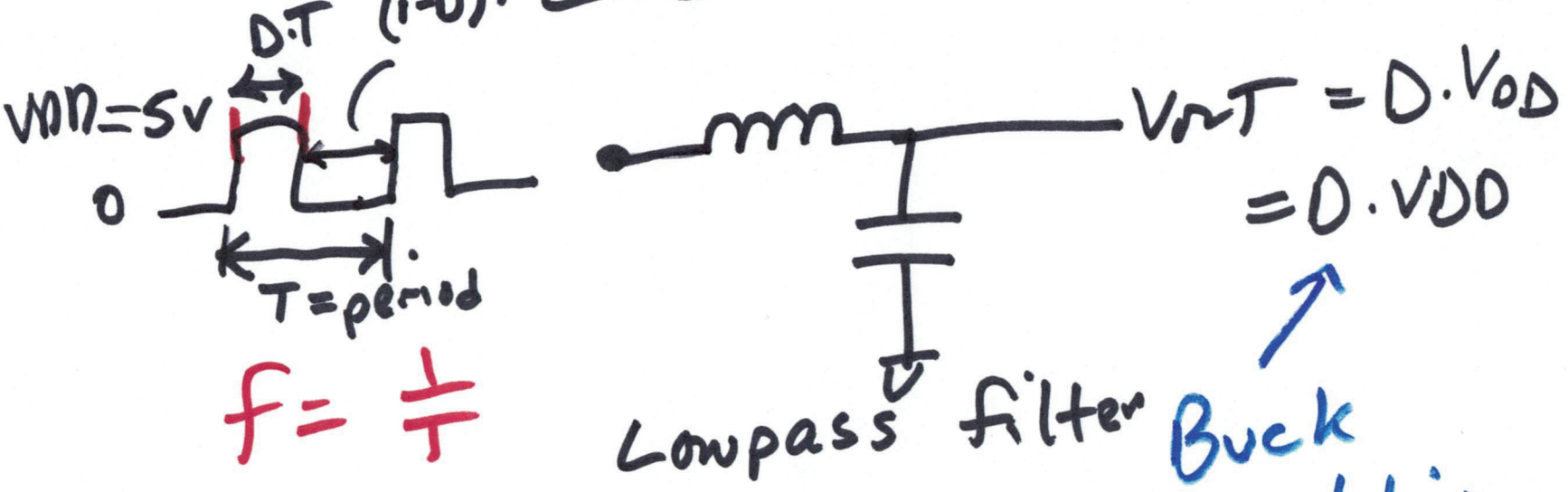
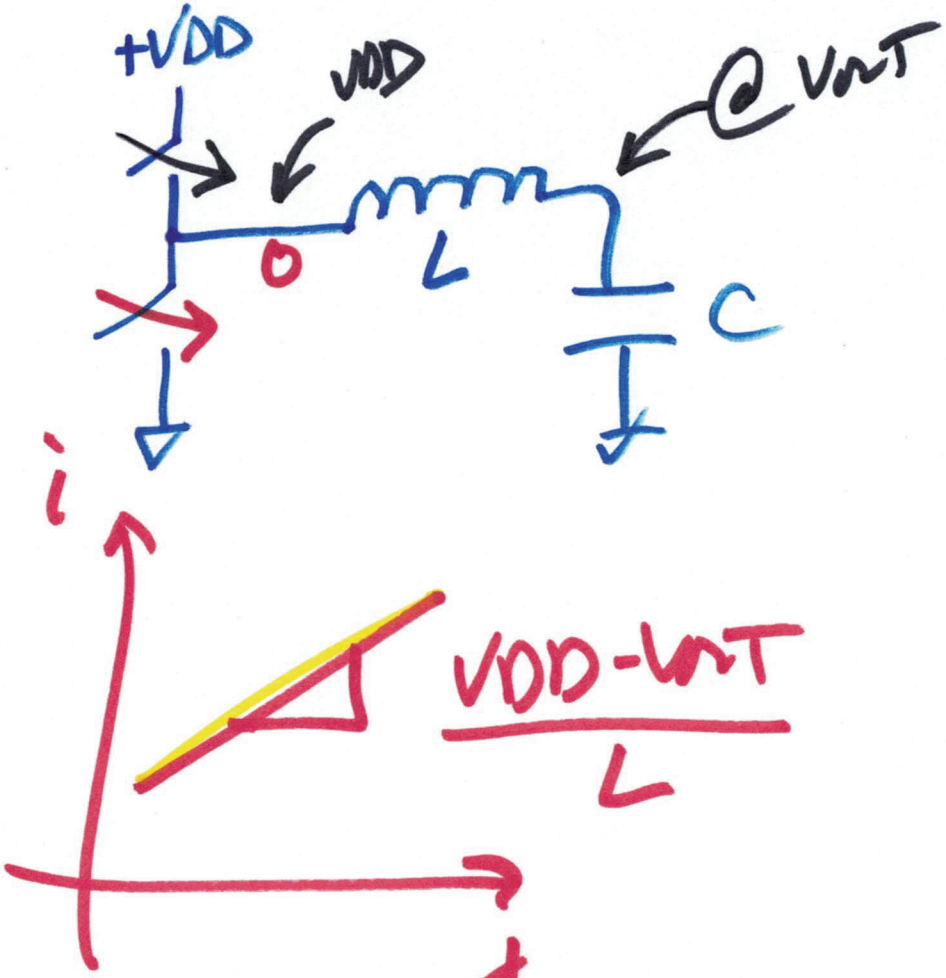
EE 421 / ECG 621
Digital IC Design
October 18, 2023
Lecture 14





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

$$VDD - V_{inT} = L \cdot \frac{di}{dt}$$

$$\frac{VDD - V_{inT}}{L} = \frac{di}{dt}$$

$$i(t) = \text{ramp}$$

$$\frac{VDD - V_{inT}}{L}$$

$$0 - V_{inT} = L \cdot \frac{\Delta i}{\Delta t}$$

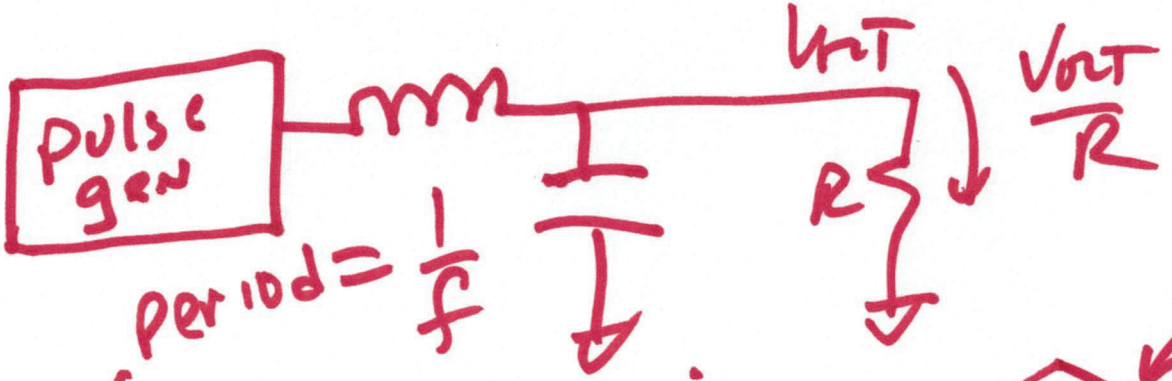
$$(1-D)T \quad \frac{\Delta i}{\Delta t} = \frac{-V_{inT}}{L}$$

$$VDD - V_{inT} = L \cdot \frac{\Delta i}{\Delta t}$$

$$\Delta i = \frac{VDD - V_{inT}}{L} \cdot \Delta t$$

$$\Delta i = (1-D)T = \frac{VDD - V_{inT}}{L} \cdot DT$$

$$\cdot \left(-\frac{V_{inT}}{L}\right)$$



duty cycle

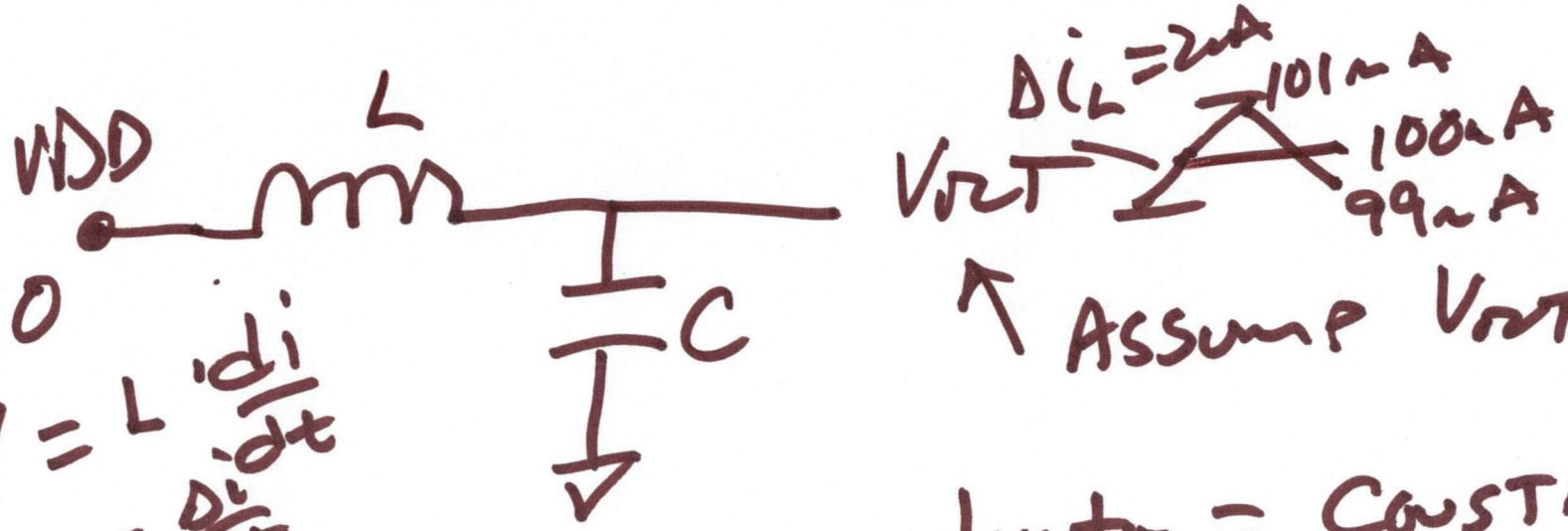
$D \cdot T \cdot \frac{VDD - V_{out}}{L} = \Delta i$

$D \cdot T \cdot \frac{(VDD - V_{out})}{L} = \frac{+V_{out} \cdot (1-D)T}{L}$

$D \cdot T \cdot VDD - D T \cdot V_{out} = +V_{out}(1)T$

$- + V_{out} DT$

$D\,VDD = V_{out}$



↑ Assump V_{OUT} = CONST

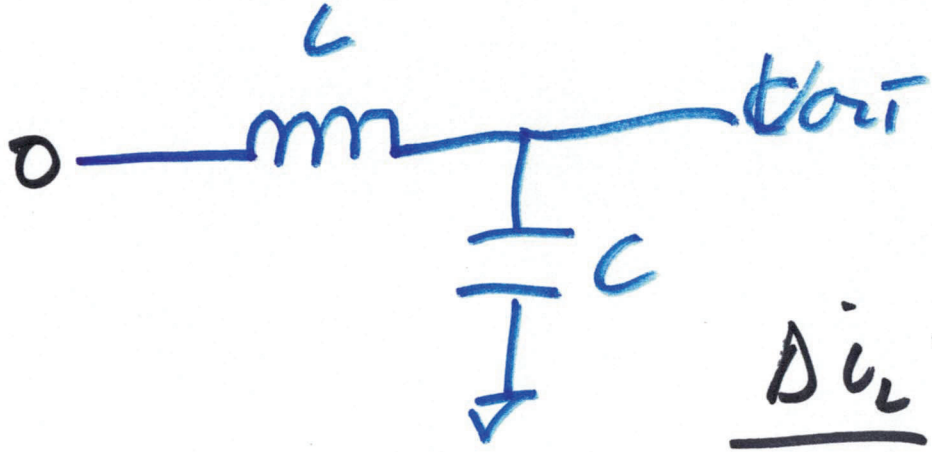
$V = L \frac{di}{dt}$

↑ CONST $V = \frac{\Delta i}{\Delta t}$

= Voltage Across Inducto = CONSTANT =

$$\frac{VDD - V_{OUT}}{L} = \frac{\Delta i_L}{\Delta t} = \frac{\Delta i_L}{D \cdot T}$$

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



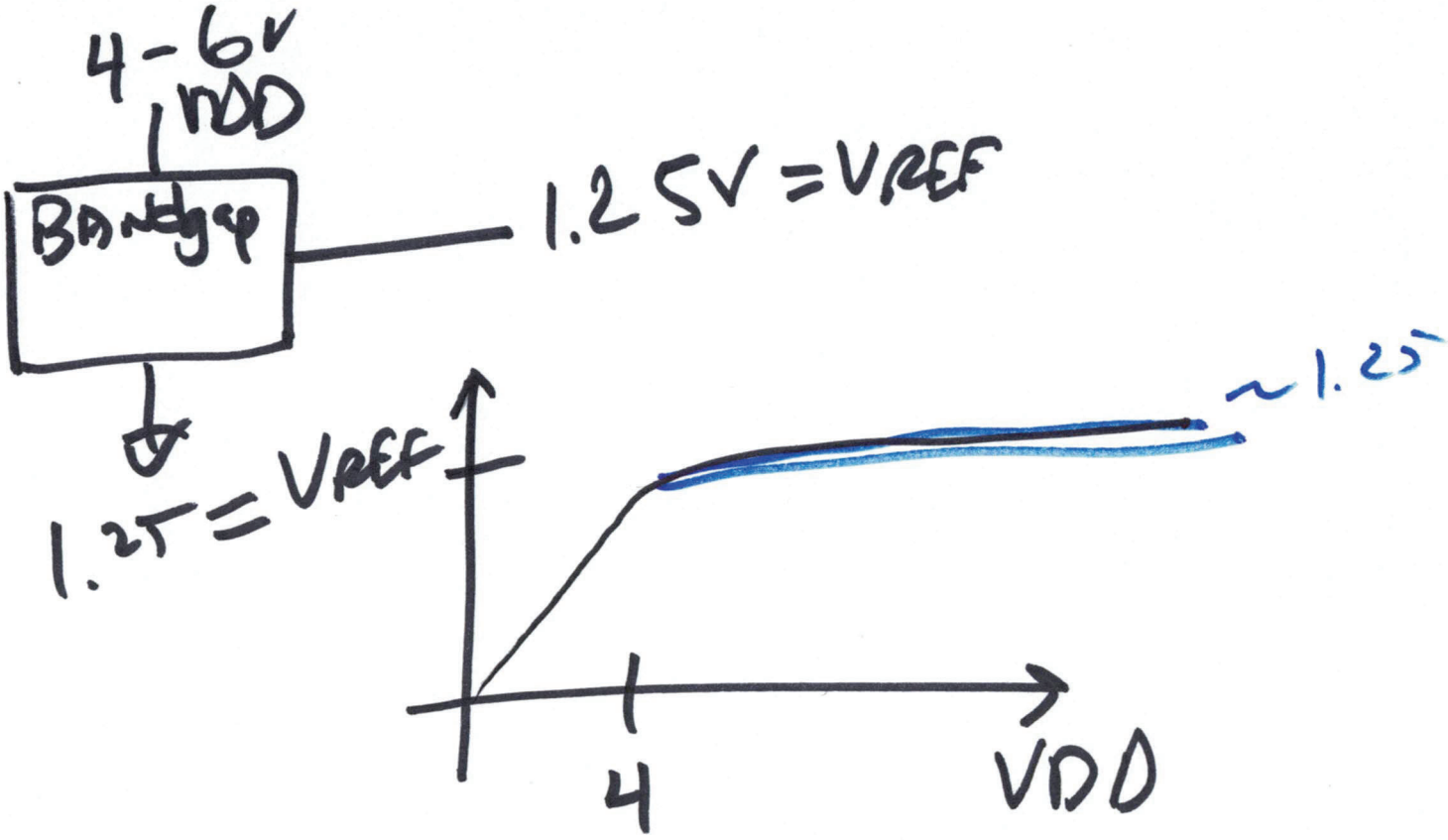
$$\frac{\Delta i_L}{(1-D)T} = \frac{0 - V_{OUT}}{L}$$

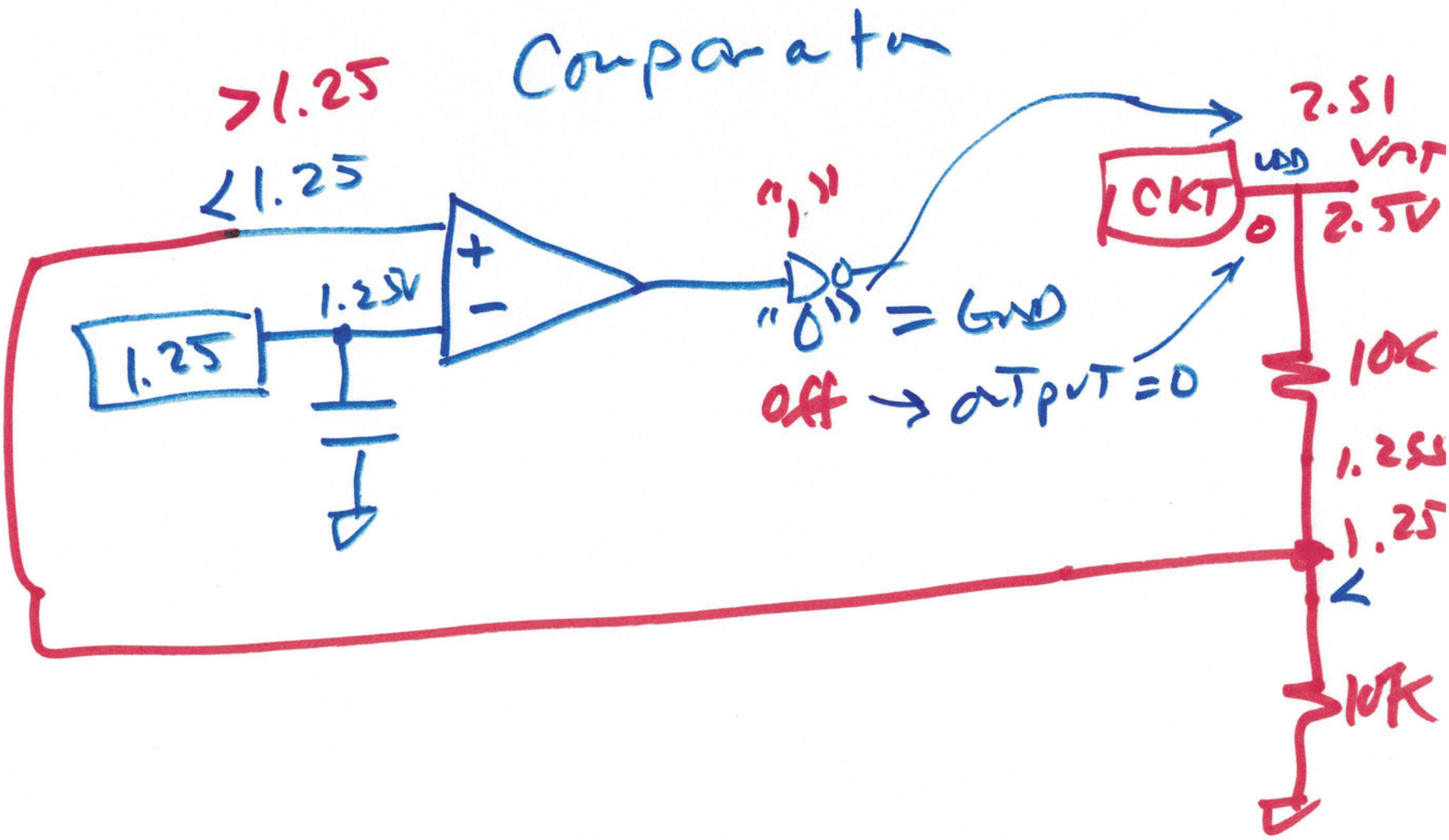
$$\Delta i_L = \frac{-V_{OUT} \cdot (1-D)T}{L}$$

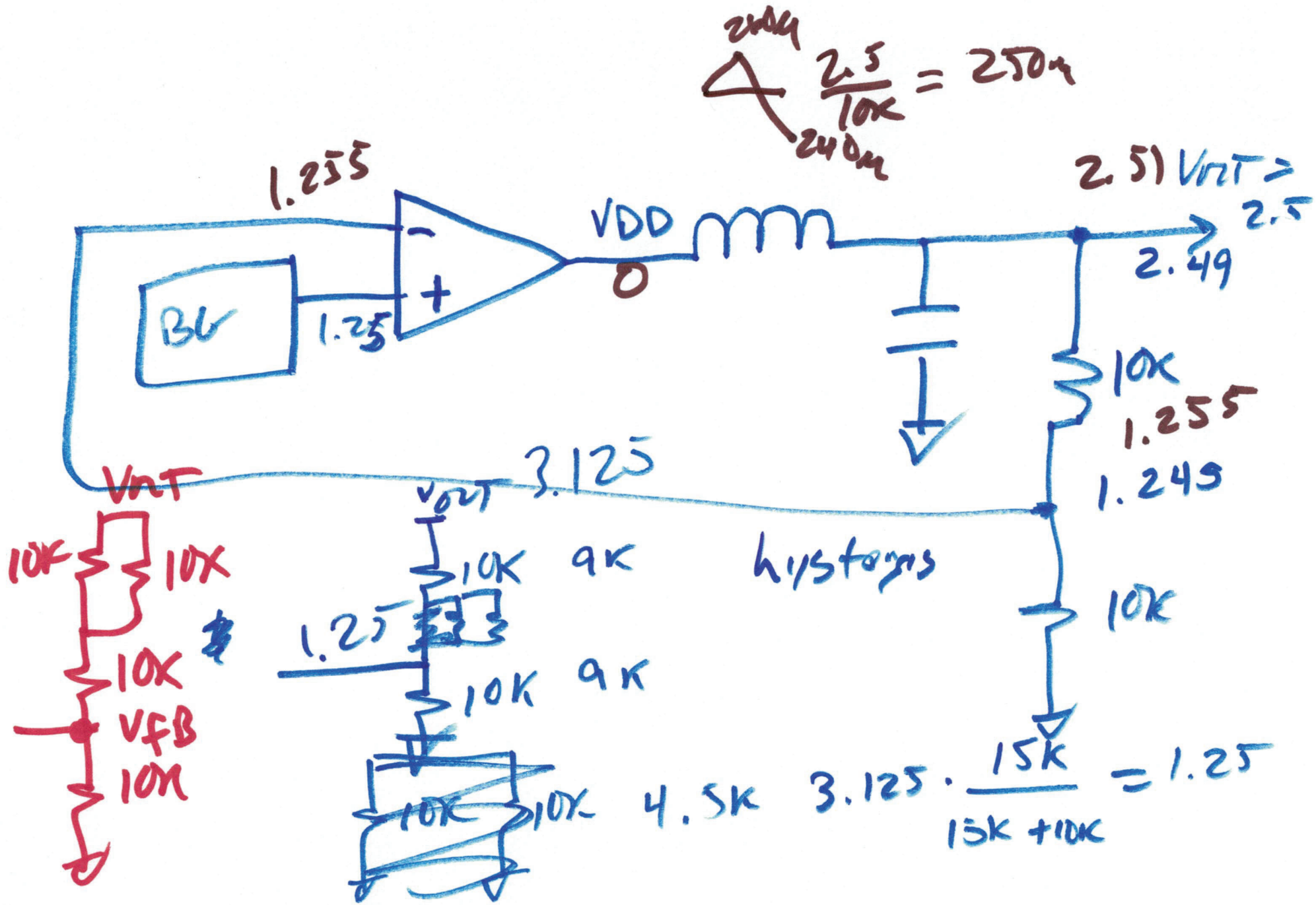
$$\frac{DT}{L}(V_{DD} - V_{OUT}) = \frac{V_{OUT}}{L}(1-D)T$$

$$DV_{DD} - DV_{OUT} = V_{OUT} - DV_{OUT}$$

$$\boxed{D \cdot V_{DD} = V_{OUT}}$$

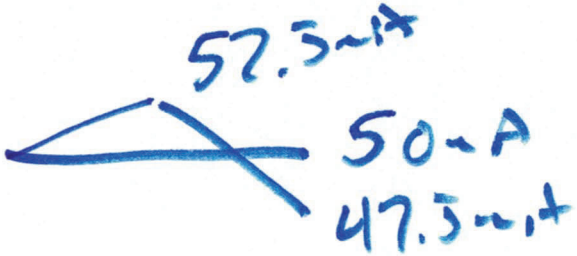

4-6V
VDD
Bandgap
1.25V = VREF
1.25 = VREF
~1.25
4
VDD


Comparator
>1.25
<1.25
1.25
1.25V
+
−
"1"
"0" = GND
off → output = 0
CKT
VDD
2.5V
2.5V
0
10K
1.25
1.25
10K



$$\Delta i = D \cdot T \frac{(VDD - V_{HT})}{L}$$

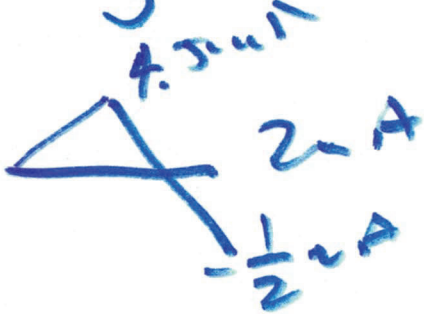
$$f = \frac{1}{T}$$



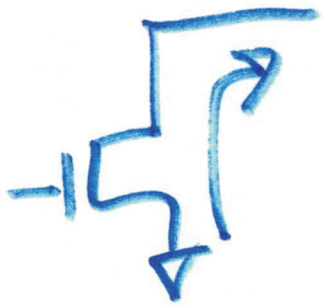
$$L = \frac{D \cdot (VDD - V_{HT})}{\Delta i \cdot f}$$

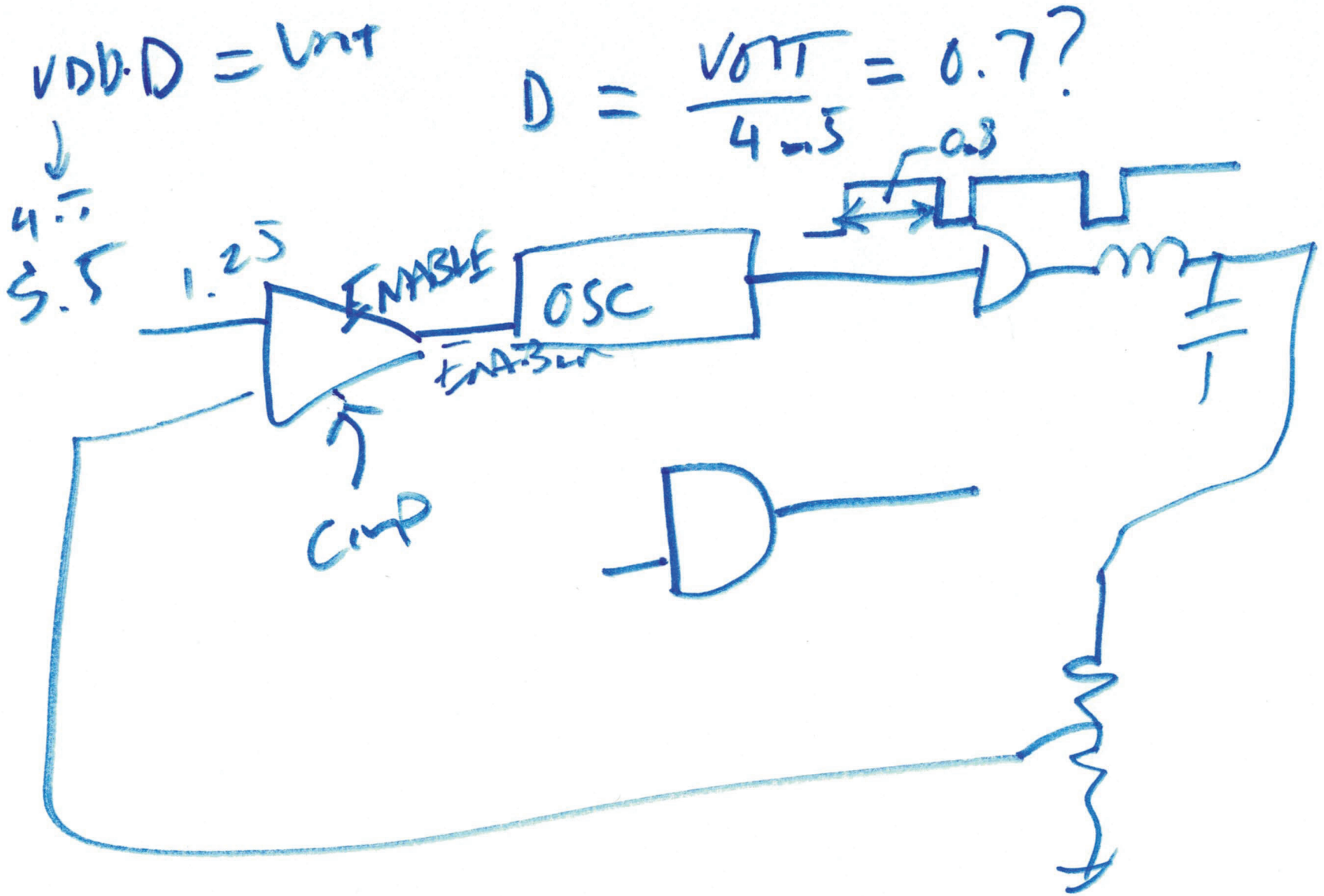
$$D = \frac{3.125}{5}$$

$$L = \frac{\frac{V_{HT}}{VDD} \cdot (VDD - V_{HT})}{5mA \cdot f}$$



$$\frac{P_L}{P_{supply}} = \text{Eff}$$




VDD·D = Vout
D = VOUT / 4.5 = 0.7?
4.5
5.5
1.25
ENABLE
OSC
ENABLE
CMP
0.8
I
1