

Title of the experiment

Highly Efficient Switching Mode Power Supply Using LM2596

Theory:

The LM2596 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version.

Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation, and a fixed frequency oscillator.

The LM2596 is not available in the eSim library so we have created a hierarchal sheet schematic using a comparator and a pulse generator (fall time is made zero to get a sawtooth waveform) to generate PWM and a switching npn transistor to resemble IC LM2596. The output of the PWM is given to a npn switching transistor as shown in schematic below. Here we have designed the LM 2596 IC as a fixed 5V version.

Schematic diagram:

The circuit schematic of the Highly Efficient Switching Mode Power Supply Using LM2596 in eSim is as shown below:

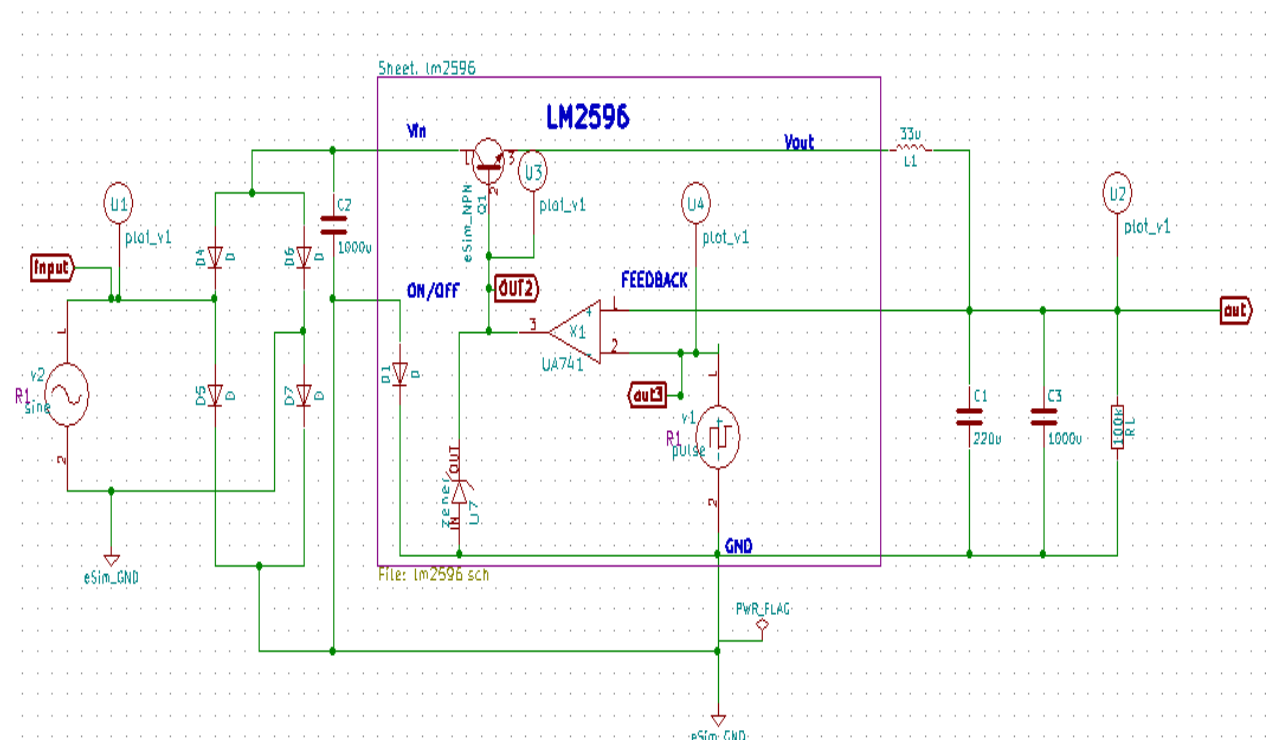


Figure 1: Highly Efficient Switching Mode Power Supply Using LM2596

Simulation Results:

1. Ngspice Plots-

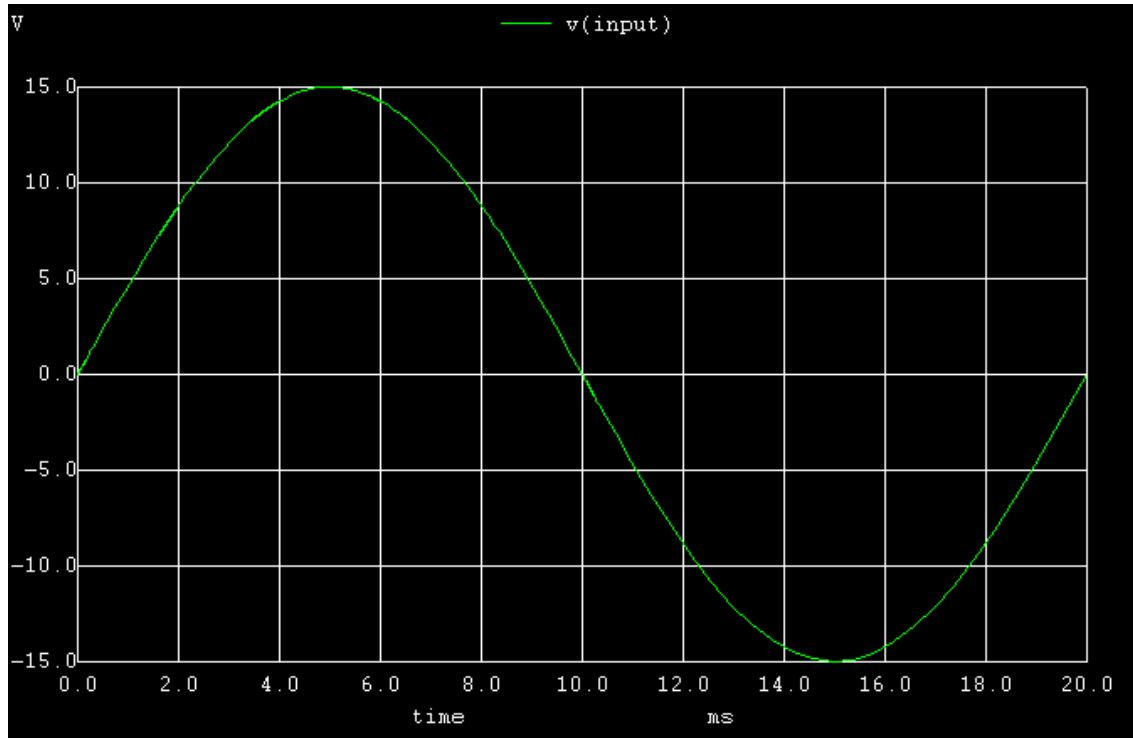


Figure 2: Ngspice Input Signal to the bridge rectifier Plot

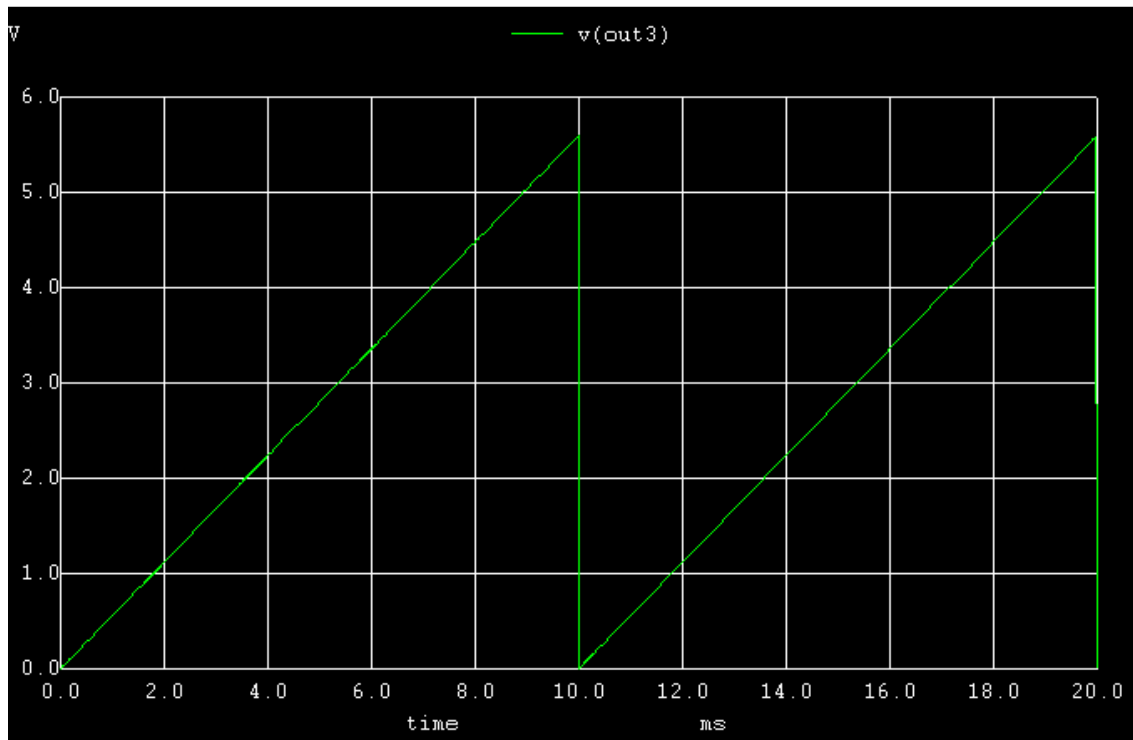


Figure 3: Ngspice Output of pulse generator (Sawtooth Wave) Plot

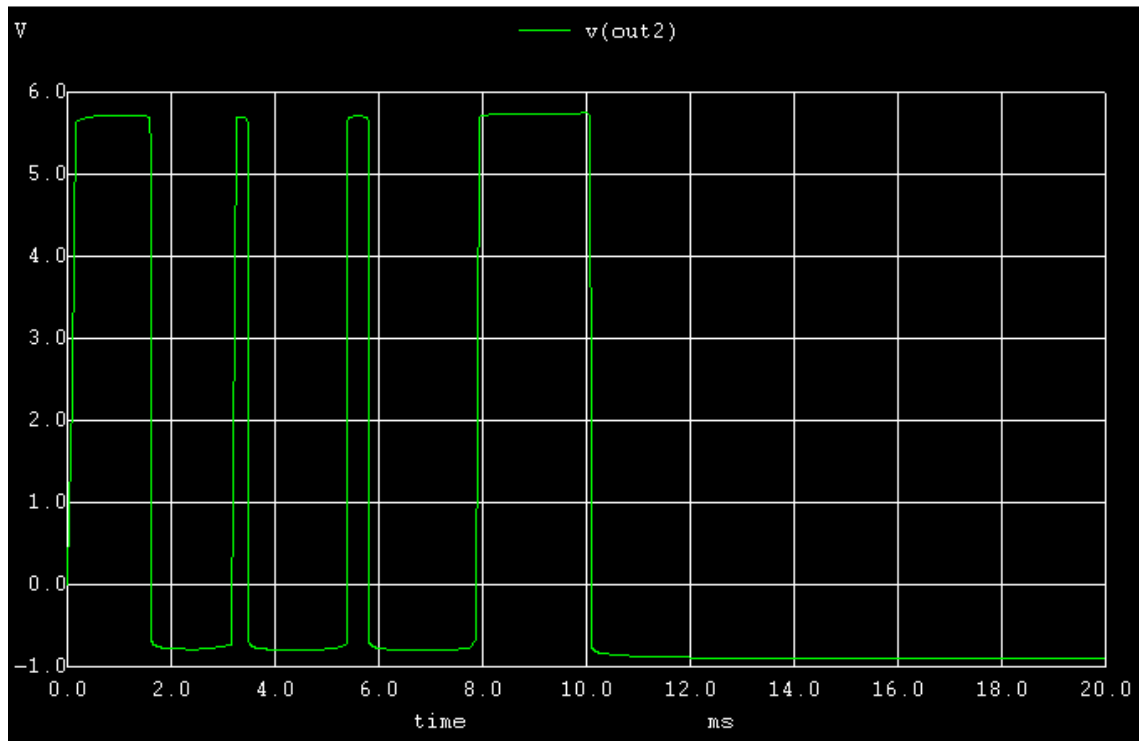


Figure 4: Ngspice Output of comparator (PWM) Plot



Figure 5: Ngspice Final Output Plot

2. Python Plots-

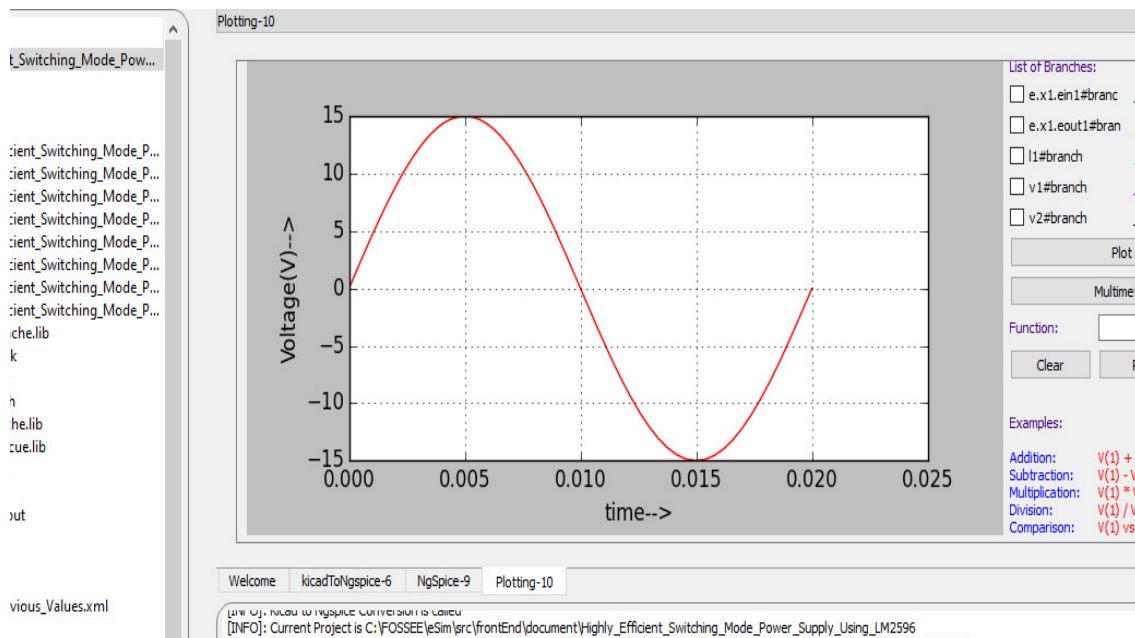


Figure 6: Python Input Signal to the bridge rectifier Plot

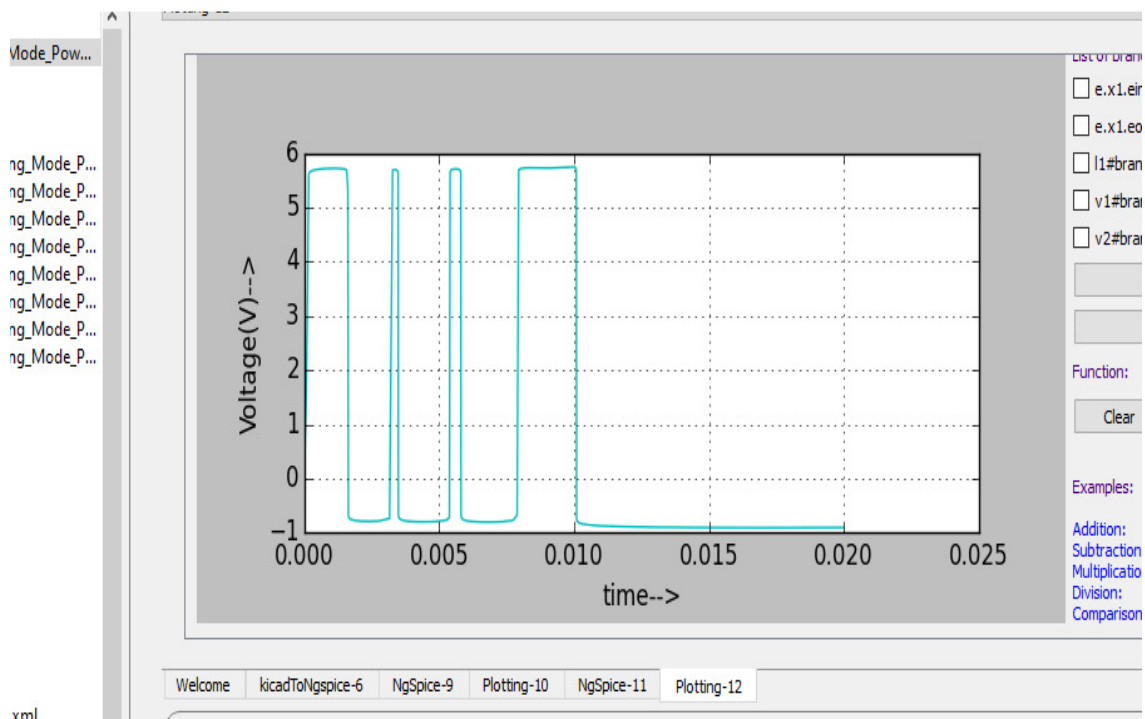


Figure 7: Python Output of comparator (PWM) Plot

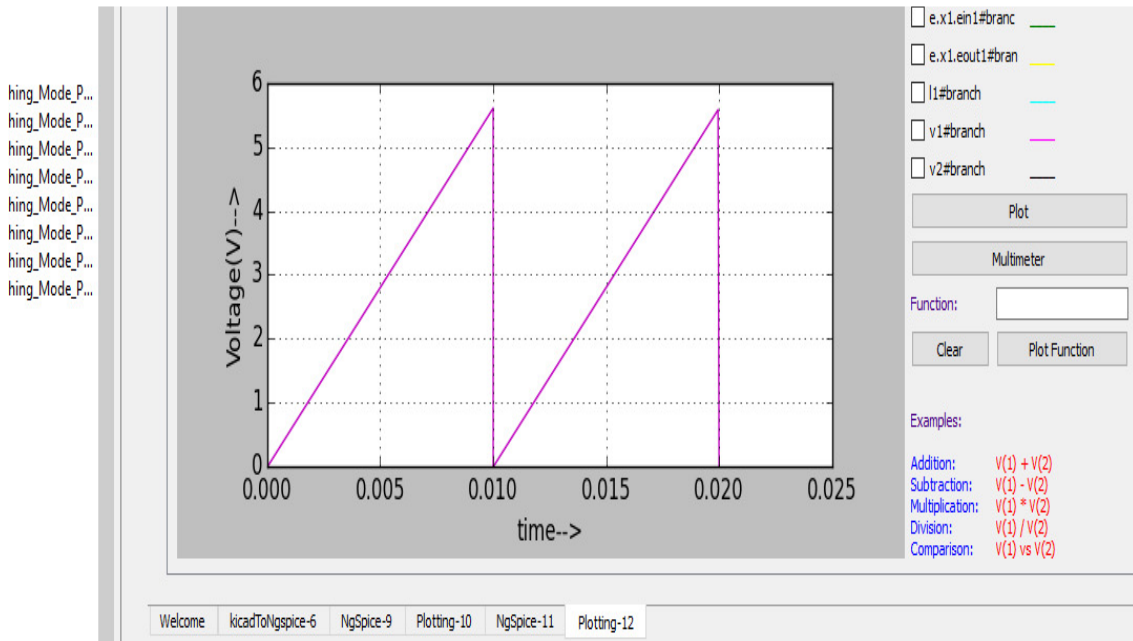


Figure 8: Python Output of pulse generator (Sawtooth Wave) Plot

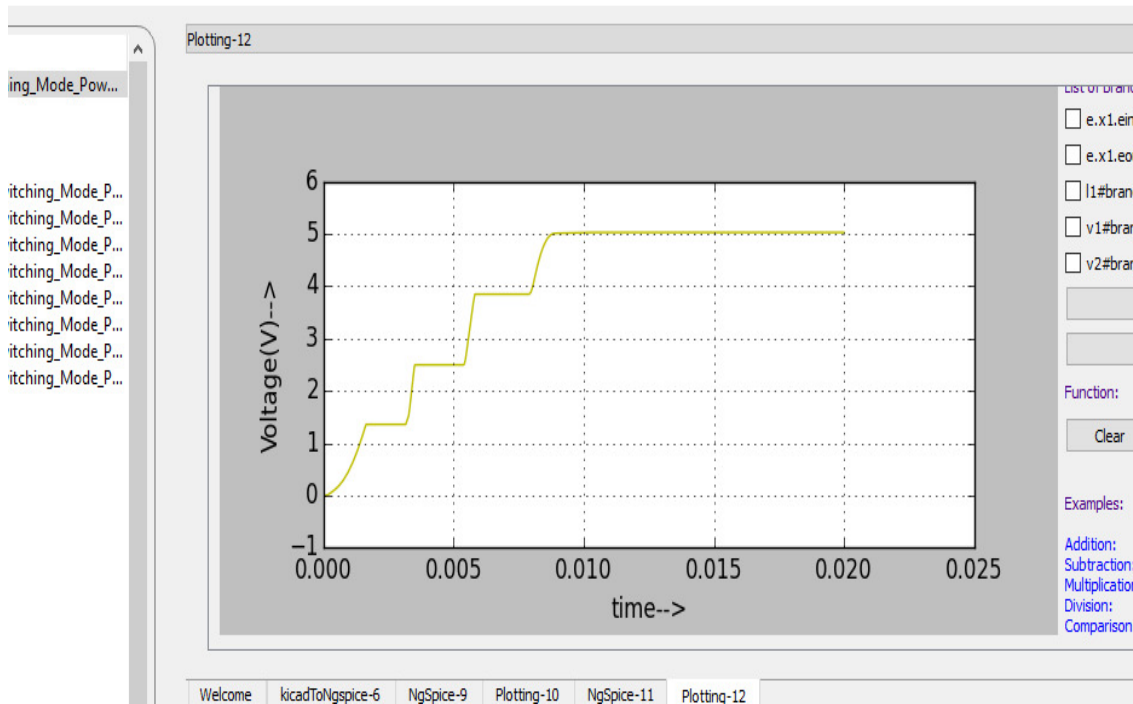


Figure 9: Python Final Output Plot

Conclusion:

Thus, we have studied the Highly Efficient Switching Mode Power Supply using LM2596 and the simulation plot of ngspice and python plot obtained in eSim.

References:

- 1) <http://www.ti.com/lit/ds/symlink/lm2596.pdf>
- 2) https://en.wikipedia.org/wiki/Switched-mode_power_supply
- 3) <https://www.electronics-tutorials.ws/power/switch-mode-power-supply.html>