

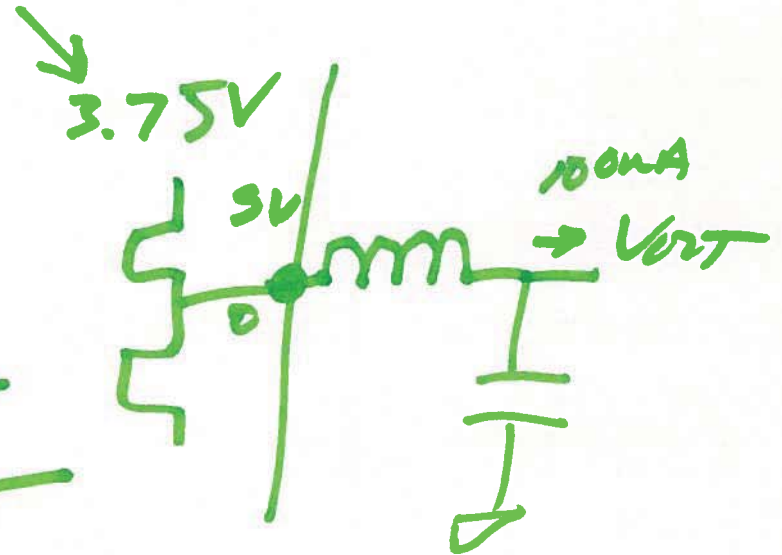
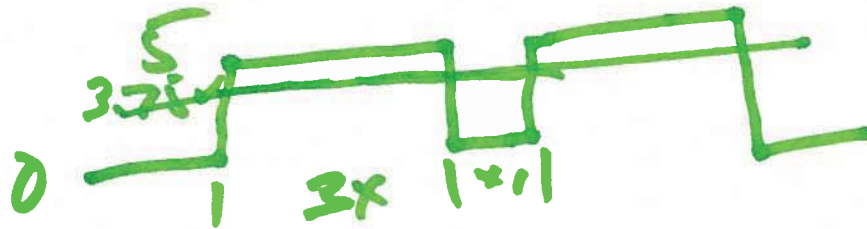
EE421 / ECG 621

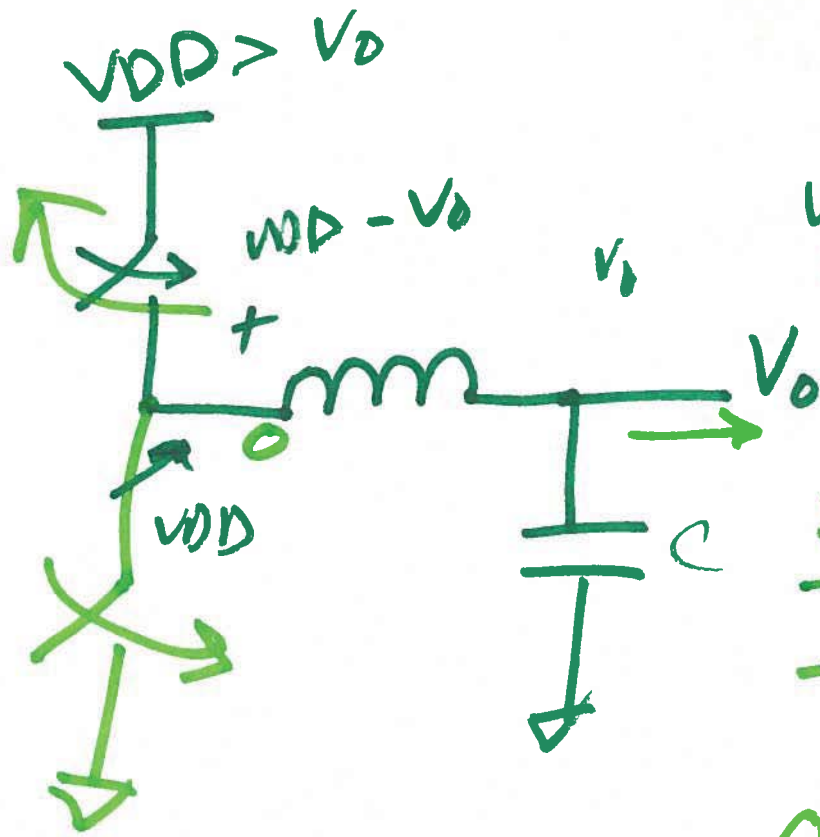
Digital IC Design

Lecture 14, 2017, Oct. 18

Buck converter

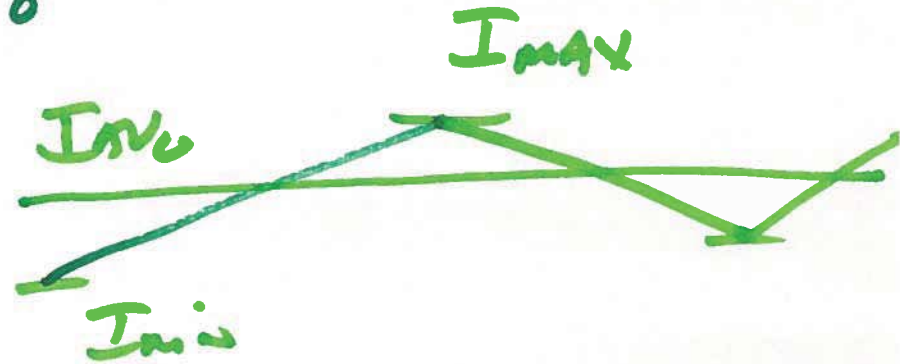
4.4 → 5.5 > 90%





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

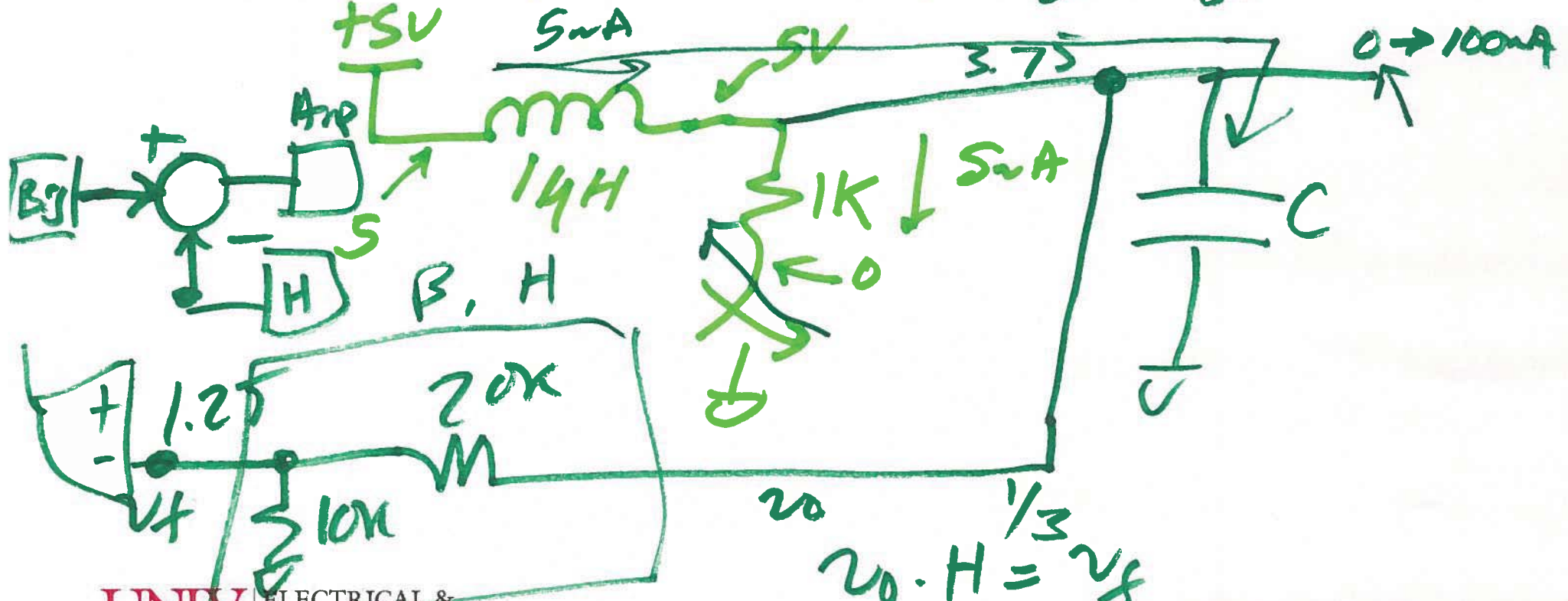
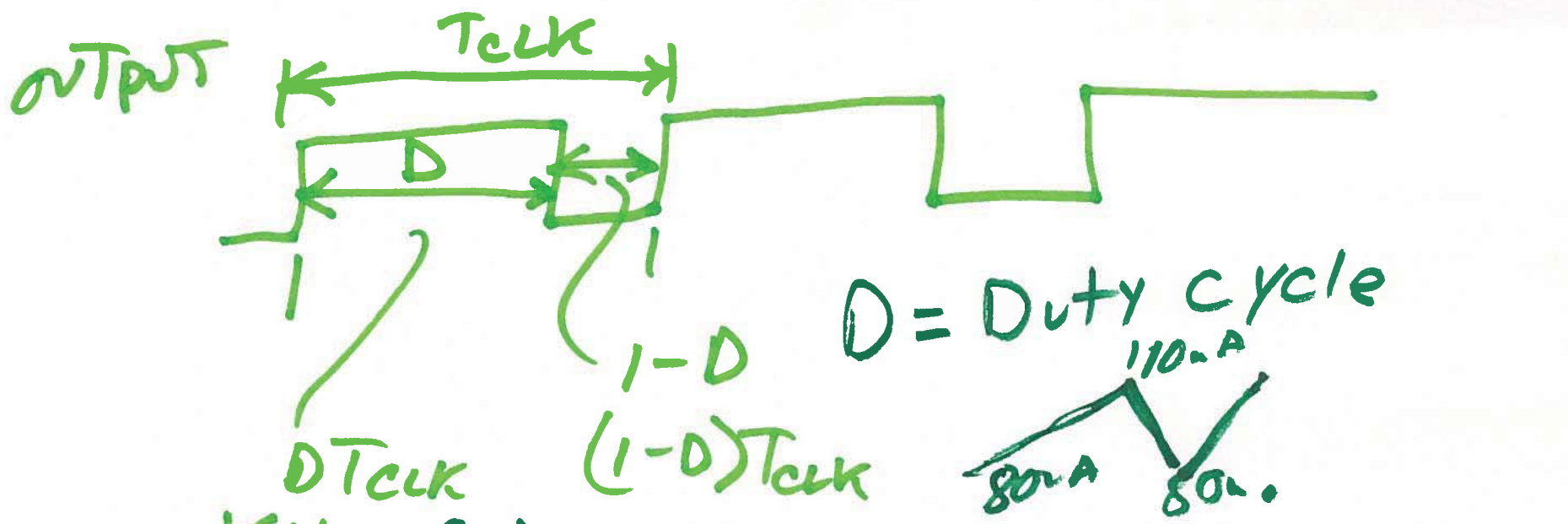
$$\frac{V_{DD} - V_0}{L} = \frac{di}{dt} = \text{CONST}$$



$$\frac{0 - V_0}{L} = \frac{di}{dt}$$

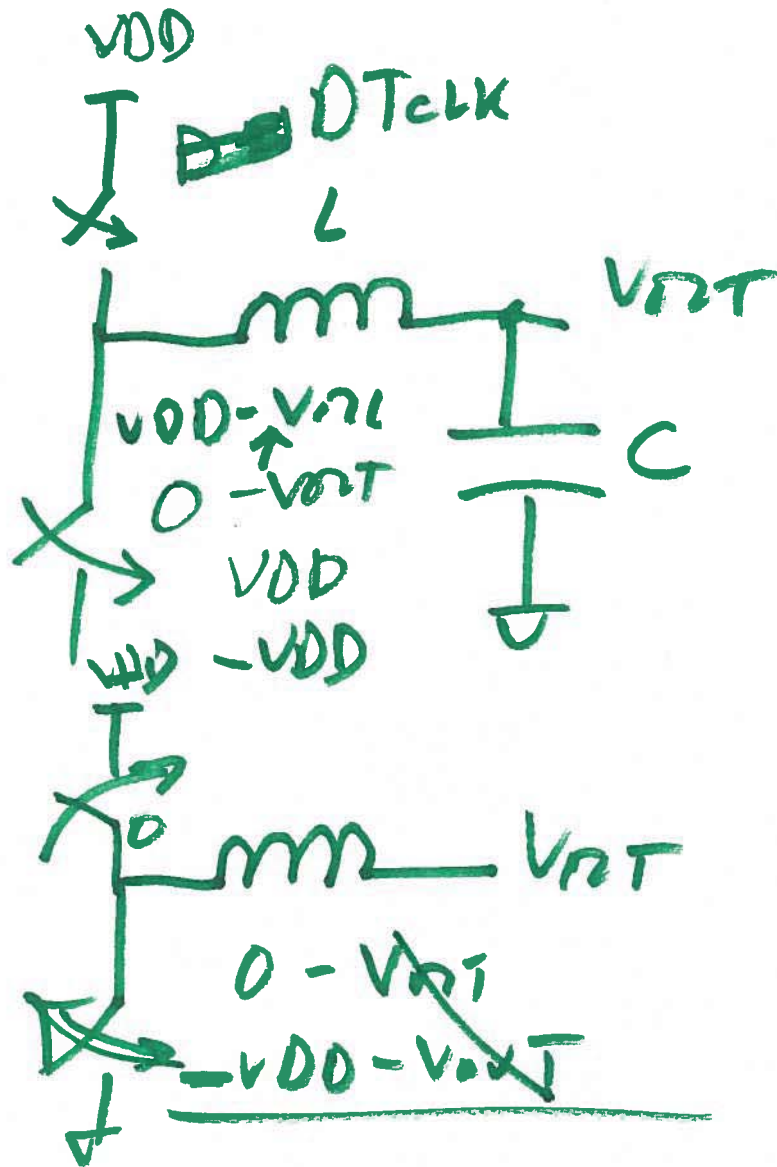
$$I_{avg} = \frac{I_{max} + I_{min}}{2}$$

$100nA$



3)

$$V_{out} = D \cdot V_{DD}$$



$$\frac{V}{L} = \frac{di}{dt}$$

$$\frac{V_{DD} - V_{out}}{L} = \frac{di}{dt}$$

$$\frac{di}{dt} \rightarrow \frac{V_{DD} - V_{out}}{DT_{clk}}$$

4)

$$V_{out} = D \cdot V_{DD}$$

$$\Delta i_{up} = \frac{(V_{DD} - V_{out}) \cdot D \cdot T_{clk}}{L}$$

$$\Delta i_{down} = \frac{-V_{out}}{L} (1-D) T_{clk}$$

$$\Delta i_{up} = \frac{5 - 3.75}{1 \mu A} \cdot 0.75 \mu s = \frac{5}{4} \cdot \frac{3}{4} = \frac{15}{16} \mu A$$

$$\frac{-3.75}{1 \mu A} \cdot 25 \mu s = \frac{15}{4} \cdot \frac{1}{4} \mu A = \frac{15}{16} \mu A$$

5)

select $f_{clk} = 20\text{MHz}$

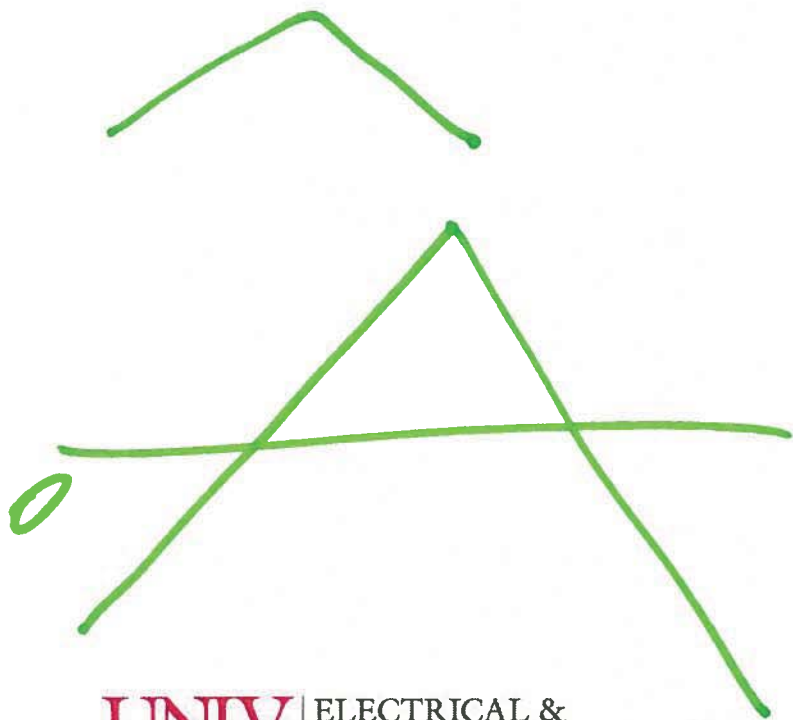
$T_{clk} = 50\text{ns}$

$$L = \frac{(5 - 375) \cdot 75 \cdot 50\text{ns}}{1\text{A}}$$

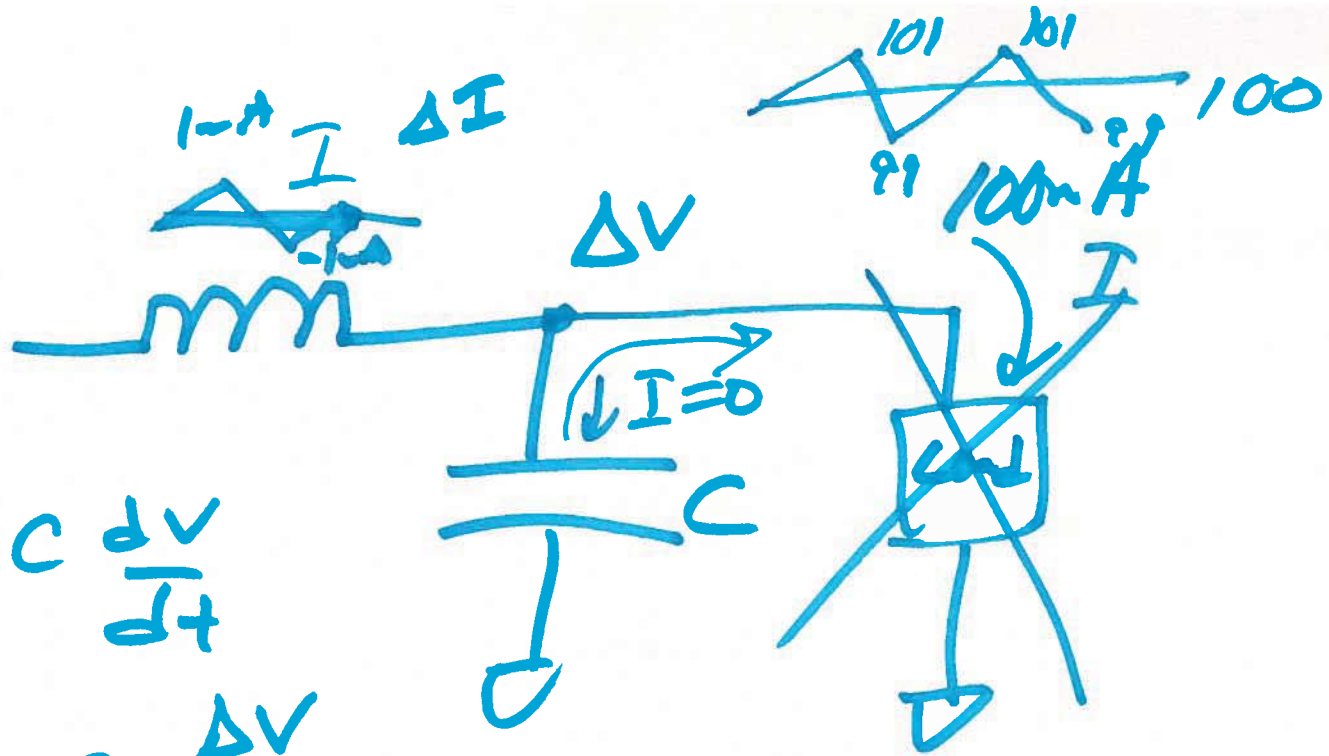
$$= 1.25 \cdot 75 \cdot 50\mu$$

$$\frac{5}{4} \cdot \frac{3}{4} \cdot \frac{200}{4} \mu$$

$$50\mu\text{H} \approx \frac{3000}{64} \mu\text{H}$$



b)



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

$$\Delta I = C \cdot \frac{\Delta V}{(1-D)T_{clk}}$$

$$\frac{12.5 \text{ nA} \cdot 100}{100 \text{ nV}} = C = 12.5 \text{ nF} = 0.0125 \mu\text{F}$$

$$C = \frac{(1-D) \cdot T_{clk} \Delta I}{\Delta V}$$

↓
D.C. p