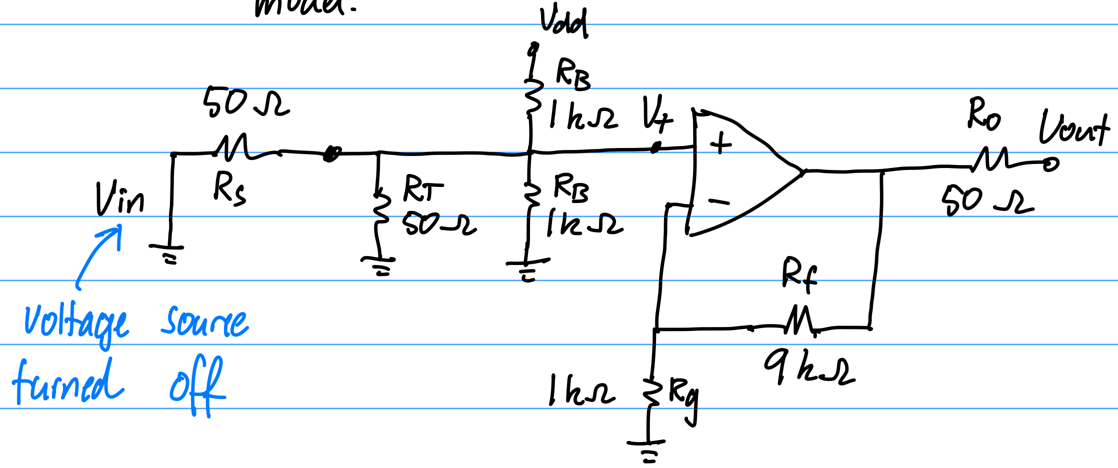
(a) Turn off V_{in} and draw the AC small signal model.



$$V_+ = \frac{(R_B \parallel R_T \parallel R_s)\, V_{dd}}{R_B + (R_B \parallel R_T \parallel R_s)} = 0.02381\ V_{dd}.$$

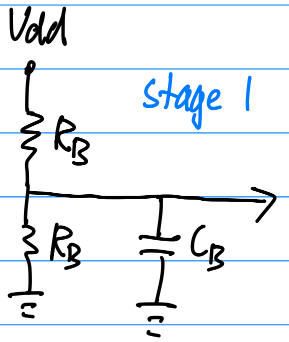
$$V_{out} = \left(1 + \frac{R_f}{R_g}\right) V_+ = 10\ V_+ = 0.2381\ V_{dd}.$$

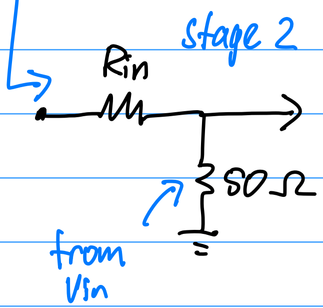
$$\therefore\ \text{Isolation} = 20 \log_{10}(0.2381) = -12.5\ \text{dB}$$

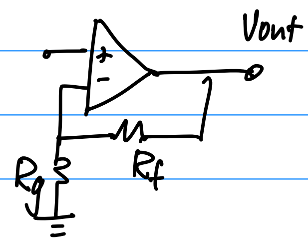
Not very much isolation.

(b)

For large R_{in} we can neglect its effect on stage 1.







Low freq $A_v = \frac{1}{2}$

Pole at $w = \frac{1}{R_B C_B / 2}$

$$A_v = \frac{50}{50 + R_{in}}$$

$$A_v = 10$$

$\therefore$ Low freq isolation $= \frac{1}{2} \times \frac{50}{50 + R_{in}} \times 10$

$$= \frac{250}{50 + R_{in}}.$$

Require better than -50 dB, i.e.

$$10^{-50/20} > \frac{250}{50 + R_{in}}$$

$$50 + R_{in} > \frac{250}{10^{-50/20}}$$

$$R_{in} > 79 \text{ k}\Omega$$

A standard value is $R_{in} = 82 \text{ k}\Omega$.

$= -50.3$ dB

$\therefore$ Low freq isolation $= \frac{250}{50 + 82000} = 3.047 \times 10^{-3}$

Given the pole location $w = (R_B C_B/2)^{-1}$, the transfer function is:

$$H(s) = \frac{3.047 \times 10^{-3}}{1 + R_B C_B s/2}.$$

Require $|H(jw)| < -100$ dB at $w = 2\pi \times 100 \times 10^6$

$$\therefore \left| \frac{3.047 \times 10^{-3}}{1 + R_B C_B j 2\pi \times 100 \times 10^6/2} \right| < 10^{-100/20}$$

$$304.7 < |1 + j R_B C_B \pi \times 100 \times 10^6|$$

$$(304.7)^2 < 1^2 + 9.8696 \times 10^{16} \times R_B^2 C_B^2$$

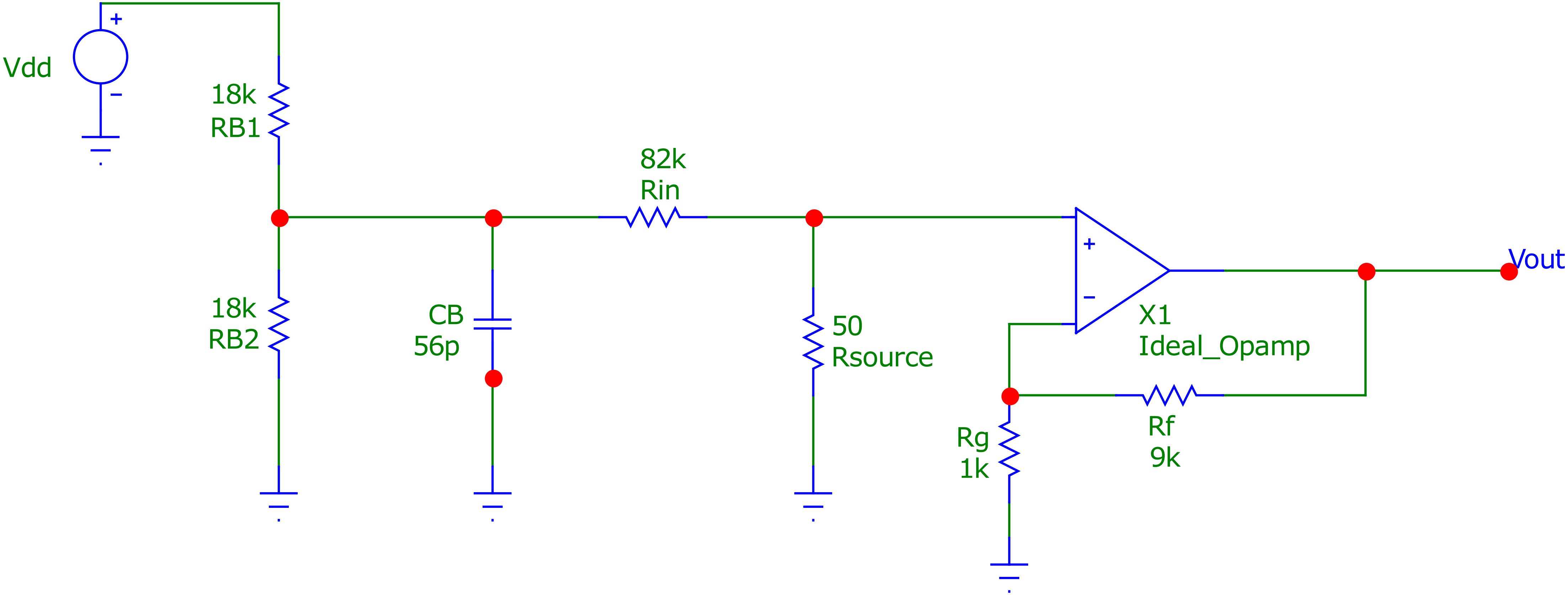
$$9.4068 \times 10^{-13} < R_B^2 C_B^2$$

$$9.7 \times 10^{-7} < R_B C_B$$

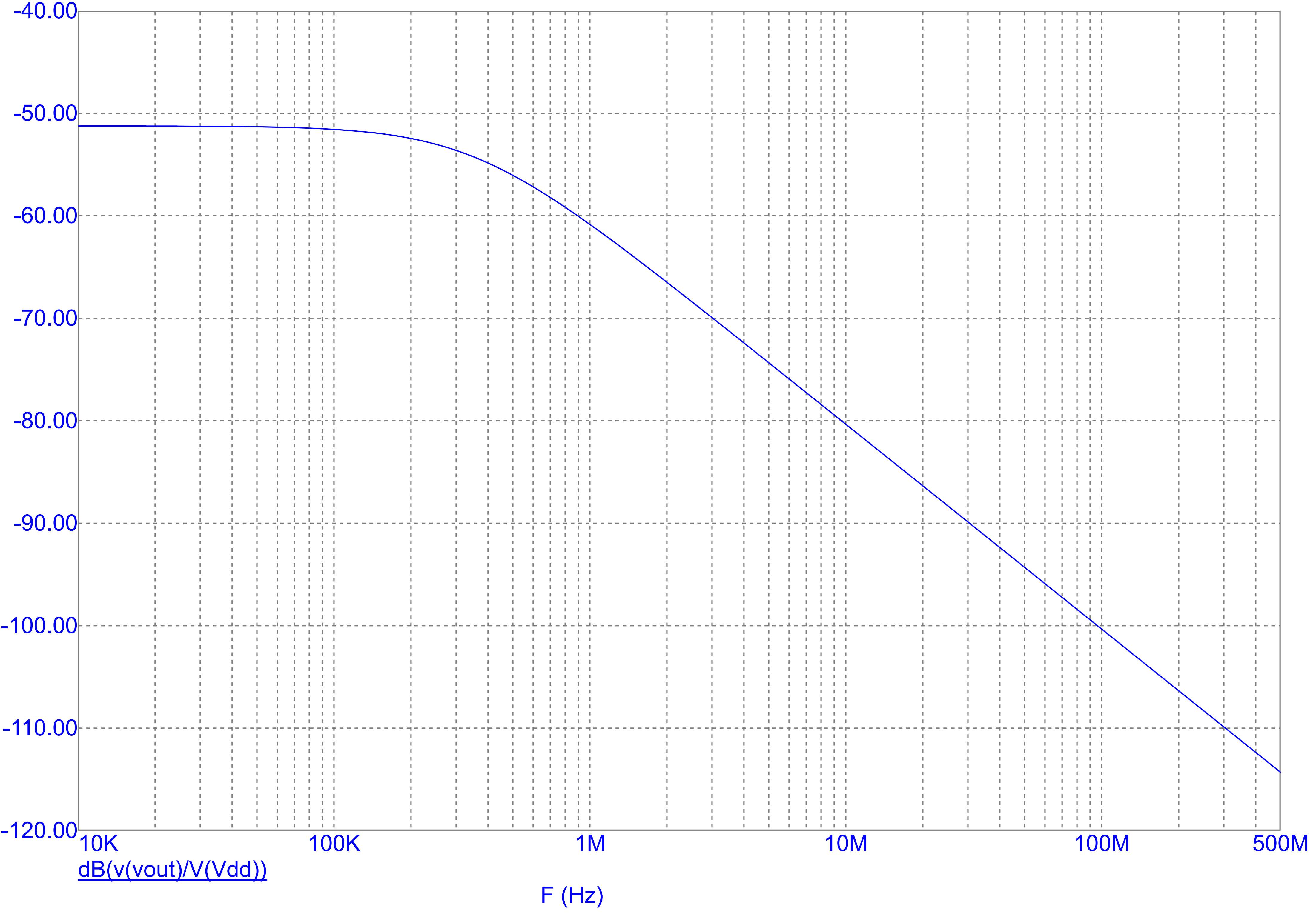
Since we assumed $R_B/2 \ll R_{in}$ choose $\frac{R_B}{2} \approx 0.1 R_{in}$

$\therefore R_B \approx 16 \text{k}\Omega$. Choose standard value $R_B = 18 \text{ k}\Omega$.

$\therefore C_B > 54$ pF, Choose $C_B = 56$ pF.



Vdd
18k
RB1
82k
Rin
Vout
18k
RB2
CB
56p
50
Rsource
X1
Ideal_Opamp
Rg
1k
Rf
9k


-40.00
-50.00
-60.00
-70.00
-80.00
-90.00
-100.00
-110.00
-120.00
10K
100K
1M
10M
100M
500M
dB(v(vout)/V(Vdd))
F (Hz)