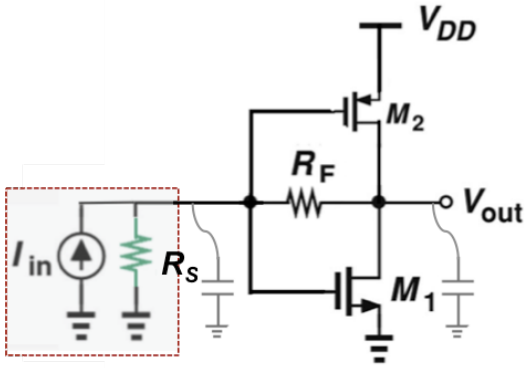
Homework III – Shunt-Shunt Feedback Amplifier
Due date : 2022. 11. 28 10:00pm
First release : 2022. 11. 14

This homework is for you to design a **shunt-shunt feedback transimpedance amplifier (TIA)**. The problem sets include HSPICE simulations and the hand calculations. The SPICE model is cic018.l. Please use the parameters from HSPICE simulation results for hand calculations.

Please note again:

1. Please hand in your report using eeclass system.
2. 若無於繳交期限前，先行向老師說明並獲許可，作業一律不同意補交!
3. 嚴禁抄襲(參考)!
4. Please generate your report with pdf format. At first page please add your student ID and name. Try to make the information "readable". (Note: Don't use black color in background for your screen capture figures). (Without performance table, -10pt)
5. Please hand in the spice code file (.sp) for each item of work. Do not include output file.
6. Please fill the number into HW3.xls. (Without excel file, -20pt)
7. Please do not zip your report.
8. Please write down the "values" associated with each variable in the equations. Do not just give answer directly.

In this circuit, please use V_{DD}=1.5V. The shunt resistance R_F is assumed *3KΩ*. Input and output nodes are both with *0.5pF capacitance*. Input current source is assumed with *100KΩ* source impedance R_S.



(Current-reuse transimpedance amplifier)

Please design your core amplifier M1, M2, to get the transimpedance DC gain (V_{out}/I_{in}) within 3KΩ ± 5%. And its bandwidth (-3dB point to DC gain) has to be wider than 200MHz.

(a) Please use **.op** command to print out the device parameters. And use the parameters from HSPICE to hand-calculate the results.

(b) Please calculate the open-loop gain.

(c) Please use **.tf** command to print out the gain, input and output impedances. And compare the simulation results with the hand calculations using the small signal parameters from (a).

(d) Plot this feedback amplifier frequency response and mark the bandwidth (DC gain -3dB point) and the poles, zeros. Please use **.pz** command and print out the data. And compare the simulation results with the hand calculations using the small signal parameters from (a).

(e) The FoM in this design is "Bandwidth (MHz) / Current (mA)". Try to maximize this FoM.

(f) Please discuss your design flow and results, especially on the loop gain and device size selection.

Working Item	Specification	Simulation result	Hand calculation
Vdd	1.5-V		
$I_{\_GND}$ current (mA)	(mA) (#2)		
Transimpedance gain (KΩ) (for shunt Resistor 2KΩ)	3KΩ ± 5%		
core amp size (W/L_1, W/L_2)			
core amp gm (gm_1, gm_2)			
core amp ro (ro_1, ro_2)			
Bandwidth (-3dB) (MHz)	> 200 MHz (#1)		
Closed-loop poles/zeros (p1, p2, z1)			
Closed-loop input impedance			
Closed-loop output impedance			
FoM (MHz)/(mA)	(#1) / (#2)		