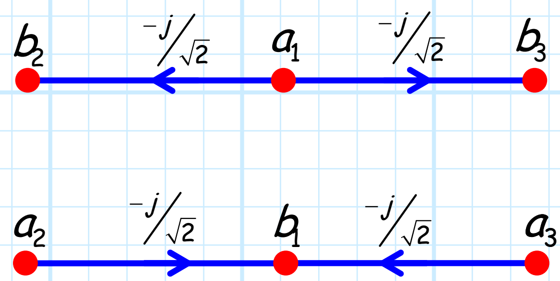
The Wilkinson Power Divider

The **Wilkinson power divider** is a 3-port device with a scattering matrix of:

$$\mathcal{S}=\begin{bmatrix} 0 & {}^{-j}/_{\sqrt{2}} & {}^{-j}/_{\sqrt{2}} \\ {}^{-j}/_{\sqrt{2}} & 0 & 0 \\ {}^{-j}/_{\sqrt{2}} & 0 & 0 \end{bmatrix}$$



Note this device is **matched** at port 1 ($S_{11}=0$), and we find that magnitude of column 1 is:

$$|S_{11}|^2+|S_{21}|^2+|S_{31}|^2=1$$

Thus, just like the **lossless divider**, the incident power on port 1 is **evenly** and **efficiently** divided between the outputs of port 2 and port 3:

$$P_2^- = |S_{21}|^2 P_1^+ = \frac{P_1^+}{2} \qquad\qquad P_3^- = |S_{31}|^2 P_1^+ = \frac{P_1^+}{2}$$

But now look closer at the scattering matrix. We also note that the ports 2 and 3 of this device are **matched** !

$$S_{22}=S_{33}=0$$

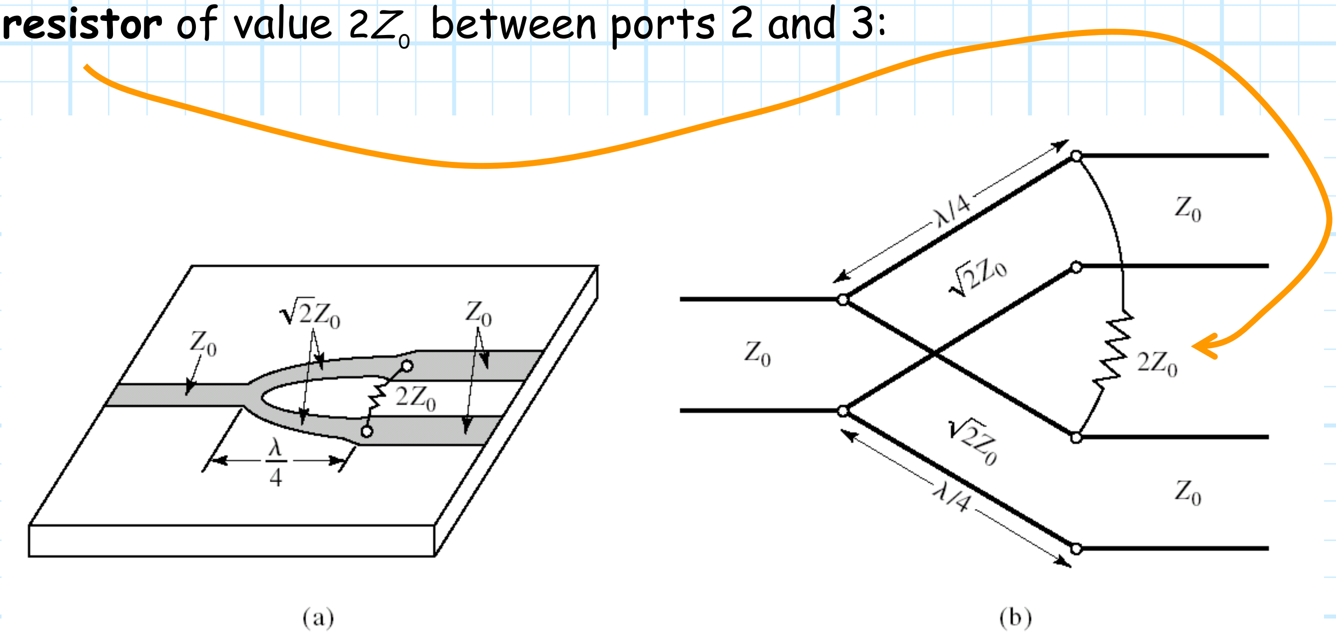
Likewise, we note that ports 2 and ports 3 are **isolated**:

$$S_{23} = S_{32} = 0$$

→ It's the (nearly) **ideal** 3dB power divider!!!

Q: *So just how do we **make** this Wilkinson power divider?*

It looks a lot like a **lossless 3dB divider**, only with an additional **resistor** of value $2Z_0$ between ports 2 and 3:



This resistor is the **secret** to the Wilkinson power divider, and is the reason that it is **matched** at ports 2 and 3, and the reason that ports 2 and 3 are **isolated**.

Note however, that the **quarter-wave** transmission line sections make the Wilkinson power divider a **narrow-band** device.

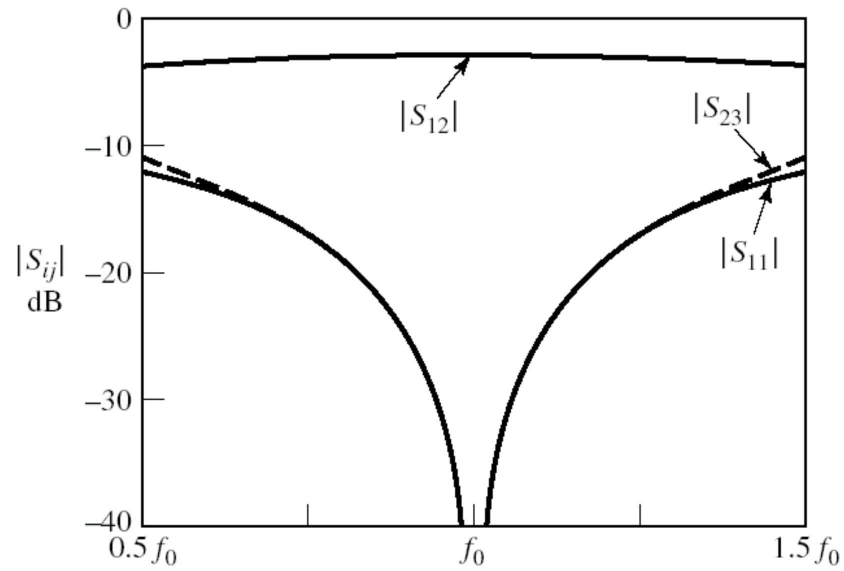


Figure 7.12 (p. 322)
Frequency response of an equal-split Wilkinson power divider. Port 1 is the input port; ports 2 and 3 are the output ports.