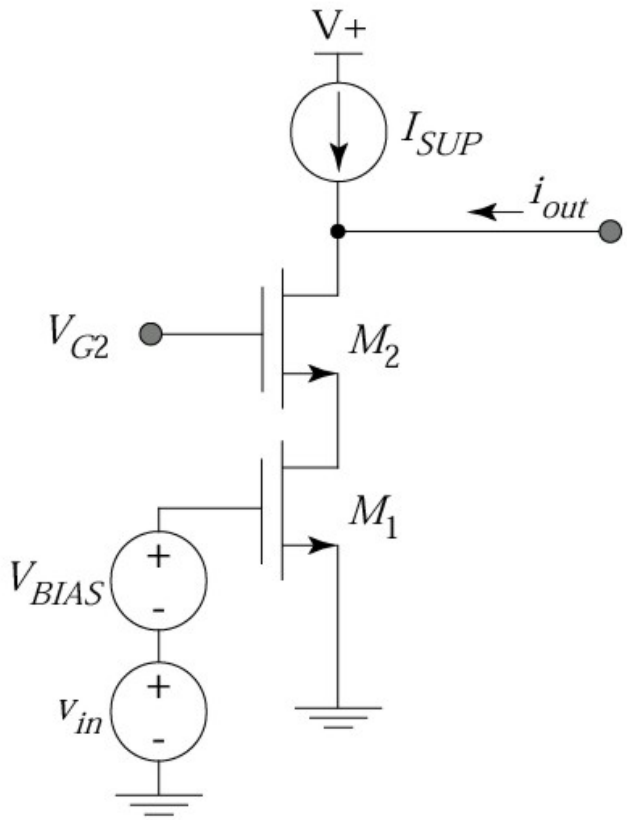
Lecture 35

- Last time:
  - More examples of cascades
  - DC coupling issues
- Today :
  - Cascode amplifiers
  - Totem pole voltage supplies
  - Start: multistage amplifier design examples

The Cascode Configuration

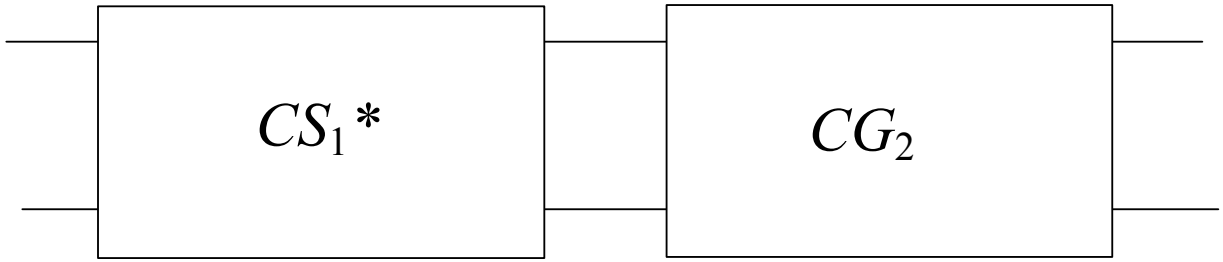


Common source / common gate cascade is one version of a *cascode* (all have shared supplies)

DC bias:

Two-port model: first stage has no current supply of its own

Cascode Two-Port Model

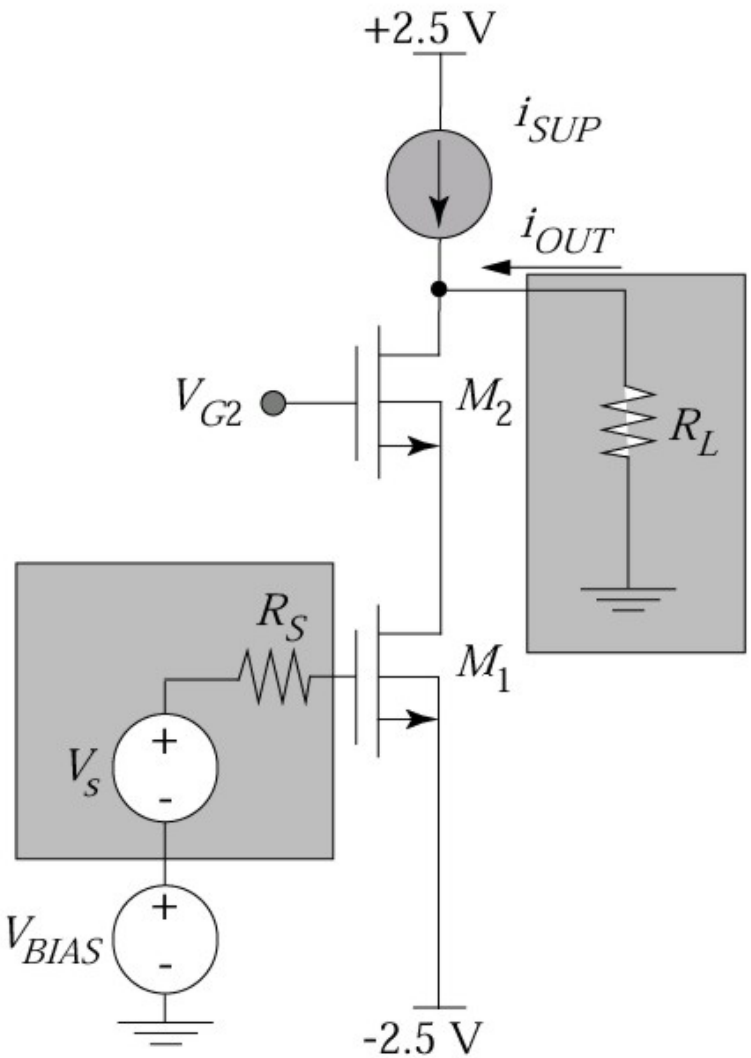


Output resistance of first stage = $R_{out,CS^*} = R_{down,CS} = r_{o1}$

Why is the cascode such an important configuration?

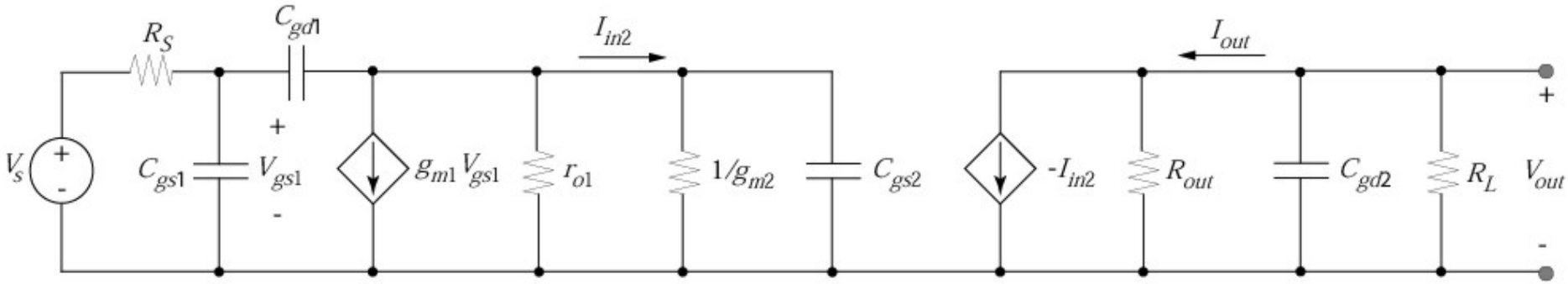
Miller Capacitance of Input Stage

Find the Miller capacitance for C_{gd1}



Input resistance to common-gate second stage is low → gain across C_{gd1} is small.

Two-Port Model with Capacitors



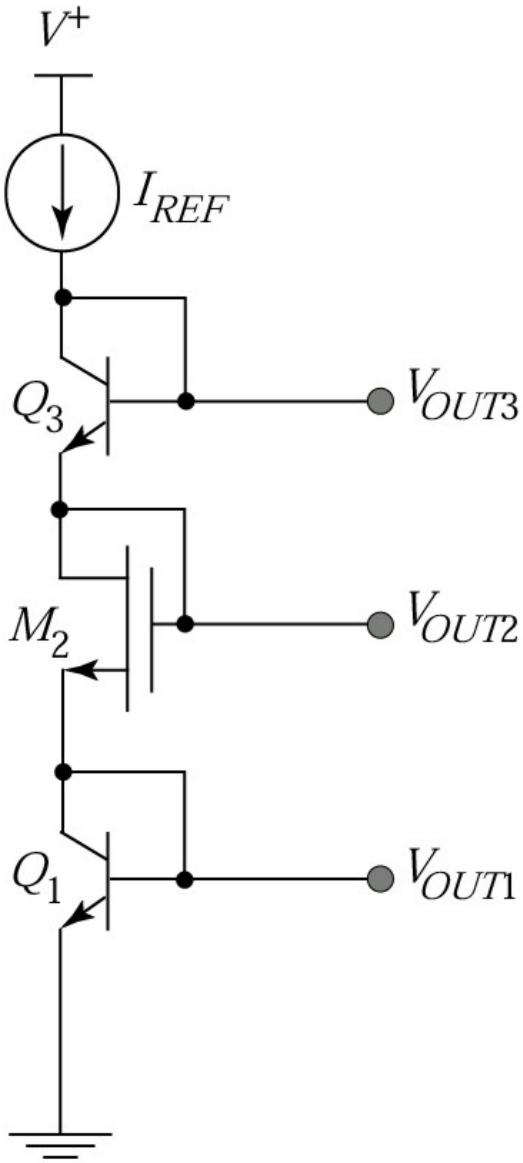
Miller capacitance: $C_M = (1 - A_{vC_{gs1}})C_{gs1}$

Other Cascode Configurations

Basic configuration: transconductance stage
followed by current buffer

CE_n-CG_n CS_n-CB CS_p-CG_n

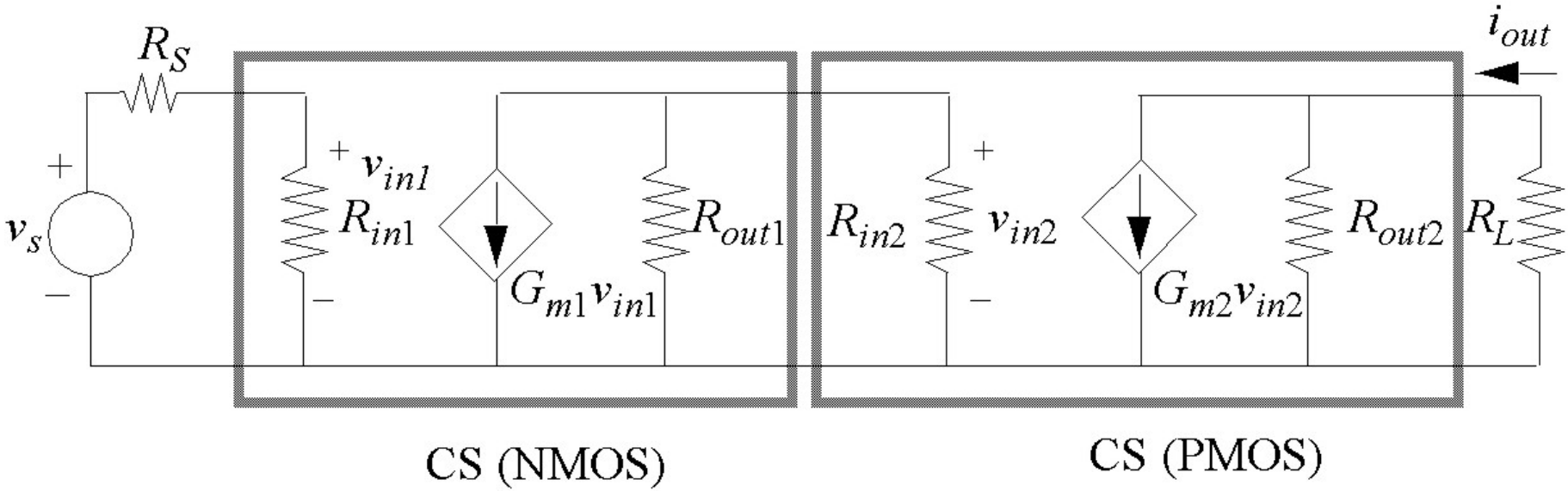
Generating Multiple DC Voltages



Stack-up diode-connected MOSFETs or BJTs and run a reference current through them → pick off voltages from gates or bases as references

Multistage Amplifier Design Examples

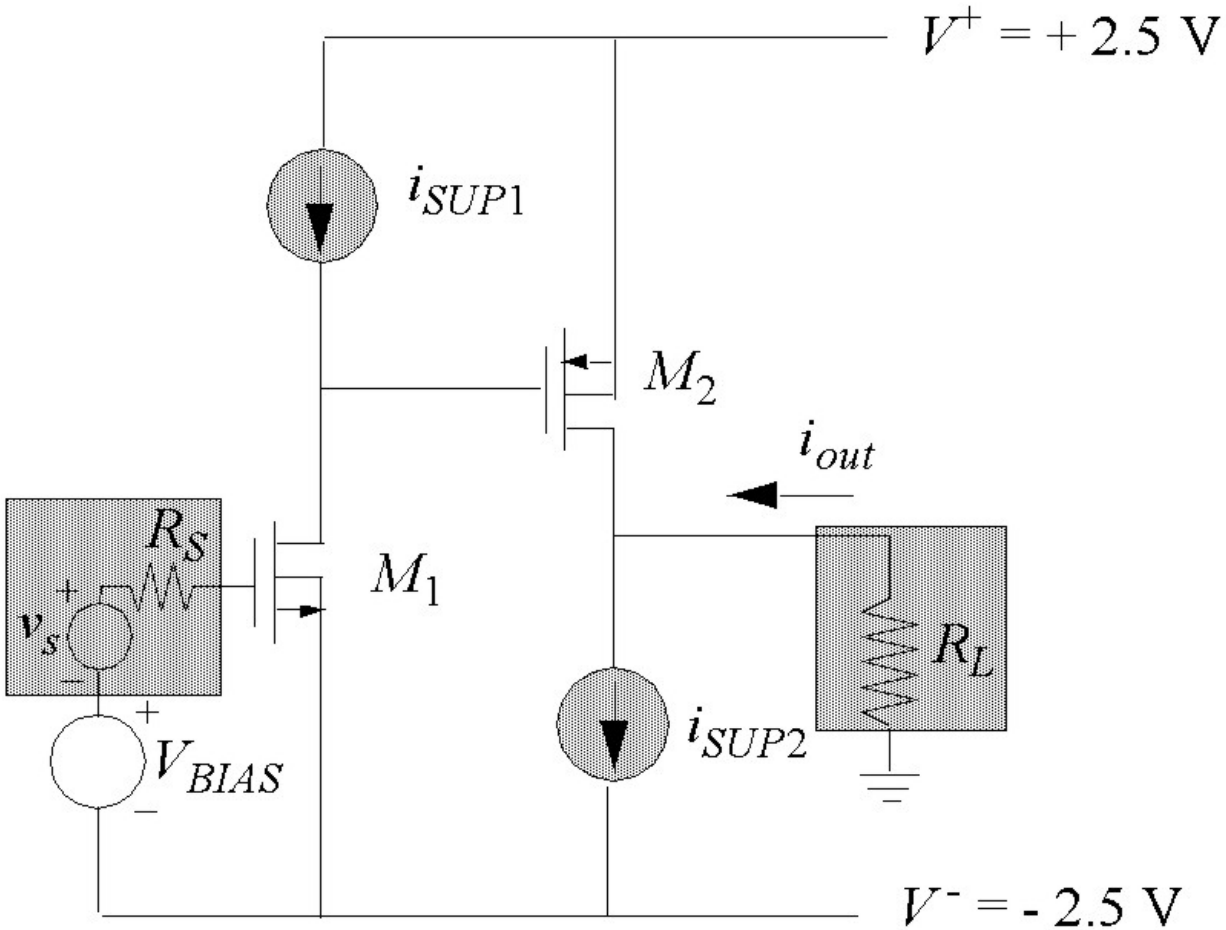
Start with basic two-stage transconductance amplifier:



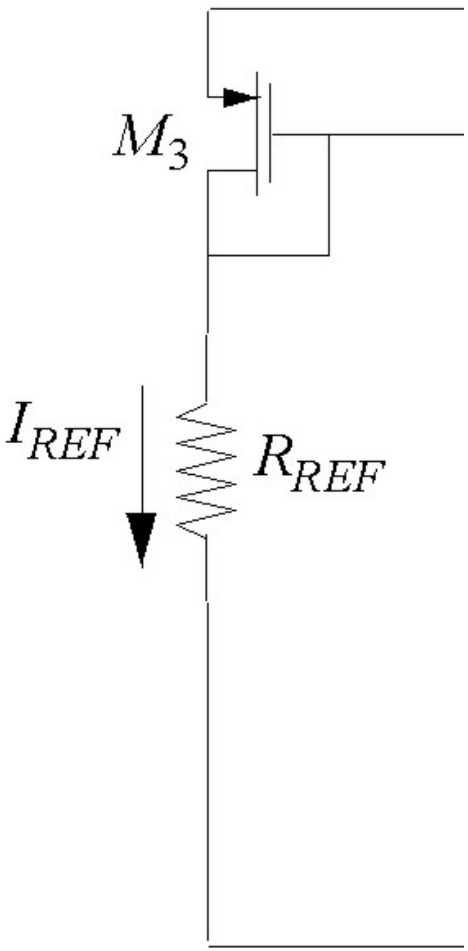
Why do this combination?

Two-Stage Amplifier Topology

Direct DC connection: use NMOS then PMOS



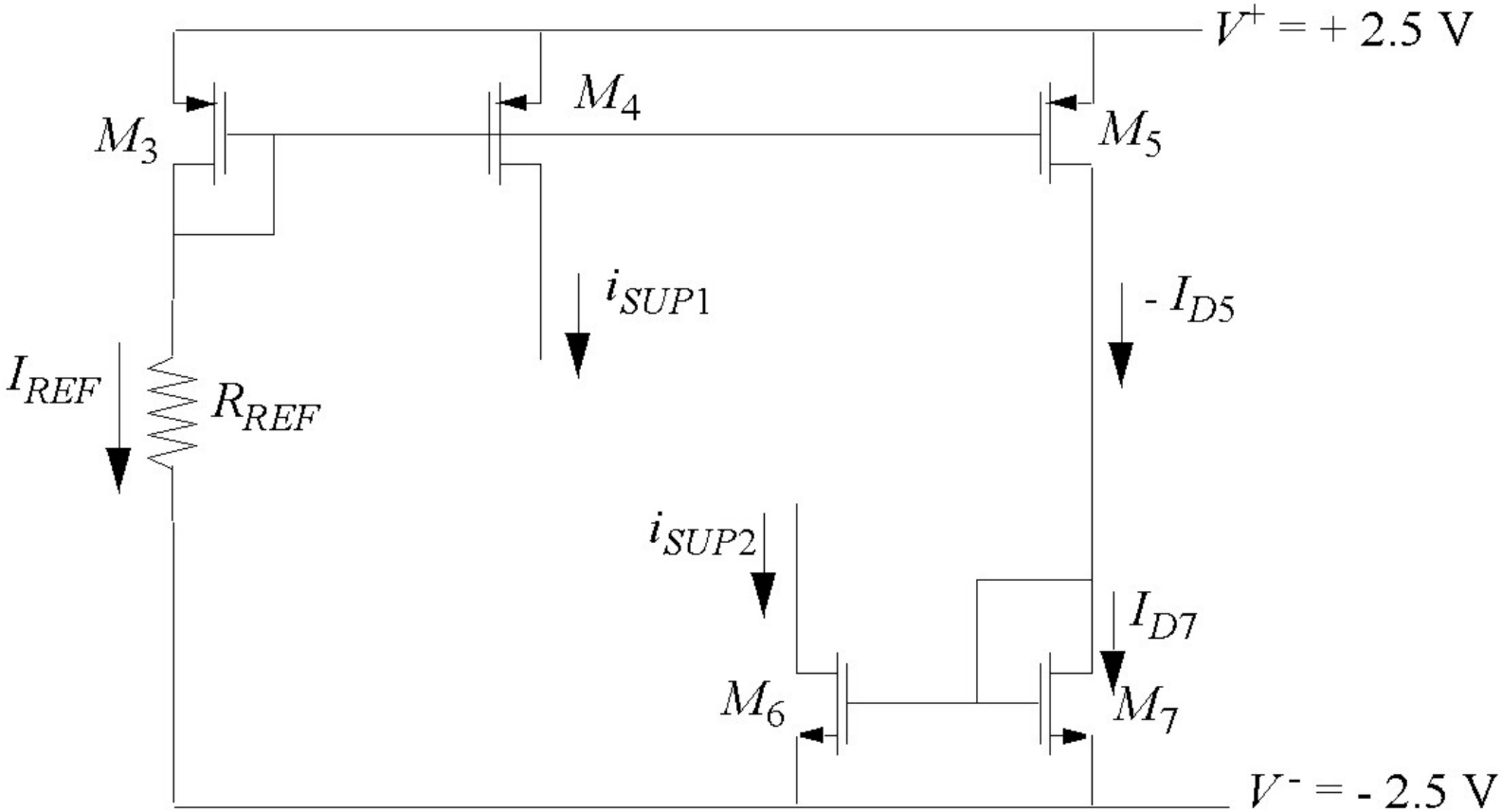
Current Supply Design



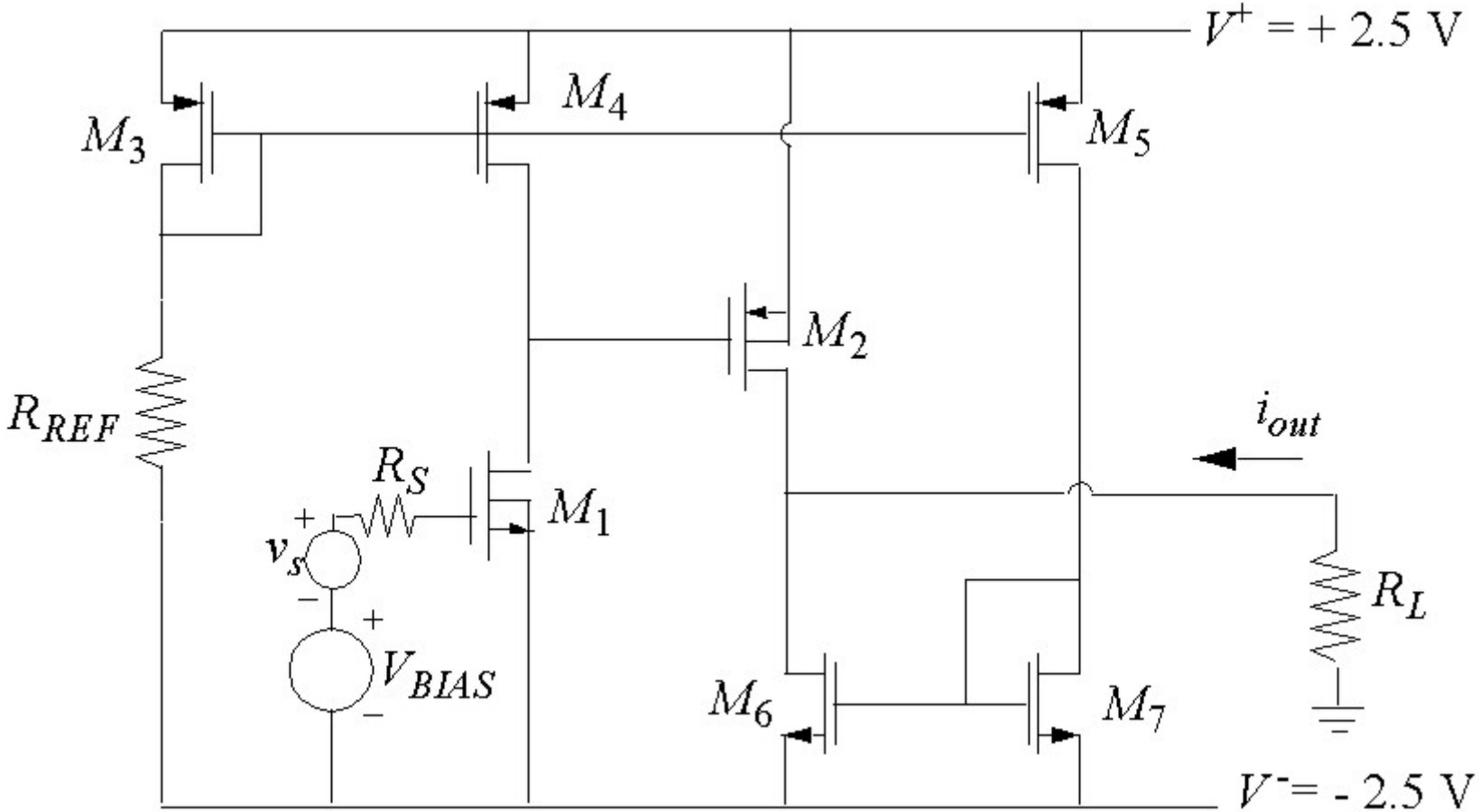
Assume that the reference is a "sink" set by a resistor

Must mirror the reference current and generate a sink for $i_{SUP\,2}$

Use Basic Current Supplies



Complete Amplifier Topology



What's missing? The device dimensions and the bias voltage and reference resistor