

# Cuk Converter

## Project File

cuk.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.

The typical scematic circuit for the Cuk Converter is as shown in Fig. 1. The capacitor  $C_1$  acts as a primary means to store and transfer the power from input to output. The voltage  $v_{c1}$  is always greater than either input or output voltage.

The average output to input relations are similar to that of a buck-boost converter circuit. The output voltage is controlled by controlling the switch-duty cycle. The ratio of output voltage to input voltage is given by:

$$\frac{V_o}{V_{in}} = D \cdot \frac{1}{1 - D} = \frac{I_{in}}{I_o} \quad (1)$$

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 Cuk PWM dc-dc converter as shown in Figure 1. In the present example, the input voltage is kept at 25V. The Load resistance is kept at  $50\Omega$ . The output filter capacitor is chosen as  $100\mu\text{F}$ . The capacitor  $C_1$  is chosen as  $100\mu\text{F}$ . The switch is controlled by a signal “gce clock”, kept at 25kHz frequency and with duty cycle 80%. The output can be controlled by changing the *duty cycle* parameter for the clock. The switch and diode are ideal switch and diode, respectively.

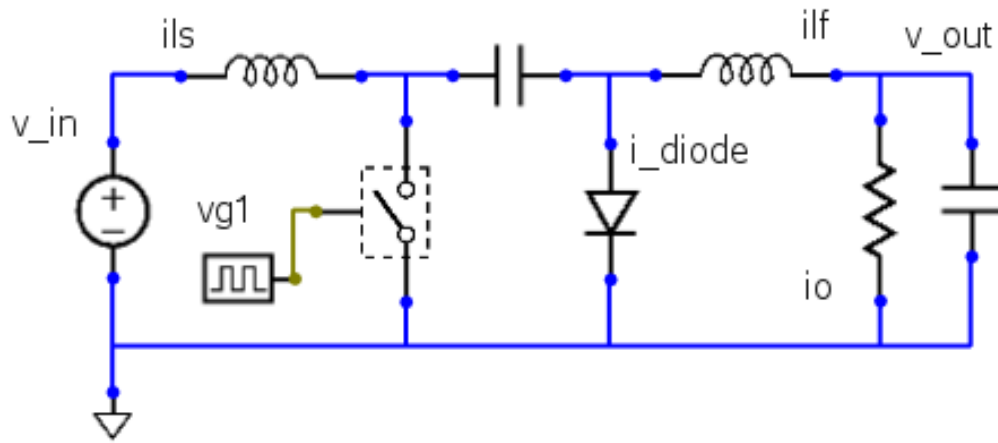


Figure 1: The Schematic circuit for the buck converter

## 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 and output voltages. The third plot shows the switch current, diode current and the source current. 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 discontinuous current conduction and observe its effect on output voltage. Study which parameters influence this condition and find the boundary conditions and verify 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 discontinuous 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

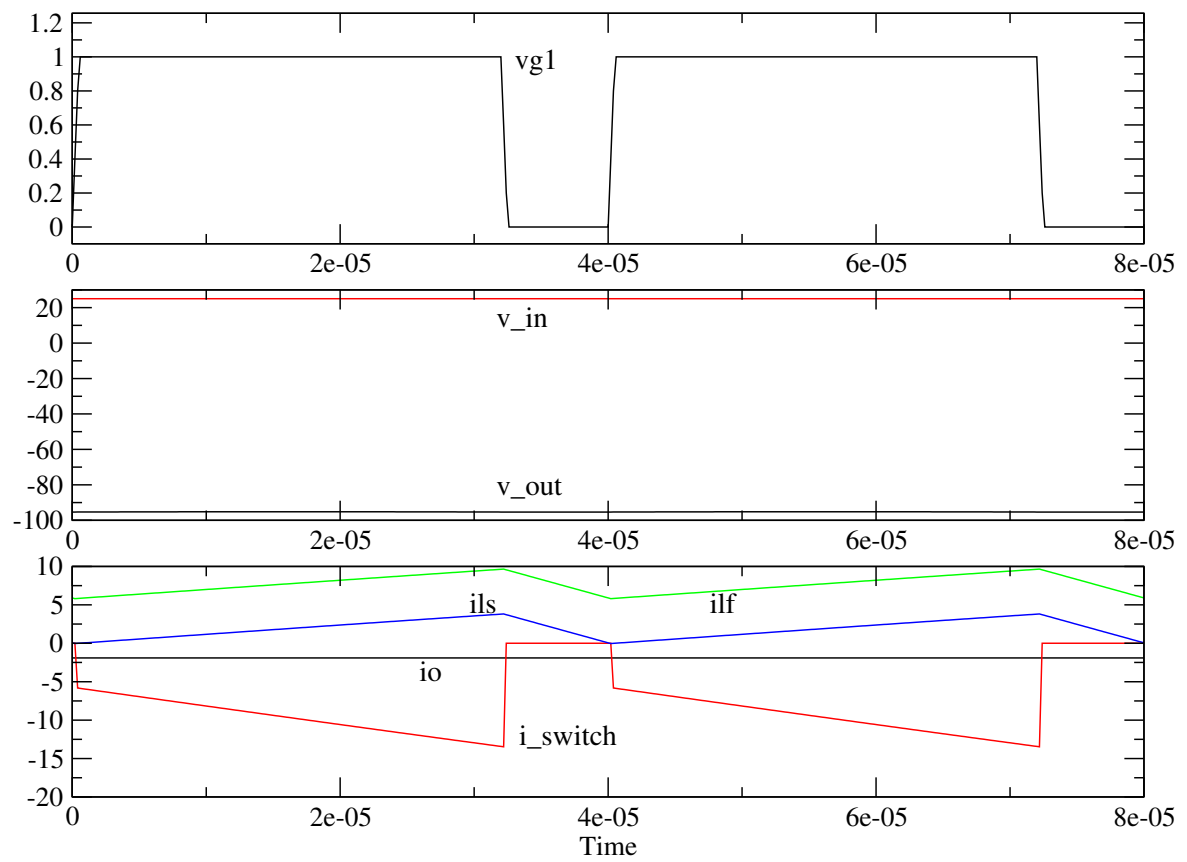


Figure 2: Simulation Plots for Cuk Converter