Two Port Parameters

$$\begin{bmatrix} v_2 \\ i_2 \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} v_1 \\ i_1 \end{bmatrix} + \begin{bmatrix} V_1 \\ I_1 \end{bmatrix}$$ (abcd, or chair parameters)

$$\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} + \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$ (z parameters)

$$\begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$ (y parameters)

$$\begin{bmatrix} v_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} V_1 \\ I_2 \end{bmatrix}$$ (h parameters)

I_1, I_2, V_1, and V_2 are independent sources within the two port network.

$$a = \left. \frac{v_2 - V_2}{v_1} \right|_{i_1 = 0}$$ (dimensionless)

$$b = \left. \frac{v_2 - V_2}{i_1} \right|_{v_1 = 0}$$ (ohms)

$$c = \left. \frac{i_2 - I_2}{v_1} \right|_{i_1 = 0}$$ (siemens)

$$d = \left. \frac{i_2 - I_2}{i_1} \right|_{v_1 = 0}$$ (dimensionless)

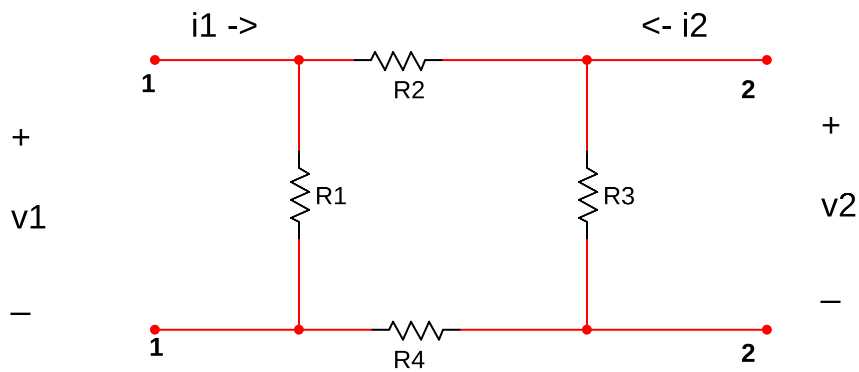
$$V_2 = \left. v_2 \right|_{\substack{v_1 = 0 \\ i_1 = 0}}$$ V

$$I_2 = \left. i_2 \right|_{\substack{v_1 = 0 \\ i_1 = 0}}$$ A

If I_1 and I_2 (independent sources) are zero the value of the y parameters can be calculated using:

$$y_{11} = \frac{i_1}{v_1}\Big| v_2 = 0 \qquad y_{21} = \frac{i_2}{v_1}\Big| v_2 = 0$$

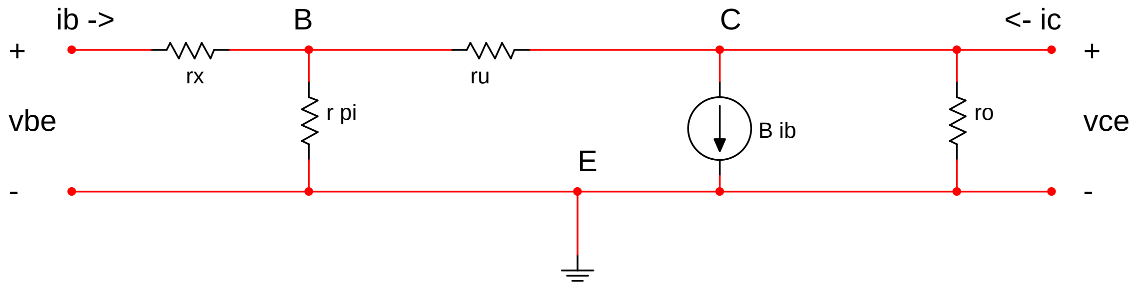
$$y_{12} = \frac{i_1}{v2}\Big| v_1 = 0 \qquad y_{22} = \frac{i_2}{v_2}\Big| v_1 = 0$$



$$y_{12} = -\frac{1}{R_2 + R_4} \qquad y_{22} = \frac{1}{R_3 \| (R_2 + R_4)}$$

$$y_{21} = -\frac{1}{R_2 + R_4} \qquad y_{11} = \frac{1}{R_1 \| (R_2 + R_4)}$$

H Parameters for the BJT



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

$$v_{be} = h_{ie}\, i_b + h_{re}\, v_{ce}$$
$$i_c = h_{fe}\, i_b + h_{oe}\, v_{ce}$$

$$h_{ie} = \frac{v_{be}}{i_b} \Big| v_{ce} = 0 \qquad h_{re} = \frac{v_{be}}{v_{ce}} \Big| i_b = 0 \qquad h_{fe} = \frac{i_c}{i_b} \Big| v_{ce} = 0 \qquad h_{oe} = \frac{i_c}{v_{ce}} \Big| i_b = 0$$

$$\begin{bmatrix} v_{be} \\ i_c \end{bmatrix} = \begin{bmatrix} (r_x + r_{pi} \| r_u) & (\frac{r_{pi}}{r_u + r_{pi}}) \\ B & (\frac{1}{r_o}) \end{bmatrix} \begin{bmatrix} \dfrac{i_b}{v_{ce}} \end{bmatrix}$$