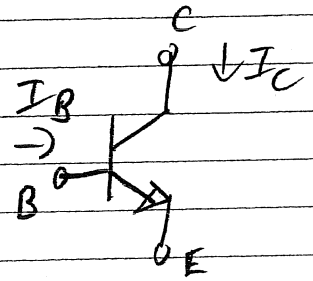
USE OF COMPOUND DEVICES

BJT

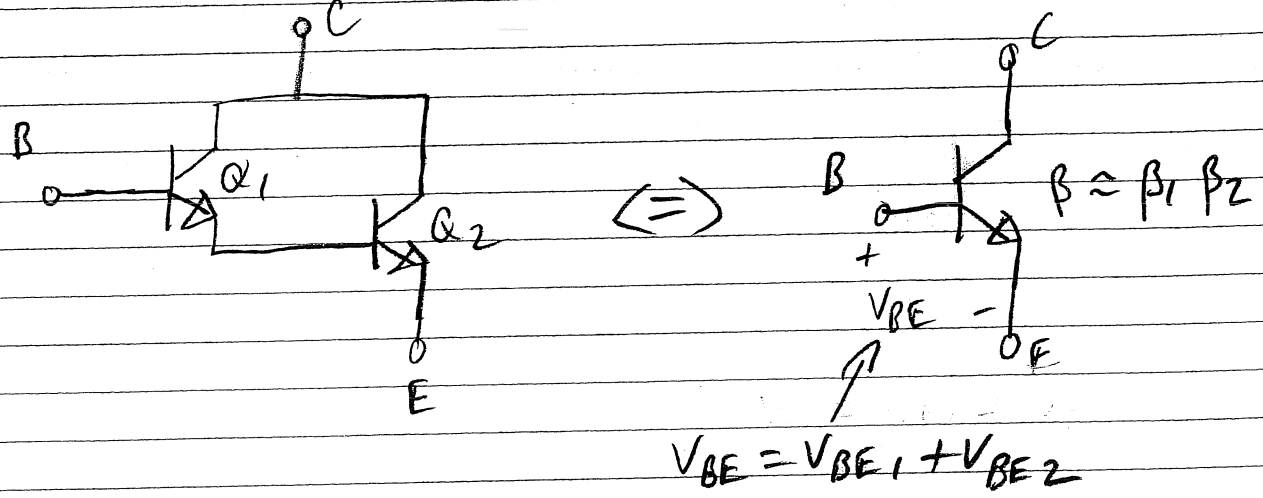
CURRENT GAIN $\beta = \frac{I_C}{I_B}$



(ACTIVE REGION)

TO INCREASE CURRENT GAIN

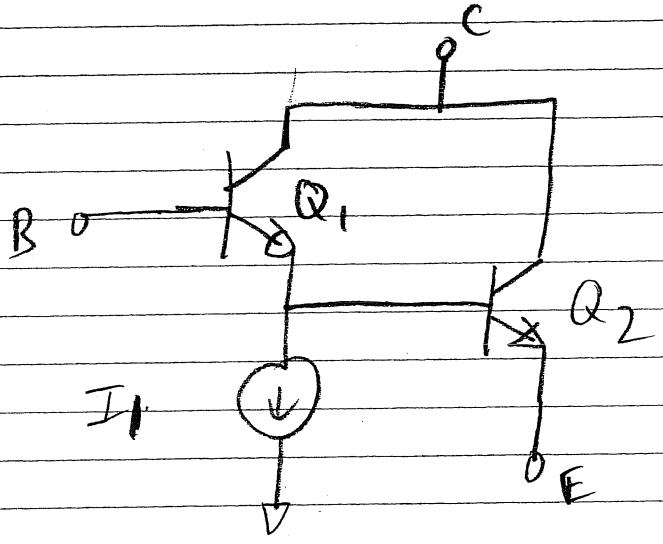
USE A DARLINGTON CONFIGURATION



IF USED AS SHOWN ABOVE Q_1 BIASED WITH ONLY I_{B2} (MAY BE TOO SMALL A BIAS CURRENT)

SO

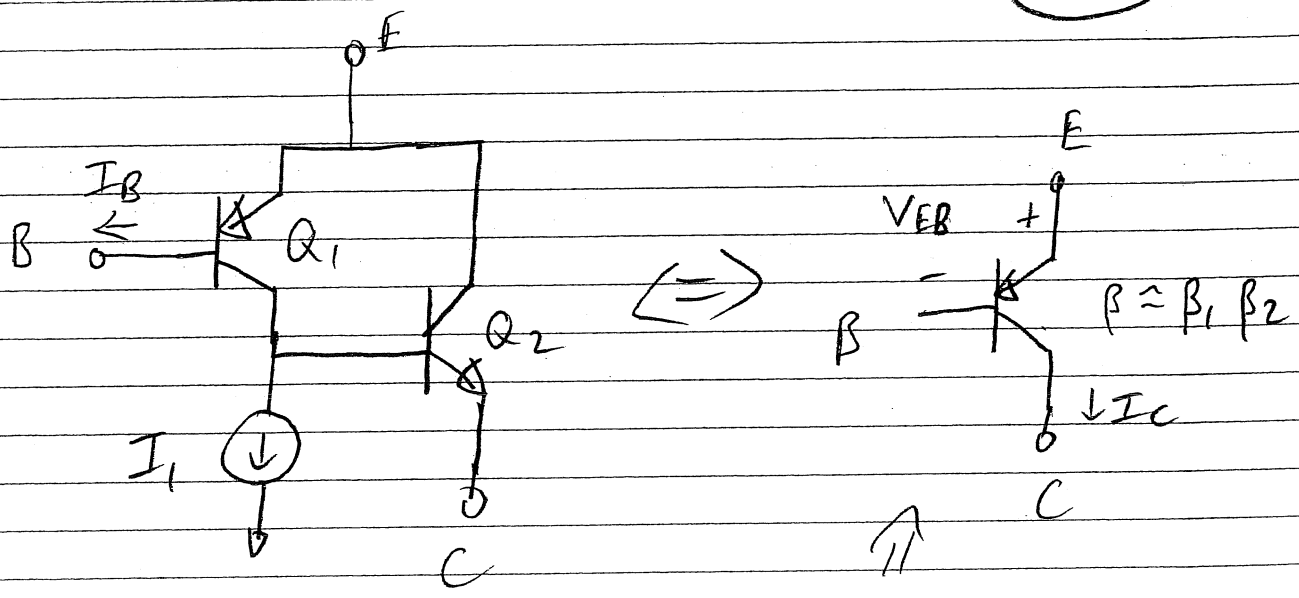
USUALLY ADD BIAS CURRENT TO Q_1 $\Rightarrow$ ALSO HELPS TURN OFF Q_2 IF Q_1 TURNED OFF



FOR PNP $\Rightarrow$ OFTEN USE NPN TOGETHER WITH PNP TO IMPROVE PNP

(NPN USUALLY HAVE BETTER PERFORMANCE THAN PNP
(HIGHER β & HIGHER f_t)

ESPECIALLY IF PNP BUILT AS LATERAL DEVICE RATHER THAN VERTICAL DEVICE



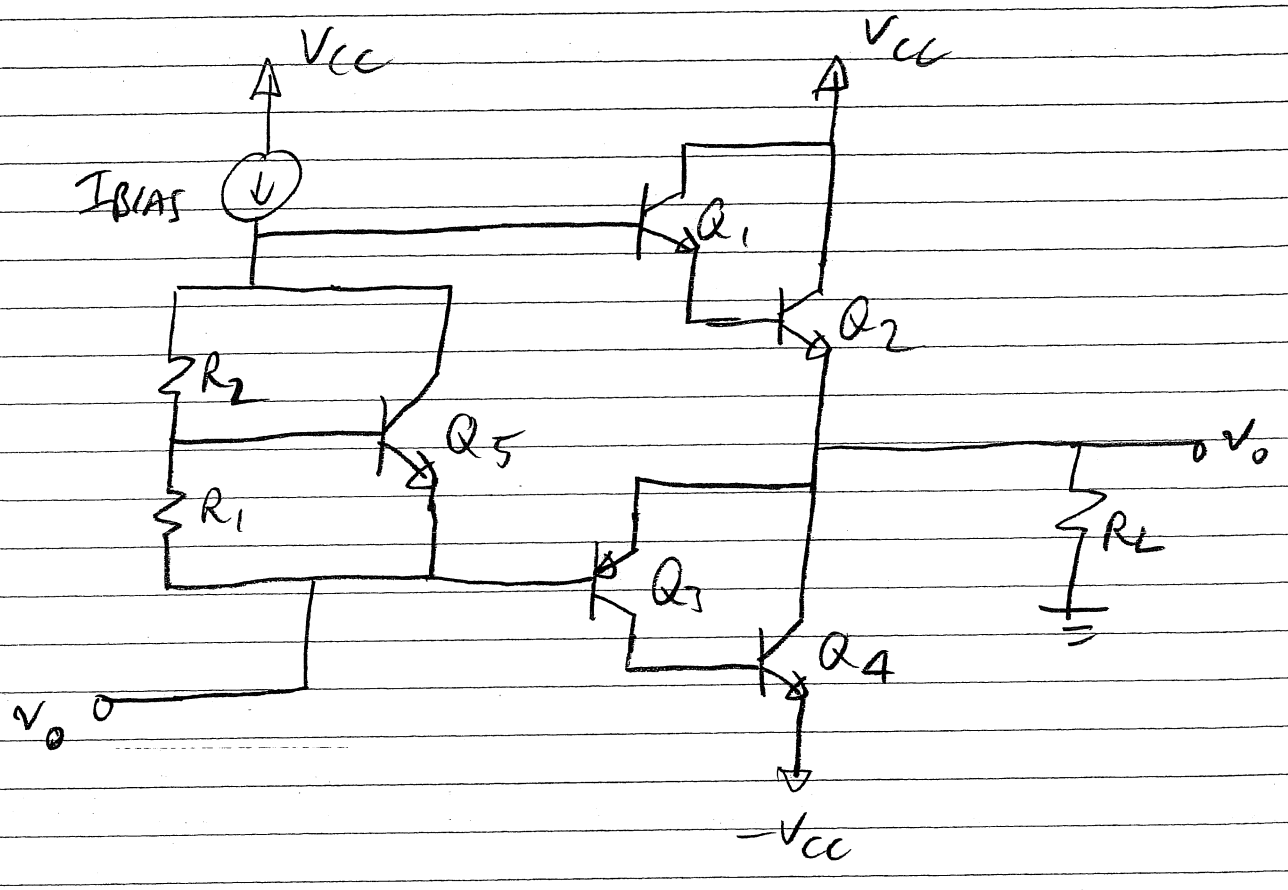
$$I_S \cong \beta_N I_{SP}$$

WHERE I_{SP} IS SCALE CURRENT OF PNP Q_1

$$I_C \cong \beta_N I_{SP} e^{V_{EB}/V_T}$$

NOTE THERE IS A FEEDBACK LOOP AROUND Q_1 & Q_2 HERE SO STABILITY MUST BE CONSIDERED

USE IN AN OUTPUT STAGE



MIN V_o $\Rightarrow$ $V_{o\_MIN} + V_{EB3}$

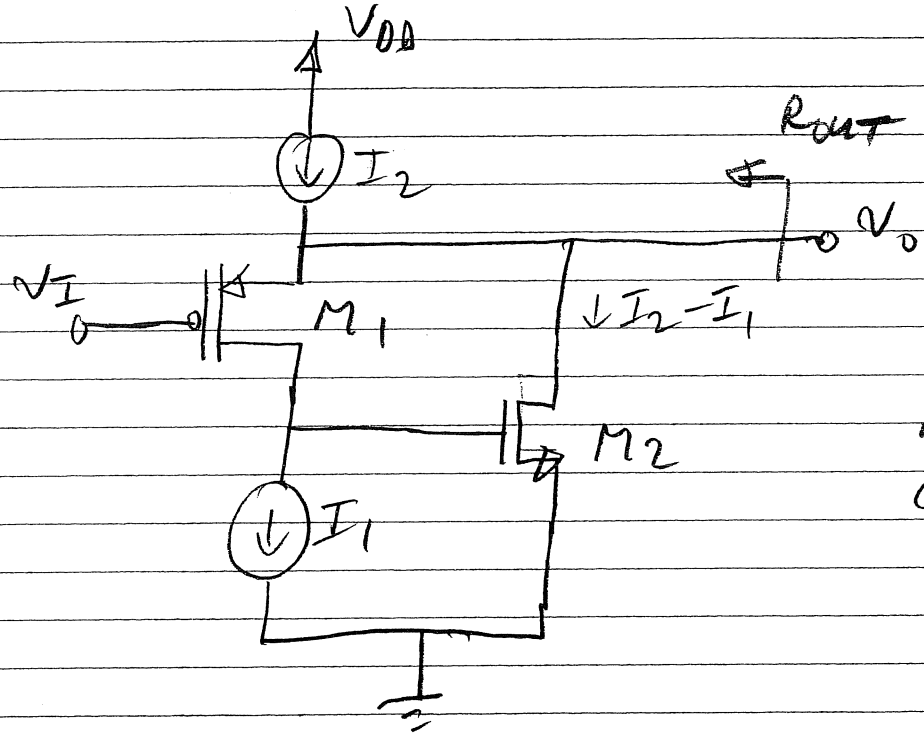
(SIMILAR TO PNP ALONE)

MAX V_o $\Rightarrow$ $V_{CC} - V_{BIAS} - V_{BE1} - V_{BE2}$

(EXTRA V_{BE} DROP)

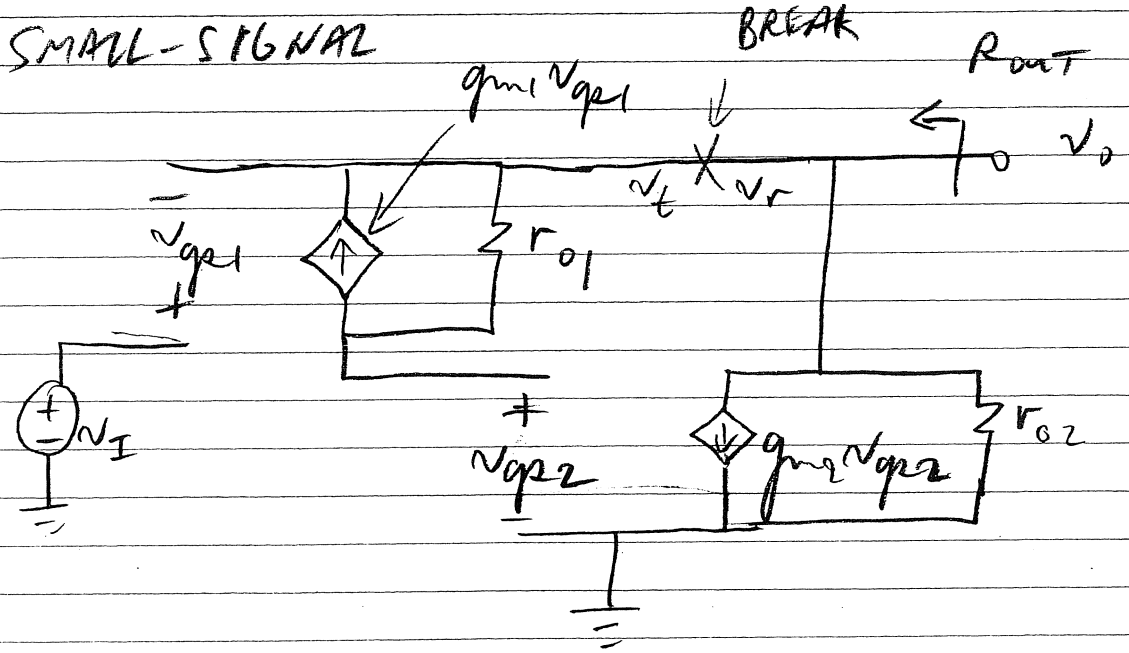
CMOS

SUPER SOURCE FOLLOWER



PMOS
NMOS
COMBINATION

SMALL-SIGNAL



CD6

IMPEDANCE SEEN TO LEFT OF BREAK $\Rightarrow \infty$

$$\frac{v_{gs2}}{v_t} = \left(1 + g_{m1} r_{o1}\right) \simeq g_{m1} r_{o1}$$

$$\frac{v_r}{v_{gs2}} = -g_{m2} r_{o2}$$

$$L \equiv -\frac{v_r}{v_t} \cong g_{m1} g_{m2} r_{o1} r_{o2}$$

$$R_{p0} = r_{o2}$$

$$R_{OUT} = R_{p0}\left[\frac{1+L_S}{1+L_0}\right] \qquad L_S = 0 \quad L_0 = L$$

$$R_{OUT} = \frac{r_{o2}}{g_{m1} g_{m2} r_{o1} r_{o2}} = \frac{1}{g_{m2}\left(g_{m1} r_{o1}\right)}$$

$$R_{OUT} \ll \frac{1}{g_{m2}}$$