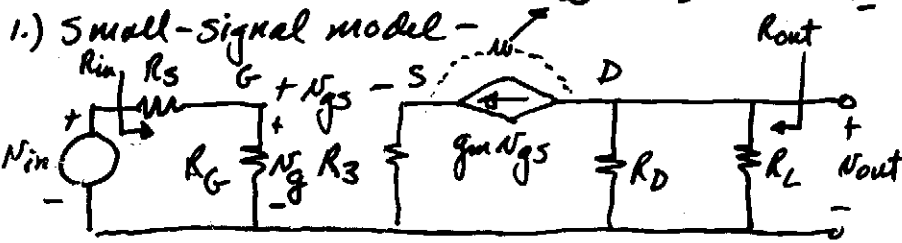
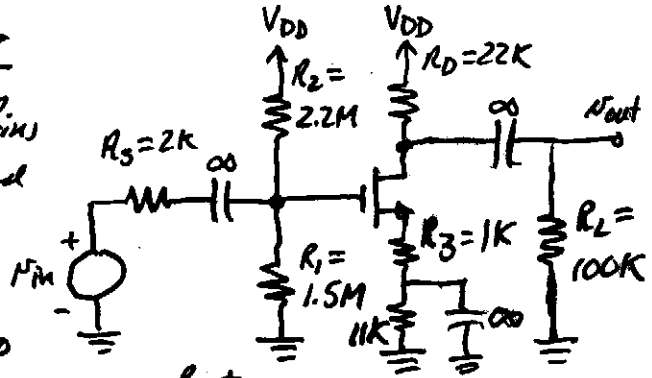


"Common Nothing" Amplifier

Find the input resistance, R_{in} , the output resistance, R_{out} , and the voltage gain, N_{out}/N_{in} if $g_m = 1\text{mA/V}$ and $r_{ds} = \infty$.



$$R_G = R_1 || R_2 = 892\text{k}$$

2.) $g_m = 1\text{mA/V} = 1\text{mS}$ and $r_{ds} = \infty$.

3.) $R_{in} = R_s + R_G = \underline{894\text{k}\Omega}$

$$R_{out} = R_D || R_L = \underline{18\text{k}\Omega}$$

$$\frac{N_{out}}{N_{in}} = \left(\frac{N_{out}}{N_{gs}}\right) \left(\frac{N_{gs}}{N_g}\right) \left(\frac{N_g}{N_{in}}\right)$$

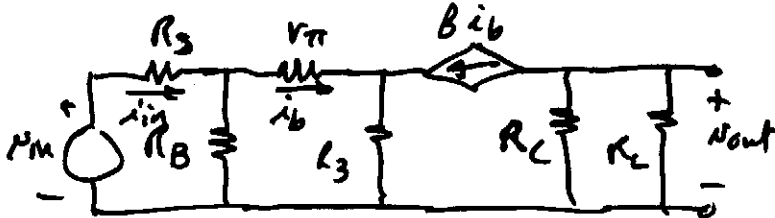
$$N_{gs} = N_g - V_s = N_g - g_m R_s N_{gs}$$

$$N_{gs} (1 + g_m R_s) = N_g$$

$$= (-g_m R_{out}) \left(\frac{1}{1 + g_m R_s}\right) \left(\frac{R_G}{R_s + R_G}\right) = (-1.18) \left(\frac{1}{1 + 1.1}\right) \left(\frac{892}{894}\right)$$

$$= \underline{-9\text{V/V}}$$

What if the transistor was a BJT?



$$R_{in} = R_s + R_B || [r_{\pi} + (\beta + 1)R_E]$$

$$R_{out} = R_C || R_L$$

$$\frac{N_{out}}{N_{in}} = \left(\frac{N_{out}}{i_b}\right) \left(\frac{i_b}{i_{in}}\right) \left(\frac{i_{in}}{N_{in}}\right) = (-\beta R_C || R_L) \left[\frac{R_B}{R_B + r_{\pi} + (\beta + 1)R_E}\right] \left(\frac{1}{R_{in}}\right)$$

Example 14.6 - Design of a Buffer

Design a single-transistor amplifier to satisfy the following specs.:

$R_{in} \geq 20\text{M}\Omega$ and a gain of greater than 0.85 V/V with an external load of $3\text{k}\Omega$.

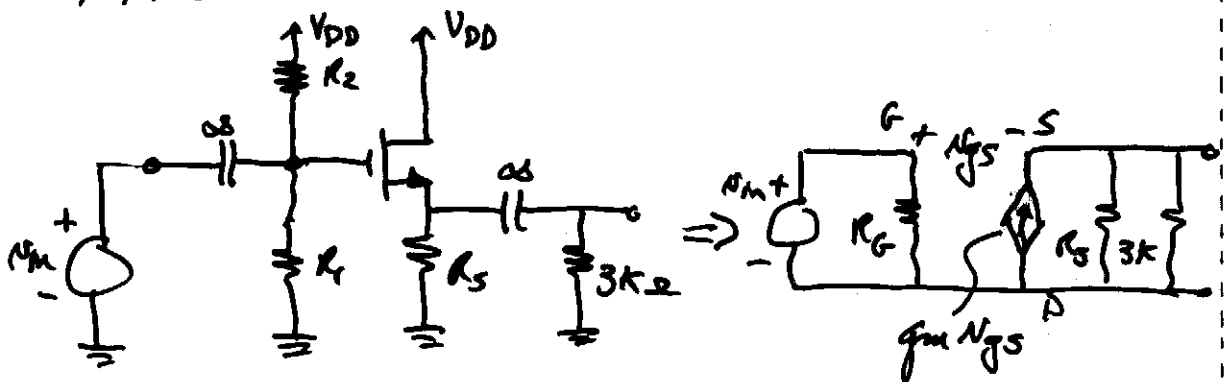
- 1.) Should be either a CC or CD (emitter follower or source follower)

$R_{in} = 20\text{M}\Omega \rightarrow$ No problem for MOSFET

$$R_{in} = r_{\pi} + (1+\beta)3\text{k} \approx \beta 3\text{k} = 20\text{M}\Omega \Rightarrow \beta = 6667!!!$$

\therefore USE MOSFET.

- 2.) MOS Follower -



$$\frac{V_{out}}{V_{in}} = \frac{g_m (R_S \parallel 3\text{k})}{1 + g_m (R_S \parallel 3\text{k})} = 0.85 \rightarrow g_m (R_S \parallel 3\text{k}) \geq 5.67$$

Choose $R_S = 3\text{k} \rightarrow g_m \geq 3.78\text{mS}$

Typically range of g_m for a MOSFET is

0.1mS to 20mS.

- 3.) Range of I_D ?