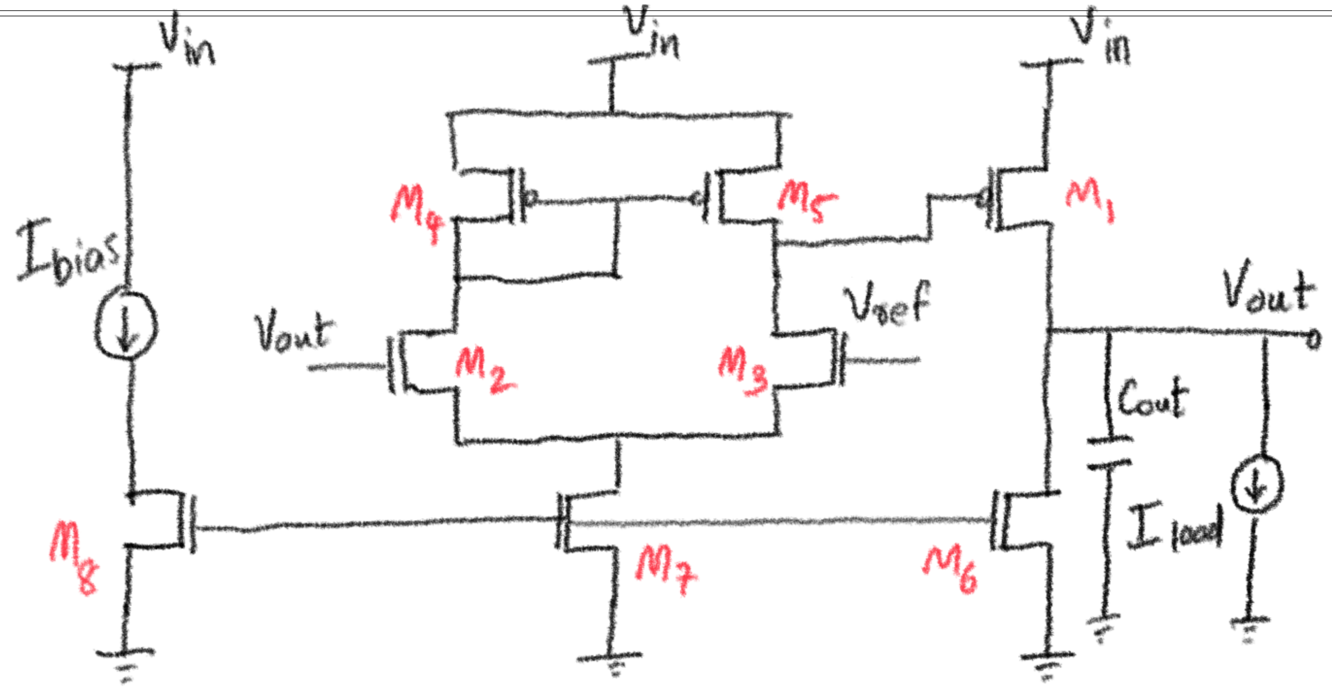

Inputs to the Script.

1. V_{in} (V)
2. V_{out} (V)
3. $I_{load, max.}$ (mA)
4. $I_{load, min}$ (mA)
5. C_{load} (μF)
6. $I_{quiscent} = I_{Bias}$ (μA)
7. loop gain
8. g_m/I_d Value.
9. Length {min}

Calculation of loop gain.

We have worst low frequency PSRR (DC PSRR) = 40dB given, gain margin to DC PSRR = 20dB.

$$\Rightarrow 60\,dB = 20\log_{10}(\text{loop gain})$$

$$\Rightarrow \text{loop gain} = 1000.$$

Calculation in Sizing of Pass transistor (M_1):

we know that $g_m/I_d = 10$. ; we are considering minimum length for pass transistor

For pass transistor (M_1)

$$I_d = I_{load,max}.$$

to get g_m of pass transistor. (M_1)

$$\frac{g_m}{I_d} \times I_{load,max} = g_{m,M_1}$$

1. we will get the value of $g_m r_o$ from the $g_m r_o$ v/s g_m/I_d for $g_m/I_d = 10$

r_{o,M_1} = output resistance of pass transistor M_1

then $$r_{o,M_1} = \frac{g_m r_o}{g_{m,M_1}}$$ $$g_m r_o = A_{M_1}$$

$$\omega_{P_1} = \frac{1}{C_{out} \times r_{o,M_1}}$$

$$f_{P_1} = \frac{1}{2\pi \times C_{out} \times r_{o,M_1}}$$

2. We will get the Value of I_d/W from I_d/W v/s g_m/I_d plot. for $g_m/I_d = 10$.

then $$W_{M_1} = \frac{I_{load,max}}{I_d/W}$$

3. we will get the Value of f_T from f_T v/s g_m/I_d plot for $g_m/I_d = 10$.

w.k.T $$f_T = \frac{g_m}{2\pi C_{gg}}$$

then $$C_{gg,M_1} = \frac{g_m}{2\pi f_T}$$

$$\omega_{P_2} = \frac{1}{C_{gg} \times r_{o,\text{diff Amp}}}$$

Here we are trying for $PM = 45^\circ$ which means $\omega_{ugb} = \omega_{P_2}$.

w.r.t $\omega_{ugb} = \text{loop gain} \times \omega_{P_1}$

$$\omega_{P_2} = \text{loop gain} \times \omega_{P_1}$$

$$\frac{1}{C_{gg} \times r_{o,\text{diff Amp}}} = \text{loop gain} \times \frac{1}{C_{out} \times r_{o,M_1}}$$

$$r_{o,\text{diff Amp}} = \frac{C_{out} \times r_{o,M_1}}{\text{loop gain} \times C_{gg}}$$

$$r_{o,\text{diff Amp}} = (r_{o,M_3} \,//\, r_{o,M_5})$$

Considering

$$r_{o,M_3} = r_{o,M_5}$$

$$r_{o,\text{diff Amp}} = \frac{r_{o,M_3}}{}$$

gain of diff Amp. (A_{diff})

$$\text{loop gain} = A_{diff} \times A_{M_1}$$

$$A_{diff} = \frac{\text{loop gain}}{A_{M_1}}$$

$$g_{m,diff} \times r_{o,diff} = \frac{\text{loop gain}}{A_{M_1}}$$

$$g_{m,diff} \times r_{o,M_3} = \frac{2 \times \text{loop gain}}{A_{M_1}}$$

then we got

$$g_{m,M_3} \times r_{o,M_3} = \frac{2 \times \text{loop gain}}{A_{M_1}}$$

Calculations in sizing of nmos input transistors (M_2 , M_3)

Here $I_d = \frac{I_{Quiscent}}{2} = \frac{I_{bias}}{2}$

to get g_{m,M_3}

$$g_{m,M_3} = \frac{2 \times \text{loop gain}}{A_{M_1} \times r_{o,M_3}}$$

to get g_m/I_d of M_3 transistor

$$\left(g_m/I_d\right)_{M_3} = \frac{g_{m,M_3}}{\left(I_{bias}/2\right)}$$

now we got g_m/I_d and $g_m r_o$ Values from these Values we will Calculate the Length of M_3 transistor.

For this length we will calculate the Value of I_d/W from I_d/W v/s g_m/I_d for a Value of $(g_m/I_d)_{M_3}$.

then $$W_{M_3} = \frac{\left(I_{bias}/2\right)}{I_d/W}$$

Calculations in sizing of PMOS transistors (M_4, M_5).

Here we are considering $g_m/I_d = 10$.

$$I_d = \frac{I_{bias}}{2} = \frac{I_{Quiscent}}{2}$$

$$g_{m,M_5} = g_m/I_d \times \frac{I_{bias}}{2}$$

W.K.T $r_{o,M_5} = r_{o,M_3}$.

then $(g_m r_o)_{M_5} = g_{m,M_5} \times r_{o,M_5}$

From the Values of $(g_m r_o)_{M_5}$ and g_m/I_d we will find the length of M_5 in tech plots.

For this length we will Calculate I_d/W Value from I_d/W V/s g_m/I_d for $g_m/I_d = 10$

then $W_{,M_5} = \dfrac{(I_{bias}/2)}{I_d/W}$

Calculations in sizing of bias transistors (M_6, M_7, M_8)

we consider $g_m/I_d = 10$, $L = L_{min}$.

$$I_d = I_{bias} = I_{Quiscent}.$$

We will find the value of I_d/W from I_d/W v/s g_m/I_d for $g_m/I_d = 10$.

$$W_{M_5} = \frac{I_{bias}}{I_d/W}.$$

→ formula to be added in the script

→ width calculation formulas already there in the script

→ pole frequency calculation formulae.