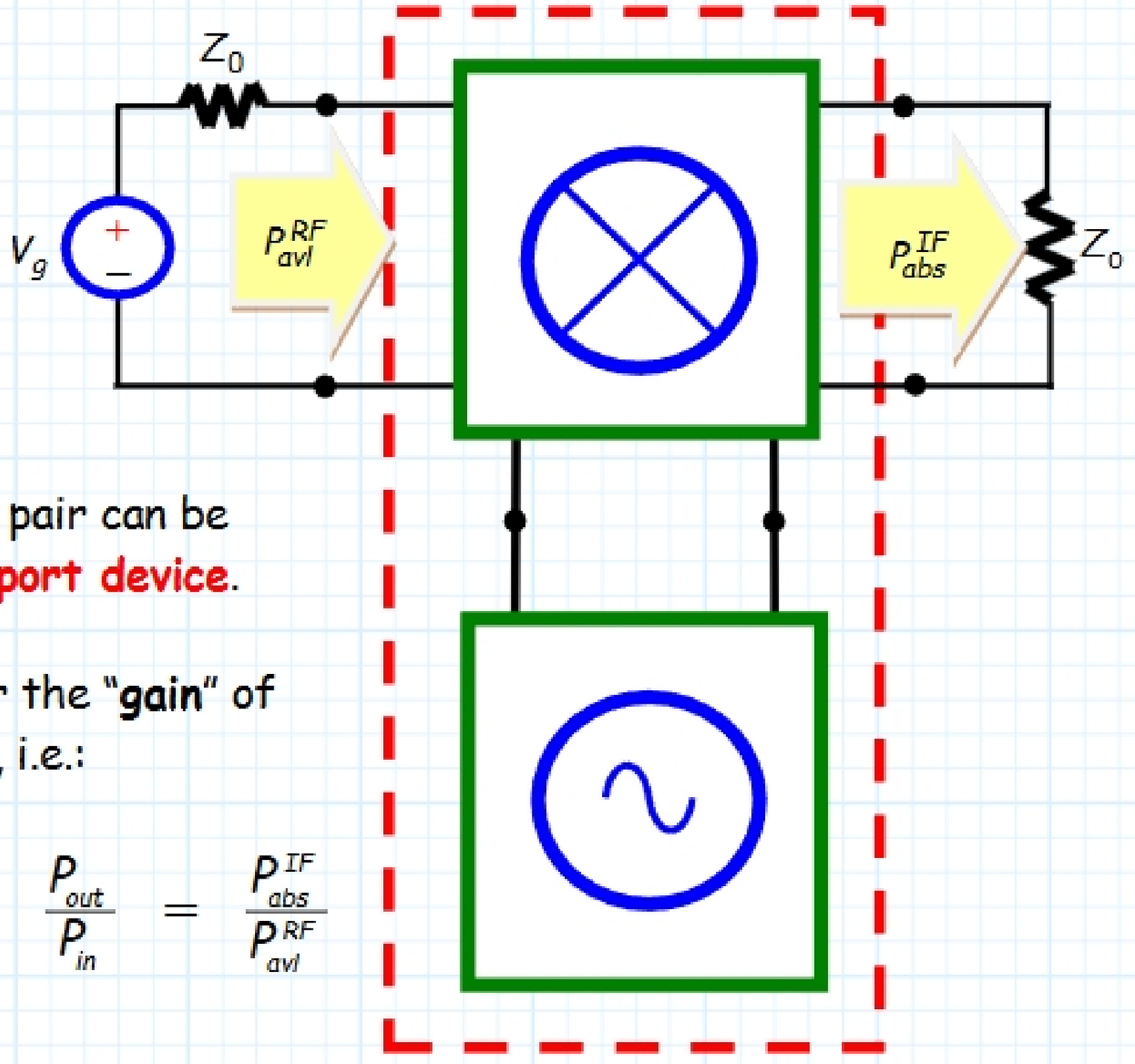
Mixer Conversion Loss



Again, a mixer/LO pair can be considered a **two-port device**.

Now, let's consider the "**gain**" of this 2-port device, i.e.:

$$\text{Mixer "Gain"} = \frac{P_{out}}{P_{in}} = \frac{P_{abs}^{IF}}{P_{avl}^{RF}}$$

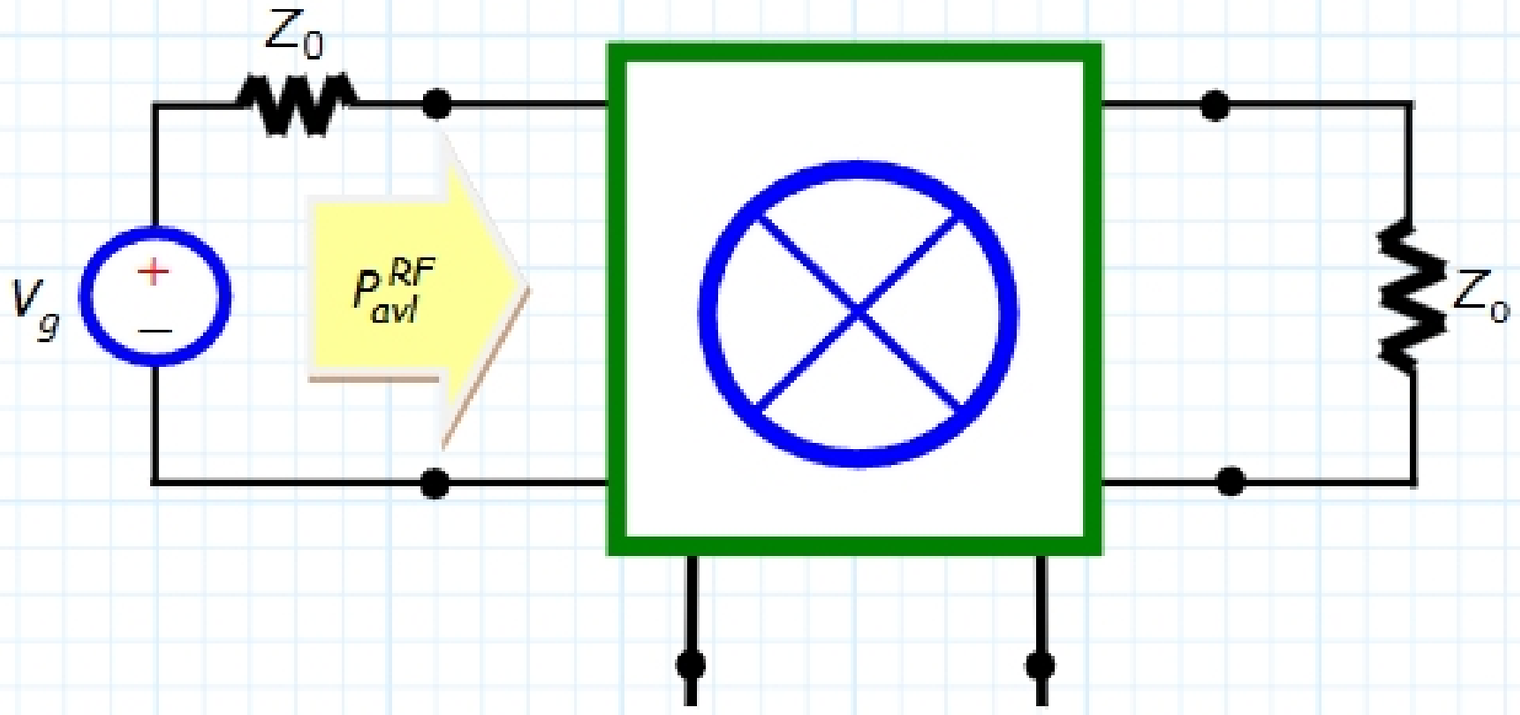
Available power

If the RF port of the mixer is **reasonably matched**, then total voltage is approximately equal the **incident voltage** on the RF port:

$$v_{RF}(t) = v_{RF}^{+}(t) = A_{RF}\cos\left[\omega_{RF}\,t + \varphi_{RF}\right]$$

And so, the **available power** of the "matched" source is:

$$P_{avl}^{RF} = \frac{|V_g|^2}{8Z_0} = \frac{A_{RF}^2}{2Z_0}$$



Absorbed power

Likewise, the **total** down-converted signal voltage at the IF port is equal to the **incident voltage** on the "**matched" load**:

$$v_{IF}(t) \;=\; v_{IF}^{+}(t) \;=\; A_{RF}\,\frac{2}{\pi}\cos\left[\left(\omega_{RF}-\omega_{LO}\right)t+\varphi_{RF}\right]$$

And so the **power absorbed** by the "matched" load is:

$$P_{abs}^{IF} \;=\; \frac{A_{RF}^{2}}{2Z_0}\left(\frac{2}{\pi}\right)^{2} \;=\; P_{avl}^{RF}\left(\frac{2}{\pi}\right)^{2}$$