Input resistance of CE amplifier is very high → $r_\pi \uparrow$

$$R_{in} = r_\pi = \frac{\beta}{g_m} \rightarrow g_m \downarrow$$

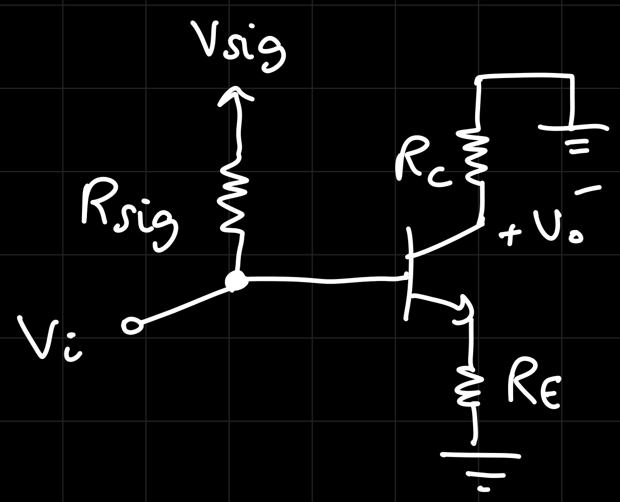
$$A_v = \frac{V_o}{V_i} = -g_m(R_C \parallel R_L)\left(\frac{r_\pi}{r_\pi + R_{sig}}\right)$$

$$G_v = \frac{V_o}{V_{sig}}$$

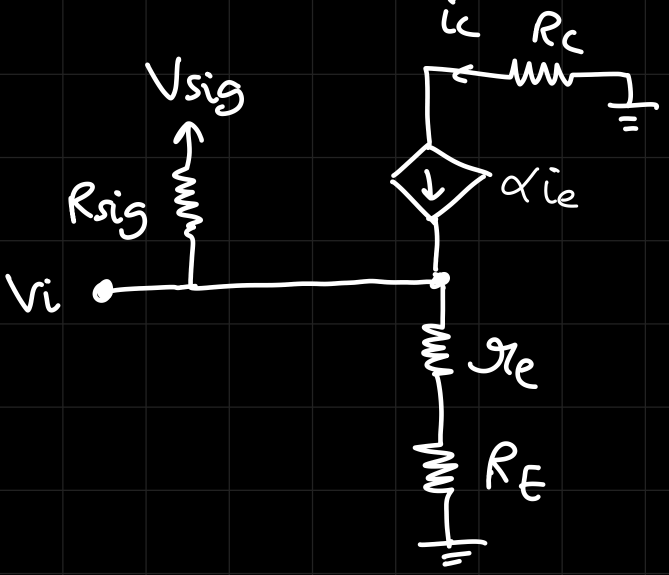
$g_m \downarrow \rightarrow A_v \downarrow$

emitter follower circuit (modified CE)

→ helps to achieve high



T model of this ckt → (AC equivalent)



$$R_{in} = \frac{V_i}{i_b} \rightarrow \quad V_i = i_e(r_e + R_e)$$

$$i_e = (\beta+1)\, i_b$$

$$R_{in} = (\beta+1)(r_e + R_e)$$

$$R_{in} \text{ (in CE w/o } R_E) = r_\pi = (\beta+1)\, r_e$$

$$\frac{R_{in} \text{ (CE with } R_E)}{R_{in} \text{ (CE w/o } R_E)} = \frac{r_e + R_E}{r_e} = 1 + \frac{R_e}{r_e}$$

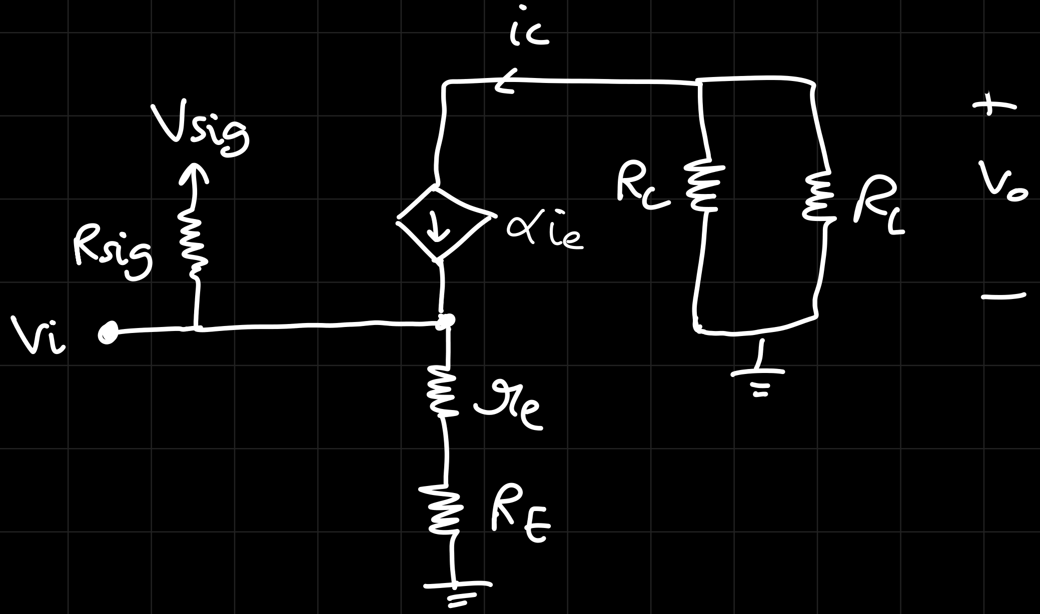
$$V_o = -i_c R_C = -\alpha i_e R_C$$

$$V_i = i_e(r_e + R_e)$$

$$A_{V_o} = \frac{V_o}{V_i} = \frac{-\alpha R_C}{r_e + R_e}$$

Open ckt volt gain

now with R_L = ?



$$A_v = \frac{V_o}{V_i}$$

$$V_o = -i_c(R_C \parallel R_L) = -\alpha i_e (R_C \parallel R_L)$$
$$V_i = i_e(r_e + R_e)$$

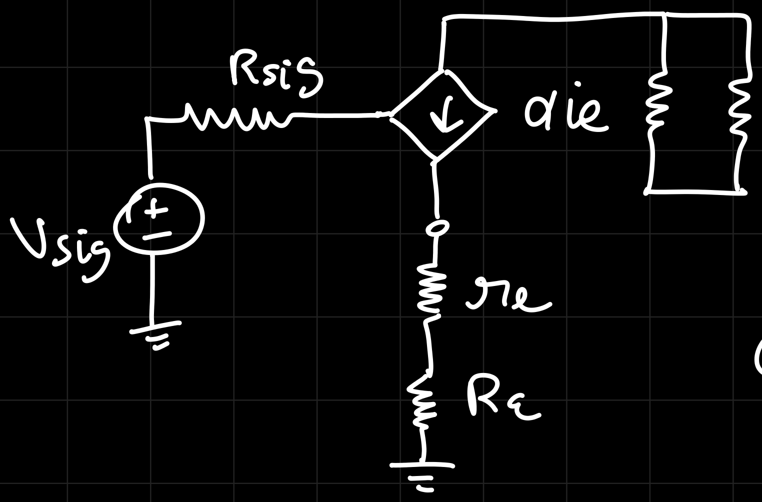
$$A_v = -\frac{\alpha(R_C \parallel R_L)}{r_e + R_e}$$

in the OC gain → $A_{vo} = \dfrac{-\alpha R_C}{r_e + R_e}$

$$= \frac{-\alpha}{r_e}\left(\frac{R_C}{1+\frac{R_e}{r_e}}\right) = \frac{-\alpha g_m R_C}{1+g_m R_e}$$

Input impedance depends on your input signal swing

Condition : $R_{in} >> R_{sig}$



$$G_v = \frac{V_o}{V_{sig}} = \frac{V_o}{V_i} \times \frac{V_i}{V_{sig}}$$

$$G_v = \frac{-\alpha i_e (R_C \| R_L)}{i_e (r_e + R_e)} \times \frac{V_i}{V_{sig}} = \frac{-\alpha (R_C \| R_L)}{r_e + R_e + R_{sig}}$$

$$V_i = V_{sig} \times \frac{r_e + R_e}{r_e + R_e + R_{sig}}$$

Other way → $V_{sig} = V_i + i_B R_{sig}$

$$V_{sig} = i_e(R_e + r_e) + i_B R_{sig}$$

$$= i_B\left((\beta+1)(R_e + r_e) + R_{sig}\right)$$

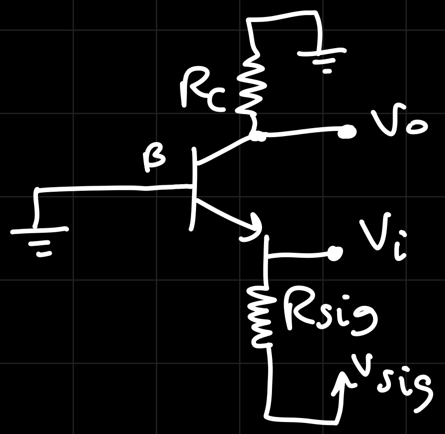
$$\frac{V_i}{V_{sig}} = \frac{(\beta+1)\quad(R_e + r_e)}{(\beta+1)(R_e + r_e)}$$

1. R_{in} is much higher than standard CE
2. A_{v_o} reduces
3. G_v is more tolerant to β variations

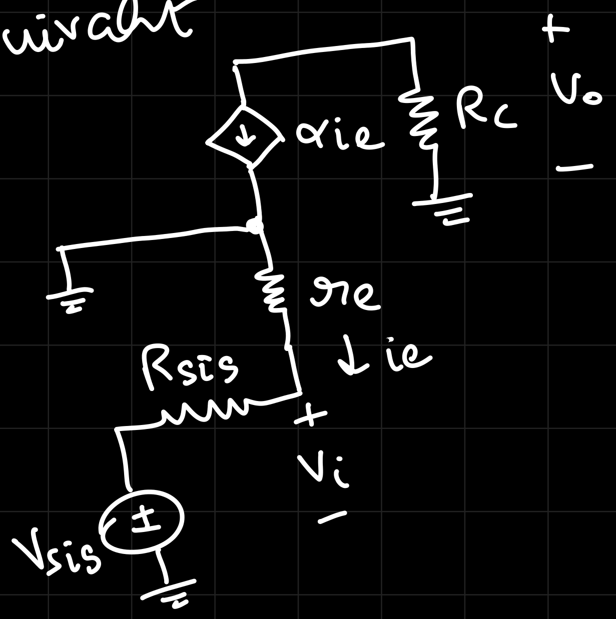
> Note: CE amp : phase out of 180° in V_o wrt v_i

CB amp : same phase
i.e. gain +ve

Common Base Configuration



AC equivalent

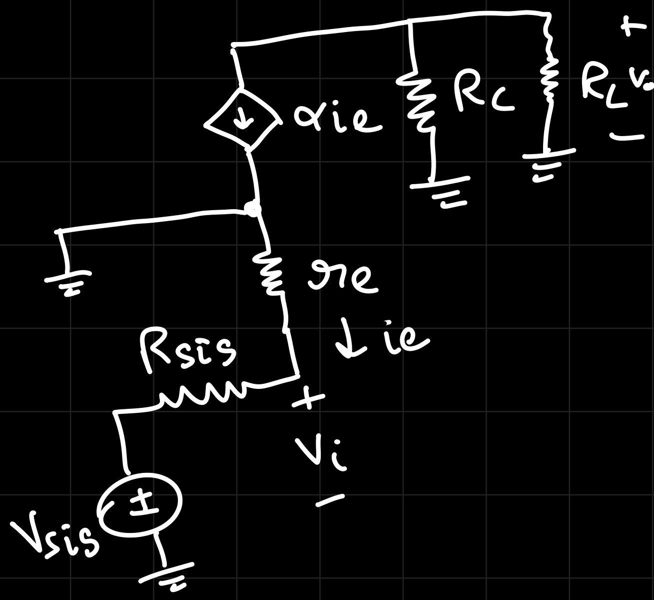


$$\alpha \simeq 1 \rightarrow \quad R_{in} = r_e = \frac{1}{g_m}$$

$$A_{vo} = \frac{V_o}{V_i} = \frac{-\alpha i_e (R_C)}{-i_e r_e} = \frac{\alpha R_C}{r_e} = \frac{g_m R_C}{}$$

same phase gain

put Load R



$$A_v = \frac{-\alpha i_e (R_C \| R_L)}{-i_e r_e}$$

$$= g_m (R_C \| R_L)$$

$$G_v = \frac{V_o}{V_{sig}} = \frac{-\alpha i_e (R_C \| R_L)}{V_{sig}}$$

$$V_i = V_{sig} \times \frac{r_e}{r_e + R_{sig}}$$

$$G_v = \frac{\alpha (R_C \| R_L)}{r_e + R_{sig}}$$ ✓

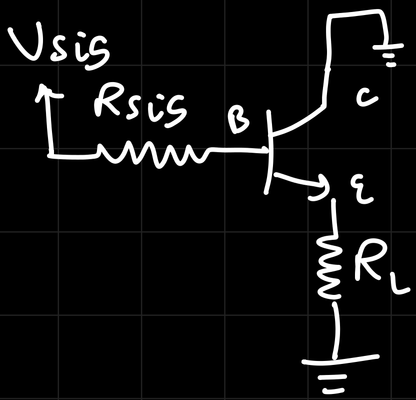
TRADEOFF:

+ve → output follows input phase

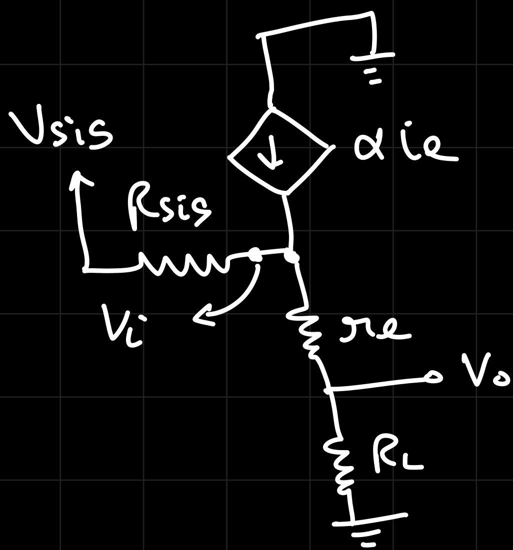
−ve → Rin smaller than CE amp
because $R_{in} = r_e$ here but $R_{in} = r_\pi$ there and $r_e \ll r_\pi$

Common collector config

buffer amp



$\rightarrow$

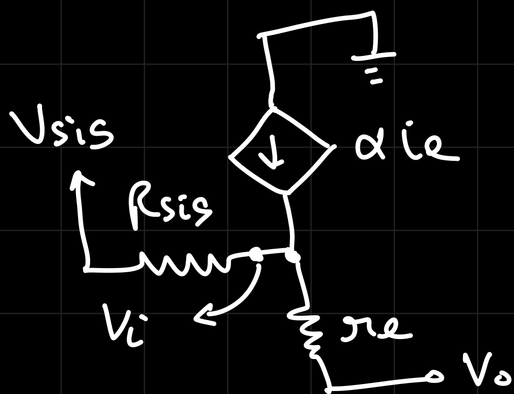


$$R_{in} = \frac{V_i}{i_B} = \frac{V_i(\beta+1)}{i_e} = (r_e + R_L)(\beta+1)$$

$$A_v = \frac{V_o}{V_i} = \frac{\underline{i_e R_L}}{i_e(r_e+R_L)} = \frac{R_L}{r_e+R_L}$$

$$A_{vo} = \frac{V_o}{V_i} \rightarrow \text{remove } R_L$$

$$= \frac{i_e r_e}{i_e r_e} = \boxed{1}$$



or mathematically $\rightarrow R_L = \infty$

$$A_{vo} = \frac{1}{1 + r_e/R_L} \simeq \frac{1}{1}$$

$$G_v = \frac{V_o}{V_{sig}} = \frac{V_o}{V_i} \times \frac{V_i}{V_{sig}} = \frac{R_L}{\cancel{r_e+R_L}} \times \frac{i_e(\cancel{r_e+R_L})}{V_{sig}}$$

$$V_i = V_{sig} \times \frac{(r_e+R_L)(\beta+1)}{(\beta+1)(r_e+R_L)+R_{sig}}$$

$$V_{sig} = \frac{i_e(\cancel{r_e+R_L})}{} \times \frac{r_e+R_L+R_{sig}}{\cancel{r_e+R_L}}$$

$$G_v = \frac{(\beta+1)R_L}{(\beta+1)(R_L+r_e)+R_{sig}}$$ $\simeq$ comes down to almost unity ($\sim$0.9–1)

$(\beta+1)R_L$ is the main scaling factor and if $(\beta+1)R_L$ becomes much much greate than $R_{sig} \rightarrow G_v \simeq 1$

Used when src resistance is very high