If we construct the network defined by Eq. of I_e.

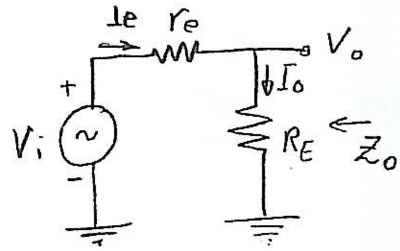


Fig (5-28)
Defining the output impedance for emitter-fol

To determine Z_o, V_i is set to Zero and

$$Z_o = R_E \parallel r_e \cong r_e \quad (\text{low}) \text{ if } R_E \gg r_e$$

Av

$$V_o = V_i * \frac{R_E}{R_E + r_e} \quad (\text{voltage divider rule})$$

$$A_V = \frac{V_o}{V_i} = \frac{R_E}{R_E + r_e}$$

R_E is usually much greater than r_e

$R_E + r_e \cong R_E$ and :

$$A_V = \frac{V_o}{V_i} \cong 1$$

V_o and V_i are inphase

Effect of r_o

Zi

$$Z_b = \beta r_e + \frac{(\beta+1)R_E}{1 + \frac{R_E}{r_o}} \quad (\text{high})$$

if $r_o \geq 10R_E$

$$Z_b = \beta r_e + (\beta+1)R_E \cong \beta(r_e + R_E) \qquad r_o \geq 10R_E$$

Zo

$$Z_o = r_o \parallel R_E \parallel \frac{\beta r_e}{(\beta+1)}$$

using $(\beta+1) \cong \beta$

$$Z_o = r_o \parallel R_E \parallel r_e$$

and since $r_o \gg r_e$

$$Z_o \cong R_E \parallel r_e \simeq r_e \quad (\text{very low})$$

Av

$$A_V = \frac{(\beta+1)R_E / Z_b}{1 + \frac{R_E}{r_o}} \qquad \text{for } r_o \geq 10R_E, \; \beta+1 \cong \beta$$

$$A_V \cong \frac{\beta R_E}{Z_b} \qquad \text{but } Z_b = \beta(r_e + R_E)$$

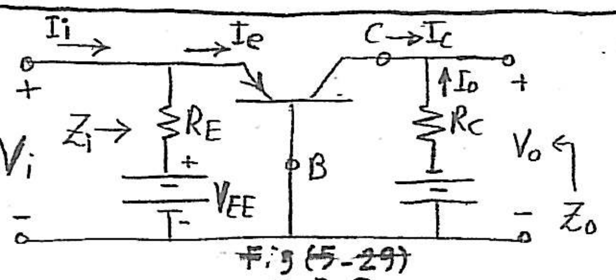
so that

$$A_V \cong \frac{\beta R_E}{\beta(r_e + R_E)} \cong \frac{R_E}{r_e + R_E}$$

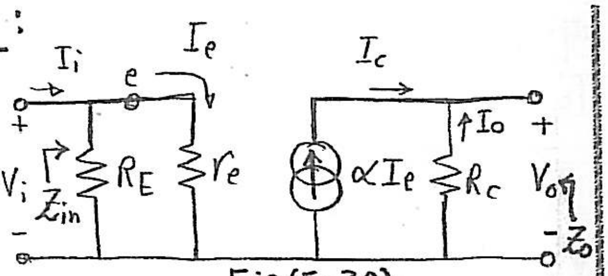
Ai

$$A_i = -A_V * \frac{Z_{in}}{R_L} \cong -1 * \frac{\beta \cancel{R_E}}{\cancel{R_E}} \cong -\beta$$

10) COMMON-BASE CONFIGURATION :



~~Fig (5-29)~~
C.B.C



~~Fig (5-30)~~
re equivalent circuit

* The C.B.C is characterized by low input and high output impedance and a current gain less than 1. The voltage gain, however, can be quite large.

Z_i

$$Z_i = R_E // r_e \approx r_e$$

Z_o

$$Z_o = R_C$$

A_V

$$V_o = -I_o R_C = -(-I_c) R_C = \alpha I_e R_C$$

$$I_e = \frac{V_i}{r_e}$$

$$V_o = \alpha \left(\frac{V_i}{r_e}\right) R_C$$

$$A_V = \frac{V_o}{V_i} = \frac{\alpha R_C}{r_e} \cong \frac{R_C}{r_e}$$

A_i assume $R_E \gg r_e$ yields

$$I_e \cong I_i$$

$$I_o = -\alpha I_e = -\alpha I_i$$

$$A_i = \frac{I_o}{I_i} = -\alpha \cong -1$$

* For C.B.C, $r_o = \frac{1}{h_{ob}}$ is typically in the megohm range so $r_o // R_C \cong R_C$

11) COLLECTOR FEEDBACK CONFIGURATION :

* The collector feedback network of Fig (5-31) employs a feedback path from collector to base
* Substituting the equivalent circuit and redrawing the network results in the configuration of Fig (5-32).

Z_i //

$$\grave{I} = \frac{V_o - V_i}{R_F}$$

$$V_o = -I_o R_C$$

$$I_o = \beta I_b + \grave{I}$$

$$\beta I_b \gg \grave{I}$$

$$I_o \cong \beta I_b$$

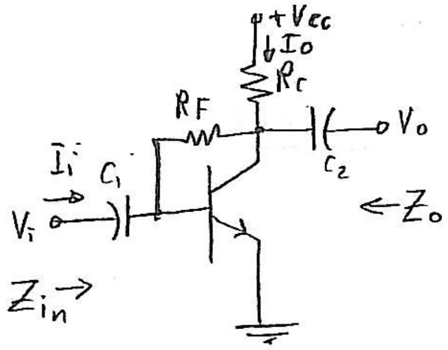


Fig (5-31)
Collector feedback Configuration

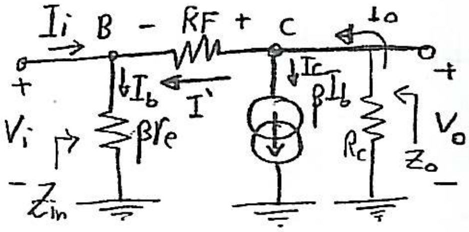


Fig (5-32)
re equivalent Circuit

$$V_o = -(\beta I_b) R_C = -\beta I_b R_C$$

$$I_b = \frac{V_i}{\beta r_e}$$

$$V_o = -\beta\left(\frac{V_i}{\beta r_e}\right) R_C = -\frac{R_C}{r_e} V_i \quad \Rightarrow \underline{A_V} = -\frac{R_C}{r_e}$$

$$\grave{I} = \frac{V_o - V_i}{R_F} = \frac{V_o}{R_F} - \frac{V_i}{R_F} = -\frac{R_C V_i}{r_e R_F} - \frac{V_i}{R_F} = -\frac{1}{R_F}\left[1 + \frac{R_C}{r_e}\right] V_i$$

$$V_i = I_b \beta r_e = (I_i + \grave{I}) \beta r_e = I_i \beta r_e + \grave{I} \beta r_e$$

$$V_i = I_i \beta r_e - \frac{1}{R_F}\left[1 + \frac{R_C}{r_e}\right] \beta r_e V_i$$

$$V_i \left[1 + \frac{\beta r_e}{R_F}\left(1 + \frac{R_C}{r_e}\right)\right] = I_i \beta r_e \quad \ldots$$

$$Z_i = \frac{V_i}{I_i} = \frac{\beta r_e}{1 + \frac{\beta r_e}{R_F}\left[1 + \frac{R_C}{r_e}\right]}$$

but $R_C \gg r_e$

$$1 + \frac{R_C}{r_e} \cong \frac{R_C}{r_e}$$

so that $$Z_i = \frac{\beta r_e}{1 + \frac{\beta R_C}{R_F}} = \frac{r_e}{\frac{1}{\beta} + \frac{R_C}{R_F}}$$

Z_o // if we set V_i to Zero as required to define Z_o, the network will appear as shown in Fig (5-33). The effect of βr_e is removed and R_F appears in parallel with R_C and

$$Z_o \cong R_C // R_F$$

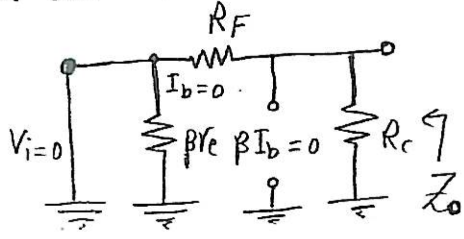


Fig (5-33)

A_V // at node C $\quad I_o = \beta I_b + \grave{I}$

$\beta I_b \gg \grave{I}$ and $I_o \cong \beta I_b$

$$V_o = -I_o R_C = -(\beta I_b) R_C$$