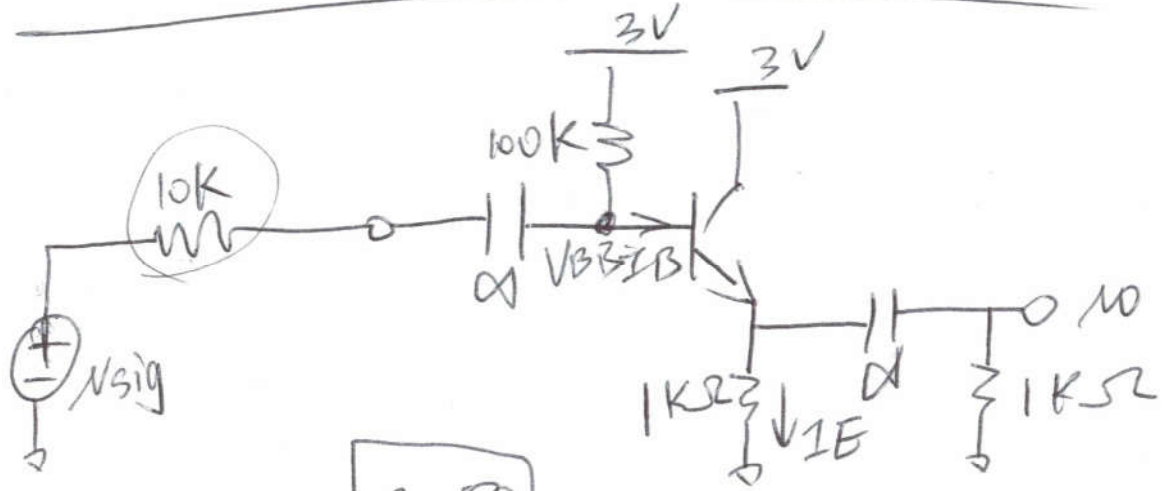
More BJT Examples



$\beta = 50$

DC? AC?

$$\begin{cases} \frac{3 - V_{BB}}{100K} = I_B \\ \frac{V_{BB} - 0.7}{1K} = (1+\beta) I_B = 51 \cdot I_B \end{cases}$$

$$\frac{V_{BB} - 0.7}{1K \cdot 51} = \frac{3 - V_{BB}}{100K}$$

$$2V_{BB} - 1.4 = 3 - V_{BB}$$

$$3V_{BB} = 4.4$$

$$V_{BB} = 1.47\,V$$

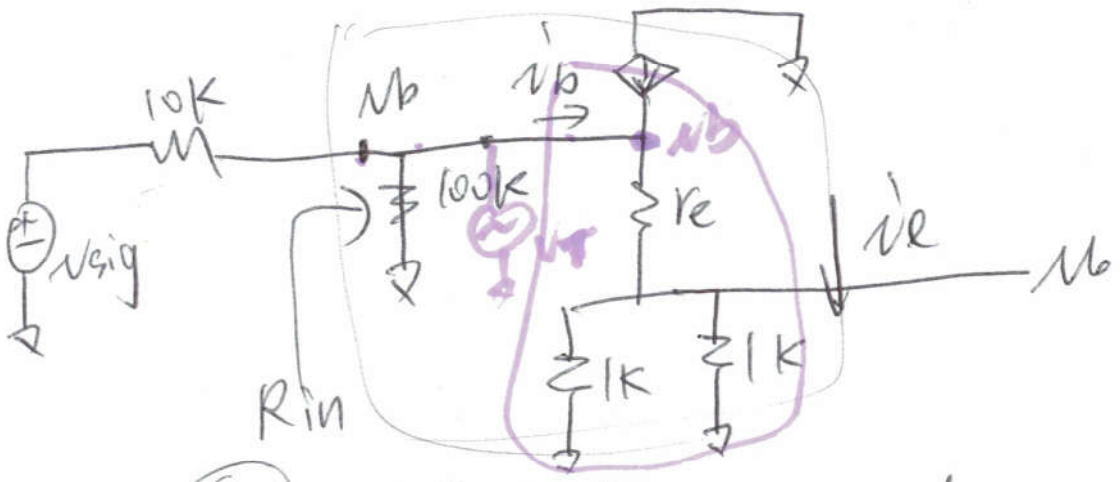
$$I_B = \frac{3 - 1.47}{100K} = 15.3\,\mu A$$

$$I_E = (1+\beta) \cdot I_B = 51 \cdot 15.3\,\mu A = 780.3\,\mu A$$

$$I_C = \alpha \cdot I_E = \frac{\beta}{1+\beta} \cdot I_E \approx 780.3\,\mu A$$

$$V_E = V_{BB} - 0.7 = 1.47 - 0.7 = 0.77\,V.$$

用T-model



$$g_m = \frac{IC}{V_T} = \frac{780.3\mu A}{25mV} = 31.2 mA/V.$$

$$\frac{Nb}{Vsig} = \frac{Rin}{10k + Rin}$$

$$Rin = 100k \,//\, \frac{Nb}{ib}$$

$$\frac{Nb}{ib} = \frac{Nb}{\left(\frac{Ne}{1+\beta}\right)} = \frac{Nb}{ie}(1+\beta) = \left(re + (1K//1K)\right)(1+\beta)$$

$$Rin = 100k \,//\, \left(re + (1K//1K)\right)(1+\beta)$$

$$\frac{Nb}{Vsig} = \frac{Rin}{10k + Rin}$$

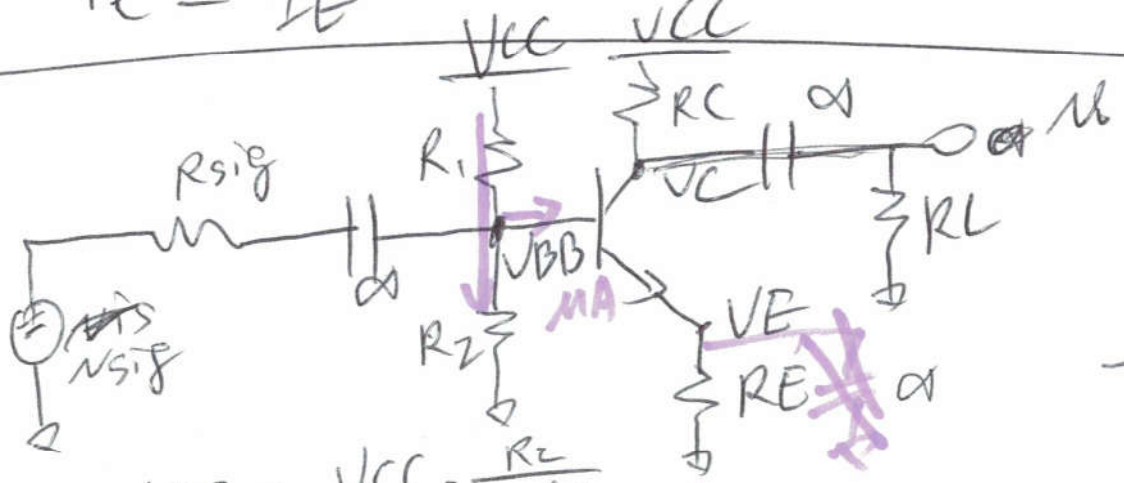
$$\frac{No}{Nb} = \frac{1K//1K}{re + (1K//1K)}$$

$$Rin = 100k \,//\, re + (1K//1K)$$ X

(12)

$$\frac{v_o}{v_{sig}} = \frac{v_o}{v_{sig}} = \frac{R_{in}}{10K + R_{in}} \cdot \frac{1K // 1K}{r_e + (1K // 1K)}$$

$$r_e = \frac{V_T}{I_E}$$



$\beta = 100$

$$V_{BB} = V_{CC} \cdot \frac{R_2}{R_1 + R_2}$$

$$V_E = V_{BB} - 0.7 = \frac{V_{CC} \cdot R_2}{R_1 + R_2} - 0.7$$

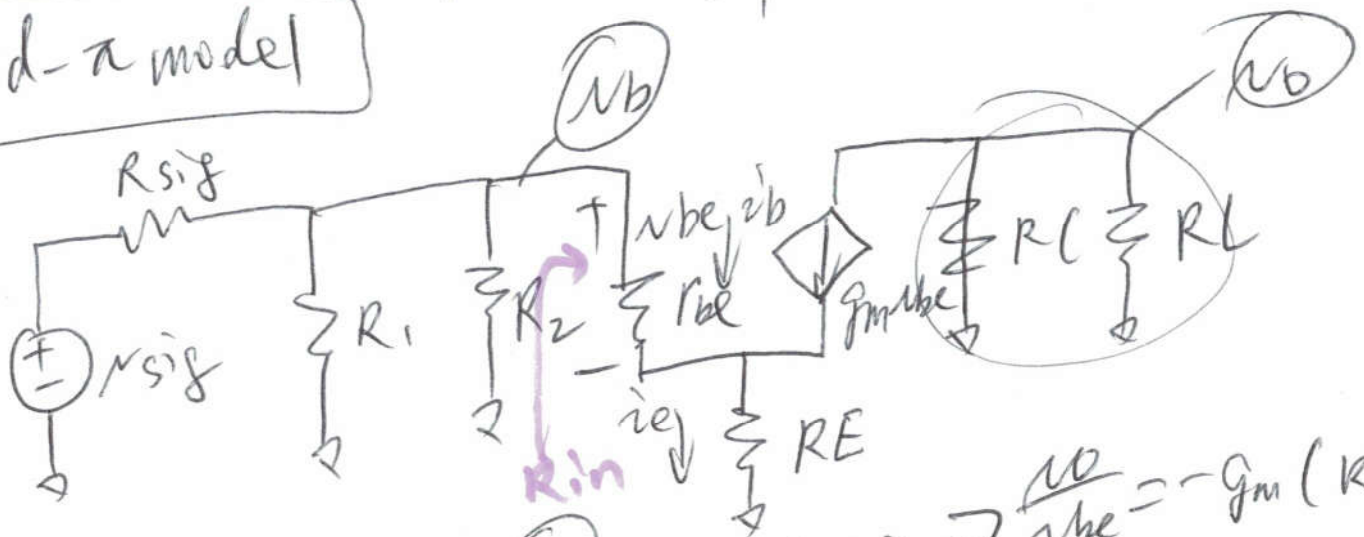
$$I_E = \frac{V_E}{H\beta} = \frac{\frac{V_{CC} \cdot R_2}{R_1 + R_2} - 0.7}{1 + \beta}$$

$$I_C = \alpha \cdot I_E = \frac{\beta}{1+\beta} \cdot \frac{\frac{V_{CC} \cdot R_2}{R_1 + R_2} - 0.7}{1 + \beta}$$

$$V_C = V_{CC} - R_C \cdot I_C$$

$g_m = \frac{I_C}{V_T} = \frac{\quad}{V_T}$

Hybrid-π model



$$\frac{No}{Nbe} = -g_m(RC//RL)$$

$$No = -g_m Nbe \cdot (RE//RL)$$

$$Nb = r_{be}\cdot i_b + RE\cdot i_e = r_{be}\cdot i_b + RE\cdot(1+\beta) i_b$$

$$\frac{Nb}{i_b} = r_{be} + RE(1+\beta) = R_{in}$$

$$\frac{Nb}{N_{sig}} = \frac{R_1//R_2//R_{in}}{R_{sig} + R_1//R_2//R_{in}}$$

$$\frac{Nbe}{Nb} = \frac{i_b \cdot r_{be}}{i_b \cdot r_{be} + (1+\beta) i_b \cdot RE} = \frac{r_{be}}{r_{be} + (1+\beta)RE}$$

$$\frac{16}{\sqrt{12}} \cdot \frac{\sqrt{6}}{\sqrt{517}} \cdot \frac{\sqrt{12}}{\sqrt{6}} = \frac{16}{\sqrt{517}} = \text{- — —}$$