

2.29 Show that the input impedance of a quarter-wavelength-long lossless line terminated in a short circuit appears as an open circuit.

Solution:

$$Z_{\text{in}} = Z_0 \left(\frac{Z_L + jZ_0 \tan \beta l}{Z_0 + jZ_L \tan \beta l} \right).$$

For $l = \frac{\lambda}{4}$, $\beta l = \frac{2\pi}{\lambda} \cdot \frac{\lambda}{4} = \frac{\pi}{2}$. With $Z_L = 0$, we have

$$Z_{\text{in}} = Z_0 \left(\frac{jZ_0 \tan \pi/2}{Z_0} \right) = j\infty \quad (\text{open circuit}).$$
