E151 Lecture 12 – Current Mirrors

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Disclaimer

These are notes for Prof. Spencer to give the lecture, they were not intended as a reference for students. Students asked for them anyway, so I'm putting them up as a courtesy. Remember that they are not intended as a substitute for attending lecture.

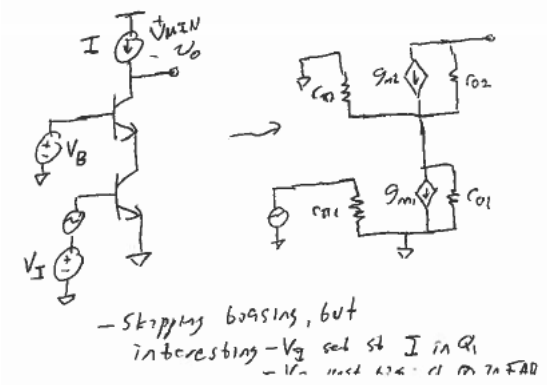
Review of Small Signal Models + Single Stage

- Class goal: build an op-amp
- Intermediate goal: build interesting multistage amplifier
- Path there: Diodes, BJTs, CE, multistage model, interesting stages
- We've noticed patterns in analysis as we added new stages

- Handout 1 ~ summary of properties of all single stage amps
- Handout 2 ~ summary of (3) small signal tricks to get rin, rout, av

Cascodes (Just a Reminder → need big Rload)

- Can we use the common base high rout for gain?
- Yes! CE-CB amplifier, called a cascade, one of two analog tricks



– skipping biasing, but interesting – V_B set so I in Q_1

$r_{in} = r_{\pi 1}$

$V_{oMAX} = V_{CC} - V_{MIN}$ } – lose swing

$V_{oMIN} = 2V_{CESAT}$

$r_{out} = r_{\pi 2} \| r_{o1} + r_{o2} + g_{m2} r_{o2} (r_{o1} \| r_{\pi 2})$

$= r_{\pi 2} \| r_{o1} + r_{o2} + \beta_2 r_{o2} r_{o1} / (r_{o1} + r_{\pi 2})$

$a_v = g_{m1} \cdot \frac{\beta_2}{\beta_2 + 1} \cdot r_{out}$

– small signal pattern
– g_{m1} off
– g_{m2} on

Recall bog a_v & r_{out}!

called a cascode! one of the big tricks!

Active Loads

- Always trading off between V_SW and av w/ resistive loads
- What's the gain of these two amplifiers (if everything is in FAR)