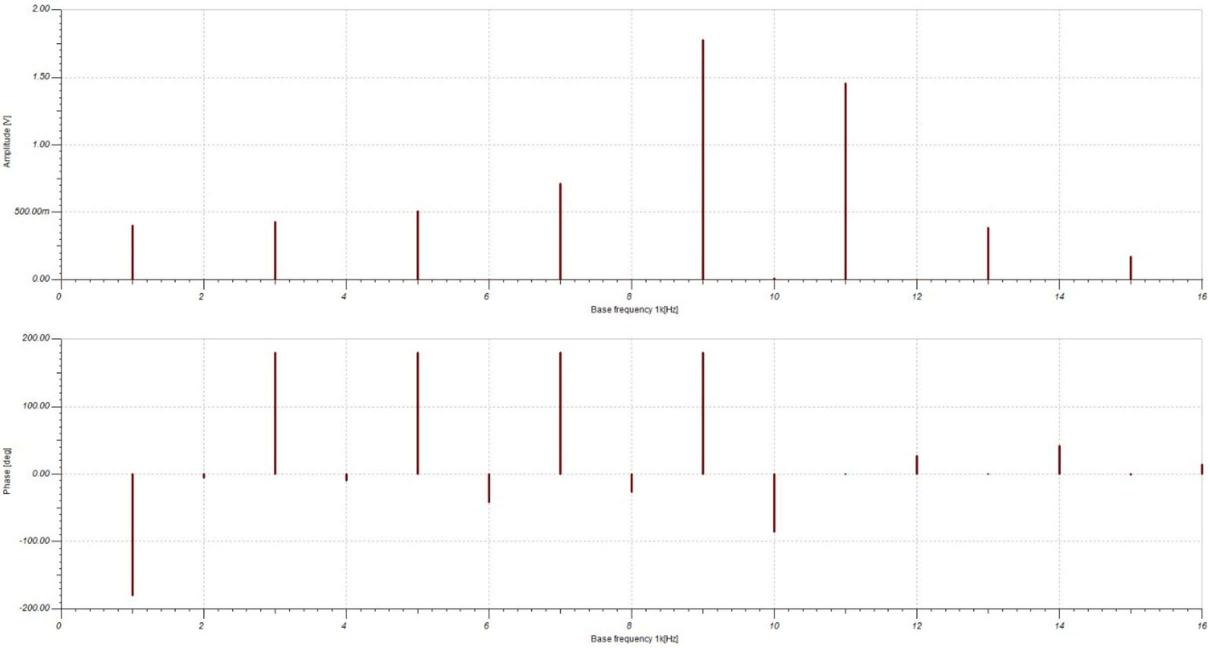


Figure 5.3 Presents graphed calculations of Fourier Series analysis.

Simulation repeated by using Triangle signal parameters, amplitude and frequency provided:

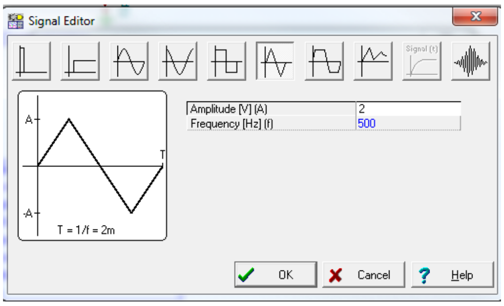


Figure 6.1 Presents presets and parameters of signal generated.

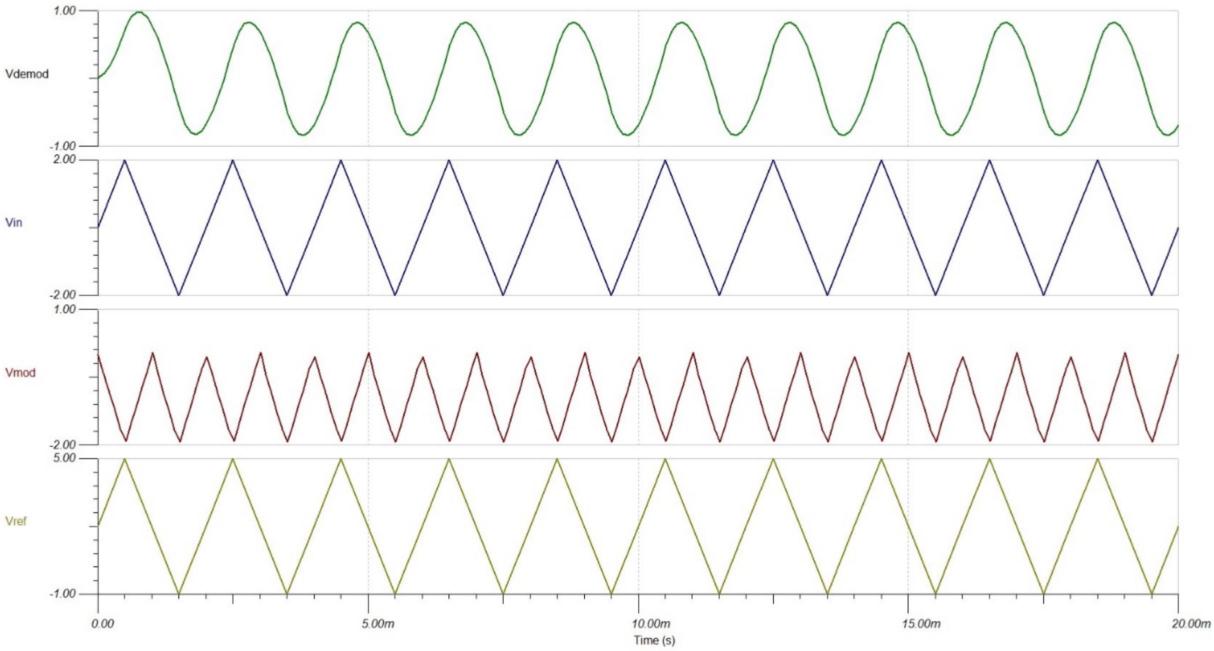


Figure 6.2 Presents results of the transient state set according to new provided parameters.

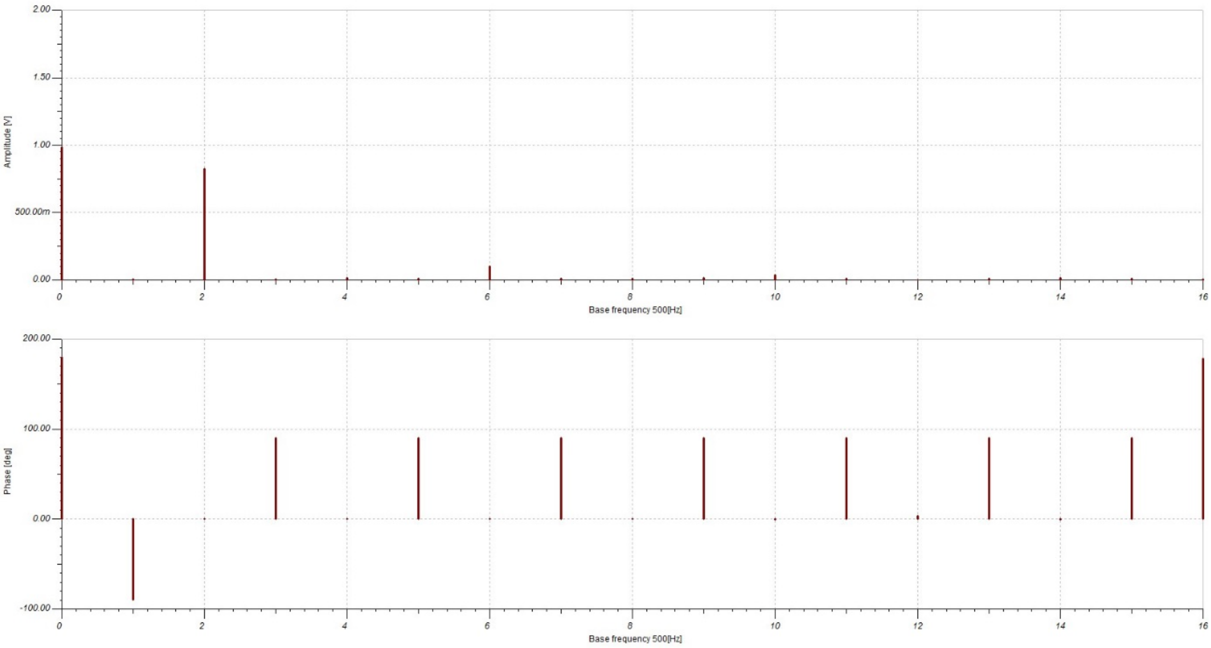


Figure 6.3 Presents graphed calculations of Fourier Series analysis.

Conclusion

DSBSC (else known as Double Side-bane Suppressed Carrier) transmission – if we are to modulate the amplitude of the carrier itself (life we've done) we would have an amplitude that varies according to the provided baseband signal. Please see attached formula $s(t) = A(t)\cos(2\pi f_c t+0)$; where fc and phase 0 are all constants; finally we have s(t) being the signal that has been carried through a channel.