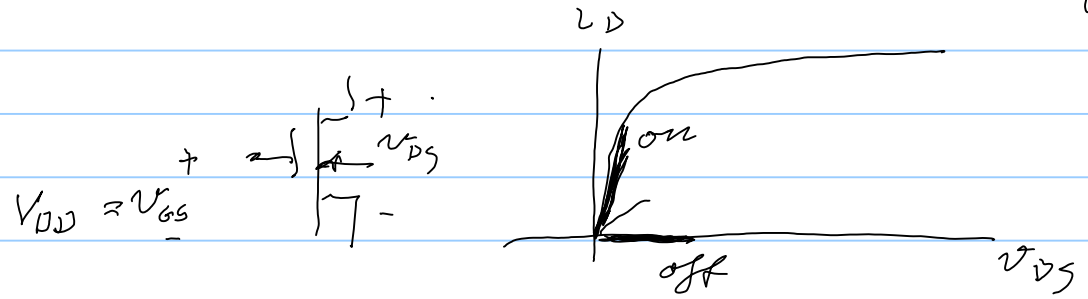
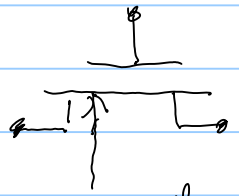
EE303H

10/15/15

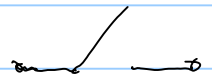
Note Title 10/15/2015

Pass transistors = transmission gates



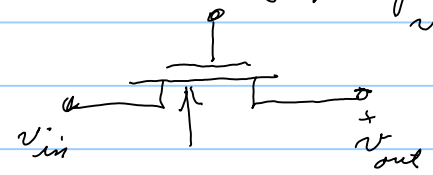


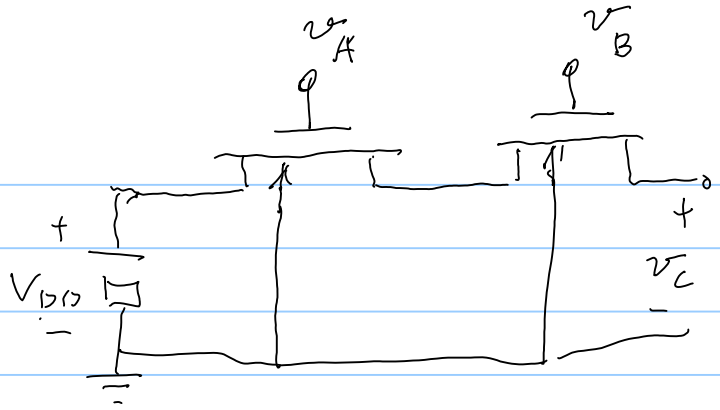
lowest potential available (actually want to connect to the source

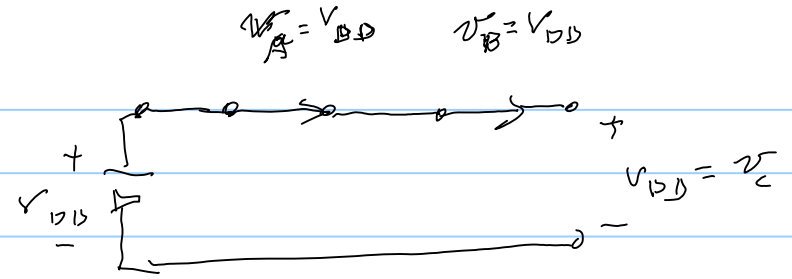


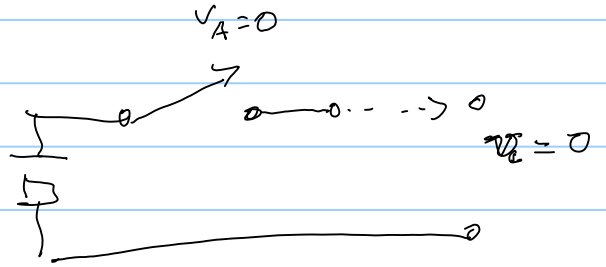
$v_G \Rightarrow$ large for on = closed

$v_G =$ gnd $\Rightarrow$ open

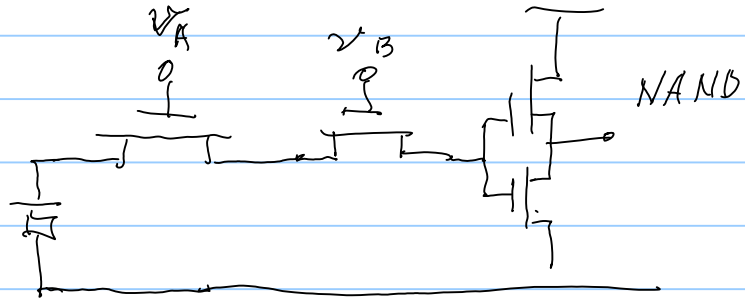




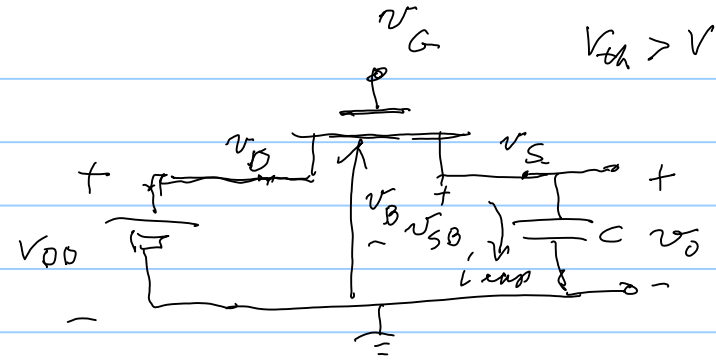




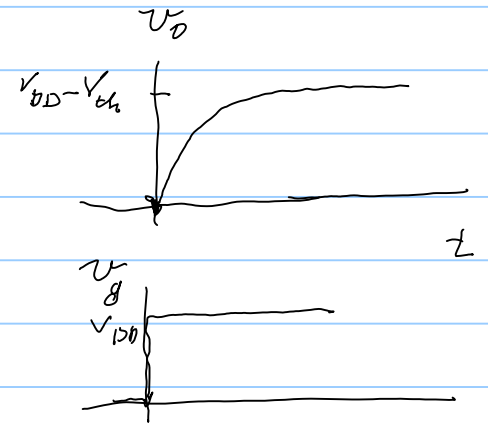
same if $v_B = 0$



$$V_{th} = V_{TO} + \gamma\left(\sqrt{v_{SB}+\phi} - \sqrt{\phi}\right)$$



$V_{th} > V_{TO}$



ohmic if $v_{GS} - V_{th} \geq v_{DS}$

saturated if $v_{GS} - V_{th} \leq v_{DS}$

if $v_G = V_{DD}$ @ $t=0$ $\quad v_{DS} = V_{DD} - v_o = V_{DD}$

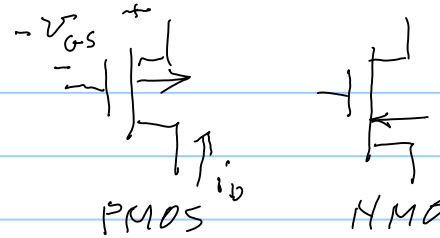
$V_{DD} - V_{th} \leq V_{DD}$ @ $t=0$ $\Rightarrow$ saturation @ $t=0$

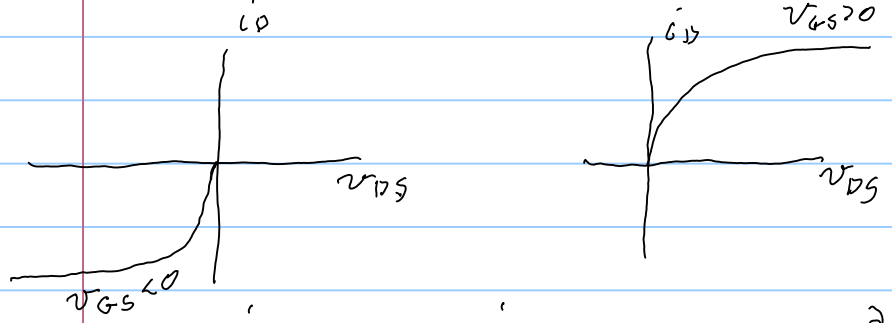
i_D: $\quad C\frac{dv_o}{dt} = i_{cap} = i_D = \frac{KP}{2}\frac{W}{L}\left(V_{DD} - v_o - V_{TO}\right)^2 \underbrace{\left(1+\lambda V_{DD}\right)}_{t=0\ V_{DD}-v_o}$

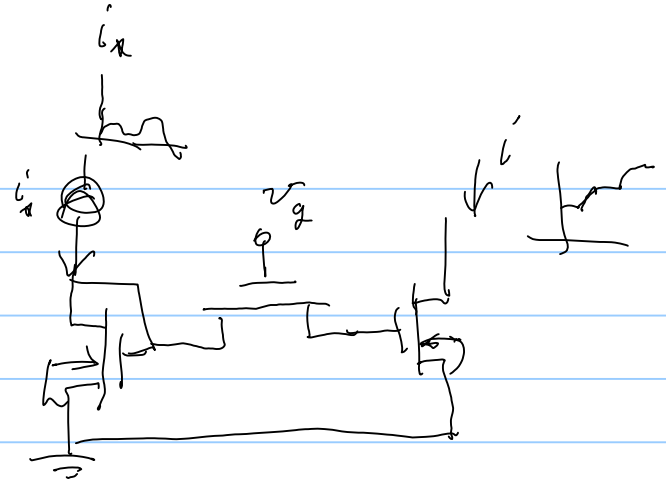
$$C\frac{dv_o}{dt} - \frac{KP}{2}\frac{W}{L}\left(V_{DD} - v_o - V_{TO}\right)^2 \approx 0 \qquad t \geq 0$$

eventually becomes ohmic $\quad$ ↑ a Riccati eq.

CMOS





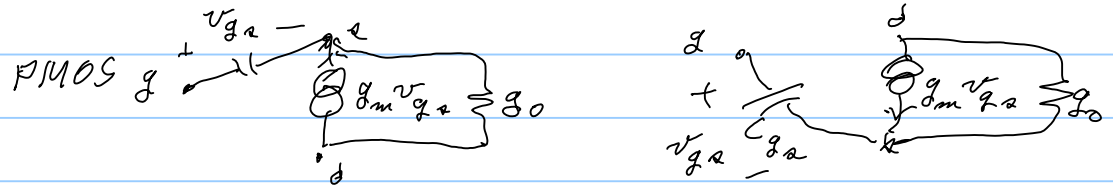


$$i_{D\,pmos} = -i_{D\,nmos}$$

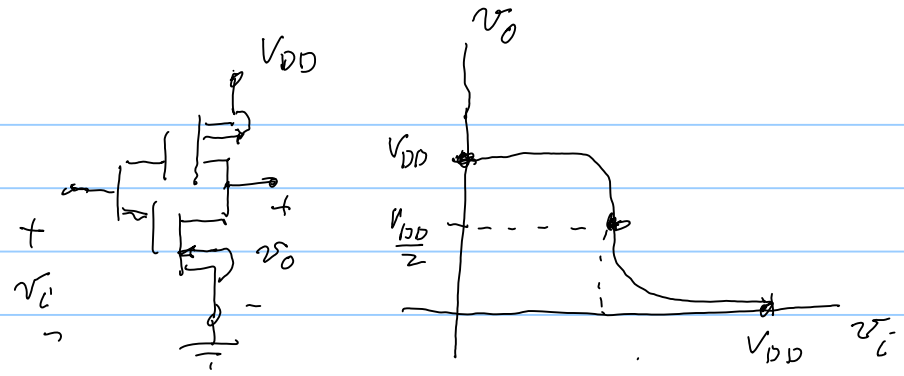
$$v_{xg\,pmos} = -v_{xg\,nmos}$$

$$\Rightarrow \left.\frac{\partial i_D}{\partial v_{DS}}\right|_{pmos} = \left.\frac{\partial -i_D}{\partial -v_{DS}}\right|_{pmos} = \left.\frac{\partial i_D}{\partial v_{DS}}\right|_{\text{complementary } nmos}$$

$\Rightarrow$ equivalent circuits (small signal) are the same.



Inverter = CMOS



$-i_{D_P} = i_{D_N}$ near $v_i = V_{DD}/2$ N & P MOS's are in saturation

$$\left(\frac{K_P}{2}\frac{W}{L}\right)_P \left(V_{DD} - v_i - |V_{TO_P}|\right)^2 = \left(\frac{K_P W}{2 L}\right)_N \left(v_i - V_{TO_N}\right)^2$$

if $\left(\frac{K_P}{2}\frac{W}{L}\right)_P = \left(\frac{K_P}{2}\frac{W}{L}\right)_N$ then $V_{DD} - v_i - V_{TO_N} = v_i - V_{TO_N}$ if $V_{TO_N} = -V_{TO_P}$

$2v_i = V_{DD} \Rightarrow v_i = V_{DD}/2$