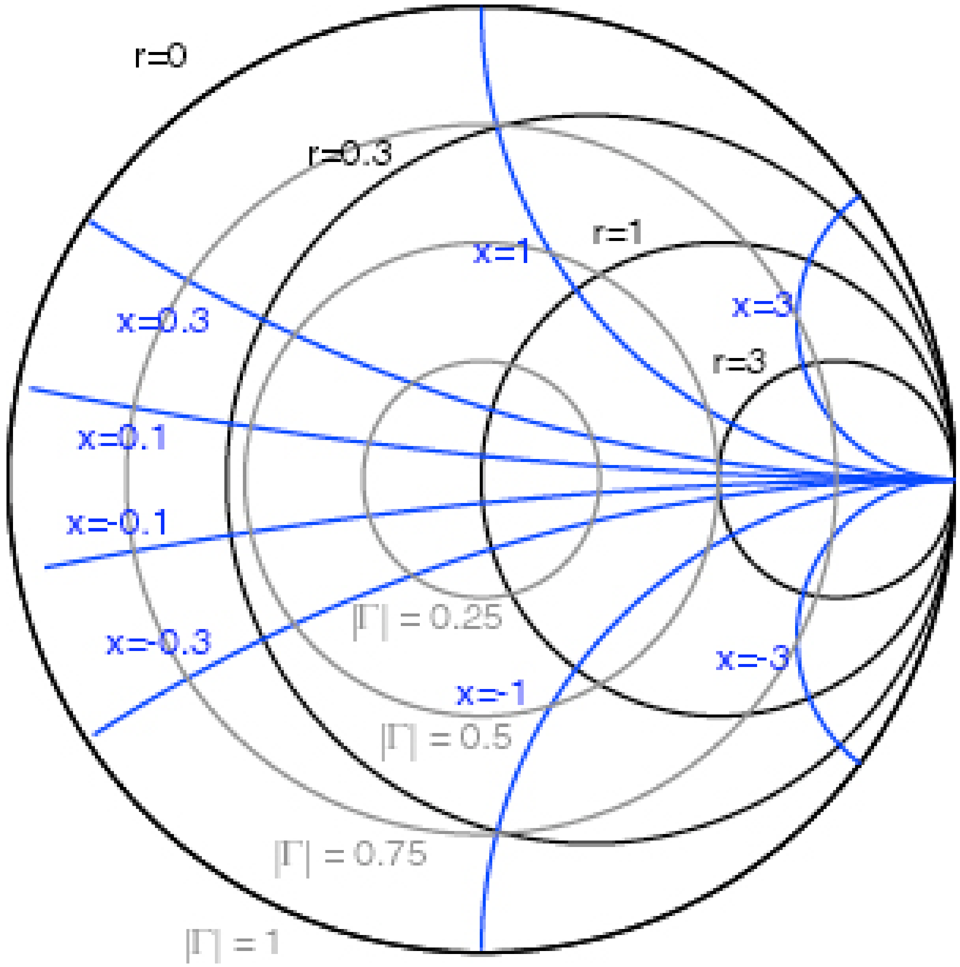
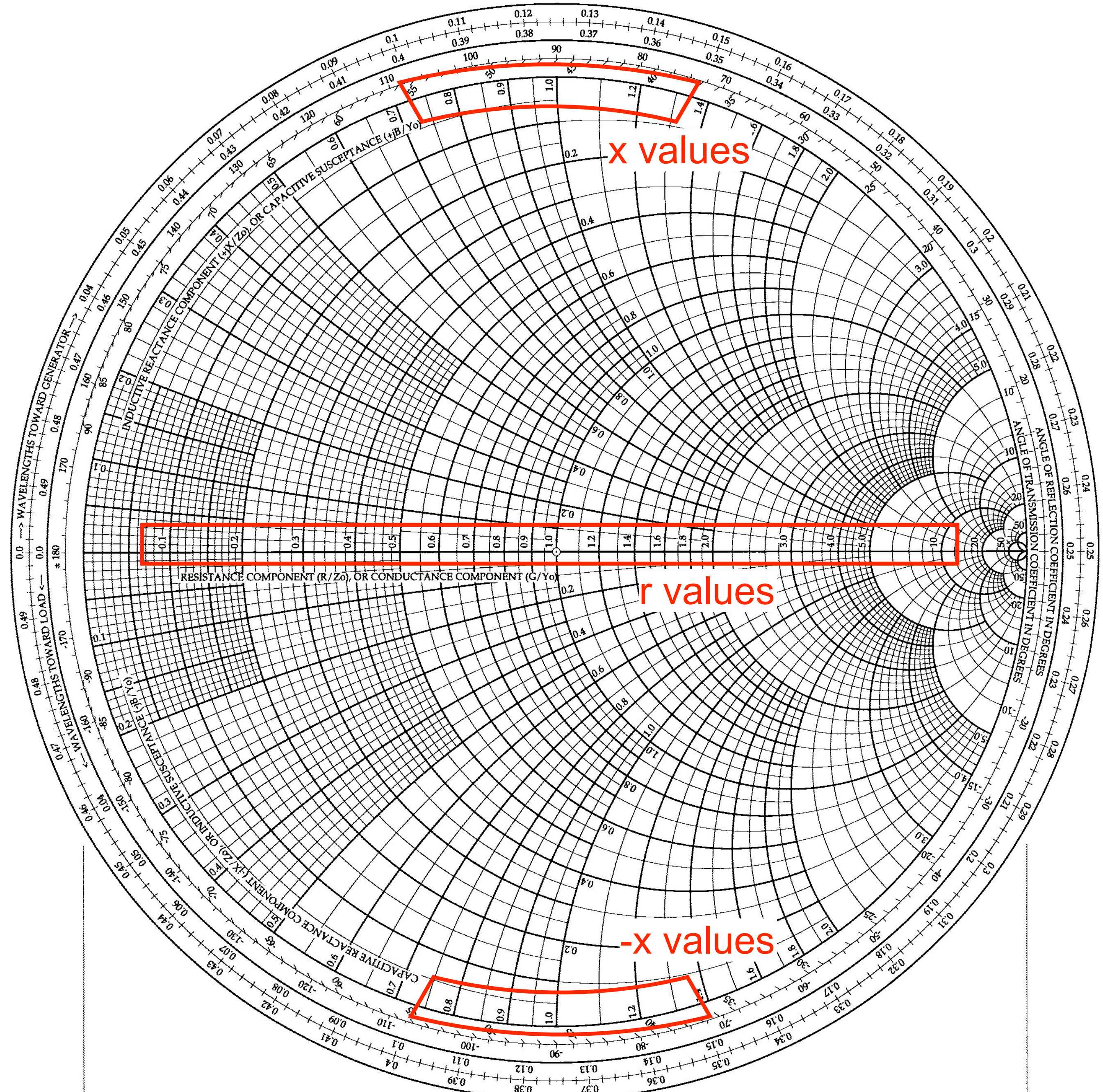
The Smith Chart

- Superimposes constant Γ, r and x circles

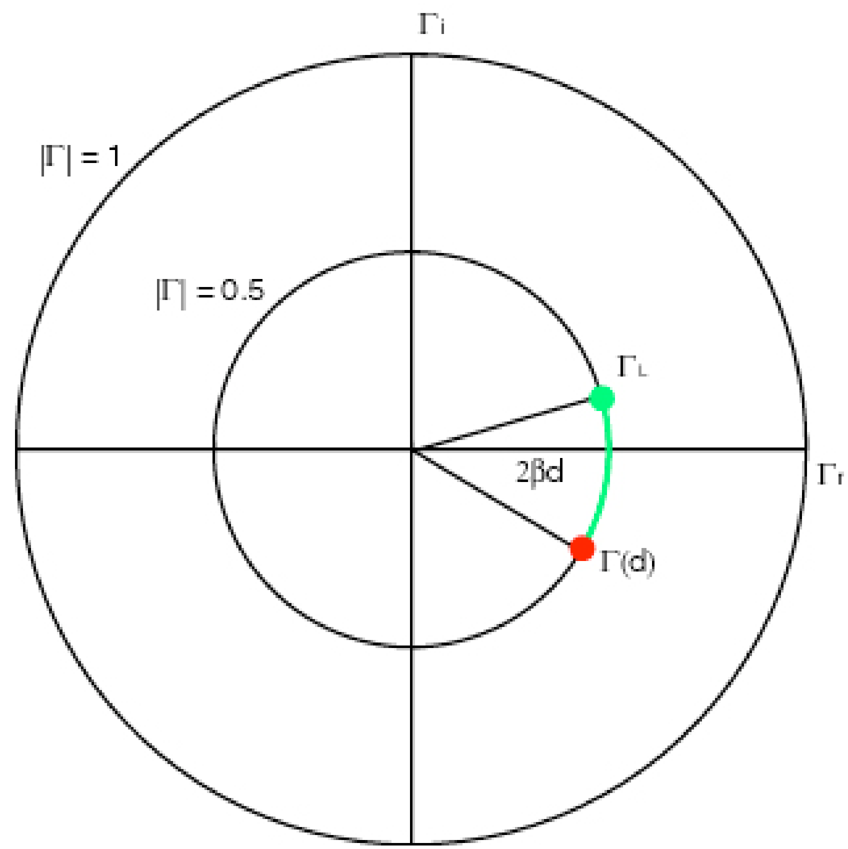
- We can quickly relate normalized line impedance to its corresponding reflection coefficient



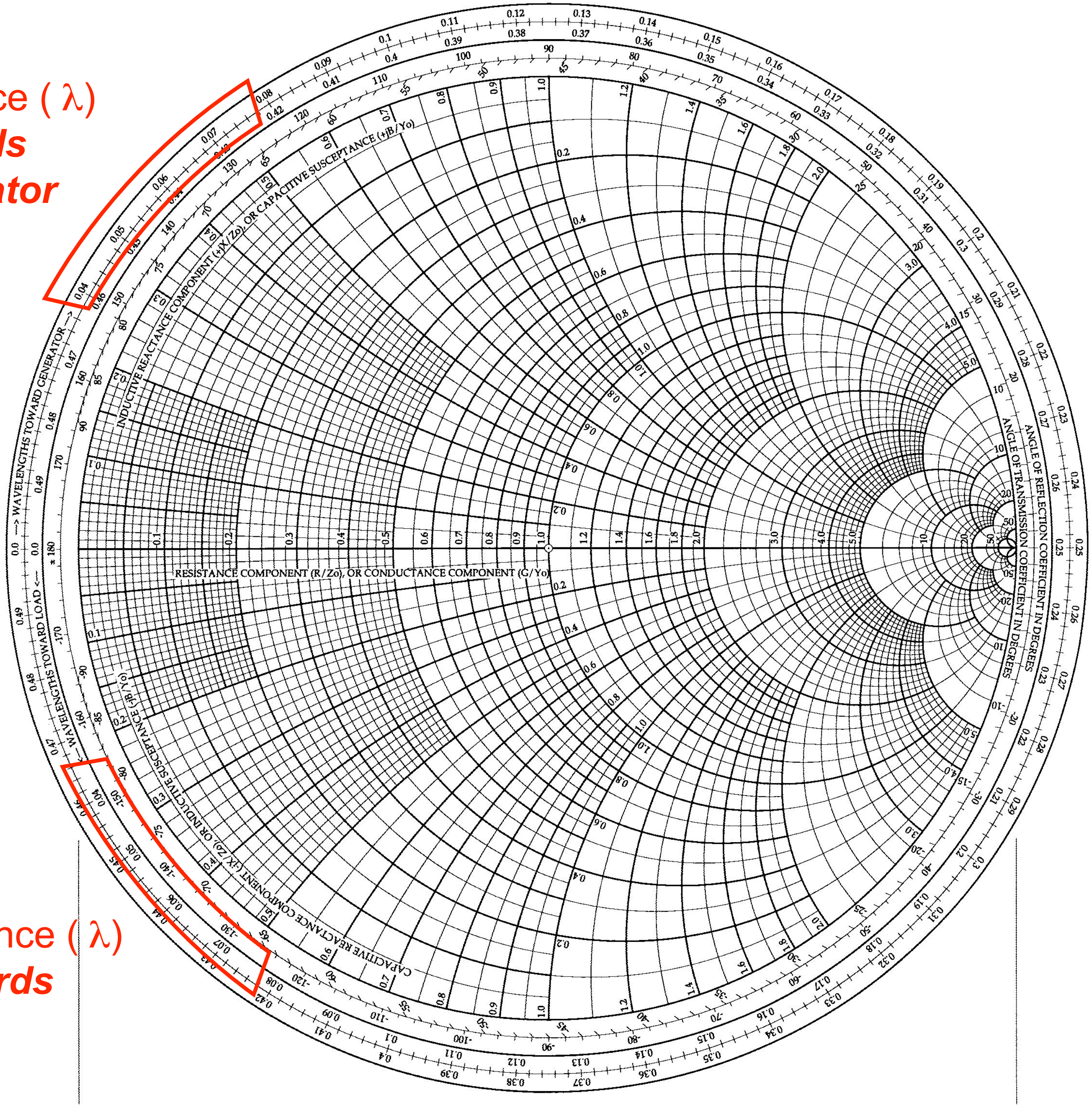

x values
r values
-x values
RESISTANCE COMPONENT (R/Zo), OR CONDUCTANCE COMPONENT (G/Yo)
INDUCTIVE REACTANCE COMPONENT (+jX/Zo) OR CAPACITIVE SUSCEPTANCE (+jB/Yo)
CAPACITIVE REACTANCE COMPONENT (-jX/Zo), OR INDUCTIVE SUSCEPTANCE (-jB/Yo)
—> WAVELENGTHS TOWARD GENERATOR —>
<— WAVELENGTHS TOWARD LOAD <—
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
ANGLE OF TRANSMISSION COEFFICIENT IN DEGREES

$\Gamma(d)$ Transformations

- $\Gamma(d) = \Gamma_L e^{-2\beta d}$
- As d changes, we trace out a circle with radius $|\Gamma(d)| = |\Gamma_L|$
- A full circle is traced every
  - $2\beta d = 2\pi$
  - $d = \lambda/2$
- As d increases (towards generator) we move counter-clockwise along a constant Γ circle



Distance (λ) ***towards generator***

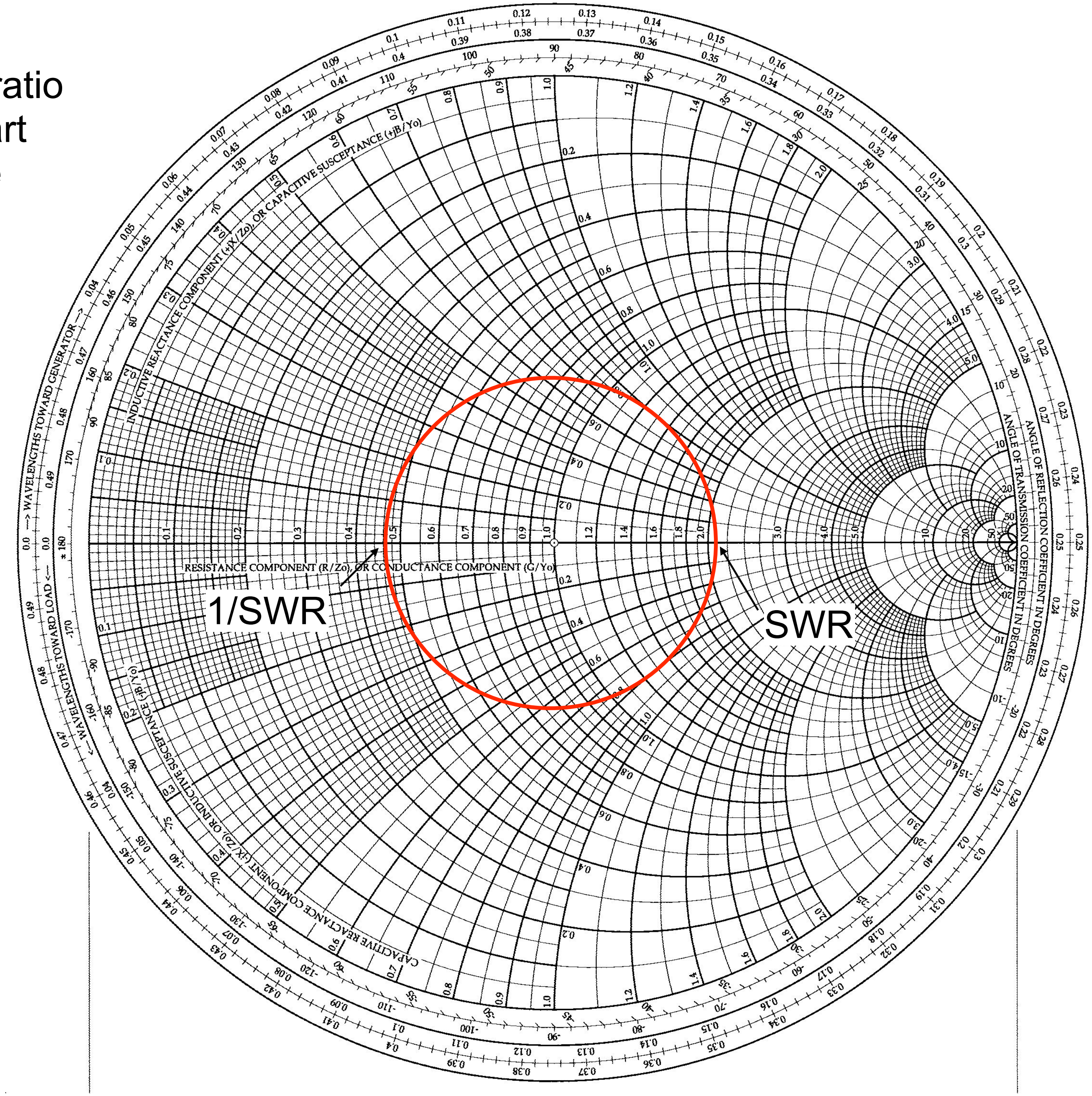


Distance (λ) ***towards load***

The standing wave ratio is read off of the chart by noting the r value where a constant Γ circle intersects the Γ_r axis

1) $SWR = Z_{max}/Z_0$
$= z_{max}$
$= r_{max}$

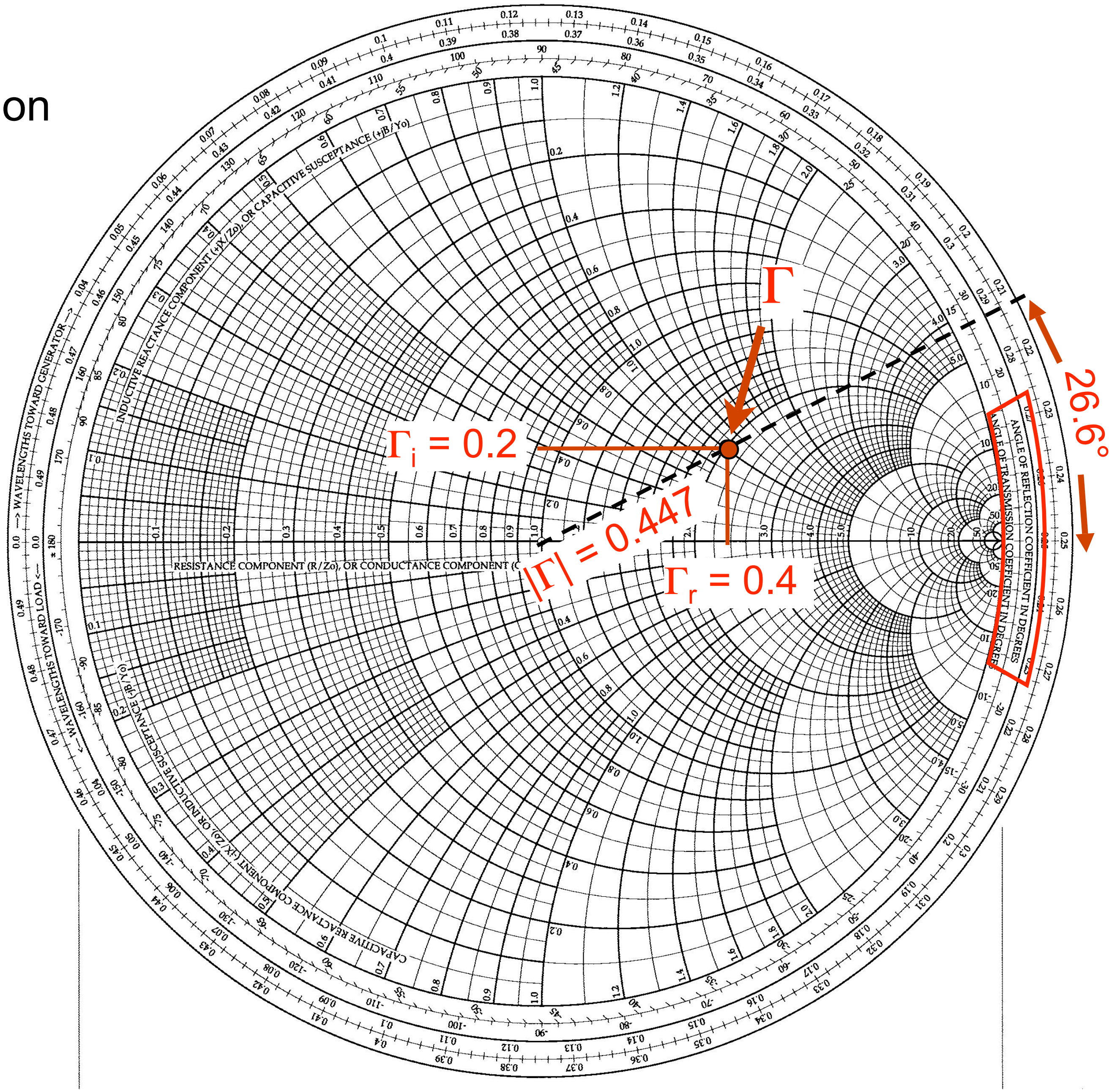
2) $SWR = Z_0/Z_{min}$
$= 1/z_{min}$
$= 1/r_{min}$



EXAMPLE:

If the effective reflection coefficient on a piece of 50 Ω line is Γ=0.4+j0.2, what is the corresponding line impedance at that point ?

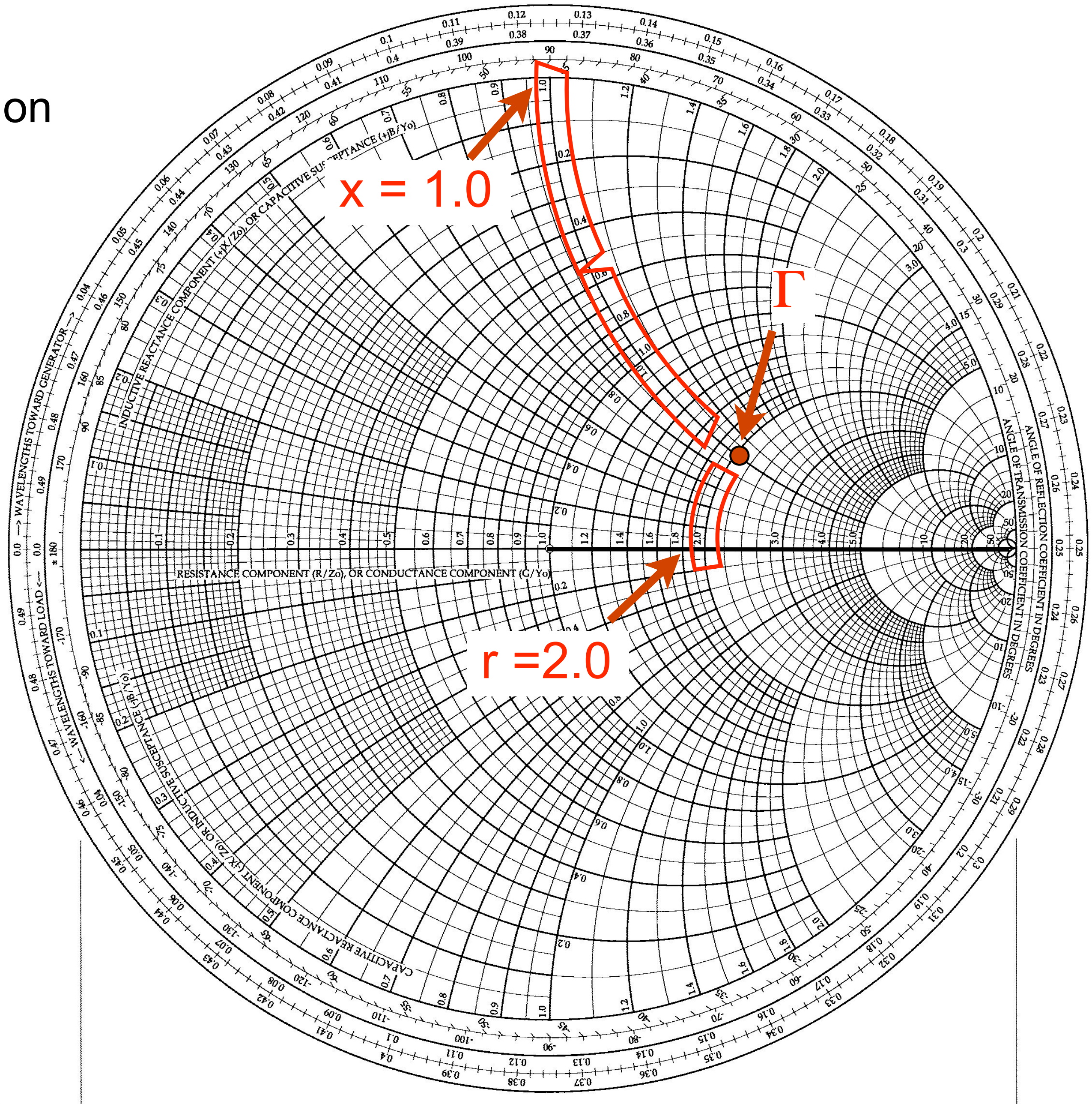
1) Find Γ on the Smith Chart



EXAMPLE:

If the effective reflection coefficient on a piece of 50 Ω line is $\Gamma=0.4+j0.2$, what is the corresponding line impedance at that point ?

1) Find Γ on the Smith Chart
2) Read r and x off of chart
3) Use Z_0 to re-normalize

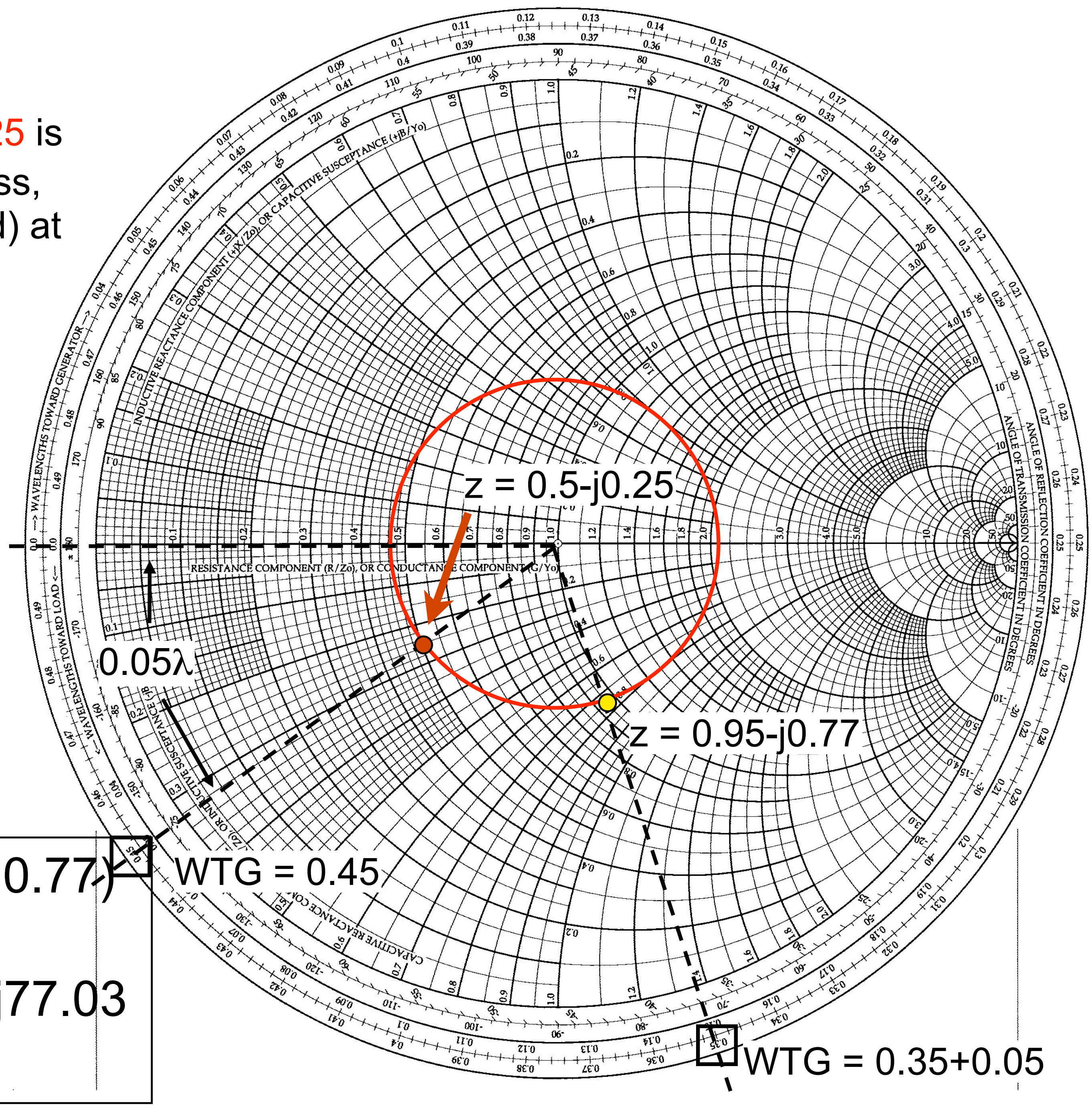


$$Z = 50\ (2.0 + j1.0)$$
$$= 100.0 + j\ 50.0\ \Omega$$

EXAMPLE:

A load with Z_L=50-j25 is attached to a lossless, 100 Ω T-L. Find Z(d) at d = 0.4λ

1) Normalize Z_L
   z = 0.5-j0.25
2) Find z on the Smith Chart
3) Rotate along constant Γ by 0.4λ
4) Read off new values of z
4) Use Z_0 to re-normalize



Z(d) = 100 (.95-j0.77)
= 95-j77 Ω

$Z(d)_{calc}$ = 95.29-j77.03

%error ~ 0.2%

We can transform z into y by rotating z half way around a constant Γ circle

Given Z = 95+j20 on a 50 Ω line, find Y

1) Find z
   z = 1.9+j0.4
2) Draw Γ circle
3) Draw line through origin
4) Find intersection with Γ circle
5) Read off y
   y = 0.5-j0.1
6) Renormalize y
   $Y = y/Z_0$
   $= 10 - j2$ mS
   $Y_{calc} = 10.1 - j2.12$ mS