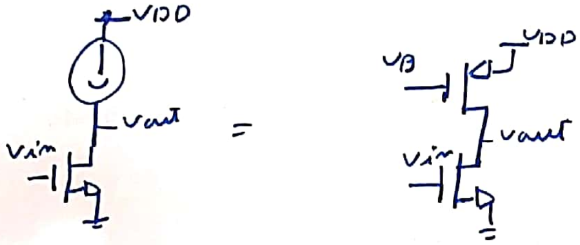
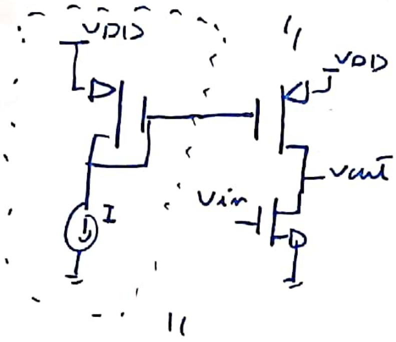
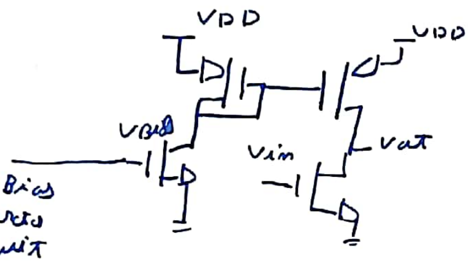
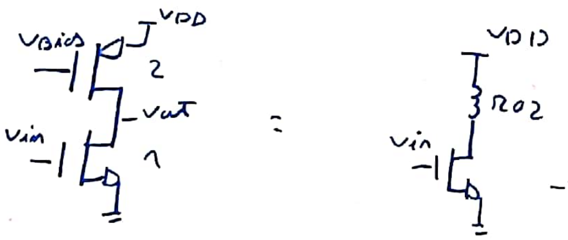




current Mirror



som Bias generator circuit



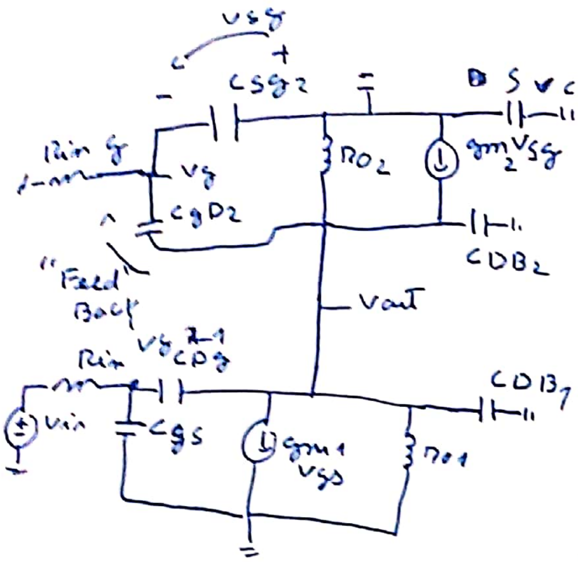
$R_{O2} \approx \frac{1}{I_D}$

→ DC is the same as Resistive CS

Ignoring the current mirror and Bias circuit

current mirror add a capacitive Impedance that can affect circuits But are very Important

$AV(s)$ → Since There is a "feedBack"



$$Z_{eq1} = \frac{1}{C_{sg2}s} \,//\, R_{in}$$

$$V_{g2} = V_{out} \times \frac{\frac{1}{C_{gD2}s}}{Z_{eq1} + \frac{1}{C_{gD2}s}}$$

$$\frac{V_{g1} - V_{in}}{R_{in}} + V_{gs}C_{gs}s + (V_{g1} - V_{out})C_{gD}s = 0$$

$$V_{g1} = \frac{\frac{V_{in}}{R_{in}} - V_{out}C_{gD}s}{\frac{1}{R_{in}} + C_{gs}s + C_{gD}s}$$

$$Z_{eq2} = \frac{1}{C_{DB2}s} \,//\, \frac{1}{C_{DB}s_1}$$

V_{out} = sum of currents at v_{out}

$$\frac{V_{out}}{R_{o2}} + \frac{V_{out}}{Z_{eq2}} + g_m V_{gs1} + (V_{out} - V_{g1})C_{Dg}s + \frac{V_{out}}{R_{o1}} + (V_{out} - V_{g2})C_{gD2}s - g_{m2}(-V_{gs2})$$

$$V_{out}\left(\frac{1}{R_{o2}} + \frac{1}{Z_{eq2}} + C_{Dg}s + \frac{1}{R_{o1}} + C_{gD2}s + \frac{\frac{g_{m2}}{C_{gD2}s}}{Z_{eq1} + \frac{1}{C_{gD2}s}} + (g_{m1} - C_{Dg}s) \times \right. \rightarrow$$

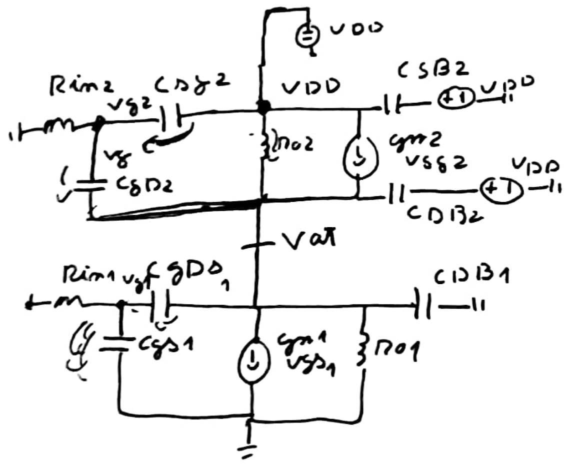
$$\rightarrow \left.\frac{C_{gD}s}{\frac{1}{R_{in}} + C_{gs}s + C_{gD}s}\right) - V_{in}\left(-g_{m1} + C_{gD2}s\underbrace{\left(\frac{\frac{1}{R_{in}}}{\frac{1}{R_{in}} + C_{gs1}s + C_{gD1}s}\right)}_{\text{"FeedBack"}}\right)$$

$$\frac{V_{out}}{V_{in}} = \frac{-g_{m1} + C_{gD2}s\left(\frac{\frac{1}{R_{in}}}{\frac{1}{R_{in}} + C_{gs1}s + C_{gD1}s}\right)}{\frac{1}{R_{o2}} + \frac{1}{Z_{eq2}} + C_{Dg}s + \frac{1}{R_{o1}} + C_{gD2}s + \frac{\frac{g_{m2}}{C_{gD2}s}}{Z_{eq1} + \frac{1}{C_{gD2}s}} + (g_{m1} - C_{Dg}s) \times \left(\frac{C_{gD}s}{\frac{1}{R_{in}} + C_{gs1}s + C_{gD1}s}\right)}$$

↓

Too complex To calculate Frequency poles maybe use software

A+ gain



$V_{g2} \rightarrow$ sum of currents at V_{g2}

$$(V_{g2} - V_{DD})\, C_{gs2}\, s + (V_{g2} - V_{out})\, C_{gD2}\, s + \frac{V_{g2}}{R_{in}} = 0$$

$$V_{g2} = \frac{V_{DD}\, C_{gs2}\, s + V_{out}\, C_{gD2}\, s}{\frac{1}{R_{in_2}} + C_{gs2}\, s + C_{gD2}\, s}$$

$$V_{g1} = \frac{V_{out}\, C_{gD}\, s_1}{\frac{1}{R_{in_1}} + C_{gD}\, s_1 + C_{gD}\, s_1}$$

sum of currents at V_{out}

$$(V_{out} - V_{DD})\, C_{DB2}\, s + (V_{out} - V_{g2})\, C_{gD2}\, s + \frac{V_{out} - V_{DD}}{R_{o2}} - g_{m2}(V_{sg}^{\,-V_{g2}})$$

$$+ \frac{V_{out}}{R_{o1}} + V_{out}\, C_{DB1}\, s + g_m V_{g1} + (V_{out} - V_{g1})\, C_{gD}\, s_1$$

V_{g1}

$$V_{out}\Bigg(C_{DB2}\, s + C_{gD2}\, s + \frac{1}{R_{o2}} + \frac{1}{R_{o1}} + C_{DB1}\, s + C_{gD}\, s_1 + \frac{g_{m1}\, C_{gD}\, s}{\frac{1}{R_{in_1}} + C_{gD}\, s_1 + C_{gD}\, s_1}$$

$$+ \frac{C_{gD2}\, s}{\frac{1}{R_{in_2}} + C_{gs2}\, s + C_{gD2}\, s}\left(g_{m2} - C_{gD2}\, s \right)\Bigg)$$

$$+ -V_{DD}\left(C_{DB2}\, s + \frac{1}{R_{o2}} + \frac{C_{gs2}\, s}{\frac{1}{R_{in2}} + C_{gs2}\, s + C_{gD2}\, s}\left(g_{m_2} - C_{gD2}\, s \right)\right)$$

$$A^+ = \frac{C_{DB2}\, s + \frac{1}{R_{o2}} + \frac{C_{gs2}\, s}{\frac{1}{R_{in2}} + C_{gs2}\, s + C_{gD2}\, s}\left(g_{m_2} - C_{gD2}\, s \right)}{C_{DB2}\, s + C_{gD2}\, s + \frac{1}{R_{o2}} + \frac{1}{R_{o1}} + C_{DB1}\, s + C_{gD}\, s_1 + \frac{g_{m1}\, C_{gD}\, s}{\frac{1}{R_{in_1}} + C_{gD}\, s_1 + C_{gD}\, s_1} \rightarrow \; \rightarrow + \frac{C_{gD2}\, s}{\frac{1}{R_{in2}} + C_{gs2}\, s + C_{gD2}\, s}\left(g_{m2} - C_{gD2}\, s \right)}$$

$\rightarrow$ ~~3Poles~~ 4° order equation

I~~t can Be sa~~ The division part can easily But

Its very hard to get the poles, a lum