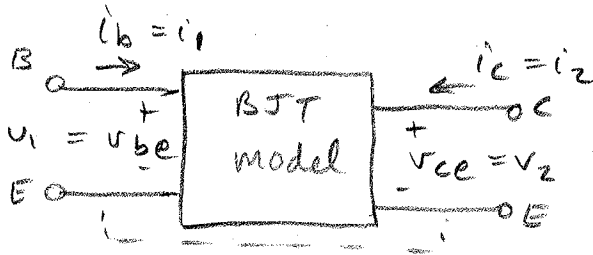


h-parameters



General matrix representation:

$$\begin{bmatrix} v_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ v_2 \end{bmatrix}$$

$$h_{11} = \frac{v_1}{i_1} \Big|_{v_2=0}$$

$$h_{12} = \frac{v_1}{v_2} \Big|_{i_1=0}$$

$$h_{21} = \frac{i_2}{i_1} \Big|_{v_2=0}$$

$$h_{22} = \frac{i_2}{v_2} \Big|_{i_1=0}$$

⇓ equiv. to

for common-emitter BJT case

$$\begin{bmatrix} v_{be} \\ i_c \end{bmatrix} = \begin{bmatrix} h_{ie} & h_{re} \\ h_{fe} & h_{oe} \end{bmatrix} \begin{bmatrix} i_b \\ v_{ce} \end{bmatrix}$$

Note that $h_{ie} = r_{\pi} = \frac{v_{be}}{i_b} \Big|_{v_{ce}=0}$

$h_{fe} = \beta = \frac{i_c}{i_b} \Big|_{v_{ce}=0}$

$h_{oe} = \frac{1}{r_o} = \frac{i_c}{v_{ce}} \Big|_{i_b=0}$

← these conditions are typically ignored unless r_o is used.

← This is the extra collector current beyond βi_b .

h_{re} is not typically included in the hybrid- π model.