E151 Lecture 13 – Active Loads and Current Mirrors
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ENGR151

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.
Midterm is Coming Up

• Lab on Friday, but stays in 3 hour lab time, gentle grading
• Practice problems and maybe solutions on Sakai
• In class, 1 hr 15 min, no calculator, book, notes
• Get 1 page cheat sheet, must make your own
• Note that tour through MOS physics & amplifiers is kind of a review

What’s a Current Mirror and Why?

• Active loads are pretty cool, but tough to bias
• Amount to biasing w/ a current source ... ideal load (inf. Z, inf. Vsw)
• Fix biasing by using current mirrors
What do we care about w/ mirrors?

- Mirror design specifications – functions of IC, compare @ same IC
  - $V_{IN}$
  - $V_{MIN}$
  - Error = $\varepsilon = \frac{I_{OUT}}{I_{IN}}$
  - $r_{out}$

Use Mirrors to Make Active Loads

- $av = gm^*(r_{o1} | r_{o2})$ – very high! (~1/2 of what we saw w/ isrc load)
- Need to pick $V_B$ st we’re in FAR, do w/ load line or another mirror
Current Mirror Reminder and Error

- Error example here, not commonly calculated b/c MOSFETs different
- Similarly, lots of cool types of mirrors ~ Widlar has feedback for low $\varepsilon$
- But cascode mirror commonly used in MOS b/c big $r_{out}$
- Reminder: FOM are $V_{IN}$, $V_{MIN}$, $\varepsilon$, $r_{out}$

\[ I_{in} = I_{on} + I_{c1}, \quad I_{on} = I_{in} (\beta + 1) \]

\[ I_{on} = I_{in} \beta \]

\[ V_{in} = 2V_{be}, \quad V_{out, min} = 2V_{be}, \quad \varepsilon \]