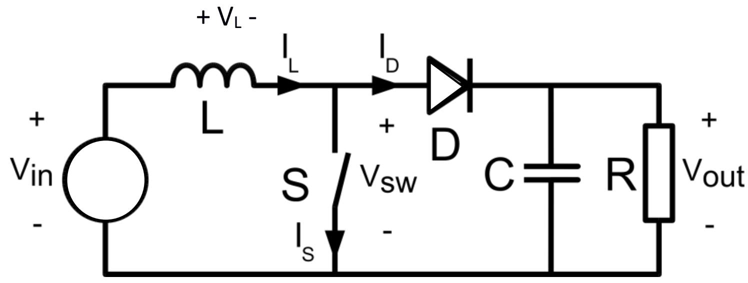
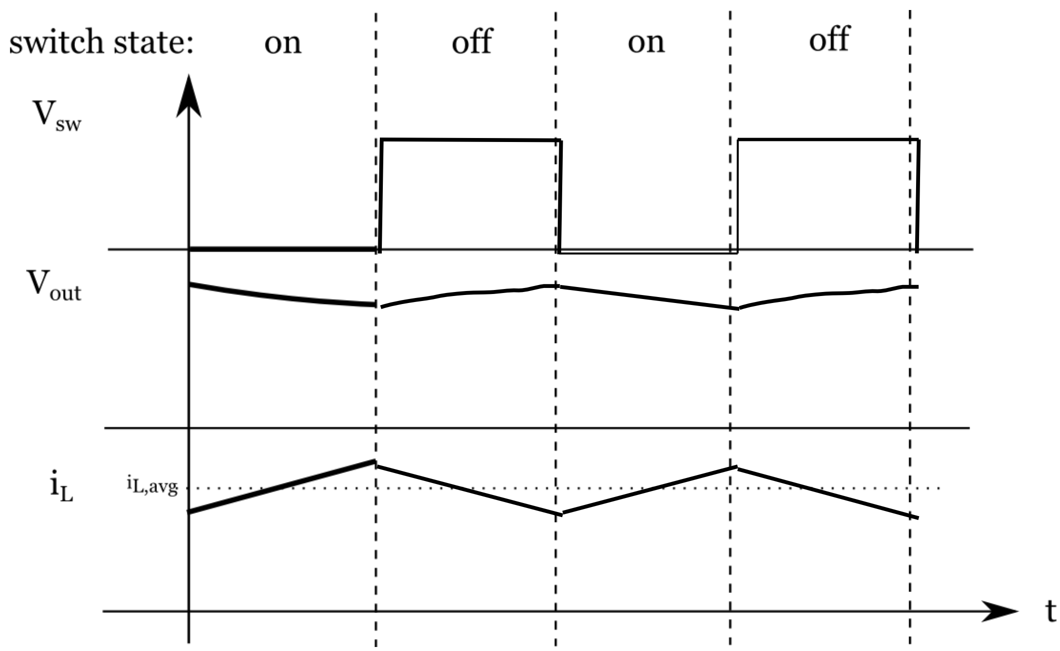
Boost Converter (draft 2/27/2015)

- Switching type DC-DC converter
- Output voltage is greater than input voltage



1. Fill in the plots for two periods of the boost converter's operation.



For simplicity, assume i_L goes from i_{max} to i_{min} in a linear fashion in time T_{off}, with a change of $\Delta i = i_{min} - i_{max}$ (<0). Also assume V_{out} is approximately constant. During T_{off} the instantaneous power delivered to the capacitor and load from the inductor in series with V_{in} is $p(t) = i_L(t)\,(-V_L(t) + V_{in})$.

The inductor voltage during T_{off} is assumed constant: $V_L(t) = L\,\Delta i / T_{off}$, where V_{in} is boosted by V_L.

The work delivered per cycle from battery and inductor (when switch is open) is:

$$W = i_L\,(-V_L + V_{in})\,T_{off} = i_L\,(-L\,\Delta i / T_{off} + V_{in})\,T_{off} = i_L\,(-L\,\Delta i + V_{in}\,T_{off})$$

The time average power delivered to the load (through the diode) is W/T=

$$P_{ave} = i_L\,(-L\,\Delta i + V_{in}\,T_{off}) / (T_{on} + T_{off}) = (L\,(i^2_{max} - i^2_{min})/2 + i_L\,V_{in}\,T_{off}) / (T_{on} + T_{off})$$

Note that there is a contribution from energy stored in the inductor and the power provided by battery.

The average power in the load should equal delivered power to load so

$$P_{ave} = (L\,(i^2_{max} - i^2_{min})/2 + i_L\,V_{in}\,T_{off}) / (T_{on} + T_{off}) = V_{out}^2 / R$$

Note that the current may instead oscillate around an average current value, delivering more power to load.