2-Stage OpAMP Design (1st stage -> NMOS Diff Amp, 2nd stage -> PMOS CSA)

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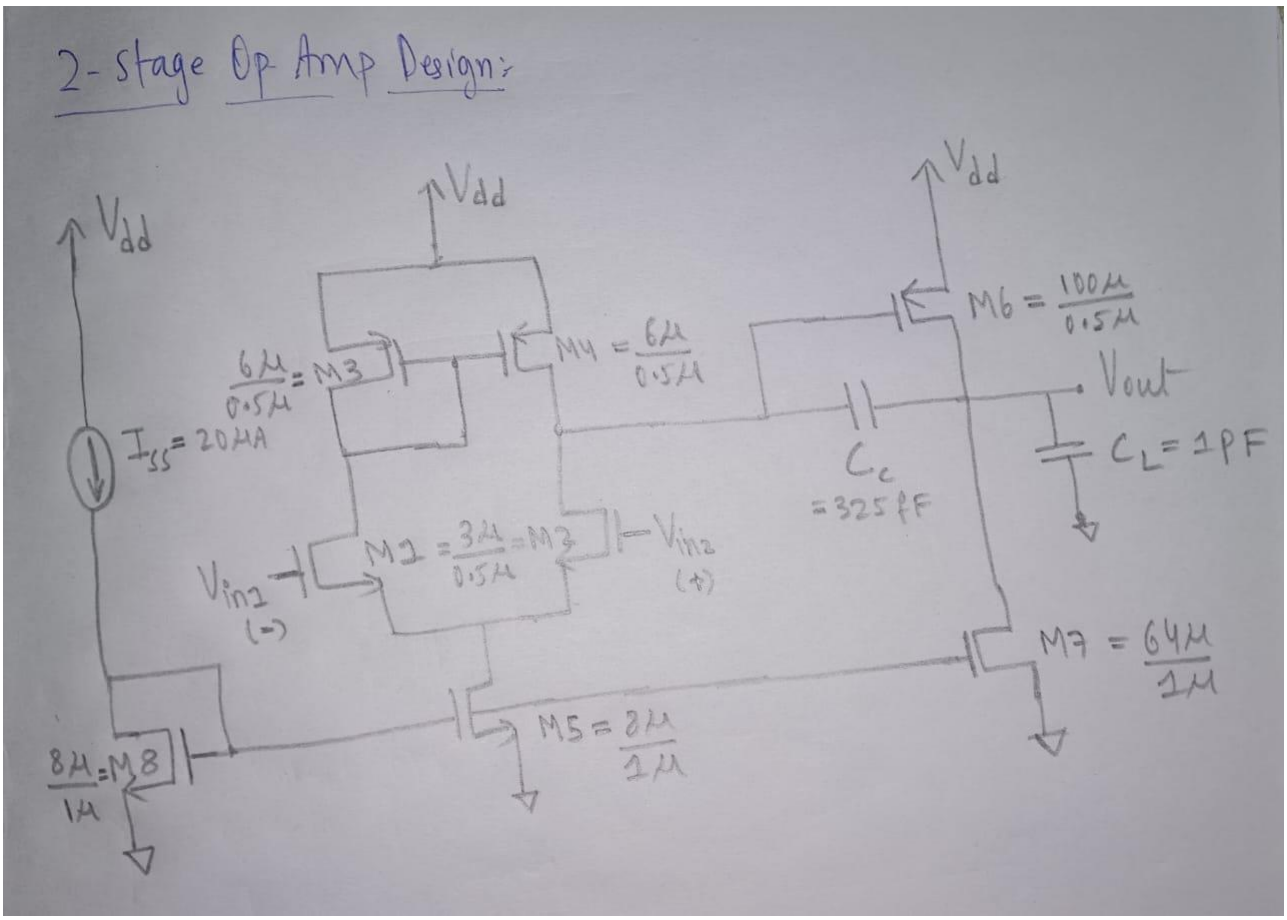
Required Specifications of the Design:

Low Frequency Gain (DC Gain)	1000 (60dB)
Gain x Bandwidth product	50 MHz
Phase Margin	60 deg
Slew Rate	30 V/usec
Load Capacitance	1 pF

VDD	1.8 V
ICMR(+)	1.6 V
ICMR(-)	0.8 V
Power	400 uW
Technology	UMC-180 nm



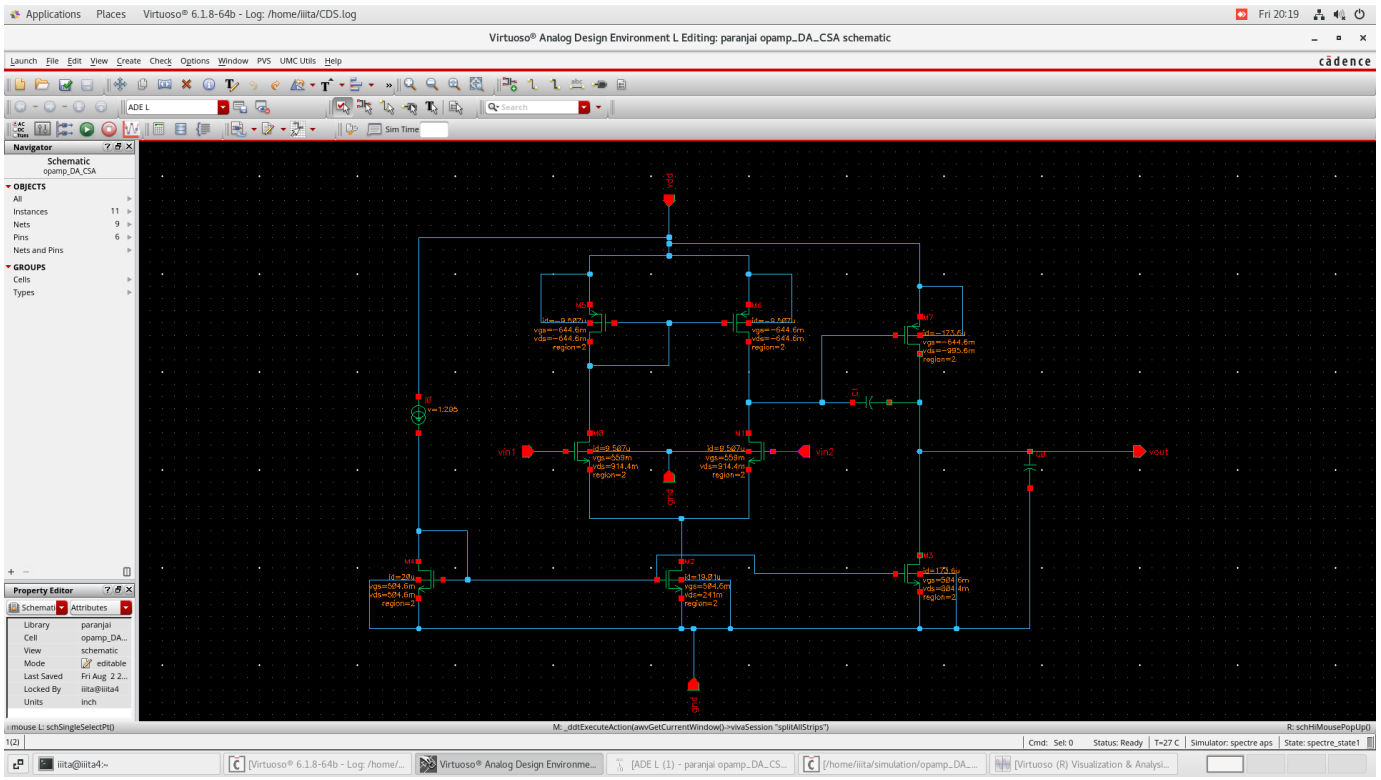
Design Parameters after Final Tuning:

Channel Length (L)	500 nm
Compensation Capacitance (C_c)	325 fF
Tail Current (I_{ss})	20 uA
M1, M2	(w/l) = (3u/0.5u)
M3, M4	(w/l) = (6u/0.5u)
M6	(w/l) = (100u/0.5u)
M7	(w/l) = (64u/1u)
M5, M8	(w/l) = (8u/1u)

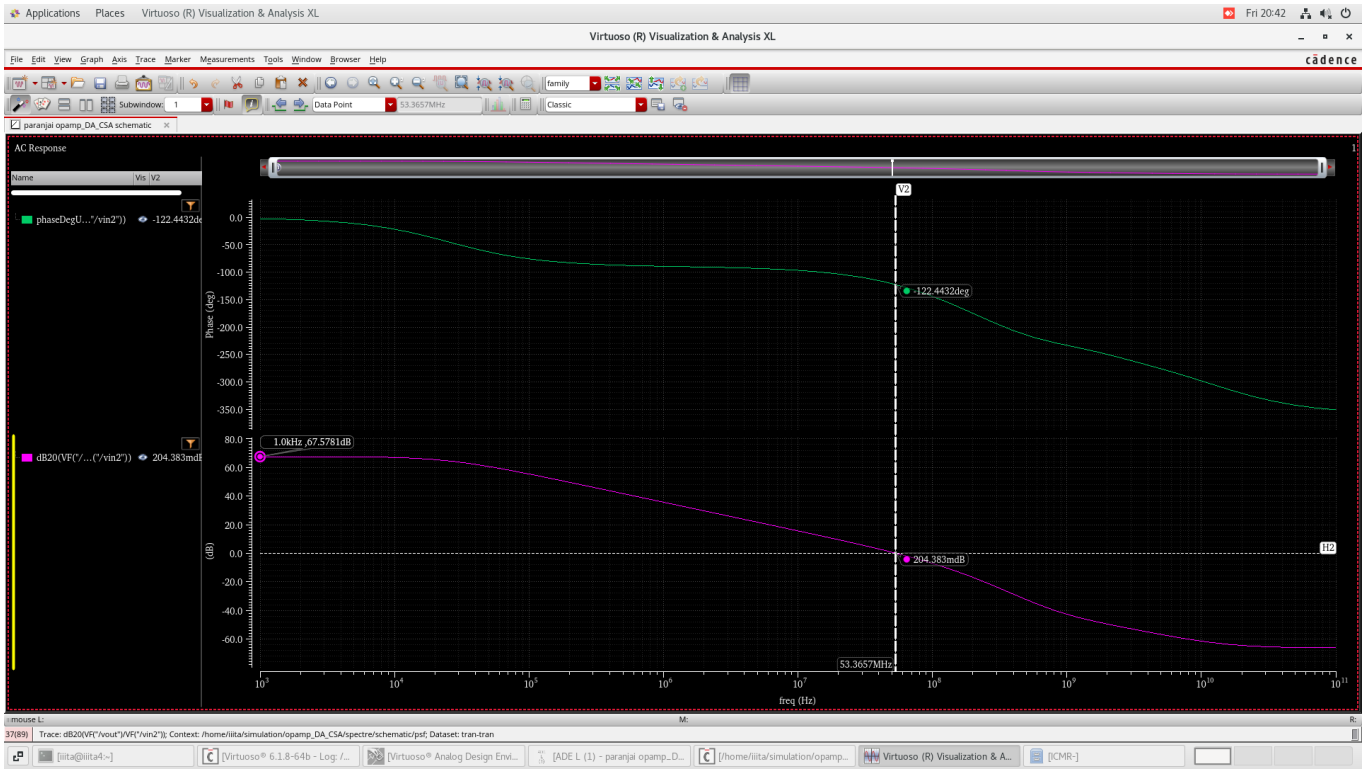
Sample Outputs

1) Vin = ICMR(-)

Schematic : (The DC operating point of each MOSFET is annotated beside)



Gain and Phase Plot:

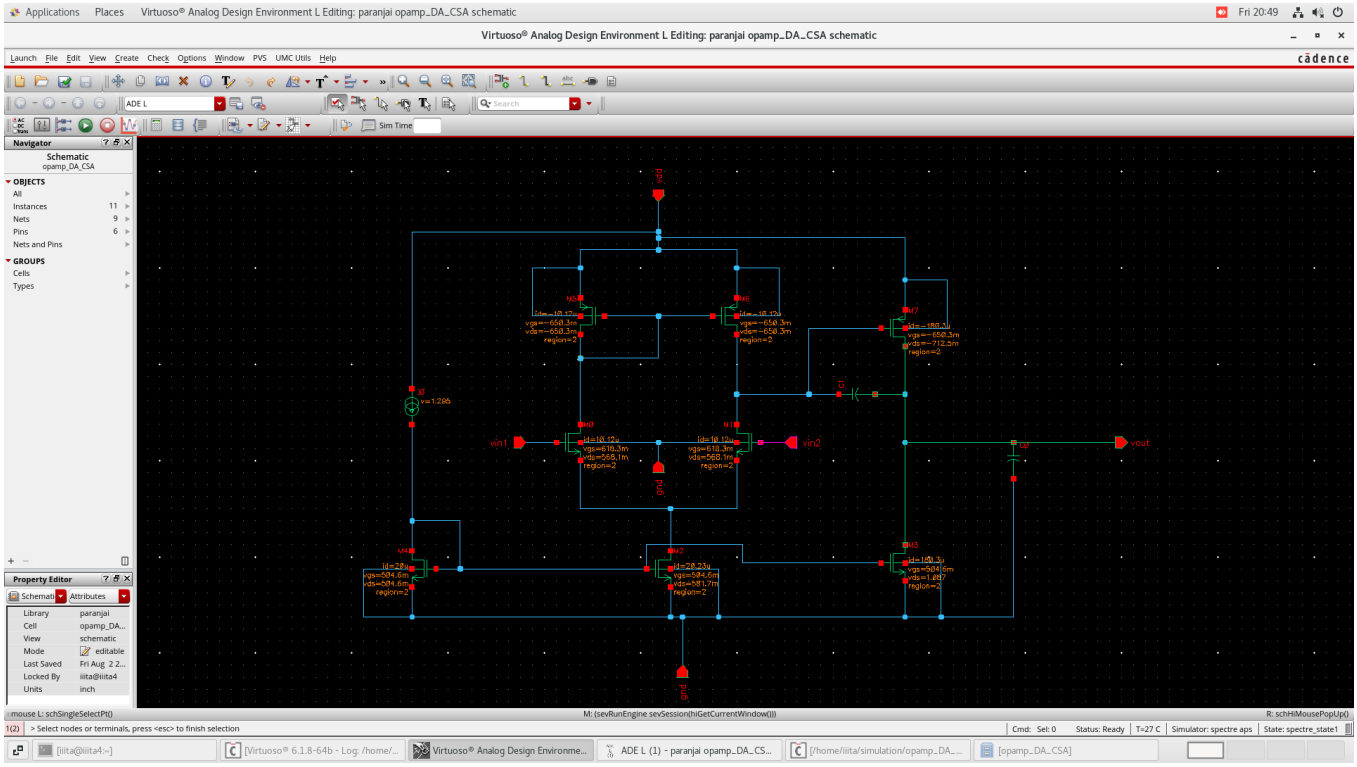


Obtained:

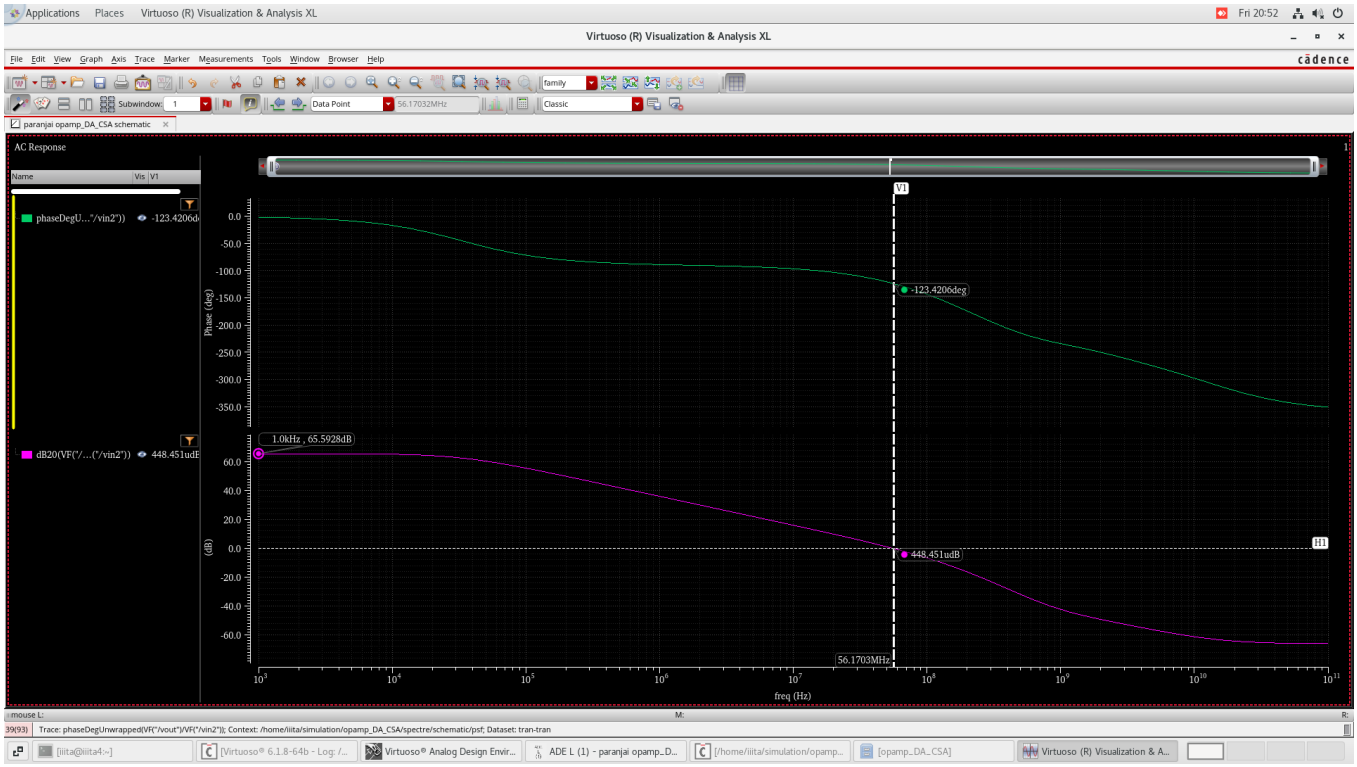
DC Gain = 67.5781 dB	Bandwidth = 53 – 54 MHz	Phase Margin = 57.5568 deg	Power = 346.698 uW

2) Vin = 1.2 V

Schematic: (The DC operating point of each MOSFET is annotated beside)



Gain and Phase Plot:

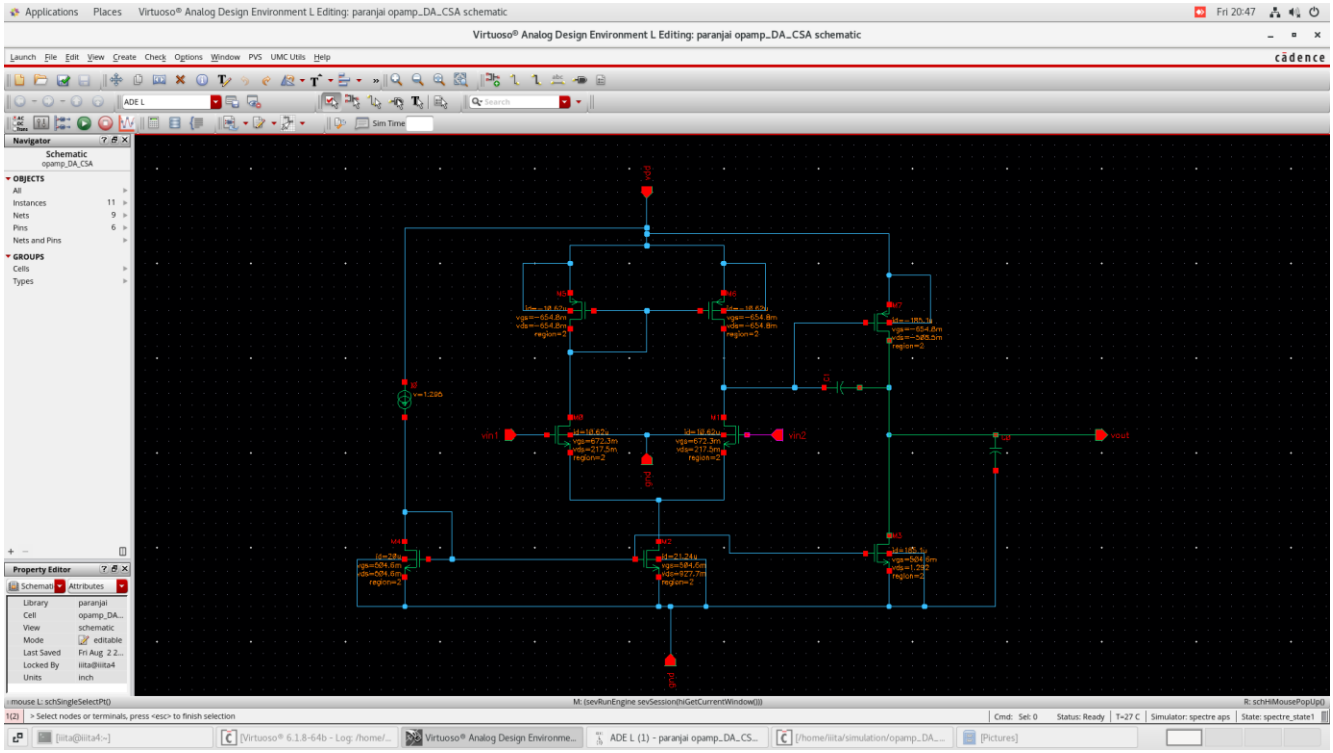


Obtained:

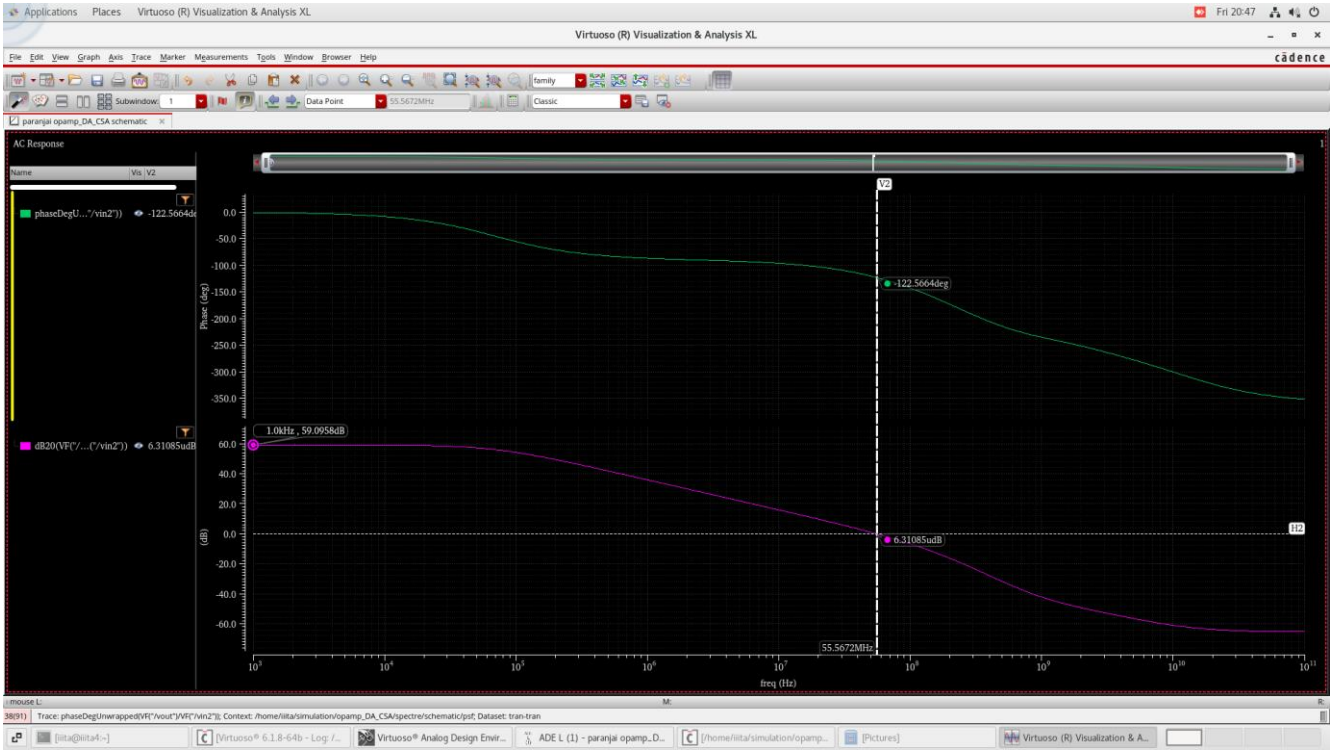
DC Gain = 65.5928 dB	Bandwidth = 56-57 MHz	Phase Margin = 56.5794 deg	Power = 360.954 uW

3) Vin = ICMR(+)

Schematic: (The DC operating point of each MOSFET is annotated beside)



Gain and Phase Plot:



Obtained:

DC Gain = 59.0958 dB	Bandwidth = 55-56 MHz	Phase Margin = 57.434 deg	Power = 371.412 uW

Obtained Slew Rate and Power of the Design:

Slew Rate	61.5 V/usec
Average Power	359.688 uW