

N-CHANNEL

$$I_D = K_n (V_{GS} - V_{TN})^2$$

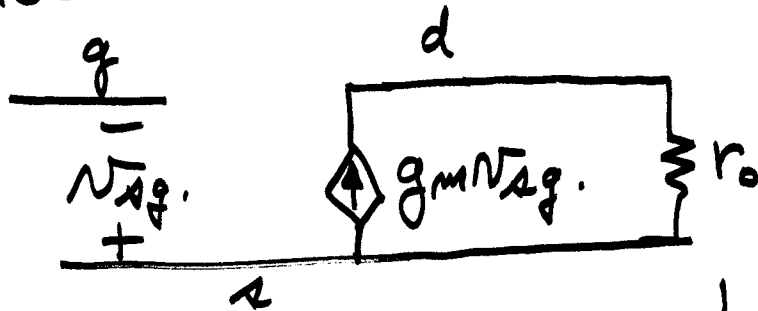
P-CH.

$$I_D = K_p (V_{SG} + V_{TP})^2$$

$$V_{TP} < 0 \quad V_{TP} = -|V_{TP}|$$

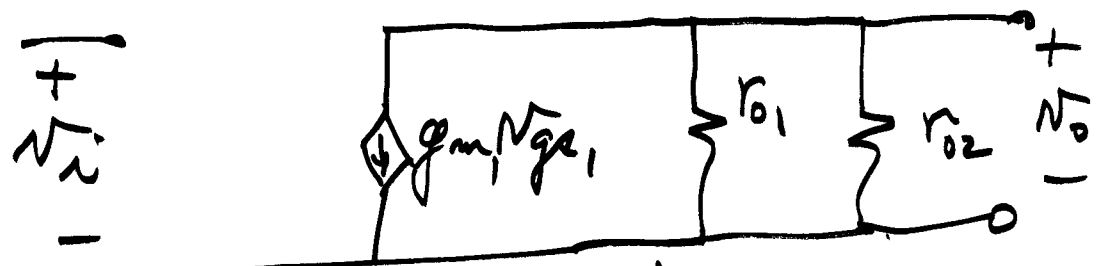
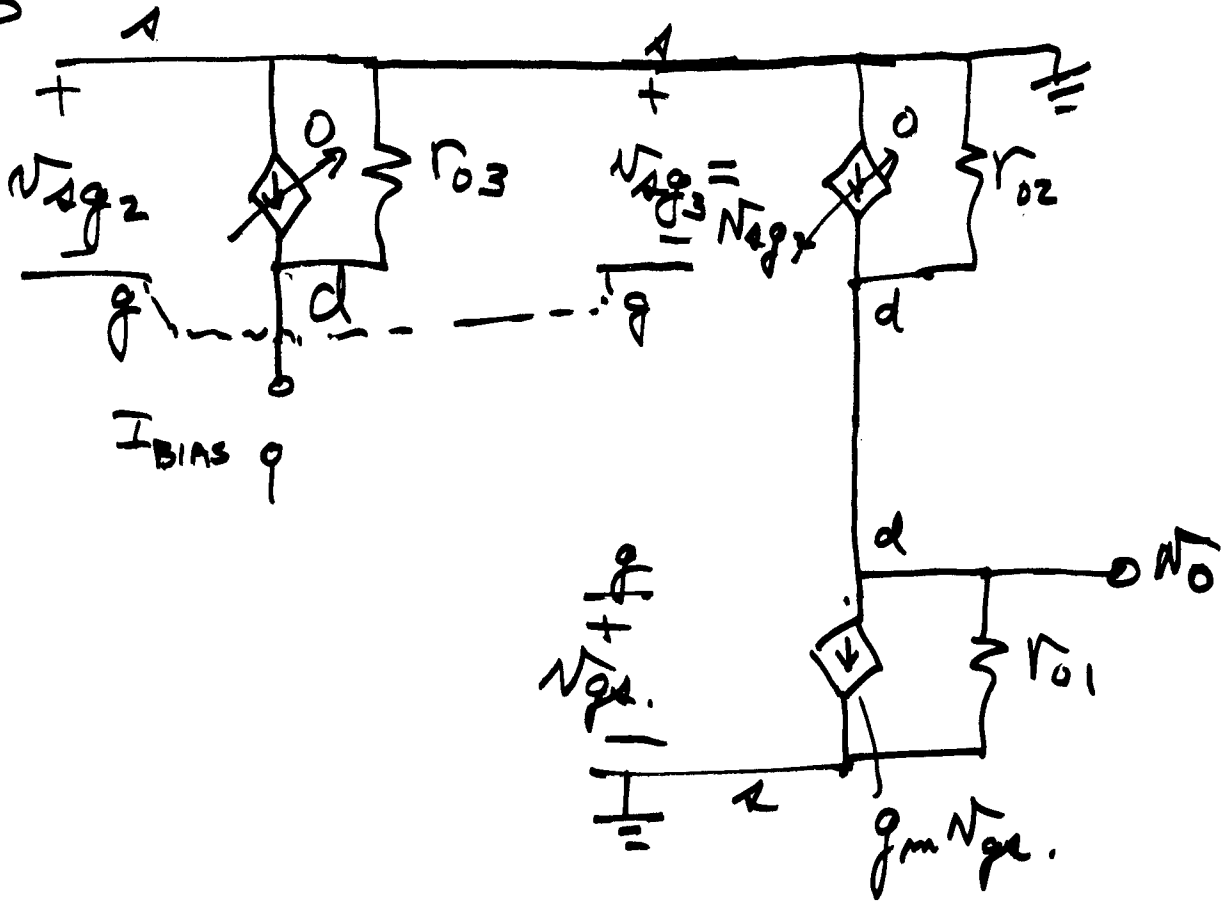
$$I_D = K_p (V_{SG} - |V_{TP}|)^2$$

PMOS



$$r_o = \frac{1}{\lambda I_D}$$

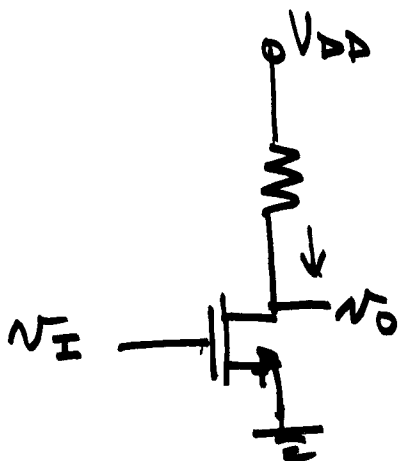
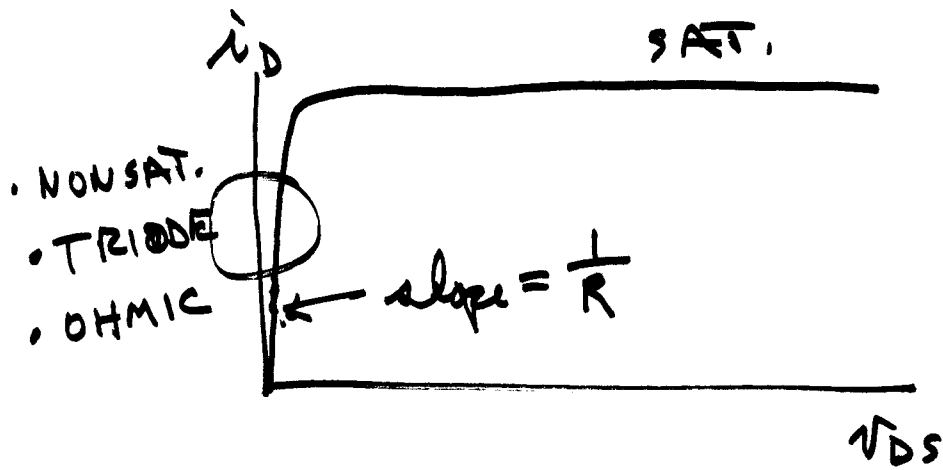
M3



$$v_o = g_m v_i (r_{o1} \parallel r_{o2})$$

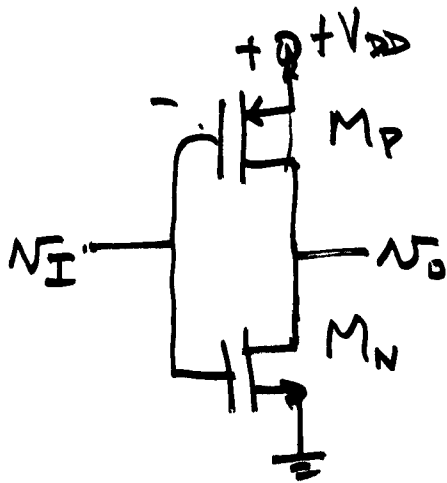
$$\boxed{\text{gain} = \frac{v_o}{v_i} = g_{m1} (r_{o1} \parallel r_{o2})}$$

# MOSFETS AS SWITCHES



"1" "0"  
 $v_I = \text{HIGH } V. \Rightarrow v_O = \text{LOW}$

$v_I = 0 \text{ V.} \Rightarrow v_O = V_{DD}$   
 <  $V_{TN}$  "1"



$v_I = 0 \Rightarrow M_P \text{ "ON", } M_N = \text{OFF}$   
 $v = \text{"1"}$

$v_I = V_{DD} \Rightarrow M_P = \text{OFF } M_N = \text{ON}$   
 $v = 0$

CMOS