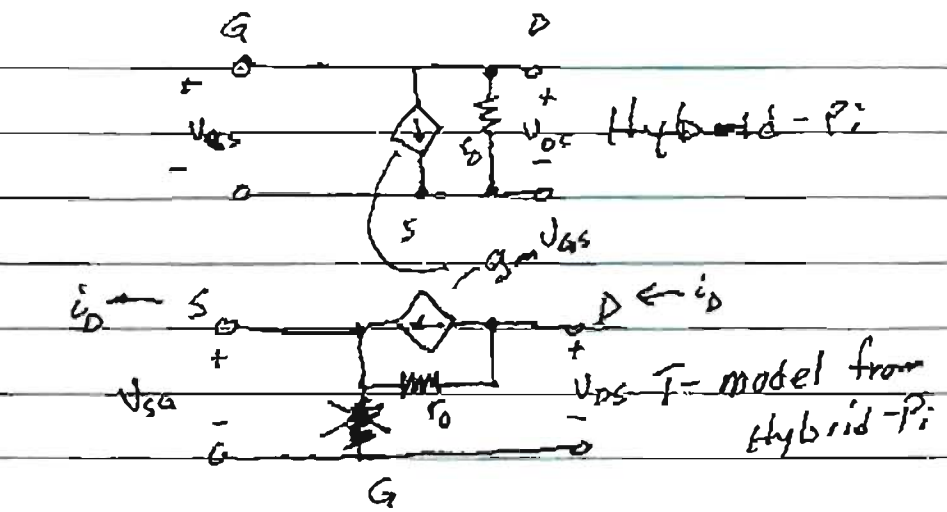
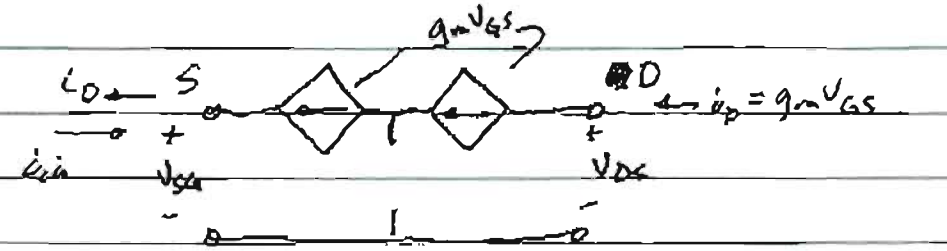
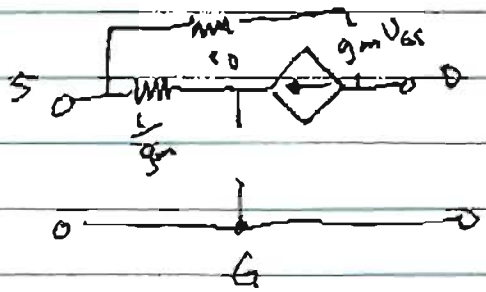


temp remove r_o

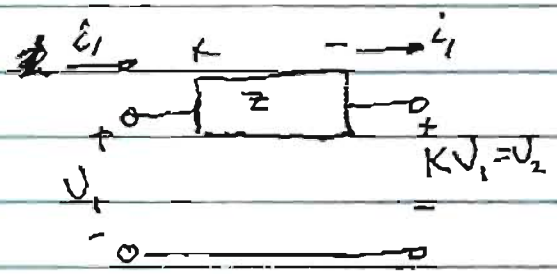


$$R_{in} = \frac{-v_{GS}}{-i_D} \qquad (i_{in} = -i_D$$

$$= \frac{-v_{GS}}{-g_m v_{GS}} = \frac{1}{g_m}$$ wow!



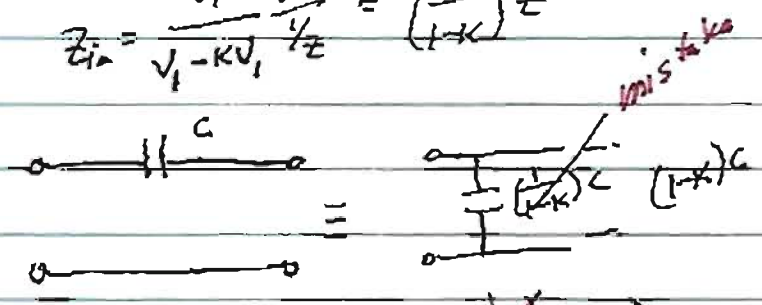
T-model



$$Z_{in} = \frac{V_1}{i_1}$$

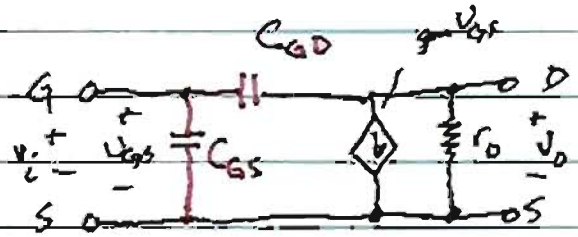
$$i_1 = (V_1 - V_2)\left(\frac{1}{Z}\right)$$

$$Z_{in} = \frac{V_1}{V_1 - KV_1} \frac{1}{1/Z} = \left(\frac{1}{1-K}\right) Z$$

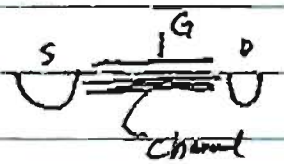


C is multiplied by $(1-K)$

"Miller Effect"

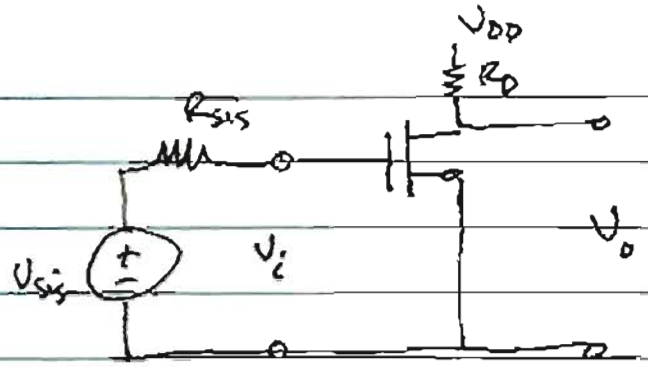


cross-section

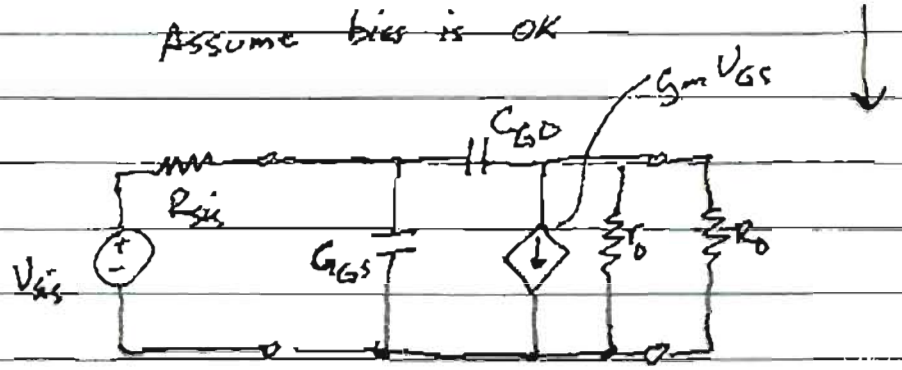


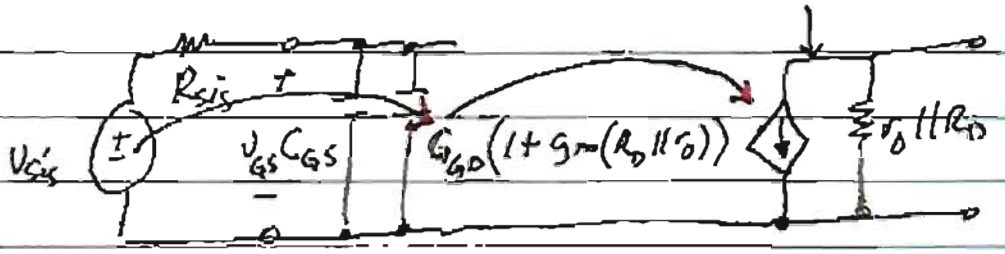
$$V_o = -g_m(r_o \| R_D) \gg 1 \equiv K$$

effective $C_{in} = C_{GS} + (1 + g_m(r_o \| R_D) C_{GD}$



Assume bias is OK

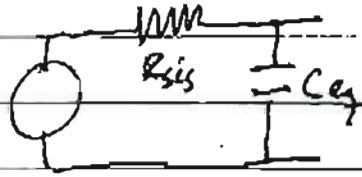




~~typical numbers~~:

$C_{GS} = 2pf$, $C_{GD} = 3pf$

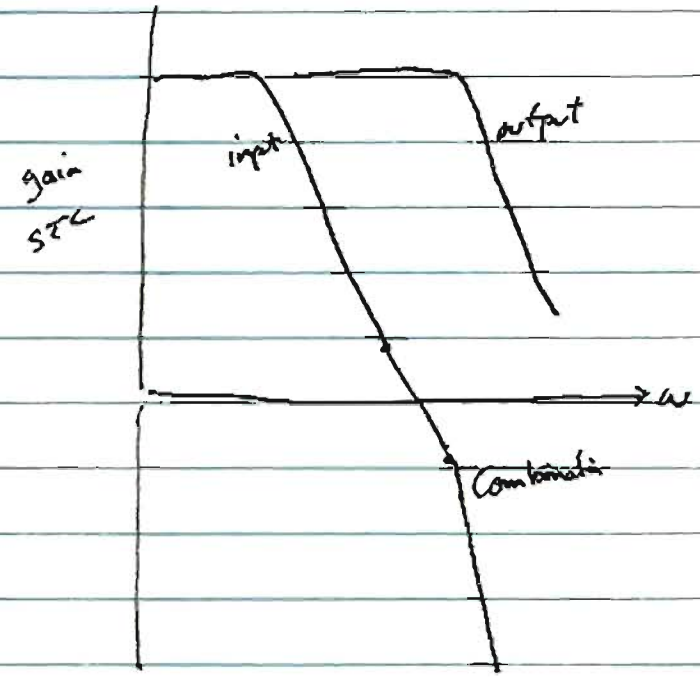
~~$(\pi g_m)(R_{eq}) = 70$~~



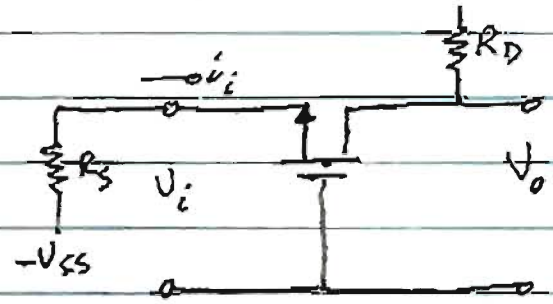
went from 2pf to 20+2pf

$$\omega_0 = \frac{1}{RC_{eq}}$$

(Gain)(Bandwidth) = constant



CS, CG, CD going back



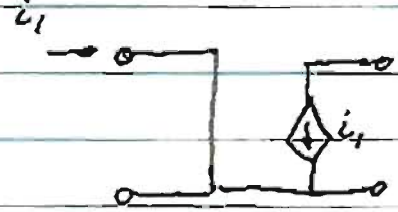
any V or i is combinatn of ac + dc

arrows show net direction

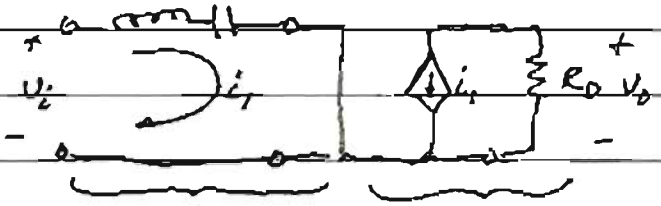
Small input R

Unity current gain

Large output R



impedance transformer



$V_o = -i_1 R_D$

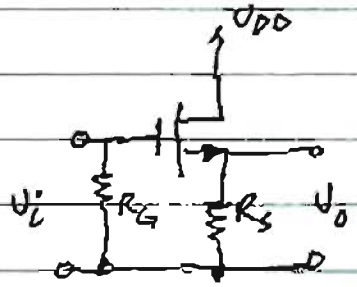
$i_1 = v_i / Z_{in}$

~~transadmittance~~ ~~transimpedance~~

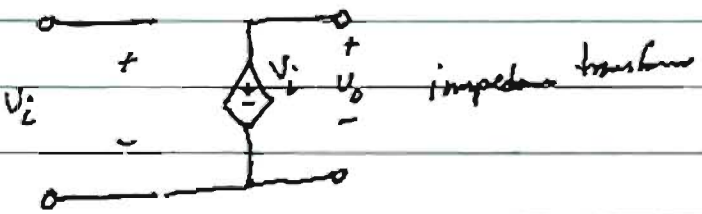
$v_i = V_{in} \rightarrow i_{out}$ $i_{out} \rightarrow V_o$

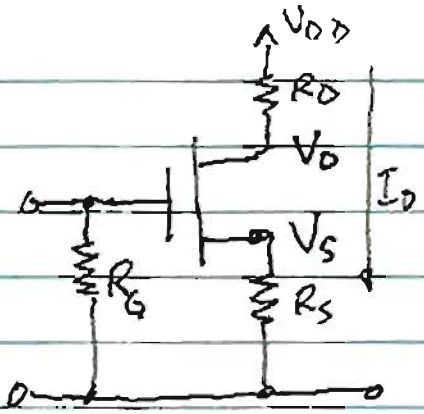
overall gain $A_v = Y_T \cdot Z_T$ = whatever (no dimension)
(pure gain)

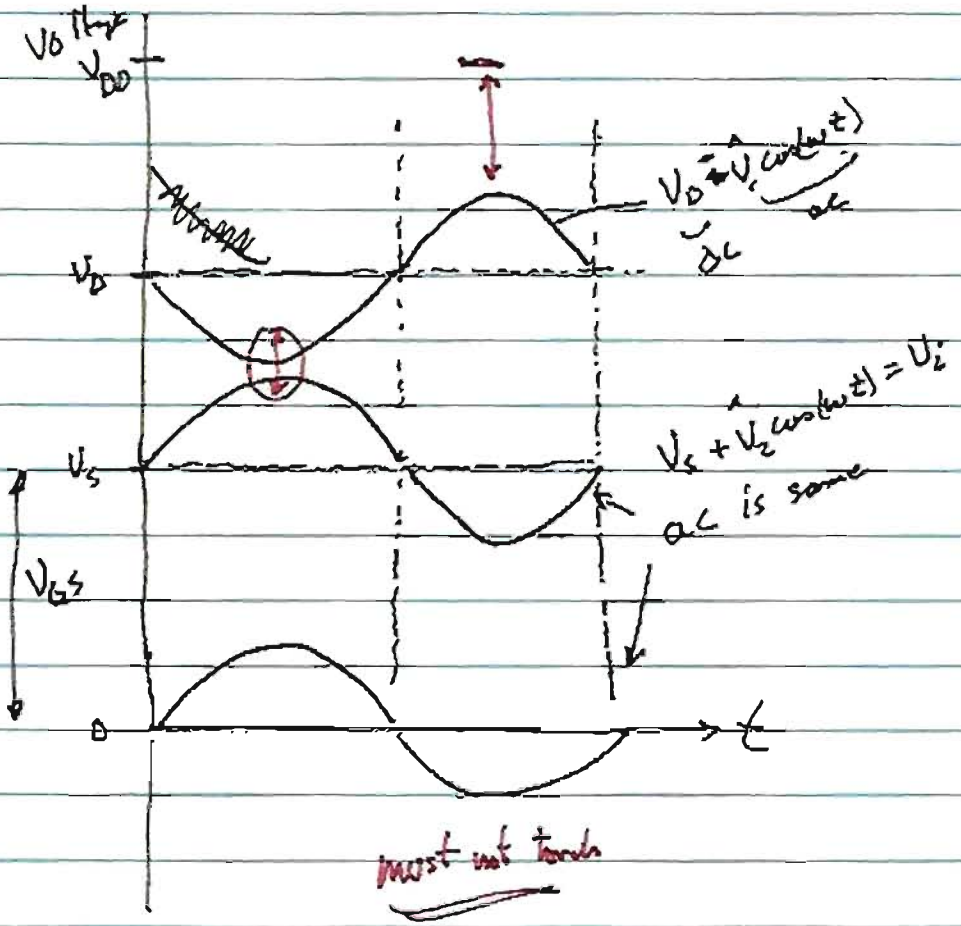
CD ≡ Source Follower

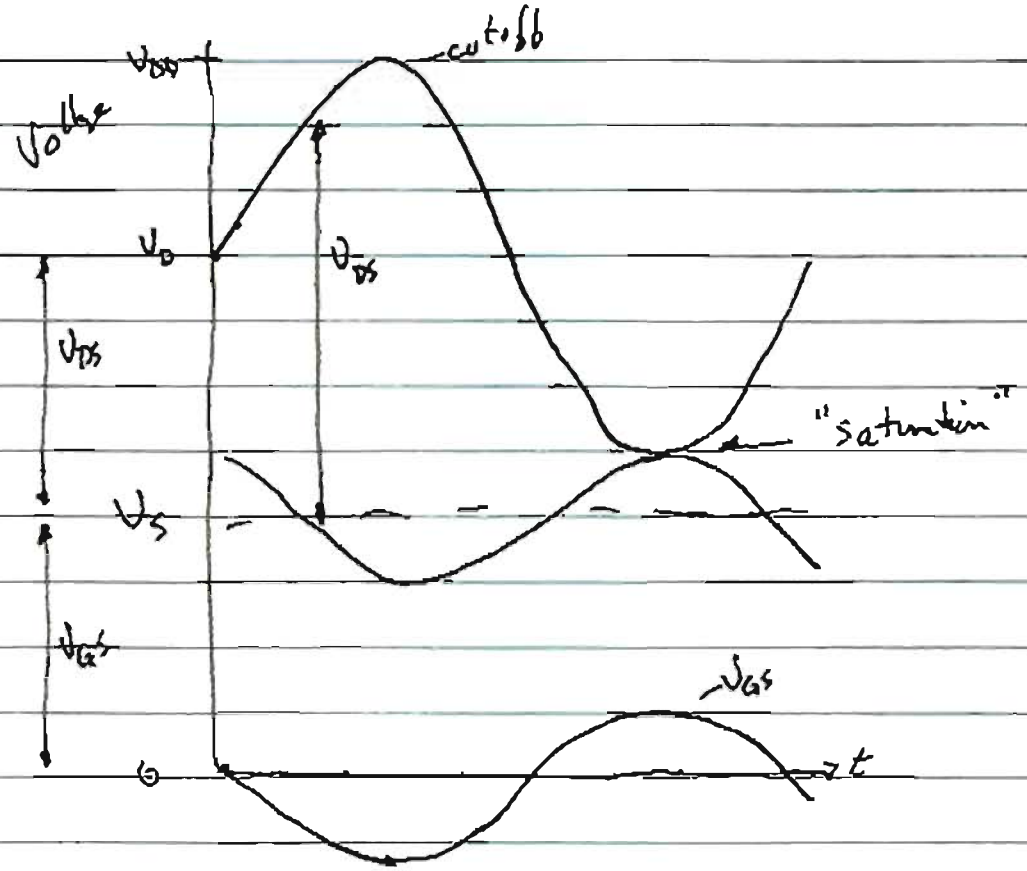


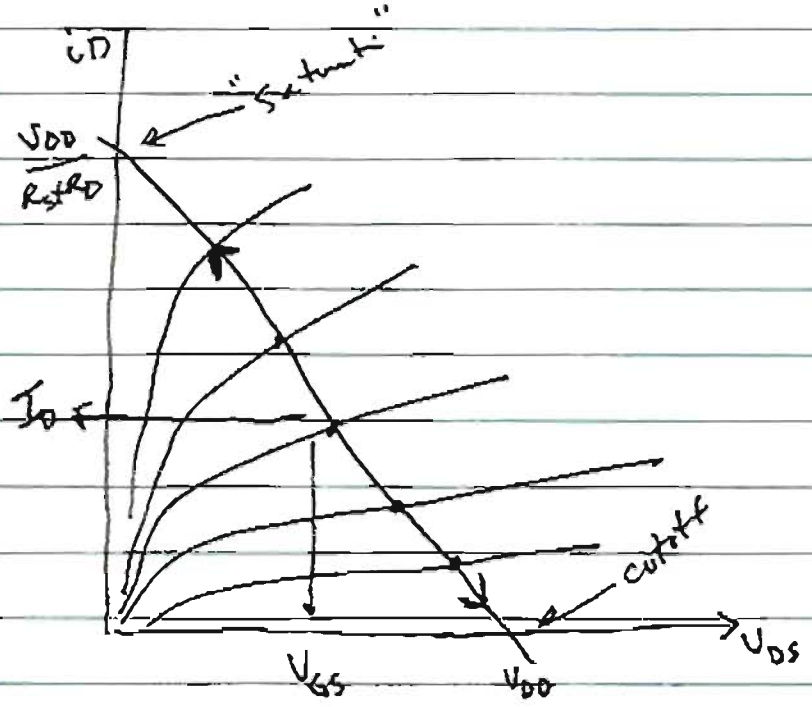
Large input R ($R_G \| \infty$)
unity voltage gain
small output R




V_{DD}
R_D
V_D
I_D
V_S
R_G
R_S


V_D
V_{DD}
$V_D + V_i \cos(\omega t)$
ac
dc
V_D
$V_S + V_i \cos(\omega t) = V_i$
V_S
ac is same
V_{GS}
t
most int terms


cutoff
V_{DD}
V_{out}
V_D
V_{DS}
"saturation"
V_S
V_{GS}
V_{GS}
0
t


i_D
"saturation"
$\frac{V_{DD}}{R_S+R_D}$
I_D
cutoff
V_{DS}
V_{GS}
V_{DD}