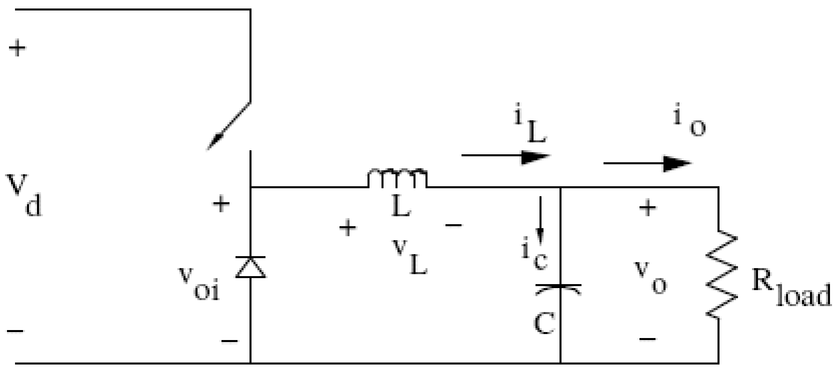
LAB 04

Step-down (BUCK) dc-dc Converter



Nominal Values:

$V_d = 8$ V (dc)
$L = 5\ \mu H$
$rL = 10\ m\Omega$
$C = 100\ \mu F$
$R_{load} = 0.5\ \Omega$
$f_s = 100$ kHz
switch duty ratio $D = 0.75$

1.

In steady state, obtain the following waveforms using Buckconv:

(a) v_L and i_L waveforms.

(b) v_o, i_L and i_c waveforms

2.

Increase the load resistance to 10 Ω. Obtain v_L and i_L waveforms in the discontinuous conduction mode [Hint: use V(0) = 5.8V and $I_L(0) = 0$]. Check if the results agree with the following equation:

$$\frac{V_o}{V_d} = \frac{D^2}{D^2 + \frac{1}{4}\left(\frac{I_o}{I_{LB,max}}\right)}$$

where $I_{LB,max} = \frac{V_d}{8Lf_s}$.

Theoretically, what is the D value which would return Vo to the nominal 6 Volt value? Confirm in SPICE.

$$D = \frac{V_o}{V_d} \sqrt{\frac{I_o / I_{LB,\max}}{1 - V_o / V_d}}$$

where

$$I_{LB,\max} = \frac{T_s V_o}{2L}$$

Go back to continuous mode (load resistance 0.5Ω)

3. Obtain the peak-to-peak ripple in the output voltage and check to see if results agree with the analytical calculations.

4. Obtain and calculate the rms value of the current through the output capacitor as a ratio of the average load current Io.