

gm/ID example:

$C_L = 10 \text{ pF}$, $SR = 10 \text{ V}/\mu\text{s}$, $GBW = 10 \text{ MHz}$, $PM = 60^\circ$, $A_{v0} \geq 60 \text{ dB}$

Miller OTA:

1. $PM = 60^\circ \Rightarrow C_C \geq 0.22C_L \Rightarrow C_C = 2.5 \text{ pF}$
2. $SR = 10 \text{ V}/\mu\text{s} \Rightarrow I_5 = SR \cdot C_C = 25 \mu\text{A} \Rightarrow I_5 = 30 \mu\text{A}$
3. The first stage, NMOS Differential pair:

$$GBW = 10 \text{ MHz} \Rightarrow \left(\frac{g_m}{I_D} \right)_1 = \frac{2 \cdot (2\pi \cdot GBW)}{SR} = 12.57$$

4. $L_{1,2} = 0.35 \mu\text{m} \Rightarrow \frac{I_D}{W} = 11.32$, $I_{D1,2} = I_5 / 2 = 15 \mu\text{A} \Rightarrow W_{1,2} = 1.34 \mu\text{m} \Rightarrow W_{1,2} = 1.4 \mu\text{m}$.

5. PMOS current Mirror

$$\left(\frac{g_m}{I_D} \right)_{3,4} = 10, L_{3,4} = 0.35 \mu\text{m} \Rightarrow \frac{I_D}{W} = 4.97 \Rightarrow W_{3,4} = \frac{15 \mu\text{A}}{4.97} \approx 3 \mu\text{m}$$

6. The second stage:

$$g_{m7} \geq 10g_{m1}, \left(\frac{g_m}{I_D} \right)_7 = 10, L_7 = 0.35 \mu\text{m} \Rightarrow \frac{I_D}{W} = 5 \Rightarrow W_7 = \frac{150 \mu\text{A}}{5} = 30 \mu\text{m}.$$

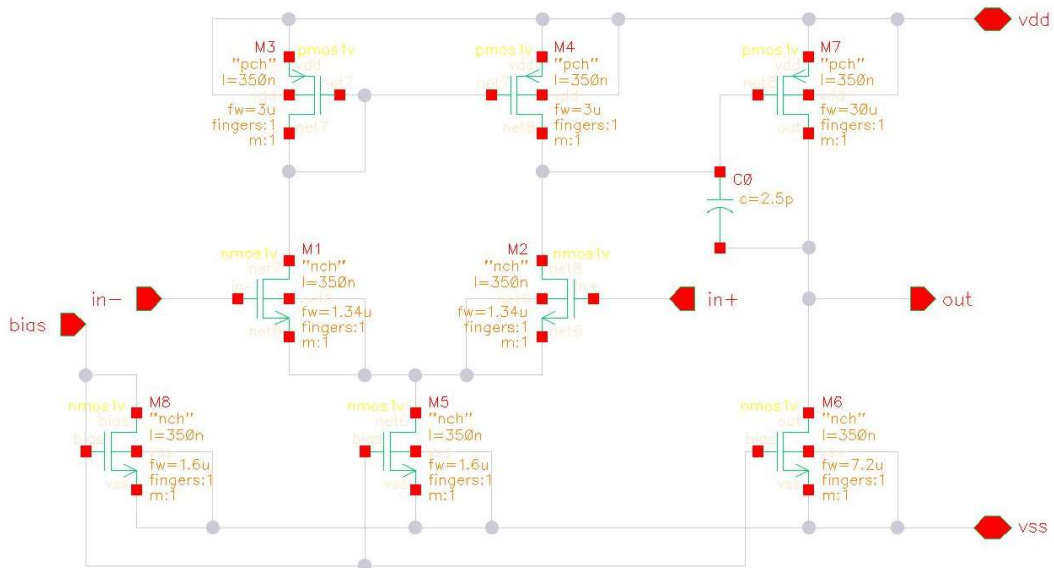
$$\left(\frac{g_m}{I_D} \right)_{5,6,8} = 10, L_{5,6,8} = 0.35 \mu\text{m}$$

$$\Rightarrow \frac{I_D}{W} = 18.86 \Rightarrow W_{5,8} = \frac{30 \mu\text{A}}{18.86} = 1.6 \mu\text{m}, W_6 = 5W_5 = 8 \mu\text{m}$$

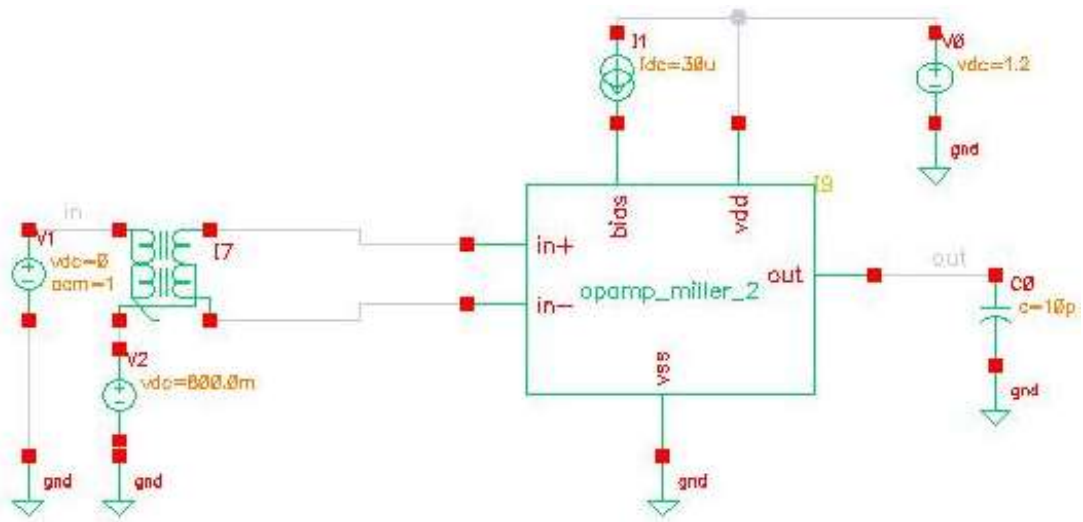
Cadence simulation:

$$W_6 = 7.2 \mu\text{m} \Rightarrow V_{OUTDC} = 620 \text{ mV},$$

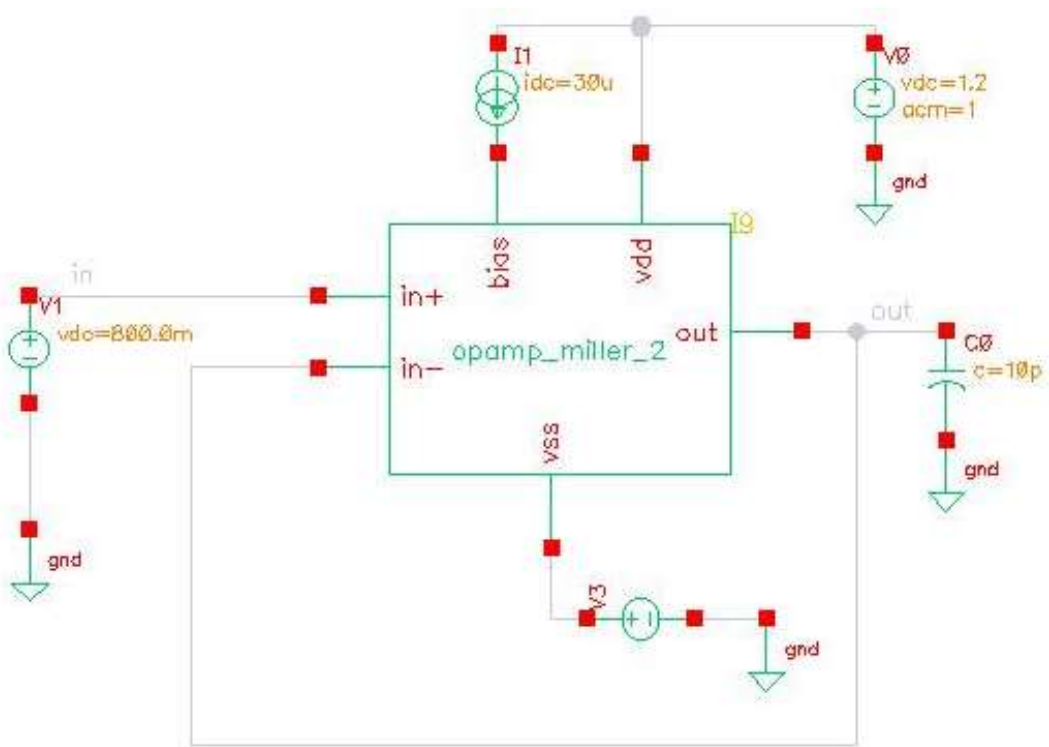
$$PM = 60^\circ, GBW = 10 \text{ MHz}.$$



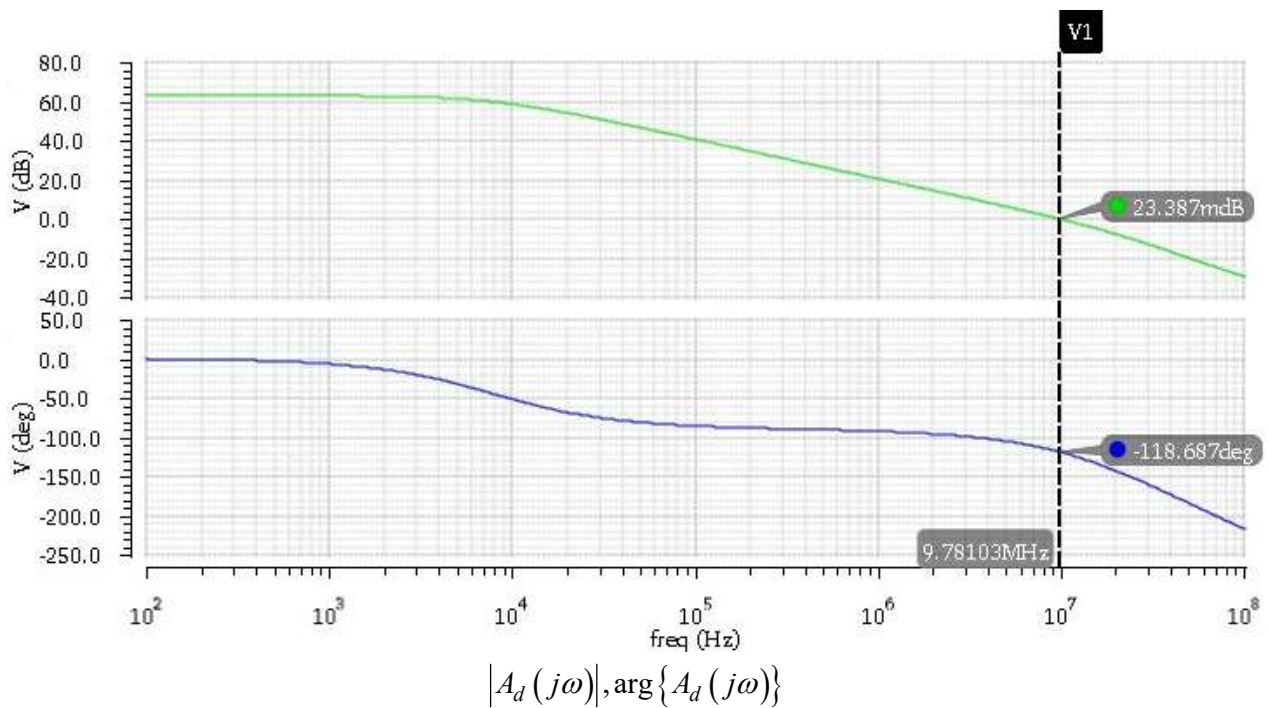
(a)



(b)



(c)



Poles (Hz)

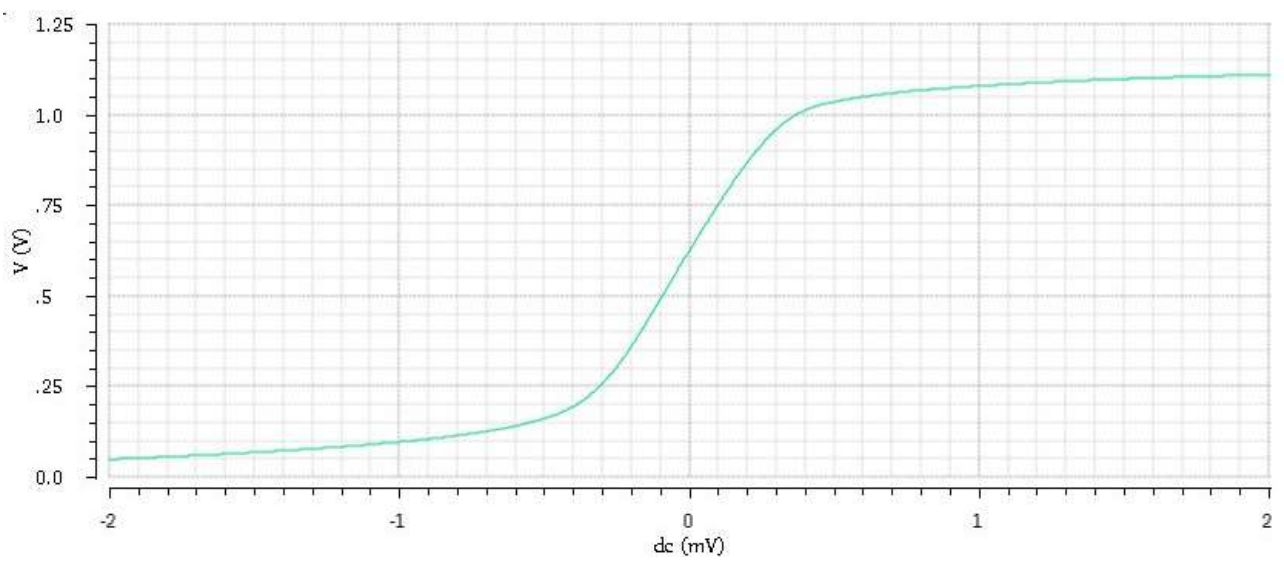
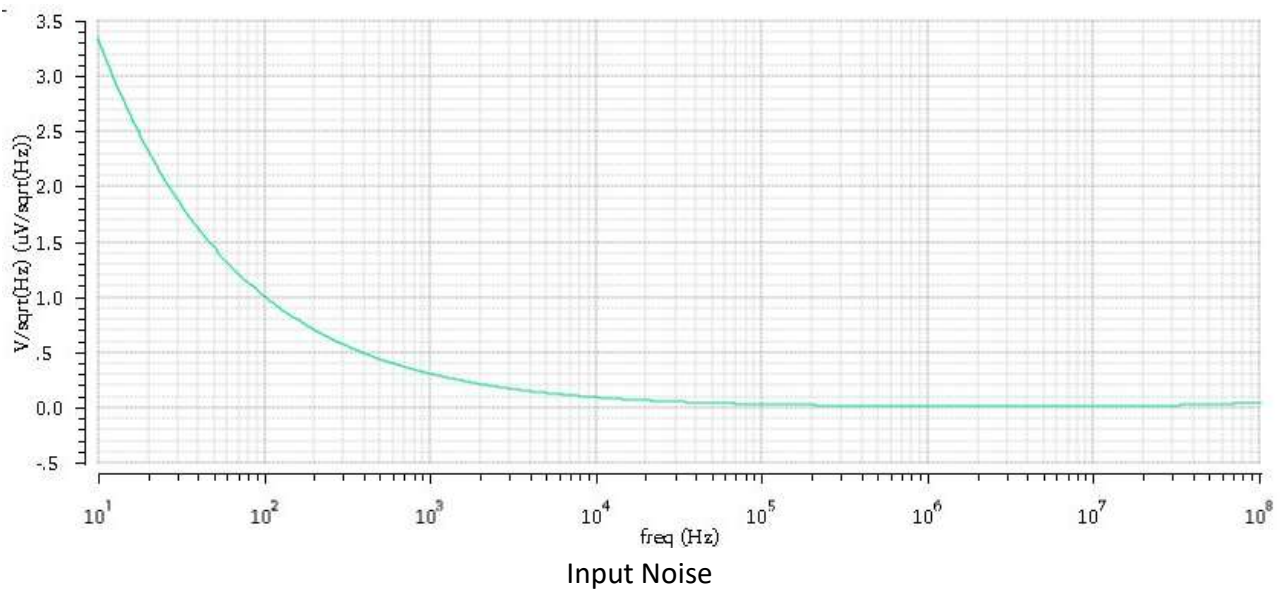
	Real	Imaginary	Qfactor
1	-7.91373e+03	0.00000e+00	5.00000e-01
2	-2.35683e+07	0.00000e+00	5.00000e-01
3	-1.03558e+09	0.00000e+00	5.00000e-01
4	-1.21511e+09	0.00000e+00	5.00000e-01
5	-4.26203e+09	0.00000e+00	5.00000e-01

Zeros (Hz)

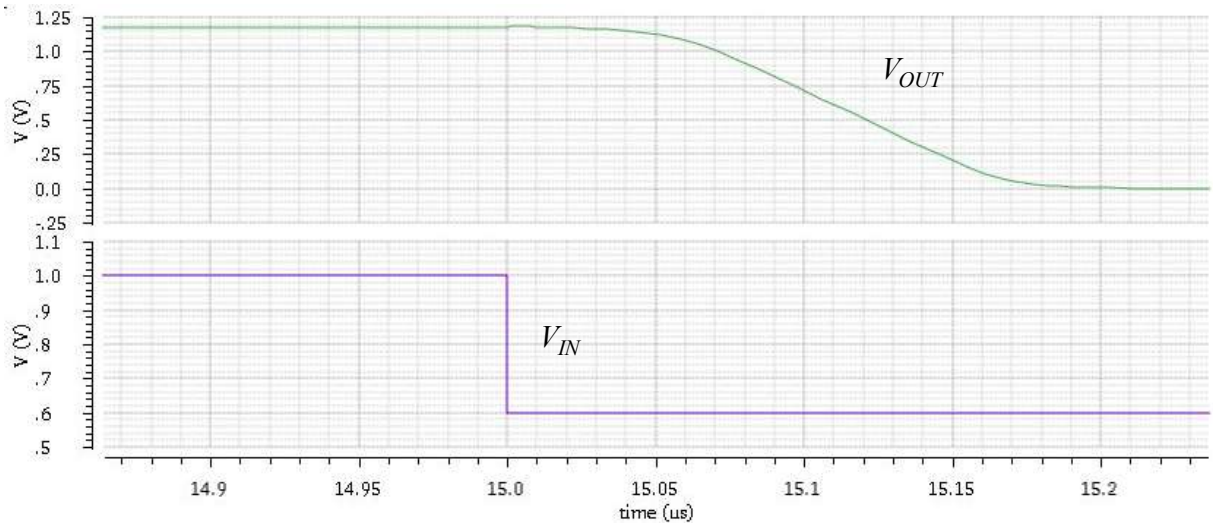
	Real	Imaginary	Qfactor
1	9.47481e+07	0.00000e+00	-5.00000e-01
2	-1.22729e+09	0.00000e+00	5.00000e-01
3	-2.23992e+09	0.00000e+00	5.00000e-01
4	-4.03430e+09	0.00000e+00	5.00000e-01
5	4.60608e+10	0.00000e+00	-5.00000e-01

Constant factor = 2.75844e-05

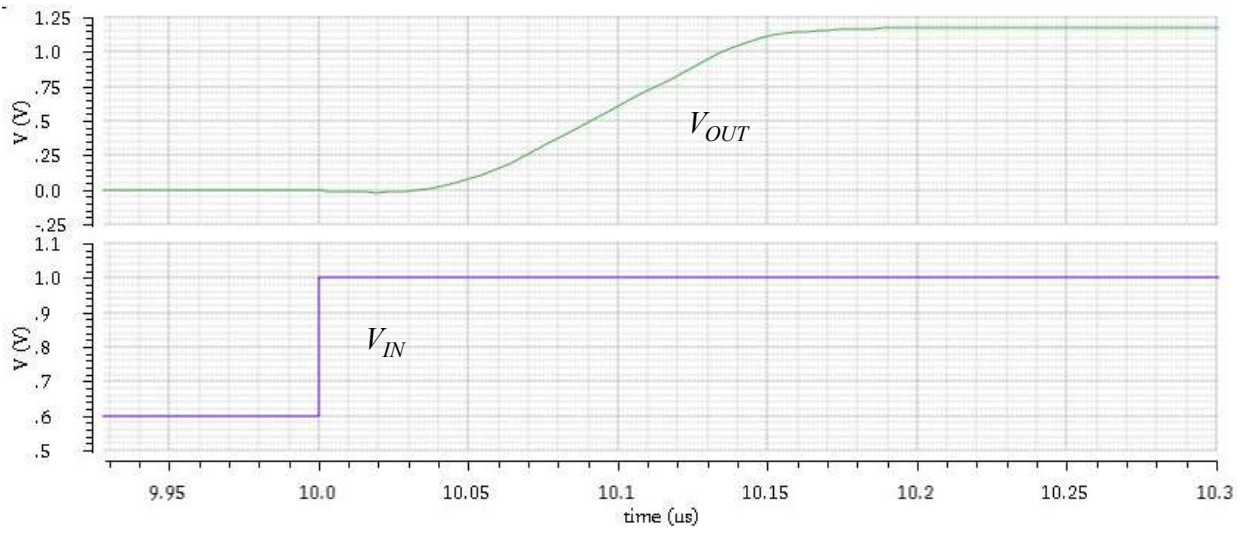
DC gain = 1.33471e+03



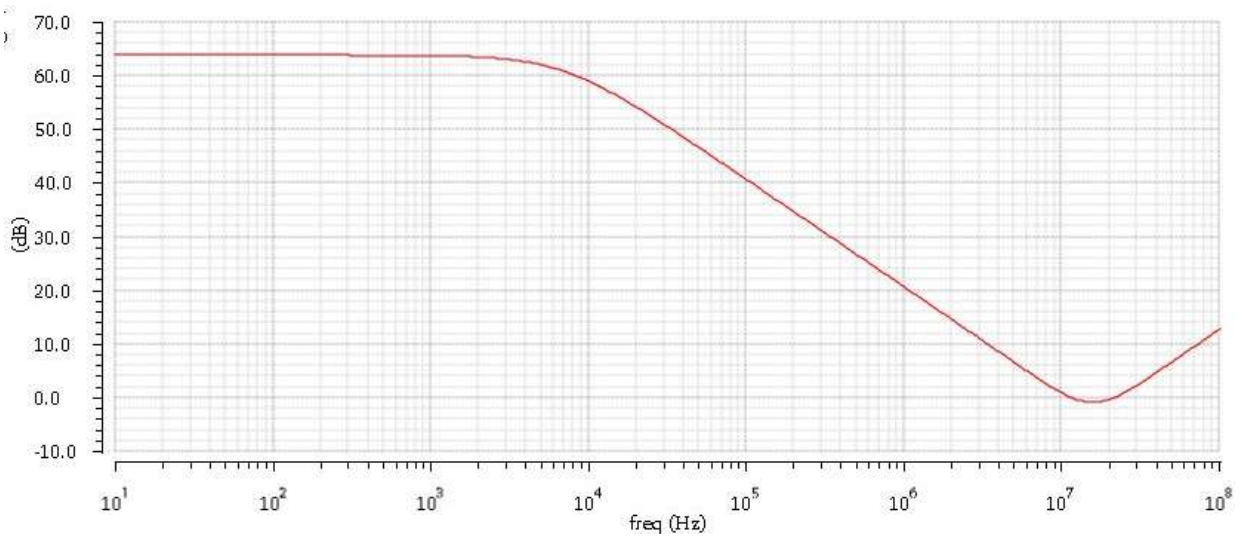
Transfer Function (a), $V_{OUT} = f(V_{IN})$.



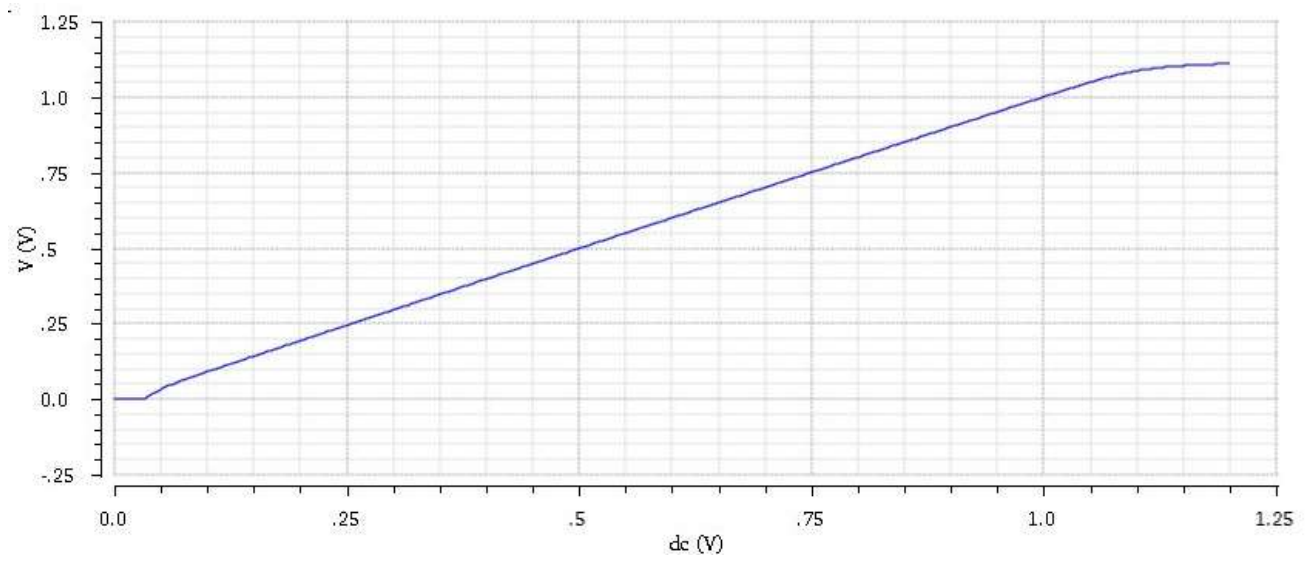
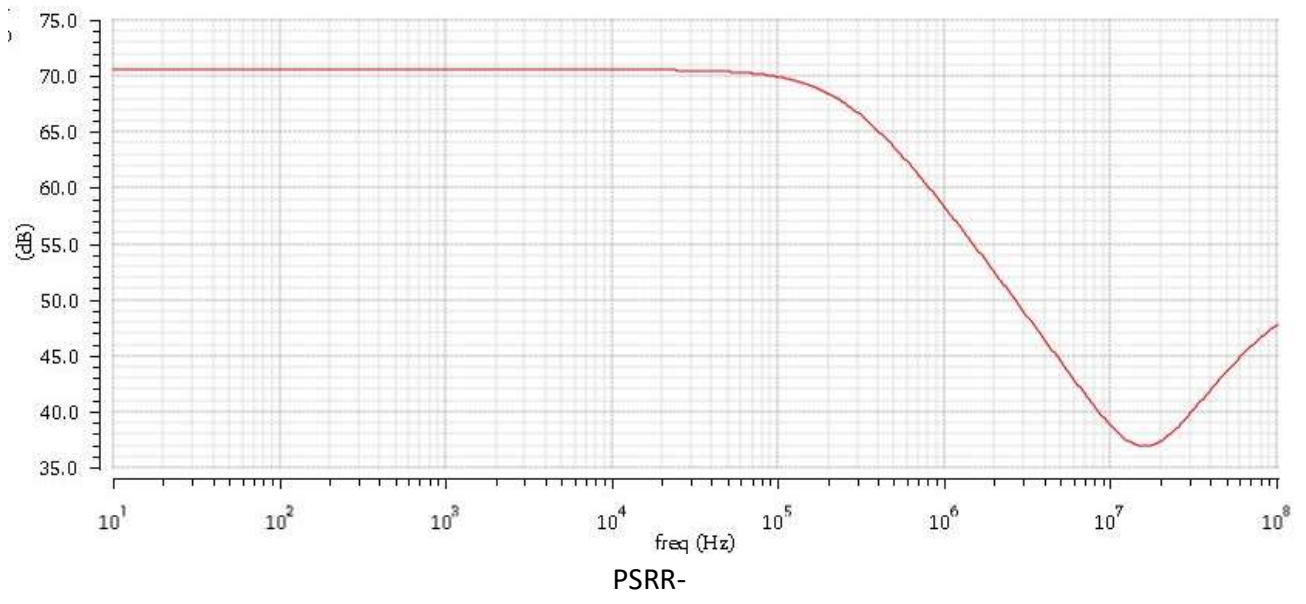
SR-



SR+



PSRR+



Transfer Function (b), $V_{OUT} = f(V_{IN+})$.