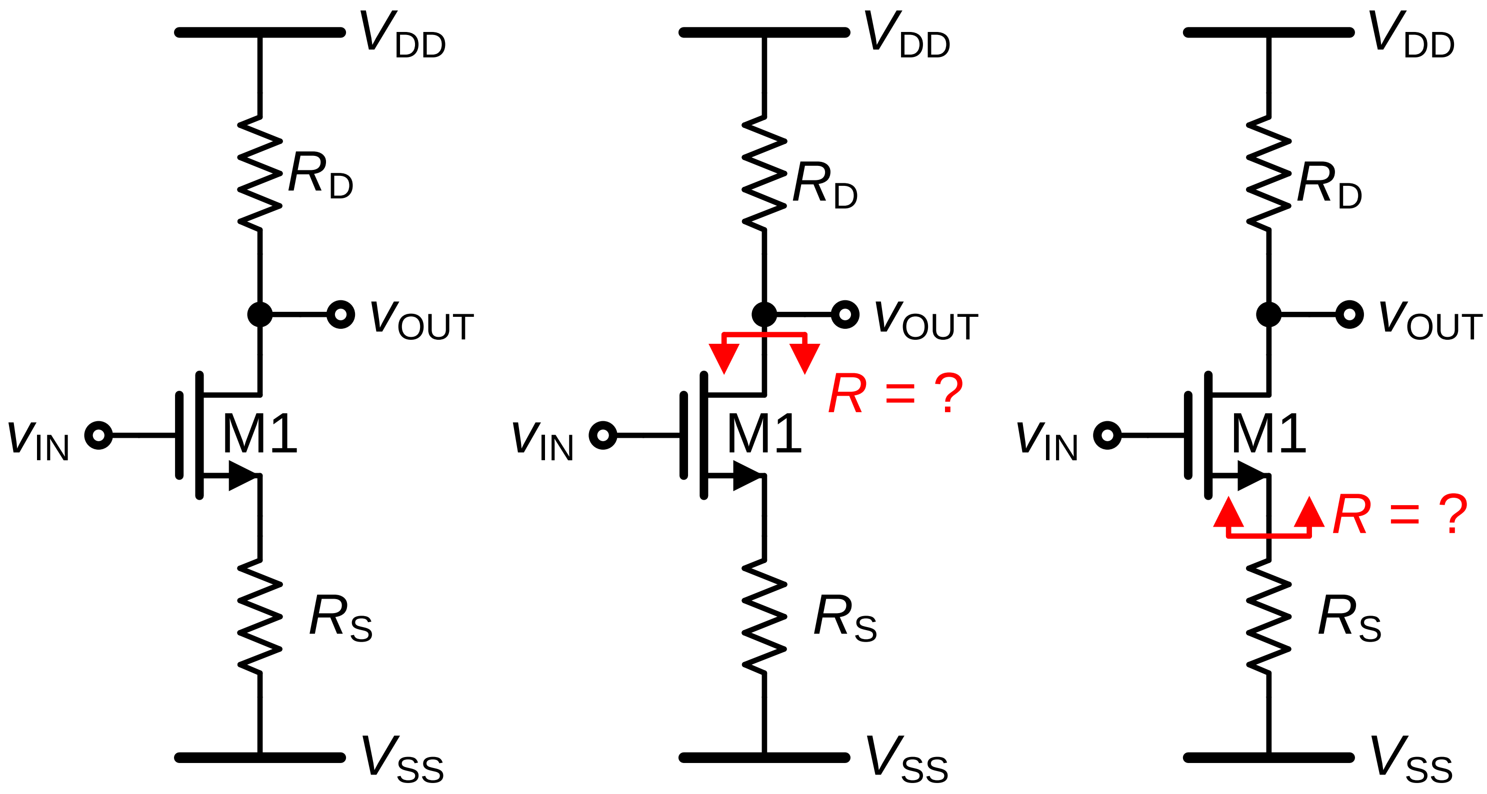
Equivalent Resistance



M1 is in the saturation zone.

Conclusion

Seen from Drain:

$$R = r_o + R_S + g_m r_o R_S$$

If $g_m R_S >> 1$,

$$R \approx g_m r_o R_S$$

If $g_m R_S << 1$,

$$R \approx r_o$$

Seen from Source:

$$R = [(1/g_m)||r_o](1+R_D/r_o)$$

If $R_D >> r_o$,

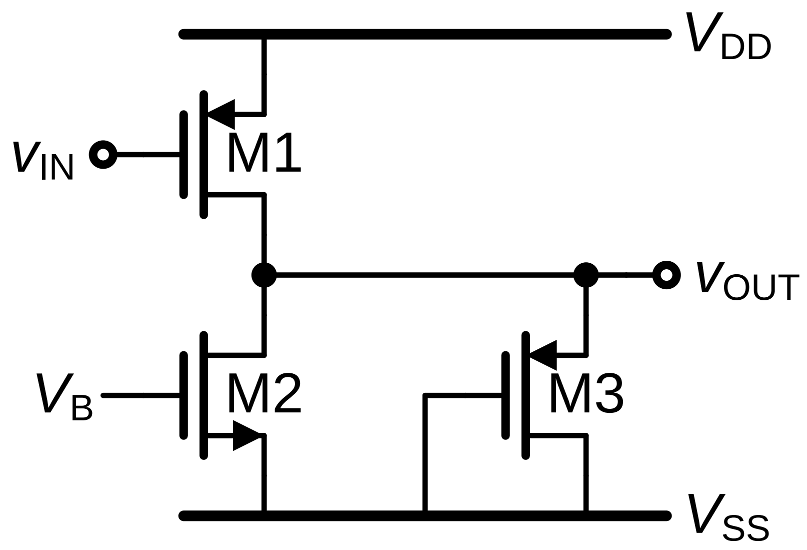
$$R \approx R_D/(g_m r_o)$$

If $R_S << r_o$,

$$R \approx 1/g_m$$

DC Gain

Hints for gain calculation:
First, find the equivalent transconductance;
Second, find the output resistance;
Third, find their multiplication.

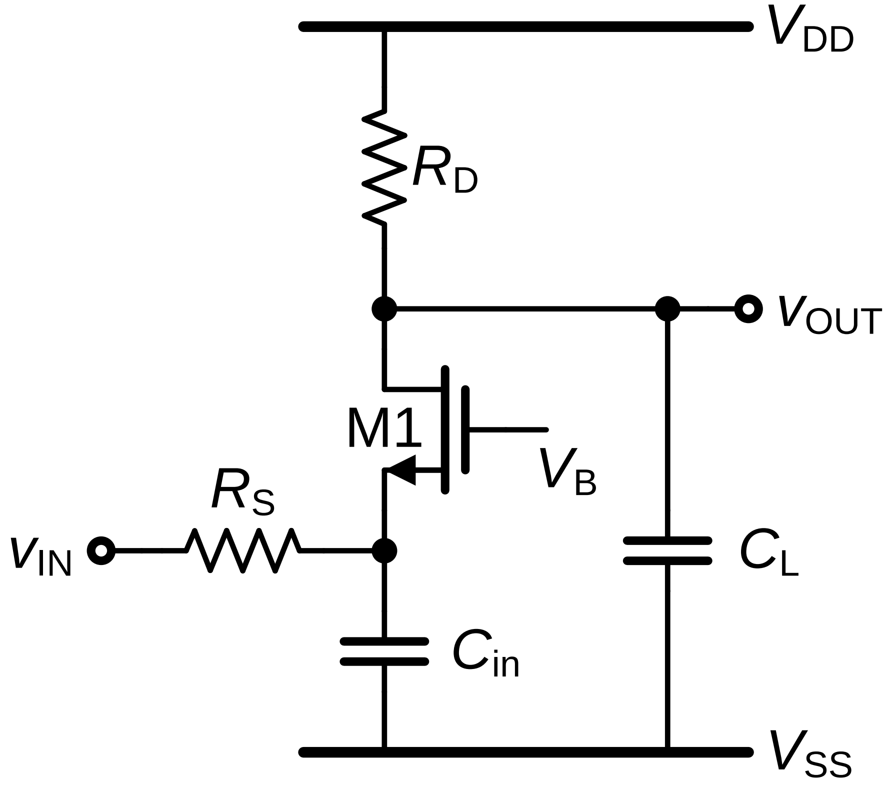


M1, M2, M3 are in the saturation zone.

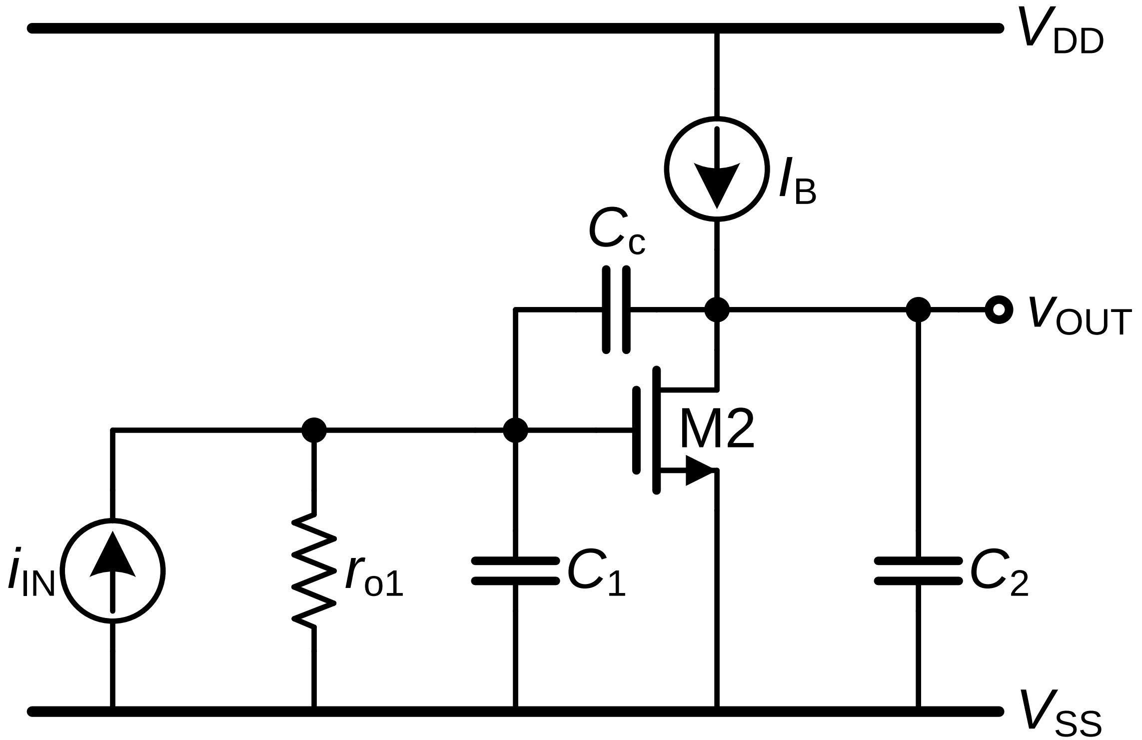
Pole

M1 is in the saturation zone, r_o is very large, $R_D << r_o$.

1. DC gain?
2. Poles?

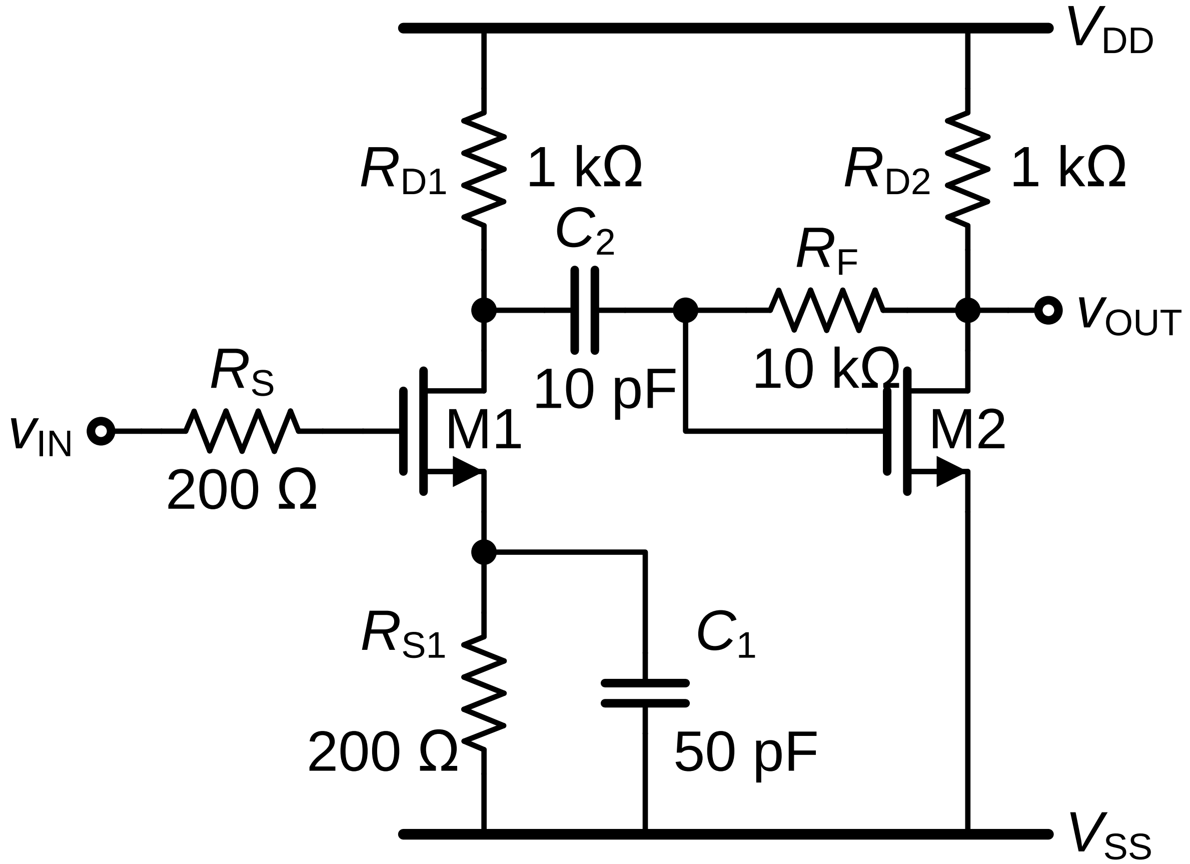


Frequency Response



M2 is in the saturation zone.

Example



M1, M2 saturated
$1/g_{m1} = 1/g_{m2} = 150\ \Omega$
$\lambda_1 = \lambda_2 = 0\ V^{-1}$
$C_{gs1} = C_{gs2} = 250$ fF
$C_{gd1} = C_{gd2} = 80$ fF
$C_{db1} = C_{db2} = 100$ fF
Find all the poles.

Thank you
for
your attention!