

Announcements

- Engineering Job Fair – Sept 16th, 2-6:00pm
 - tiny.utk.edu/EngFair

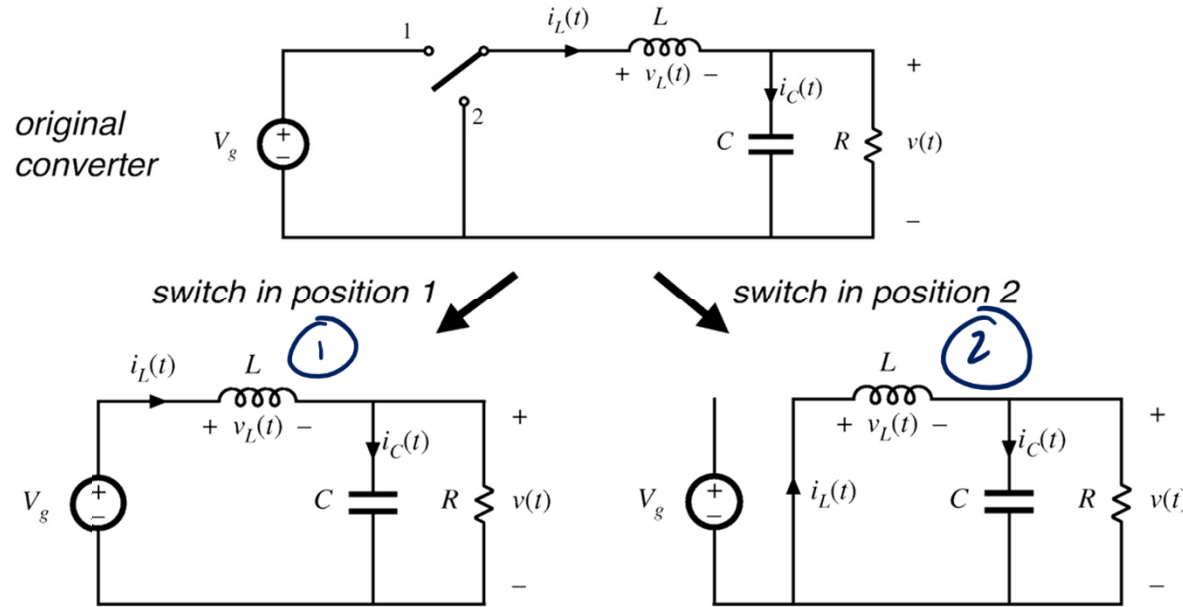


- Analog Design Engineer
- Digital Design Engineer
- Systems Engineer
- Test Engineer
- Applications Engineer
- Layout Designer

Juniors up to grad students

A promotional poster for 'Fall Job Fair Week' at the University of Tennessee. The background is dark grey with a subtle grid pattern. At the top, 'FALL' is written in white, spaced-out letters, followed by the URL 'tiny.utk.edu/falljobfairweek'. The main title 'JOB FAIR' is in large, white, bubbly letters with a double outline. Below it, 'WEEK' is written in white, spaced-out letters. Underneath, three dates are listed: '09.16' for 'Engineering & STEM', '09.17' for 'Supply Chain', and '09.18' for 'Business & Government'. A white rounded rectangle contains the text 'Student Union Ballroom · 2-6 P.M.'. To the right of the dates is a large orange tie icon. In the bottom right corner, it says 'CAREER DEVELOPMENT & ACADEMIC EXPLORATION' next to a small orange 'T' logo.

Volt-Second Balance: Direct Application



$$\langle v_L \rangle_{T_s} = \phi = \frac{1}{T_s} [v_{L1} t_1 + v_{L2} t_2]$$

$$\phi = \frac{1}{T_s} [(V_g - v) D T_s + (-v) D' T_s]$$

$$\phi = (V_g - v) D + (-v) D'$$

$$\phi = D V_g - v$$

$$\rightarrow \boxed{v = D V_g} \quad \boxed{M = \frac{v}{V_g} = D}$$

Current Ripple Magnitude

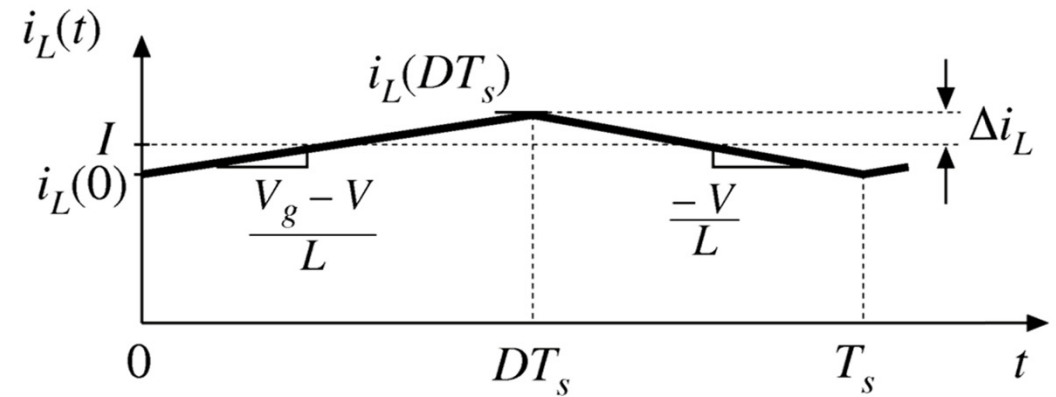
Δi_L = peak-to-average current ripple in steady-state

$$2 \Delta i_L = \frac{V_g - V}{L} DT_s$$

$V = DV_g$
from volt-sec balance

$$\Delta i_L = \frac{V_g - DV_g}{2L} DT_s$$

$$\Delta i_L = \frac{V_g}{2L} D'D T_s$$

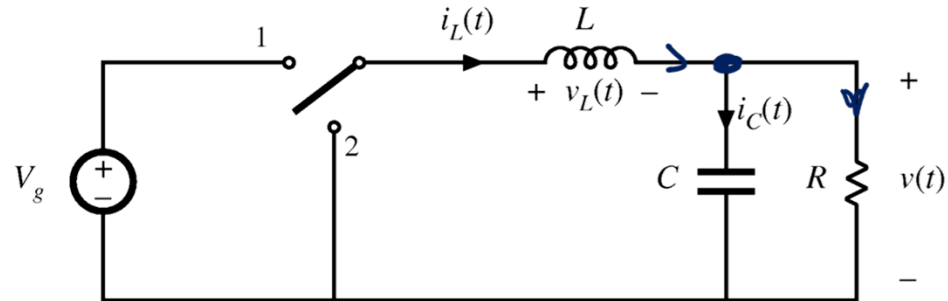


(change in i_L) = (slope)(length of subinterval)

Reduce Δi_L by

1. Increase L
2. Decrease $T_s \leftrightarrow$ Increase f_s

Buck Cap Charge Balance → Dual of volt-second balance



I_n (1)

$$i_c(t) = i_L(t) - \frac{v(t)}{R}$$

↓ SRA

$$i_c(t) = I_L - \frac{V}{R}$$

I_n (2)

$$i_c(t) = i_L(t) - \frac{v(t)}{R}$$

↓ SRA

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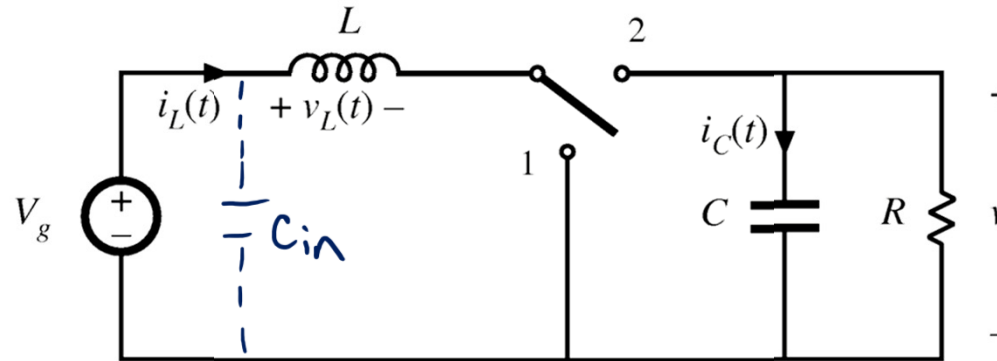
Cap-charge Balance

$$\langle i_c \rangle_{T_s} = \phi = \frac{1}{T_s} \left[D T_s \left(I_L - \frac{V}{R} \right) + D' T_s \left(I_L - \frac{V}{R} \right) \right]$$

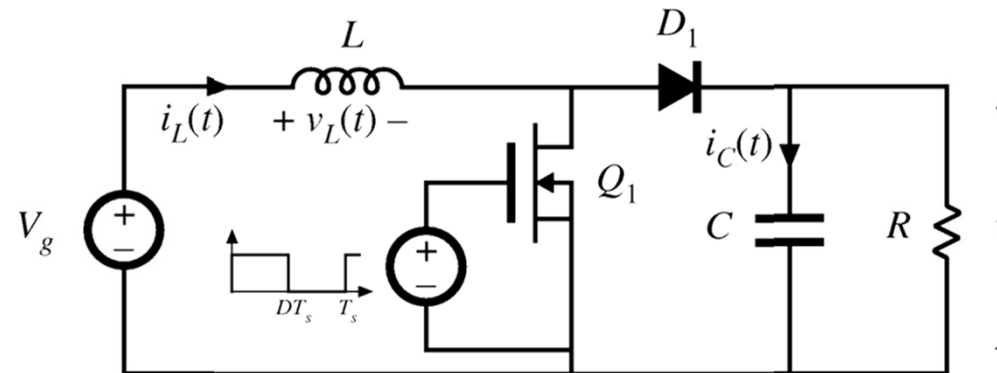
$$\phi = I_L - \frac{V}{R} \rightarrow \boxed{I_L = \frac{V}{R}}$$

The Boost Converter

Boost converter with ideal switch

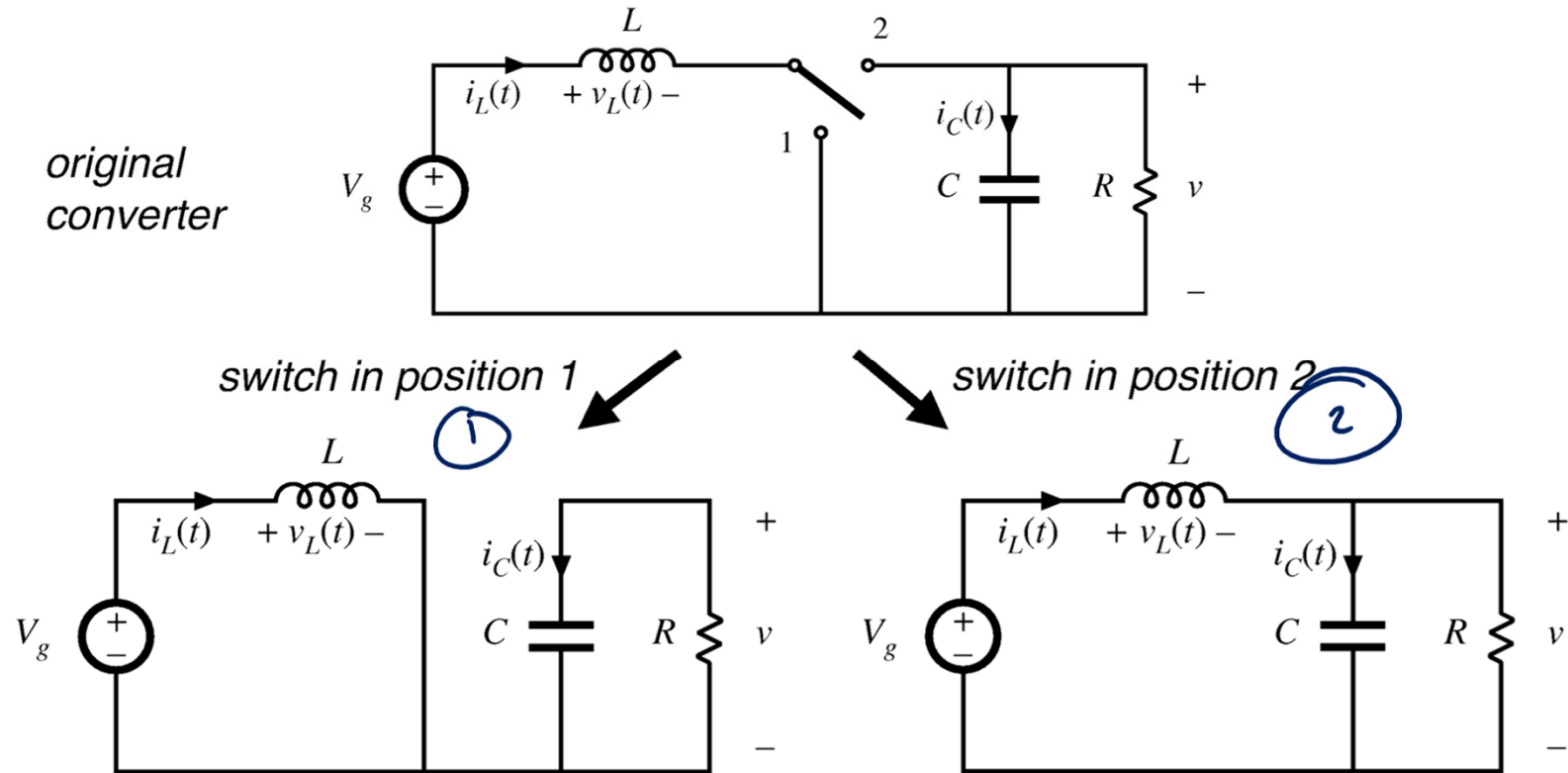


Realization using power MOSFET and diode



Chapter 4

Boost Subintervals



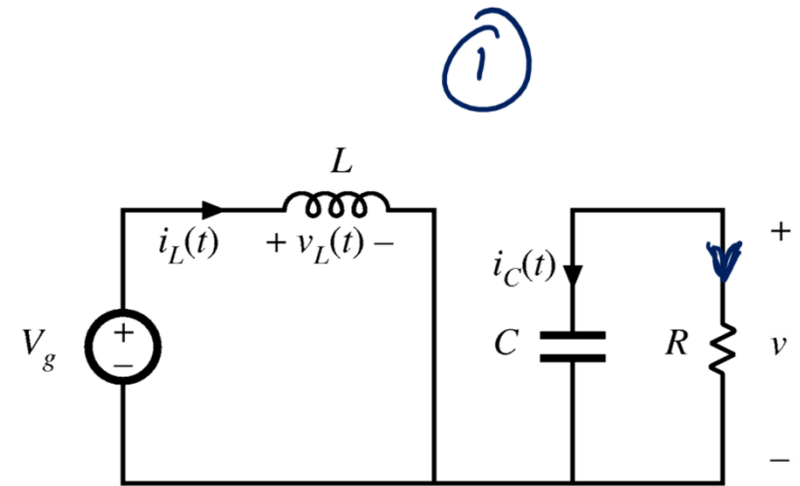
Boost: Subinterval 1

$$v_L(t) = V_g$$

$$i_C(t) = -\frac{v(t)}{R}$$

↓ Apply SRA

$$i_C(t) = -\frac{V}{R}$$



Boost: Subinterval 2

$$v_L(t) = v_g - v(t)$$

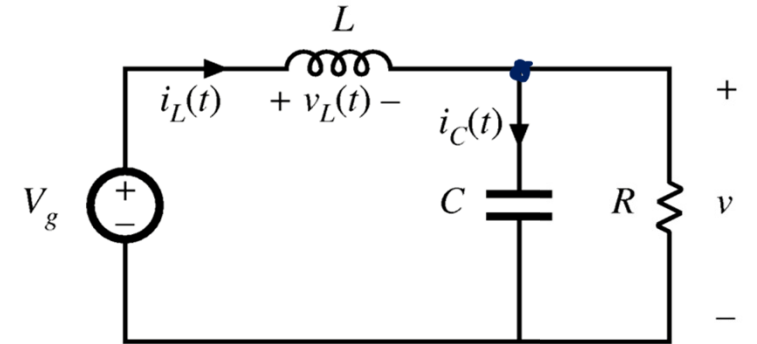
↓ Apply SRA

$$v_L(t) = v_g - v$$

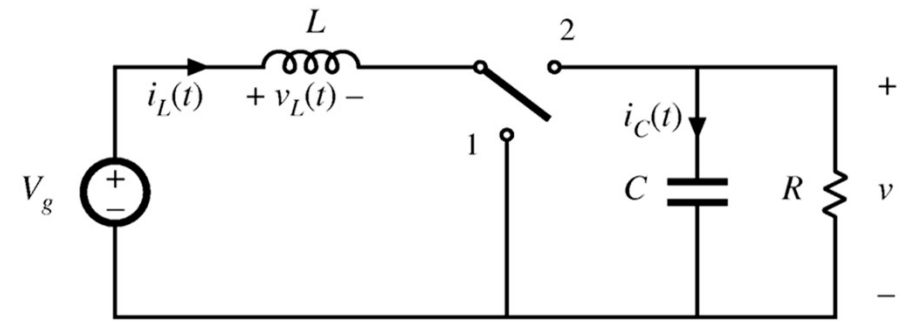
$$i_c(t) = i_L(t) - \frac{v(t)}{R}$$

↓ SRA

$$i_c(t) = I_L - \frac{v}{R}$$



Waveforms



Volt-sec balance

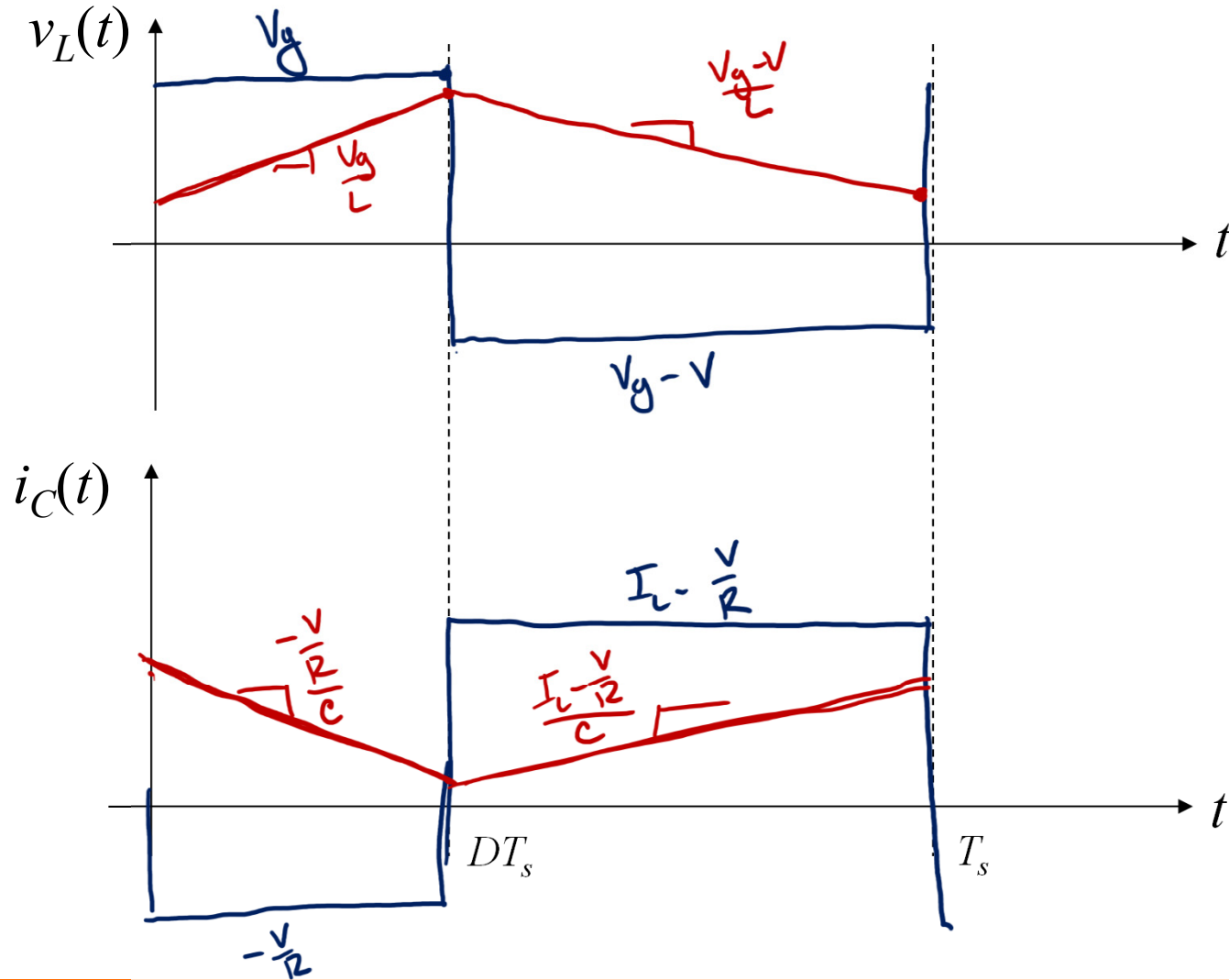
$$\langle v_L \rangle_{T_s} = V_g - D'V = 0$$

$$V = \frac{1}{D'} V_g$$

$$m = \frac{V}{V_g} = \frac{1}{D'}$$

$$\langle i_C \rangle_{T_s} = D'I_L - \frac{V}{R} = 0$$

$$I_L = \frac{1}{D'} \frac{V}{R}$$



Boost: Conversion Ratio

