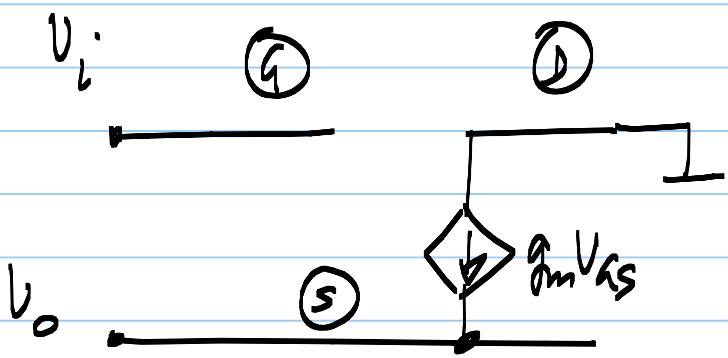
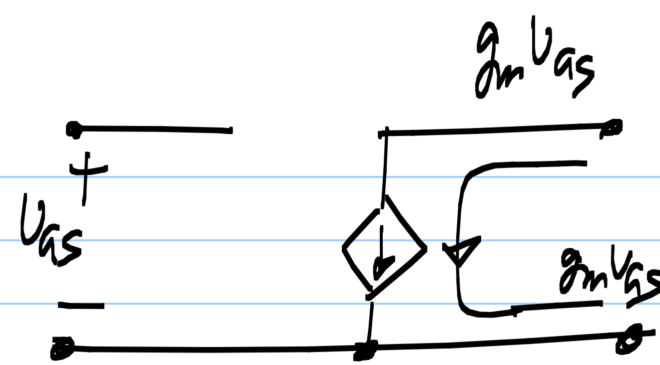
VCVS: $v_o = v_i$.



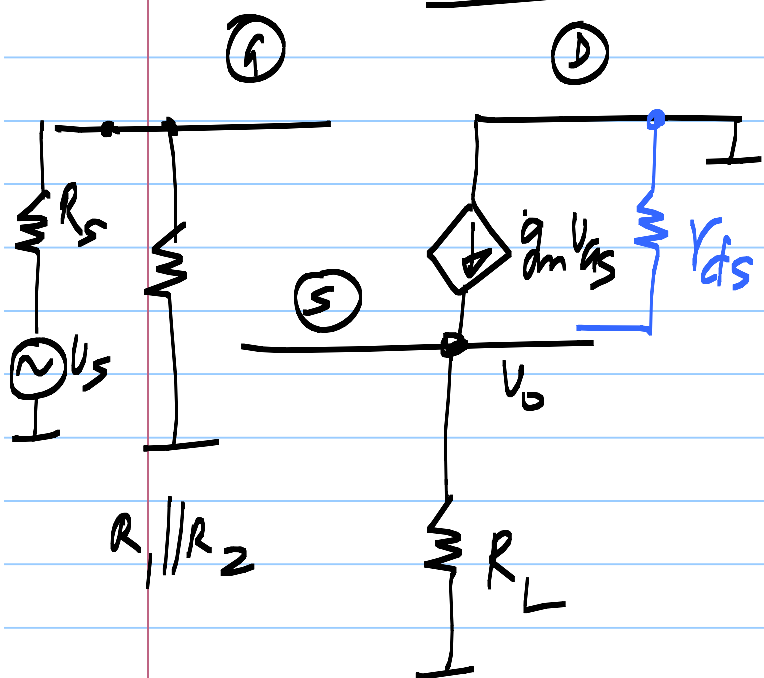


If $v_i > v_o$: current flows into the source node – increases v_o

$v_i < v_o$: " out of the source node – reduces v_o

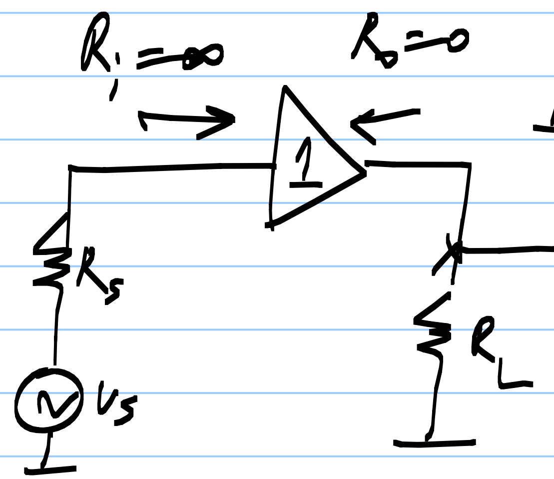
VCVS: $v_o = v_i$

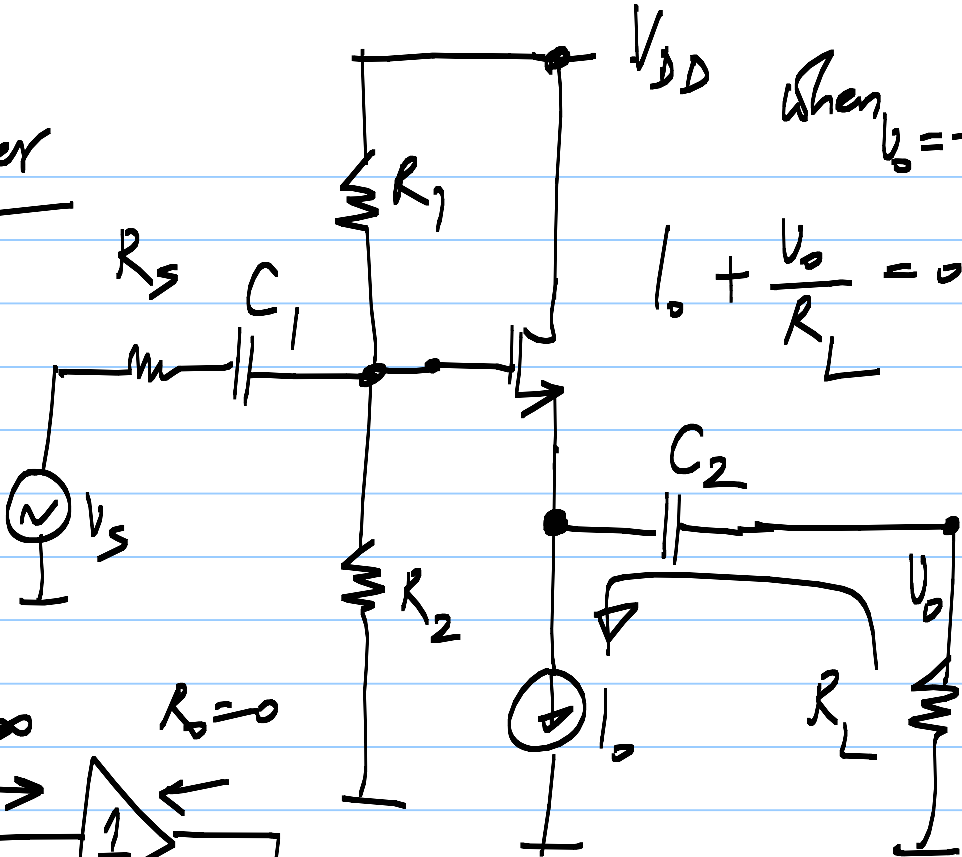
Common drain amplifier



i/p G & D

o/p S & D





When $v_o = -I_o R_L$

$$I_o + \frac{v_o}{R_L} = 0$$

Source follower

$$\frac{v_o}{v_s} = \frac{R_1 \| R_2}{R_1 \| R_2 + R_s} \cdot \underbrace{\frac{g_m R_L}{1 + g_m R_L}}$$

$$\underline{\underline{g_m R_L}} \gg 1$$

$$v_{D,tot} > v_{G,tot} - V_T$$

$$V_{DD} > V_{DD} \cdot \frac{R_2}{R_1 + R_2} + v_s - V_T$$

$$\{R_1 \| R_2 \gg R_S\}$$

$$-I_o R_L \cdot \left(\frac{g_m R_L + 1}{g_m R_L} \right) < v_s < V_{DD} \cdot \frac{R_1}{R_1 + R_2} + V_T$$

Cut off:

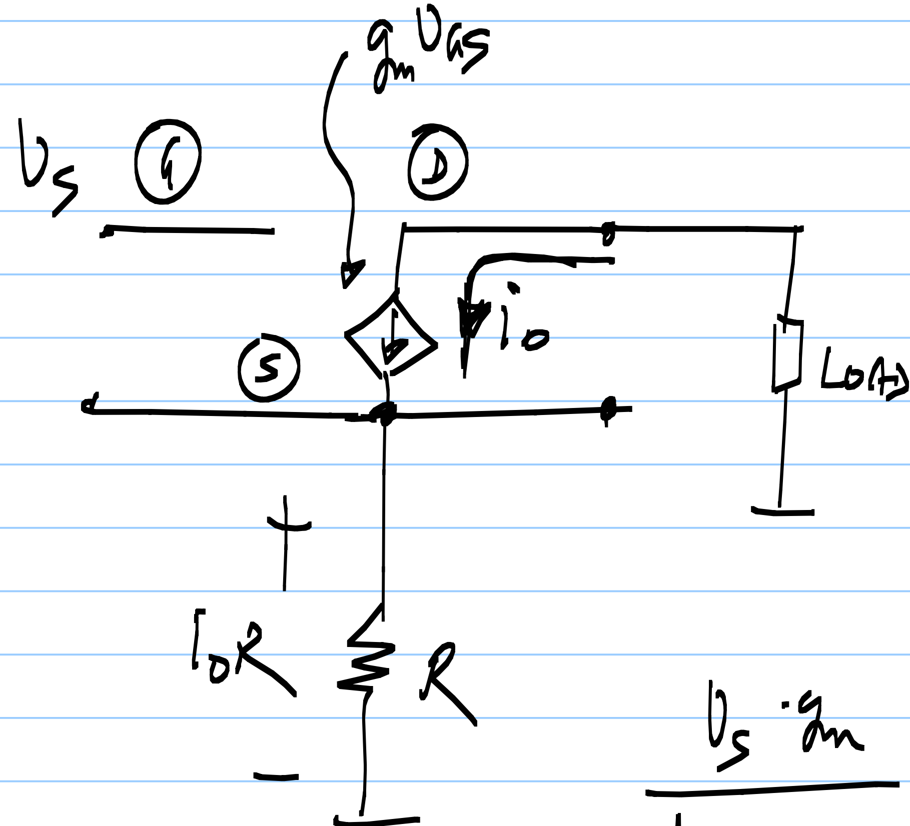
$$v_o > -I_o R_L$$

$$v_s > -I_o R_L \cdot \left(\frac{g_m R_L + 1}{g_m R_L} \right)$$

VCCS:

$$i_o = \frac{v_s}{R} = v_s \cdot G$$

$v_s = i_o R$ ✓ ✓



If $v_s > i_o R$

increase $i_o \rightarrow$ increase v_{GS}

$v_s < i_o R$

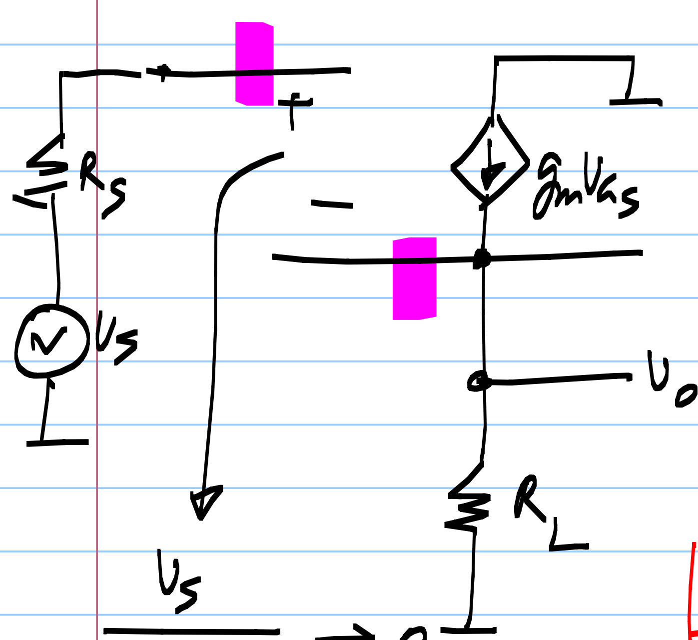
reduce i_o

$\Rightarrow$ reduce v_{GS}

$$\frac{v_s \cdot g_m}{1 + g_m R} = \frac{v_s}{R + 1/g_m}$$

Common-drain amplifier:

$$\frac{v_o}{v_s} = \frac{g_m R_L}{1+g_m R_L} \underset{g_m\to\infty}{\simeq} 1$$



$$\frac{v_s}{1+g_m R_L} \xrightarrow[g_m\to\infty]{} 0$$

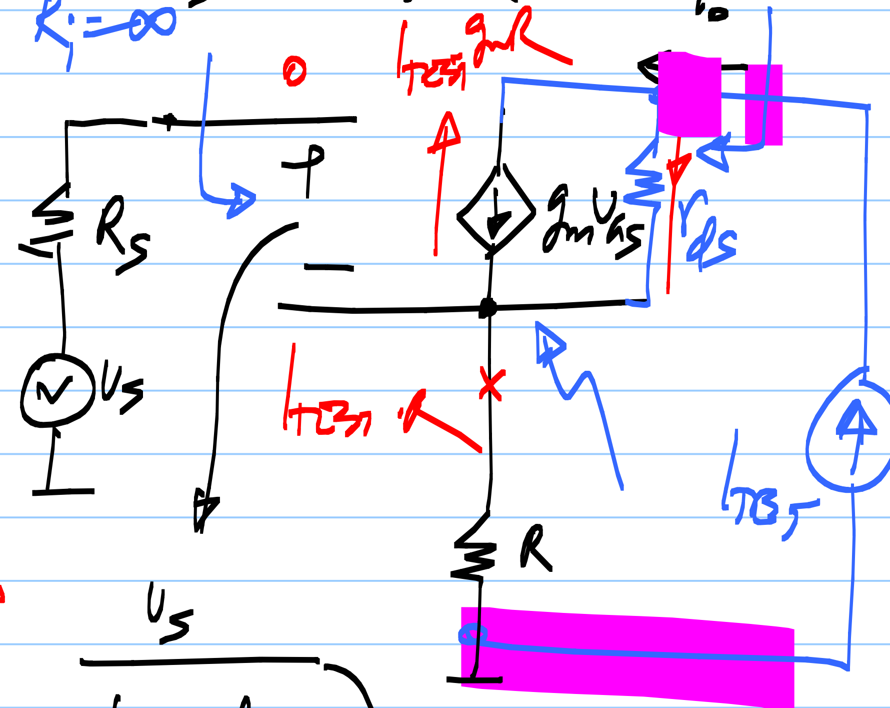
$I_{test}(g_m R+1)$

$[(1+g_m R) r_{ds} + R]$

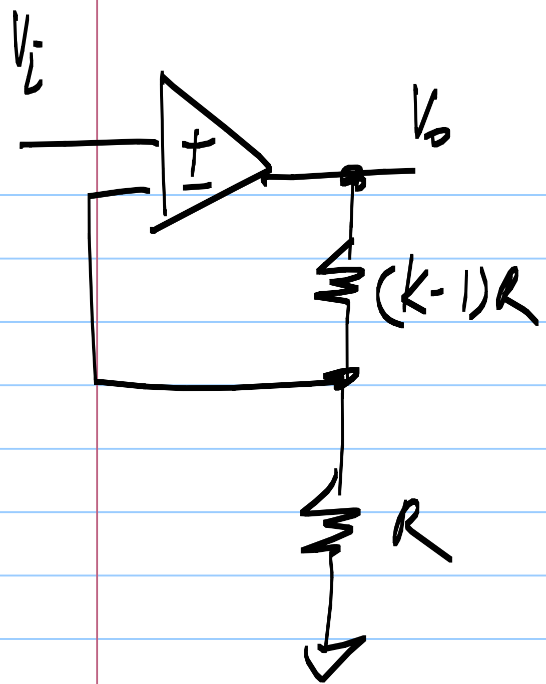
VCCS:

$$\frac{i_o}{v_s} = \frac{g_m}{1+g_m R} \underset{g_m\to\infty}{\simeq} 1/R$$

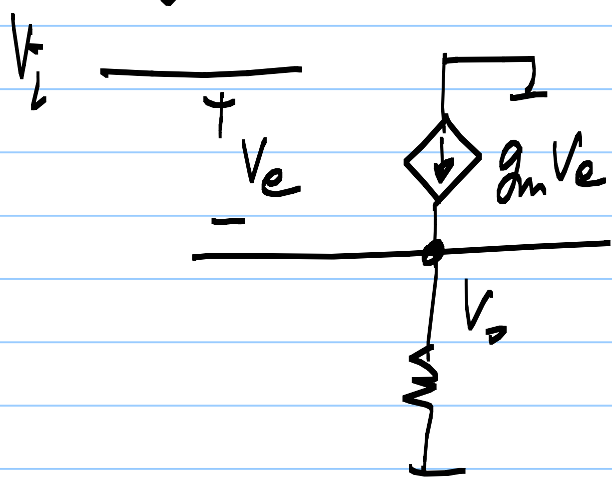
$R_i = \infty$



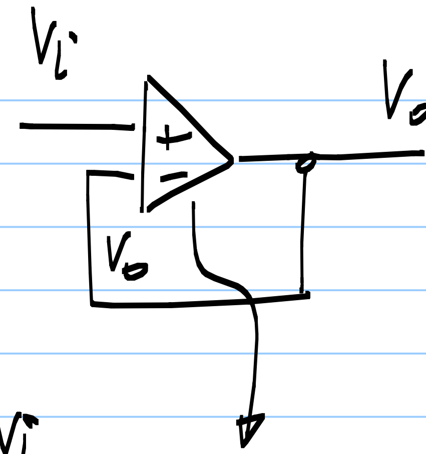
$$\frac{v_s}{1+g_m R} \xrightarrow[g_m\to\infty]{} 0$$



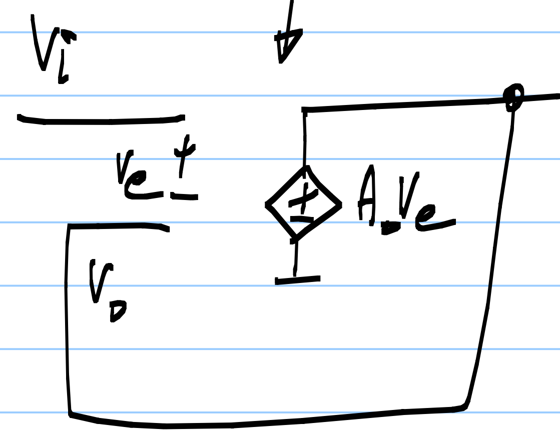
V_i
V_o
$(k-1)R$
R



V_i
V_e
$g_m V_e$
V_o



V_i
V_o
V_o



V_i
V_e
$A_o V_e$
V_o