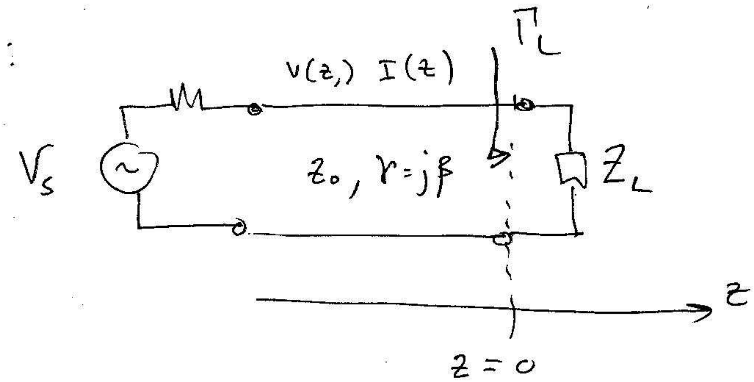
Microondas clase #2

Línea:



$\gamma = j\beta \implies$ lossless line

$$\beta = \frac{2\pi}{\lambda} \qquad \lambda = u/f$$

$$V(z) = V_0^+ e^{-j\beta z} + V_0^- e^{+j\beta z}$$

$$= V_0^+ \left(e^{-j\beta z} + \Gamma_L e^{+j\beta z}\right)$$

$$I(z) = \frac{V_0^+}{Z_0}\left(e^{-j\beta z} - \Gamma_L e^{+j\beta z}\right)$$

$$\Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{V_0^-}{V_0^+}$$

$$\Gamma(z) = \frac{V_0^- e^{+j\beta z}}{V_0^+ e^{-j\beta z}} = \Gamma_L e^{+j2\beta z}$$

$$\Gamma(-l) = \Gamma_{in} = \Gamma_L e^{-j2\beta l}$$

Potencia

$$P_{ave} = \frac{1}{2} R_e \left[V(z) \, I^*(z) \right]$$

$$= \frac{1}{2} \frac{|V_o^+|^2}{Z_o} \left(1 - |\Gamma|^2 \right)$$

Return loss: $RL = -20 \log |\Gamma| \ dB$

$$VSWR = \frac{V_{max}}{V_{min}} = \frac{1 + |\Gamma|}{1 - |\Gamma|}$$

$SWR = 1 \qquad \Gamma = 0$

$SWR = \infty \qquad \Gamma = 1 \longrightarrow$ hay onda estacionaria

$$|\Gamma| = \frac{SWR - 1}{SWR + 1}$$

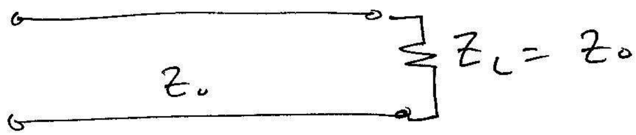
$|\Gamma| = 1$ para S.C

$|\Gamma| = 1$ para O.C.

$$\Gamma = \frac{j-1}{j+1} = j = 1 \angle 90^\circ$$

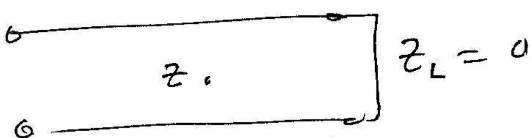
$$Z_{in} = \frac{V(-\ell)}{I(-\ell)} = Z_0 \, \frac{Z_L + j Z_0 \tan\beta\ell}{Z_0 + j Z_L \tan\beta\ell}$$

a)



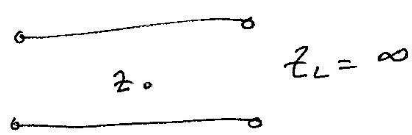
$$Z_{in} = Z_0$$

b)



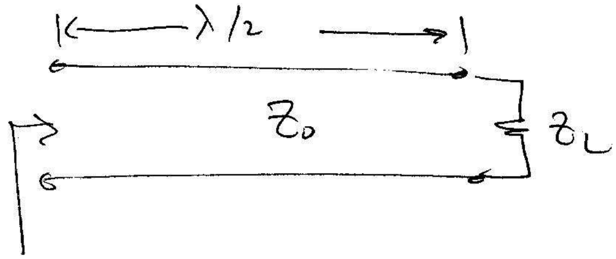
$$Z_{in} = j Z_0 \tan\beta\ell = jX$$

c)



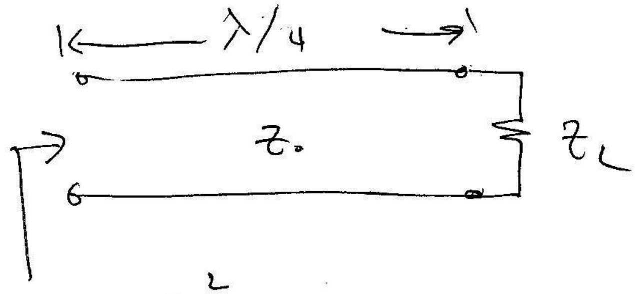
$$Z_{in} = -j Z_0 \cot\beta\ell$$

d)

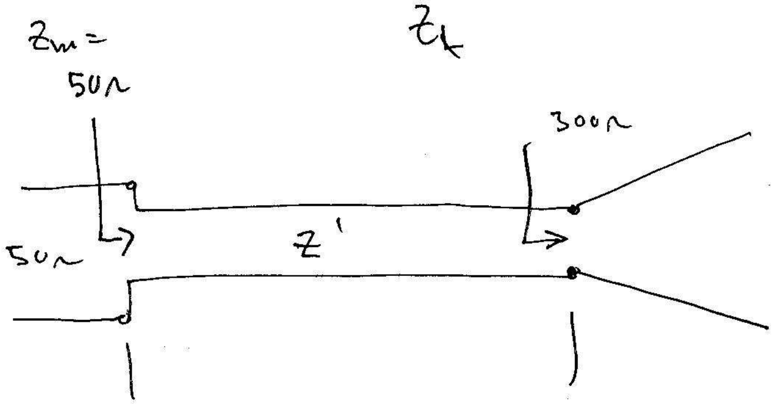


$$Z_{in} = Z_L$$

e)



$$Z_{in} = \frac{Z_0^2}{Z_L}$$



$$50 = \frac{Z'^2}{300} \implies Z' = \sqrt{(50)(300)}$$

$$= \underline{123\ \Omega}$$

Cual es el largo electrico?

Suponer que $\theta = 90^\circ$ @ 2 GHz

$$\theta = \frac{2\pi}{\cancel{\lambda}} \cdot \frac{\cancel{\lambda}}{4} = 90^\circ$$

$$l = \frac{c/2\times 10^9}{4}$$

Si $f = 1$ GHz

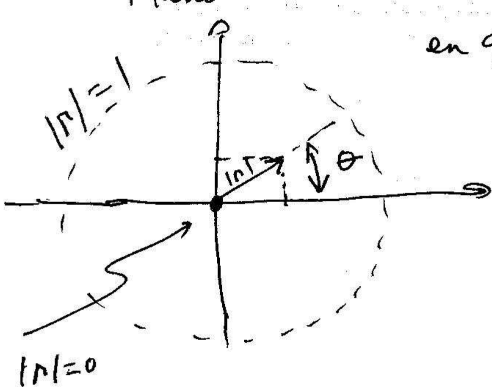
$$\theta_{1GHz} = \frac{2\pi}{\lambda}\cdot l = \underbrace{\frac{2\pi}{\left(\frac{3\times\cancel{10^8}}{1\times\cancel{10^9}}\right)}}_{\lambda} \cdot \underbrace{\left(\frac{\frac{3\times\cancel{10^8}}{2\times\cancel{10^9}}}{\cancel{4}}\right)}_{l} = \frac{\pi}{4} = 45^\circ$$

Smith Chart:

Basado en: $\Gamma = \dfrac{Z_L - Z_0}{Z_L + Z_0} = |\Gamma| \angle \theta_r$

en general complejo

Plano Γ



$|\Gamma| = 1$ (SWR $= \infty$)

$|\Gamma| = 0$ (SWR $= 1$)

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{z_l - 1}{z_l + 1} = \Gamma_r + j\Gamma_i$$

$$z_l = r + jx = \frac{1+\Gamma}{1-\Gamma} = \frac{1+\Gamma_r + j\Gamma_i}{1-\Gamma_r - j\Gamma_i}$$

$$\left[\Gamma_r - \frac{r}{1+r}\right] + \Gamma_i^2 = \left[\frac{1}{1+r}\right]^2$$ — Eq. circulo

$$\left[\Gamma_r - 1\right]^2 + \left[\Gamma_i - \frac{1}{x}\right]^2 = \left[\frac{1}{x}\right]^2$$

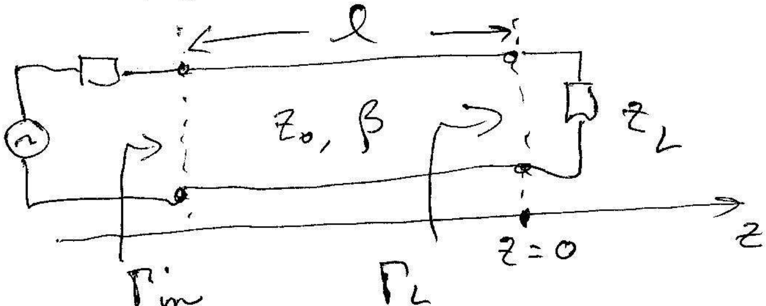
$\longrightarrow$ $(x-h)^2 + (y-k)^2 = a^2$

centro: h, k radio: a

Grafico en plano de Γ y obtengo el Smith Chart.

Localizar: $z_l = 50, \infty, 0, 25+j25\ \Omega$

Línea de Transmisión:



$$V(z) = V_0^+ e^{-j\beta z} + V_0^- e^{+j\beta z}$$

$$\Gamma(z) = \frac{V_0^-}{V_0^+} e^{+j2\beta z} = \Gamma_L e^{+j2\beta z}$$

$$\Gamma_{in} = \Gamma_\ell e^{-j2\beta\ell} = \Gamma_L \angle -2\beta\ell$$

(Si me alejo de la carga, me muevo "clockwise en plano-Γ)

Si $\ell = \frac{\lambda}{2} \Longrightarrow \theta = 2\beta\ell = 2\left(\frac{2\pi}{\lambda}\right)\left(\frac{\lambda}{2}\right)$

$\theta = 360^\circ$ $\therefore$ $\frac{\lambda}{2} \Longrightarrow 360^\circ$