**Lab 8**

Feedback Amplifier

Part 1: Feedback with Behavioral OTA

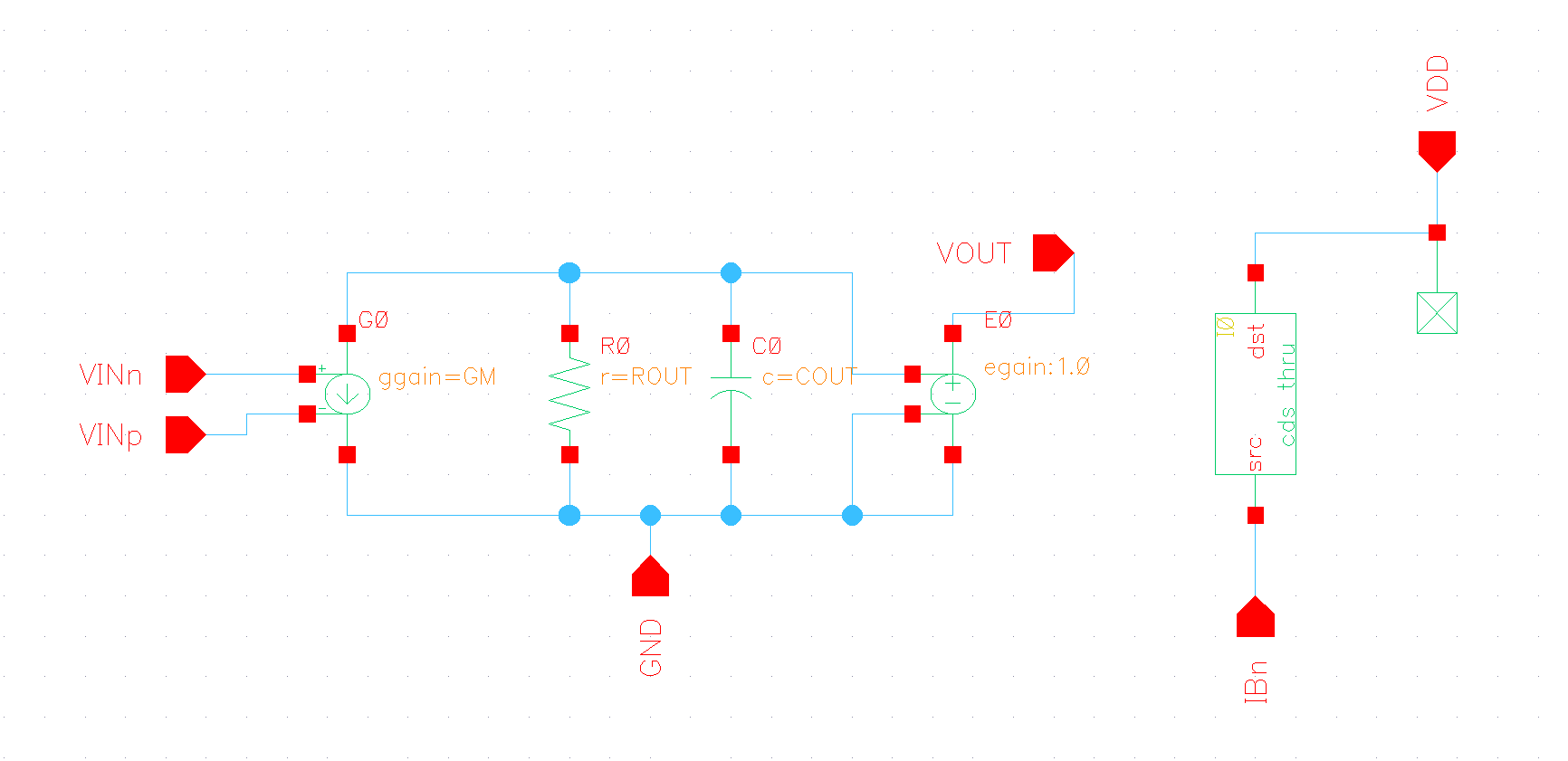


Figure 1 Behavioral Model Schematic

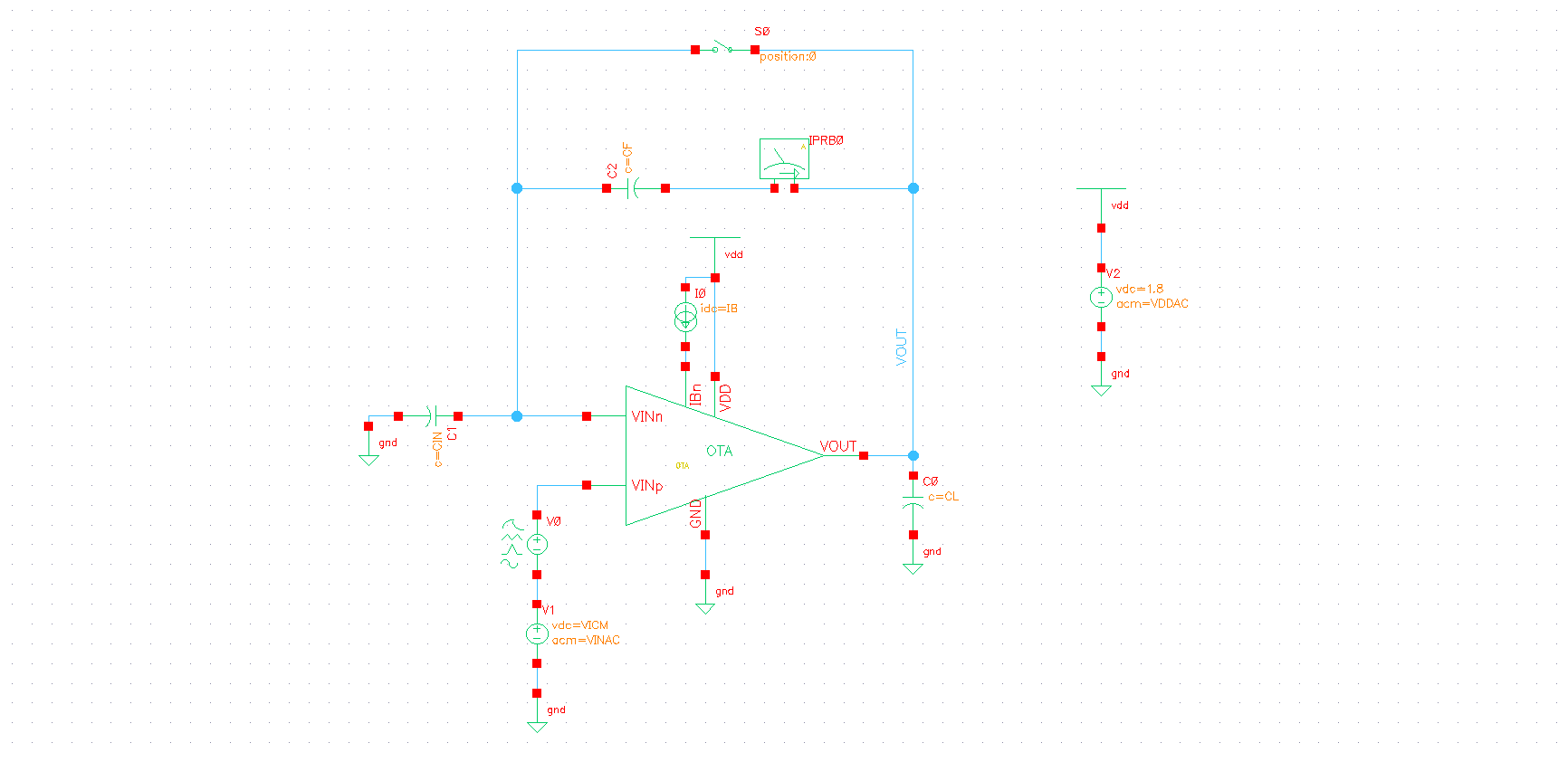


Figure 2 Testbench Schematic

* 1. Closed Loop Gain vs Frequency:

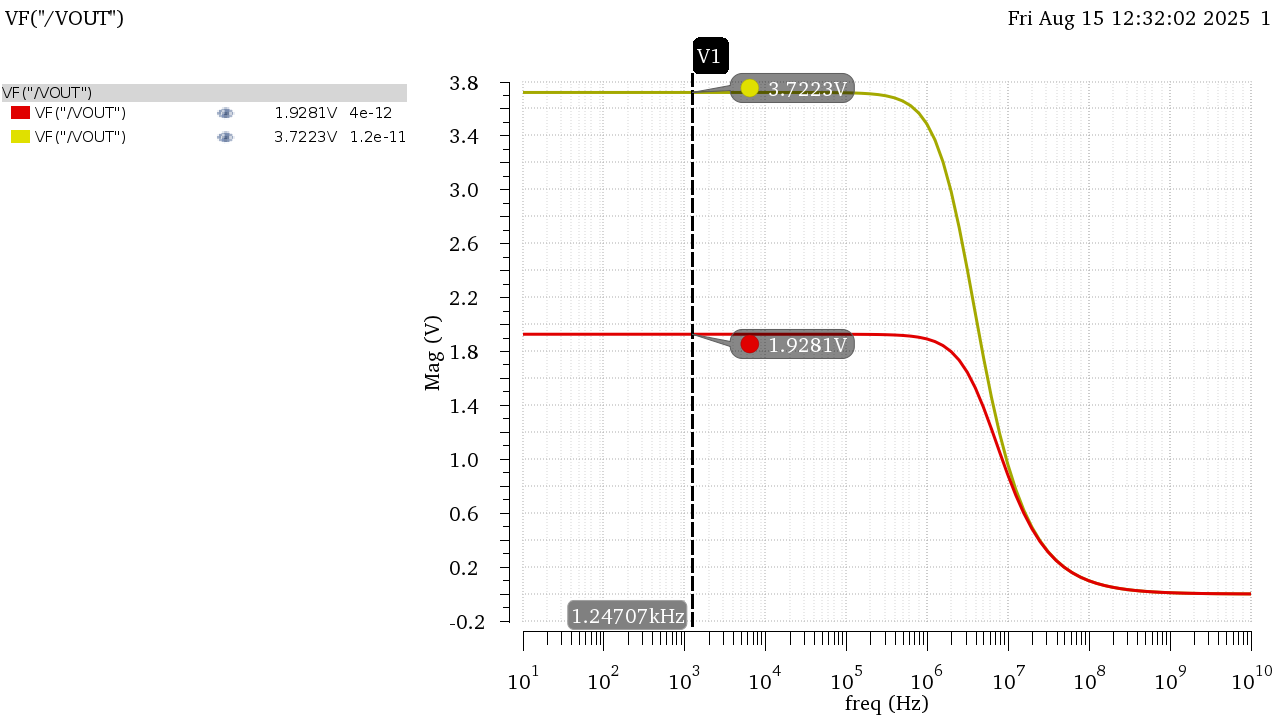


Figure 3 DC Gain in Mag

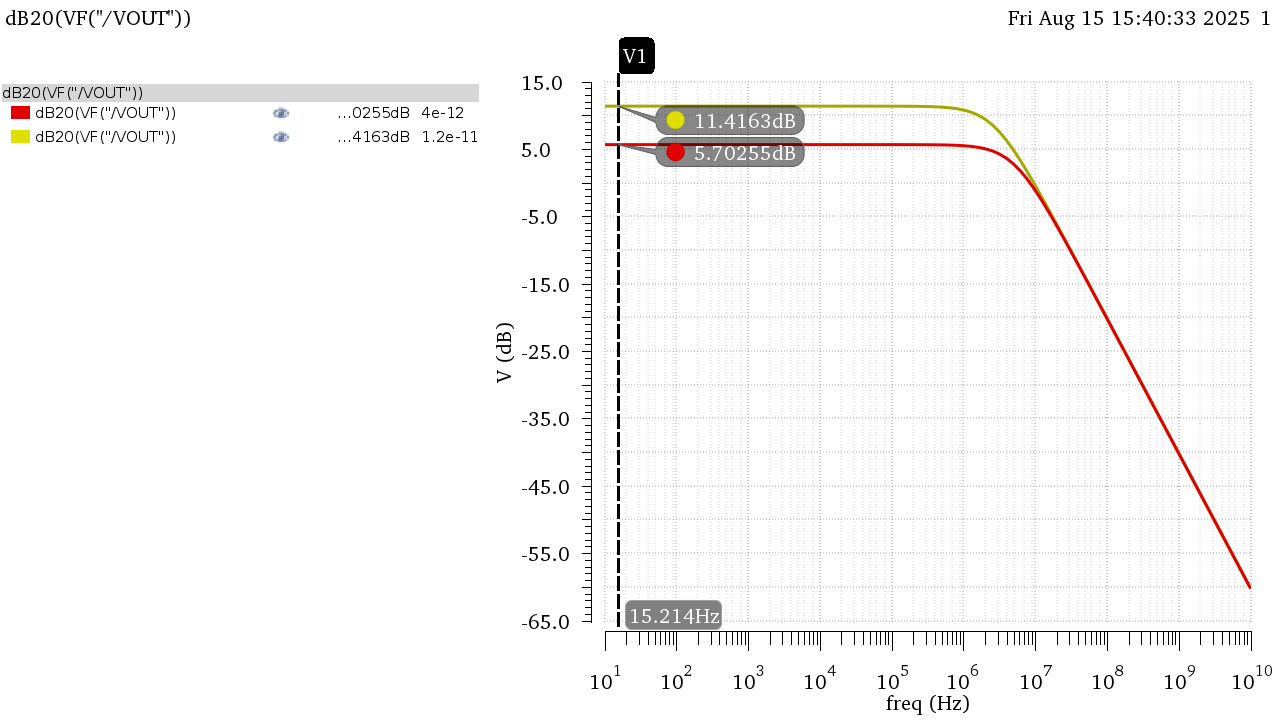


Figure 4 DC Gain in dB

A screenshot of a graph

AI-generated content may be incorrect.

Figure 5 Gain Bode Plot Annotated CIN = 4pF

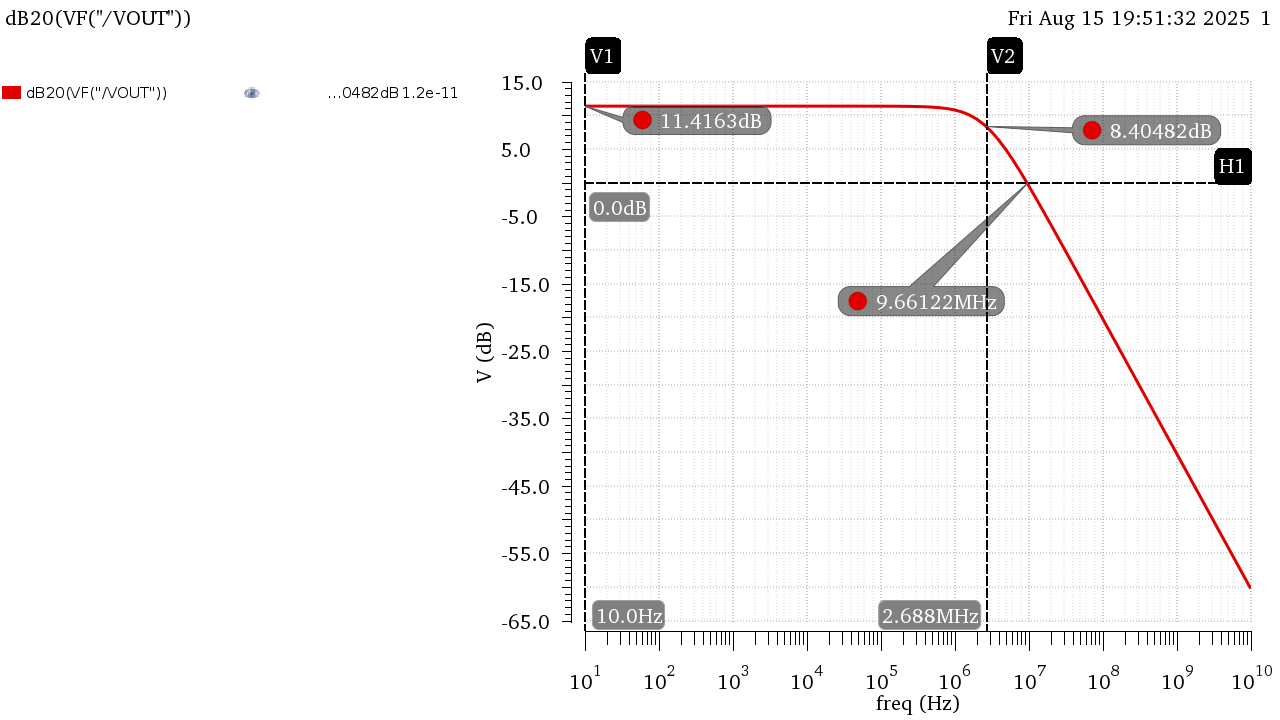


Figure 6 Gain Bode Plot Annotated CIN = 12pF

|  |  |  |
| --- | --- | --- |
|  | CIN = 4pF | CIN = 12pF |
| DC Gain (dB) | 5.703 | 11.42 |
| DC Gain | 1.928 | 3.722 |
| BW | 5.19E+06 | 2.69E+06 |
| UGF | 8.61E+06 | 9.69E+06 |
| GBW | 10E+06 | 10E+06 |

Table 1 Results from Simulation

Hand Analysis:

Open Loop Parameters from Last Lab:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **CIN = 4pF** | | **CIN = 12pF** | |
|  | Simulation | Analytic | Simulation | Analytic |
| **DC Gain (dB)** | 5.703 | 5.698 | 11.42 | 11.41 |
| **DC Gain** | 1.928 | 1.9272 | 3.722 | 3.72 |
| **BW** | 5.19E+06 | 5.25E+06 | 2.69E+06 | 2.72E+06 |
| **GBW** | 1.00E+07 | 1.01E+07 | 1.00E+07 | 1.01E+07 |

Analytic Results Agree with simulated ones in both cases of the input capacitor!

* 1. Loop Gain vs Frequency:

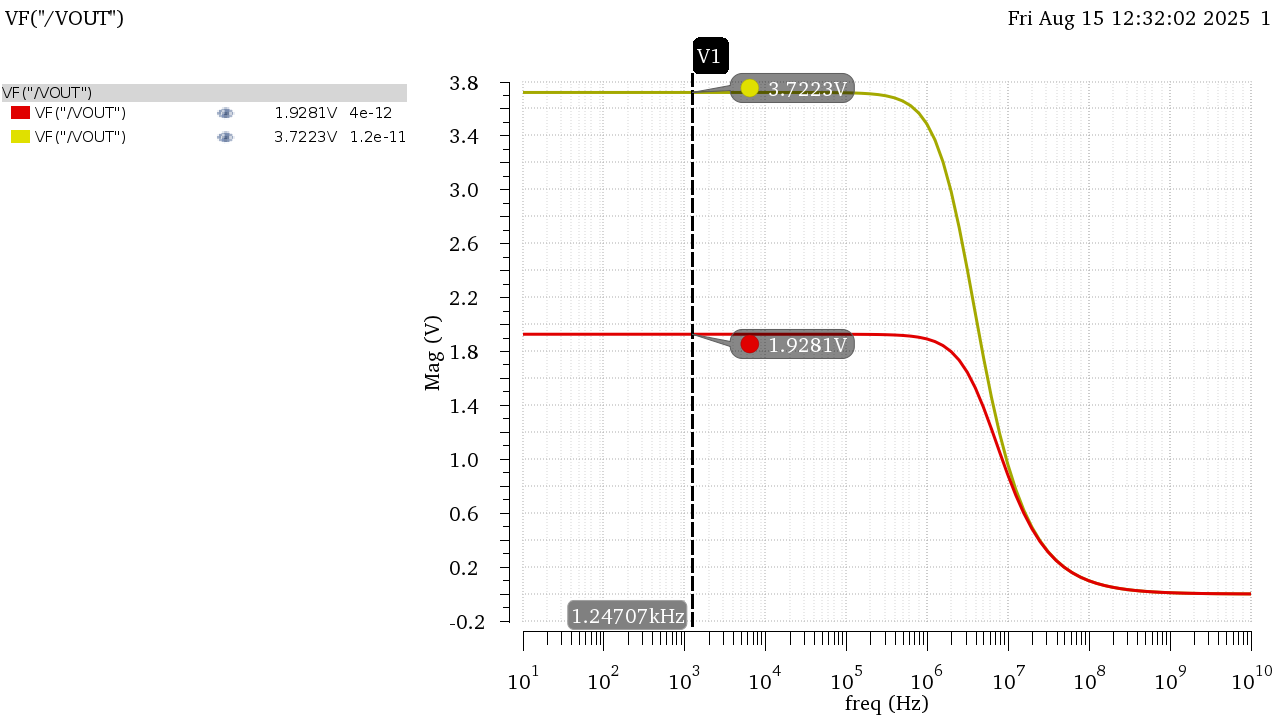


Figure 7 LG Overlaid in Mag

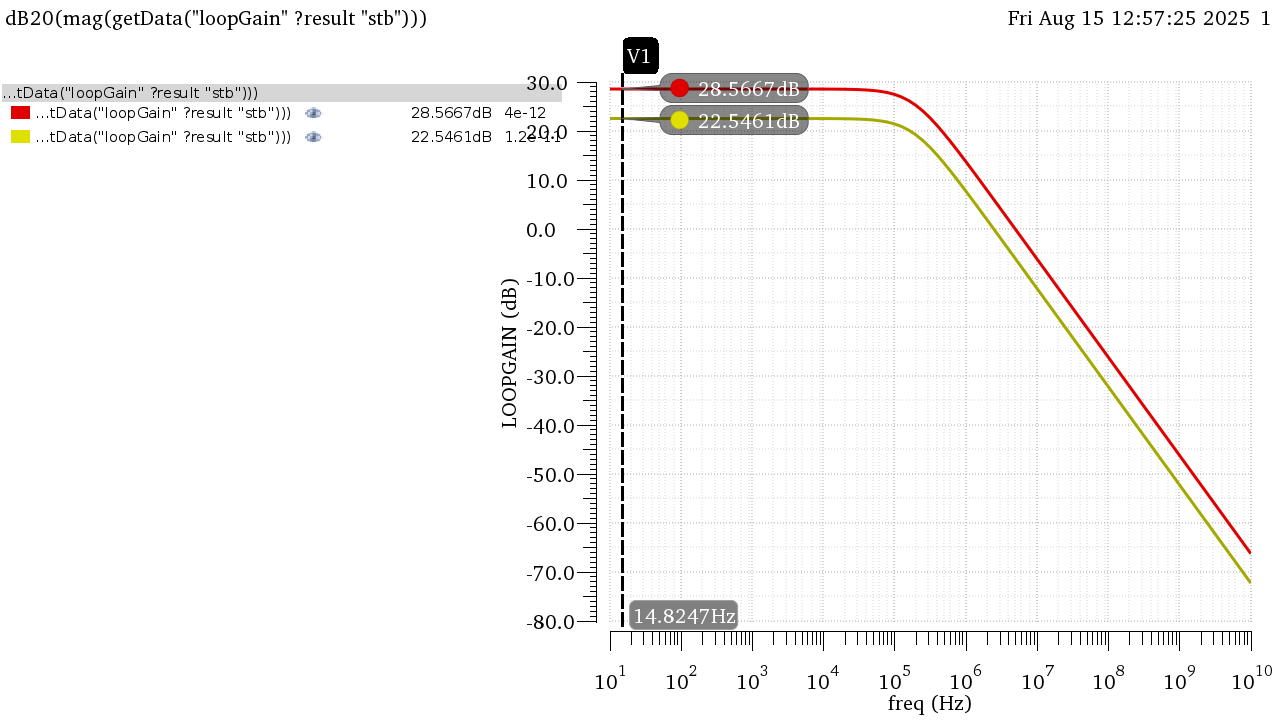


Figure 8 LG Overlaid in dB

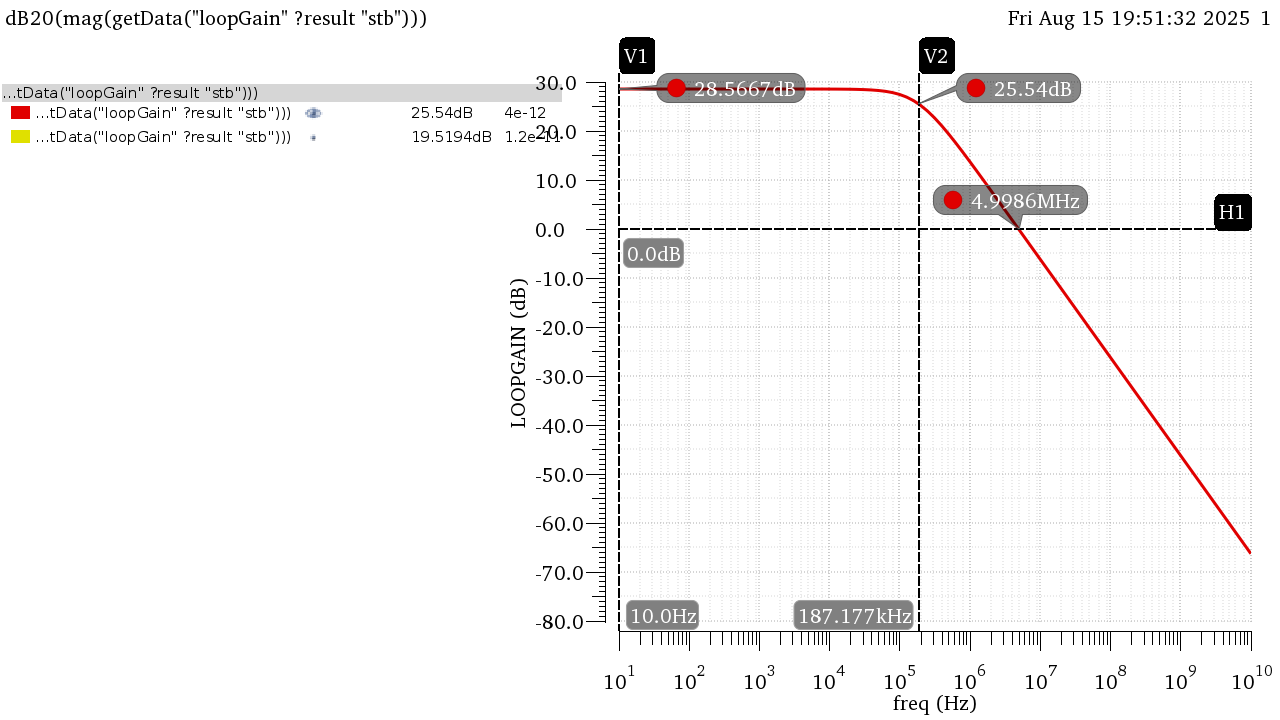


Figure 9 LG Bode Plot Annotated CIN = 4pF

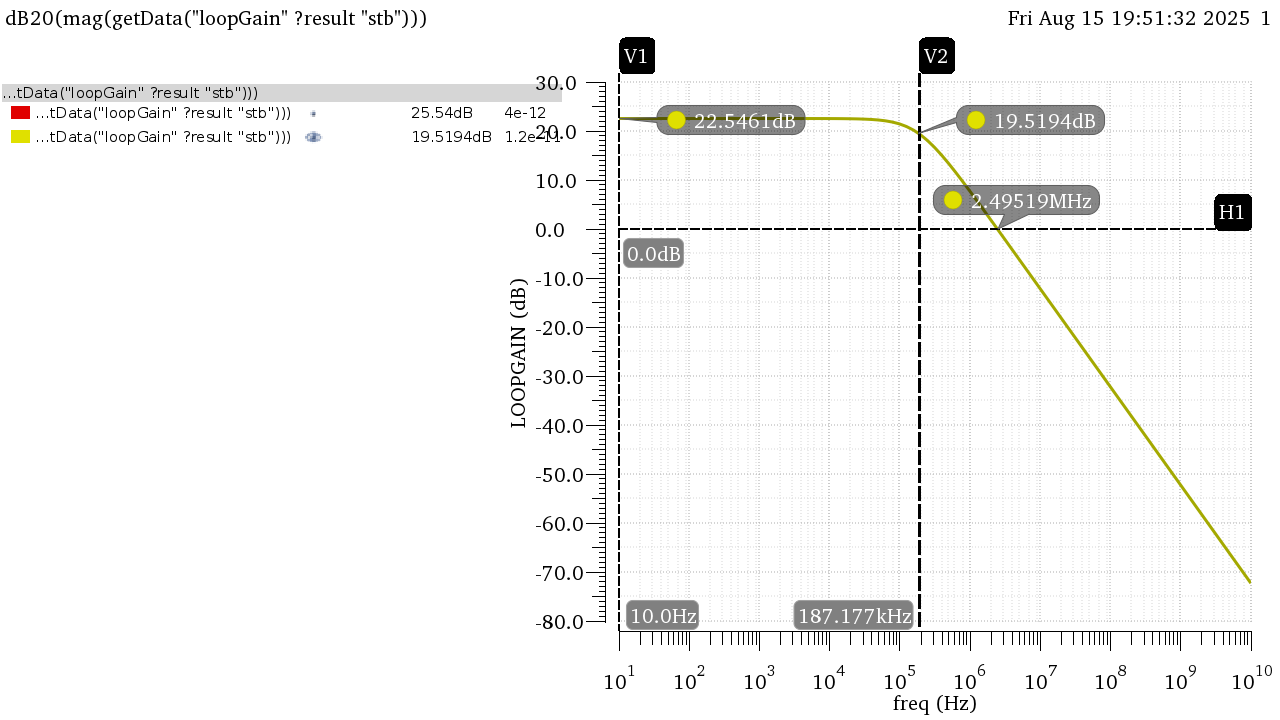


Figure 10 LG Bode Plot Annotated CIN = 12pF

|  |  |  |
| --- | --- | --- |
|  | CIN = 4pF | CIN = 12pF |
| DC Gain (dB) | 28.57 | 22.55 |
| DC Gain | 26.81 | 13.41 |
| BW | 187.17 KHz | 187.17 KHz |
| UGF | 5 MHz | 2.5 MHz |

Table 2 Results from Simulation

Hand Analysis:

Open Loop Parameters from Last Lab:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **CIN = 4pF** | | **CIN = 12pF** | |
|  | Simulation | Analytic | Simulation | Analytic |
| **DC Gain (dB)** | 28.57 | 28.465 | 22.55 | 22.444 |
| **DC Gain** | 26.81 | 26.5 | 13.41 | 13.25 |
| **BW** | 187.17 KHz | 191 KHz | 187.17 KHz | 191 KHz |
| **UGF** | 5 MHz | 5.0615 MHz | 2.5 MHz | 2.53 MHz |

Analytic Results Agree with simulated ones in both cases of the input capacitor!

* 1. Gain Desensitization:

To sweep the gain, I can either sweep GM or ROUT, I tried both and both resulted in similar results:

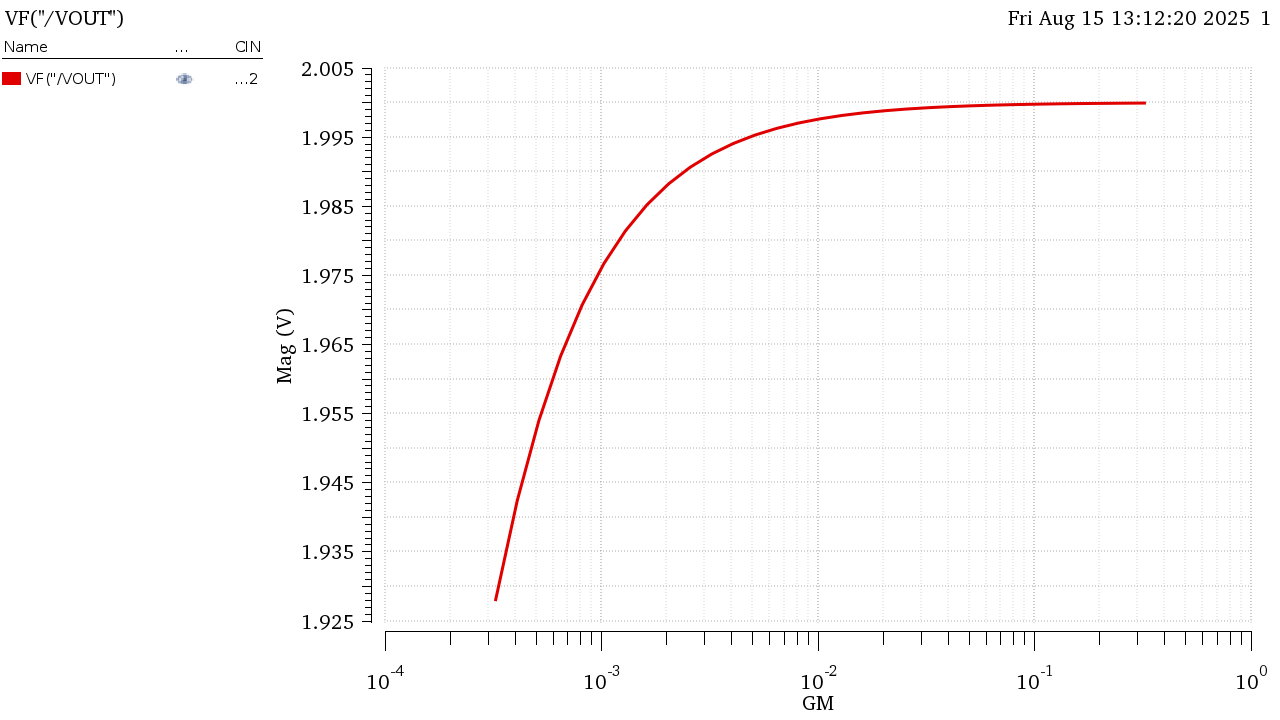


Figure 11 Gain Sweeping GM

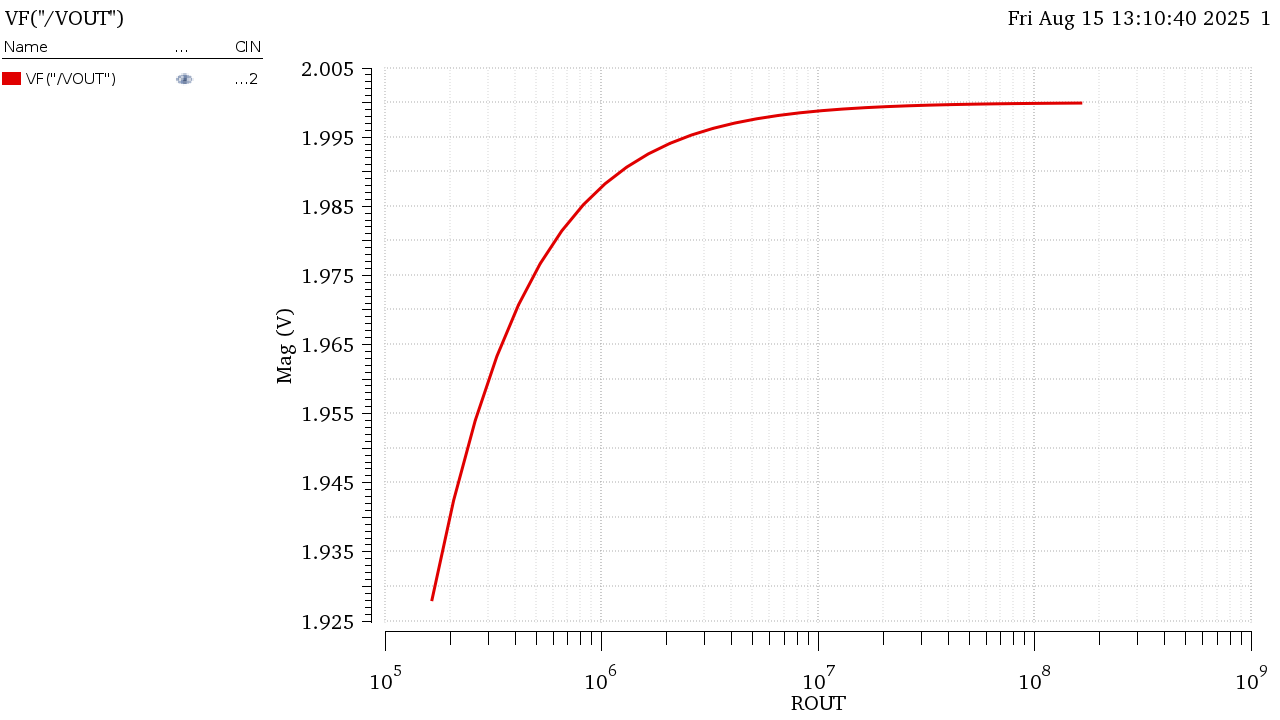


Figure 12 Gain Sweeping ROUT

The Gain is much closer to its ideal value now (Ideal Value = 2) as we increase the Open Loop gain of the amplifier it easier to approximate closed loop gain as . The percentage change would be even if we calculate for higher gains like the case of CIN = 4pF

Part 2: Feedback with Real 5T OTA

2.1 Closed Loop Gian vs Frequency: