Buck-Boost Converter

Project File

buck-boost.sqproj

Introduction

The main applications of this circuit are in regulated dc power supplies, where a negative polarity output may be desired with respect to the common terminals of the input voltage and the the average output is either higher or lower than the dc input voltage.

A buck-boost converter circuit is a combination of the buck converter topology and a boost converter topology in cascade. The output to input conversion ratio is also a product of ratios in buck converter and the boost converter. The output voltage is controlled by controlling the switch-duty cycle. The ratio of output voltage to input voltage is given by:

$$\frac{V_o}{V_{in}} = D \cdot \frac{1}{1-D} = \frac{I_{in}}{1_o} \tag{1}$$

Where, V_o and V_{in} are the output and input voltages, respectively. The term I_o and I_{in} are the output and input currents, respectively. The term D is the duty ratio and defined as the ratio of the on time of the switch to the total switching period.

This shows the output voltage to be hgher or lower than the input voltage, based on the duty-ratio D.

Simulation Example

The simulation example consists of a simple boost PWM dc-dc converter as shown in Figure 1. In the present example, the input voltage is kept at 50V. The Load resistance is kept at 50Ω. The output filter capacitor is chosen as 100μF. The switch is controlled by a signal "gce clock". The output can be controlled by changing the $d$uty cycle parameter for the clock. The switch and diode are ideal switch and diode, respectively.

Sample Plots

The sample simulation plots are shown in Fig. 2. Here, the first upper plot shows the gate driver pulse. The second plot shows the switch current, diode current and the source

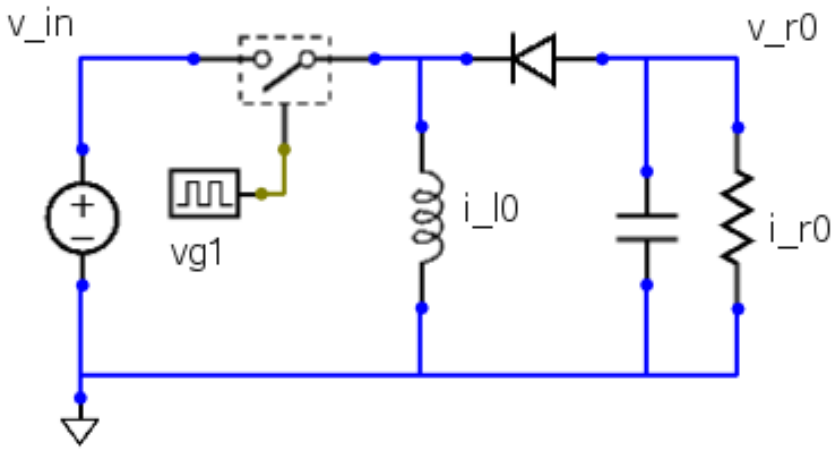

Figure 1: The Schematic circuit for the boost converter

current. The third plot shows the output voltage at the capacitor. All the plots are steady and plotted for one cycle with reference to the time scale.

Few sample exercises are given here to get the complete understanding of the topic.

Exercises

1. Change the duty cycle, re-run the simulation and verify output voltage
2. Create a condition of discontinuose current conduction and observe its effect on output voltage. Study which parameters influnce this condition and find the boundary conditions and verfy it by simulation with appropriate parameter values.
3. See the effect of change in the frequency
4. See the effect of change in inductor on the boundary conditions for discontinuose current conduction.
5. See the effect of change in output filter capacitance value.

References

[1] Ned Mohan, T.M.Undeland and W.P. Robbins, *Power Electronics: Converter, Applications and Devices*, Second Edition, John Wiley and Sons, 1995

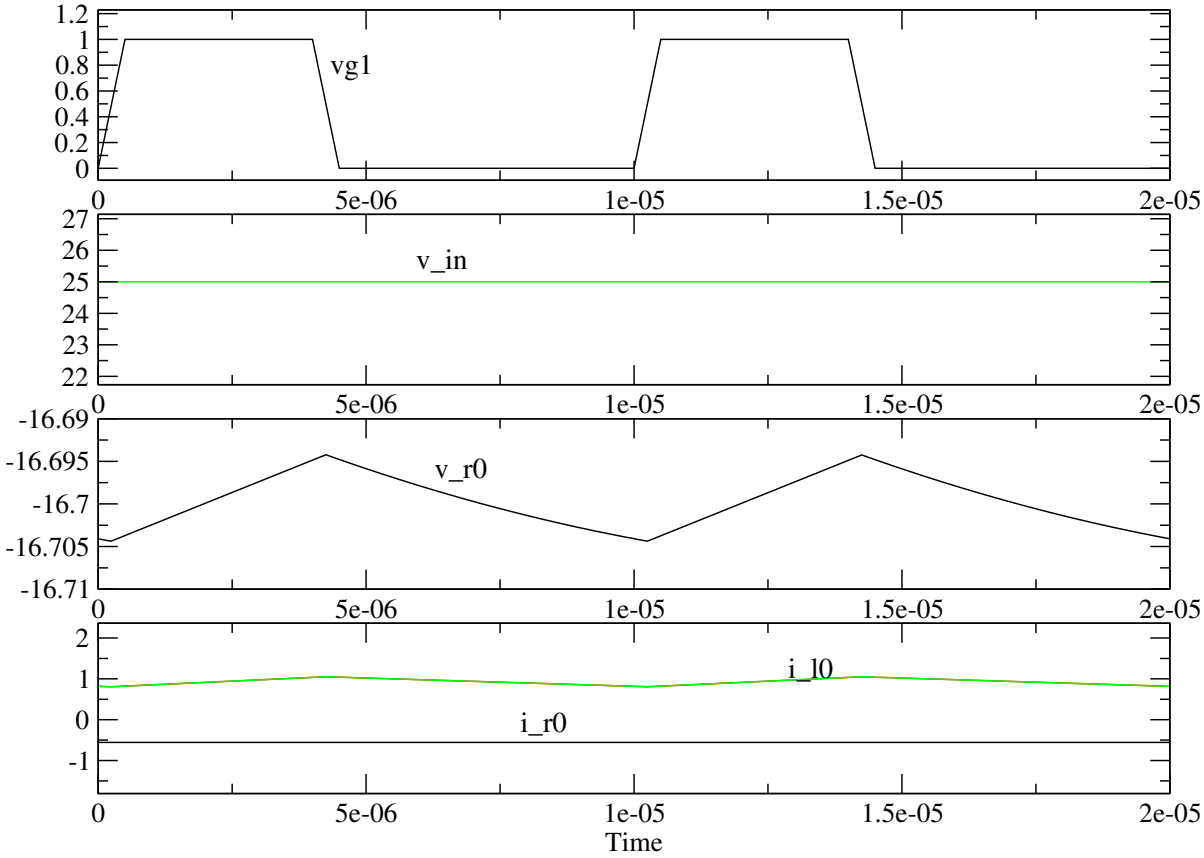

Figure 2: Simulation Plots for Buck-Boost Converter