Miller Effect

Notice Miller Capacitance is defined as

$$C_M = C(1 + A_v)$$

Miller Effect

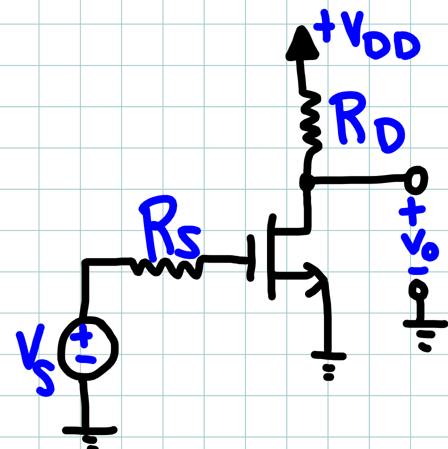
Miller Cap

Capacitor of amplifier

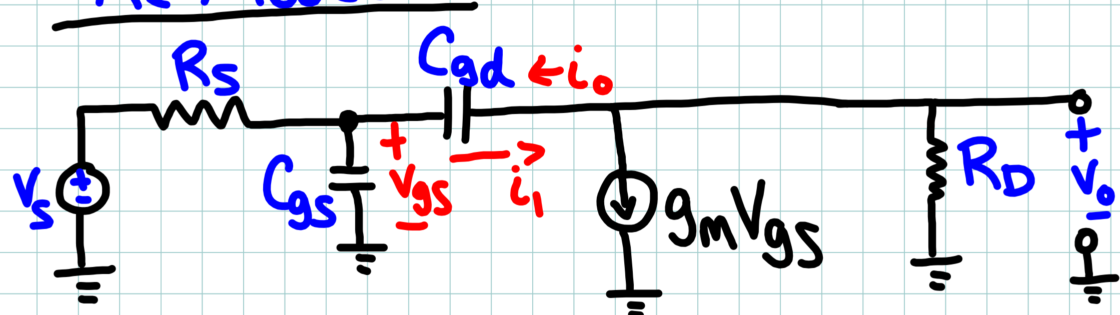
Amplifier Gain

Let's derive this through example

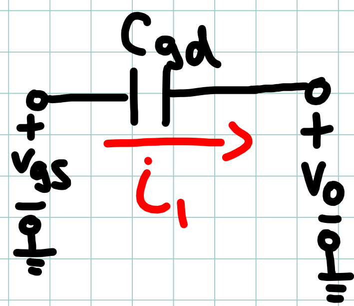
Example Common Source Amplifier



AC Model



Let's Look at current i_1 Flowing through C_{gd}.



$$i_1 = \frac{V_{gs}-V_o}{\left(\frac{1}{sC_{gd}}\right)}$$

$$i_1 = sC_{gd}(V_{gs}-V_o)$$

Let's Solve for V_{out} and plug it's result back in.

<u>For low frequencies C_{gd} is an open</u>

<u>Therefore</u>

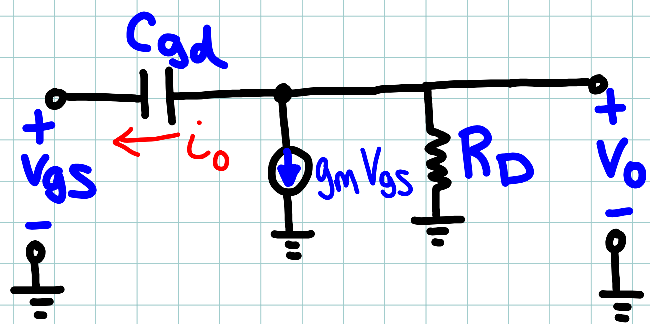
$$V_o = -g_m V_{gs} R_D$$

$$i_1 = sC_{gd}(V_{gs}-V_o) = sC_{gd}\left(V_{gs}+g_m R_D V_{gs}\right)$$

$$i_1 = V_{gs}[1+g_m R_D]sC_{gd}$$

$$C_M = C_{gd}[1+g_m R_D]$$

Let's look at current i_o



$$i_o = (V_o - V_{gs}) sC_{gd}$$

$$V_o = -g_m V_{gs} R_D$$

or $$V_{gs} = \frac{-V_o}{g_m R_D}$$

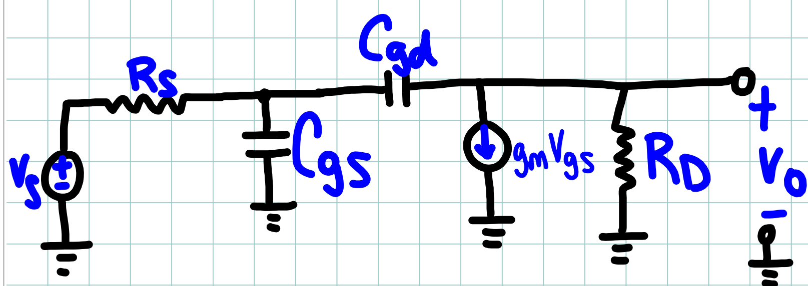
$$\therefore\ i_o = \left(V_o + \frac{V_o}{g_m R_D}\right) sC_{gd}$$

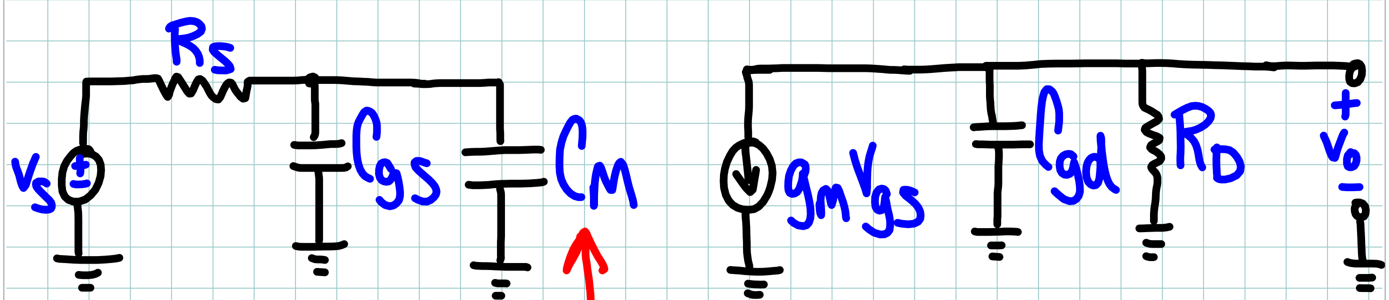
$A = g_m R_D$

A is very large

$$\therefore\ i_o \approx V_o\, sC_{gd}$$

Therefore The following two circuits are equivalent.





$$C_M = C_{gd}\left[1 + g_m R_L\right]$$