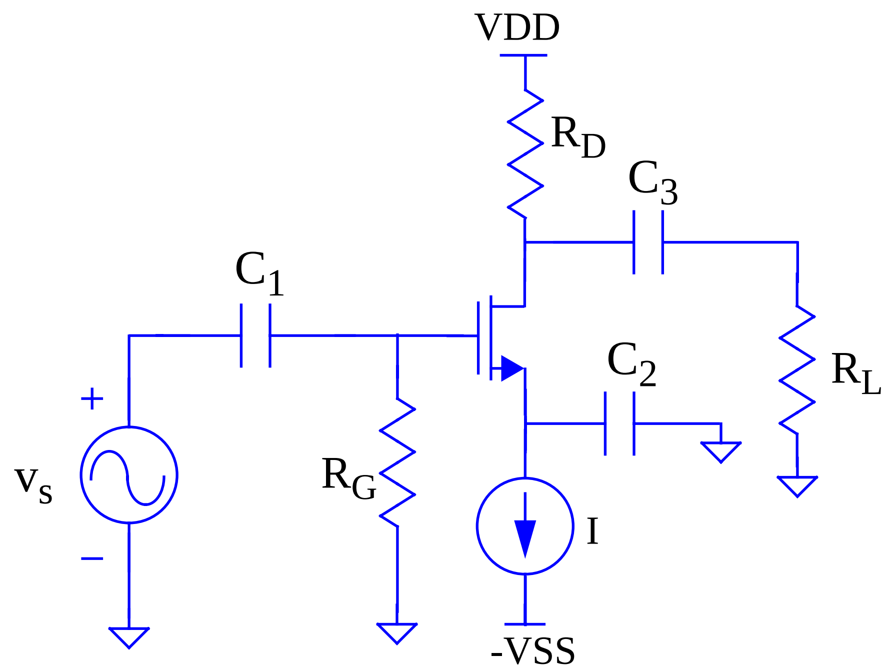
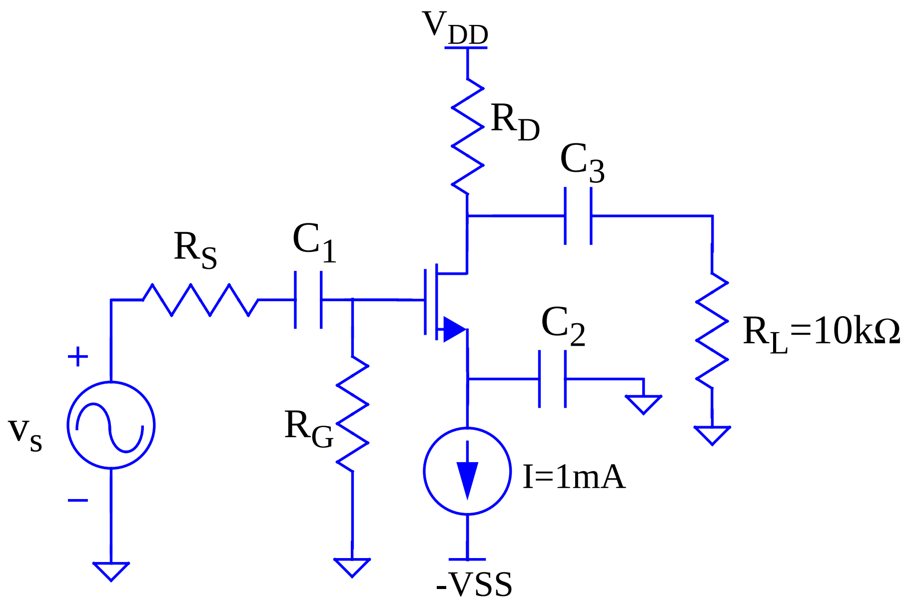
Common Source Amplifier



- A discrete common source amplifier can be constructed that is very similar in form to a common emitter
- Biasing with a current source is quite common, particularly for ICs
- But IC amplifiers do not include decoupling/bypass capacitors and biasing resistors

Common Source Amplifier

- Design the amplifier for maximum possible output voltage swing



$K=0.25mA/V^2$

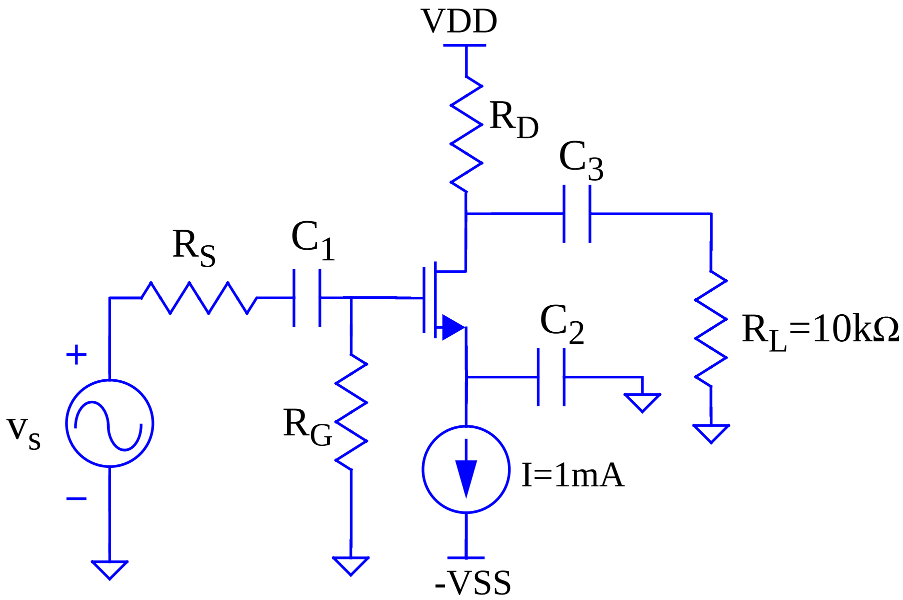
$V_t=2V$

VDD=10V

$R_G=500k$ (>> R_S)

$\lambda=0.02$

Common Source Amplifier



$K=0.25mA/V^2$

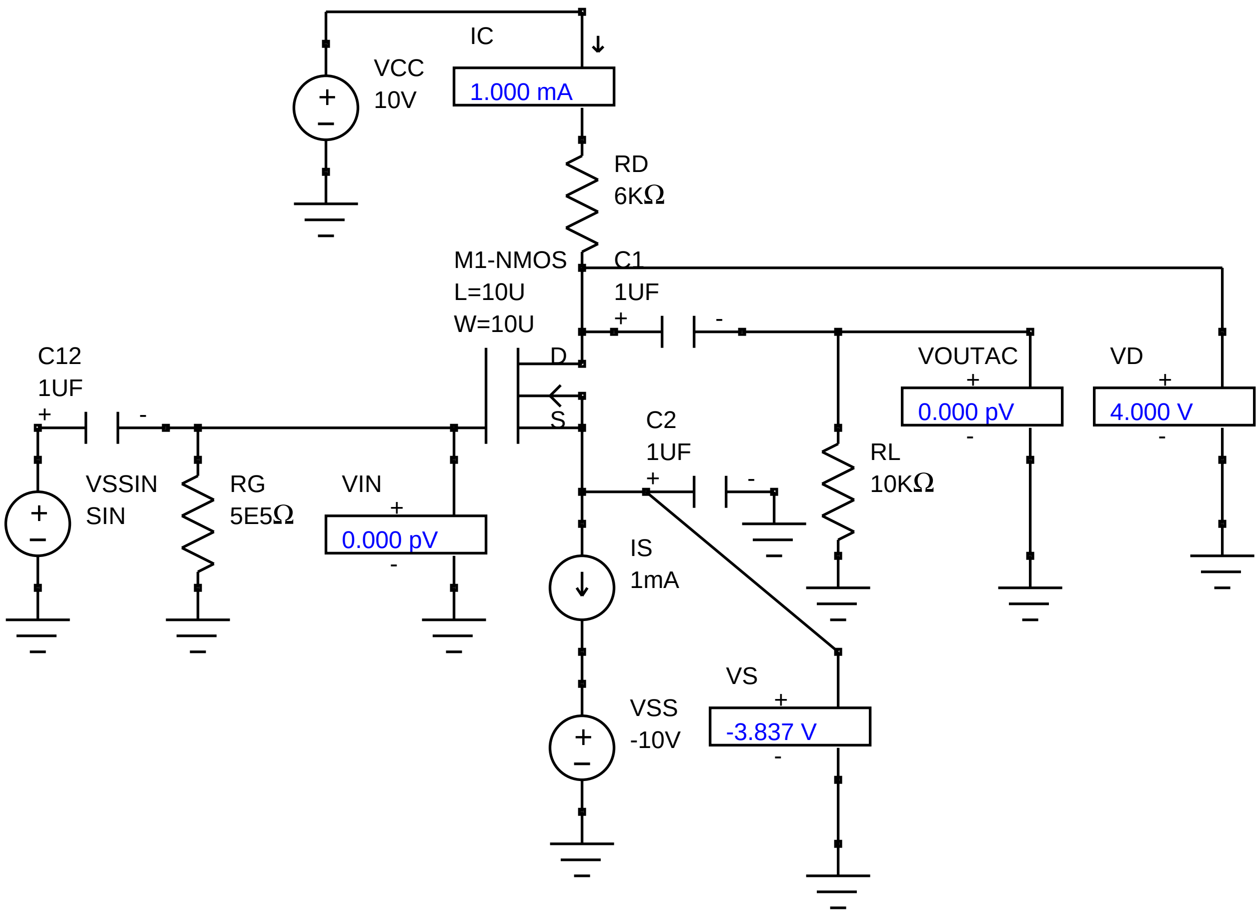
$V_t=2volts$

$VDD=10volts$

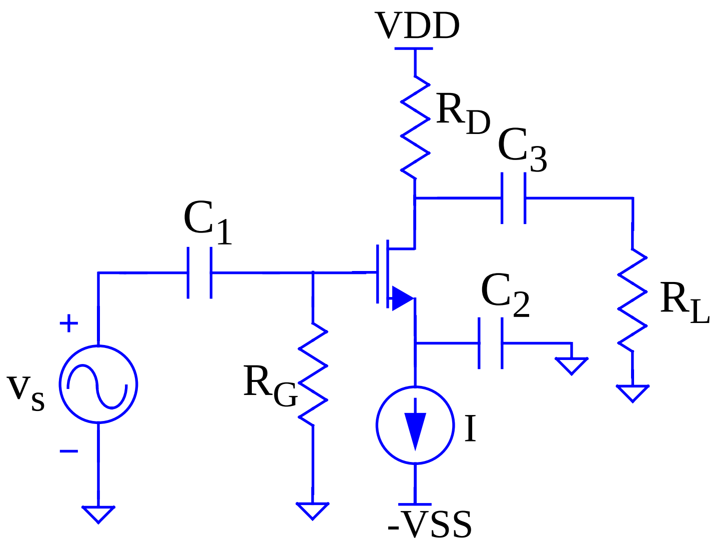
$R_G=500k$ (>> R_S)

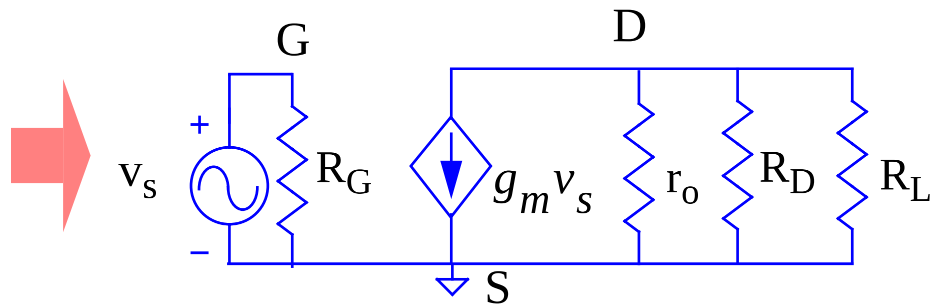
Common Source Amplifier

- Analyze the circuit --- first solve for the dc bias point:

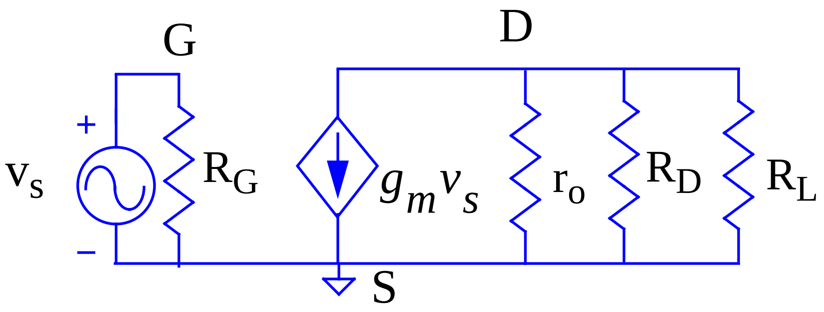


Small Signal Model



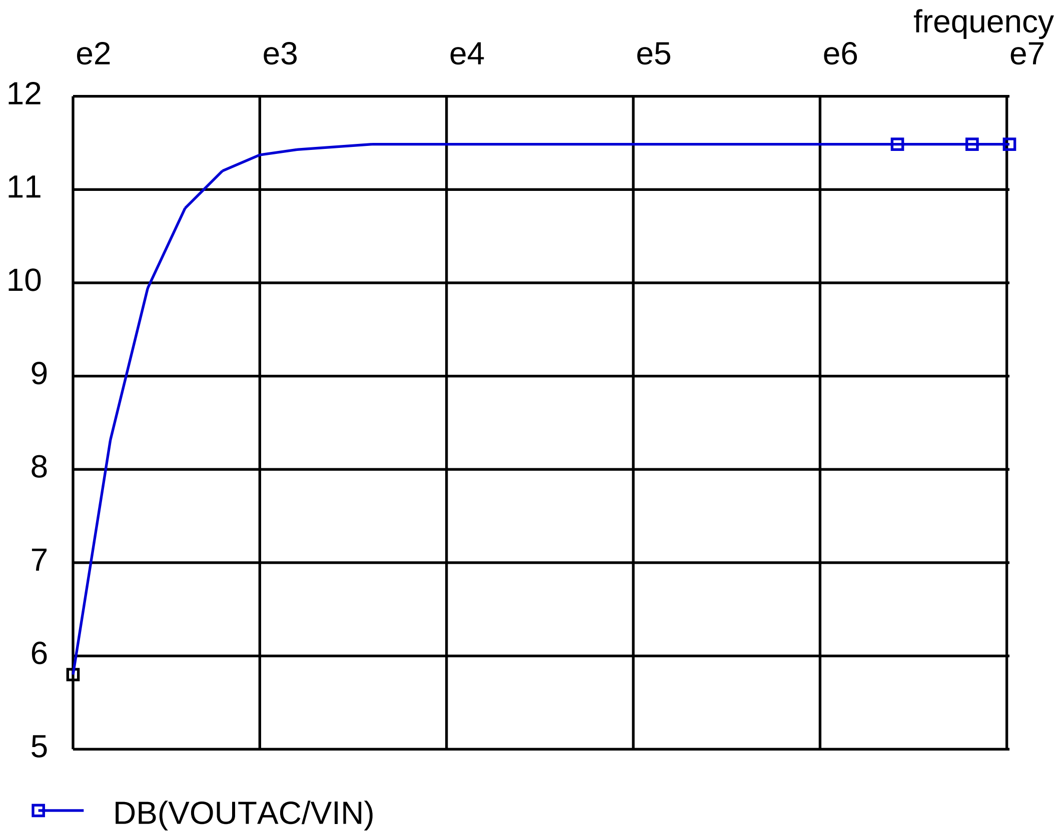


Small Signal Model



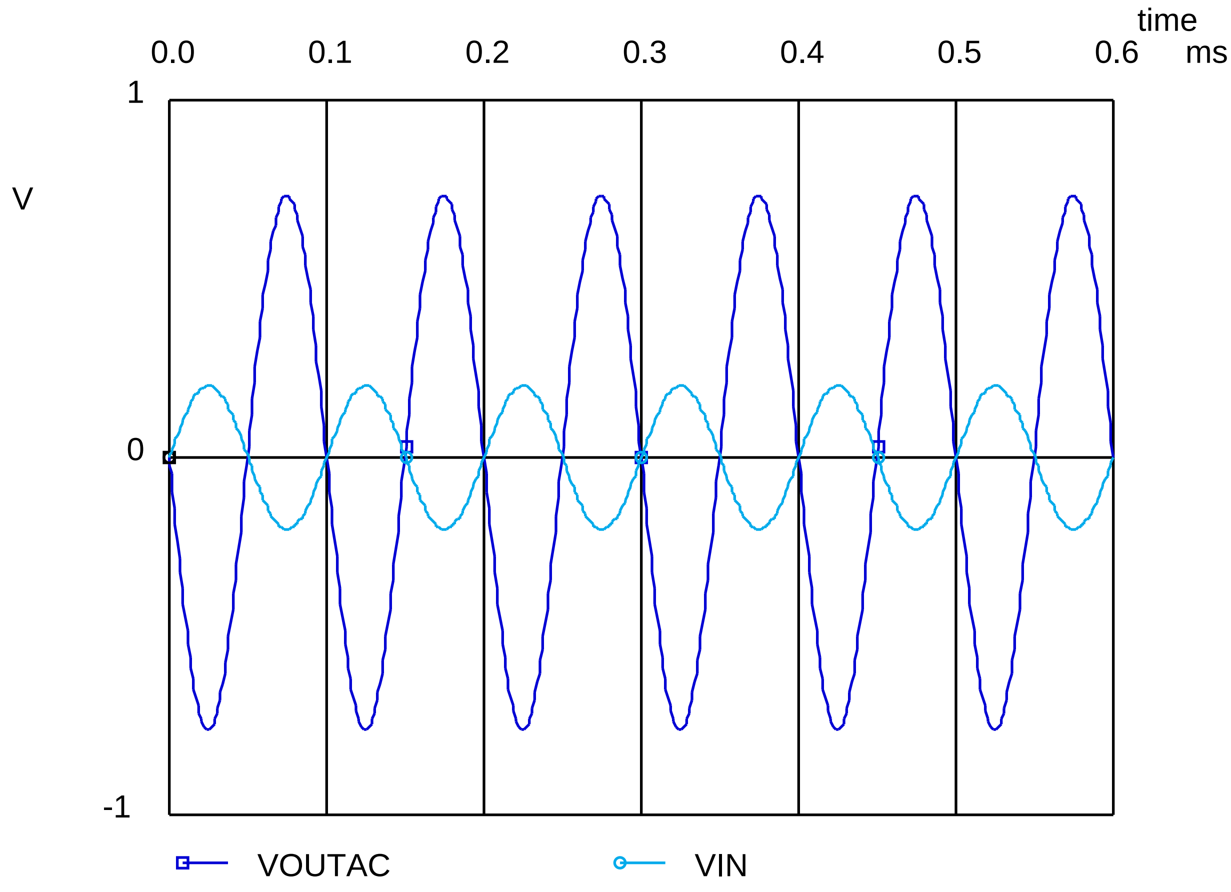
ac Response

- Frequency response with lamda=0.02



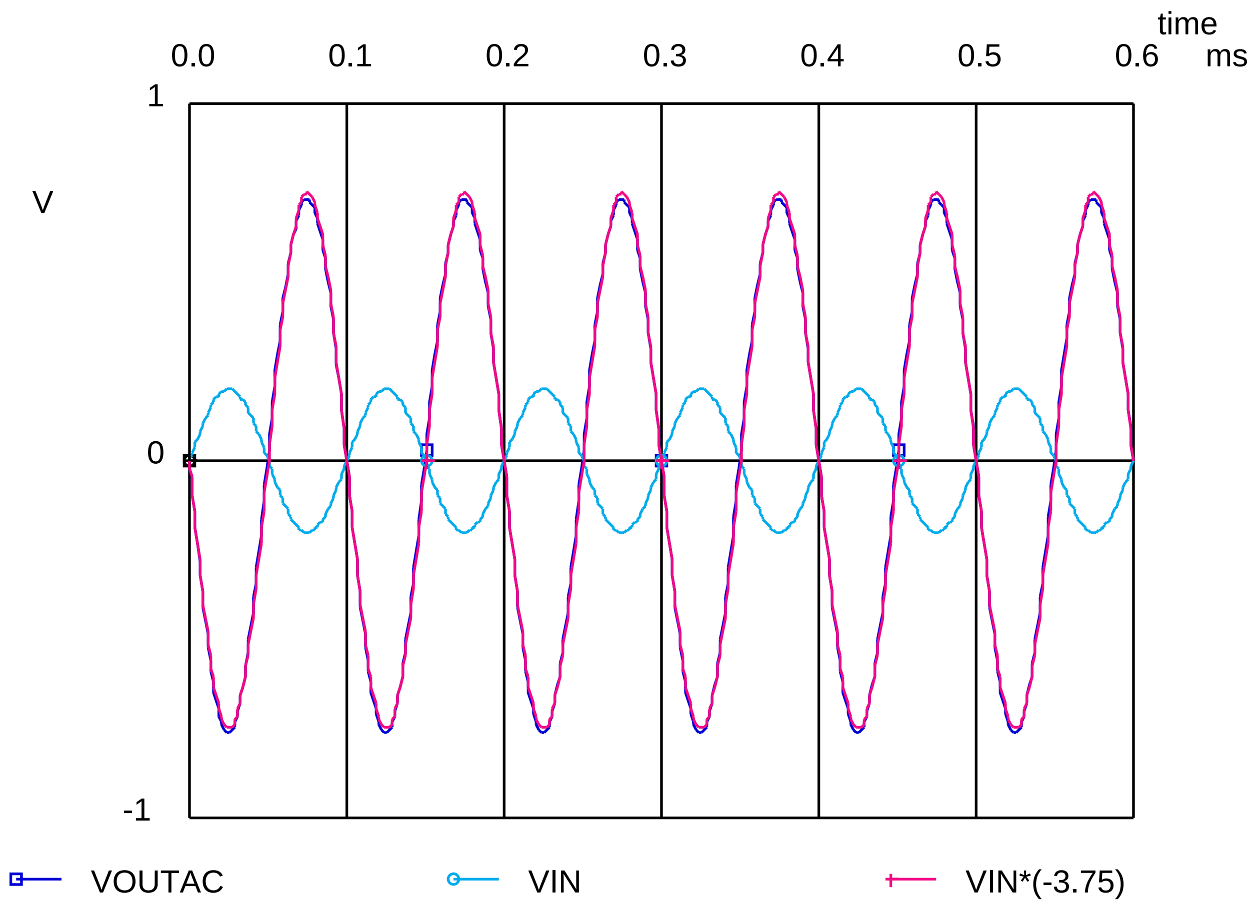
Transient Response

- Time-domain response for a 10kHz, 0.2v peak ac input signal with lamda=0.02



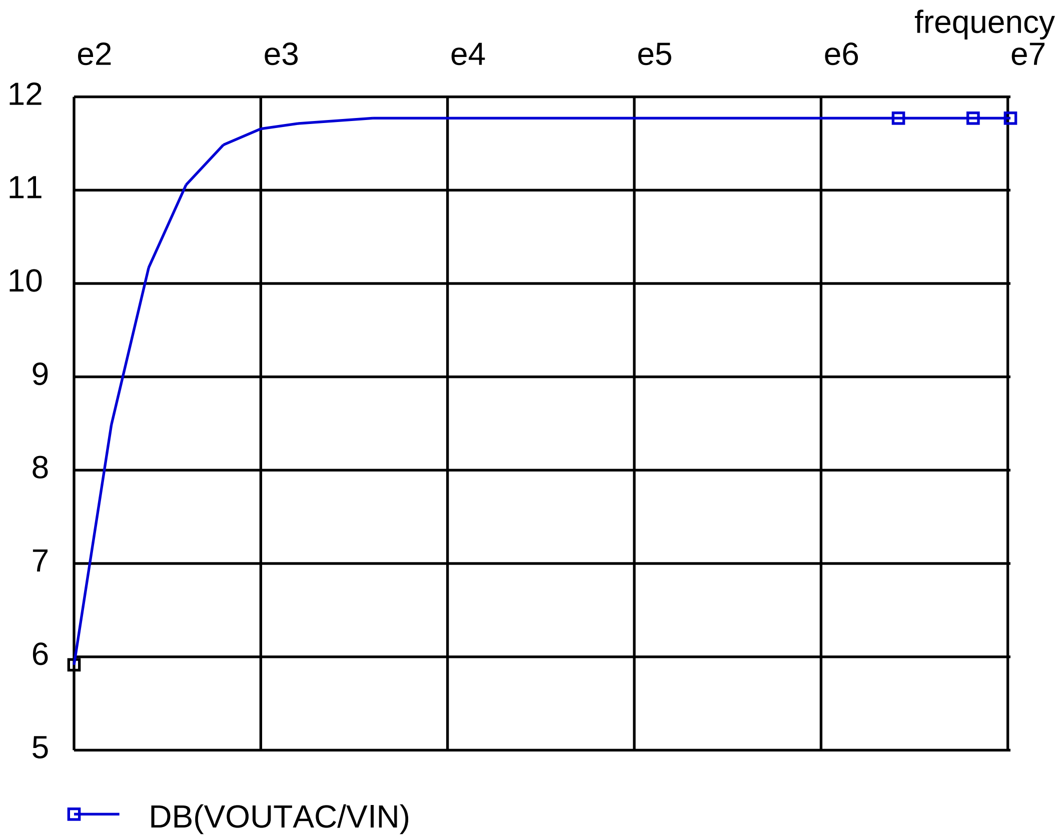
Transient Response Distortion?

- Vin multiplied by the midband gain, and shifted in phase by 180° demonstrates that there is very little distortion



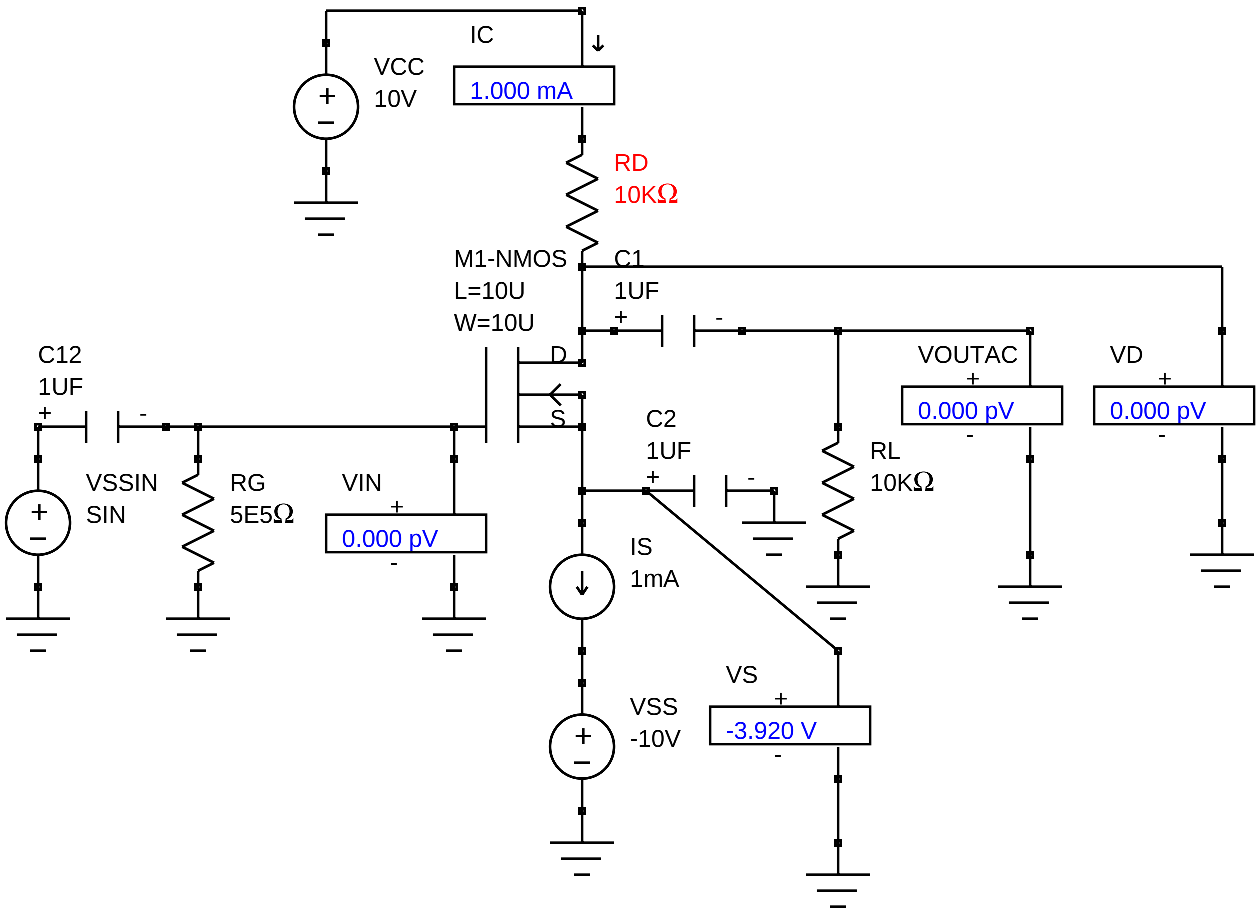
ac Response

- Response for a 10kHz, 0.2v peak ac input signal with lamda=0
- How can we change the design so that lamda is practically zero?

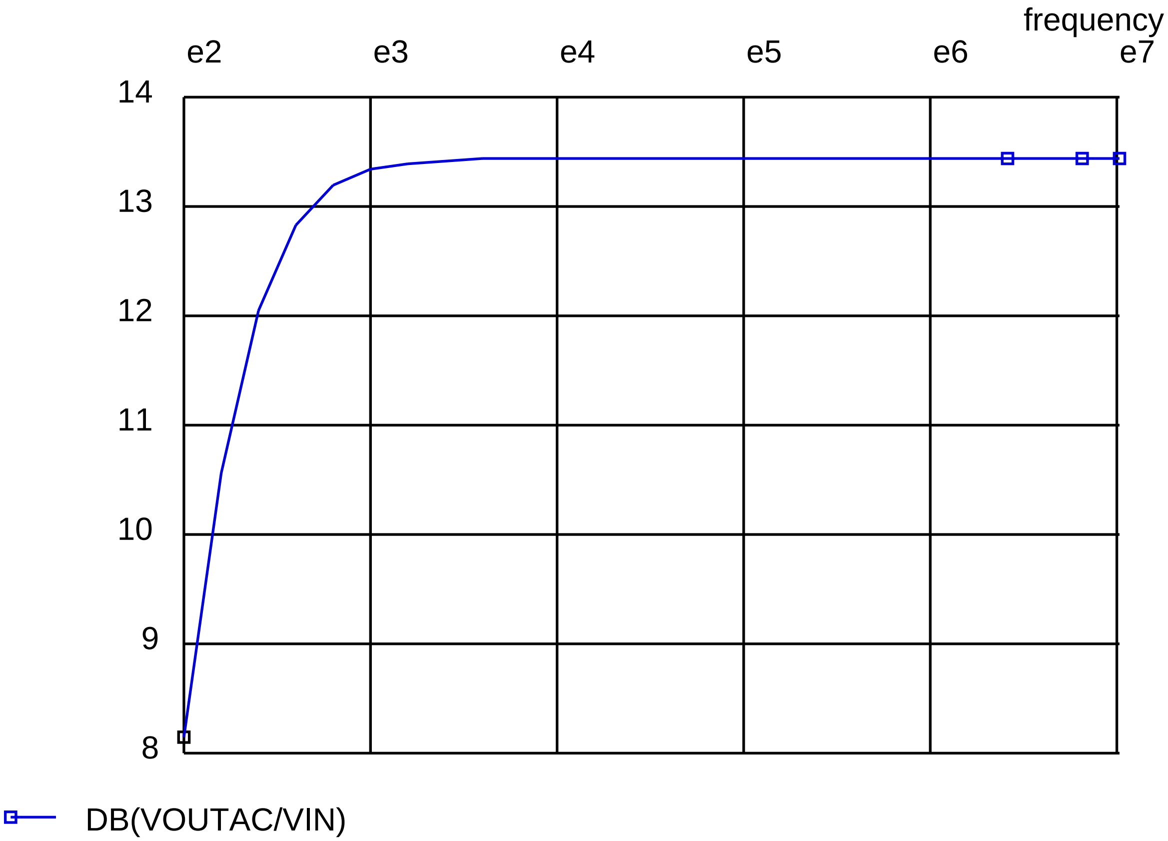


Improving the Gain

- Assuming that the peak ac output is less than 1.0 volt, we can use a larger value of R_D to increase the gain but still keep the transistor out of the triode region

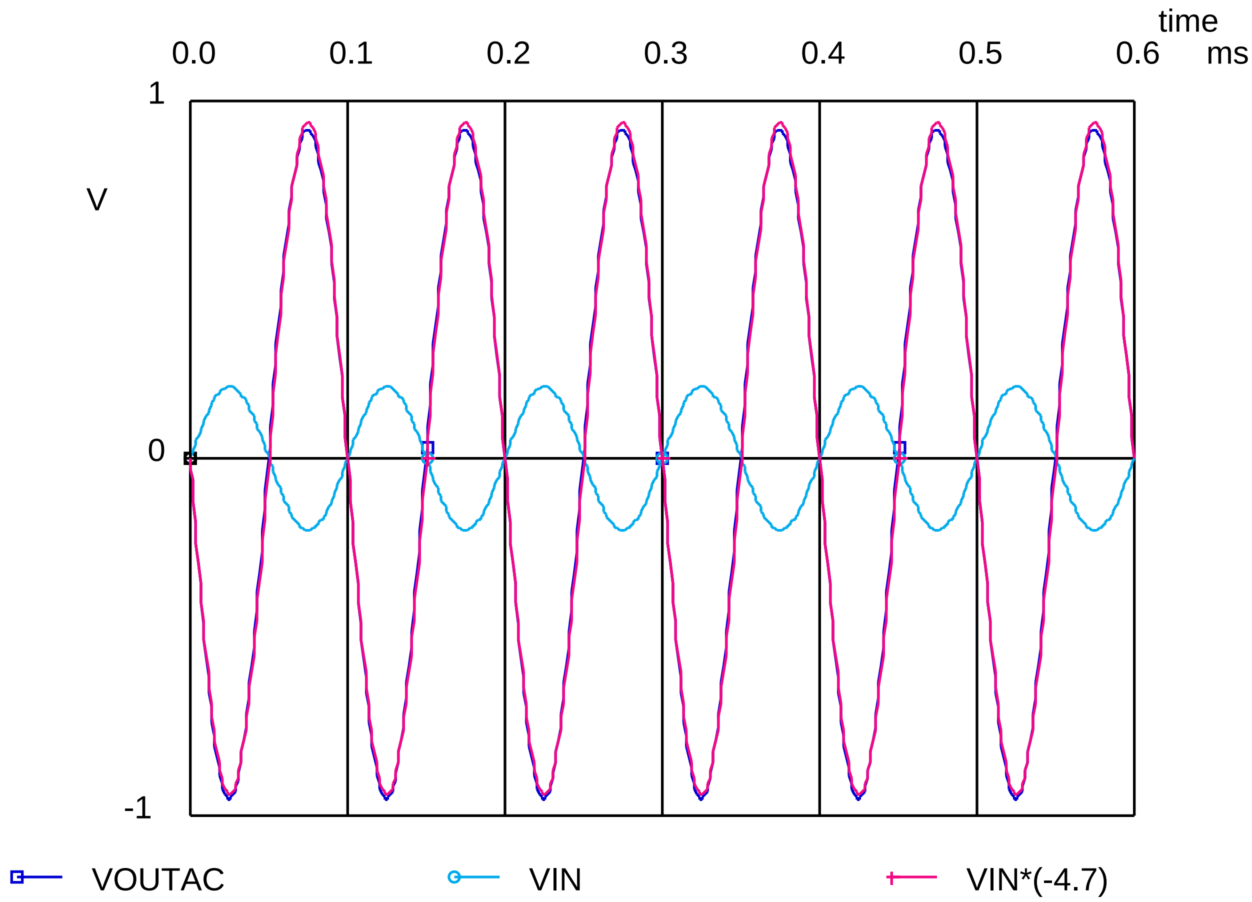


Improving the Gain

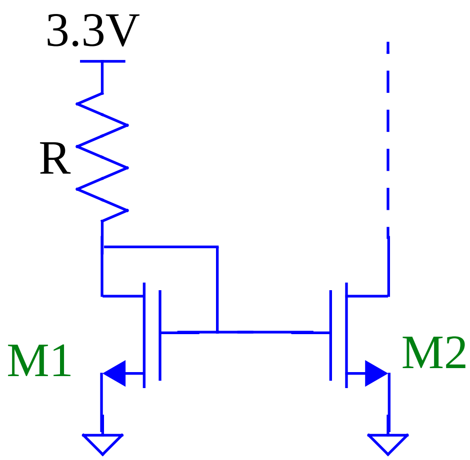


Improving the Gain

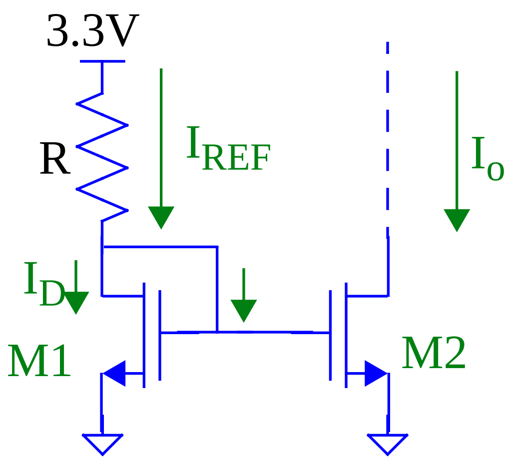
- But further increase in R_D is not possible



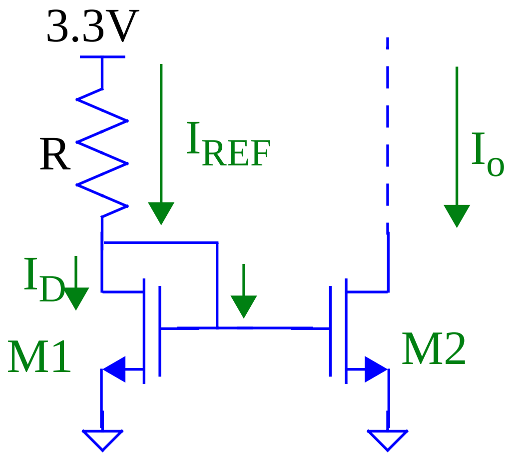
Current Mirrors



Current Mirrors - Output Resistance



Current Mirrors-Accuracy



Current Steering