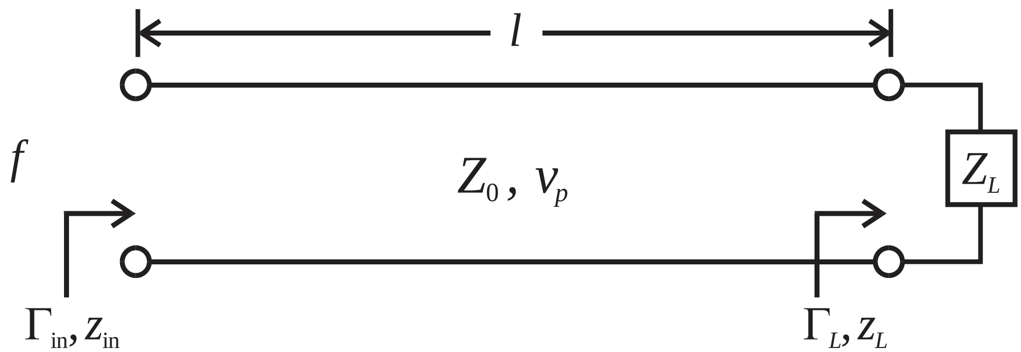


For the lossless transmission line circuit above, the frequency, length, and phase velocity will be left unspecified while $Z_0 = 75\,\Omega$ and $Z_L = 56.25 - j\,75\,\Omega$.

1) Normalize and plot load impedance

- Normalize $z_L = Z_L / Z_0 = (56.25 - j\,75) / 75 \;\Rightarrow$ <u>**z_L = 0.75 - *j* 1 Ω/Ω**</u>.
- Plot z_L on Smith charts by finding the intersection of the $r = 0.75$ circle with the $x = -1$ arc.

2) Find load reflection coefficient, RL, and VSWR (method 1)

- Set compass to distance between center of Smith charts and z_L. Use "REFL. COEFF. V or I" scale at bottom right to determine <u>$|\Gamma_L| = 0.5$</u> or <u>0.51</u>.
- Use straight-edge to draw radial line from center of Smith chart through z_L and outer rings of Smith charts. Use "ANGLE OF REFLECTION COEFFCIENT IN DEGREES" scale to read <u>$\angle\,\Gamma_L = -74°$</u>.
- Put magnitude and angle together to get <u>**Γ_L = 0.5∠-74°**</u> or <u>**0.51∠-74°**</u>. For comparison, the analytic result is $\Gamma_L = 0.5114\angle{-74.29°}$.
- Use compass to draw |Γ| = 0.5 arc, centered on Smith chart scales, through SWR (VSWR) scale on bottom left. Read <u>**VSWR = 3.1**</u> **.**
- Use compass to draw |Γ| = 0.5 arc, centered on Smith chart scales, through RETN LOSS scale on bottom right. Read <u>**RL = 6 dB**</u> or <u>**5.8 dB**</u>**.**

3) Find VSWR (method 2)

- Draw a circle, centered on Smith charts, through z_L.
- Read value of normalized resistance *r* where the |Γ| = 0.5 circle crosses the horizontal/real axis to the right of the origin to get <u>**r_{max} = VSWR = 3.1**</u>.

4) Find load admittance

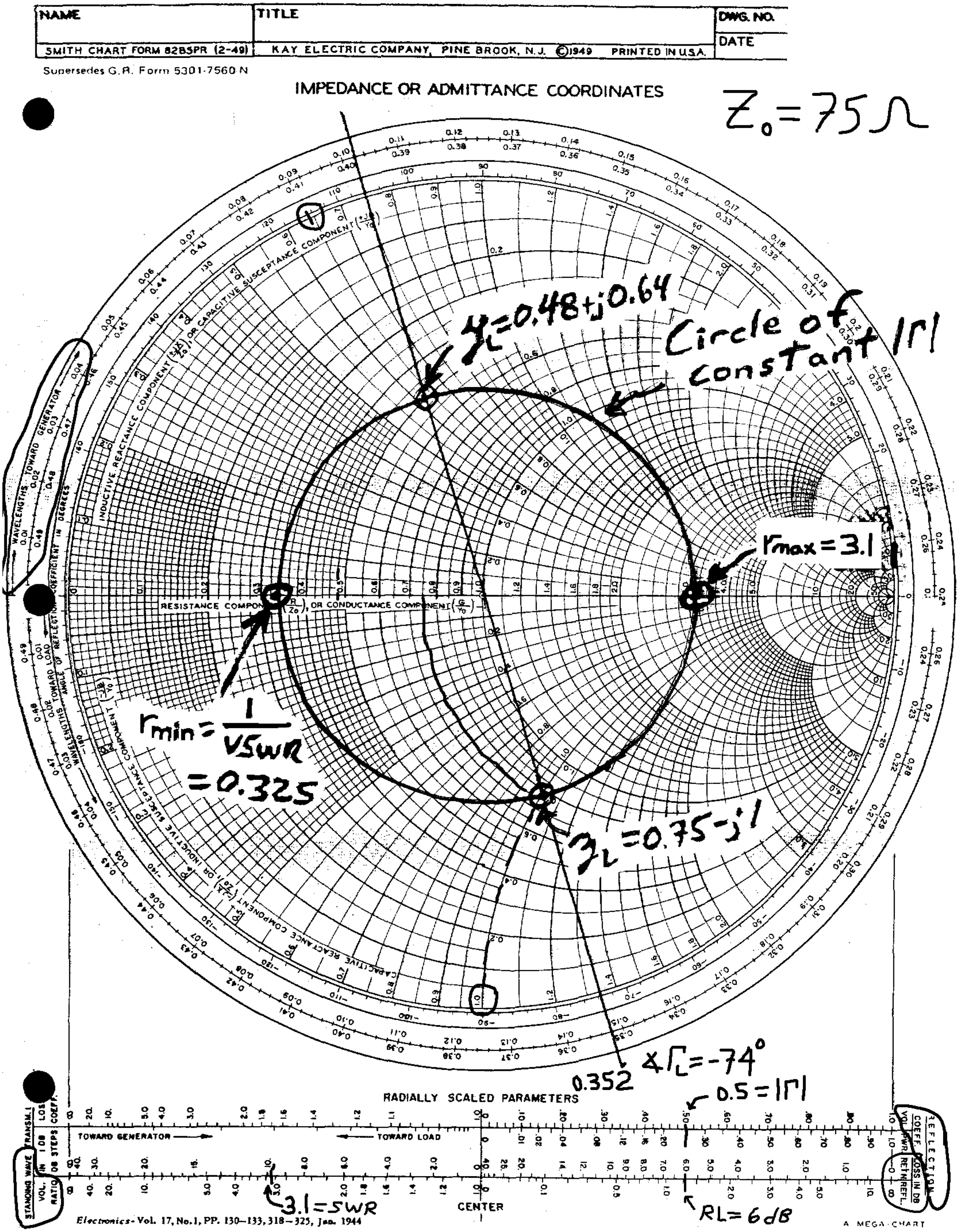
- Use straight-edge to draw line from edge-to-edge of Smith charts through center of Smith charts and z_L point.
- Where the line intersects the $|\Gamma| = 0.5$ circle on the side opposite to z_L, locate and read/interpolate value of appropriate "*g*" circle as $g_L = 0.48$.
- Where the line intersects the $|\Gamma| = 0.5$ circle on the side opposite to z_L, locate and read/interpolate value of appropriate "*b*" arc as $b_L = 0.64$.
- Put together to get normalized load admittance $\mathbf{y_L = 0.48 + j0.64}$ **S/S.**
- Find load admittance by dividing y_L by characteristic impedance Z_0 to get $Y_L = y_L / Z_0 = (0.48 + j\,0.64)/75 \Rightarrow \mathbf{Y_L = 0.0064 + j\,0.0083\ S = 6.4 + j\,8.3\ mS}$.

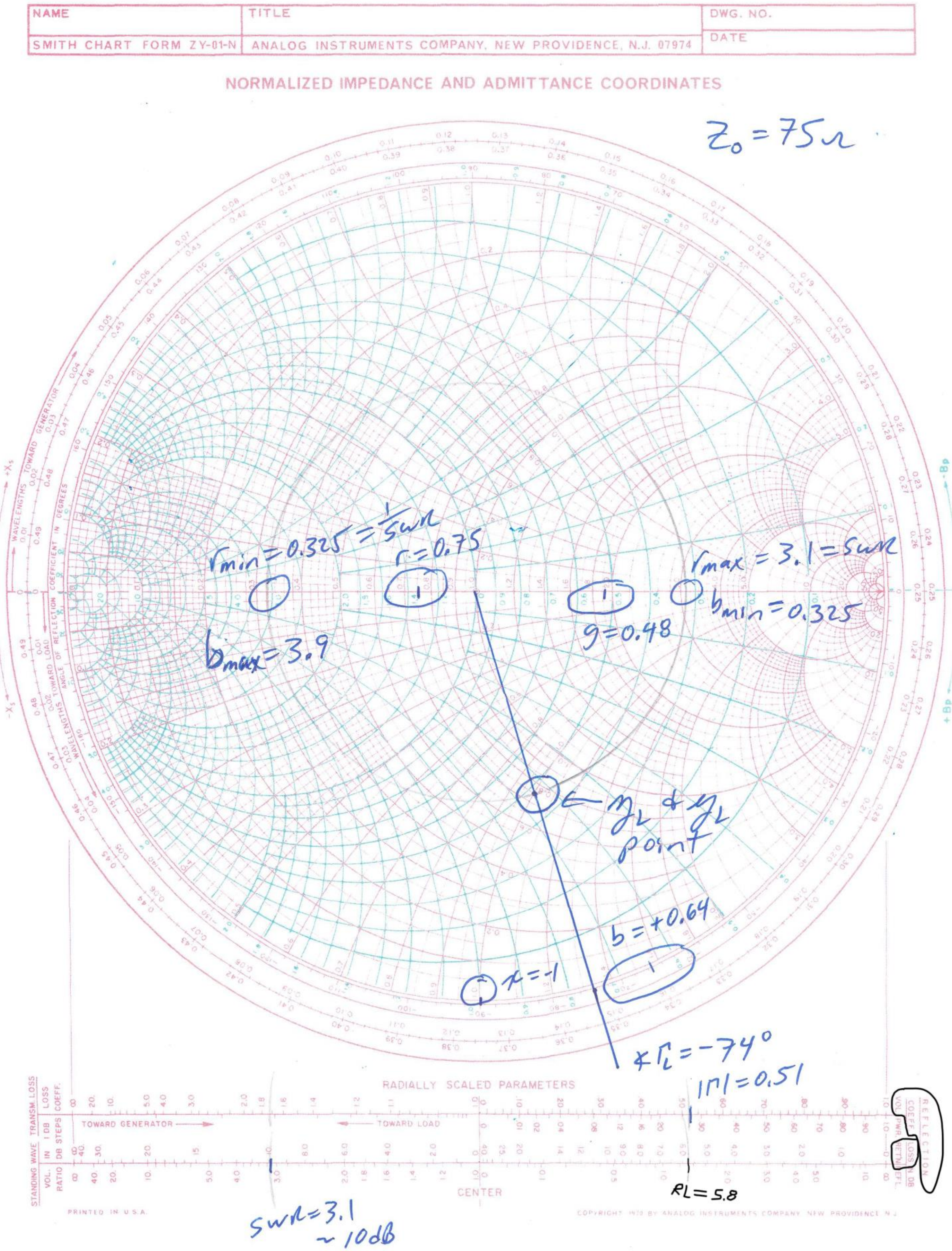
5) Find/locate voltage and impedance maxima

- Impedance maxima occur where the $|\Gamma| = 0.5$ circle crosses the real axis to the right of origin. Read/interpolate "*r*" circles to get $\mathbf{r_{max} = 3.1}$.
- The maximum impedance along the transmission line is found by multiplying r_{max} w/ Z_0 to get $Z_{max} = Z_0\, z_{max} = 75(3.1) \Rightarrow \mathbf{Z_{max} = 232.5\ \Omega}$.
- Voltage maxima along the transmission line occur at r_{max}. Starting where the radial line through z_L crosses the "WAVELENGTHS TOWARD GENERATOR" scale at 0.352, move toward the generator to the real axis to the right of origin (r_{max} location) where the scale reads 0.25. The total distance is $(0.5\text{-}0.352)\,\lambda + 0.25\lambda = 0.398\lambda$.
- As everything repeats at $\lambda/2$ intervals on lossless TLs, the voltage maxima locations in distance from the load are $\mathbf{l_{max} = 0.398\lambda + n\lambda/2}$**.**

5) Find/locate voltage and impedance minima

- Impedance minima occurs where the $|\Gamma| = 0.5$ circle crosses the real axis to the left of origin. Read/interpolate "*r*" circles to get $\mathbf{r_{min} = 0.325}$.
- The minimum impedance along the transmission line is found by multiplying r_{min} w/ Z_0 to get $Z_{min} = Z_0\, z_{min} = 75(0.325) \Rightarrow \mathbf{Z_{min} = 24.375\ \Omega}$.
- Voltage minima along the transmission line occur at r_{min}. Starting where the radial line through z_L crosses the "WAVELENGTHS TOWARD GENERATOR" scale at 0.352, move toward the generator to the real axis to the left of origin (r_{min} location) where the scale reads 0.5. The total distance is $(0.5\text{-}0.352)\,\lambda = 0.148\lambda$.
- As everything repeats at $\lambda/2$ intervals, the voltage minima locations in distance from the load are $\mathbf{l_{min} = 0.148\lambda + n\lambda/2}$**.**


NAME
TITLE
DWG. NO.
DATE
SMITH CHART FORM 82BSPR (2-49)
KAY ELECTRIC COMPANY, PINE BROOK, N.J. ©1949 PRINTED IN U.S.A.
Supersedes G.R. Form 5301-7560 N
IMPEDANCE OR ADMITTANCE COORDINATES
Z0 = 75 Ω
yL = 0.48 + j0.64
Circle of constant |Γ|
rmax = 3.1
rmin = 1 / VSWR = 0.325
zL = 0.75 - j1
0.352
∠ΓL = -74°
0.5 = |Γ|
RADIALLY SCALED PARAMETERS
TOWARD GENERATOR
TOWARD LOAD
CENTER
3.1 = SWR
RL = 6 dB
Electronics - Vol. 17, No. 1, PP. 130—133, 318—325, Jan. 1944
A MEGA-CHART


NAME
TITLE
DWG. NO.
DATE
SMITH CHART FORM ZY-01-N
ANALOG INSTRUMENTS COMPANY, NEW PROVIDENCE, N.J. 07974
NORMALIZED IMPEDANCE AND ADMITTANCE COORDINATES
Z₀ = 75Ω
r_min = 0.325 = 1/SWR
r = 0.75
r_max = 3.1 = SWR
b_min = 0.325
g = 0.48
b_max = 3.9
← y_L & y_L point
b = +0.64
x = -1
∡Γ_L = -74°
|Γ| = 0.51
RADIALLY SCALED PARAMETERS
TOWARD GENERATOR
TOWARD LOAD
CENTER
RL = 5.8
SWR = 3.1
~ 10dB
PRINTED IN U.S.A.