Objective

In this assignment, you are to design active-cascode gain-enhancement structures for the folded-cascode amplifier you designed in HW#2 and investigate its settling behavior.

You need to configure your amplifier in feedback as shown in the diagram below. The total capacitive loading should be close to 5 pF. You may use an ideal level shifter plus two large resistors as your CMFB circuit in this assignment. You are free to choose the input CM bias (at $V_{id}$ side); the output CM bias (at $V_{od}$ side) must be set to close to $V_{DD}/2$.

Note that the goal of this exercise is NOT to obtain a high settling speed with minimum power consumption. The goal is to study the dynamics of the active-cascode structure.

1. Construct your four active-cascode circuits using ideal VCVS or VCCS plus some resistors and capacitors to emulate the finite-bandwidth effect of the circuits. Make the circuit work. Try to shoot for an overall DC gain of over 80 dB if possible.

2. Sweep the unity-gain bandwidth of the active cascodes and observe the step response (settling behavior) of your overall amplifier. Can you observe all three types of the settling behavior covered in class?

3. Repeat Part 1 by replacing the ideal aux. amplifiers with real transistor-based circuits. Make the circuit work. Pay attention to the input/output CM levels of your aux. amplifiers.

4. Repeat Part 2 and sweep the bandwidth of the boosters (by adding a capacitor at the output node of each booster). Can you still observe all three types of settling behavior?

5. In both Parts 2 and 4, how does the P-side or N-side booster individually affect the settling behavior of the amplifier? Depending on your particular design, your input signal path may travel on the N- or P-side. Does the settling behavior seem to depend on this?
Report Guideline

Write a concise report, not exceeding 3 pages of text and 2 pages of figure. It is very important that you show your results clearly. Please typewrite your report with simulation results/figures attached.

Teamwork Policy

Individual works are expected. Discussion with others in class is encouraged. However, please submit a genuine report and design. No sharing of SPICE decks.