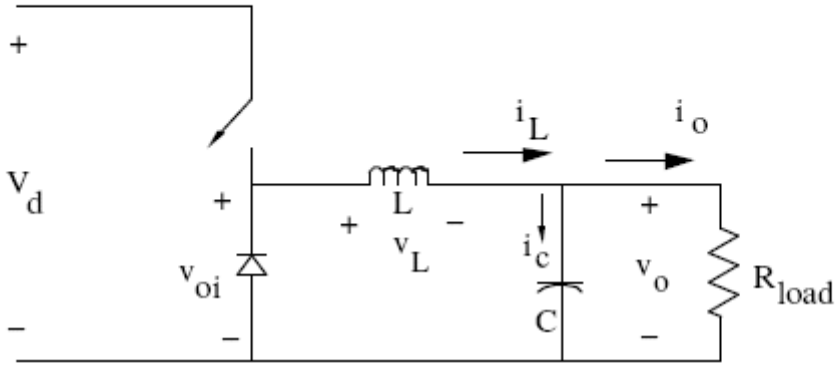
LAB 04

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 $V(0) = 5.8$V 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.

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. Calculate the rms value of the current through the output capacitor as a ratio of the average load current Io