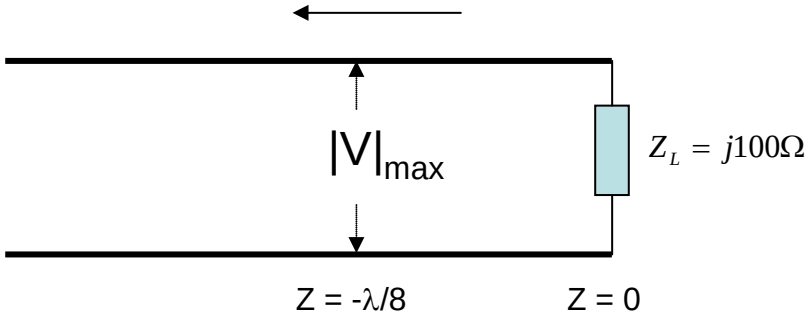
EE Problem 8

A lossless transmission line is terminated with a load Z_L, $Z_L = j100\Omega$ (see figure below). The characteristic impedance Z_0 of the transmission line is unknown. The first voltage maximum $|V|_{max}$ is located at $z = -\lambda/8$ from load.

(1) Calculate the voltage standing wave ratio (VSWR);

(2) Find out the characteristic impedance Z_0 of the transmission line



Solution:

(1) The voltage reflection coefficient Γ is: $\Gamma = \dfrac{Z_L - Z_0}{Z_L + Z_0}$,

Therefore:

$|\Gamma| = \left|\dfrac{Z_L - Z_0}{Z_L + Z_0}\right| = \dfrac{\sqrt{(100)^2 + Z_0^2}}{\sqrt{(100)^2 + Z_0^2}} = 1$, Z_0 is real for a lossless transmission line.

The formula for voltage standing wave ratio (VSWR) is:

$VSWR = \dfrac{1+|\Gamma|}{1-|\Gamma|} = \infty$

(2) The first voltage maximum occurs at

$2\beta(-\lambda/8) + \theta_r = 0$, θ_r is the angle of the reflection coefficient.

so, $2\dfrac{2\pi}{\lambda}(-\dfrac{\lambda}{8}) + \theta_r = 0$, => $\theta_r = 0.5\pi$,

$\Gamma = 1\angle 0.5\pi = 0 + j1$,

$$Z_0 = Z_L \frac{1-\Gamma}{1+\Gamma} = j100\frac{1-j1}{1+j1} = 100\Omega$$

Graphic solution: