Special Problem 5.4-1

A **matching network** has been constructed to match a **complex** load to a transmission line with characteristic impedance $Z_0 = 50\ \Omega$.

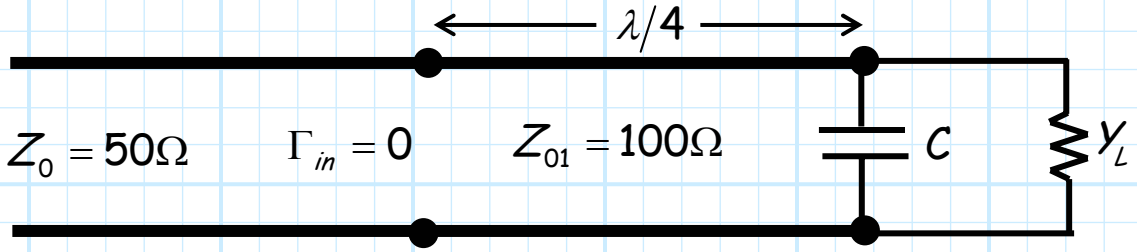
The **design frequency** of this matching network is $f_0 = 10\ MHz$.

Note that this matching network is **not** specifically one of the standard designs that we studied.

The **capacitor** has a capacitance of value:

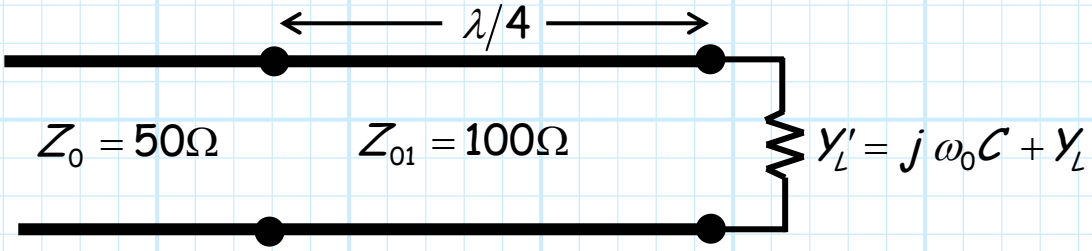
$$C = \frac{10^{-9}}{2\pi}\ farads$$

Determine the **complex admittance** Y_L of the **load**.



Solution

First, combine the capacitor and Y_L to form an new load with admittance Y_L':



where:

$$\begin{aligned} Y_L' &= j\,\omega_0 C + Y_L \\ &= j\,2\pi\left(10^7\right)\left(\frac{10^{-9}}{2\pi}\right) + Y_L \\ &= j\,0.01 + Y_L \end{aligned}$$

Now, in order for $\Gamma_{in} = 0$, we know that (because of the $\lambda/4$ transformer):

$$Z_L' = \frac{Z_{01}^2}{Z_0} \quad \Rightarrow \quad Y_L' = \frac{Z_0}{Z_{01}^2}$$

And so if matched:

$$Y_L' = \frac{Z_0}{Z_{01}^2} = \frac{50}{(100)^2} = 0.005$$

Therefore:

$$Y_L' = 0.005 = j\,0.01 + Y_L \quad \Rightarrow \quad \underline{\underline{Y_L = 0.005 - j\,0.01}}$$