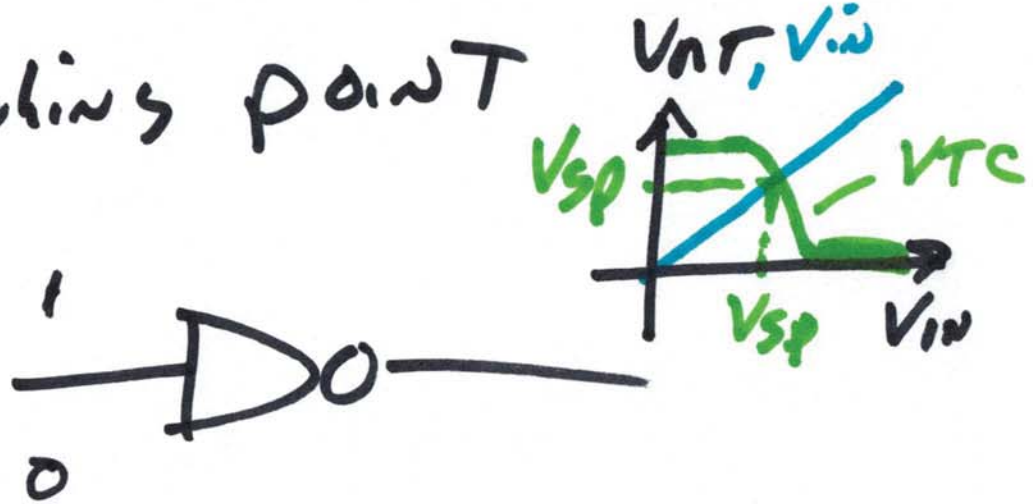
Lecture 18

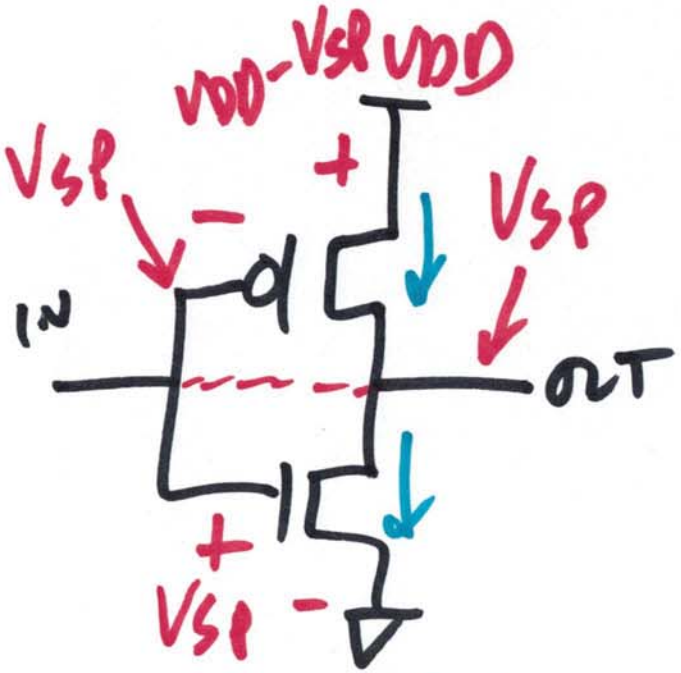
EE 421/EGG621

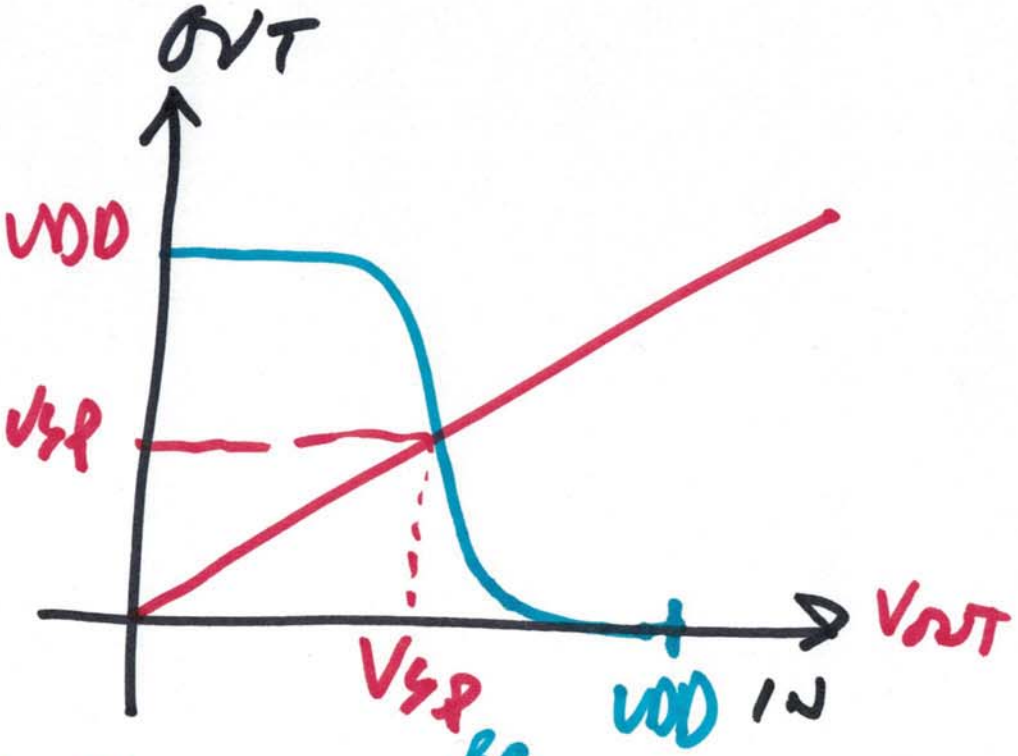
Digital IC Design

OCT. 31, 2018

inverter switching point







$\beta_N/2$

$$\frac{K_{PN}}{2}\frac{W}{L}\left(V_{SP}-V_{THN}\right)^2 = \frac{K_P}{2}\frac{W}{L}\left(VDD-V_{SP}-V_{THP}\right)^2$$

$$\sqrt{\frac{\beta_N}{\beta_P}}\left(V_{SP}-V_{THN}\right) = VDD-V_{SP}-V_{THP}$$

$$V_{SP}\left(\sqrt{\frac{\beta_N}{\beta_P}}+1\right) = VDD-V_{THP}+\sqrt{\frac{\beta_N}{\beta_P}}V_{THN}$$

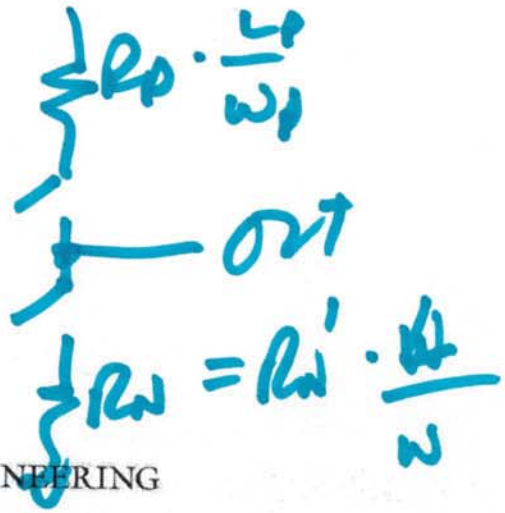
$$V_{SP} = \frac{V_{DD} - V_{THP} + \sqrt{\frac{\beta_N}{\beta_P}} V_{THN}}{1 + \sqrt{\frac{\beta_N}{\beta_P}}}$$

β_N β_P

$\beta_N >> \beta_P$

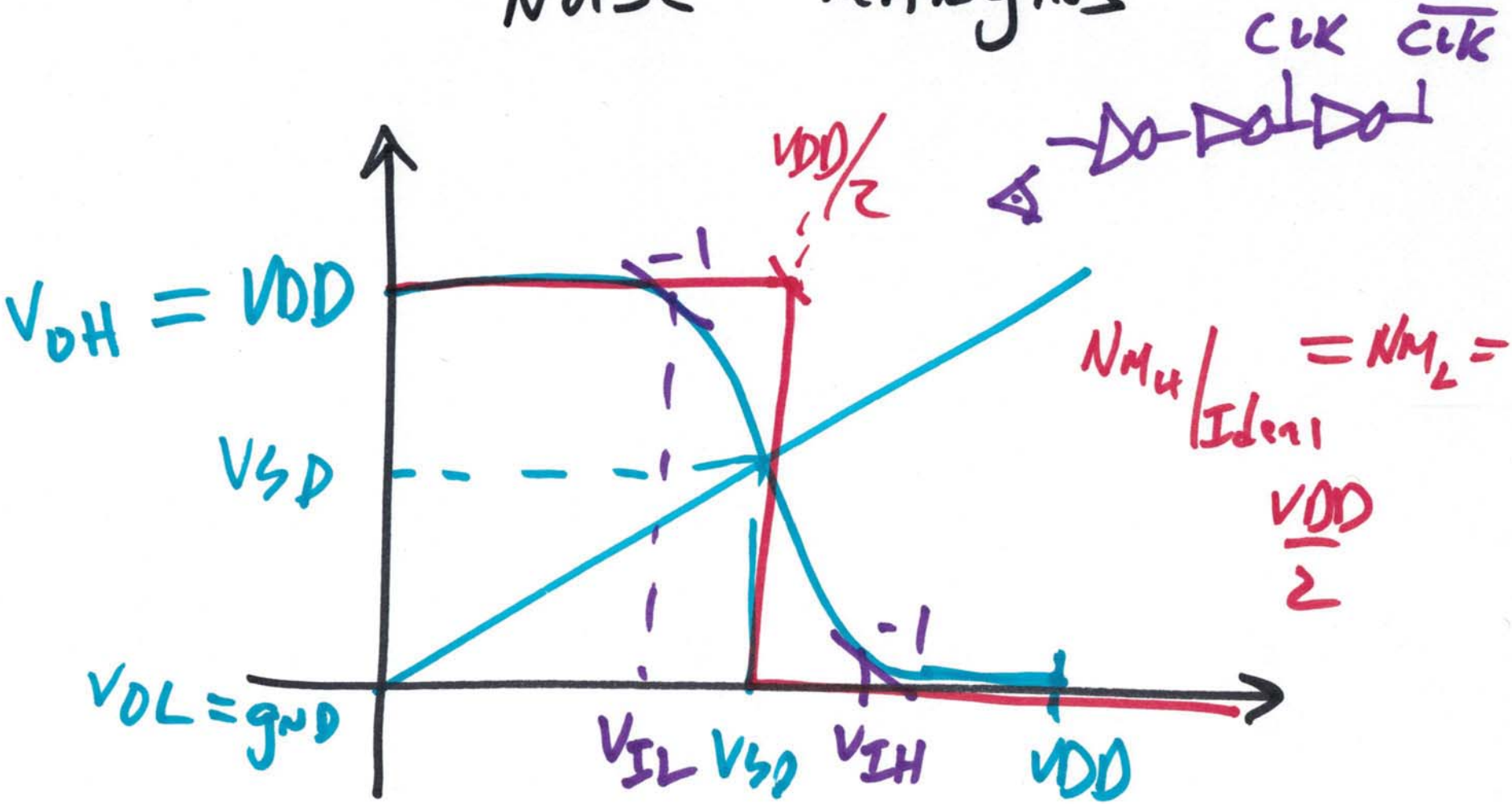
$K_N \cdot \frac{W_N}{L_N}$ $K_P \cdot \frac{W_P}{L_P}$

$V_{SP} \rightarrow V_{THN}$



$R_N << R_P$

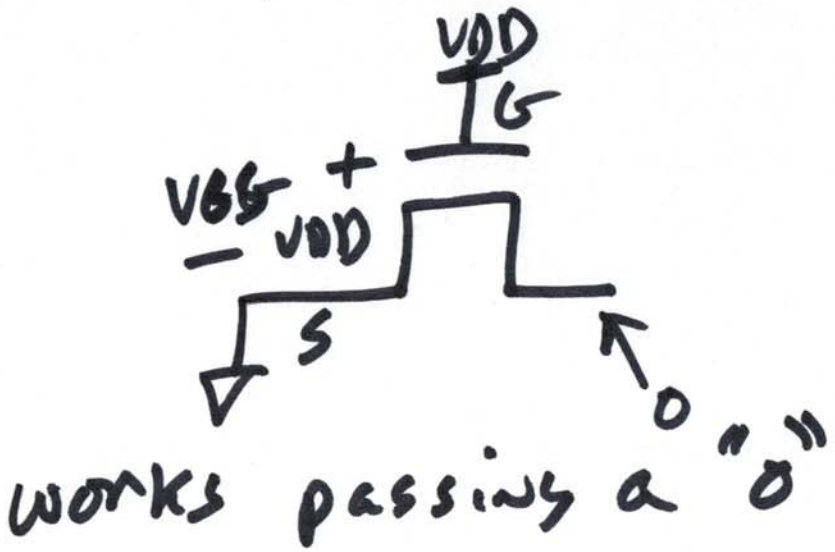
NOISE MARGINS

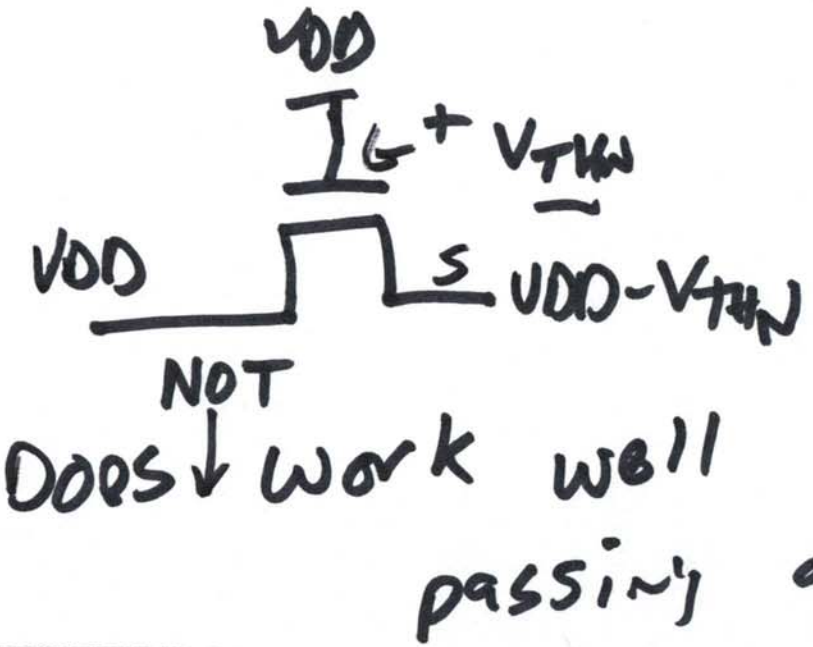


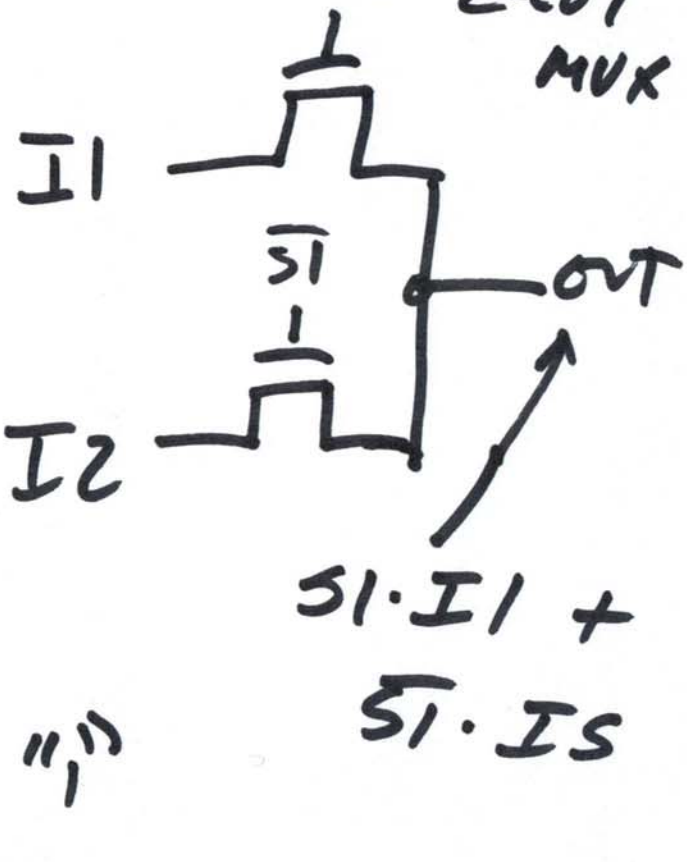
$$NM_H = V_{OH} - V_{IH}$$

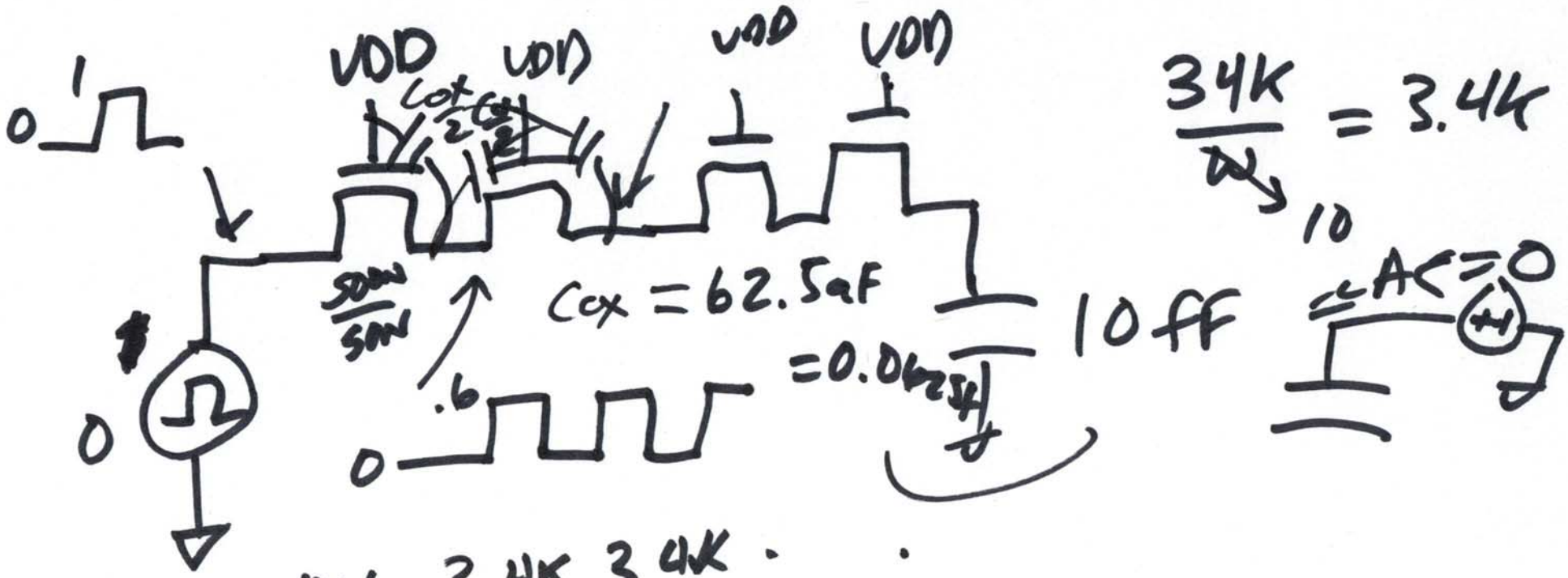
$$NM_L = V_{IL} - V_{OL}$$

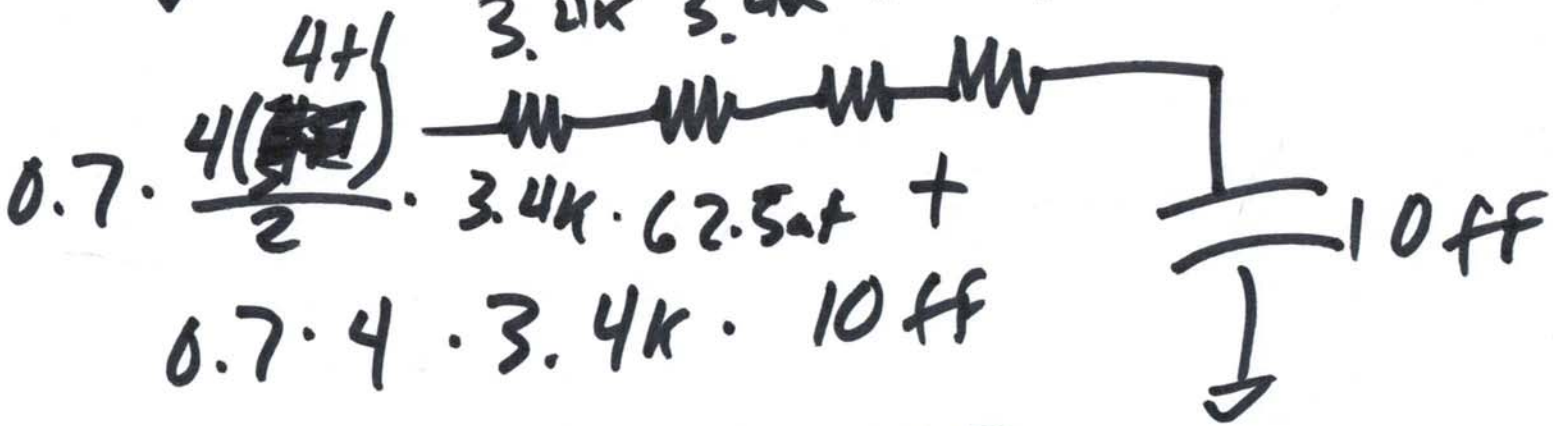
NMOS Pass Gate











34ps · 2.8

90ps

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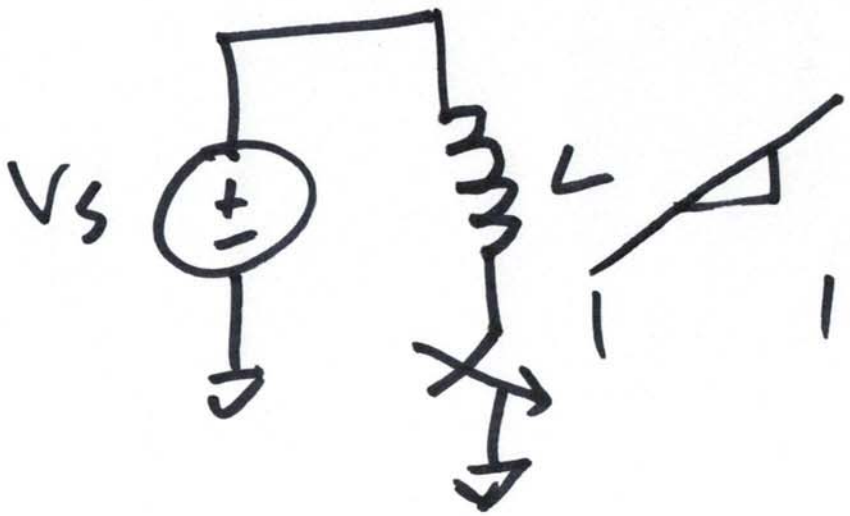
6)



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

$$V_S = L \cdot \frac{di}{dT}$$

$i(t)$

switch closes

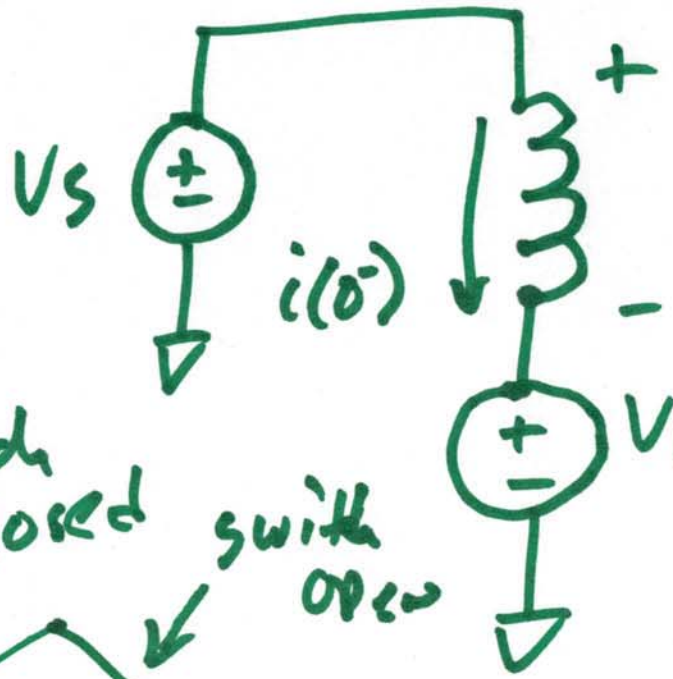
$$i(t) = \int_0^{i(t)} i(t) = \int_0^t \frac{V_S}{L} \cdot dt$$

Switch closed

$$i(t) = \frac{V_S}{L} \cdot t$$

Switch open

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

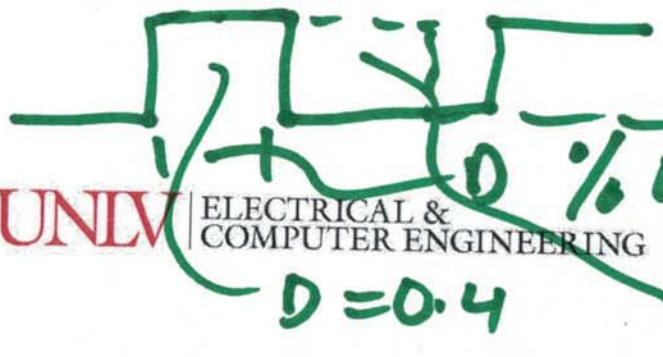


$$V_S - V_{OUT} = L \cdot \frac{di}{dT}$$

$$\int_{i(0^-)}^{i(t)} di = \int_0^t \frac{V_S - V_{OUT}}{L} \cdot dt$$

$$V_{OUT} = V_S \cdot \frac{1}{1-D}$$

$$i(t) = \frac{V_S - V_{OUT}}{L} \cdot t + i(0^-)$$



D % of time

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D = 0.4

D = .8

8)

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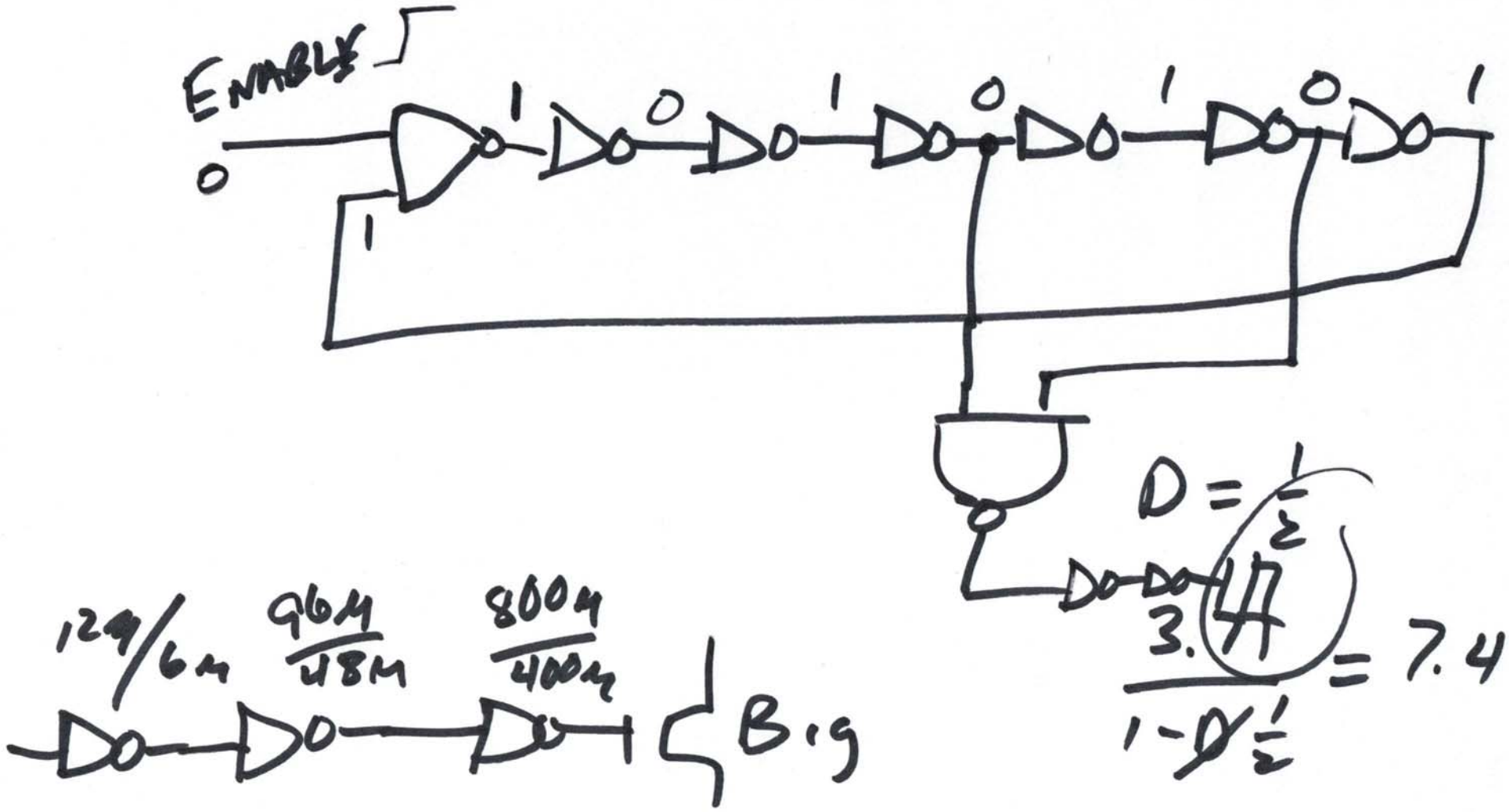
ENABLE
0
1
0
1
0
1
0
1
0
1
1
D = 1/2
3.47
= 7.4
1-D = 1/2
12μ/6μ
96μ/48μ
800μ/400μ
B.g