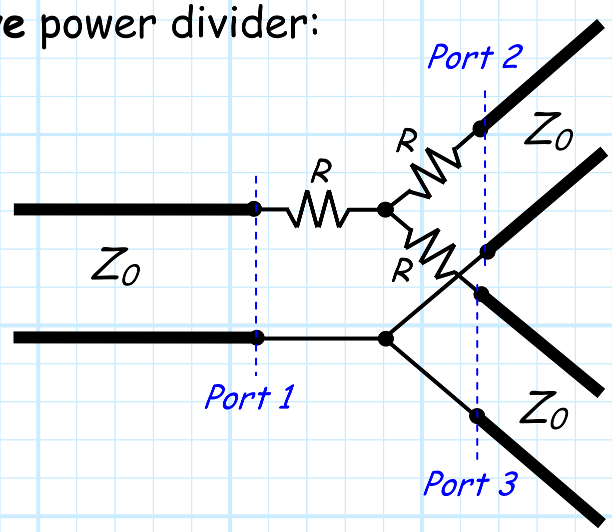
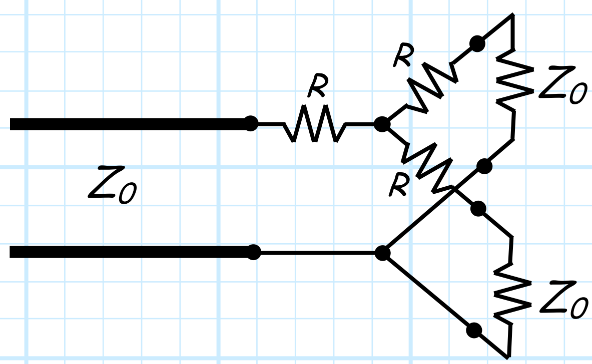
The Resistive Divider

Consider the **resistive** power divider:



This symmetric power divider will be matched at port 1 **if** R is selected as:

$$
\begin{aligned}
Z_0 &= R + (R + Z_0) \| (R + Z_0) \\
&= R + \frac{R + Z_0}{2} \\
&= 1.5R + \frac{Z_0}{2}
\end{aligned}
$$



Solving this equation, we find that port 1 is matched **if**:

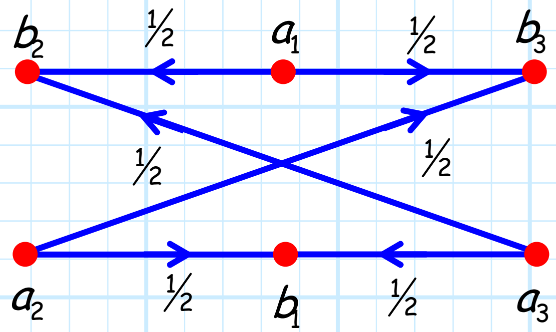
$$R = \frac{Z_0}{3}$$

From the **symmetry** of the circuit, we find that all the **other** ports will be matched as well (i.e., $S_{11} = S_{22} = S_{33} = 0$). Moreover, it can be shown that:

$$S_{12} = S_{21} = S_{31} = S_{31} = S_{23} = S_{32} = 1/2$$

So:

$$\mathcal{S} = \begin{bmatrix} 0 & 1/2 & 1/2 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/2 & 0 \end{bmatrix}$$



Note the magnitude of each column is less than one. E.G.,:

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

Therefore this power divider is **lossy**!

In fact, we find that the power out of each port is just **one-quarter** of the input power:

$$P_2^- = P_3^+ = \frac{P_1^+}{4}$$

In other words, **half** the input power is **absorbed** by the divider!