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

\[ V_{DD} \]
\[ R_G \]
\[ R_D \]
\[ C_1 \]
\[ C_2 \]
\[ C_3 \]
\[ R_L = 10k \Omega \]

\[ v_s \]
\[ I = 1mA \]
\[ K = 0.25mA/V^2 \]
\[ V_t = 2V \]
\[ V_{DD} = 10V \]
\[ R_G = 500k \ ( \gg R_S) \]
\[ \lambda = 0.02 \]
Common Source Amplifier

- $K = 0.25 \text{mA/V}^2$
- $V_t = 2 \text{volts}$
- $V_{DD} = 10 \text{volts}$
- $R_G = 500k \ (>> R_S)$

$V_D = 10k\Omega$
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 \( \lambda = 0.02 \)
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

DB(VOUTAC/VIN)
Improving the Gain

- But further increase in $R_D$ is not possible
Current Mirrors
Current Mirrors - Output Resistance
Current Mirrors-Accuracy
Current Steering

3.3V

R

I_{REF}

I_D

M1

M2

M3

M4

M5

+ V_{SG5}

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