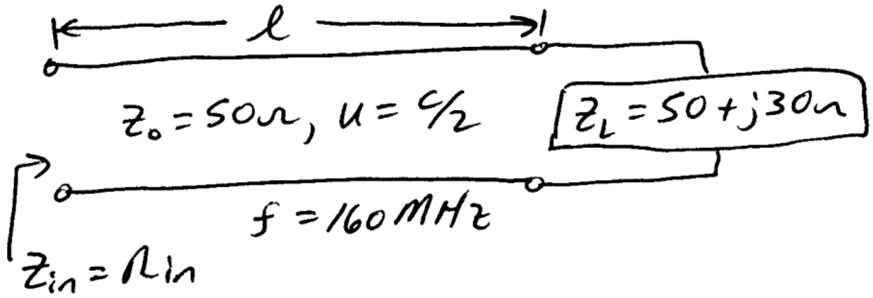
11.42 A 50 Ω transmission line operates at 160 MHz and is terminated by a load of 50 + *j*30 Ω. If its wave speed is *c*/2 and the input impedance is to be made real, calculate the minimum possible length of the line and the corresponding input impedance.



* Normalize the load impedance and plot on Smith Chart

$$z_L = \frac{Z_L}{Z_o} = \frac{50+j30}{50}$$

$$\underline{z_L = 1 + j0.6\ \Omega/\Omega}$$

* Draw arc w/compass starting @ z_L in the "WAVELENGTHS TOWARD Generator" direction until it intersects horizontal/real axis.

* Read $r_{in} = r_{max} = 1.8\ \Omega/\Omega \Rightarrow Z_{in} = r_{in} Z_o = 1.8(50)$

$$\underline{\underline{Z_{in} = 90\Omega}}$$

* Draw radial line through z_L and read off 0.1485λ on the "WAVELENGTHS TOWARD GENerator" Scale. Note that $r_{in} = r_{max}$ is at 0.25λ on this scale.

$$\ell = (0.25 - 0.1485)\lambda = 0.1015\lambda$$

$$= 0.1015\left(\frac{2.9979\times10^8/2}{160\times10^6}\right)$$

$$\underline{\underline{\ell = 0.0951\,m = 9.51\,cm}}$$

11.42

Simple Smith Chart

$Z_0 = 50\Omega$, $u = c/2$

$f = 160\,MHz$