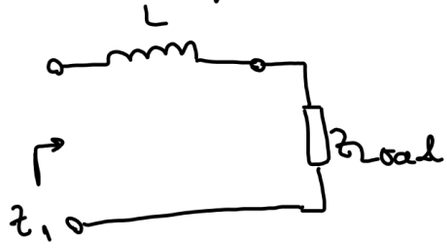
Curs 9:

Adaptarea impedanței („impedance matching")

Adaptarea impedanței → minimizarea lui Γ (minimizarea pierderilor prin reflexie)

Efectul inductanței serie



impedanța unui inductor

$$Z_{ind} = j\omega L$$

$$z_{ind} = \frac{j\omega L}{Z_0}$$

$$z_1 = z_{load} + z_{ind} = R + jX + j\cdot\frac{\omega L}{Z_0}$$

$$z_1 = R + j\left(X + \frac{\omega L}{Z_0}\right)$$

Efectul unui inductor serie → deplasare pe cercul de rezistență constantă în sensul acelor de ceasornic („clockwise").

Ex: $z_L = 1 - 2j$; $f = 1\,GHz$; $L = ?$ pentru ca z_L să fie adaptată

($Z_0 = 50\,\Omega$)

$$z_1 = 1 + j\left(-2 + \frac{\omega L}{Z_0}\right) = 1$$

adaptare („matching") → $\mathrm{Im}\{z_1\} = 0$

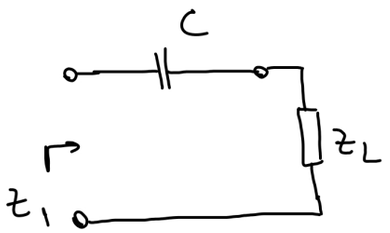
$$-2 + \frac{\omega L}{Z_0} = 0 \Rightarrow \frac{\omega L}{Z_0} = 2$$

$$L = \frac{2Z_0}{\omega} = \frac{2\times 50}{2\pi\times 10^9} = \frac{50}{\pi}\times 10^{-9}\ H$$

$$L = 15.92\ nH$$

Efectul unei capacități serie:

$$z_C = -\frac{j}{\omega C} \Rightarrow z_C = -\frac{j}{\omega C z_0}$$



$z_L = R + jX$

$z_C = -\frac{j}{\omega C z_0}$

$$z_1 = z_L + z_C = R + jX - \frac{j}{\omega C z_0}$$

$$z_1 = R + j\left(X - \frac{1}{\omega C z_0}\right)$$

Efectul unei capacități serie → deplasare pe cercurile de rezistență constantă în inversul sensului acelor de ceasornic (counterclockwise).

Exemplu: $z_L = 0.3 + j$; $f = 500\ MHz$; $C = ?$ pentru ca $z_L = 0.3$. (z_L adaptat)

$$z_1 = z_L + z_C = 0.3 + j\left(1 - \frac{1}{\omega C z_0}\right)$$

z_L adaptat $\Rightarrow 1 - \frac{1}{\omega C z_0} = 0$

$$\frac{1}{\omega C z_0} = 1$$

$$\omega C z_0 = 1$$

$$C = \frac{1}{\omega z_0} = \frac{1}{2\pi \times 50 \times 500 \times 10^6} =$$

$$= \frac{1}{2\pi \times 25 \times 10^9} = \frac{1}{50\pi} \times 10^{-9}$$

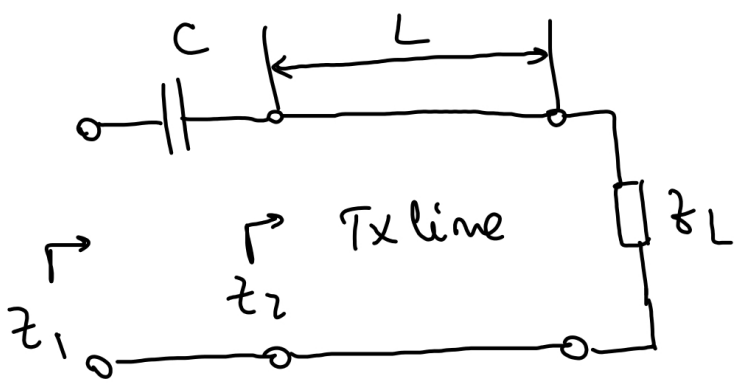
$$C = 0.0064 \times 10^{-9} = 6.4 \times 10^{-12}\ F =$$

$$= 6.4\ pF.$$

Cum putem să adaptăm z_L astfel încât $z_1 = 1$

Soluția: adaptare cu linie de transmisie + C serie
("Tx line")

Linie de transmisie → deplasare pe cercul $|\Gamma| = \text{const}$.
("towards generator")



Din diagrama Smith

$L = 0.064\lambda$

$z_2 = 1 + 2.2j$

$$z_1 = 1 + j\left(2.2 - \frac{1}{\omega C z_0}\right)$$

$$2.2 - \frac{1}{\omega C z_0} = 0$$

$$\frac{1}{\omega C z_0} = 2.2$$

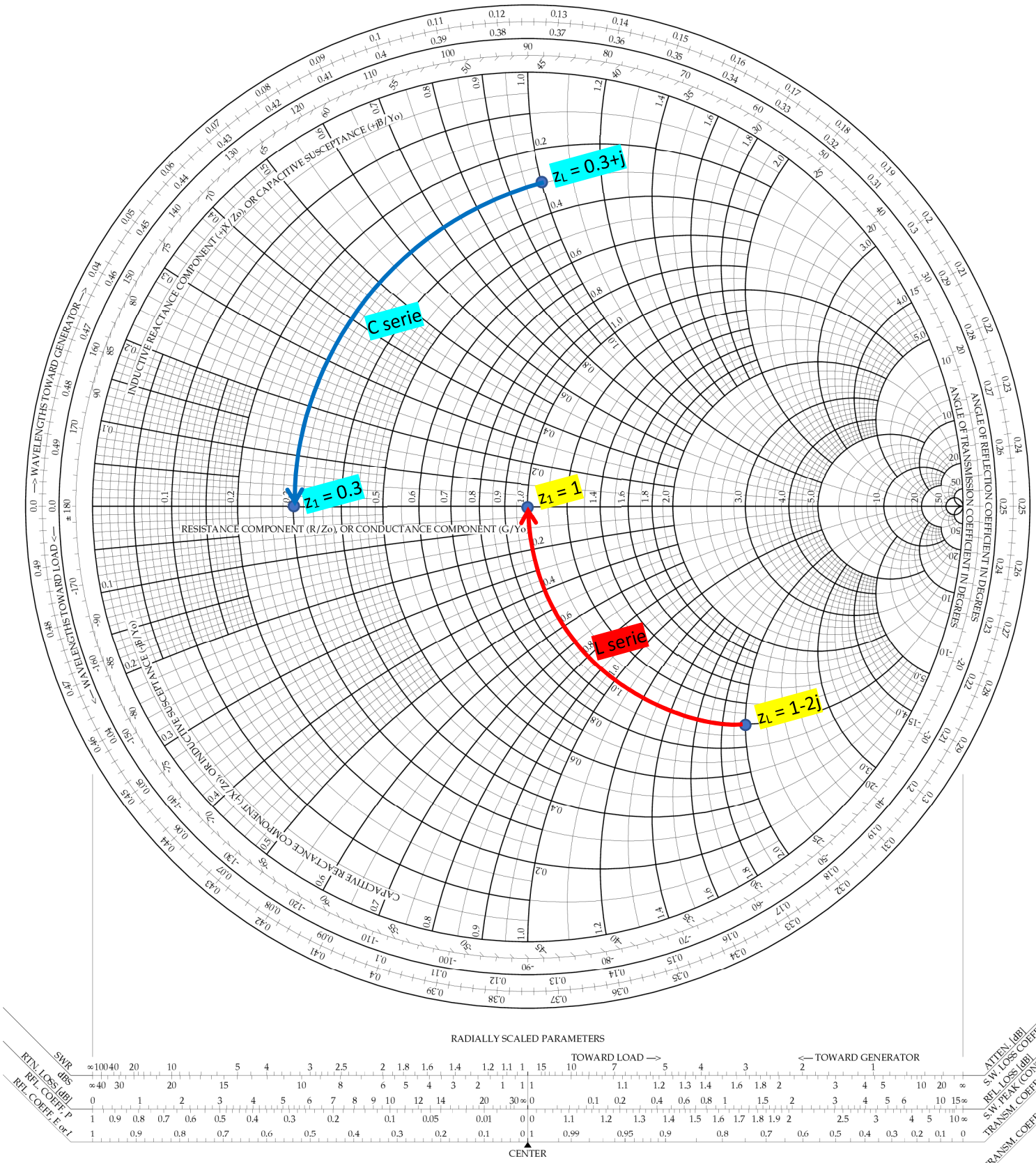
$$\frac{1}{C} = 2.2\,\omega z_0 \Rightarrow C = \frac{1}{2.2\omega z_0}$$

$$C = \frac{1}{2.2 \times 2\pi \cdot 500 \times 10^6 \times 50} = \frac{1}{4.4\pi \times 25} \times 10^{-9} =$$

$= 2.9\ pF.$

The Complete Smith Chart

Black Magic Design



The Complete Smith Chart

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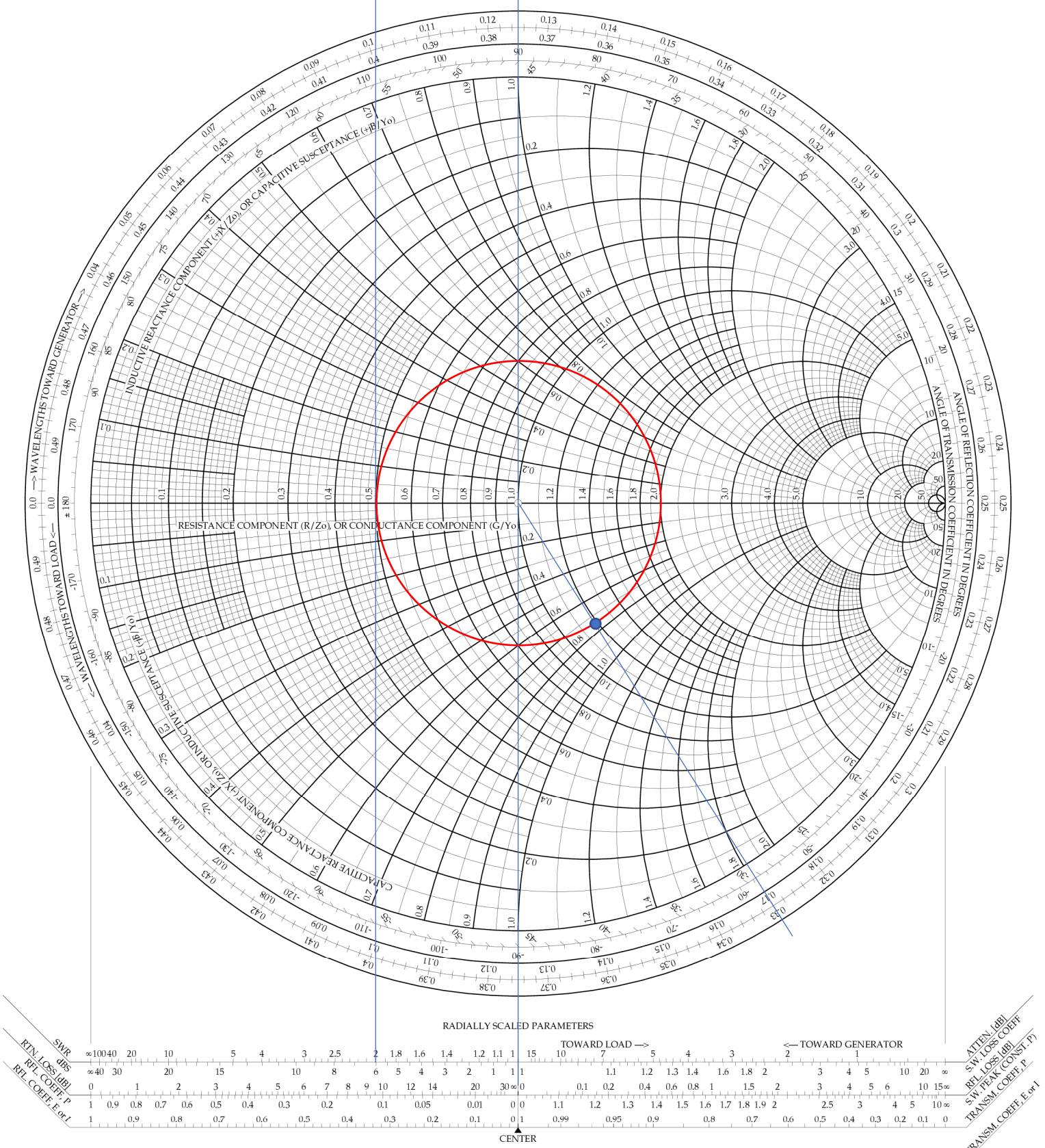

The Complete Smith Chart

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