Boost-Active Converter

Project File

*b*oost-active.sqproj

Introduction

The step-up dc-dc converter is known as boost converter. This is a modification of a basic boost converter with two switch topology. An LC circuit is added to make it soft-switching circuit.

Its main applications are in regulated dc power supplies and the regenerative braking of dc motors. The average output is always greater than the dc input voltage. The output voltage is controlled by controlling the switch-duty cycle. When the switch is on, the diode is reverse biased, and hence isolaes the output stage. During the switch on mode the inductor gets the energy from the supply and stores it. During "switch off" state, the diode becomes forward biased and the output stage receives the energy from the inductor as well as the input. Thus the net energy transfered to the output from input is always greater in a given switching cycle. The ratio of output voltage to input voltage is given by

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

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.

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 8V. The Load resistance is kept at 22.5Ω. The output filter capacitor is chosen as 100μF. The switches are controlled by the signal "gce clock" from the general element library. 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.
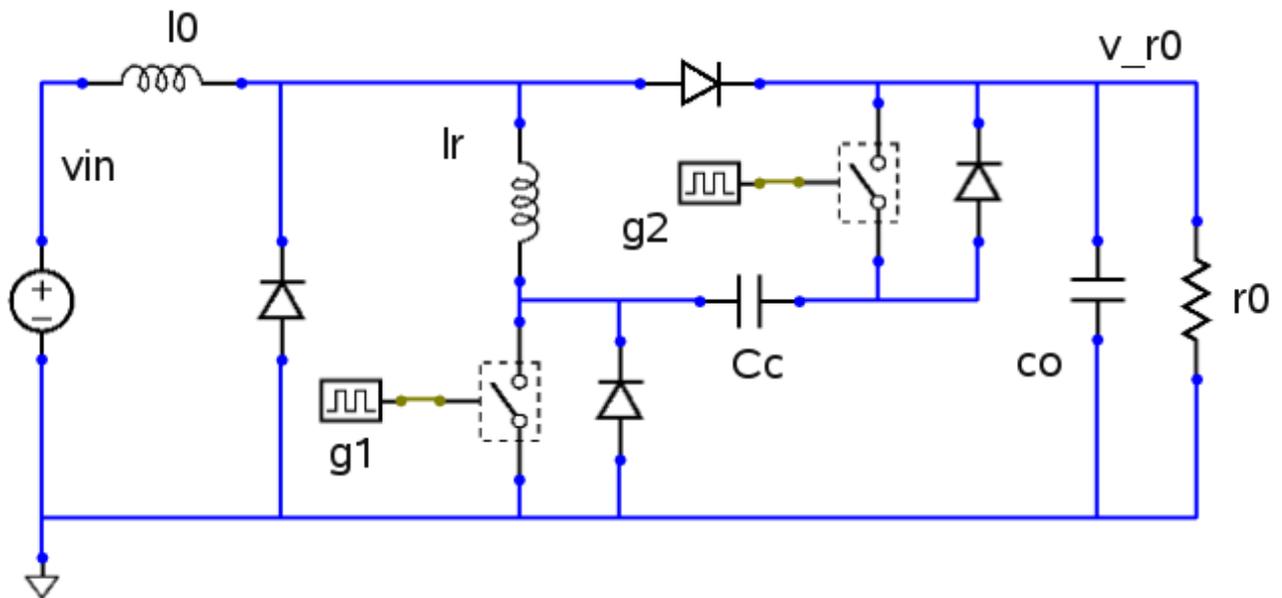
Figure 1: The Schematic circuit for the boost converter

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 input inductor current, the resonant inductor current, the C_c capacitor current and the output resistor current. The third plot shows the input and output voltages for 50% duty cycle. All the plots are steady-state and plotted for two cycles with reference to time.

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.

6. Change the values of l_r and C_c and see their effect on switch transitions and the output.
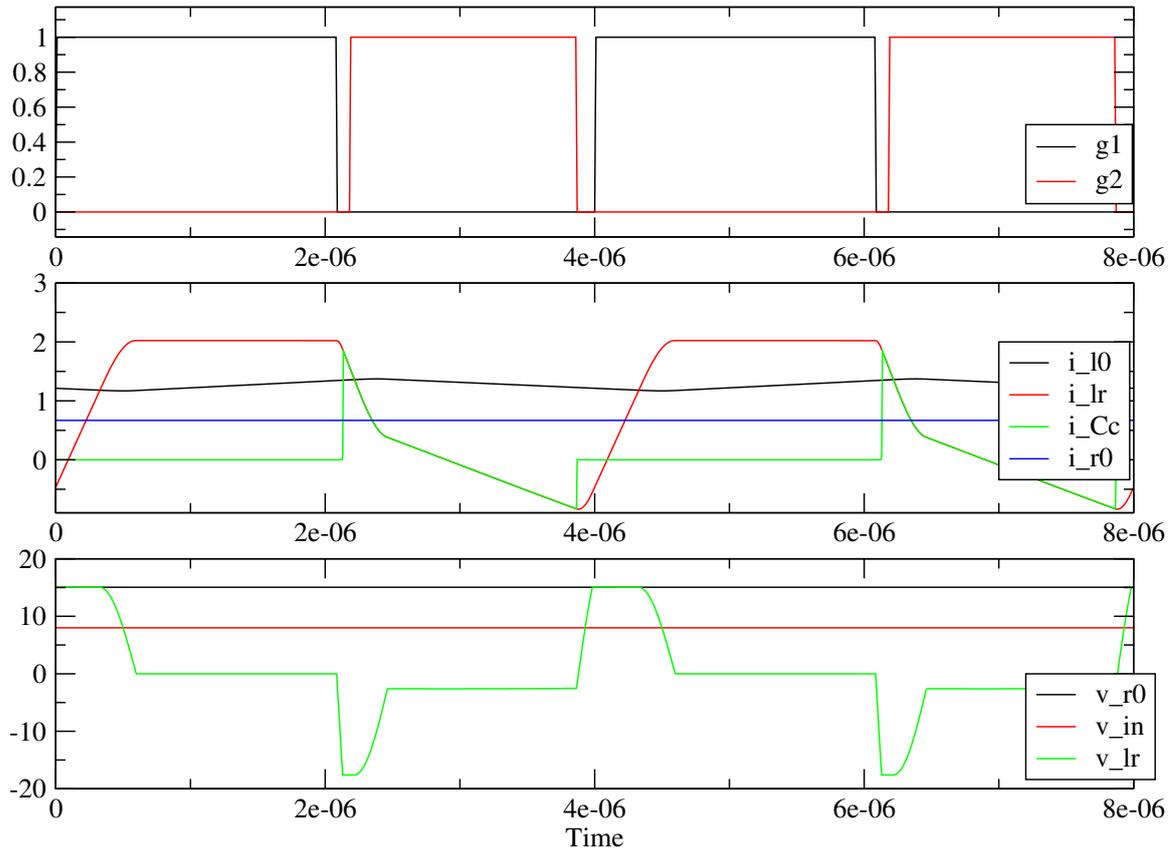
Figure 2: Simulation Plots for boost-active converter

References

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