Current Mirrors (Part 2 : Implementation)

Objectives

- To collect experimental verification of CMOS current mirror simulations performed during part 1.
- To compare the output resistance, relative error and output voltage swing for four common current mirror configurations.
- To assess tradeoffs between accuracy, voltage swing and complexity in current mirror circuits.

This is a physical lab that should be completed during your regular lab session. The report will be due the following week, and should include the combined results from your simulations (Part 1) and experiments (Part 2).

Materials

- ALD1105 MOSFET array (2)
- 1kΩ resistor (2)
- Breadboard and hookup wire

Equipment

- Dual-output power supply
- Multimeter

Procedures

Procedure 1. Carefully measure the precise value of each resistor. One value corresponds to R_{ref}, and the other to R_L. Be careful not to confuse them when assembling your circuits.

Procedure 2. On a breadboard, construct circuits corresponding (a) through (d) described in Part 1 of this lab assignment. Use N-type devices from the ALD1105 MOSFET array chips (see attached pinout). Make sure the bulk terminals are connected to GND. Connect power supply output A to the reference side of your current mirror, and connect supply output B to the output side.

Procedure 3. On the power supply, set output A as close as possible to the simulated V_{DD} value. Measure the precise voltage drop across R_{ref}. Based on this measurement, calculate the value of i_{REF}. Be careful not to change the setting on output A during the remaining measurements.

Procedure 4. On the power supply, set output B as close as possible to the simulated V_{DD} value. Measure the precise voltage drop across R_L and calculate the output current, i^*_{OUT}.

Procedure 5. Perform a DC sweep experiment by varying power supply output B from 0 to V_{DD} in small increments. For each value, record the voltage from the power supply and the voltage appearing at the current mirror's output terminal. From these measurements, calculate i_{OUT}. Collect at least ten measurement points.

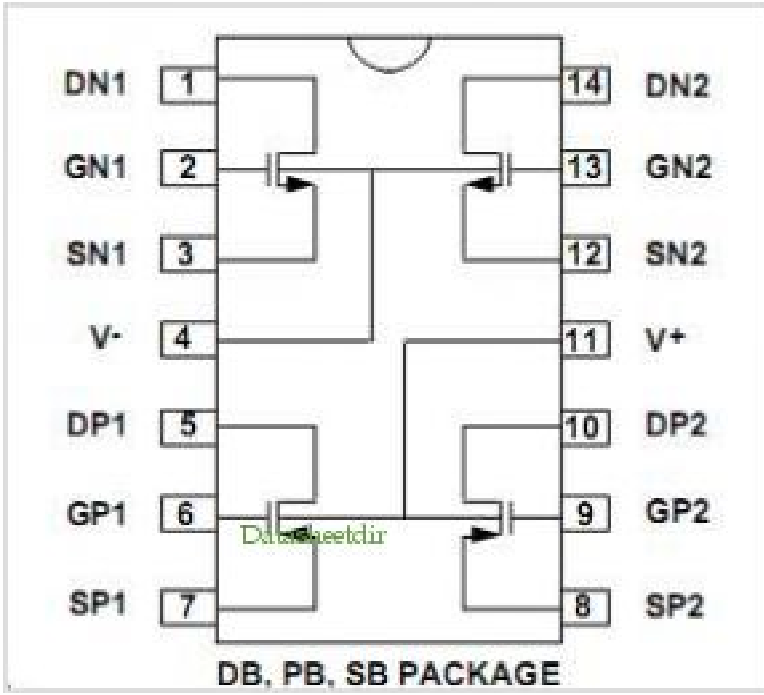
Analysis

Based on your measured data, estimate each mirror's output resistance, relative error and minimum output voltage. How do the measured results compare to your simulated values?

Report

- In your final report, answer the questions asked in Part 1. Present all data in plots created by Matlab or Octave.
- How well do the experimental results agree with the simulated predictions? Explain any discrepancies.
- Based on the comparative results for each circuit, describe the **design tradeoffs** related to current mirror circuits' complexity, accuracy and voltage swing.

ALD1105 Pinout:



And a quick reminder about device symbols:

(The bubble may or may not appear on a PMOS device symbol).