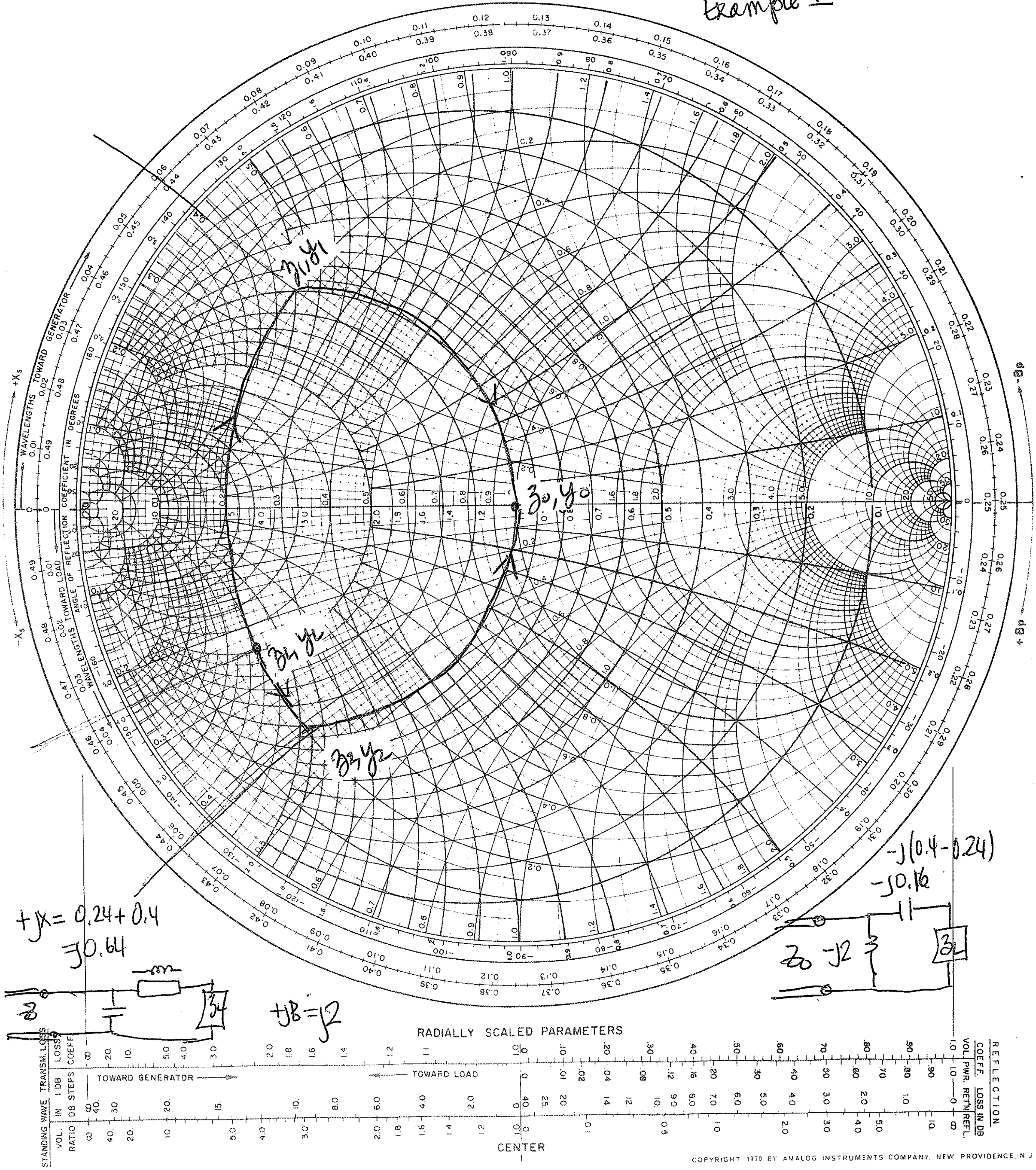
NAME	TITLE	DWG. NO.
SMITH® CHART FORM ZY-01-N	ANALOG INSTRUMENTS COMPANY, NEW PROVIDENCE, N.J. 07974	DATE Pg1

Lumped element Matching using normalized Chart

NORMALIZED IMPEDANCE AND ADMITTANCE COORDINATES

Example 1



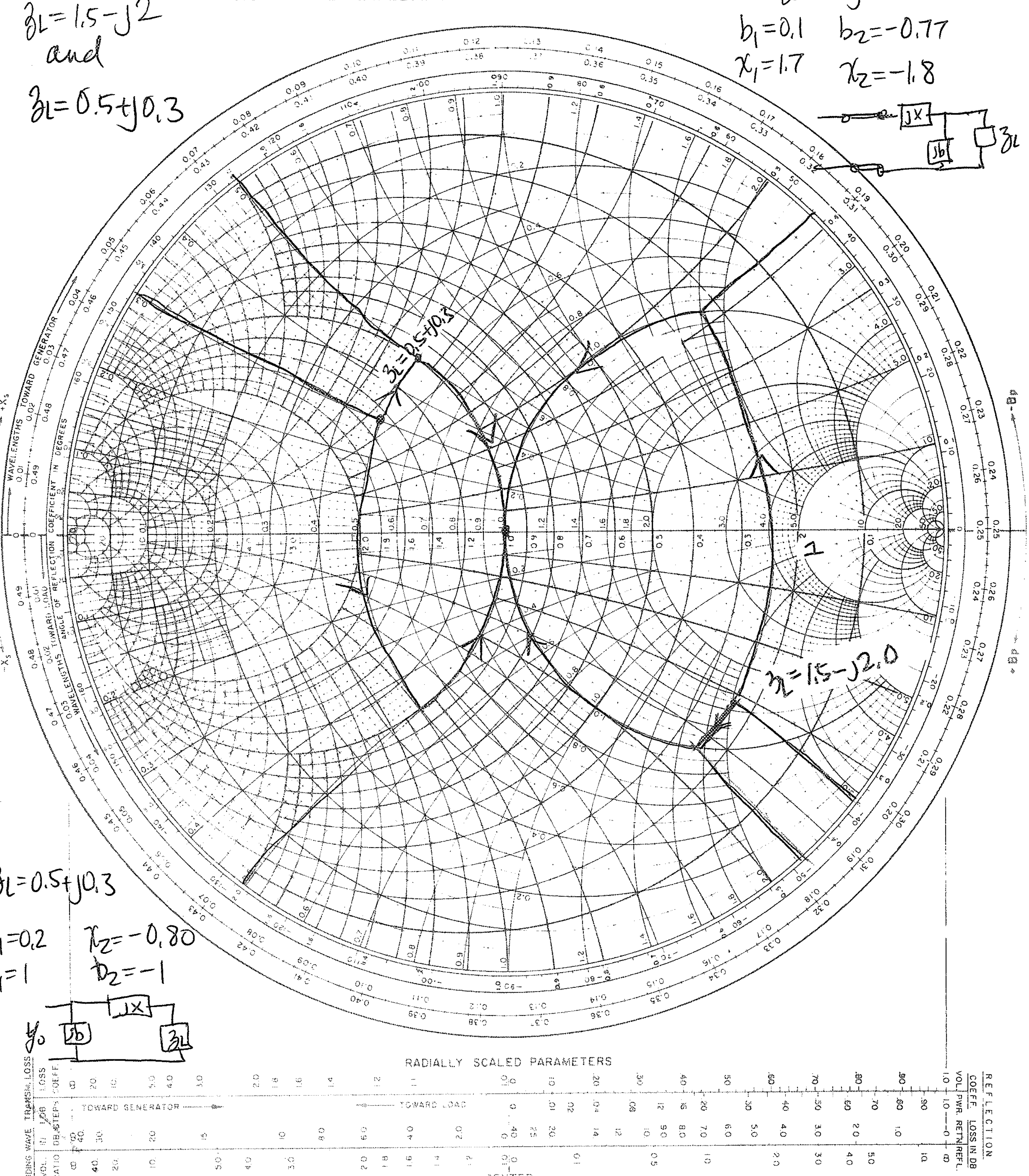
NAME	TITLE Examples lumped matching	DWG. NO.
SMITH® CHART FORM ZY-01-N	ANALOG INSTRUMENTS COMPANY, NEW PROVIDENCE, N.J. 07974	DATE pg 2

NORMALIZED IMPEDANCE AND ADMITTANCE COORDINATES $z_L = 1.5 - j2$

$z_L = 1.5 - j2$
and
$z_L = 0.5 + j0.3$

$b_1 = 0.1$ $b_2 = -0.77$
$x_1 = 1.7$ $x_2 = -1.8$

jx jb z_L



$z_L = 0.5 + j0.3$

$x_1 = 0.2$ $x_2 = -0.80$
$b_1 = 1$ $b_2 = -1$

y_0 jb jx z_L

series L case

$jx = j0.64 = j\omega L = Z_L$

$z = \frac{Z_L}{Z_0} \Rightarrow Z_L = z_L \cdot Z_0$

$\omega L = x \cdot Z_0$ $\quad z_L = x$

$L = \frac{x Z_0}{2\pi f} = 0.64\,nH$

shunt C case

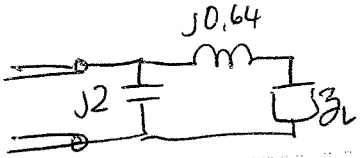
$jb = j2 = \omega C = Y_C$

$y_c = \frac{Y_C}{Y_0} \Rightarrow Y_C = y_c \cdot Y_0$ $\quad y_c = b$

$\omega C = y_c Y_0$

$C = \frac{b}{2\pi f Z_0} = 0.8\,pF$

Solution 1



Solution 2

series C

$z_c = -\frac{1}{\omega C}$

$z_c Z_0 = -\frac{1}{\omega C}$ $\quad z_c = -0.16 = x$

$C = -\frac{1}{z_c Z_0 \omega} = \frac{-1}{x Z_0 \cdot 2\pi f}$

$C = 2.5\,pF$

shunt L case

$Y_L = \frac{-1}{\omega L}$

$y_L Y_0 = -\frac{1}{\omega L}$ $\quad y_L = -2 = b$

$L = -\frac{1}{Y_0 y_L \omega} = 0.5\,nH$

$L = \frac{-1}{Y_0 b \cdot 2\pi f}$

Steps

(1) Plot normalized load z_L, this is also y_L on the normalized Z/Y chart.

(2) Note that you can only travel along constant resistance and conductance circles. Highlight the place where you want to be (for our current work it's the center of the smith chart)

(3) Note the path you might be able to take on the constant r and g circles. For this problem, we can travel from $z_L = 0.2 - j0.24$ along constant r to $z_1 = 0.2 + j0.4$; the change in reactance is $+0.64$ or $jx = j0.64$. Now consider that we have to travel along constant g so now it's the Y chart values. $y_1 = 1 - j2$

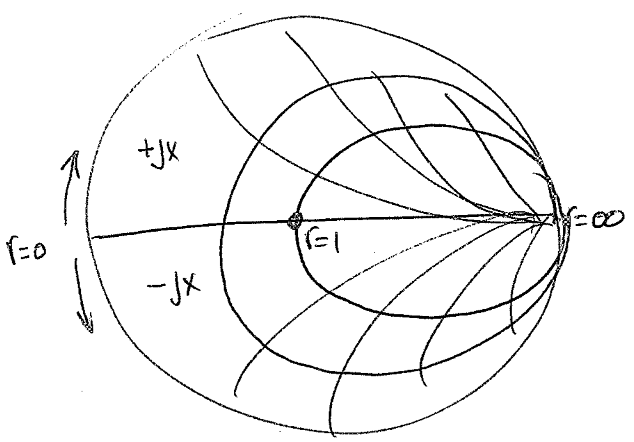
(4) We now require $+j2$ to get $y_0 = 1 - j2 + j2 = 1$ (our desired answer) where $j2$ is a susceptance value; shunt capacitance.

$jx = j0.64$ series L
$jb = j2$ shunt C

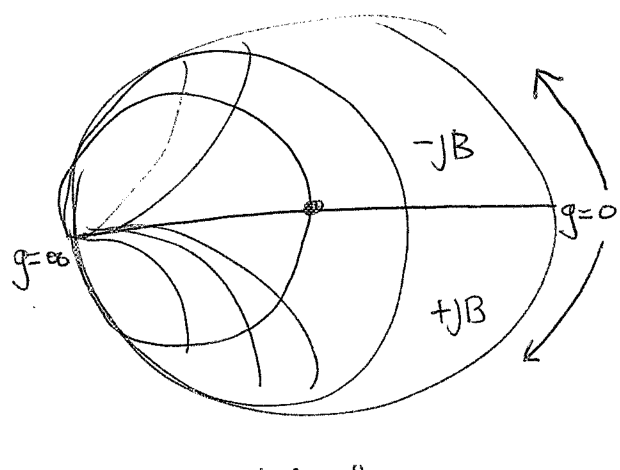
(5) For solution 2, we do the same thing going in the opposite direction

(a) Travel from z_L to z_2 on constant r circle to $z_2 = 0.2 - j0.4$ where $jx = -j0.16$ and is equivalent to a series capacitance

(b) $z_2 = \frac{1}{y_2} \Rightarrow y_2 = 1 + j2$. We have to travel along constant g to get to the center of the smith chart. The value of susceptance needed is $-j2 = jb$ and is equivalent to a shunt inductor



Impedance chart



Admittance chart

NAME	TITLE Shunt stub tuning usin open
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NORMALIZED IMPEDANCE AND ADMITTANCE COORDINATES

Soln 1

1 Plot z_L or y_L; line through y_L

1 Now consider the Y chart & 1

Draw SWR circle

1st point that intersects +jb. circle on Y chart

Soln 2

$y_2 = 1 - j1.47$, Need $+j1.47$

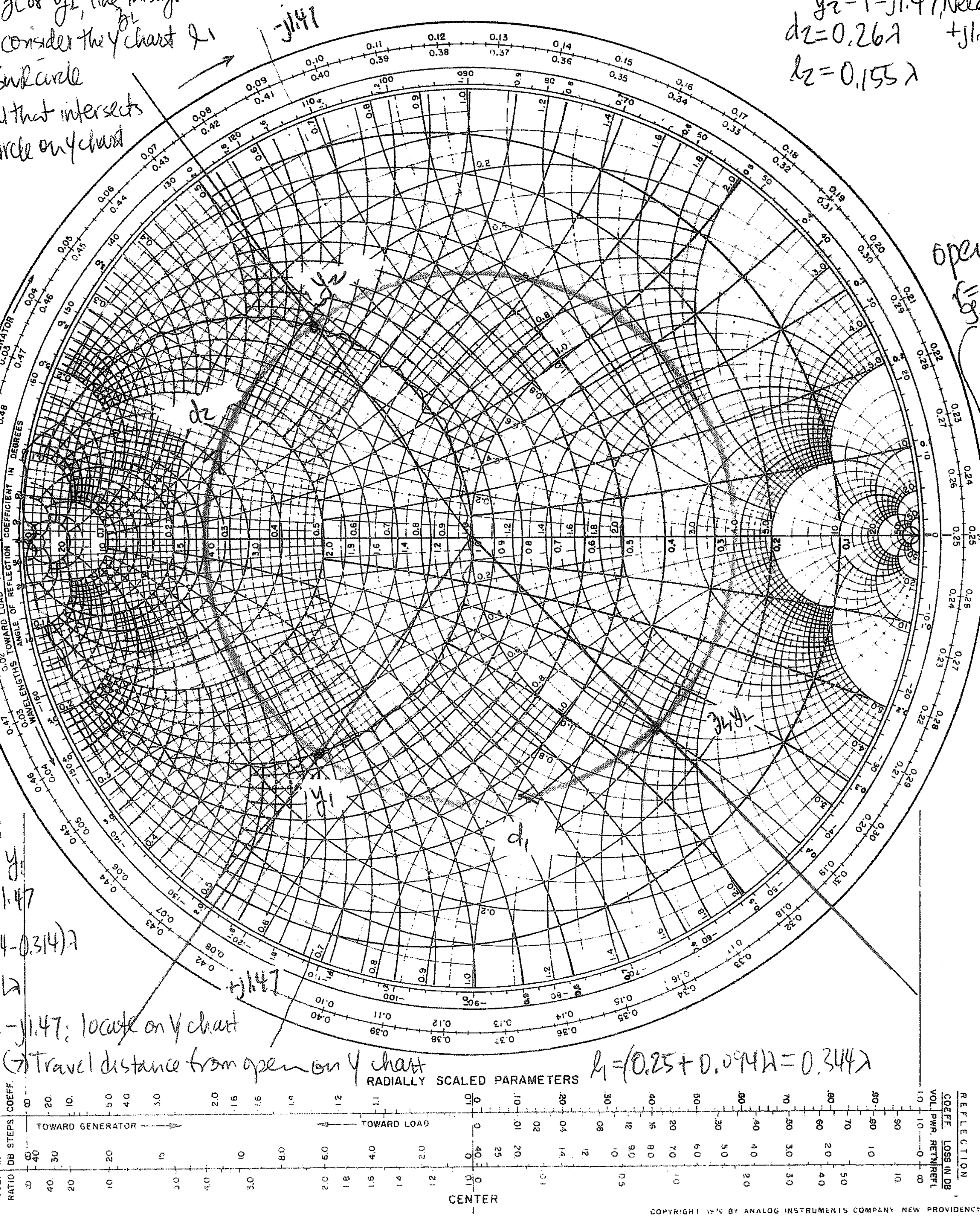
$d_2 = 0.26\lambda$

$l_2 = 0.155\lambda$

open

$\Gamma = \infty$

$g = 0$



travel TG to y_1

$= 1 + j1.47$

$= (.424 - .314)\lambda$

$= 0.11\lambda$

Need $-j1.47$; locate on Y chart

(?) Travel distance from open on Y chart $l_1 = (0.25 + 0.094)\lambda = 0.344\lambda$

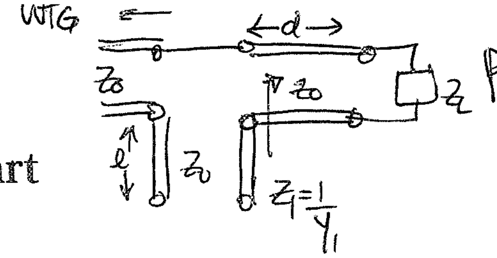
Ex $Z_L = 100 + j80$, $Z_0 = 50\Omega$ $z_L = 2 + j1.6$

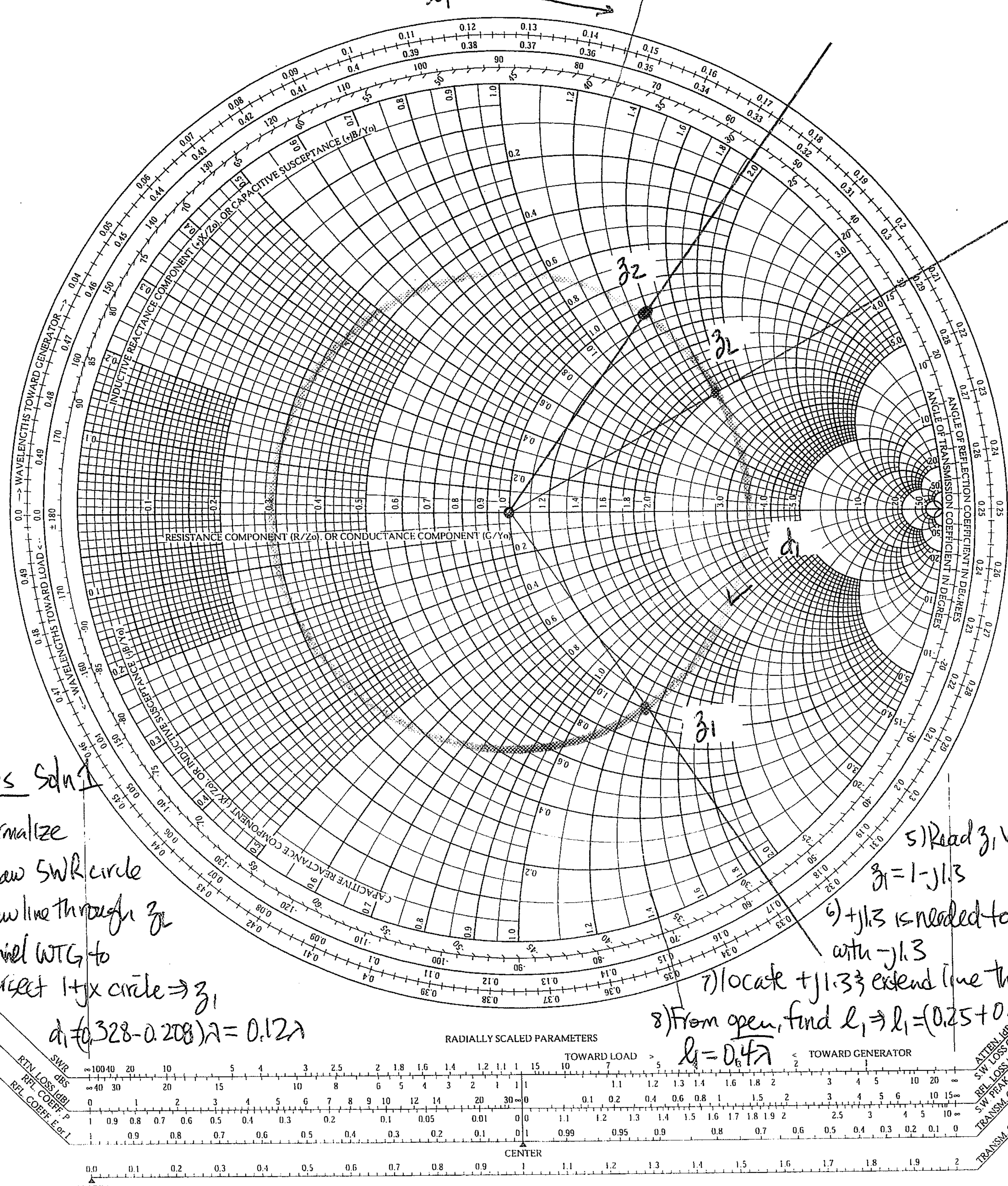
open ckt
single stub (series)

Single stub tuning (series)

The Complete Smith Chart

Black Magic Design





Steps Soln 1

1) Normalize
2) Draw SWR circle
3) Draw line through z_L
4) Travel WTG to intersect $1+jx$ circle ⇒ z_1

$d_1 = (0.328 - 0.208)\lambda = 0.12\lambda$

5) Read z_1 value

$z_1 = 1 - j1.3$

6) $+j1.3$ is needed to cancel with $-j1.3$
7) locate $+j1.3$ & extend line through SC
8) From open, find l_1 ⇒ $l_1 = (0.25 + 0.146)\lambda$

$l_1 = 0.4\lambda$

Soln 2

$d_2 = (0.5 - 0.208 + 0.174)\lambda = 0.466\lambda$; $z_2 = 1 + j1.4$; need $-j1.4$

$l_2 = (0.35 - 0.25)\lambda = 0.10\lambda$