The Small-Signal Equation Matrix

We can **summarize** our small-signal equations with the small-signal equation matrix. Note this matrix relates the **small-signal** BJT parameters v_{be}, i_b, i_c, and i_e.

Column Parameters

Row Parameters	v_{be}	i_b	i_c	i_e
v_{be}	1	$r_\pi = \beta / g_m$	$1/g_m$	$r_e = \alpha / g_m$
i_b	$\frac{1}{r_\pi} = \frac{g_m}{\beta}$	1	$1/\beta$	$1/(\beta+1)$
i_c	g_m	β	1	$\alpha = \frac{\beta}{\beta+1}$
i_e	$\frac{1}{r_e} = \frac{g_m}{\alpha}$	$\beta+1$	$1/\alpha = \frac{\beta+1}{\beta}$	1

Here's how you use this

To use this matrix, note that the **row parameter** is equal to the product of the **column parameter** and the **matrix element**. For example:

$$i_b = \frac{1}{r_\pi} v_{be}$$

	v_{be}	i_b	i_c	i_e
v_{be}	1	$r_\pi = \beta / g_m$	$1/g_m$	$r_e = \alpha / g_m$
i_b	$\frac{1}{r_\pi} = \frac{g_m}{\beta}$	1	$1/\beta$	$1/(\beta+1)$
i_c	g_m	β	1	$\alpha = \frac{\beta}{\beta+1}$
i_e	$\frac{1}{r_e} = \frac{g_m}{\alpha}$	$\beta+1$	$1/\alpha = \frac{\beta+1}{\beta}$	1