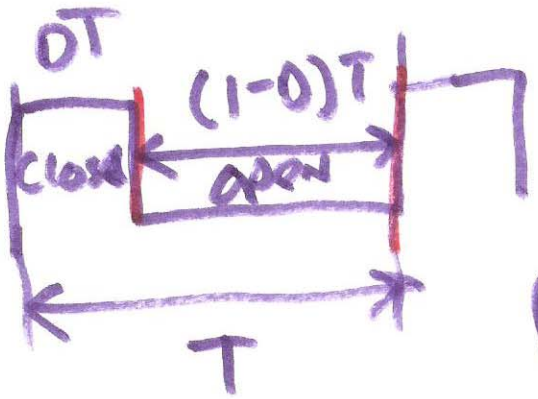
ECE 5/472 Power Electronics

BOISE STATE UNIVERSITY

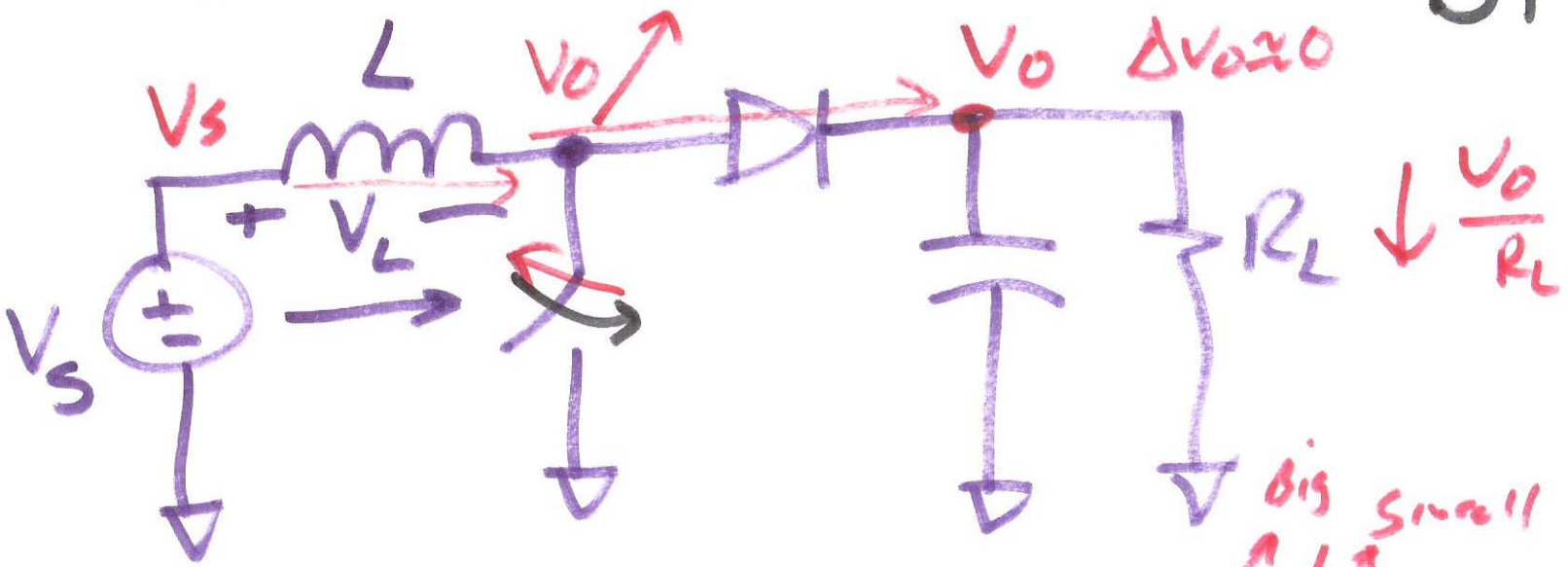
Lecture 5 Sept. 2, 2011



$V_o > V_s$

Boost converter

$$V_s = L \cdot \frac{\Delta i_L}{DT}$$



$$\Delta i_L = \frac{V_s \cdot DT}{L}$$

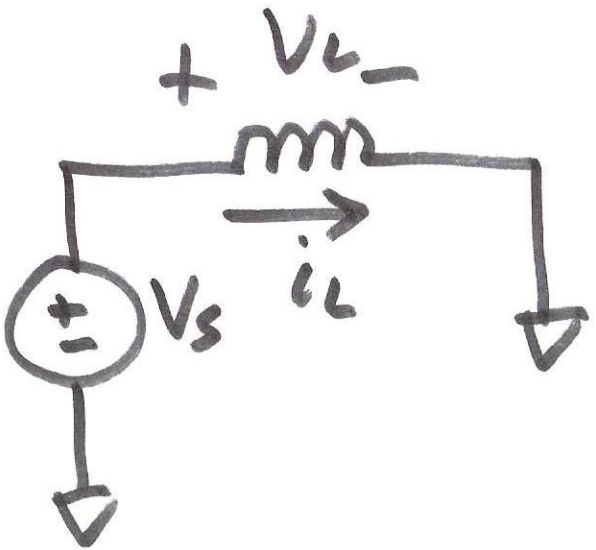
$40\mu = \frac{1}{25kHz} = T$

$D = 0.6 \cdot$

$TD = 0.6 \cdot 40\mu$

$= 24\mu s$

2)



$V_L = V_S$

$$V_L = L \cdot \frac{di_L}{dt}$$

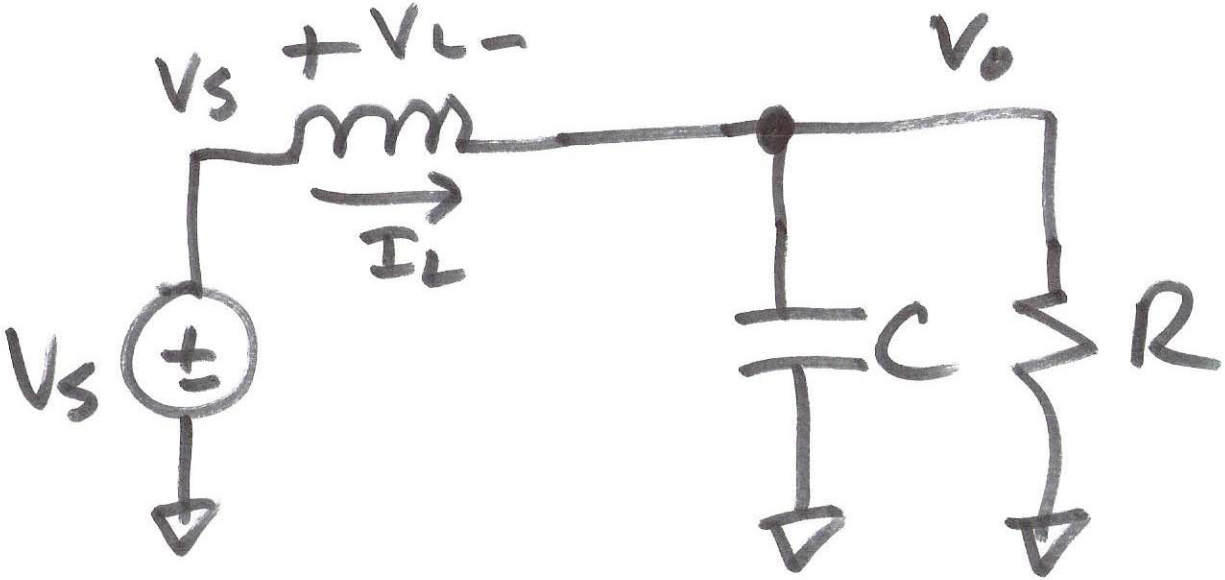
$$V_S = L \cdot \frac{\Delta i_L}{D \cdot T}$$

DT = time switch closed ☺

$$\boxed{\Delta i_L = \frac{V_S \cdot D \cdot T}{L}}$$

EQ 6.25

switch open



$V_L = L \cdot \frac{di}{dt}$

$V_s - V_o$

$= L \cdot \frac{\Delta i_L}{(1-D)T}$

$I_{AVG} = \frac{V_o}{R}$

$\Delta i_L = \frac{(V_s - V_o)}{L} \cdot (1-D)T$

$peak = \frac{\Delta i_L}{2} + I_{AVG}$

$valley = I_{AVG} - \frac{\Delta i_L}{2}$

$(1-D)T =$ Time switch closed

$T = \frac{1}{f}$

4)

$$\frac{V_S - V_O}{K} \cdot (1-D)T = -\frac{V_S \cdot D \cdot T}{K}$$

$$V_S - V_O - DV_S + DV_O = -DV_S$$

$$(D-1)V_O = V_S(D + D - 1)$$

$$V_O = V_S \frac{(2D-1)}{D-1}$$

$$V_S = V_O \cdot (1-D)$$

$$\boxed{(V_O) = \frac{V_S}{1-D}}$$

5)

100% Efficient

$$V_S \cdot I_S = V_o \cdot I_o$$

$$V_o = \frac{V_S}{1-D} \qquad \frac{V_o}{V_S} = \frac{1}{1-D}$$

$$I_S \cdot \cancel{I_S} = \cancel{V_S} \cdot \frac{I_o}{1-D}$$

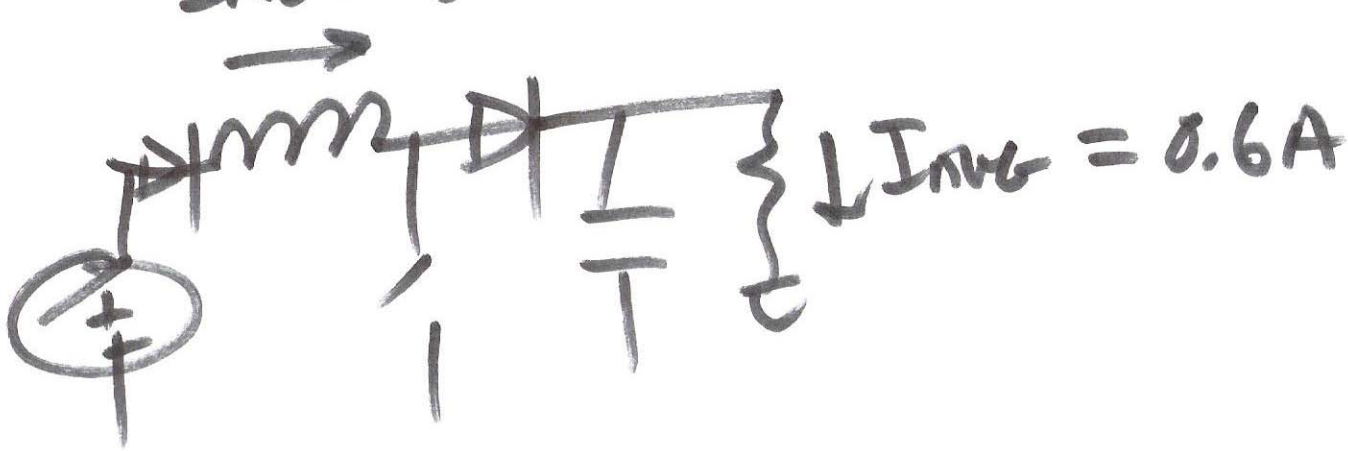
$$I_L = I_S = \frac{I_o}{1-D} \qquad \frac{I_o}{I_S} = \frac{V_S}{V_o} = 1-D$$

Return to Ex 6.4

$$\frac{30V}{50\Omega} = I_0 = 0.6A \quad \text{AVG.}$$

$$I_S = I_L = \frac{I_0}{1-D} \quad \text{AVG.}$$

$$= \frac{0.6}{1-0.6} = \frac{0.6}{0.4} = \underline{\underline{1.5A}}$$



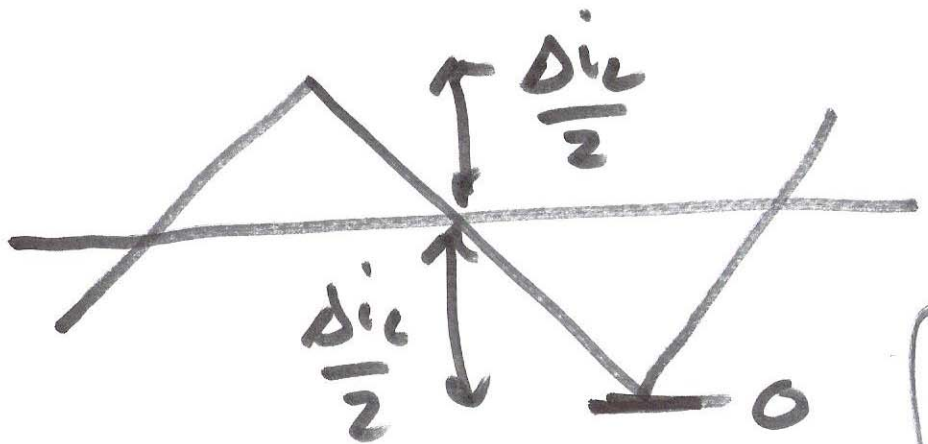
7)

L_{MIN}

$$\frac{\Delta i_L}{2} = \frac{V_S \cdot D \cdot}{f \cdot L \cdot 2} \qquad V_O = \frac{V_S}{1-D}$$

$$I_L = \frac{I_O}{1-D} = \frac{V_O}{(1-D)R} = \frac{V_S}{(1-D)^2 R}$$

$$\frac{V_S \cdot D}{f L_{MIN} \cdot 2} - \frac{V_S}{(1-D)^2 R} = 0$$



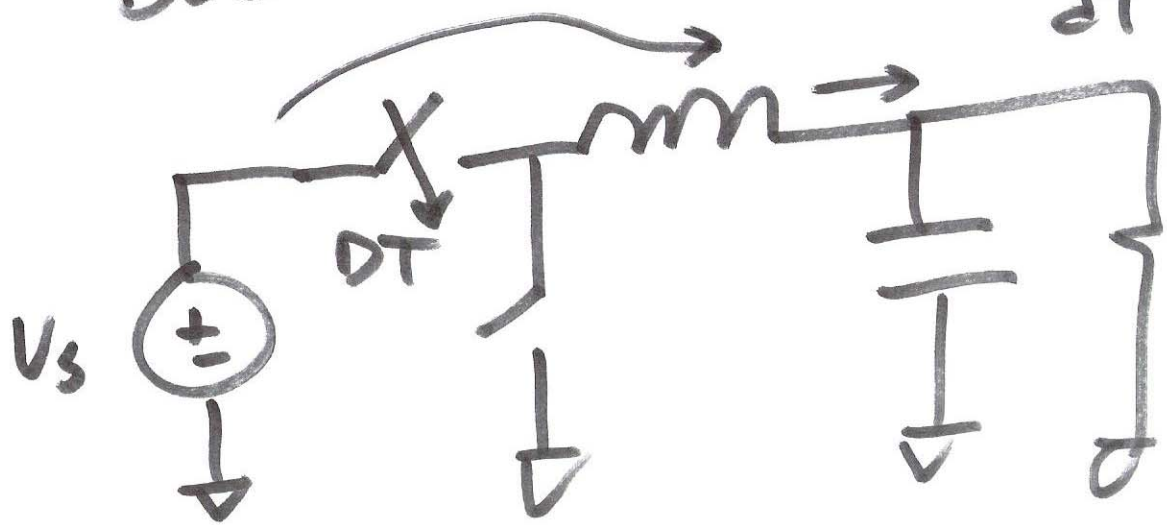
$$L_{MIN} = \frac{(1-D)^2 R \cdot D}{2f}$$

EQ. 6.32

8)

Buck

$C\frac{dv}{dT} = I$



$$C = \frac{1-D}{8L\cdot\left(\frac{\Delta V}{V}\right)f^2}$$

$$\Delta Q = \frac{V_o}{R}DT$$

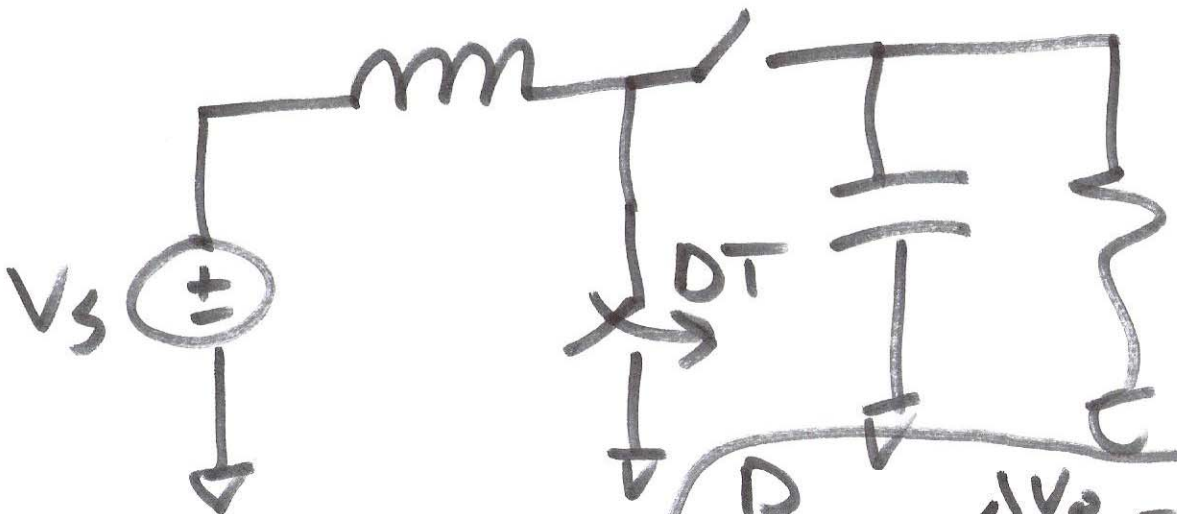
$CV = Q$

$\Delta Q = C\cdot\Delta V_o$

$$\Delta V_o = \frac{R\cdot\Delta Q}{DT}$$

$$V_o = \frac{R\cdot C\cdot\Delta V_o}{DT}$$

Boost



$$\frac{D}{RCf} = \frac{\Delta V_o}{V} = \frac{DT}{RC}$$