At 1.6 GHz, match a load of $Z_L = 25 + j\,75\ \Omega$ to a lossless transmission line ($Z_0 = 50\ \Omega$, $u = 2 \times 10^8$ m/s) using a quarter-wave transformer (you may assume $u = 2 \times 10^8$ m/s). Find and sketch both possible solutions for smallest possible circuit. Use 50 Ω transmission lines for everything but the quarter-wave transformers.

→ $\lambda = u/f = \frac{2\times10^8}{1.6\times10^9} = 0.125\,m$

→ $z_L = \frac{Z_L}{Z_0} = \frac{25 + j75\,\Omega}{50\,\Omega} = 0.5 + j1.5\ \Omega/\Omega$ ← plot on Smith Chart

→ Find two possible match points

$r_{max} = 7\ \Omega/\Omega \qquad R_{max} = 7(50) = \underline{350\,\Omega}$

$r_{min} = 0.145\ \Omega/\Omega \qquad R_{min} = 0.145(50) = \underline{7.25\,\Omega}$

→ Find distances from z_L to r_{max} & r_{min} (λ toward generator)

$\ell_{max} = 0.25\lambda - 0.1615\lambda = \underline{\underline{0.0885\lambda = 0.01106\,m}}$

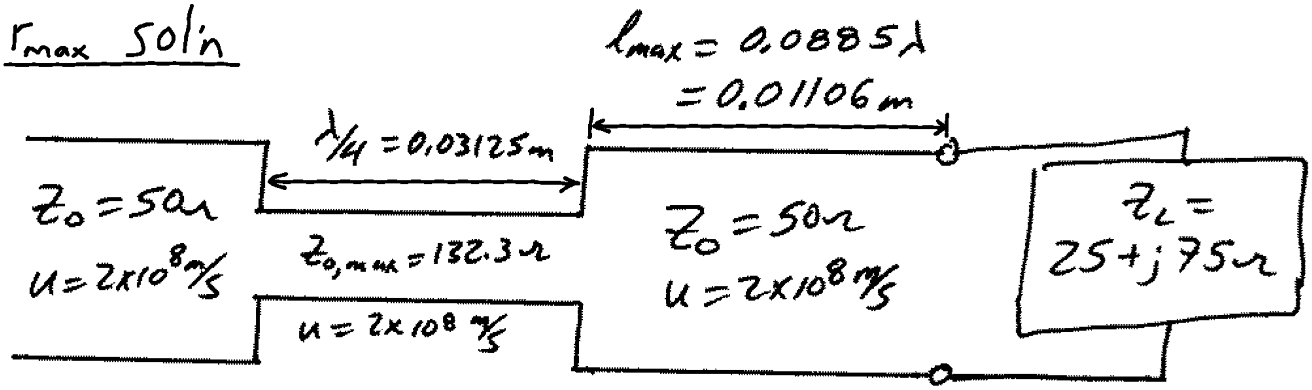
$\ell_{min} = 0.5\lambda - 0.1615\lambda = \underline{\underline{0.3385\lambda = 0.04231\,m}}$

→ Find impedances of the respective $\lambda/4$ transformers

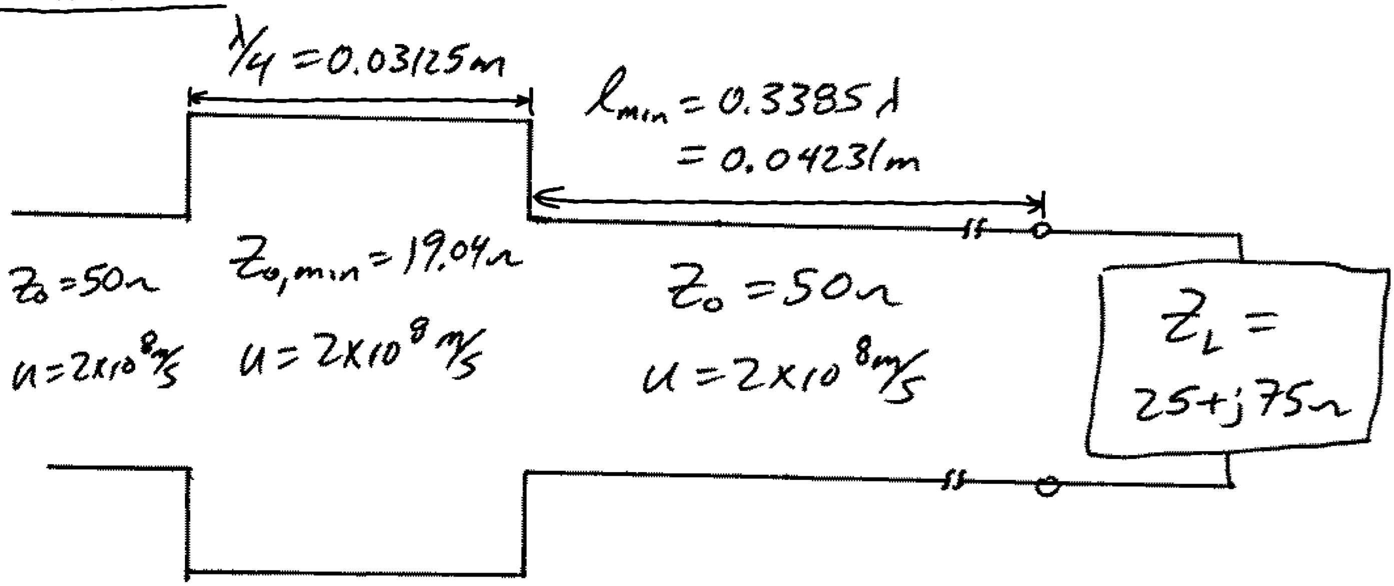
(11.58) $Z_{0,max} = \sqrt{50(350)} = \underline{\underline{132.29\,\Omega}} \qquad \lambda/4 = 0.03125\,m$

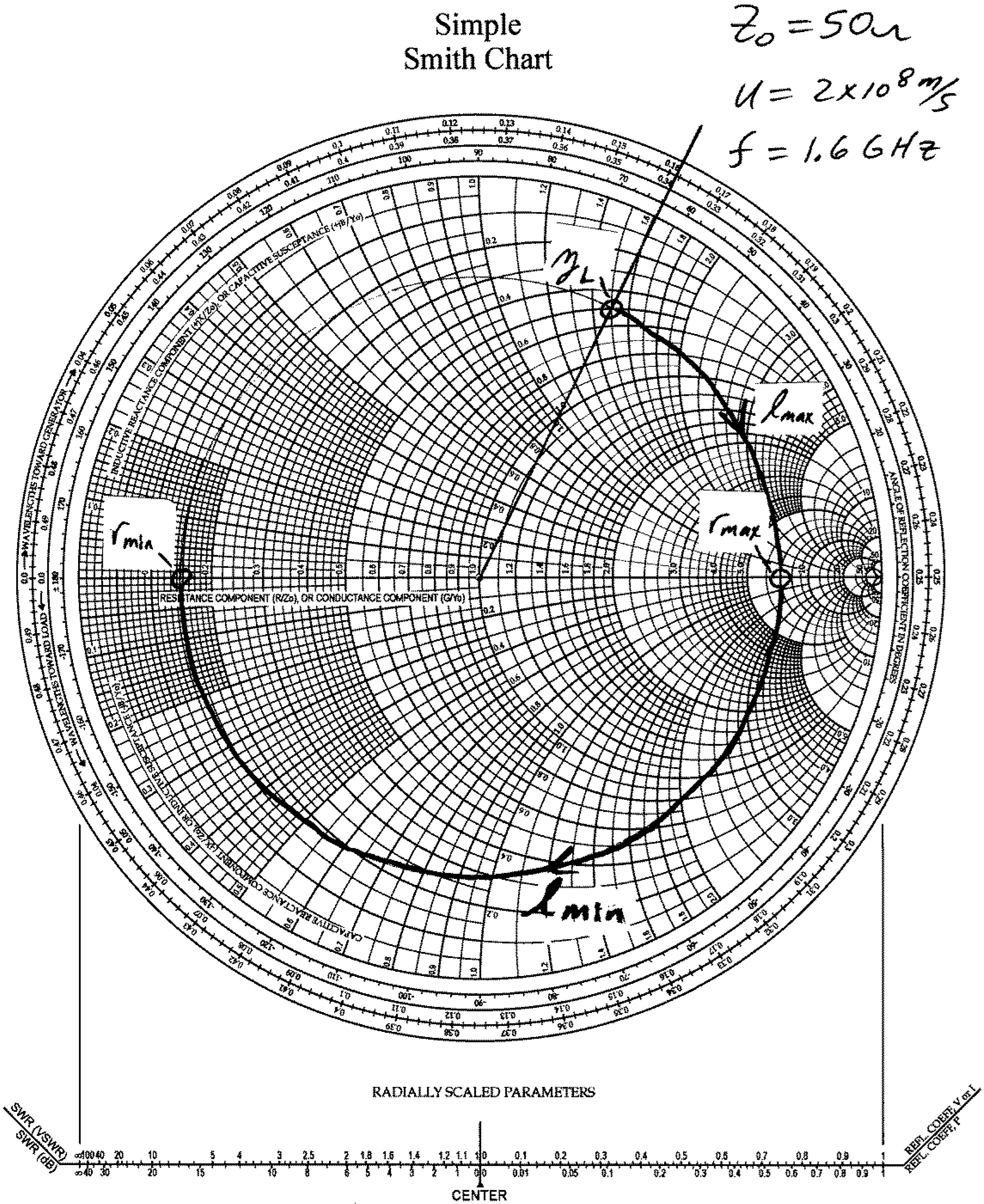
$Z_{0,min} = \sqrt{50(7.25)} = \underline{\underline{19.04\,\Omega}} \qquad \lambda/4 = 0.03125\,m$

r_{max} sol'n



r_{min} sol'n




Simple
Smith Chart
$Z_0 = 50\Omega$
$u = 2\times10^8$ m/s
$f = 1.6$ GHz
y_L
l_{max}
r_{max}
r_{min}
l_{min}
RESISTANCE COMPONENT (R/Zo), OR CONDUCTANCE COMPONENT (G/Yo)
INDUCTIVE REACTANCE COMPONENT (+jX/Zo), OR CAPACITIVE SUSCEPTANCE (+jB/Yo)
CAPACITIVE REACTANCE COMPONENT (-jX/Zo), OR INDUCTIVE SUSCEPTANCE (-jB/Yo)
WAVELENGTHS TOWARD GENERATOR
WAVELENGTHS TOWARD LOAD
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
RADIALLY SCALED PARAMETERS
SWR (VSWR)
SWR (dB)
REFL. COEFF, V or I
REFL. COEFF, P
CENTER