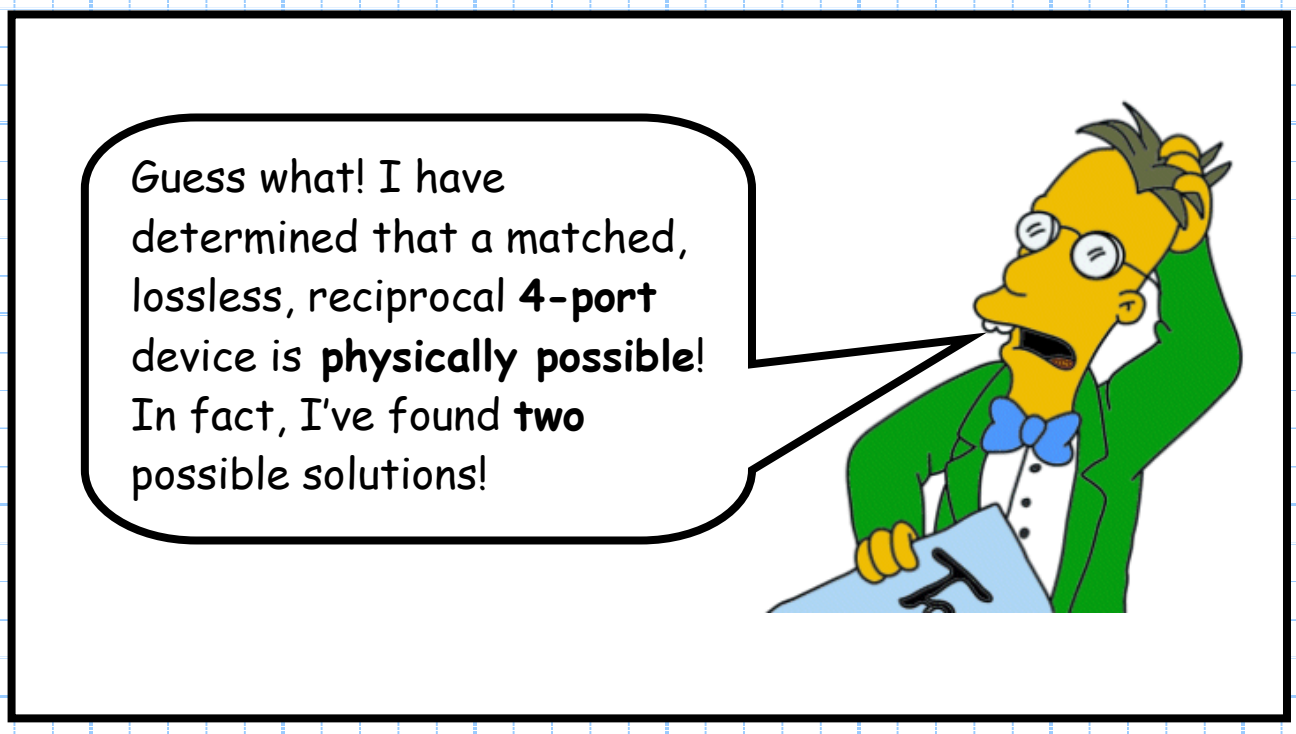
The 4-Port Coupler



The two solutions are:

$$\bar{\bar{S}} = \begin{bmatrix} 0 & \alpha & j\beta & 0 \\ \alpha & 0 & 0 & j\beta \\ j\beta & 0 & 0 & \alpha \\ 0 & j\beta & \alpha & 0 \end{bmatrix}$$

and

$$\bar{\bar{S}} = \begin{bmatrix} 0 & \alpha & \beta & 0 \\ \alpha & 0 & 0 & -\beta \\ \beta & 0 & 0 & \alpha \\ 0 & -\beta & \alpha & 0 \end{bmatrix}$$

where it is evident that in order for the scattering matrix to be unitary, the values α and β are related as:

$$\alpha^2 + \beta^2 = 1$$

We will study three types of 4-port couplers:

1) The 90° Hybrid

2) The 180° Hybrid

3) The Coupled-Line Coupler