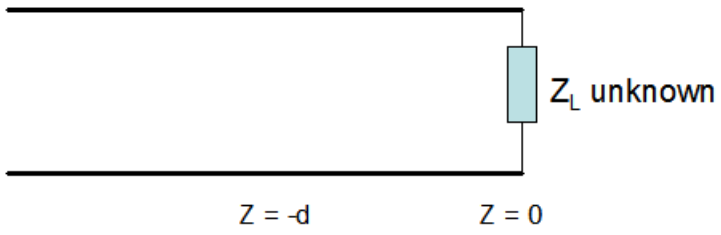
EE Problem 7

A 50Ω lossless transmission line is terminated with an unknown load Z_L (see figure below). The minimum voltages on the transmission line are zeros. The first voltage minimum $|V|_{min}$ is located at z = -d from load, d = λ/8.

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

(2) Find out the load impedance Z_L;

(3) Find out the voltage reflection coefficient Γ



Solution:

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

$$VSWR = \frac{|V|_{\max}}{|V|_{\min}} = \frac{|V|_{\max}}{0} = \infty ,$$

Since $VSWR = \frac{1+|\Gamma|}{1-|\Gamma|} = \infty$, $|\Gamma| = 1$.

(2) The first voltage minimum occurs at

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

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

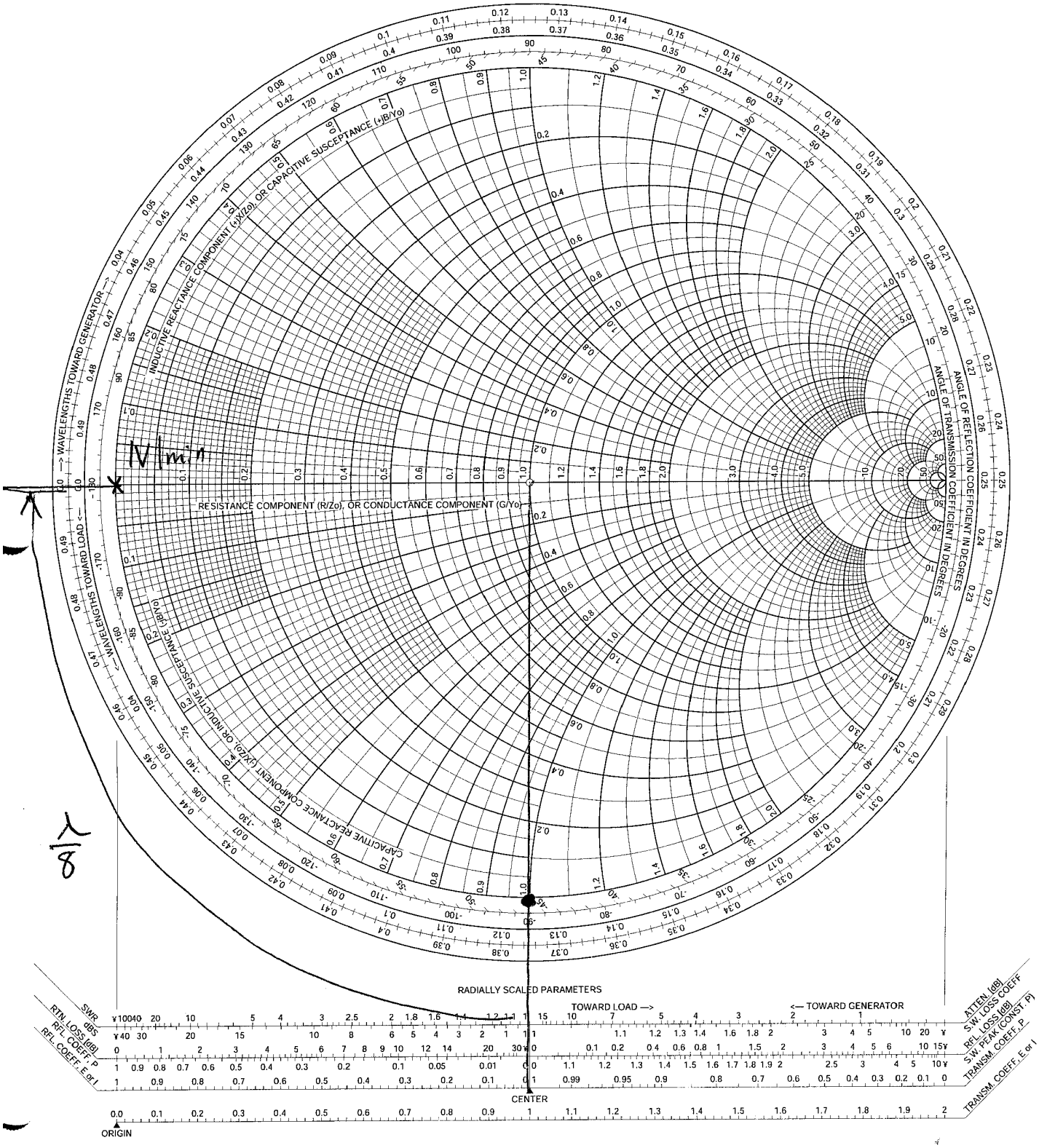
$$\Gamma = 1\angle -0.5\pi = 0 - j1.$$

(3) The normalized load is

$$\frac{Z_L}{Z_0} = \frac{1+\Gamma}{1-\Gamma} = \frac{1-j1}{1+j1} = -j ,$$

Therefore, the load impedance Z_L = -j50Ω.

Graphic solution:



λ/8