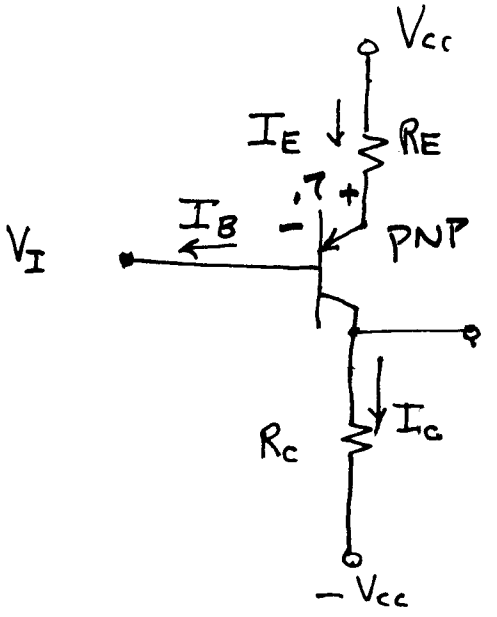
ALTERNATIVE LEVEL SHIFTER

DC



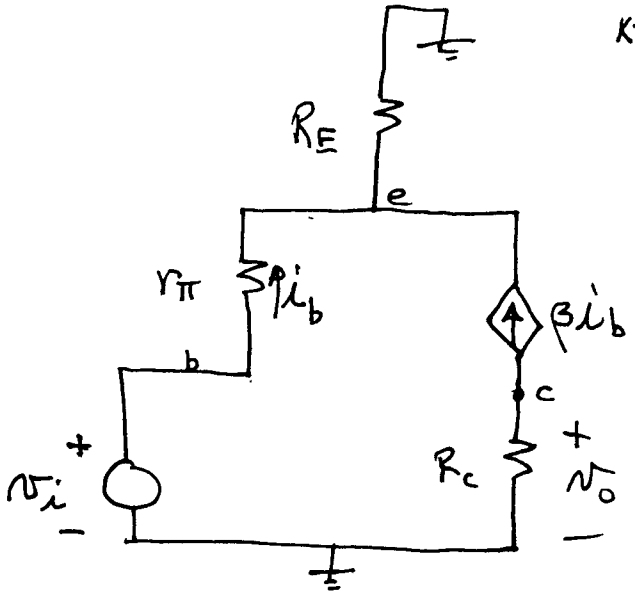
$$V_{cc} = I_E R_E + 0.7 + V_I$$

$$I_E = \frac{V_{cc} - .7 - V_I}{R_E}$$

$$V_o = I_c R_c - V_{cc}$$

$$I_c = \alpha I_E$$

SMALL-SIGNAL



KVL: $v_i = i_b r_\pi + (\beta+1) i_b R_E$

$$v_o = -\beta i_b R_c$$

$$\frac{v_o}{v_i} = \frac{-\beta R_c}{r_\pi + (\beta+1) R_E}$$

if $(\beta+1) R_E \gg r_\pi$, $\frac{v_o}{v_i} = -\frac{\beta R_c}{(\beta+1) R_E} \approx \frac{-R_c}{R_E}$

$$\frac{v_o}{v_i} \approx -\frac{R_c}{R_E}$$