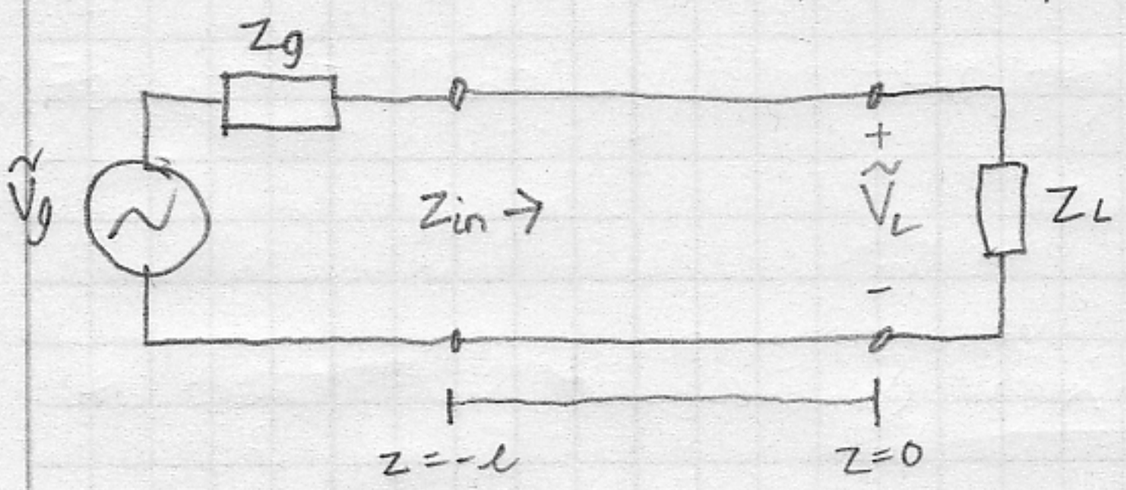
Tx-line Input Impedance



$$Z_{in}(-\ell) = \frac{Z_L + jZ_0 \tan(\beta\ell)}{Z_0 + jZ_L \tan(\beta\ell)} Z_0$$

Impedance at point $z=-\ell$ on the transmission line.

↖ Waby equation (2.63)

Example

A lossless 50 Ω air spaced tx-line 5 m in length is terminated by a load impedance $Z_L = 100 + j50\ \Omega$. If the operating frequency of the generating source is 300 MHz what is the input impedance?

Air-spaced lossless line ∴ $\varepsilon_r = 1$ and $v_p = c$ [1]

$$\lambda = c \cdot f = 3\times10^8 / 100\times10^6 = 1\ m$$

$$\beta = 2\pi/\lambda = 2\pi/1 = 2\pi \quad rad/m$$

$$Z_{in}(-5) = \frac{(100+j50) + j50\tan((2\pi)(5))}{50 + j(100+j50)\tan((2\pi)(5))}, 50$$

$$= \frac{(100+j50) + j50(0)}{50 + j(100+j50)(0)}, 50$$

$$= 100 + j50\ \Omega$$

Notice that because β is a multiple of π that it doesn't matter what length the tx-line is this equation will always simplify to Z_L.

[1] Waby p. 54