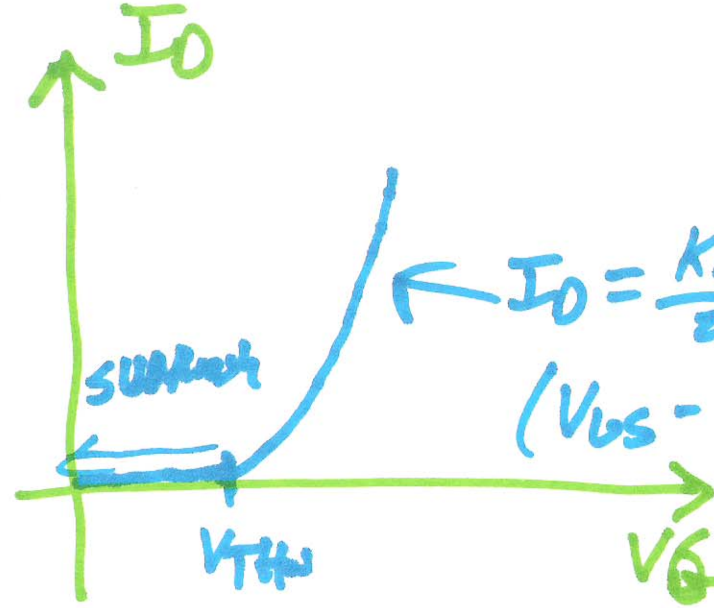
EE 420/ECG 620

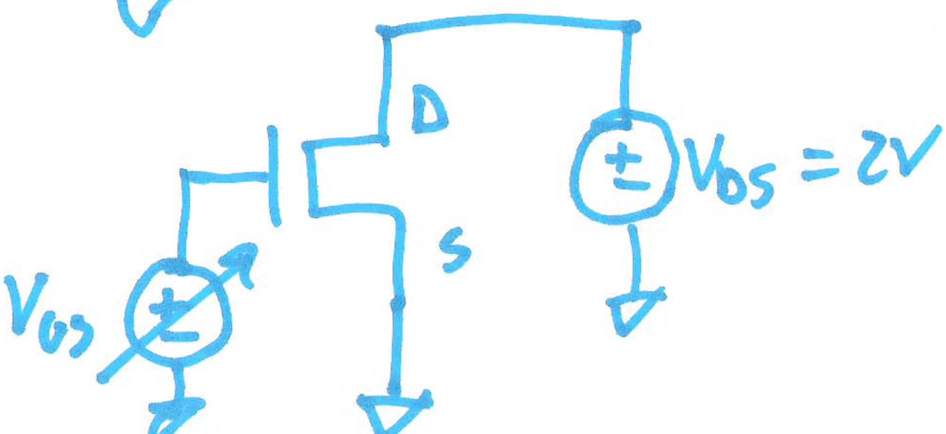
Lecture 2

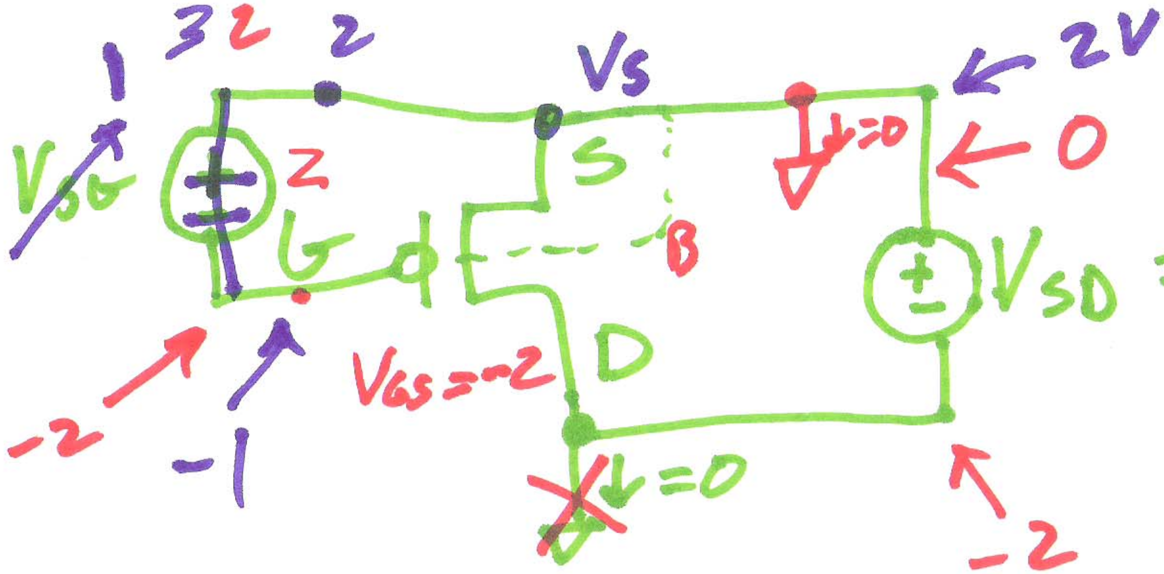
January 23, 2015

Square-law Equations



$$I_D = \frac{KP_n}{2}\frac{W}{L}\left(V_{GS} - V_{THN}\right)^2$$





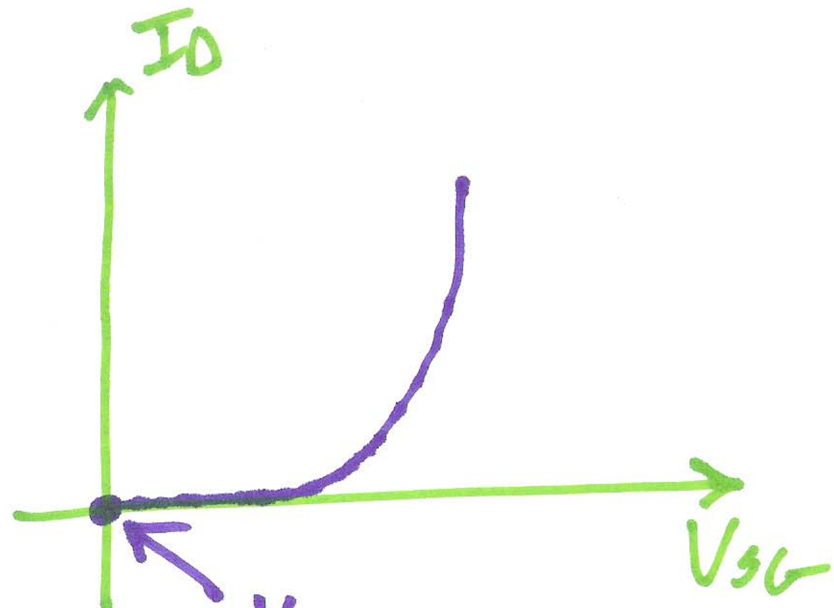
$V_D - V_S = V_{DS}$

V_{SD}

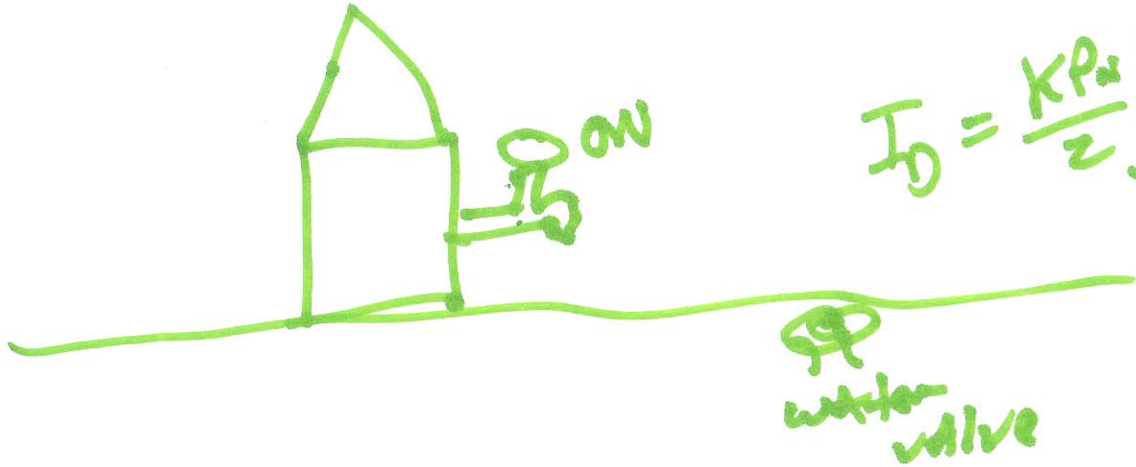
$$I_D = \frac{KP_p}{2}\frac{W}{L}\left(V_{SG} - V_{THP}\right)^2$$

2 .7 .9

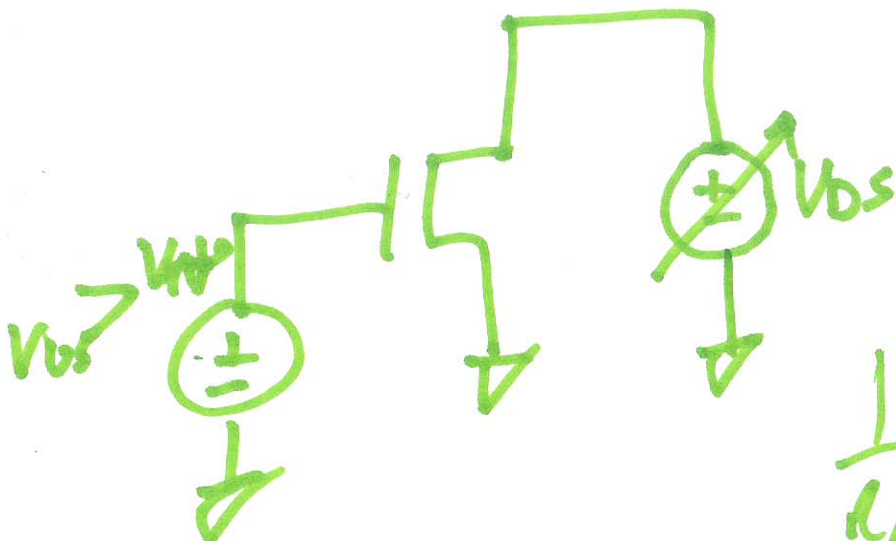
$V_S - V_G = 2$

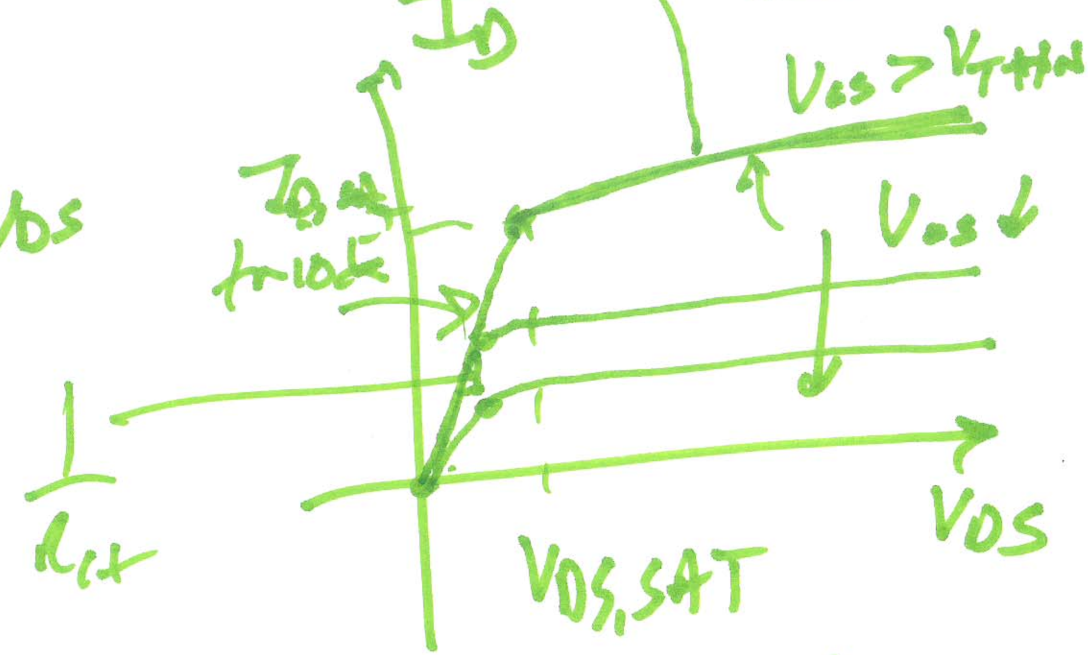


$V_{SG} = 0$
$V_S = 2$
$V_G = 2$



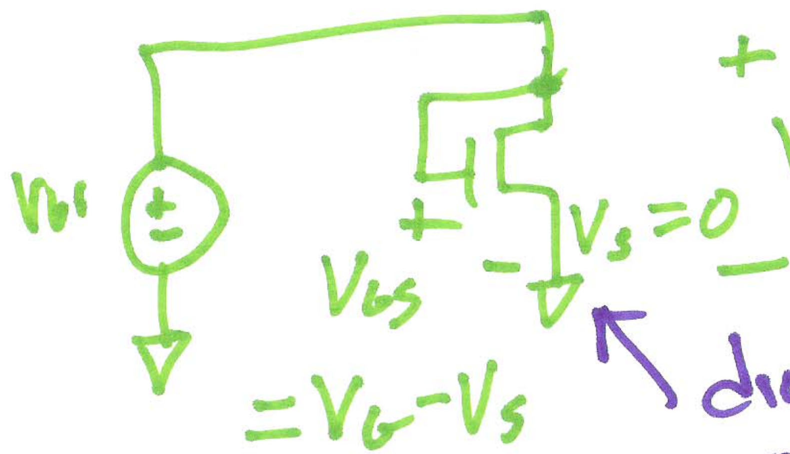
$$I_D = \frac{KP_n}{2}\frac{W}{L}\left(V_{GS}-V_{THN}\right)^2\left(1+\lambda\left(V_{DS}-V_{DS,SAT}\right)\right)$$





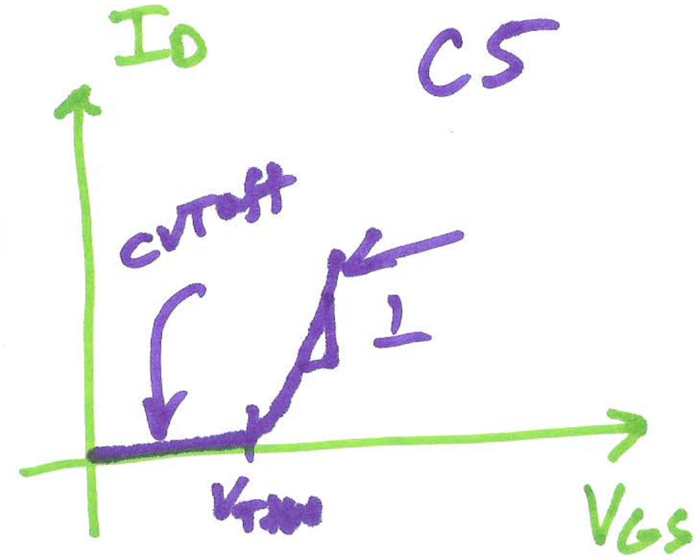
$$V_{DS,SAT} = V_{GS} - V_{THN}$$

CS



$V_{DS} = V_{GS}$

diode-connected MOSFET



$$\left.\begin{array}{l} V_{DS} > V_{GS} - V_{THN} \\ V_{DS} > V_{DS,sat} \end{array}\right\} \text{Saturation}$$

$$V_D - \cancel{V_S} > V_G - \cancel{V_S} - V_{THN}$$

$$V_D = V_G$$

$$0 > -V_{THN} \quad \text{Saturation}$$

$$I_D = \frac{KP_n}{2} \cdot \frac{W}{L} \left(V_{GS} - V_{THN}\right)^2$$

$$I_D = \frac{KP_n}{2} 10 \left(V_{GS} - 0.8\right)^2$$

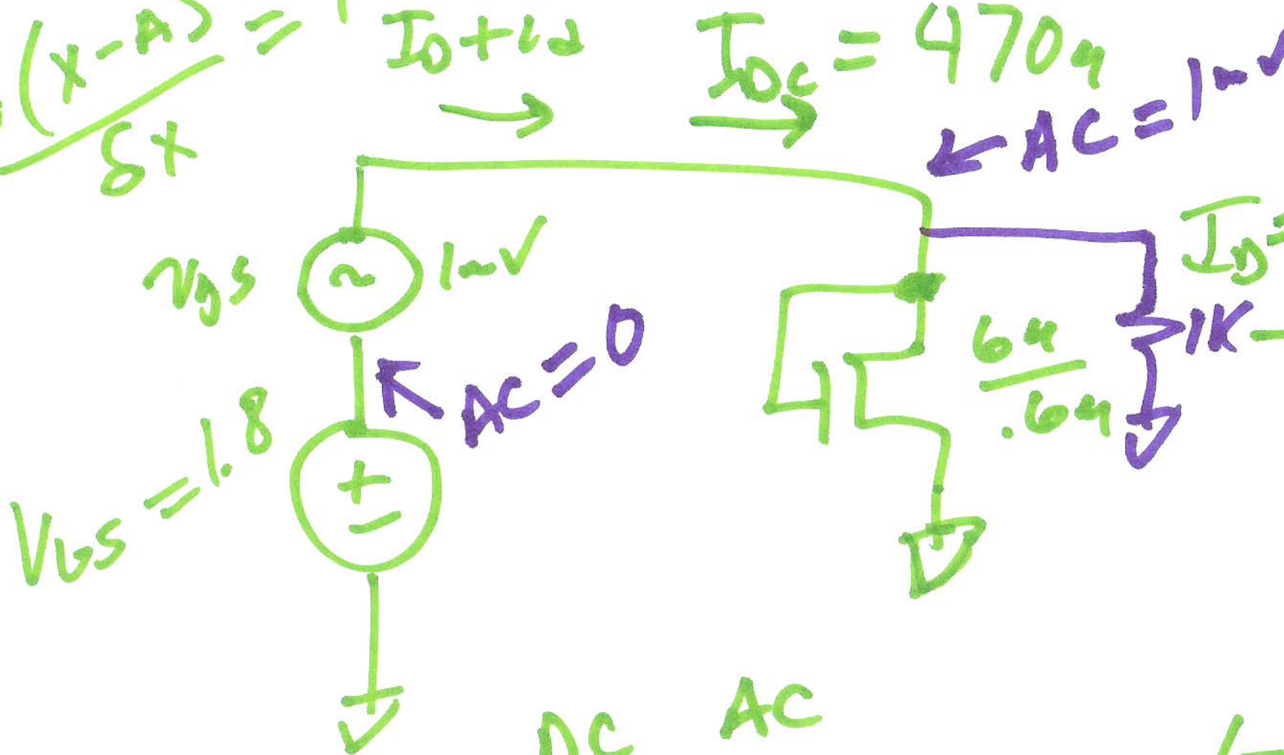
$$470\,\mu A = KP_n \cdot 5 \cancel{\left(1.8 - .8\right)^2} \rightarrow 1$$

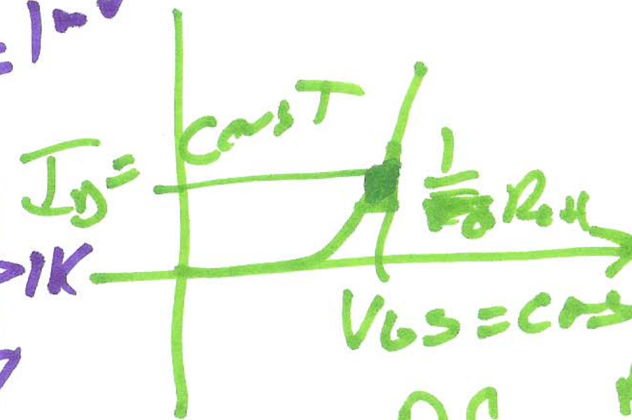
$$\frac{\epsilon_{ox}}{t_{ox}}$$

$$KP_n = 94 \frac{\mu A}{V^2} \approx \underline{\underline{100 \frac{\mu A}{V^2}}} = \mu_n \cdot C_{ox}$$

$$V_{THN} = \underline{\underline{800\,mV}}$$

$$\frac{\delta(x-A)}{\delta x} = 1$$





$$\overset{DC}{} \quad \overset{AC}{}$$

$$v_{GS} = V_{GS} + v_{gs}$$

$$\left.\frac{\delta i_D}{v_{GS}}\right|_{\substack{I_D = \text{CONST} \\ V_{DS} = \text{CONST}}} = \delta \overset{DC}{I_D} + \overset{AC}{i_d} = \frac{KP_n}{2}\frac{W}{L}\Big(\overbrace{\underbrace{V_{GS} + v_{gs}}_{\substack{= v_{GS} \\ 1.8 \; + \; 1mV}} - V_{THN}}\Big)^2$$

$$\frac{1}{R_{CH}} = KP_n \cdot \frac{W}{L}\left(V_{GS} + v_{gs} - V_{THN}\right)$$

$$R_{CH} = \frac{1}{\frac{100\,\mu A}{V^2} \cdot 10 \cancel{(1.8 - .8)} V}$$

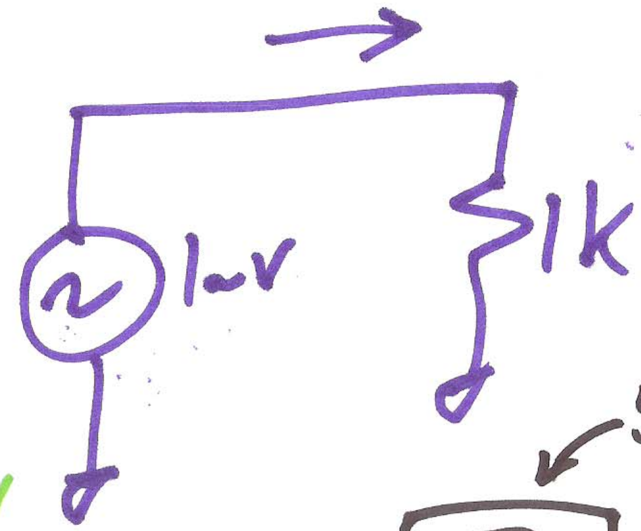
$$R_{CH} = \frac{1}{KP \cdot \frac{W}{L}(V_{GS} - V_{THN})}$$

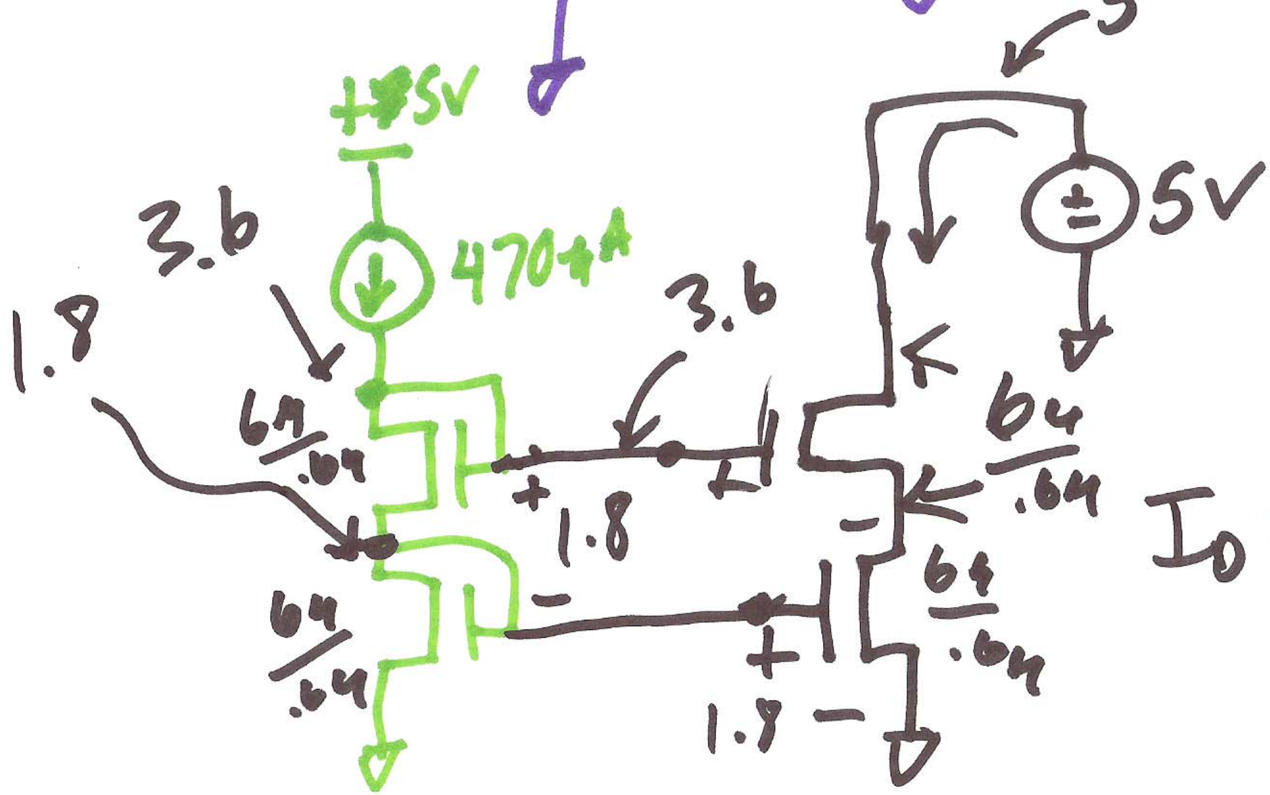
$$R_{CH} = \frac{1}{\frac{1\,mA}{V}} = \underline{\underline{1\,k\Omega}}$$

$1mV/1k = 1\mu A \Rightarrow 20 \log 1\mu$

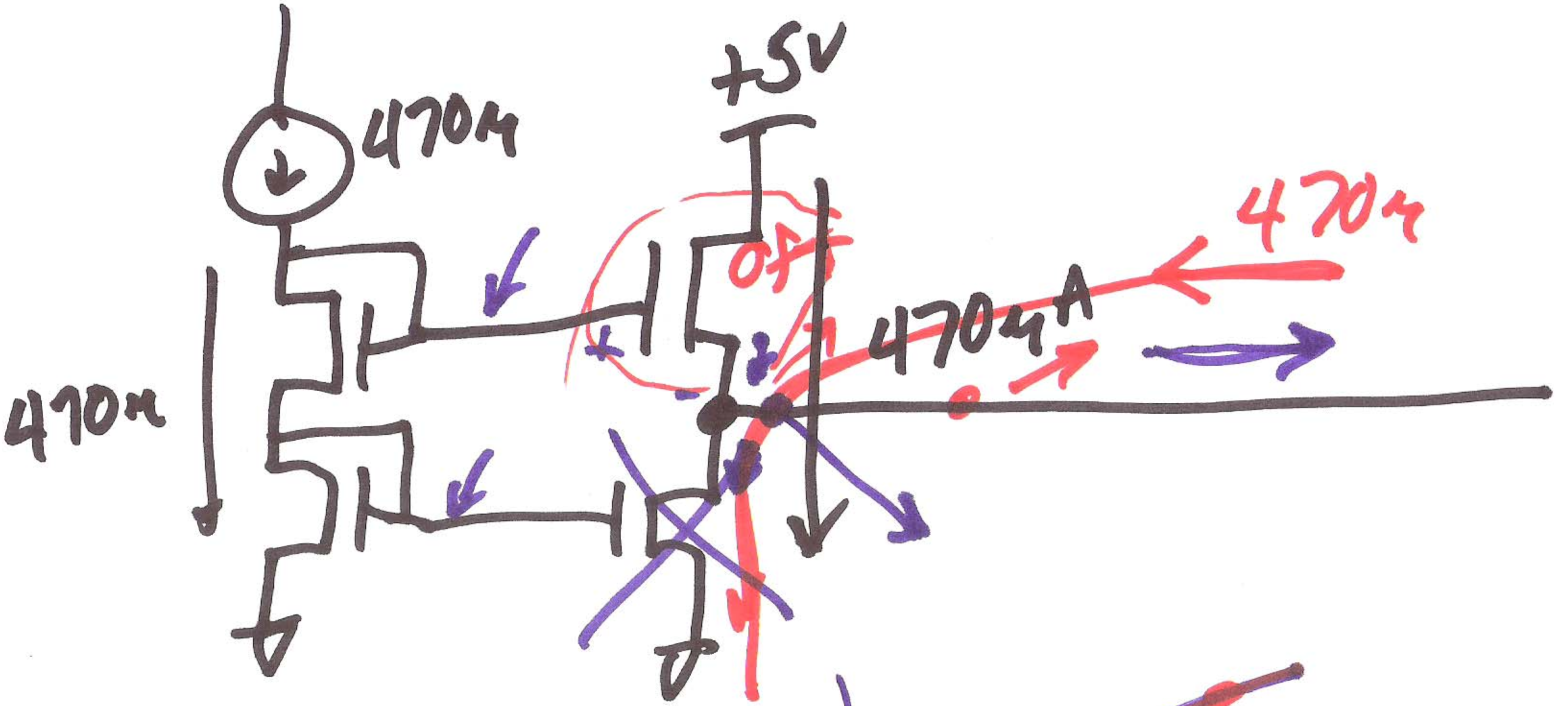
$20 \log 10^{-6}$

$\underline{\underline{-120\,dB}}$





$$I_D = \frac{KP}{2}\frac{W}{L}(1.8-.8)^2$$


470u
470u
+5V
off
470uA
470u