Lecture 10: High Swing Current Sources

- Announcements:
  - HW#3 due today
  - HW#4 online
  - Lab#2 online
  - Monday Labs: due to holiday next week, shift to the following Monday
  - Monday Lab#1's are due in the 140 Box on Tuesday next week
  - No lecture during our regular time on Thursday
  - Make-up lecture still TBA … either Thursday evening or Friday sometime, I hope
- Lecture Topics:
  - Output Swing (Headroom)
  - High Swing Current Sources
  - Current Source Matching Considerations
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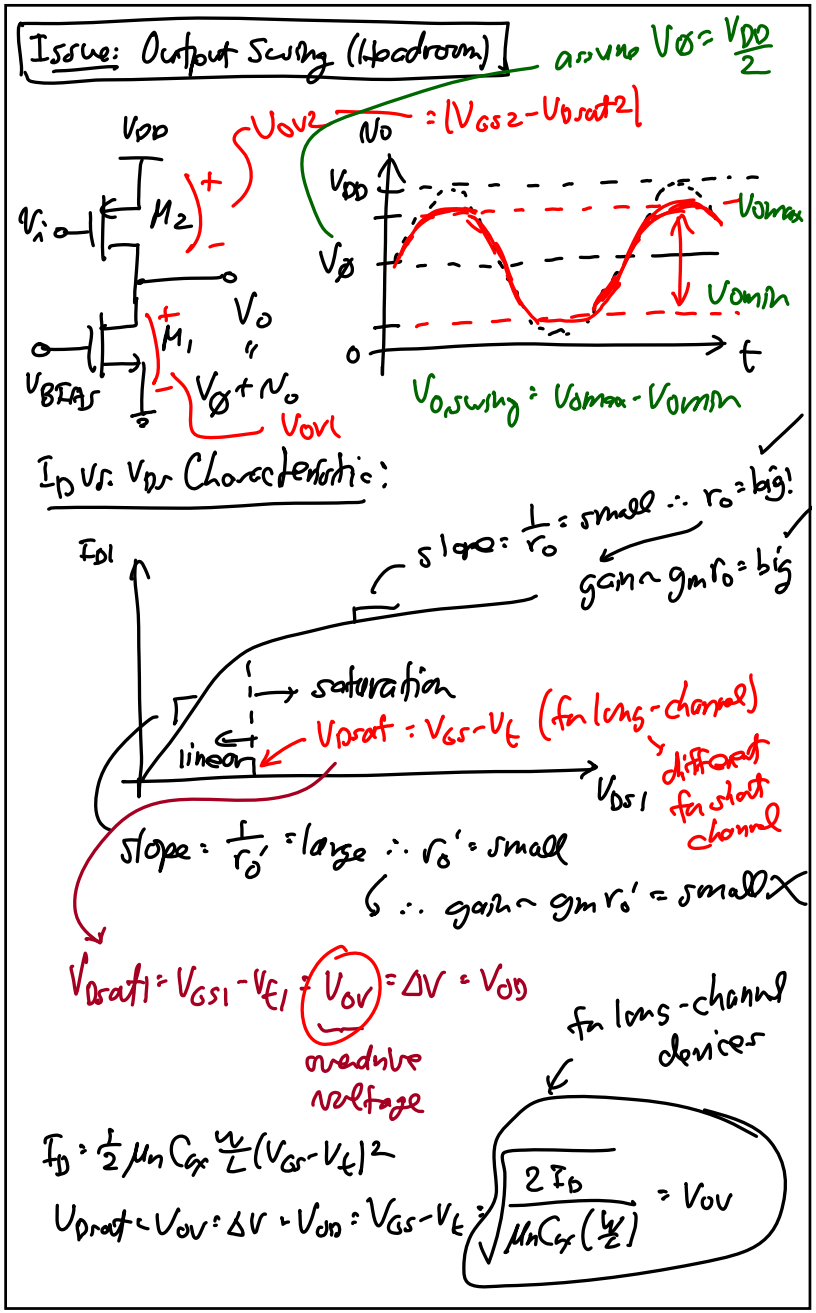
- Last Time:
- Reviewed current sources using prepared lecture material
- Finished with Widlar current sources

over



The min. voltage that still keeps M_1 as a good current source (i.e., R_o = large)

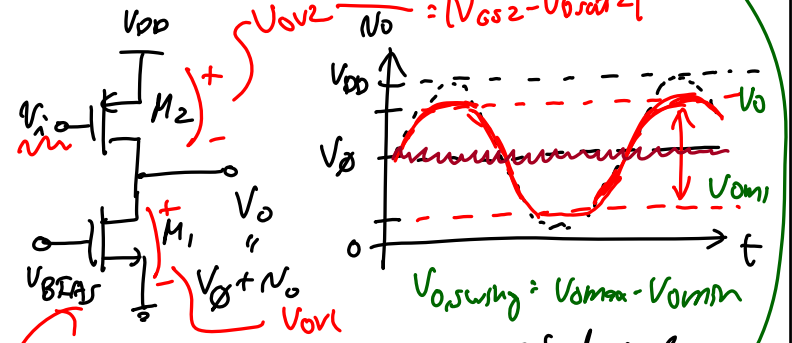
$V_{o,min} = V_{DSat} = V_{ov1}$

∴ the output swing:

$V_{o,swing,pp} = V_{DD} - V_{ov1} - V_{ov2}$

peak-to-peak

Noise



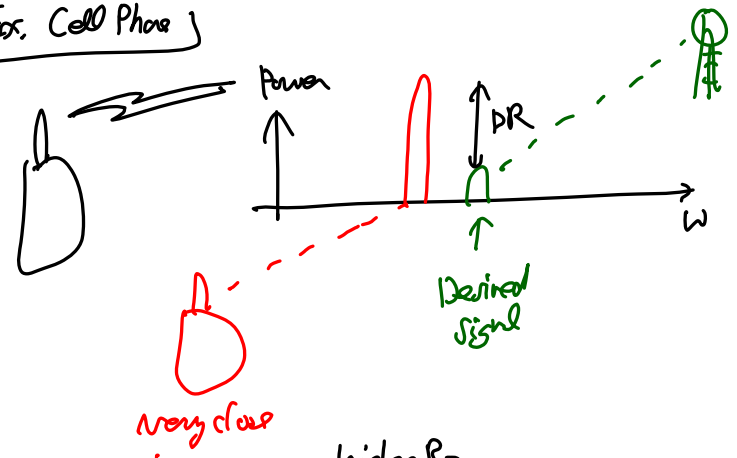
Dynamic Range = DR = $\frac{\text{maximum output signal}}{\text{minimum input signal}}$

simple current source → one transistor

determined by output swing

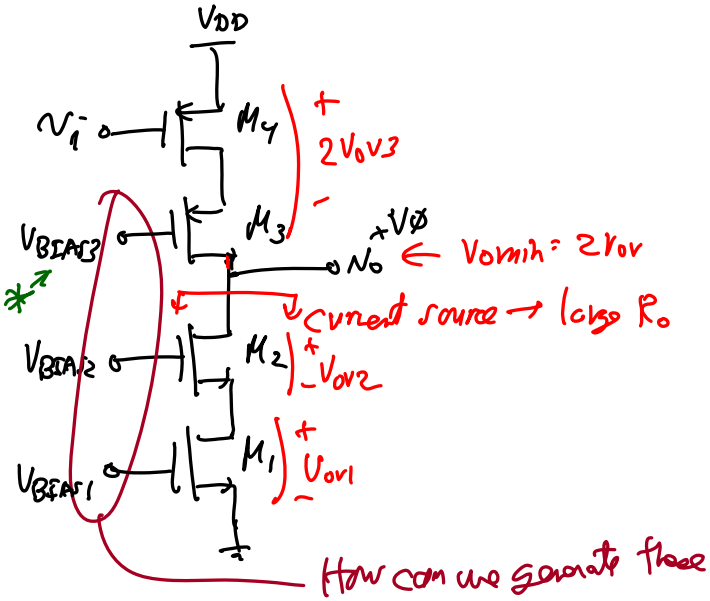
determined by noise!

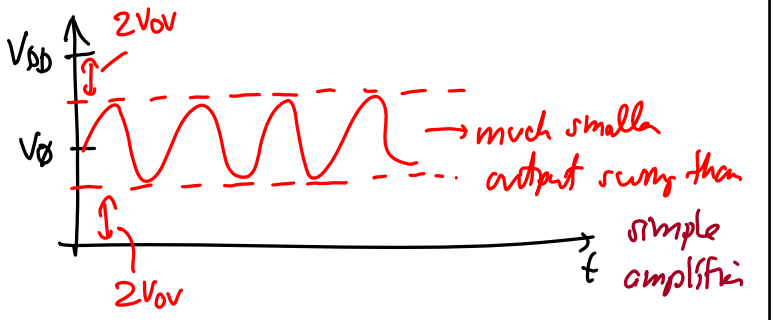
Ex. Cell Phone



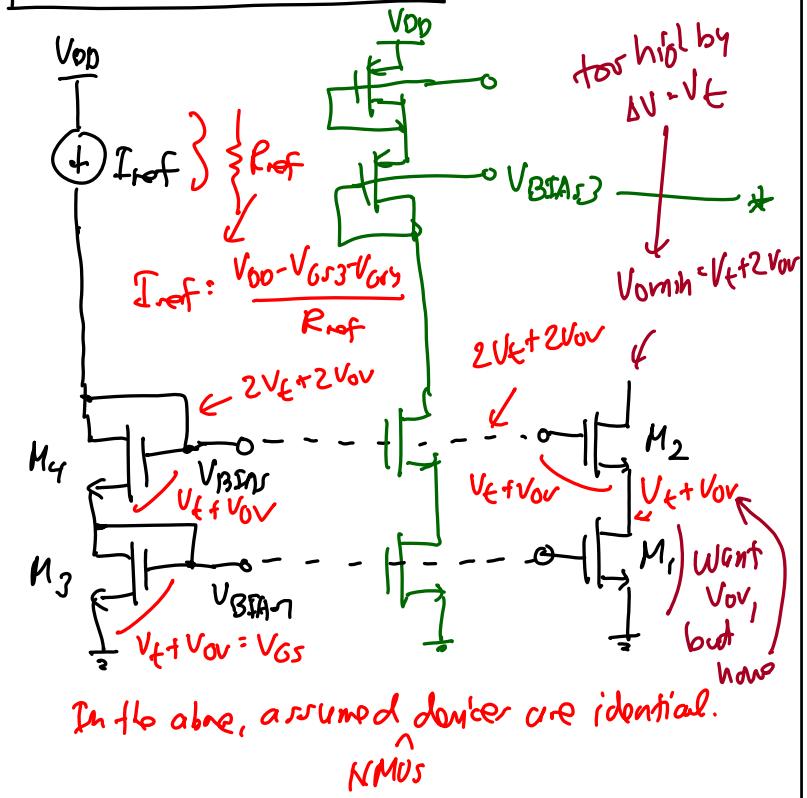
What about better current sources, like the cascode current source?

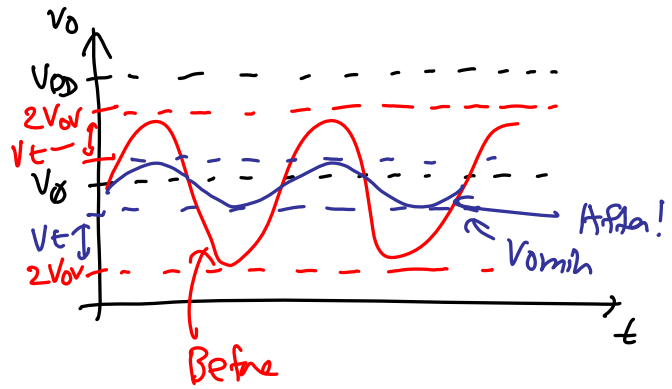
higher R_o





MOS Cascode Current Source





$V_{omin} = V_t + 2V_{ov}$

$(typ.) \cong 0.7 + 2(0.3) = 1.3V$

This is a lot in a 2V supply!
↳ these days, lots of digital cktr. have $V_{DD} = 1V$.

this ↓ not permissible in 1V technology (or arguably, 2V tech)

Soln: **High Swing Cascode** (V_{BIAS}-generated)

↓

Basic Idea: level-shift down to reduce V_{G2}.