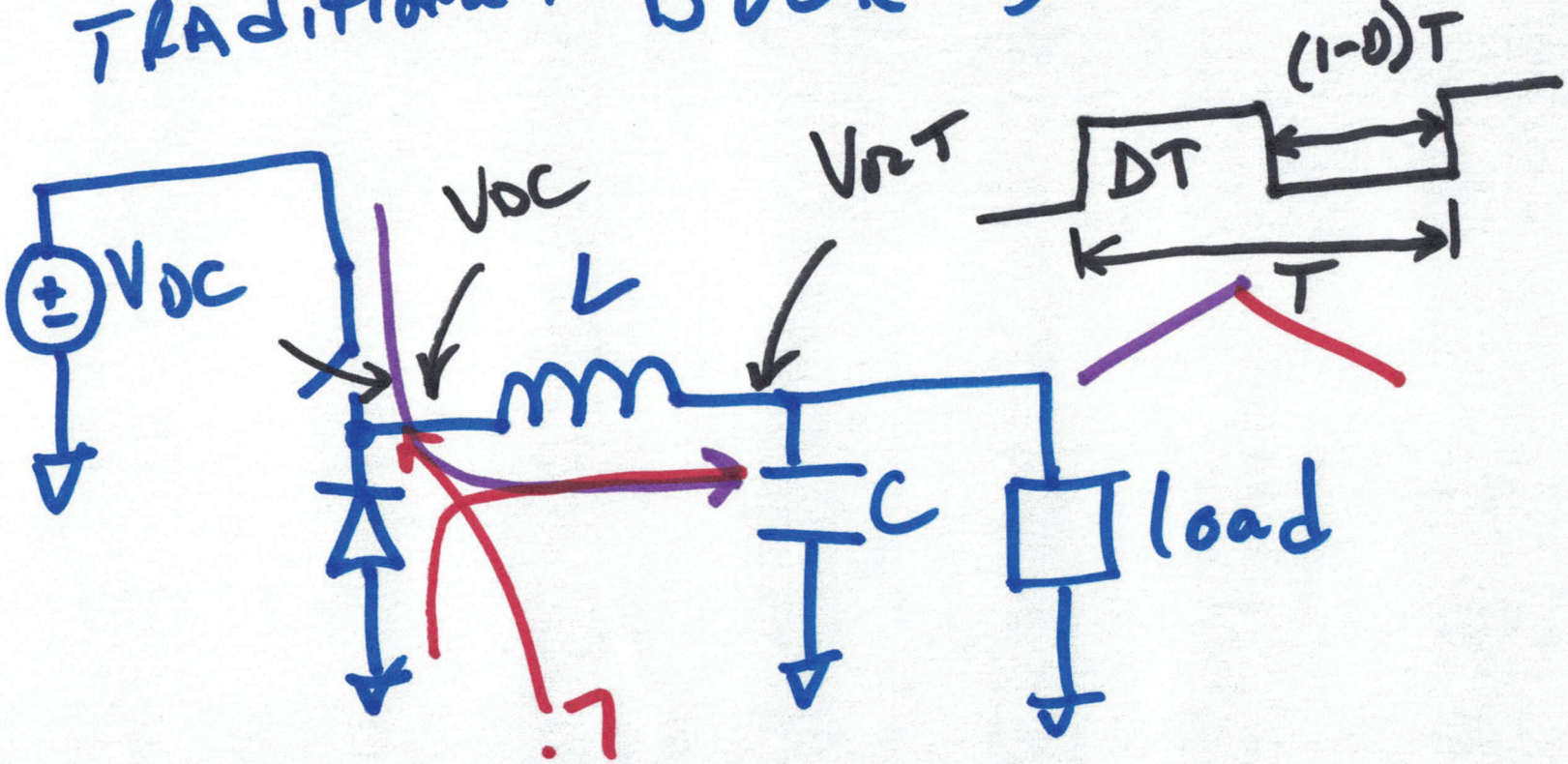
EE 442 / ECE 642
Power Electronics

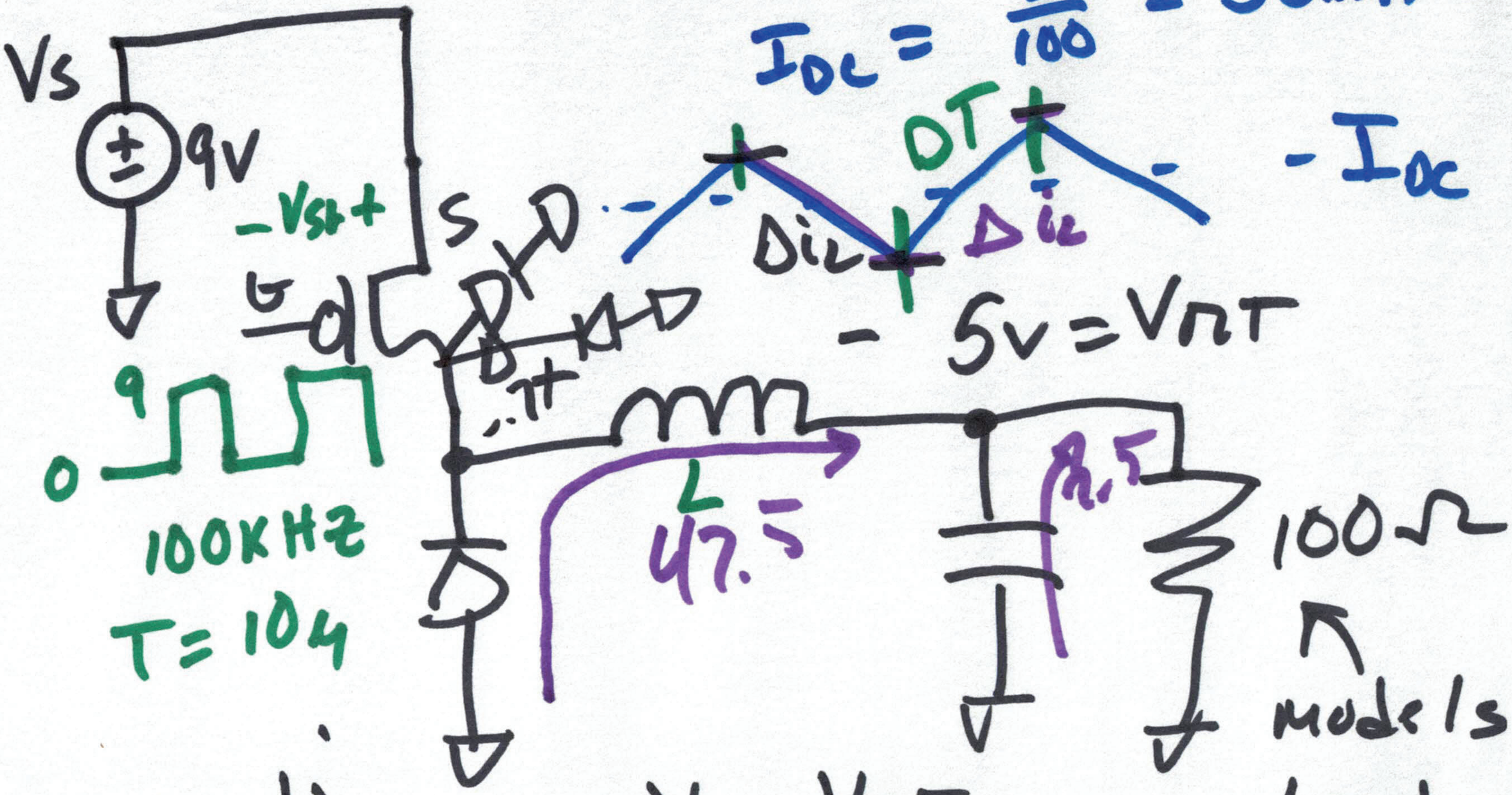
Lecture 6

Sept. 19, 2022

Traditional Buck SPS

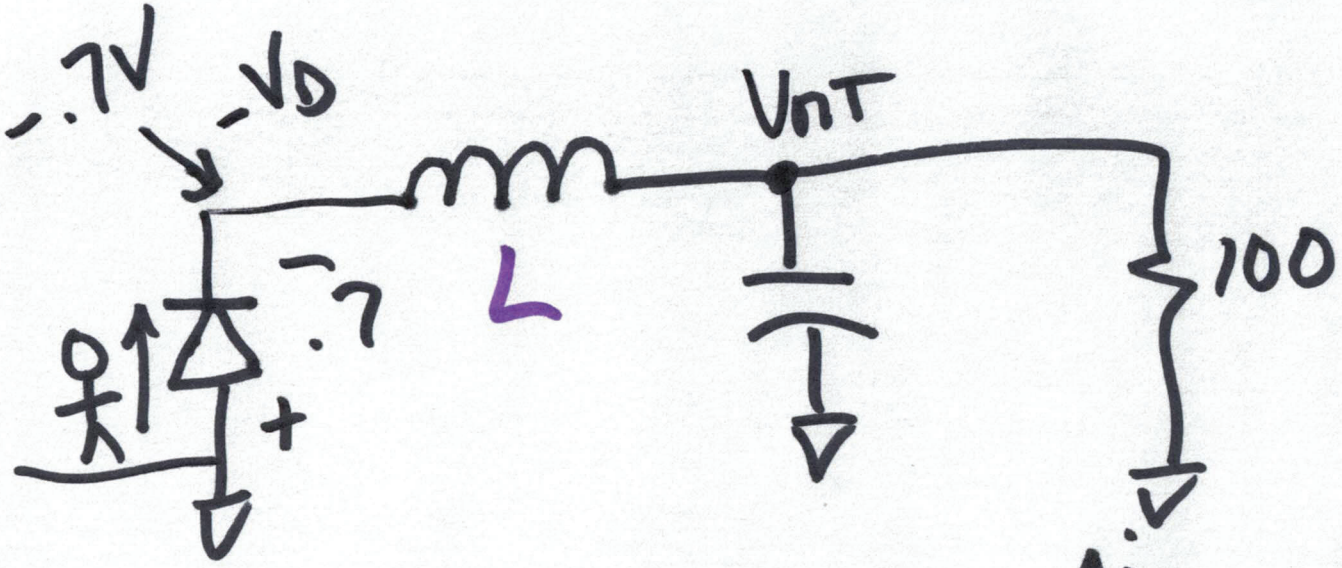


$I_{DC} = \frac{5}{100} = 50mA = I_L$



$V = L \cdot \frac{di}{dt} \rightarrow V_S - V_{\Omega T} = L \cdot \frac{\Delta i_L}{D \cdot T}$

$$\Delta i_L = \frac{D \cdot T}{L}\left(V_S - V_{\Omega T}\right)$$



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

$$\Delta i_L = \left(-V_D - V_{OUT}\right)\frac{(1-D)T}{L}$$

$$\frac{D \cdot T}{L}(V_S - V_{OUT}) = \left|(-V_D - V_{OUT})\frac{(1-D)T}{L}\right|$$

$$DV_S - DV_{OUT} = +V_D + V_{OUT} - DV_D - DV_{OUT}$$

if $V_D = 0$

$$\boxed{V_{OUT} = DV_S}$$

$$V_{OUT} = DV_S - V_D + DV_D$$

$$V_{OUT} = DV_S - (1-D)V_D$$

$$5 = D9 - .3 \cdot .6$$

$$5 + .18 = D9$$

$$D = \frac{5.18}{9}$$

$$\boxed{D = .58}$$

4)

$$5 = D \cdot 9 - (1-D).7$$

$$5 = 9D - .7 + .7D$$

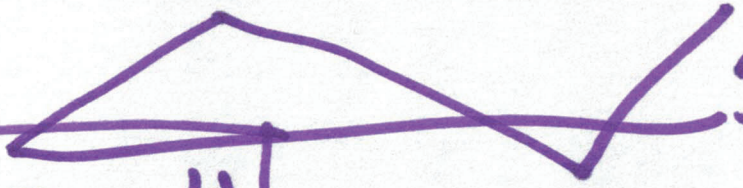
$$5.7 = 9.7D$$

$$\boxed{D = .59}$$

$$\Delta i = 5mA$$

$$5mA = \frac{.59 \cdot 10u(9-5)}{L}$$

$$I_{AVG} = 50mA = \frac{5}{100}$$



$$\boxed{L = 4.72mH}$$

$\Delta V = 25\,mV$

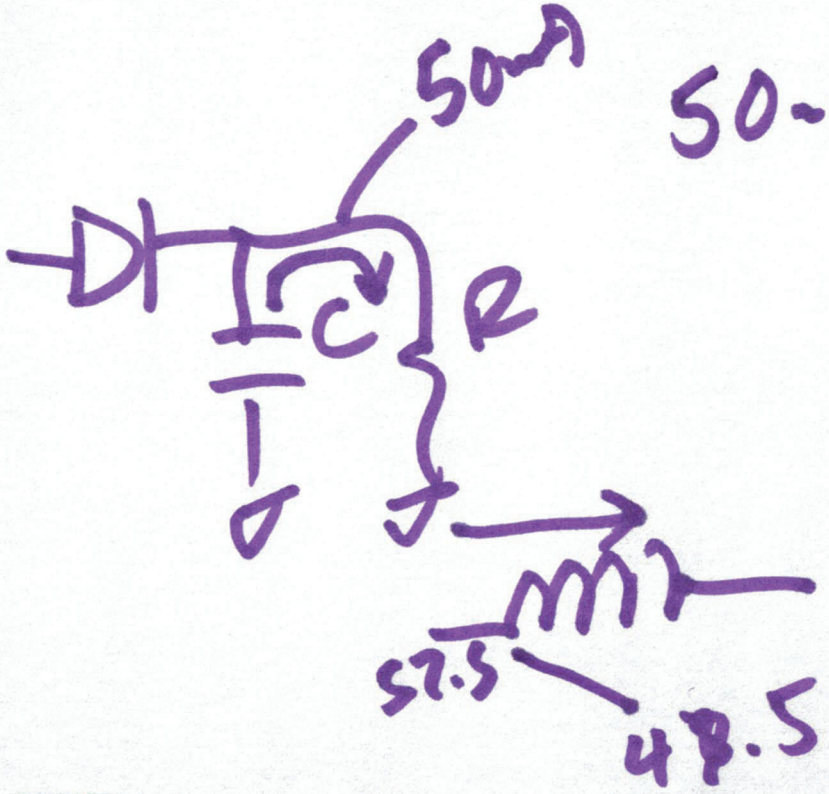
$I = 50\,\mu A$

$I = C\frac{dV}{dt}$

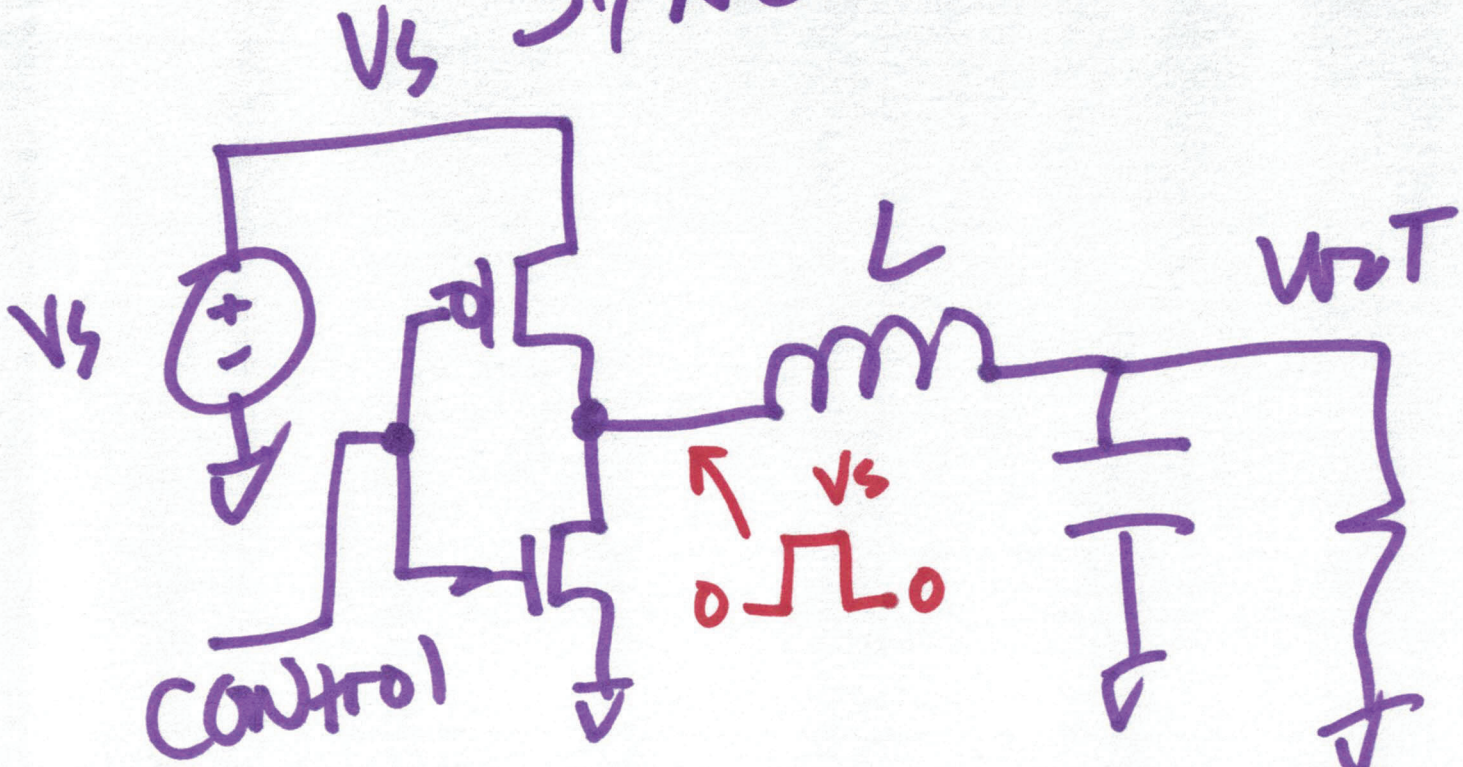
$50\,\mu A = C \cdot \frac{\Delta V}{\Delta t}$

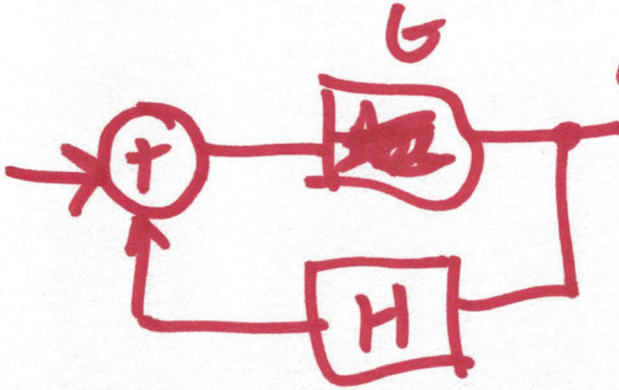
$C = \frac{50\,\mu A \cdot 10\,n}{25\,mV}$

$= 20\,nF$



Synchronous Buck





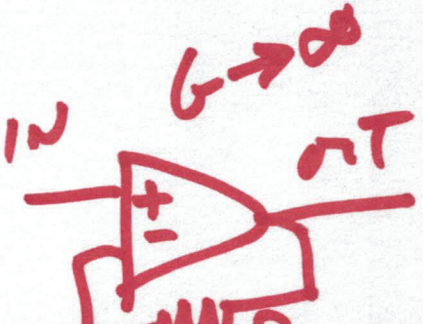
$$D \cdot V_S = V_{OUT}$$

$$D = \frac{5}{9} = .56$$

$$\frac{OUT}{IN} = \frac{G}{1+GH} D = \frac{5}{9}$$

$$= \frac{\frac{1}{H}}{\frac{1}{G}+H} = \frac{1}{H}$$

$G \to \infty$



$$R_{2H} = \frac{R_2}{R_1+R_2}$$

$$\frac{1}{H} = \left(\frac{R_1+R_2}{R_2}\right)$$