Demonstration 4

Equations used from previous lectures

Steady state

The average voltage over an inductor $V_L = 0$
The average current through a capacitor $I_c = 0$

Step-Up (Boost) Converter

Continuous conduction mode (CCM)

$$I_L \geq \Delta i_L / 2$$

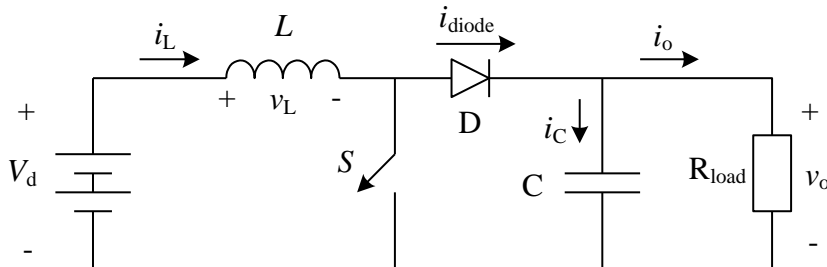Discontinuous conduction mode (DCM)

$$I_L < \Delta i_L / 2$$

Literature: Undeland book Chapter 7

Tutorial exercises

Problem 1 (P7-7 in Undeland book)

In a step-up converter, consider all components to be ideal. The input voltage (V_d) varies between 8V and 16V. The output voltage (V_o) is regulated and kept constant at 24V. The switching frequency (f_{sw}) is 20kHz, the output capacitance is 470µF and the output power (P_o) is always greater than 5W.
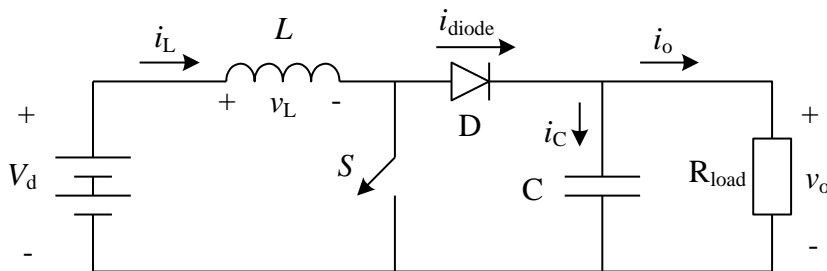

We assume that the converter is in steady state and that the output capacitor is so large that the output voltage can be treated as a DC voltage.

Find the minimum value of the inductor that makes the boost converter operate in CCM for the entire operating range.

Problem 2 (P7-8 in Undeland book)

A step-up converter has the following specifications: $V_d = 12V$, $V_o = 24V$, $I_o = 0.5A$, $f_{sw} = 20kHz$, $C = 470µF$ and $L = 150µH$.

Calculate the peak-to-peak output voltage ripple.

Self-study exercises

From Undeland book:
P7-9, P7-12