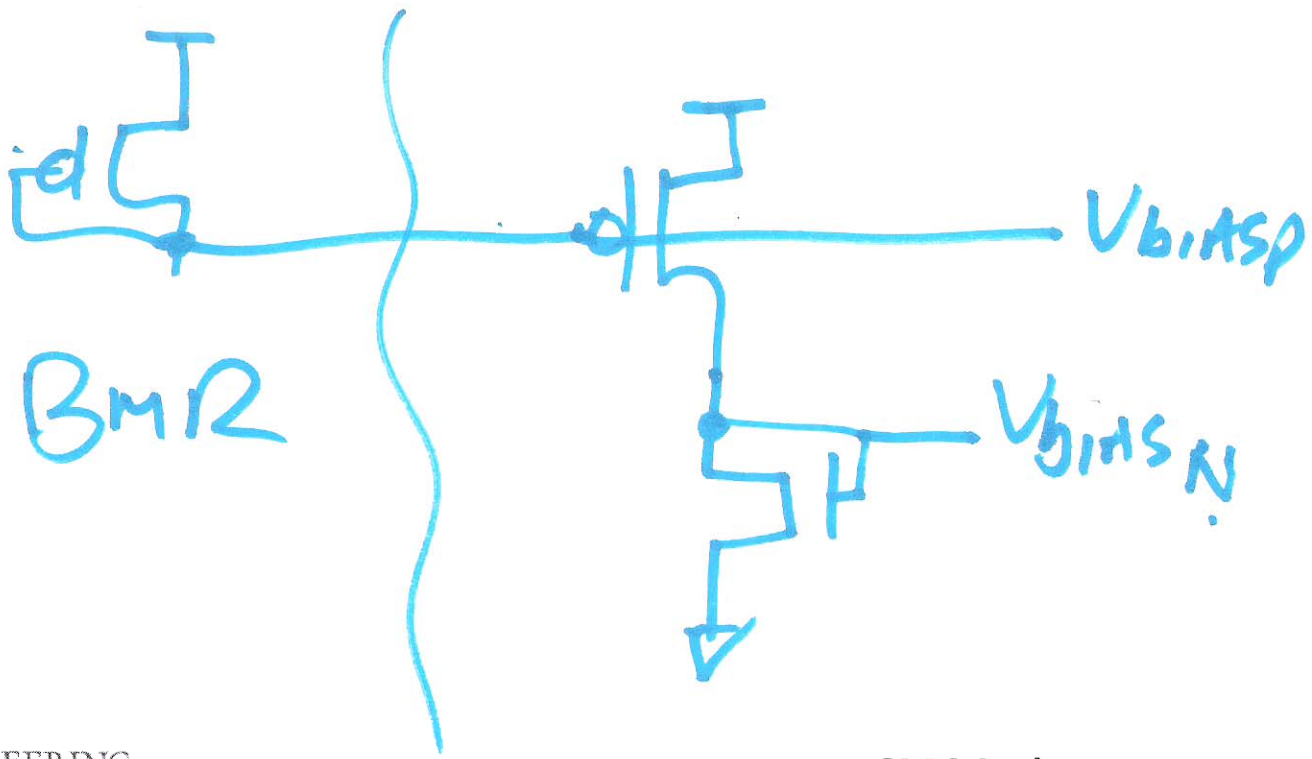
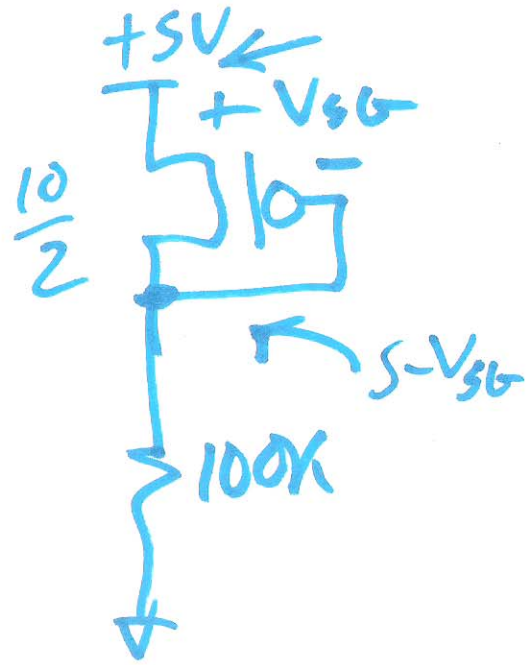
EE 420/ECE 620
Analog IC Design
Lecture 11
Feb. 23, 2015





$$V_{SG} = \sqrt{\frac{2I}{K_p \cdot \frac{W}{L}}} + V_{THP}$$

$$\frac{5 - V_{SG}}{100K} = I$$

$$V_{SG} = 5 - 35.1 \cdot 10^{-6} \cdot 10^5 = 1.49$$

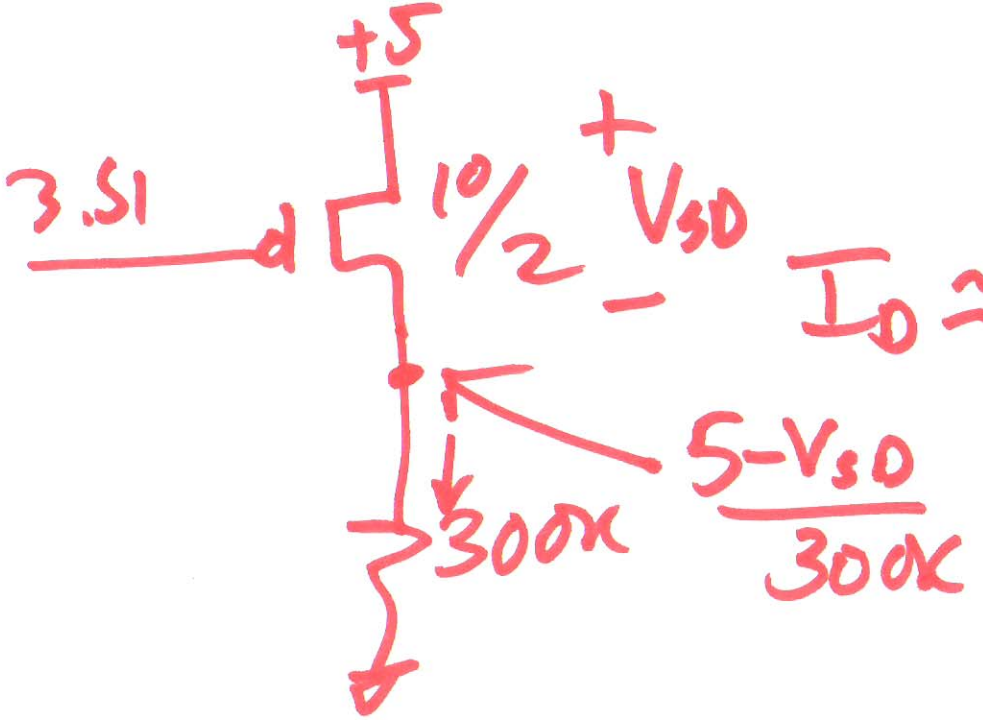
$$5 - I \cdot 10^5 = V_{SG} = 4.1$$

$$\frac{5 - I \cdot 10^5}{} = \sqrt{\frac{2I}{40n \cdot 5}}$$

$$\sqrt{I} = \frac{-100 \pm \sqrt{10^4 + 4 \cdot 10^5 \cdot 4.1}}{210^5} \quad \text{let } \sqrt{I} = X$$

$$= 35.14\,\mu A \qquad 0 = X^2 \cdot 10^5 + 100X - 4.1$$

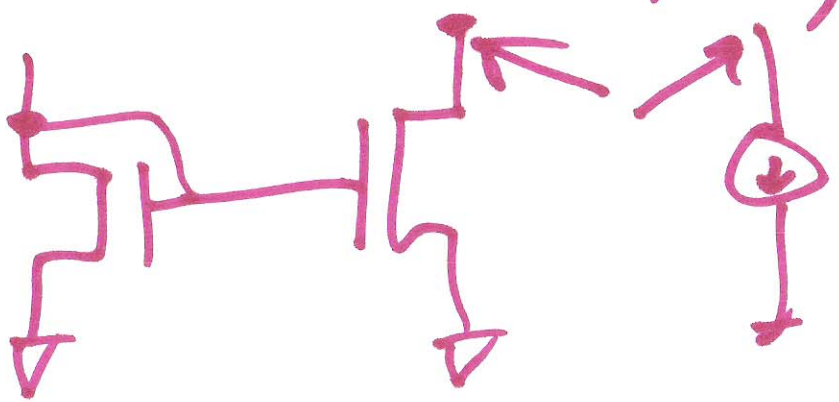
2)



$$I_D \simeq KP \cdot \frac{W}{L}\left((V_{SG}-V_{T_{HN}})V_{SD}\right)$$

$$\frac{5-V_{SD}}{300K} = 404 \cdot 5\left(1.49-.9\right)V_{SD}$$

$V_{OS,SAT}$, V_{OV}, $V_{DS}-V_{T_{HN}}$

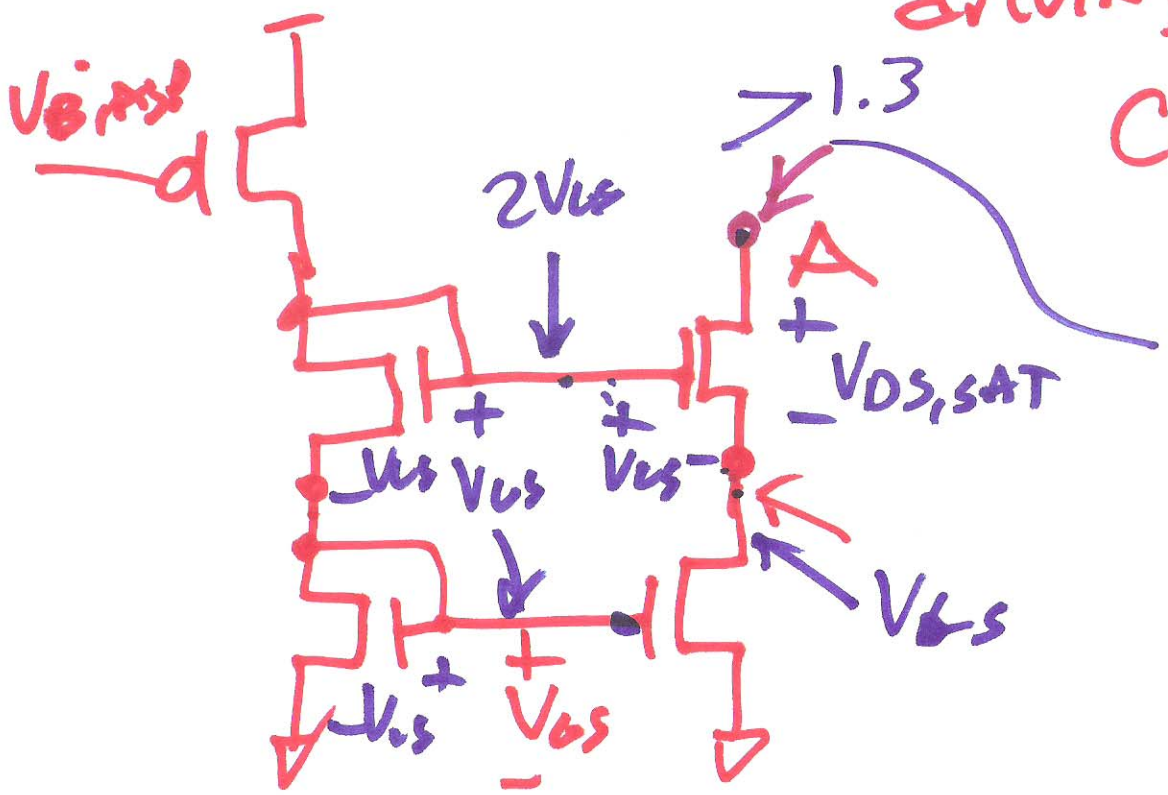


CASCODE → Miller^ killer^ → C.S.

CASCADE COMMON-CAthode

driving

COMMON-grid → C.G.



$V_{DS,SAT} + V_{GS}$

TABLE 9.1

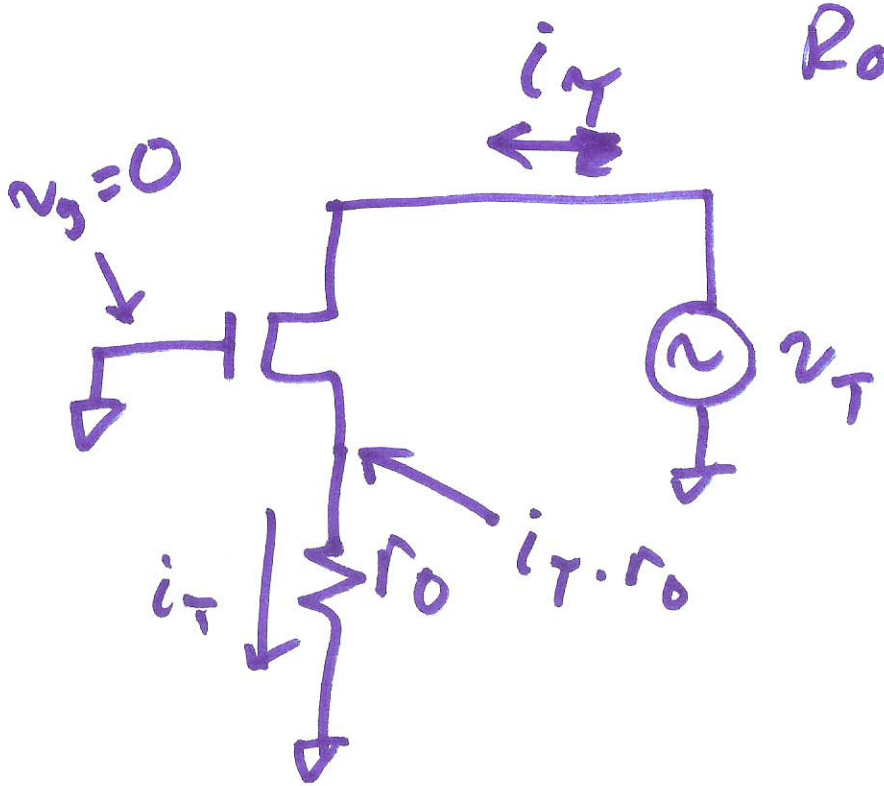
$V_{GS} = 1.05$

$V_{THN} = .8$

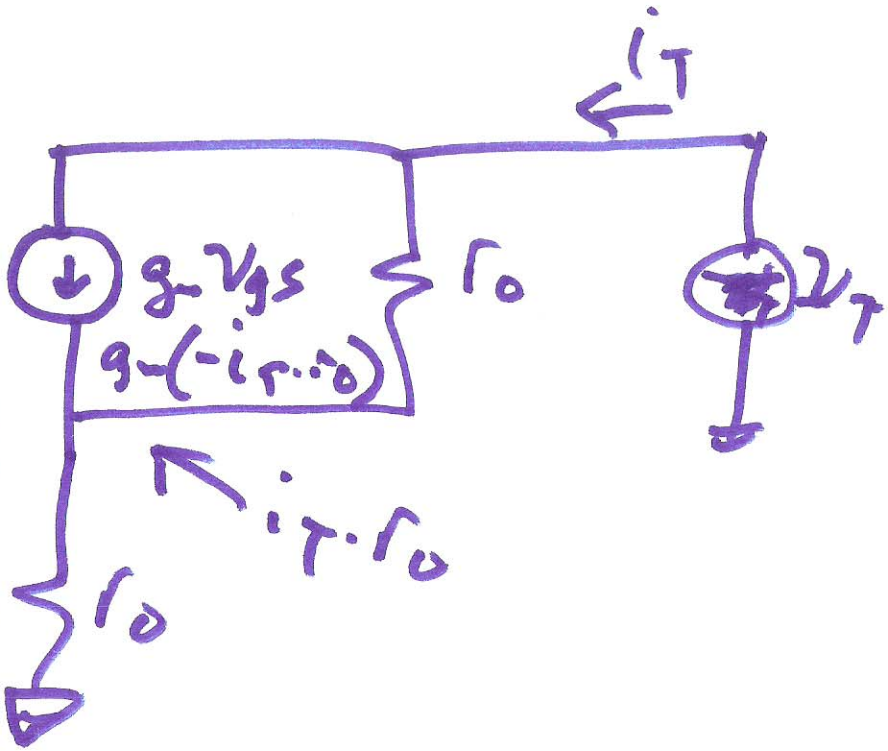
$V_{DS,SAT} = .25$

CASCODE CURRENT MIRROR

$$R_{OCMS} = \frac{v_T}{i_T}$$



$$v_{gs} = -i_T r_o$$



$$i_T = g_m(-i_T \cdot r_o) + \frac{v_T - (i_T \cdot r_o)}{r_o}$$

$$i_T \cdot r_o = -g_m i_T r_o^2 + v_T - i_T r_o$$

$$i_T(r_o + g_m r_o^2 + r_o) = v_T$$

$$R_{OCTS} = \frac{v_T}{i_T} = r_o(1 + g_m r_o) + r_o$$

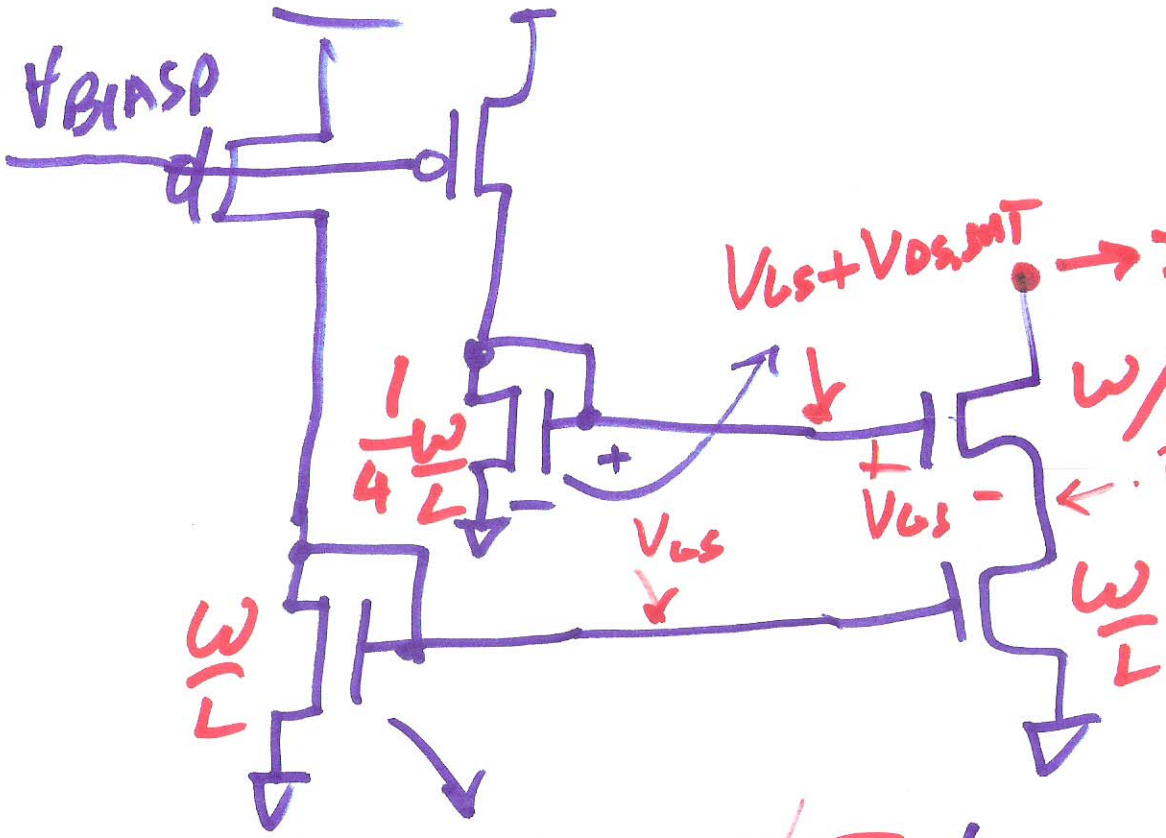
$$\simeq g_m r_o^2$$

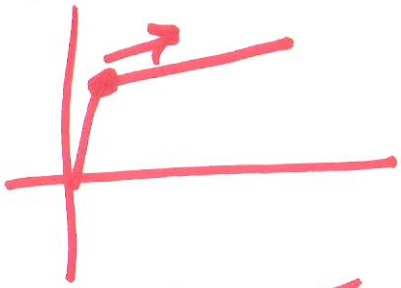
TABLE 9.1

$g_m = 150\mu$

$r_o = 5\,MEG$

$R_{OCTS} \simeq 3.75\,G\Omega$





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

$$2\left(V_{GS}-V_{THN}\right) \leftarrow \left(V_{GS}+V_{DS,SAT}-V_{THN}\right)^2$$

$$V_{GS}-V_{THN}$$

$$\sqrt{W}(V_{DS}-V_{THN}) = \sqrt{W_N}\cdot 2(V_{DS}-V_{THN})$$

$$\sqrt{W} = \sqrt{K\cdot W}\cdot 2$$

$$K = \frac{1}{4}$$