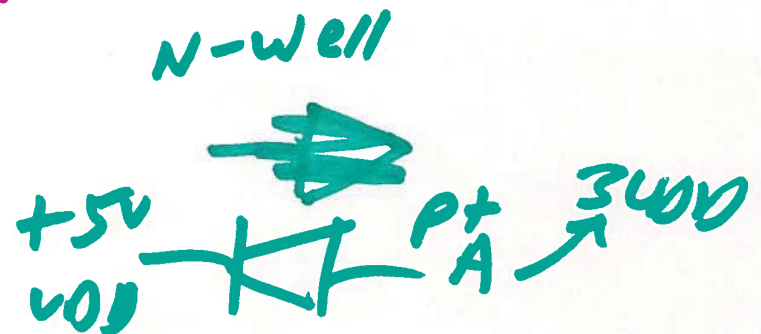
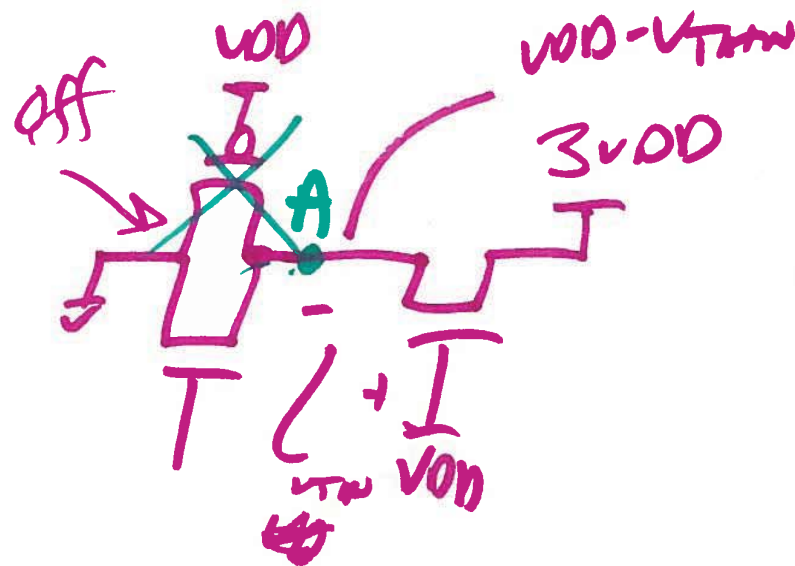


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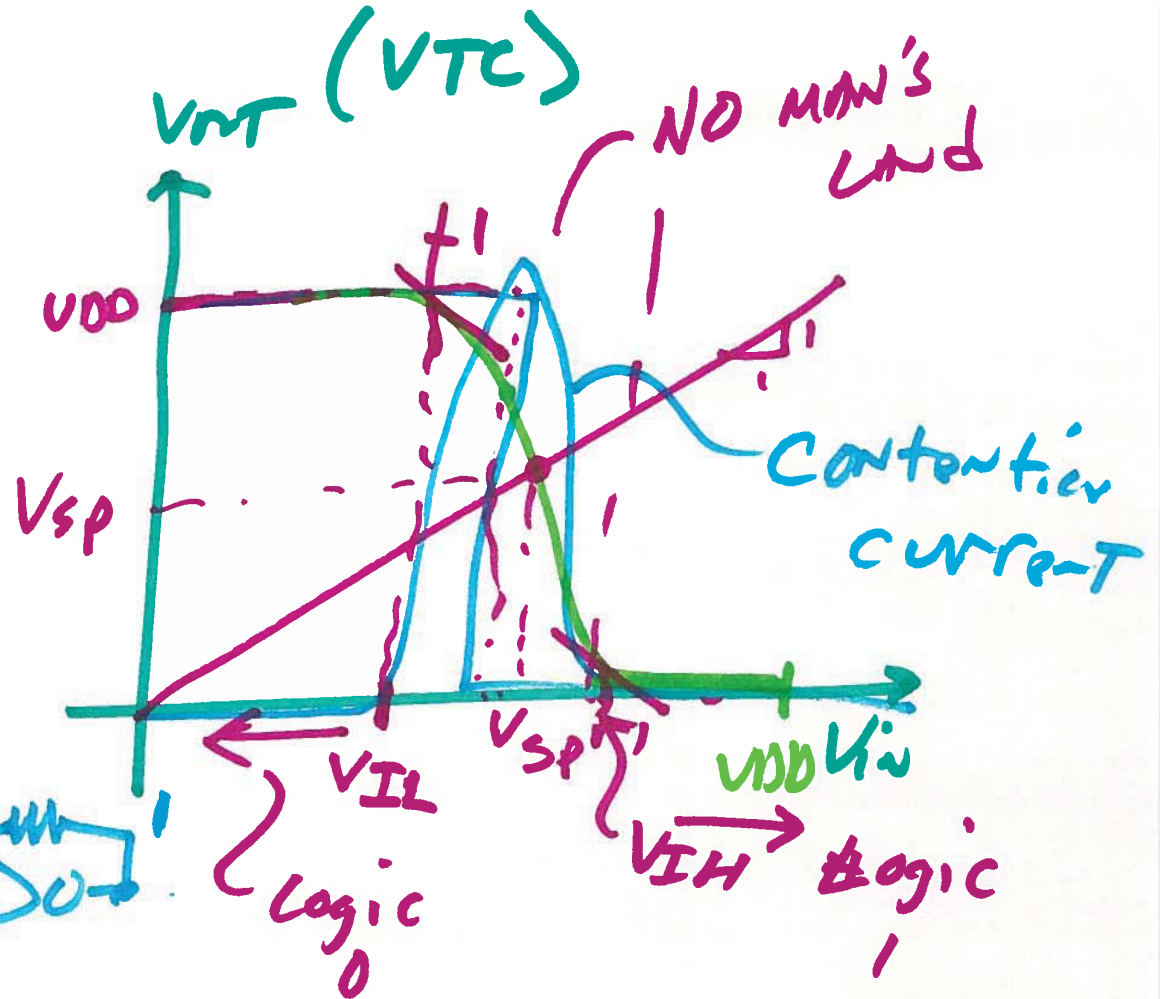
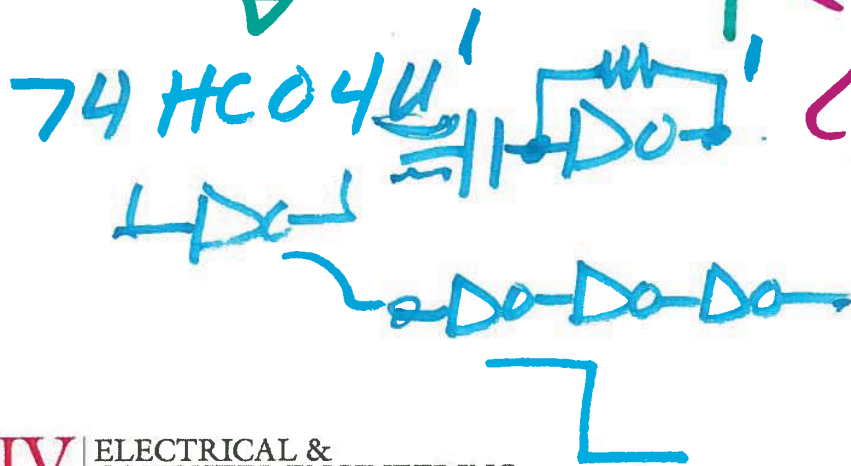
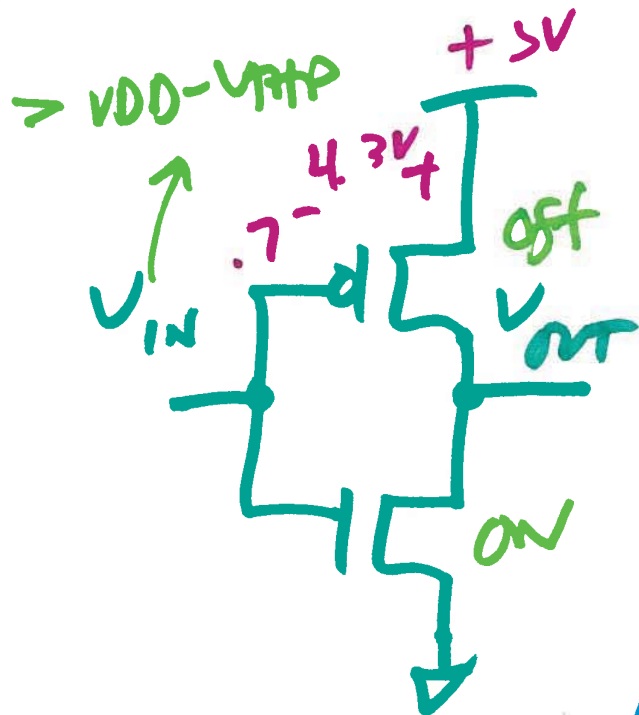
Digital IC Design

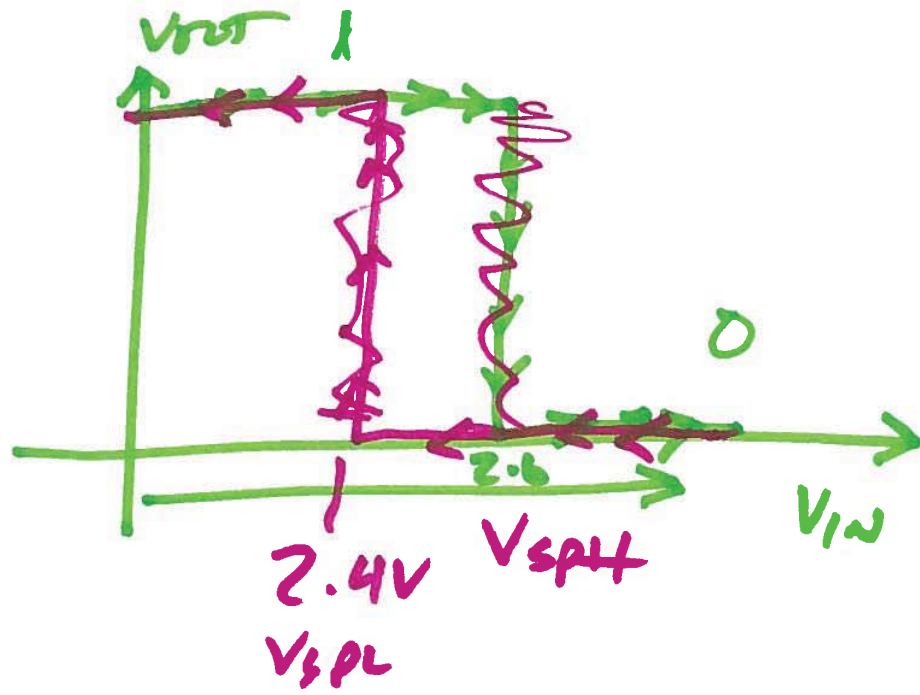
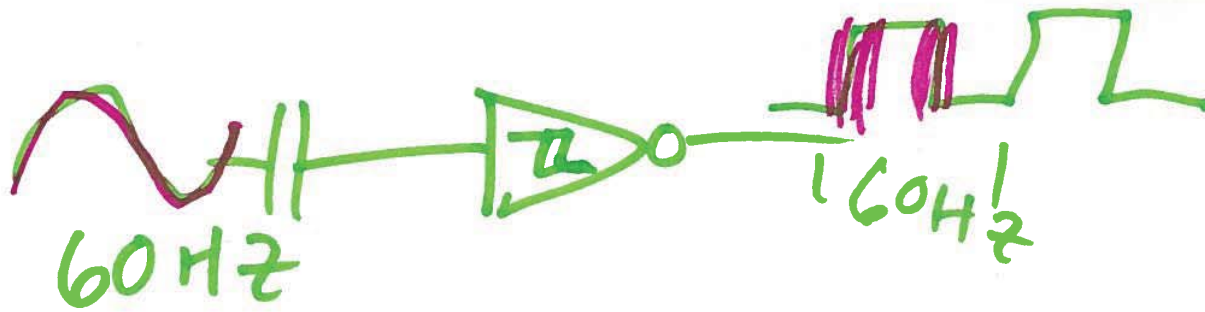
OCT. 30, 2017

Lecture 17

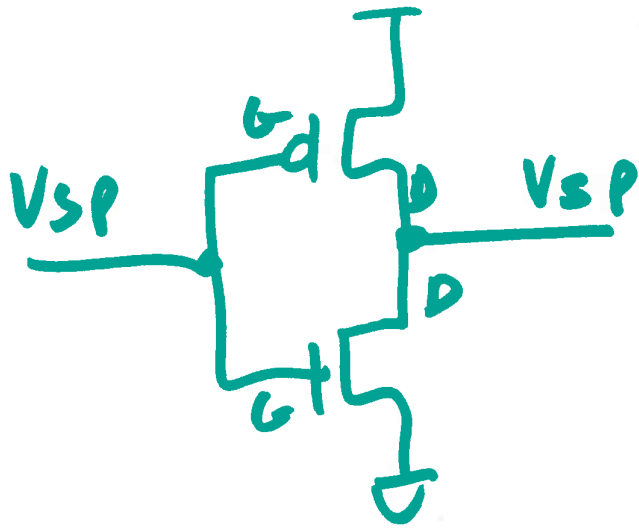


Voltage transfer curves





3)



$$V_{sp} = ?$$

$$\frac{K_{PN} \cdot W_N}{2} \frac{V_{sp} - V_{TN}}{L_N} =$$

$$\frac{K_{PP} \cdot W_P}{2} \frac{V_{DD} - V_{sp} - V_{TP}}{L_P}$$

$$V_{DS} \geq V_{GS} - V_{TN}$$

$$V_D - V_S \geq V_G - V_S - V_{TN}$$

$$0 \geq -V_{TN}$$

$$\frac{K_{PN} \cdot \frac{W_N}{L_N}}{K_{PP} \cdot \frac{W_P}{L_P}} \cdot (V_{sp} - V_{TN}) =$$

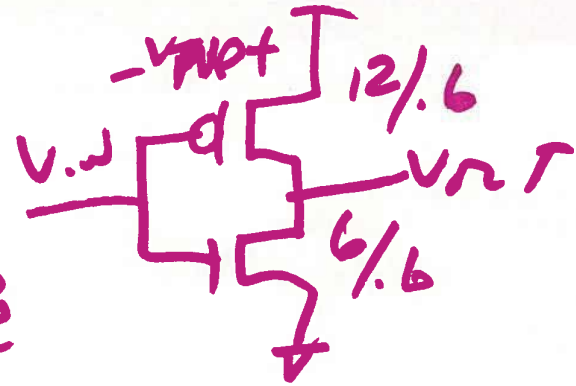
$$V_{SP} \left(\sqrt{\frac{K_{PN} \cdot \frac{W_N}{L_N}}{K_{PP} \cdot \frac{W_P}{L_P}} + 1} \right) = V_{DD} - \cancel{V_{THP}} - V_{THP} + \sqrt{} \cdot V_{THN}$$

$$V_{SP} = V_{DD} - V_{THP} + \sqrt{\frac{K_{PN} \cdot \frac{W_N}{L_N}}{K_{PP} \cdot \frac{W_P}{L_P}}} \cdot V_{THN}$$

$$1 + \sqrt{\frac{K_{PN} \cdot \frac{W_N}{L_N}}{K_{PP} \cdot \frac{W_P}{L_P}}} \cdot \cancel{}$$

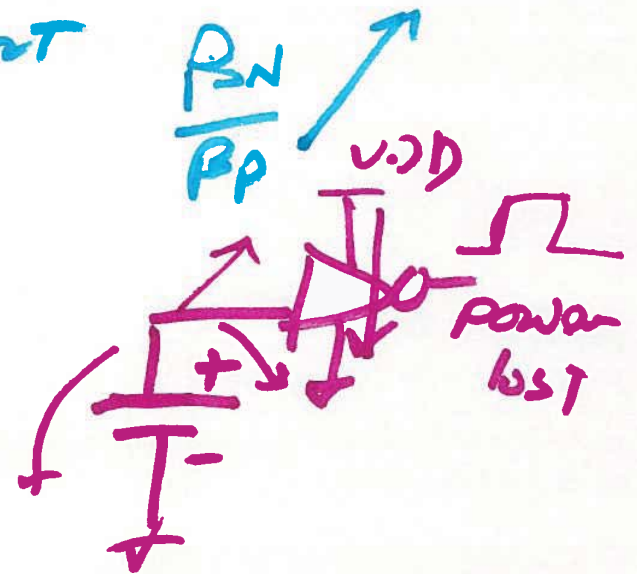
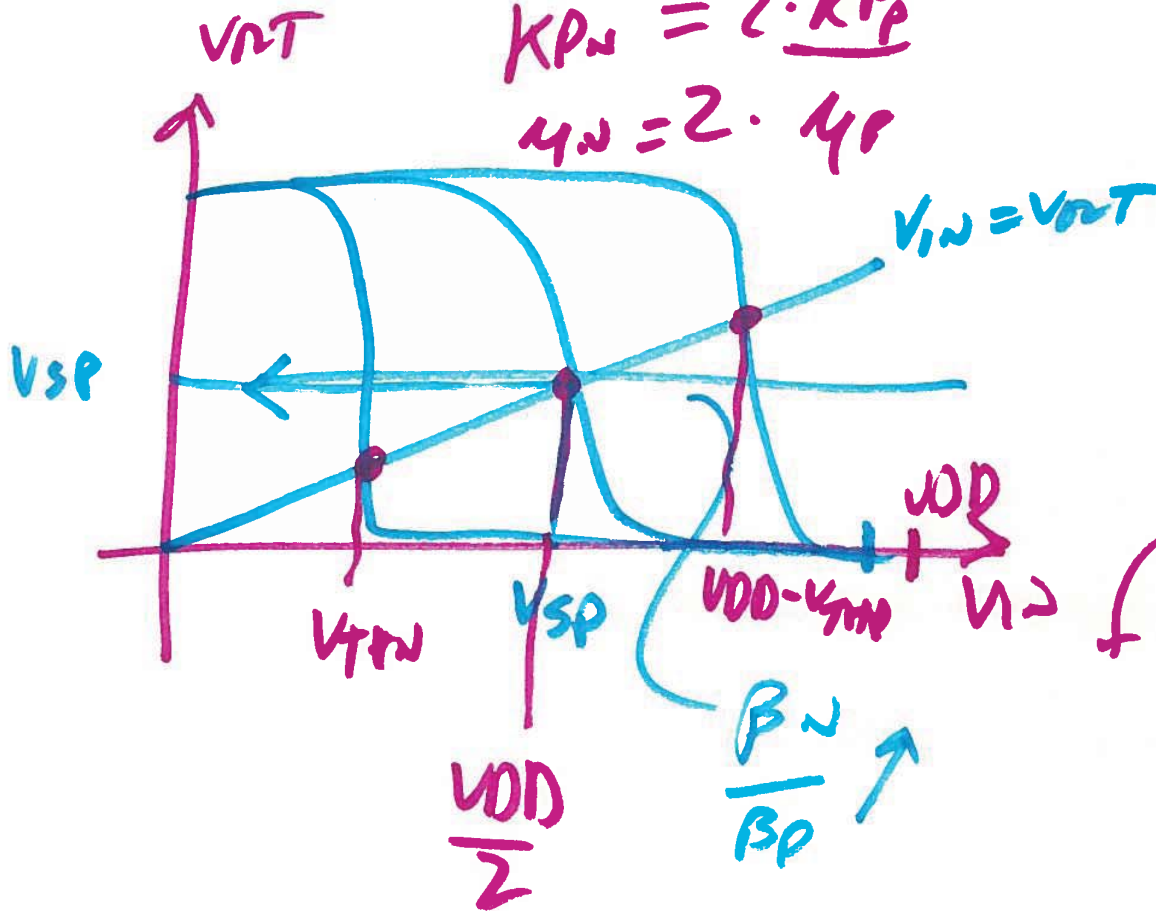


$$\frac{\beta_N}{\beta_P} = \frac{K_{PN} \cdot W_N / L_N}{K_{PP} \cdot W_P / L_P}$$

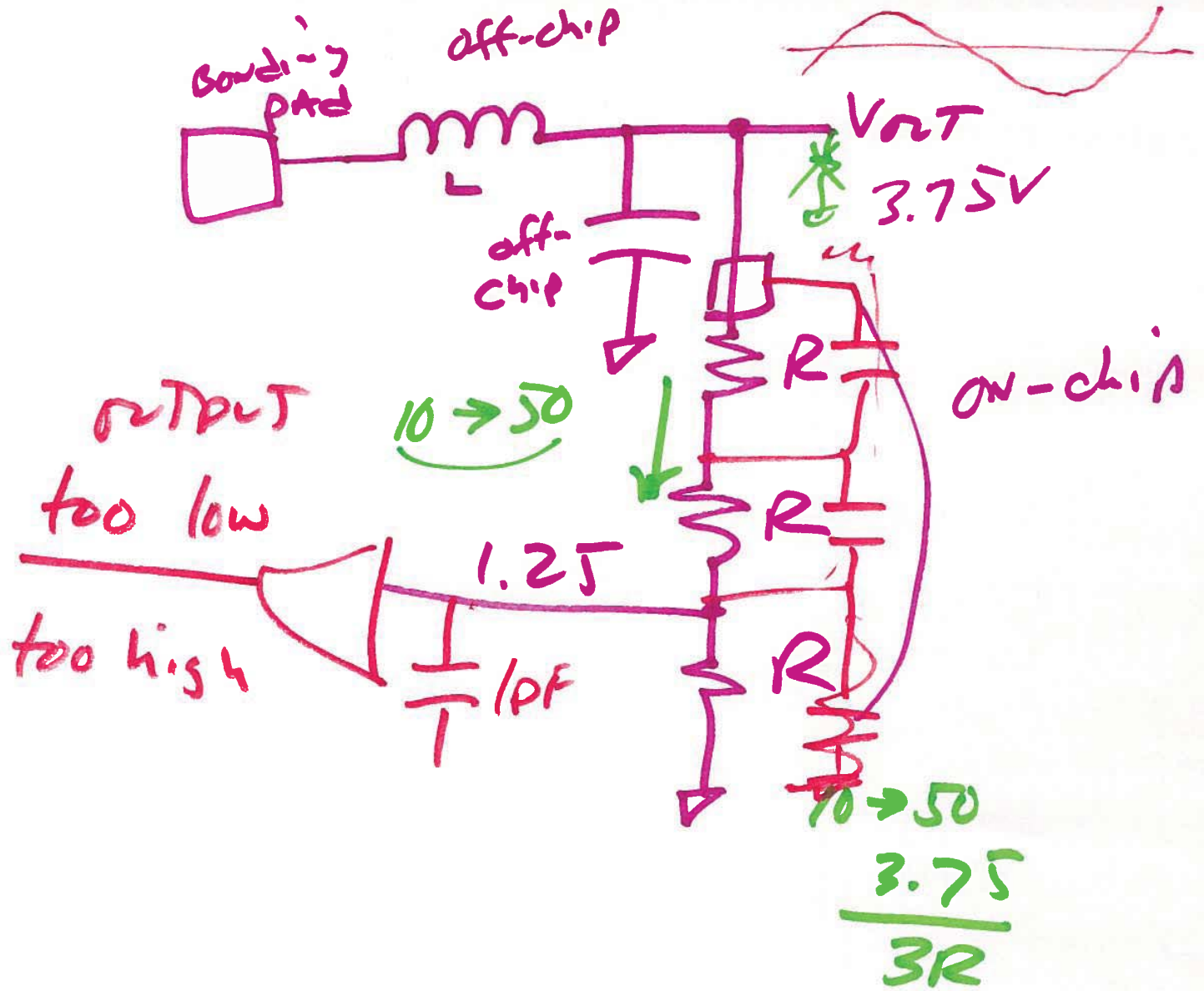


$$K_{PN} = 2 \cdot K_{PP}$$

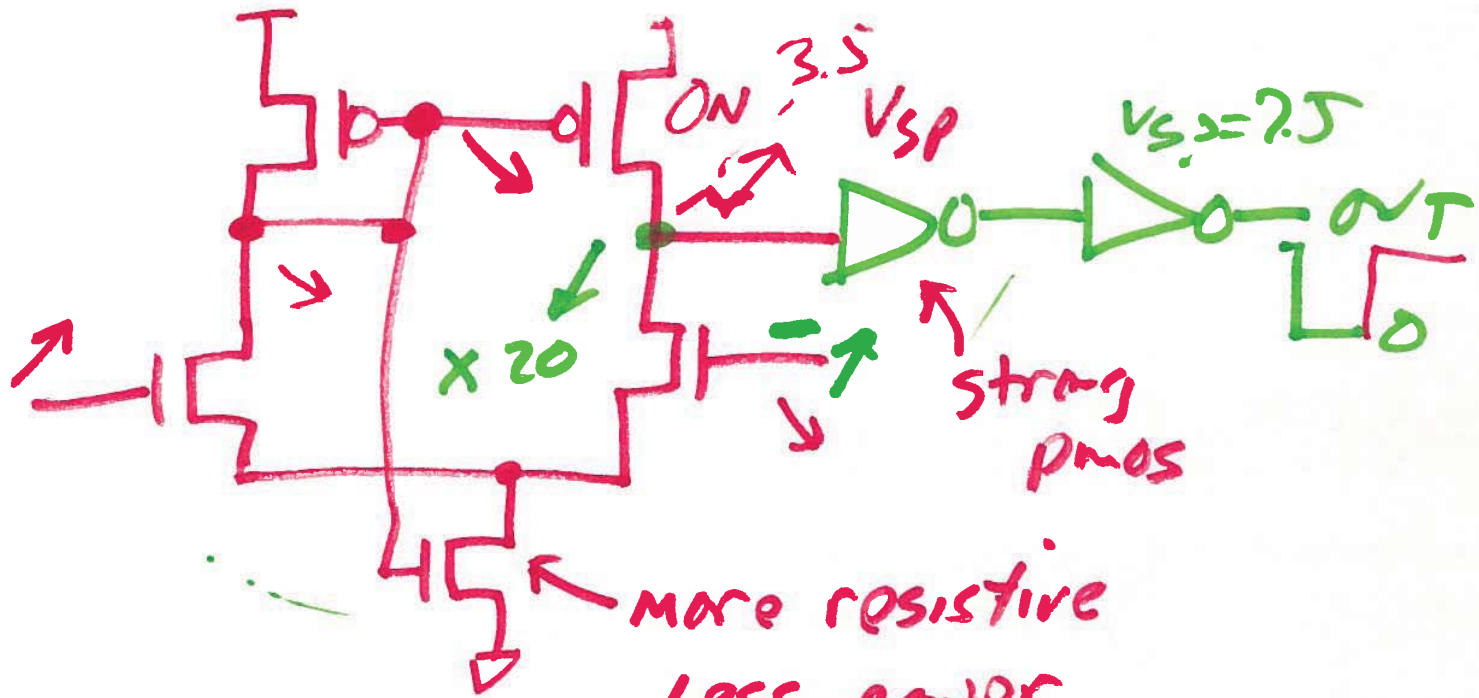
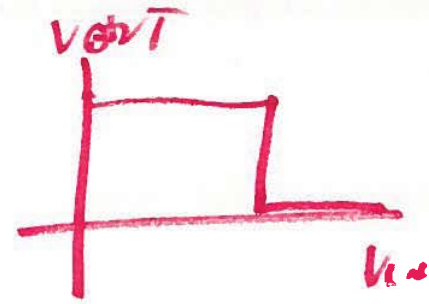
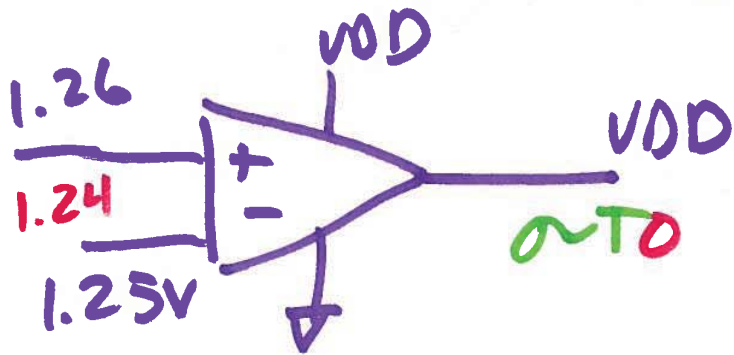
$$W_N = 2 \cdot W_P$$



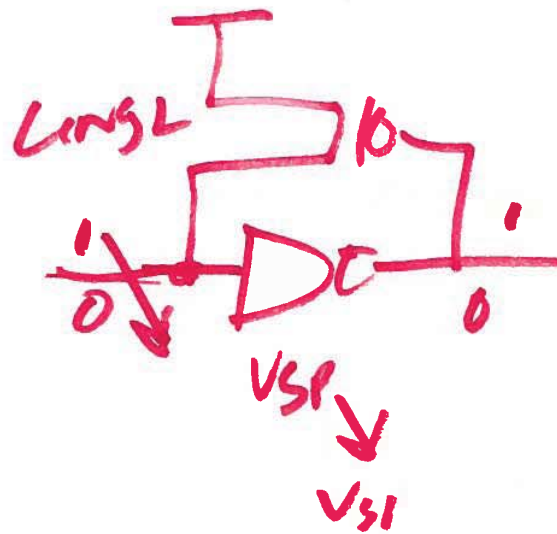
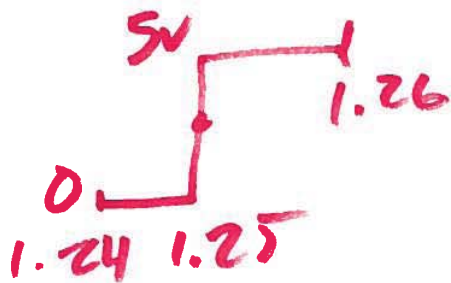
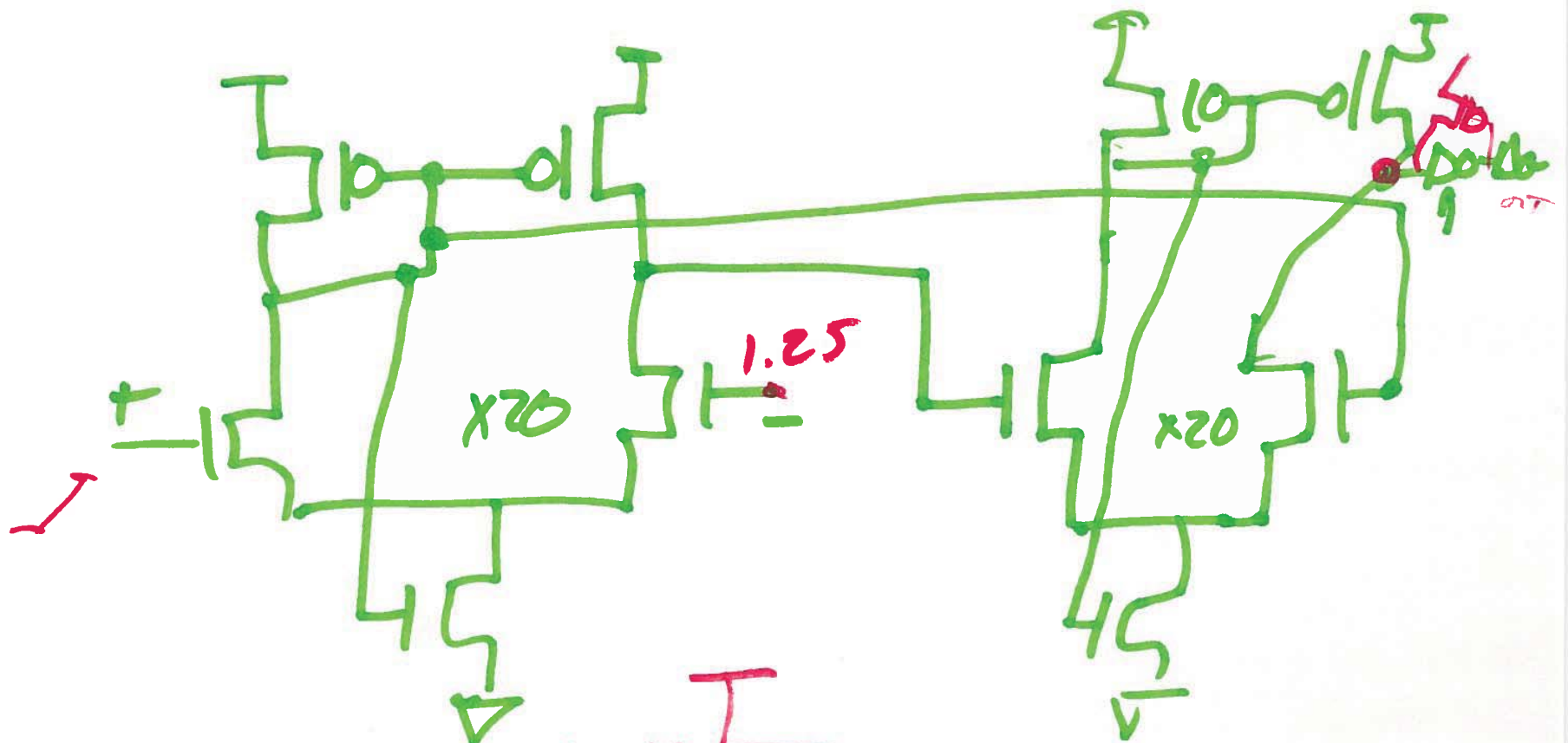
6)



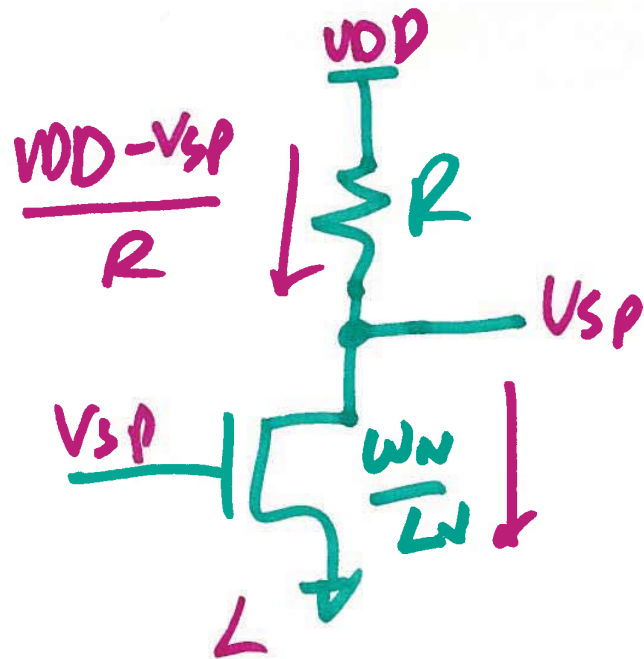
7)



more resistive
 LESS power
 AND more gain!



9)



$$\frac{V_{DD} - V_{sp}}{R} = \frac{\mu_n C_{ox}}{2} \cdot \frac{W}{L} (V_{sp} - V_{thn})^2$$

V_{sp}	L	R
3		