**A REPORT**

**ON**

**ANALOG ASSIGNMENT**

Submitted in partial fulfillment of the course

**Analog & Digital VLSI Design**

BY

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**Ques 40.**

**Design a two stage single-ended output OPAMP(differential +gain stage) for the following specification**

**a) Analysis of all equations of your design, with a systematic derivation of all transistors W/L ratios and spectre simulation of circuit for the following specifications.**

**i) DC gain ≥ 80 dB**

**ii) UGB ≥ 400MHz**

**iii) Output voltage swing ≥ 2V**

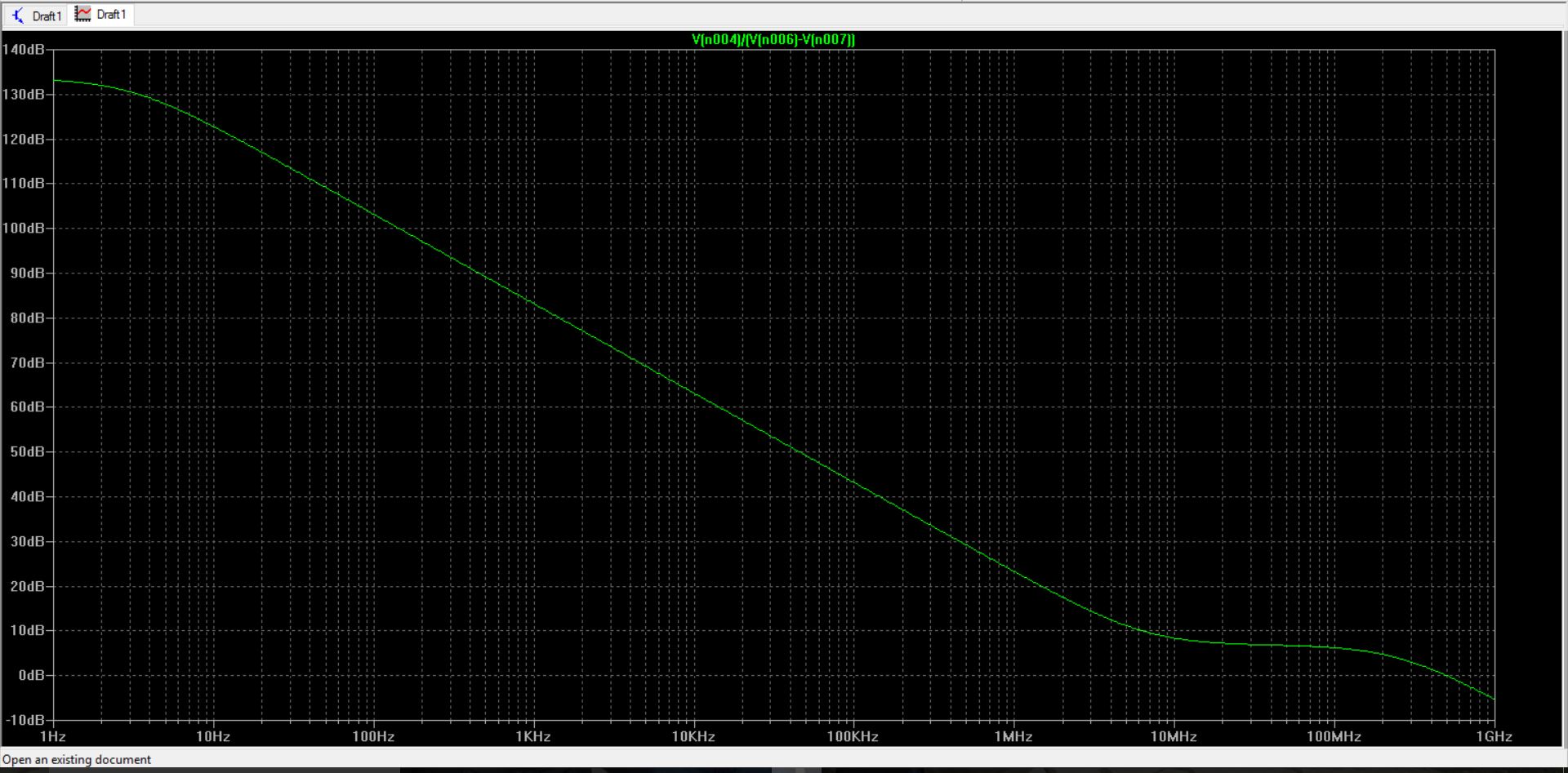
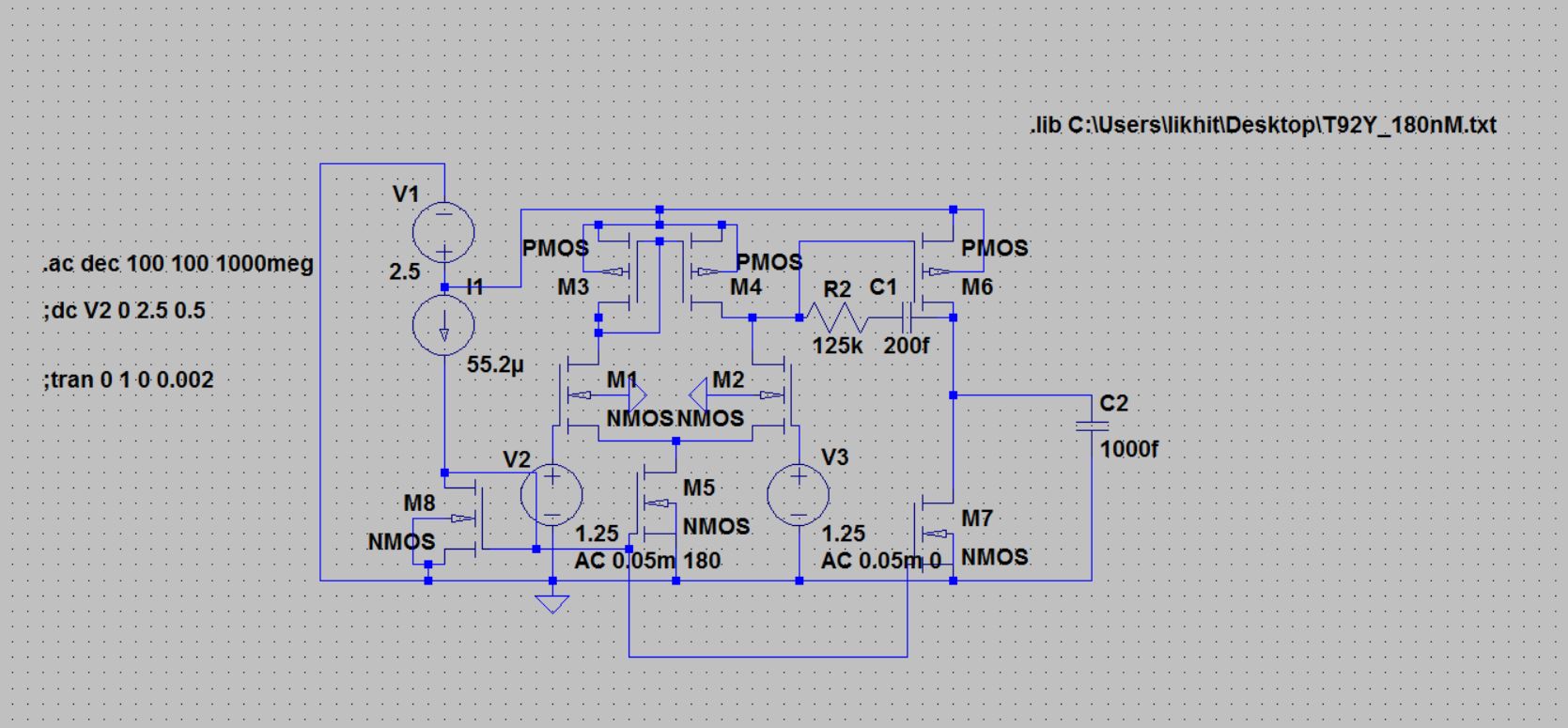
**iv) PSRR ≥ 120dB**

**v) Output offset voltage ≤ 40mV**

**b) Show a biasing circuitry to bias all the voltages in your design (except the input).**

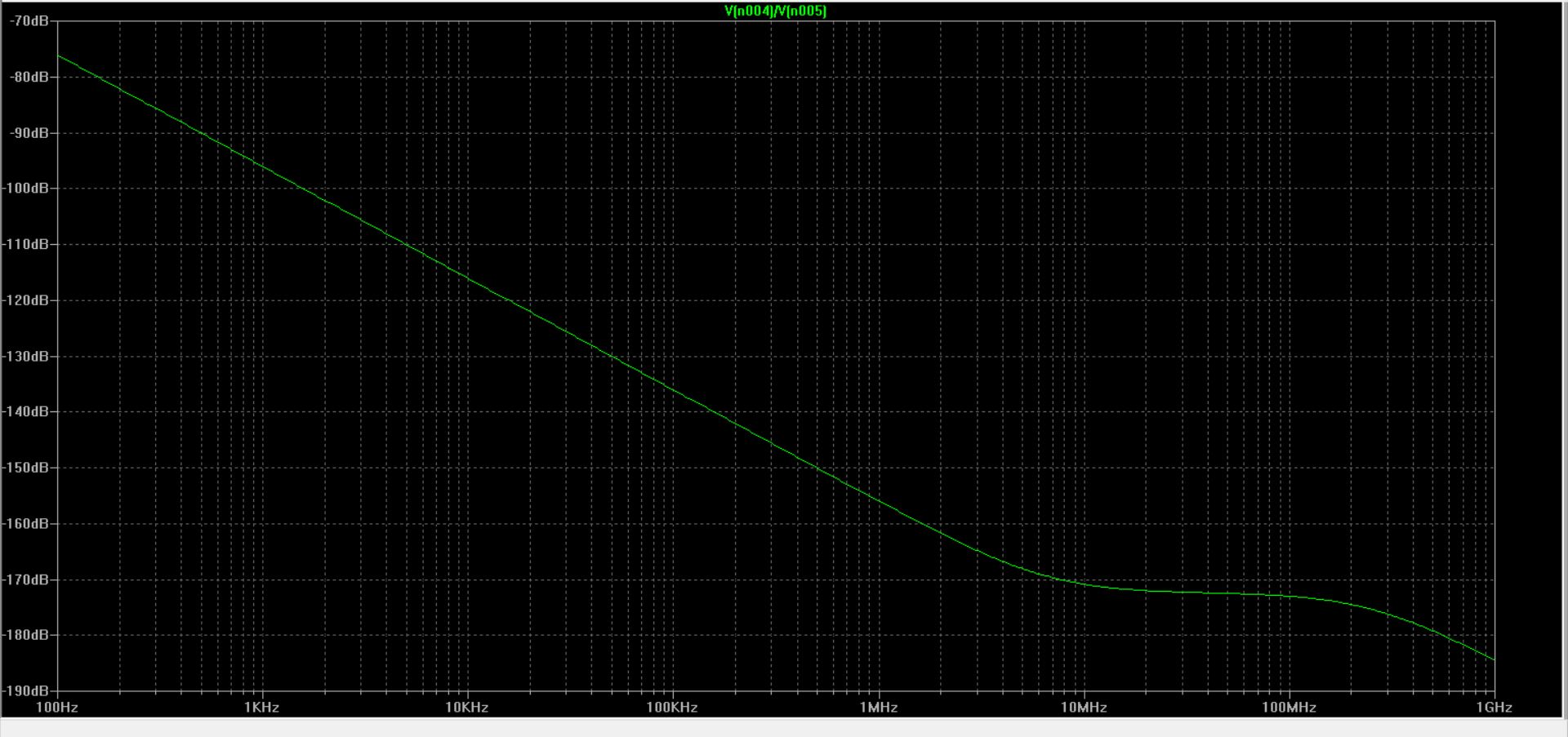
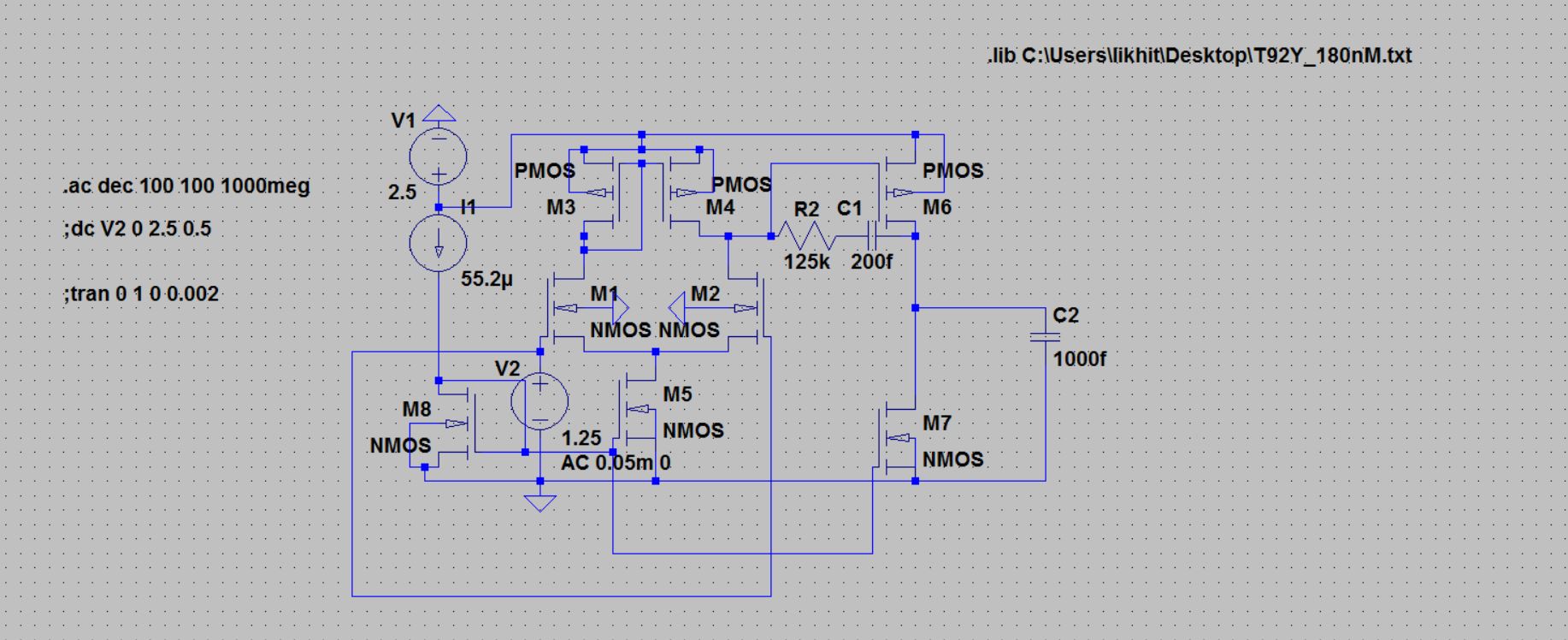
**c) STB analysis to calculate the closed loop gain and phase margin for the OPAMP.**

**d) Calculate and plot the following parameters for your OPAMP: DC gain, Bode plot for AC gain and phase, CMRR plot, ICMR plot, PSRR plot, slew rate, settling time, Output voltage swing (dc + Transient), power consumption, and input and output offset voltage.**

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**Differential Mode Gain Schematic and Plot**

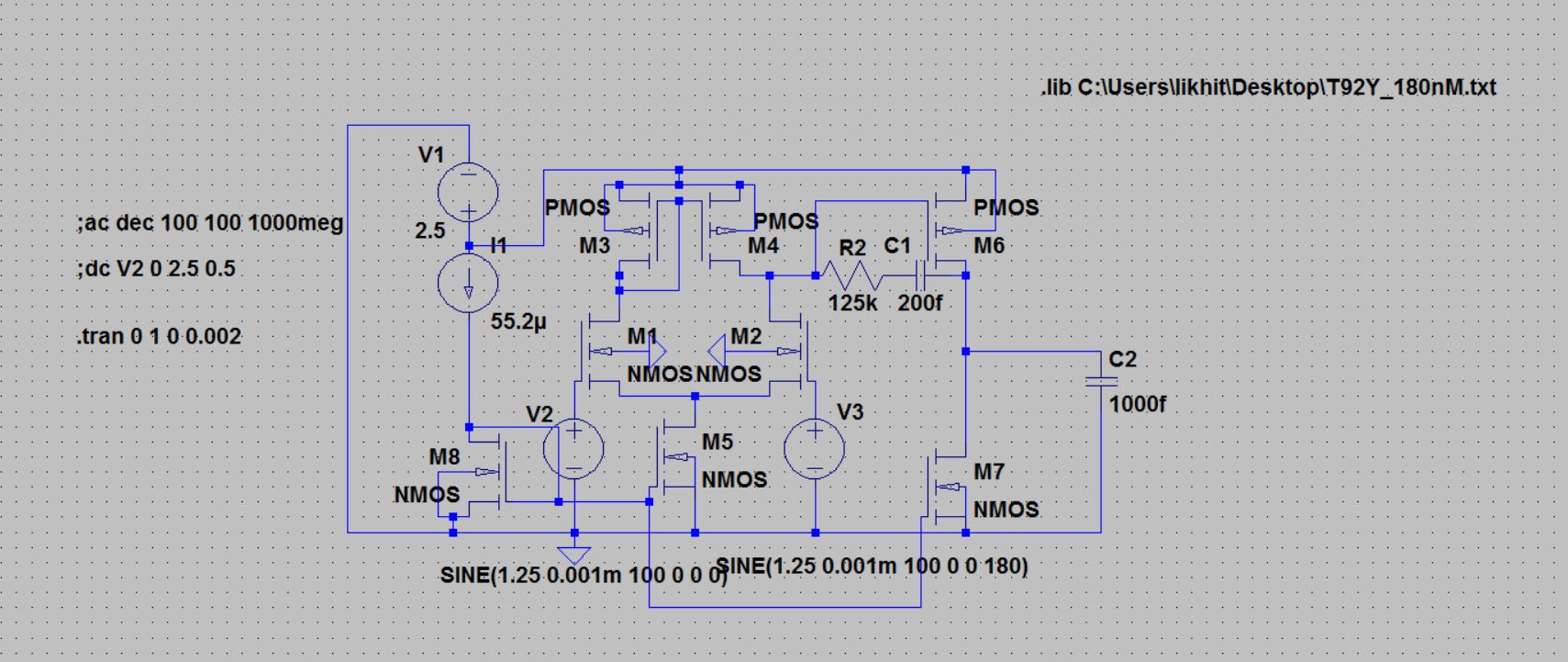
**Adm = 132 dB (approx.)**

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**Common Mode Gain Schematic and Plot**

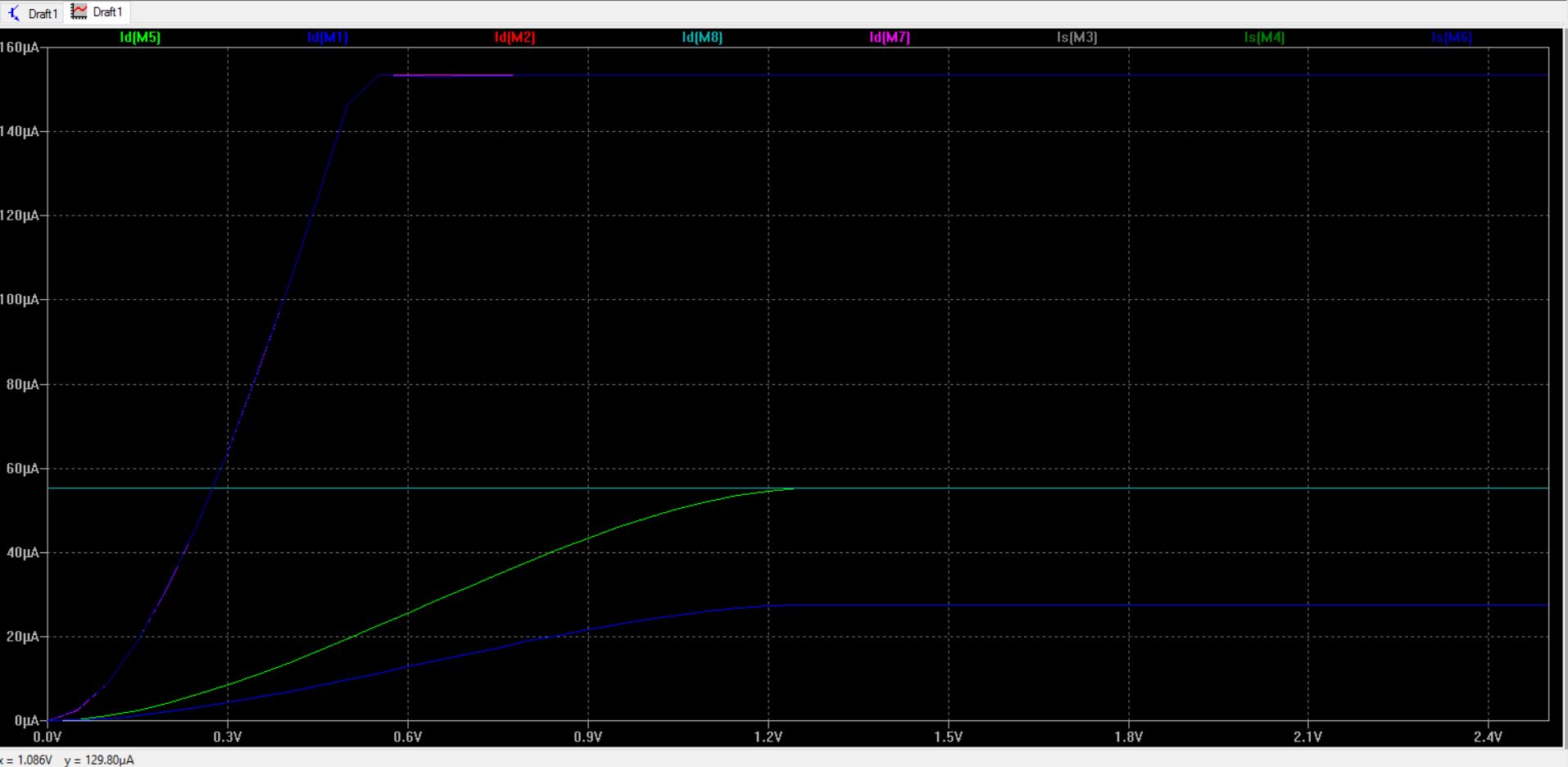
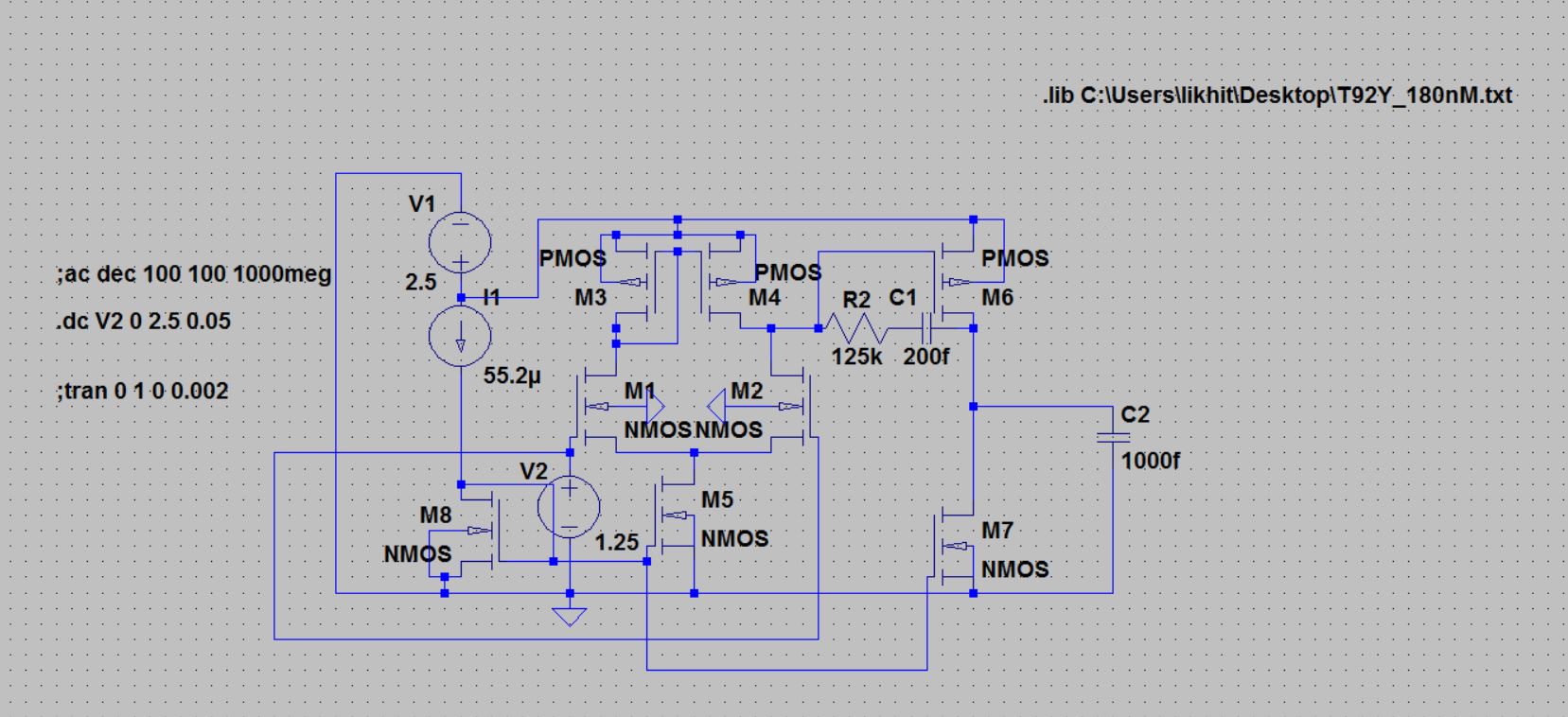
**Acm = -78 dB ( approx.)**

**CMRR = Adm(dB) – Acm(dB) = 210 dB(approx.)**

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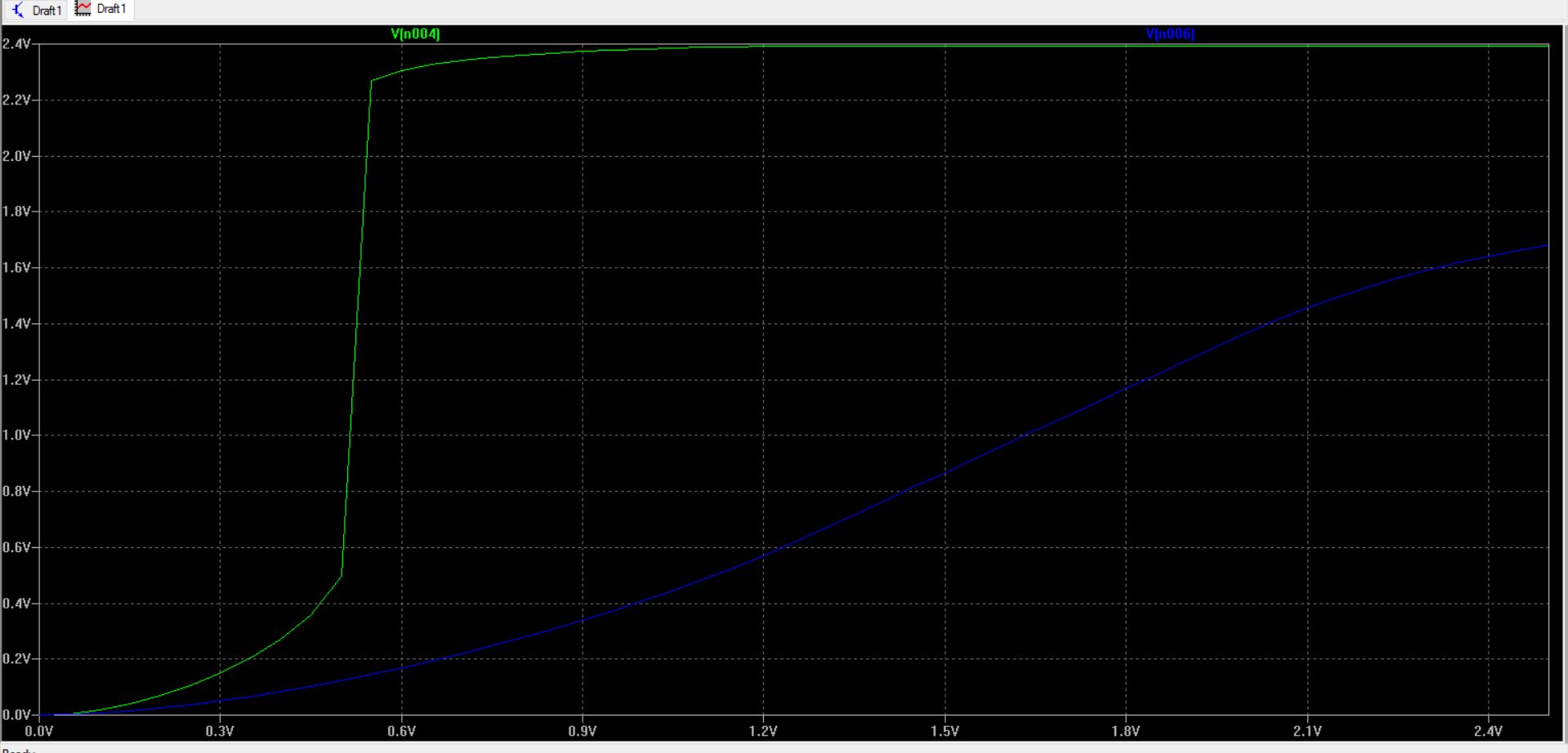
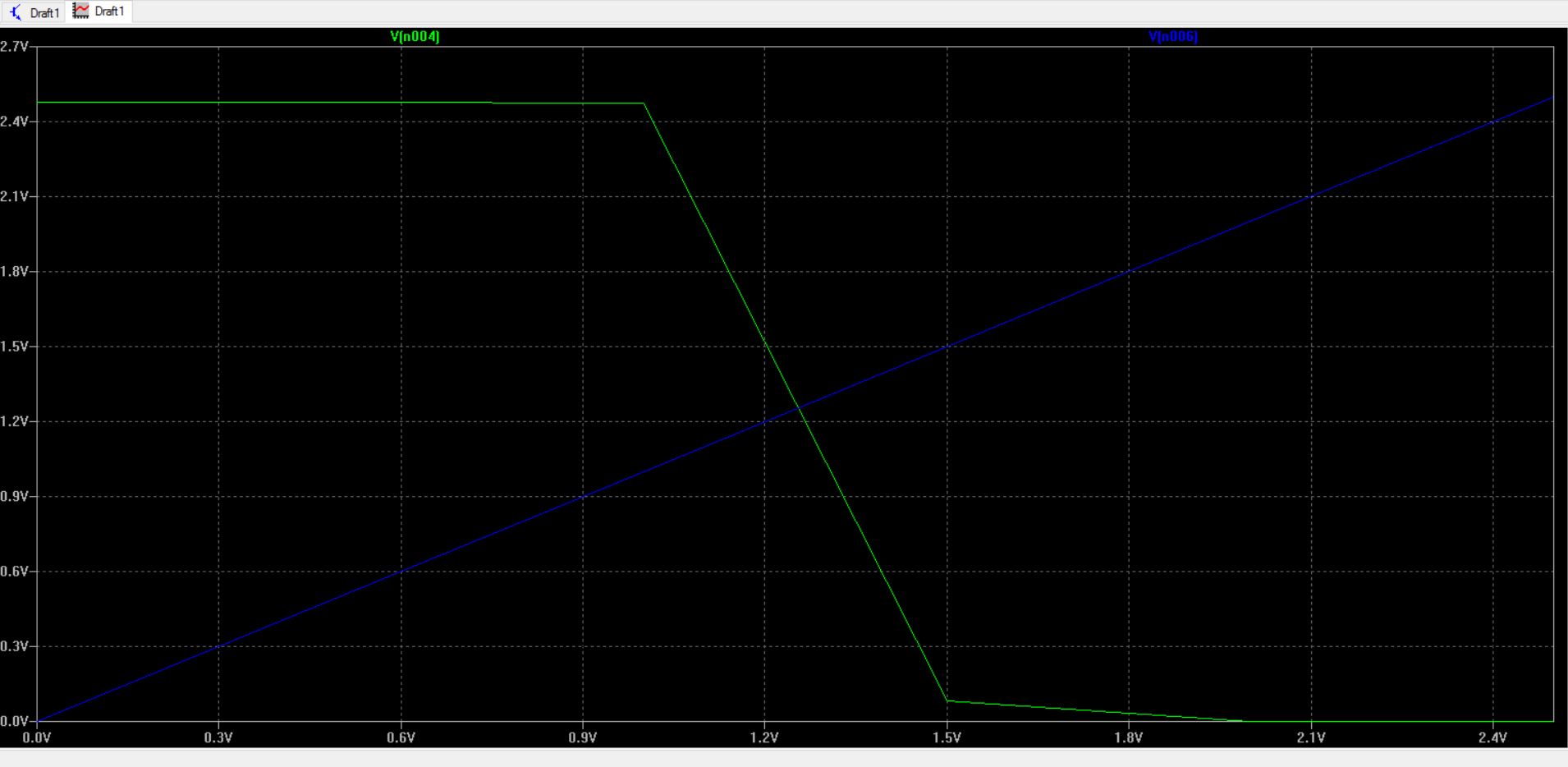
**DC Gain Schematic and Plot**

**DC Gain = 85 dB (approx.)**

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**ICMR Schematic and Plot**

**ICMR = 2.5 V – 1.2 V = 1.3V**

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**Output Swing Plot**

**Output Swing = 2.4 V**

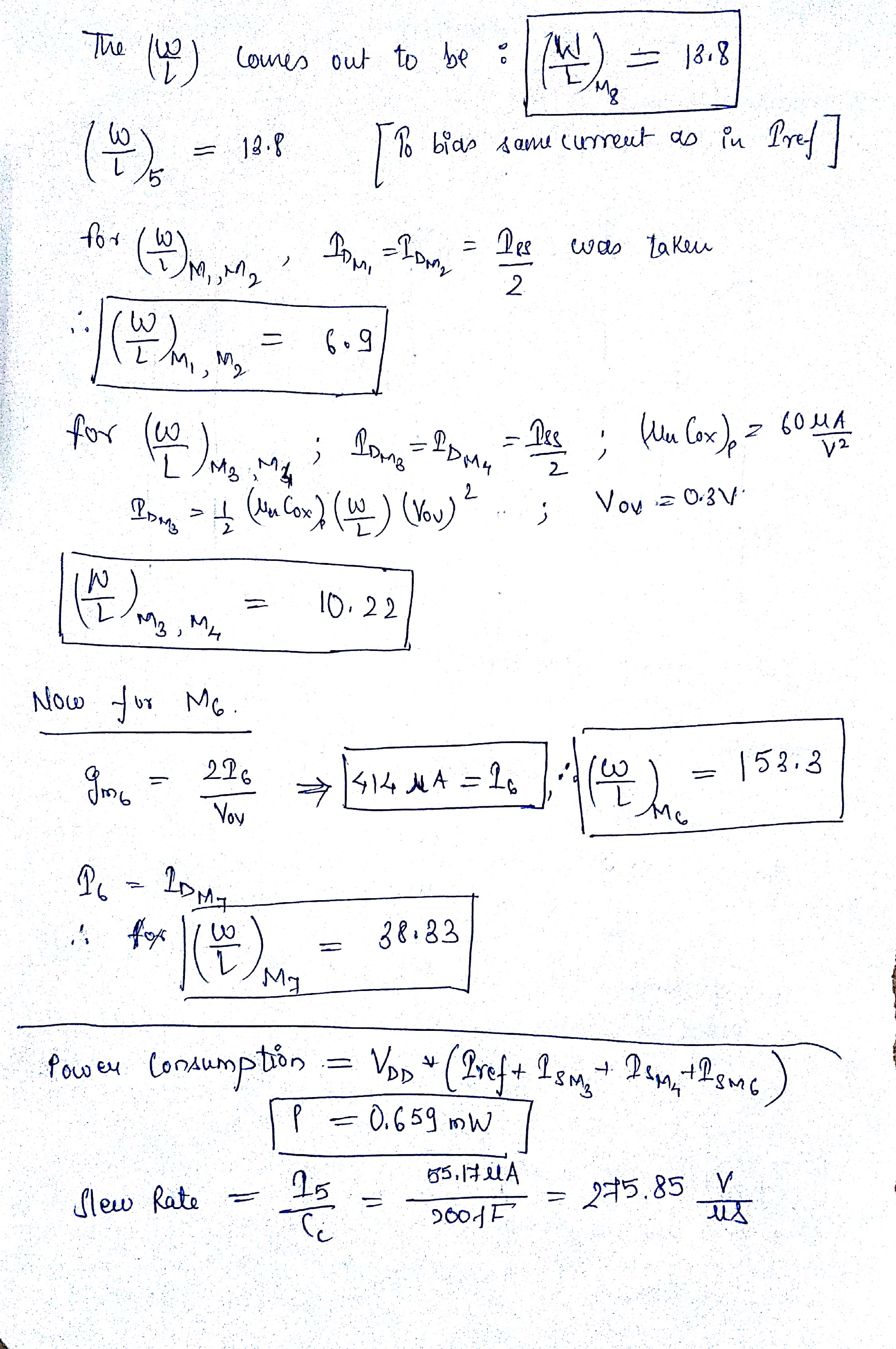
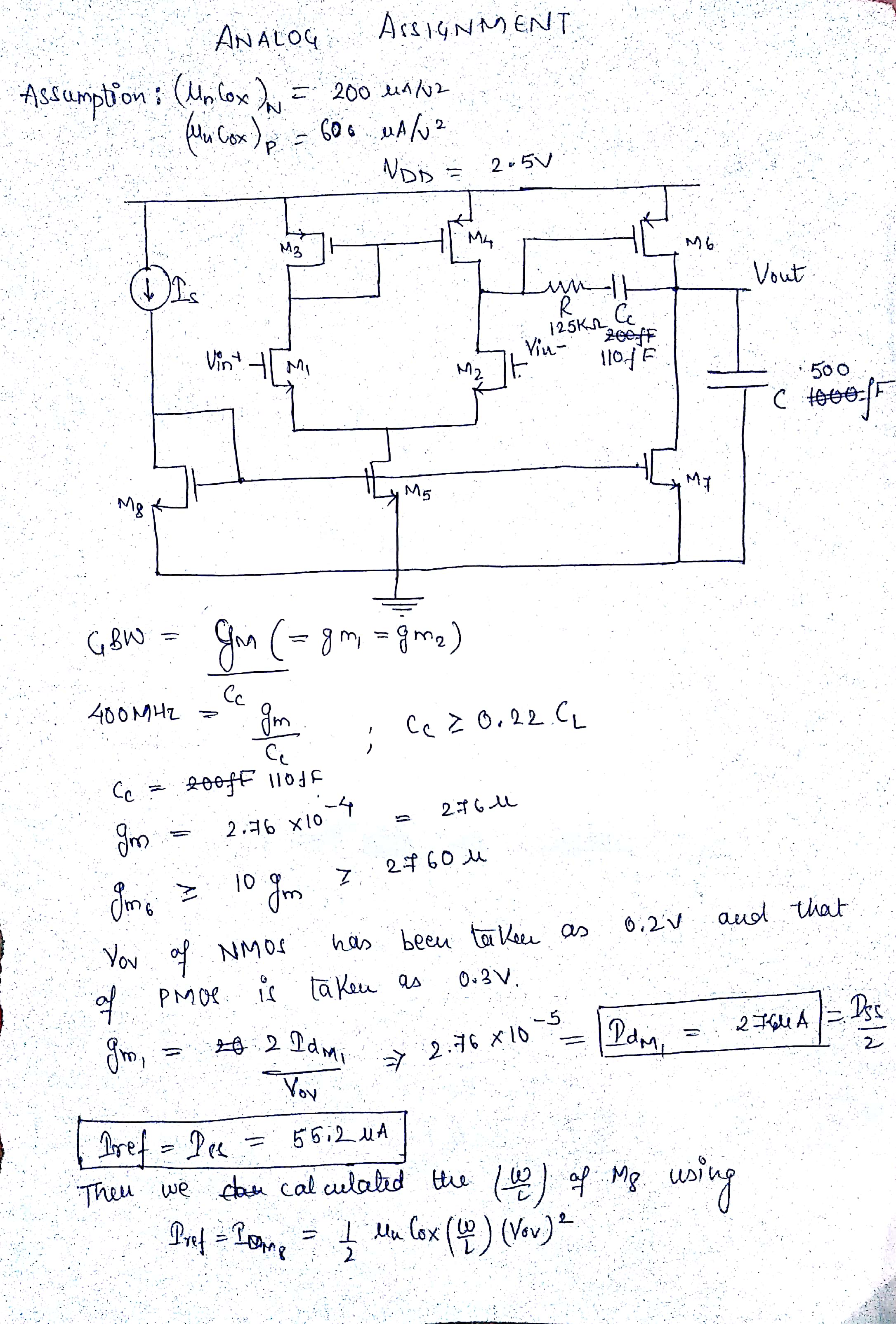


**PSRR Plot (change in Vdd/change in Vout)**

**PSRR [dB]=20\*log((change in Vdd/change in Vout)\*Gain)**

(Add the above graph with Adm graph for different frequencies)

**Hand Calculations :**



|  |  |
| --- | --- |
| MOSFETs | W/L ratios |
| M1 | 6.9 |
| M2 | 6.9 |
| M3 | 10.22 |
| M4 | 10.22 |
| M5 | 13.8 |
| M6 | 153.3 |
| M7 | 38.33 |
| M8 | 13.8 |

Table 1: W/L values for all MOSFETs

|  |  |  |  |
| --- | --- | --- | --- |
| SL No. | Quantity | Value | Required specs |
| 1. | DC gain | 85 dB | >=80 dB |
| 2. | Output Swing | 2.4 V | >=2 V |
| 3. | ICMR | 1.2 V – 2.5 V | - |
| 4. | Slew Rate | 275.85 V/µs | - |
| 5. | Power dissipation | 0.659 mW | <=3mW |
| 6. | Input Offset Voltage | 0 V |  |
| 7. | Output Offset Voltage | 0 V |  |
| 8. | PSRR | 130 dB | >=120 dB |
| 9. | UGB | 500 Mhz | >=400Mhz |

Table 2: Calculated and required specs