Smith Chart - Application

❖ **Show the locations of the following impedances:**

$\bar{Z}_A = (1.0 + j0.0)$

$\bar{Z}_B = (1.0 + j1.0)$

$\bar{Z}_C = (\infty + j0.0)$ ***o.c***

$\bar{Z}_D = (0.0 + j0.0)$ ***s.c***

$\bar{Z}_E = (1.0 - j1.0)$

❖ **Show the locations of the following admittance:**

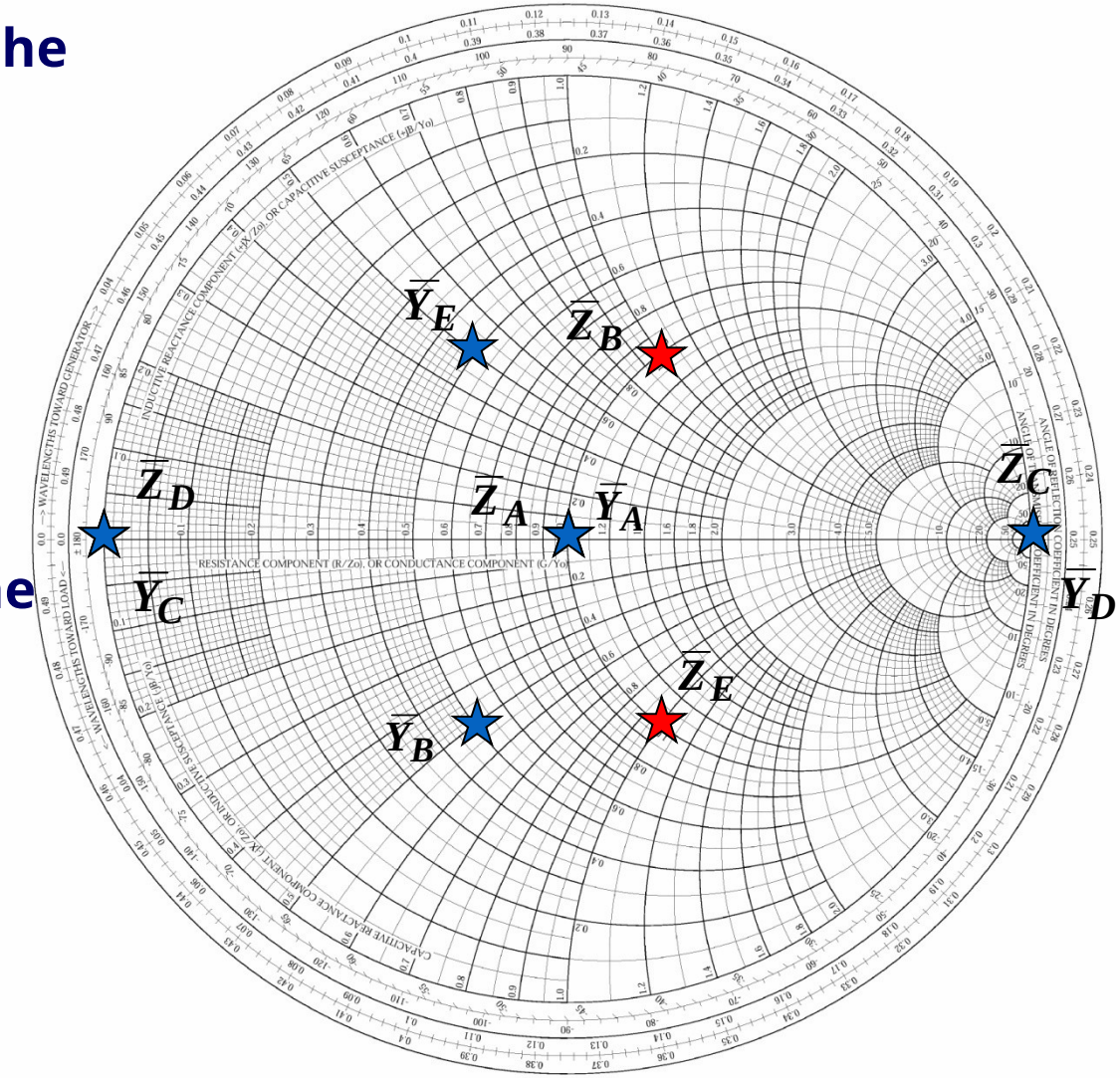
$\bar{Y}_A = (1.0 + j0.0)$

$\bar{Y}_B = (0.5 - j0.5)$

$\bar{Y}_C = (0.0 + j0.0)$ ***o.c***

$\bar{Y}_D = (\infty + j0.0)$ ***s.c***

$\bar{Y}_E = (0.5 + j0.5)$

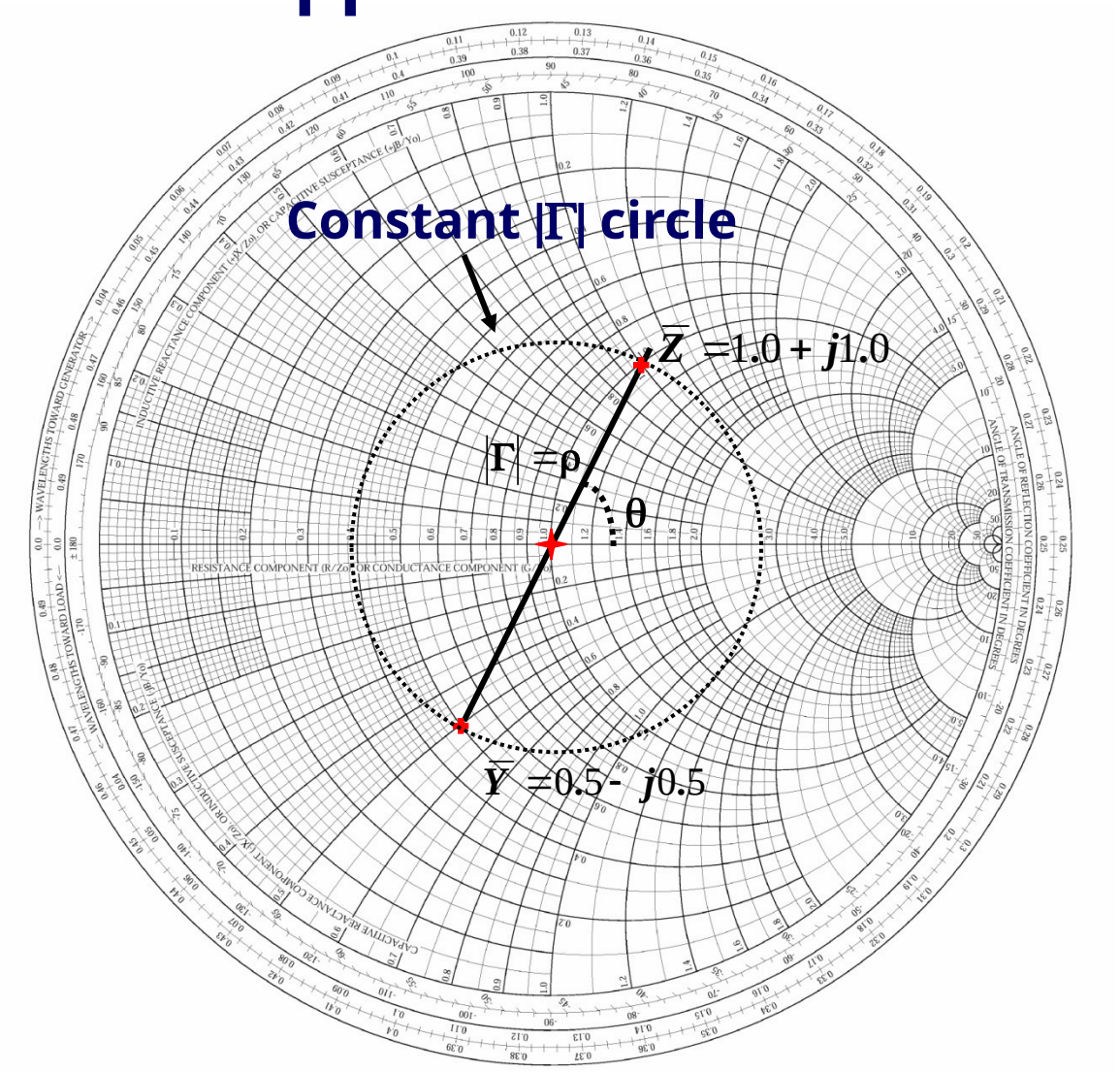


Smith Chart - Applications

- Find the admittance from a given impedance, or vice versa:

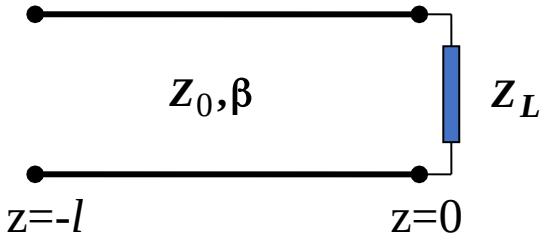
$$\bar{Z} = \frac{1+\Gamma}{1-\Gamma}$$

$$\bar{Y} = \frac{1-\Gamma}{1+\Gamma}$$



Smith Chart - Applications

- Find the input impedance of a TL terminated in a load impedance Z_L.

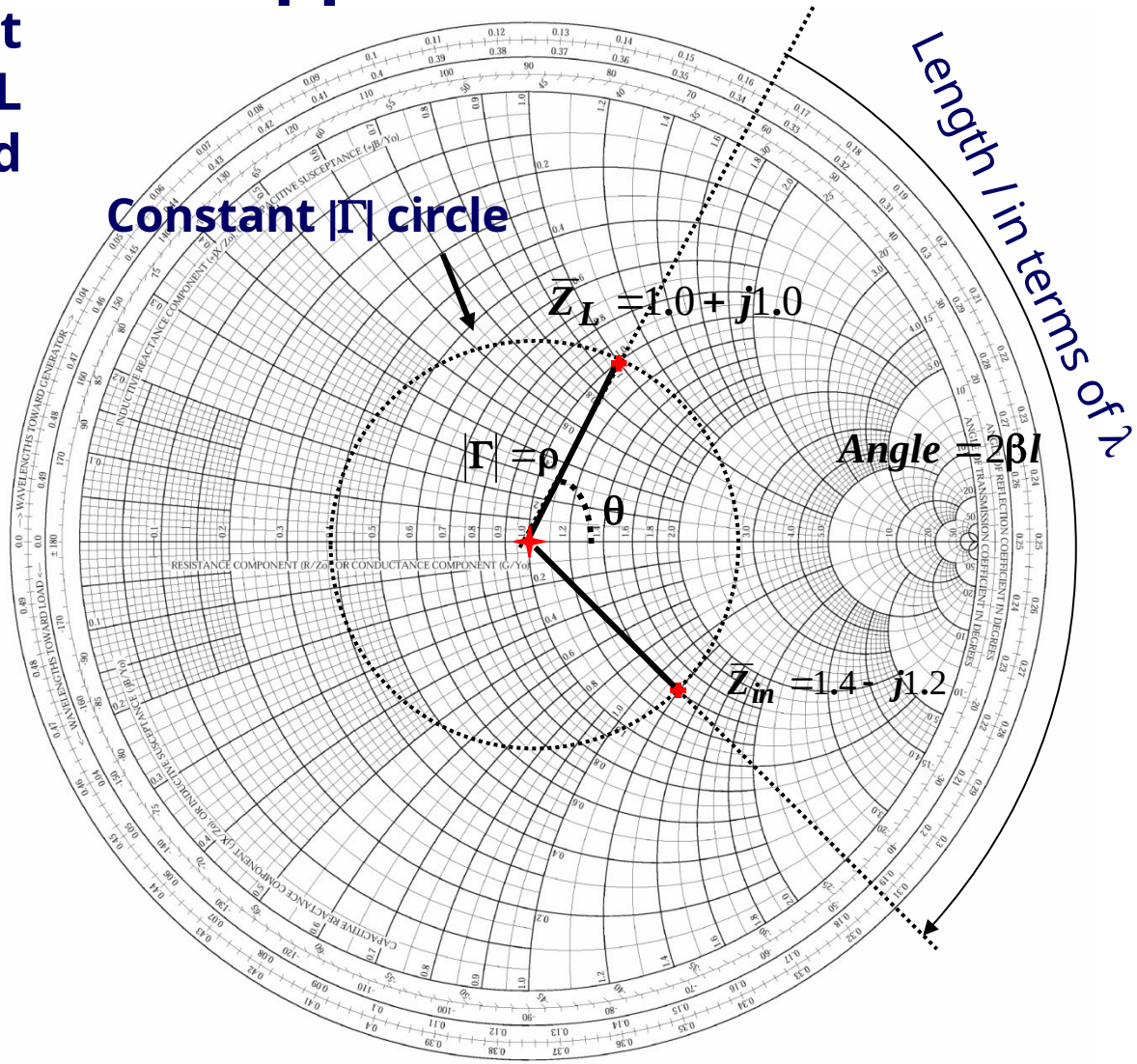


$$\bar{Z}_L = 1.0 + j1.0$$

$$l = 0.148\lambda$$

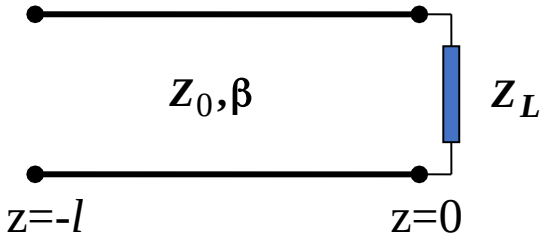
$$\bar{Z}_{in} = \frac{1+\Gamma_{in}}{1-\Gamma_{in}} = \frac{1+\Gamma_L e^{-j2\beta l}}{1-\Gamma_L e^{-j2\beta l}}$$

$$\bar{Z}_{in} = \frac{1+\rho e^{j(\theta-2\beta l)}}{1-\rho e^{j(\theta-2\beta l)}}$$



Smith Chart - Applications

❖ **Find the SWR, voltage maxima and minima.**

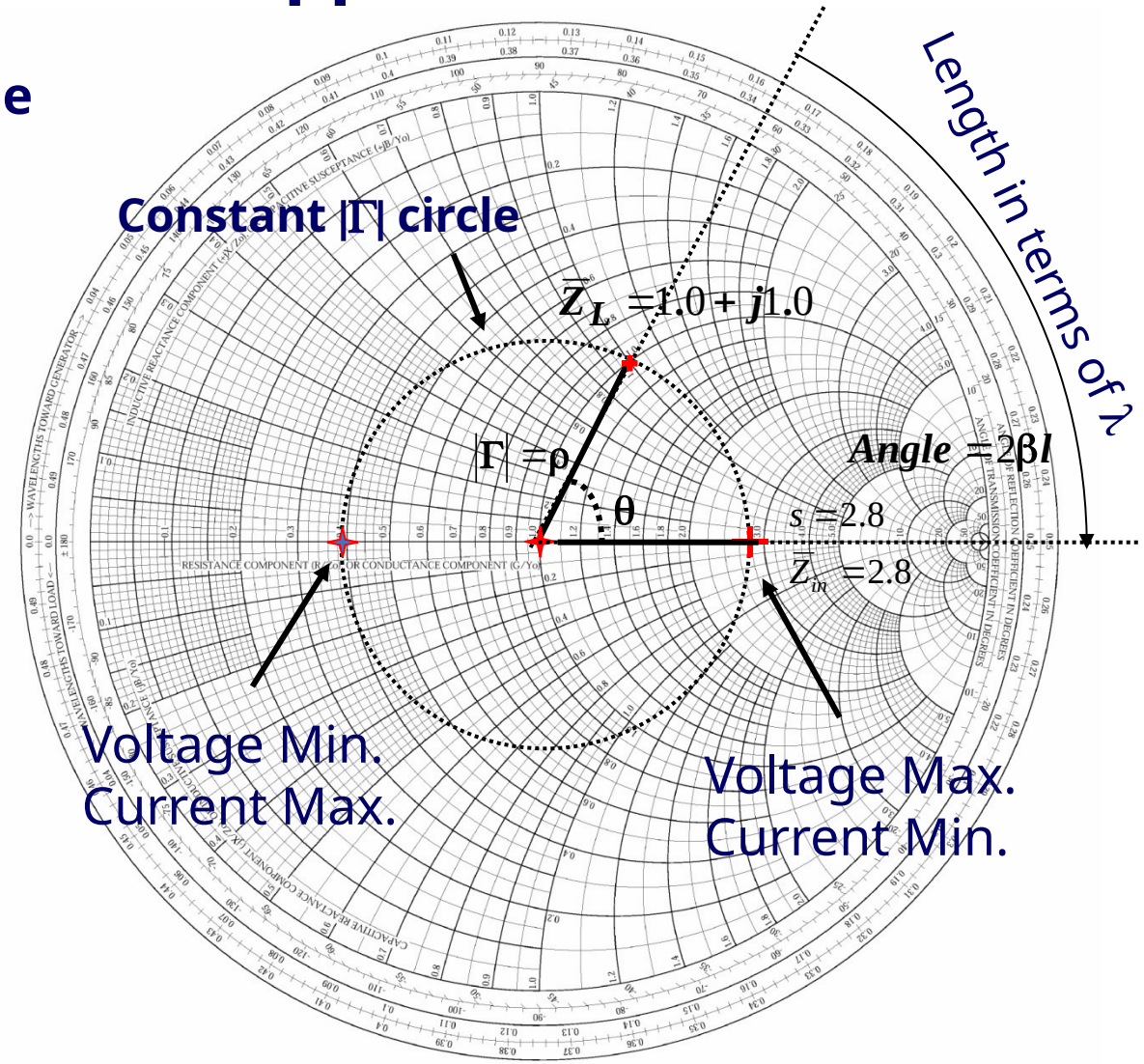


$$\bar{Z}_L = 1.0 + j1.0$$

$$l = 0.148\lambda$$

$$VSWR = s = \frac{1+|\Gamma|}{1-|\Gamma|}$$

Voltage Max.
Current Min.



Smith Chart - Applications

Example: A 5.2 cm long, lossless 100 Ω line is terminated in a load impedance Z_L=30+j50 Ω.

a) Calculate $|\Gamma_L|$, ϕ_L, and VSWR:

$$\bar{Z}_L = \frac{30 + j50}{100} = 0.3 + j0.5$$

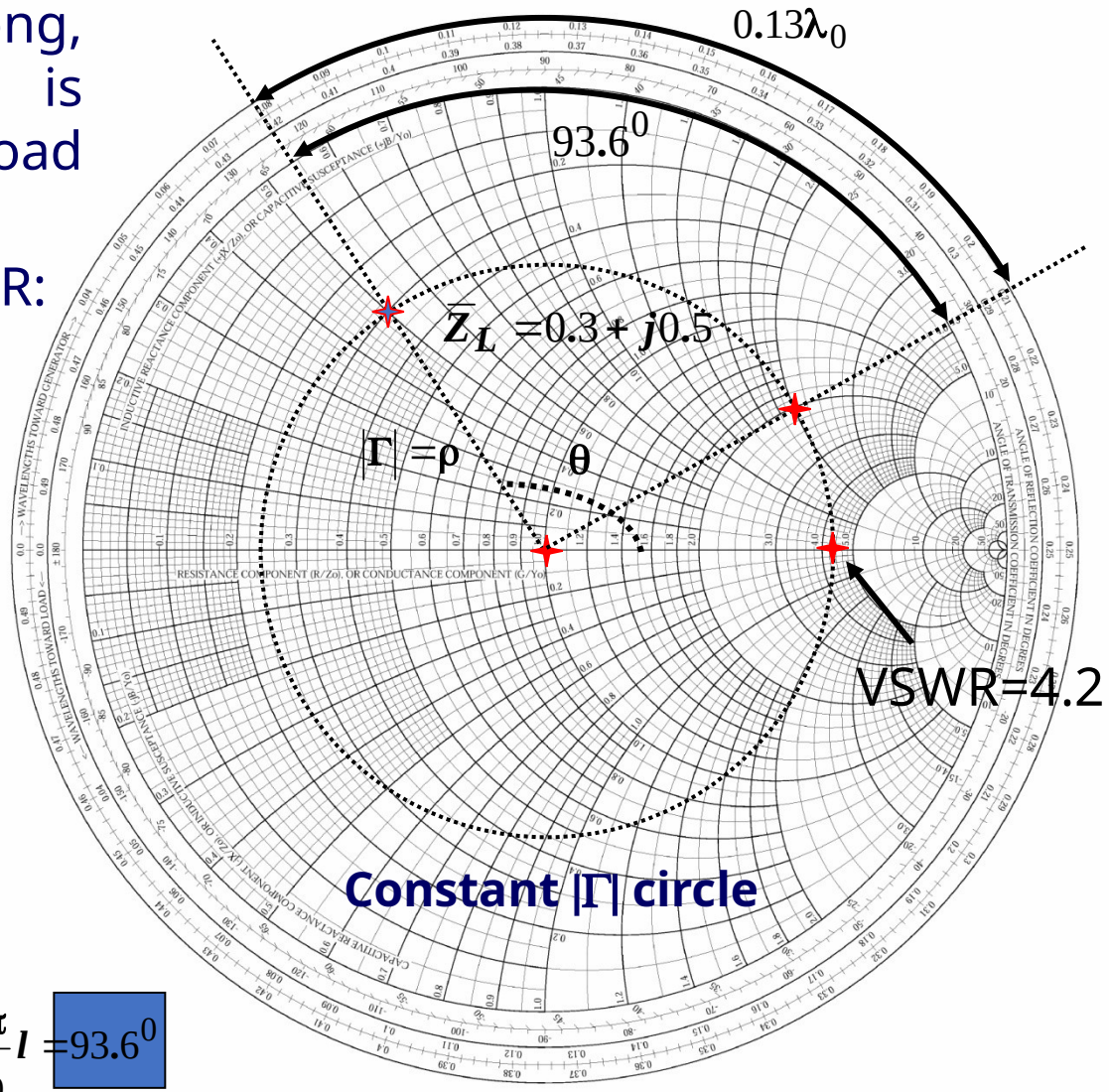
$$\Gamma_L = \frac{\bar{Z}_L - 1}{\bar{Z}_L + 1} = 0.62\angle 123.5^0$$

$$VSWR = \frac{1 + 0.62}{1 - 0.62} = 4.2$$

b) Determine the impedance at the input for the frequency of 750 MHz and $\lambda=\lambda_0$:

$$\lambda_0 = \frac{c}{f} = \frac{3.0\times 10^{10}\, cm/s}{750\times 10^6\, /s} = 40 cm$$

$$l = 5.2cm = \frac{5.2}{40}\lambda_0 = 0.13\lambda_0 \Rightarrow 2\beta l = 2\frac{2\pi}{\lambda_0} l = 93.6^0$$



Smith Chart - Applications

1. Locate Z_{in} on the S.C.;

2. Draw the constant $|\Gamma|$ circle;

3. Starting from Z_{in} move toward load by 0.1λ on constant $|\Gamma|$ circle;

$$\bar{Z}_L = 0.6 - j0.4$$

$$Z_L = \bar{Z}_L \times 50\Omega = (30 - j20)\Omega$$