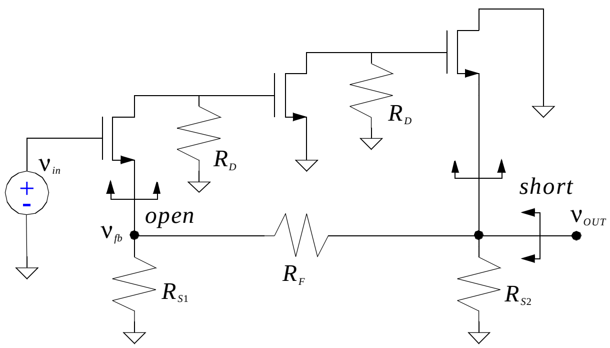
Series-Shunt

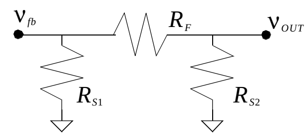
FB-58

Take OUTPUT from source of Series Triple



Series-Shunt (Cont.)

FB-59



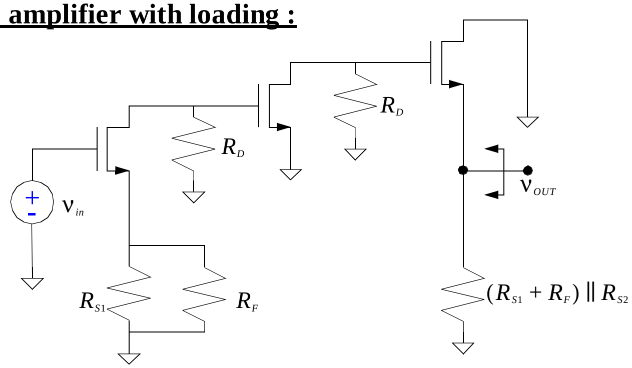
$$f_v = \frac{v_{fb}}{v_{OUT}} = \frac{R_{S1}}{R_F + R_{S1}}$$

$$R_{OUT} = \frac{r_{OUT}'}{1 + a_v' f_v}$$

Series-Shunt (Cont.)

FB-60

Basic amplifier with loading :



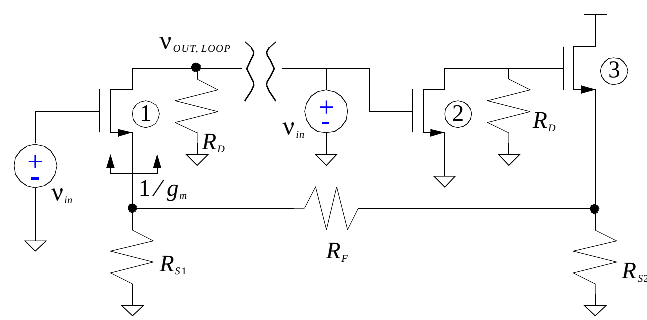
$$r_{OUT}' = \frac{1}{g_m} \| (R_{S1} + R_F) \| R_{S2}$$

$$a_v' = \frac{g_m^3 \cdot R_D^2}{[1 + (1 + \chi) \cdot g_m \cdot (R_S \| R_F)] \cdot [1 + (1 + \chi) \cdot g_m \cdot (R_{S1} + R_F) \| R_{S2}]}$$

Series-Shunt (Cont.)

FB-61

Another method is the “Break the loop” strategy for multi-stage circuits.



$$T' = \frac{v_{OUT, LOOP}}{v_{in}}$$

Series-Shunt (Cont.)

FB-62

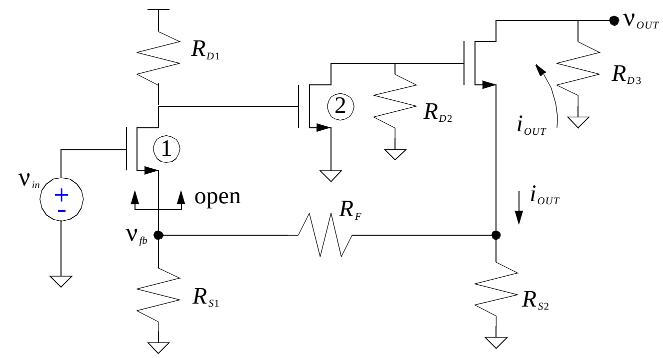
$$T' = \frac{v_{OUT,\,LOOP}}{v_{in}}$$

$$r_o \gg R_D$$

$$T' = (g_{m2}\cdot R_D)\cdot\left(\frac{g_m\cdot\left(R_{S2}\,\|\left(R_F+\frac{1}{g_m}\,\|\,R_{S2}\right)\right)}{1+g_m\cdot\left(R_{S2}\,\|\left(R_F+\frac{1}{g_m}\,\|\,R_{S2}\right)\right)}\right)\cdot\underbrace{\frac{R_{S2}\,\|\,\frac{1}{g_m}}{R_F+R_{S2}\,\|\,\frac{1}{g_m}}}_{\text{Through Feedback Network}}\cdot g_{m2}\cdot R_D$$

Series-Series / Triple

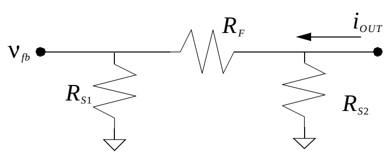
FB-63



Series-Series / Triple (Cont.)

FB-64

Sensing i_{OUT} in source, though i_{OUT} is in drain.



$$\frac{v_{fb}}{i_{OUT}} = R_{S1}\cdot\left(\frac{R_{S2}}{R_{S2}+R_F+R_{S1}}\right) = f_R$$

Series-Series / Triple (Cont.)

FB-65

$$A_G = \frac{i_{OUT}}{v_{in}} = \frac{1}{f_R}\cdot\left(\frac{T'}{1+T'}\right)$$

$$T' = a_G\cdot f_R$$

$$A_G = \frac{1}{f_R} = \left(\frac{R_{S1}+R_{S2}+R_F}{R_{S1}\cdot R_{S2}}\right)$$

$$v_{OUT} = -i_{OUT}\cdot R_{D3}$$

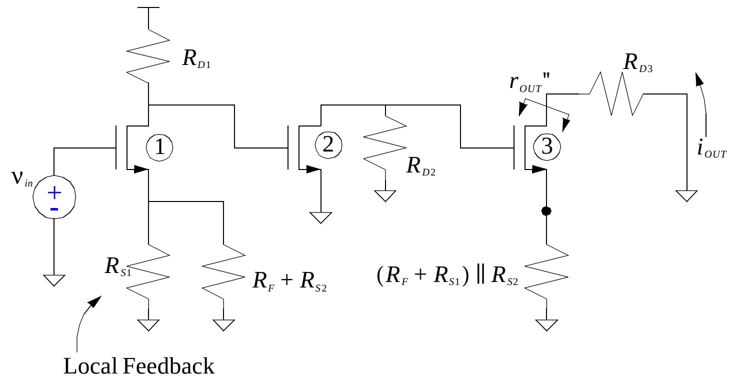
$$\frac{v_{OUT}}{v_{in}} = \frac{v_{OUT}}{i_{OUT}}\cdot\frac{i_{OUT}}{v_{in}}$$

$$\frac{v_{OUT}}{v_{in}} = -A_G\cdot R_{D3} = -\frac{(R_{S1}+R_{S2}+R_F)\cdot R_{D3}}{R_{S1}\cdot R_{S2}}$$

Series-Series / Triple (Cont.)

FB-66

Basic amplifier with loading :



If $\rightarrow R_{D1} = R_{D2} = R_{D3} = R_D$ $\quad R_{S1} = R_{S2} = R_S$

and $\rightarrow R_D \ll r_o \cdot [1 + g_m \cdot (1+\chi) \cdot R_S]$ then,

Series-Series / Triple (Cont.)

FB-67

$$a_G' = \frac{i_{OUT}}{v_{in}} = (\text{Current Division at Output}) \cdot (\text{Trans 1}) \cdot (\text{Trans 2}) \cdot (\text{Trans 3})$$

$$\text{Current Division at Output} = \frac{r_{OUT}''}{r_{OUT}'' + R_{D3}}$$

$$\text{Trans 1} = \frac{g_m \cdot R_{D1}}{[1 + (1+\chi) \cdot g_m \cdot R_S \| (R_F + R_{S2})]}$$

$$\text{Trans 2} = g_m \cdot R_{D2}$$

$$\text{Trans 3} = \frac{g_m}{1 + (1+\chi) \cdot g_m \cdot R_S \| R_F + R_{S2}}$$

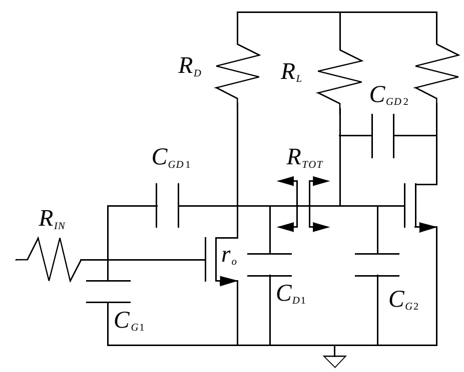
$$a_G' = \frac{g_m^3 \cdot R_D^2 \cdot \left(\frac{r_{OUT}''}{r_{OUT}'' + R_D}\right)}{[1 + (1+\chi) \cdot g_m \cdot (R_S \| (R_F + R_S))]^2}$$

Series-Series / Triple (Cont.)

FB-68

$$r_{OUT}' = R_{D3} + \underbrace{r_{o3} \cdot [1 + (1+\chi) \cdot g_m \cdot (R_S \| (R_F + R_S))]}_{r_{OUT}''}$$

$$R_{OUT}' = r_{OUT}' \cdot (1 + a_G' \cdot f_R)$$



For $C_{GD1} = 0$,

$$R_{TOT} = r_o \parallel R_D \parallel R_L$$

$$C_{TOT} = C_{D1} + C_{G2} + C_{GD2}(1 + A)$$

$$p_1 = \frac{1}{C_{TOT} R_{TOT}}$$

For C_{GD1} a short,

$$R_{TOT} = r_o \parallel R_D \parallel R_L \parallel \frac{1}{g_m}$$

C_{TOT} remains the same as above

For $R_{IN} = 0$,

$$C_{TOT} = C_{D1} + C_{G2} + C_{GD2}(1 + A) + C_{GD1}$$