Add a dominant pole without changing any of the given poles. The dominant pole will be at a low frequency and will give 90° of phase shift at high frequencies. To obtain a PM = 45°, |f| = 1 at 300 kHz because the pole at 300 kHz contributes 45° here, and the other poles contribute little phase shift.

Since the GBW is constant after the dominant pole until 300 kHz:

\[ f_{\text{dom}} = 600 \text{ Hz} \]

Bandwidth with feedback \( = 300 \text{ kHz} \)

Because \( A_c = 1/f \), the feedback factor required to make \( A_c = 20 \text{ dB} = 10 \)

\[ f = 1/10 = -20 \text{ dB} \]

Therefore:

\[ f_{\text{dom}} = 600 \text{ Hz} \]

Bandwidth with feedback \( \approx 300 \text{ kHz} \)

Move the pole at 300 kHz to a lower enough frequency. After moving this pole, it will contribute 90° at the unity gain frequency, which must now be 2 MHz.

\[ f_{\text{dom}} = 4 \text{ kHz} \]

Bandwidth with feedback \( \approx 2 \text{ MHz} \)

\[ f = 1/10 \text{ as in (b) above} \]

\[ f_{\text{dom}} = 4 \text{ kHz} \]

Bandwidth with feedback \( \approx 2 \text{ MHz} \)

\[ L_{\text{eff}} = L - 2L_{\text{D}} - 2L_{\text{D2}} = 1 - 2(0.09) - 0.1 = 0.72 \mu \text{H} \]

\[ |V_{\text{ID}}| = 200 \mu \text{A} \text{ for } M_5, M_5, M_7 \text{ and } M_6. \]

\[ |V_{\text{ID}}| = 100 \mu \text{A} \text{ for } M_1 - M_4 \]

\[ I_{\text{D1}} = I_{\text{D}} \text{ d}x \text{ from Table 2.4, } I_{\text{D}} = 0.02 \text{ um} / \mu \text{A} (N_{\text{mos}}) \]

\[ V_{\text{ID1}} = (100)(0.02)(0.02) = 5.55 \mu \text{A/V} \]

\[ V_{\text{ID2}} = (100)(0.02)(0.02) = 2.18 \mu \text{A/V} \]

\[ C_{\text{ox1}} = \frac{E_{\text{ox1}}}{E_{\text{ox}}} = 3.9(8.854 \times 10^{-14})/8 \times 10^{-8} = 4.32 \times 10^{-7} \text{ F/cm}^2 \]

\[ K_{\text{p1}} = \mu_{\text{p}} C_{\text{ox1}} = 150(4.32 \times 10^{-7} \text{ F/cm}^2) = 6.47 \text{ mA/V}^2 \]

\[ K_{\text{n1}} = \mu_{\text{n}} C_{\text{ox1}} = 450(4.32 \times 10^{-7} \text{ F/cm}^2) = 19.4 \text{ mA/V}^2 \]

\[ q_{\text{m2}} = \sqrt{2(64.7)}(150/10.72)(100) = 10.64 \text{ mA/V} \]

\[ q_{\text{m6}} = \sqrt{2(44.4)}(100/(12))(320) \approx 3.28 \text{ mA/V} \]

\[ V_{\text{f1}} = (200)(10.72)(6.024) = 11.1 \text{ mV} \]

\[ V_{\text{f6}} = (200)(10.72)(0.12) = 5.54 \text{ mV} \]

\[ V_{\text{f1+f6}} = q_{\text{m6}} (f1+66) q_{\text{m6}} (f1+66) = (16.4/8.33)(3.328/16.71) = 38700 \]

\[ R_q \frac{\text{C}}{\text{m}} \]

\[ R_q = \frac{1}{1-q_{\text{m6}} R_a} \]

\[ R_a = \frac{\text{C}}{\text{m}} \]

\[ \frac{1}{R_a} = (I/q_{\text{m6}} - R_a) \frac{\text{C}}{\text{m}} \]

\[ \frac{1}{R_a} = k_1(\frac{\text{N}}{\text{q}})(V_{\text{gq}} - V_{\text{q}} - V_{\text{ps}})(\text{q}) \text{ and } V_{\text{ps}} = 0 \]

\[ = k_1(\frac{\text{N}}{\text{q}})(V_{\text{gq}} - V_{\text{q}} - V_{\text{ps}}) \]

Assume \( g = 0 \)

\[ \frac{1}{R_a} = k_1(\frac{\text{N}}{\text{q}})(1.5 - V_{\text{gq}} - V_{\text{q}} + 1.5) \]

\[ V_{\text{gq}} = V_{\text{gq}} + V_{\text{q}} + V_{\text{gq}} + V_{\text{q}} + V_{\text{gq}} + V_{\text{q}} \]

\[ = 0.45 \text{ cm} + 0.12 \text{ cm} \]

\[ = 0.75 \text{ cm} \]

\[ V_{\text{gq}} = 1.94(\frac{\text{N}}{\text{q}})(3 - 0.75 - 0.6) \]

\[ (\frac{\text{N}}{\text{q}}) = 10 \]

\[ \frac{1}{R_a} = k_1(\frac{\text{N}}{\text{q}})(1.5 - V_{\text{gq}} - V_{\text{q}} + 1.5) \]

\[ \text{Use same drawn length as for } M_6 \]
The unity-gain frequency is the freq where \[ |A(w)| = \left| \frac{g_{m1}}{j\omega C_c} \right| = 1 \]

Unity = \[ \frac{g_{m1}}{2\pi C_c} = \frac{1.64 \times 10^{-3} A/V}{2\pi (5 \times 10^{-12} F)} = 52.2 \text{ MHz} \]

Slew Rate = \[ \frac{\Delta v}{\Delta t} \max = \frac{I_{\text{max}}}{C_c} = \frac{200 \text{ mA}}{5 \text{ pF}} = 40 \text{ V/\mu s} \]

From (3), \[ \frac{1}{R_q} = k'(wL)q (V_{GSq} - V_{tq}) \]

From KVL, \[ V_{GSq} = V_{GS1} + V_{GS2} - V_{GS6} \]

Since \( I_{D12} = I_{D6} \) and \( (wL)_{12} = (wL)_6 \), \( V_{OV12} = V_{OV6} \)

Therefore, \[ V_{SB11} = V_{GS12} = V_{tq} + V_{OV12} = V_{SBq} = V_{GS6} = V_{tq} + V_{OV6} \]

because \( V_{tq} = V_{tq} \) (neither transistor has body effect)

Since \( V_{SB11} = V_{SBq} \), \( V_{t11} = V_{tq} \) (including body effect)

Also, \( V_{OV11} = V_{OV12} \) because \( I_{D11} = I_{D12} \) and \( (wL)_{11} = (wL)_{12} \)

Therefore, \[ V_{GSq} = V_{t11} + V_{OV11} + V_{t2} + V_{OV2} = V_{tq} + V_{OV6} \]

where \( V_{OV11} = V_{OV12} \)

so \( V_{GSq} - V_{tq} = V_{t11} + V_{OV} = V_{OV} \)

Since \( V_{GSq} - V_{tq} = V_{GS6} - V_{tq} \) and \( \frac{1}{R_q} \) should = \( g_{m6} \)

To cancel the RHP zero, \[ \frac{1}{R_q} = k'(wL)q (V_{GSq} - V_{tq}) = \frac{g_{m6}}{k'(wL)q (V_{GS6} - V_{tq})} \]

Therefore, \( g_{m6} = k'(wL)q (V_{GS6} - V_{tq}) \)

\( (wL)q = (wL)_6 = 100/1 \)

To obtain 45° phase margin, set 2nd pole = unity gain frequency

\[ |P_{21}| = \frac{g_{m6} C_c}{C_{L1} + C_{L2} + C_{C C}} = \frac{g_{m7}}{C_c} = \frac{1.64 \text{ mA NA}}{5 \text{ pF}} = 328 \text{ meg} \text{ rad} /\text{s} \]

\( C_1 \) is dominated by the gate of \( M_6 \)

Minimum estimate for \( C_1 = C_{gS4} + C_{gS6}(Q) \)

\[ = \frac{2}{100}(0.62)(4.3) + 0.35(100) = 2.41 \text{ pF} \]

Maximum estimate for \( C_1 = C_{gS4} + C_{gS6}(Q) + C_{gS4}(Q) + C_{gS1} + C_{gS1}(Q) \)

\[ + C_{gD2}(Q) + C_{gD2}(Q) \]

\[ = \frac{2}{100}(0.62)(4.3) + 0.35(100) + \frac{1}{100}(0.82) + 0.35(100) + 0.35(150) + 0.35(50) = 337 \text{ pF} \]

\[ 328 \text{ meg} \text{ rad} /\text{s} = \frac{3.28 \text{ mH}(5 \text{ pF})}{C_{L1} + C_{L2}(5 \text{ pF}) + C_{C C}(5 \text{ pF})} \]

Case 1 (min \( C_1 \))

\[ C_L(2.41 \text{ pF}) + C_L(5 \text{ pF}) + 2.41 \text{ pF} = 5 \times 10^{-23} \]

\[ C_L = 9.3 \text{ pF} \]

Therefore, \( C_L \) should be less than about \( 18.9 \text{ pF} \)

Case 2 (max \( C_1 \))

\[ C_L(387 \text{ pF}) + C_L(5 \text{ pF}) + 387 \text{ pF}(5 \text{ pF}) = 5 \times 10^{-23} \]

\[ C_L = 8.9 \text{ pF} \]