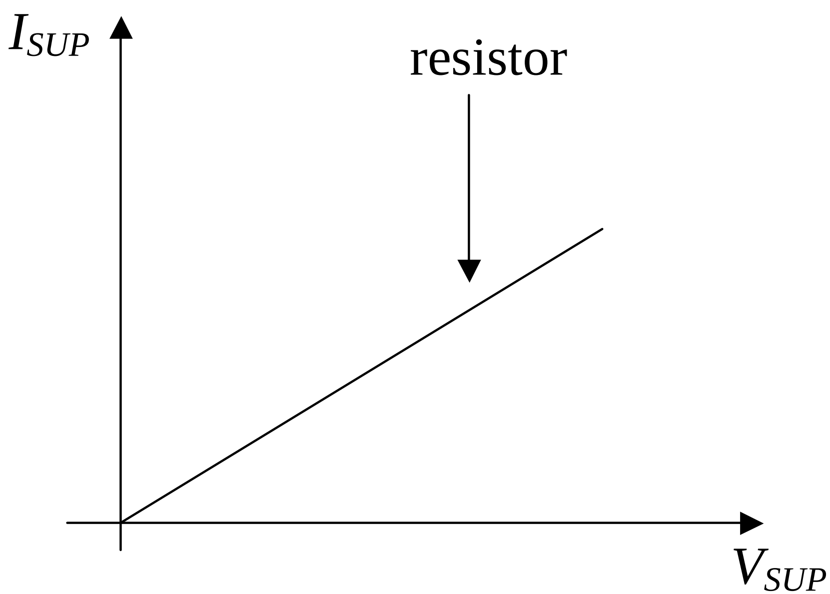
Lecture 26

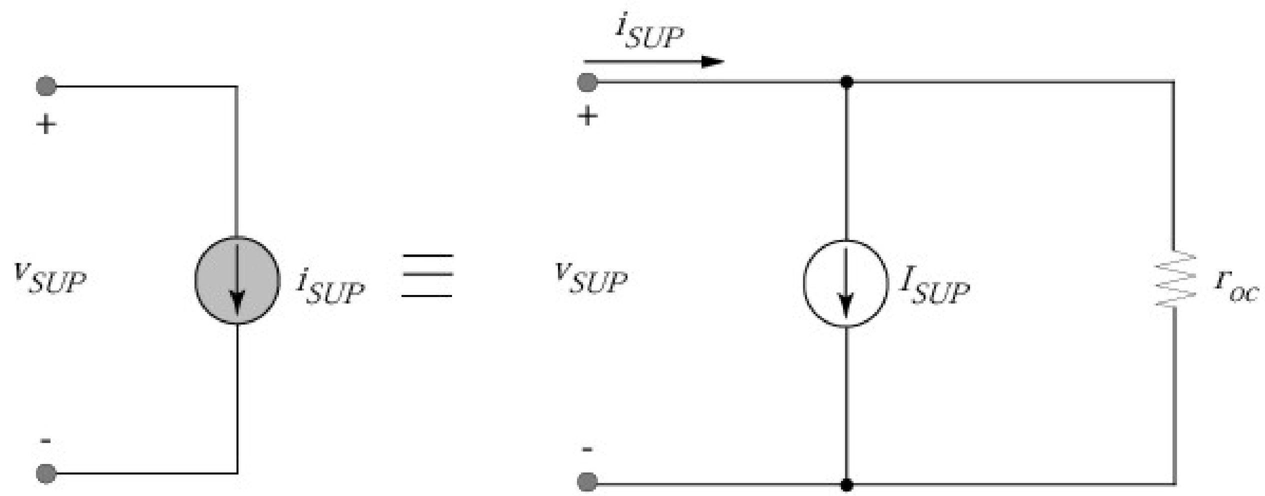
- Last time:
  - Finish methods for finding two-port model parameters
  - Start common-source amplifier
- Today :
  - Current-source supplies
  - Common-gate amplifier

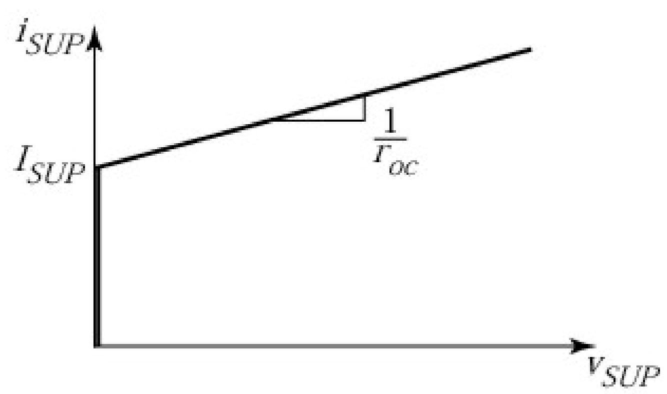
Non-Ideal Current Sources

- We want to have both R_D and a very large g_m at the same time … how to do it?
- The gain depends on the small-signal resistance; the DC current can be set by a supply → modify load line

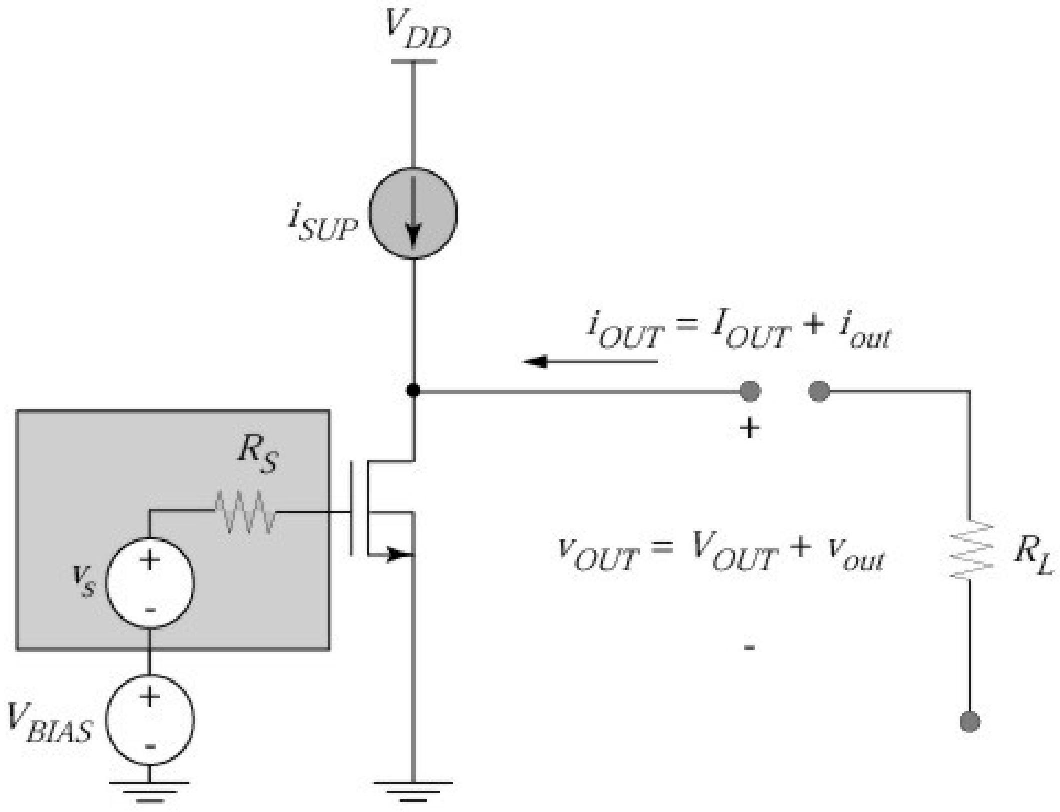


Current Source Supply

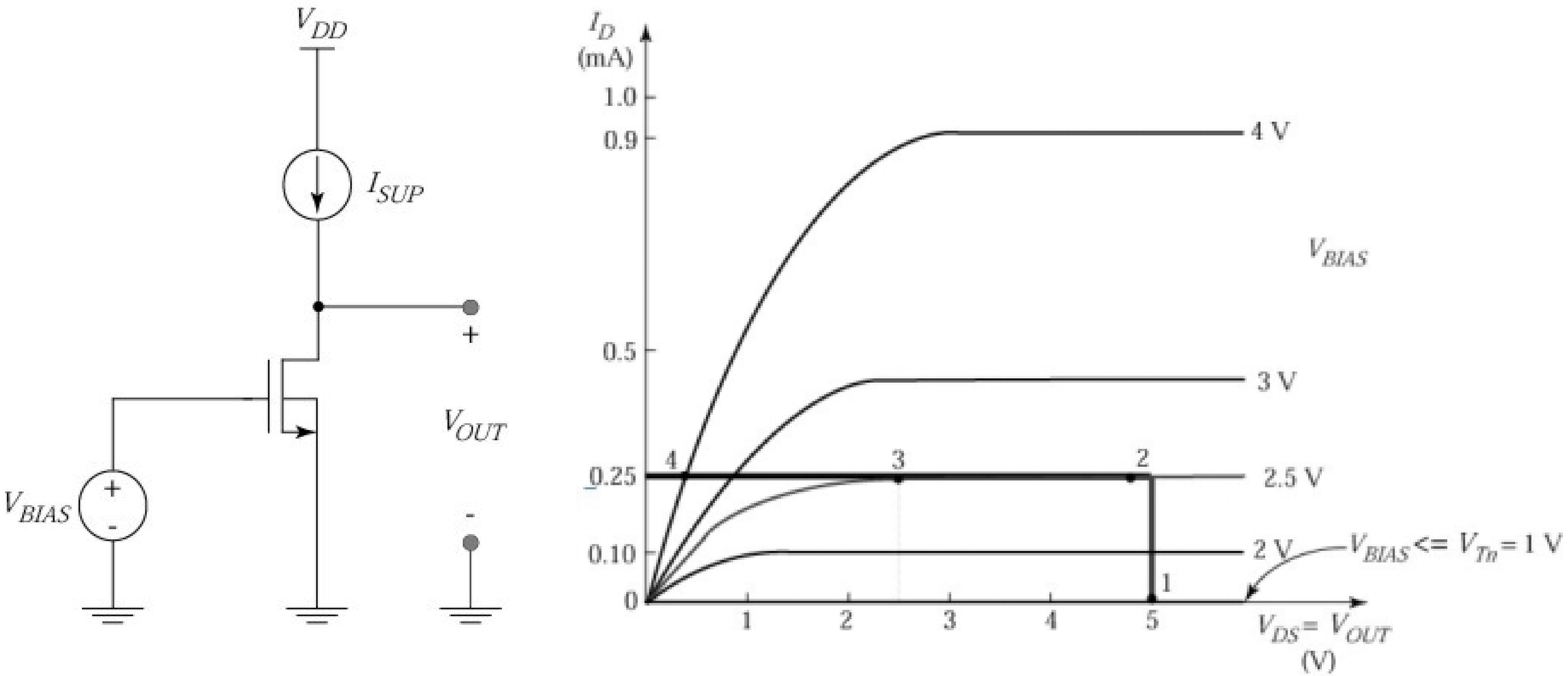




Common-Source Amplifier with Current Source Supply

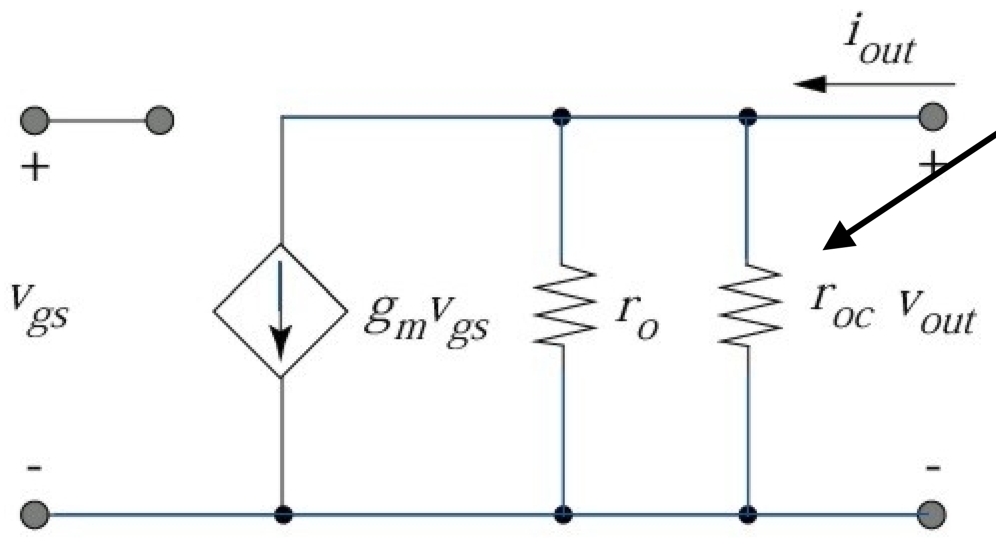


Load Line for DC Biasing



Both the I-source and the transistor are idealized for DC bias analysis

Two-Port Parameters



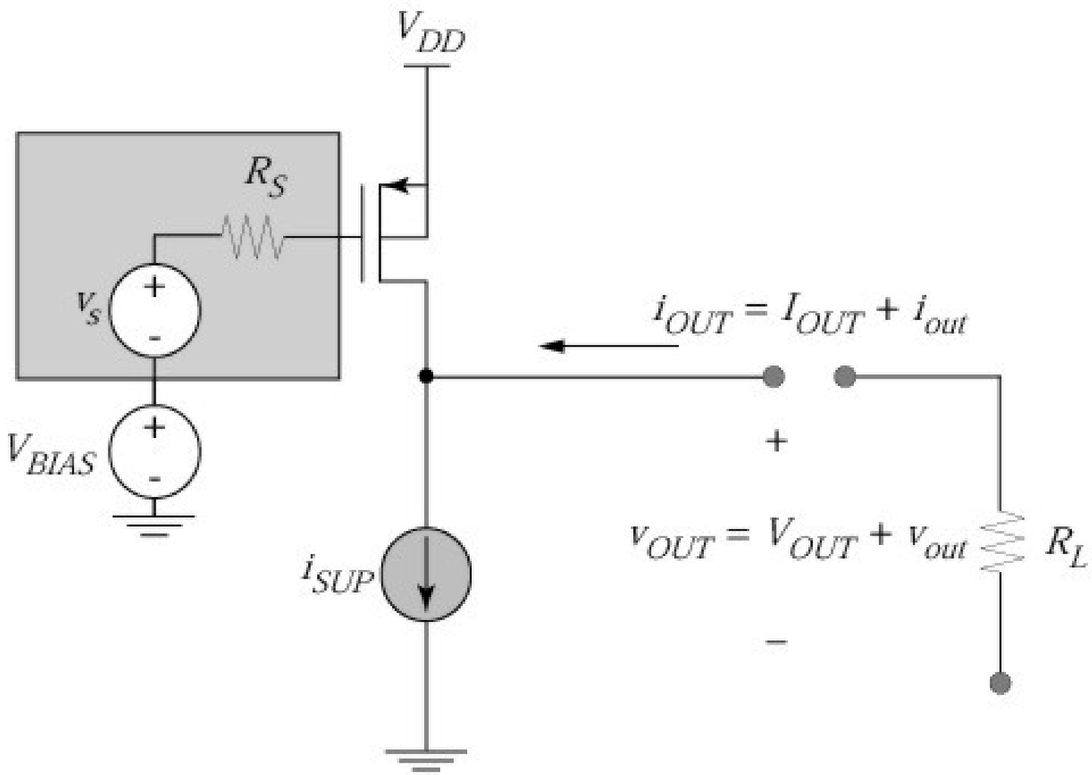
From current source supply

$R_{in} =$

$G_m =$

$R_{out} =$

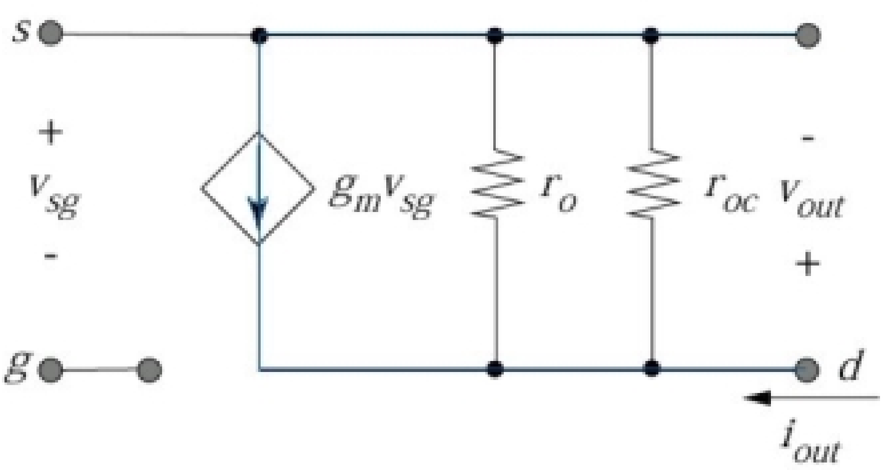
P-Channel CS Amplifier

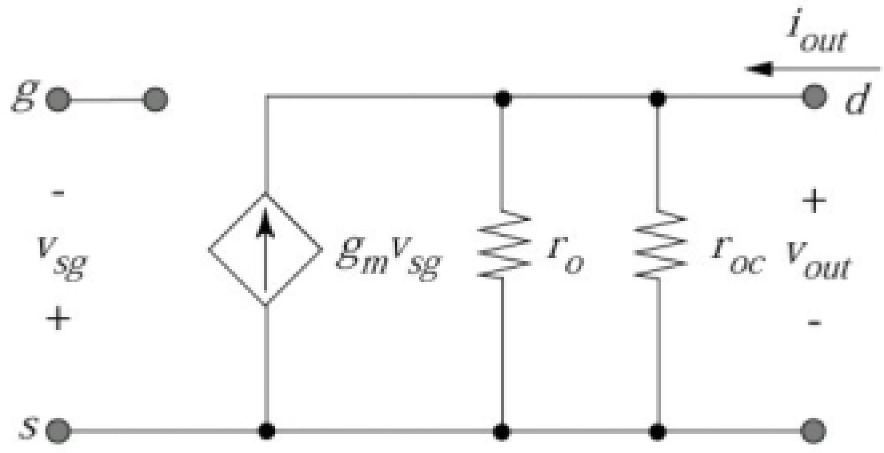


DC bias: $V_{SG} = V_{DD} - V_{BIAS}$ sets drain current $-I_{Dp} = I_{SUP}$

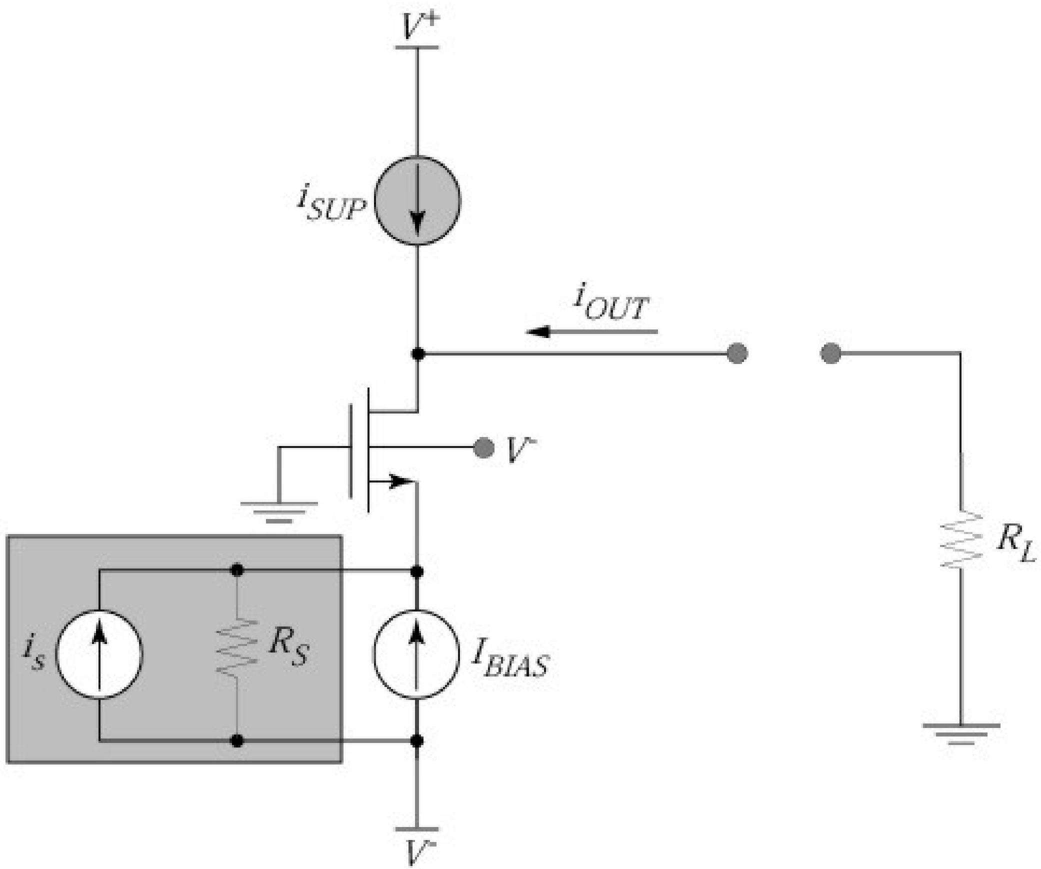
Two-Port Model Parameters

Small-signal model for PMOS and for rest of circuit



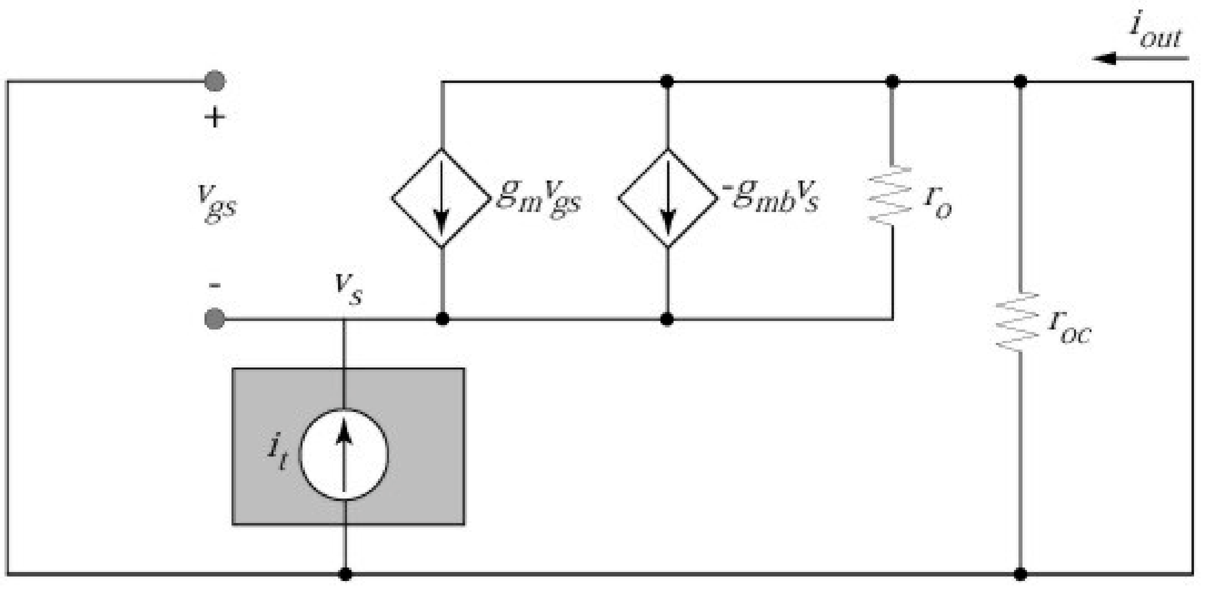


Common Gate Amplifier



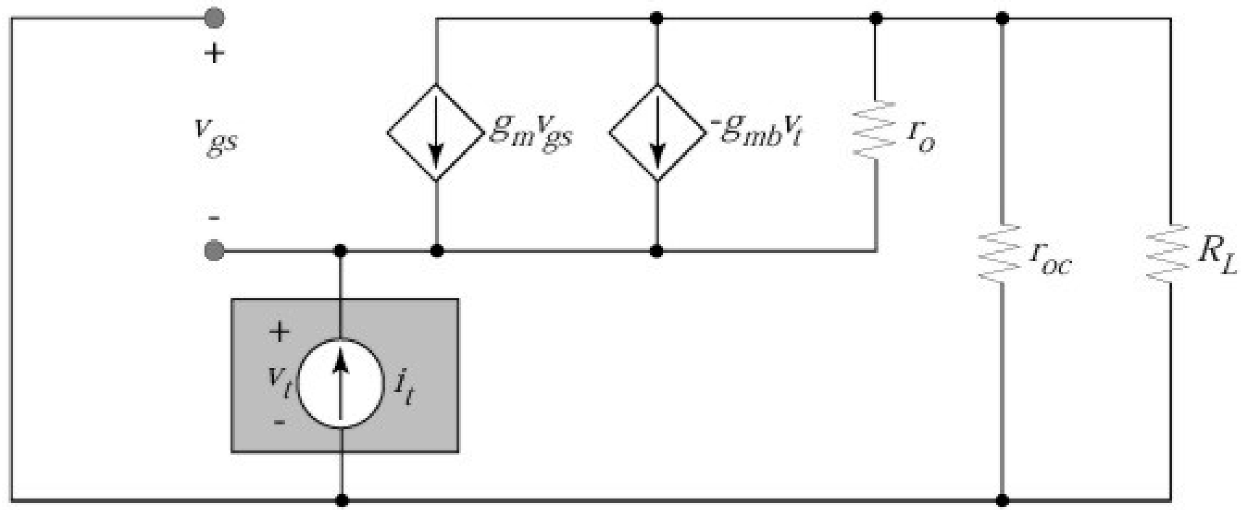
DC bias:

CG as a Current Amplifier: Find A_i



$$i_{out} = i_d = -i_g - i_s = -i_t$$

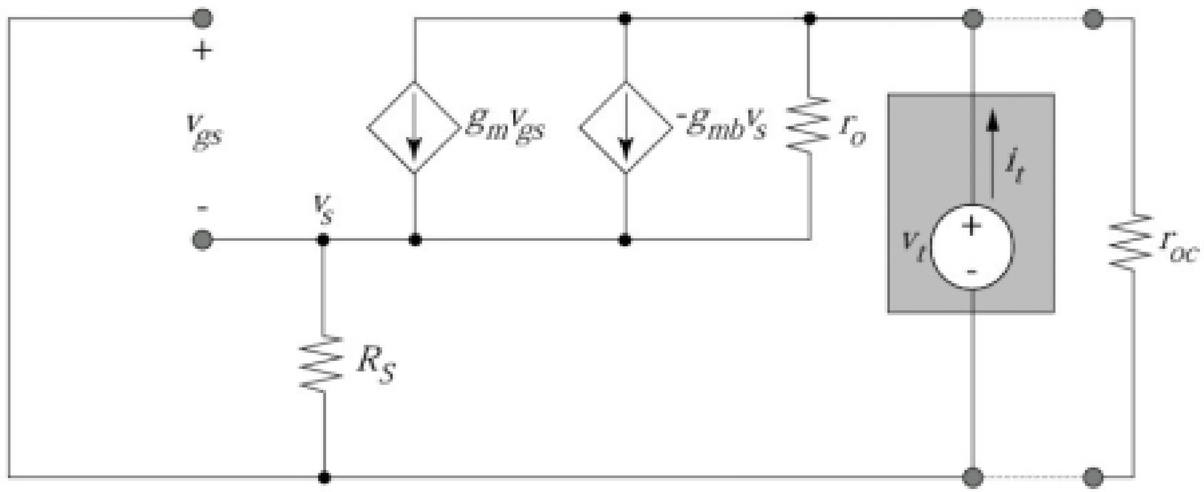
CG Input Resistance



At input: $$i_t = -g_m v_{gs} + g_{mb} v_t + \left(\frac{v_t - v_{out}}{r_o} \right)$$

Output voltage: $- i_{out} (r_{oc} \| R_L) = - (- i_t)(r_{oc} \| R_L)$

CG Output Resistance



* Kirchhoff's current law at the source resistor node: sum currents leaving node

$$\frac{v_s}{R_S} - g_m v_{gs} - (-g_{mb} v_s) + \frac{v_s - v_t}{r_o} = 0$$

$$v_s\left(\frac{1}{R_S} + g_m + g_{mb} + \frac{1}{r_o}\right) = \frac{v_t}{r_o}$$