MATCHING NETWORKS

1) QUARTER -WAVE TRANSFORMER

When your load is REAL (R_L) you can always transform this load to ANY OTHER REAL load (i.e. Z_0) using a QUARTER-WAVE TRANSFORMER of characteristic impedance Z_1 where:

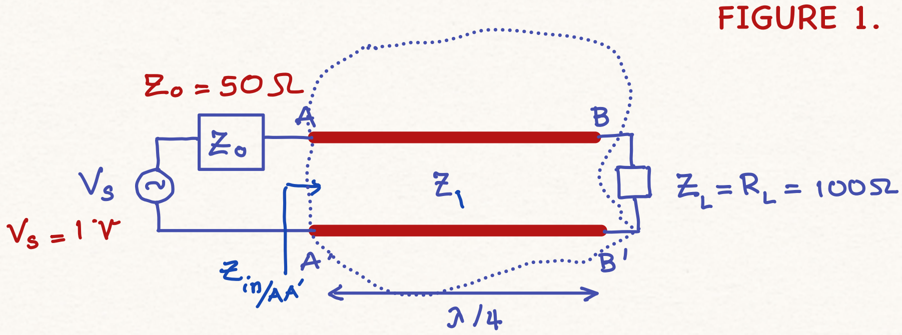
$$\boxed{Z_1 = \sqrt{Z_0 \cdot R_L}}$$

(1A)

SOLUTION

MATCHING NETWORK

FIGURE 1.



To match the load to the source we have to make

$$\boxed{Z_{in/AA'} = Z_0 = 50\Omega}$$

As a result we use:

$\Rightarrow$

$$\ell = \lambda/4$$

$$Z_1 = \sqrt{Z_{in/AA'} \cdot R_L} = \sqrt{50 \times 100} \Rightarrow$$

$$\boxed{Z_1 = 70.7\,\Omega}$$

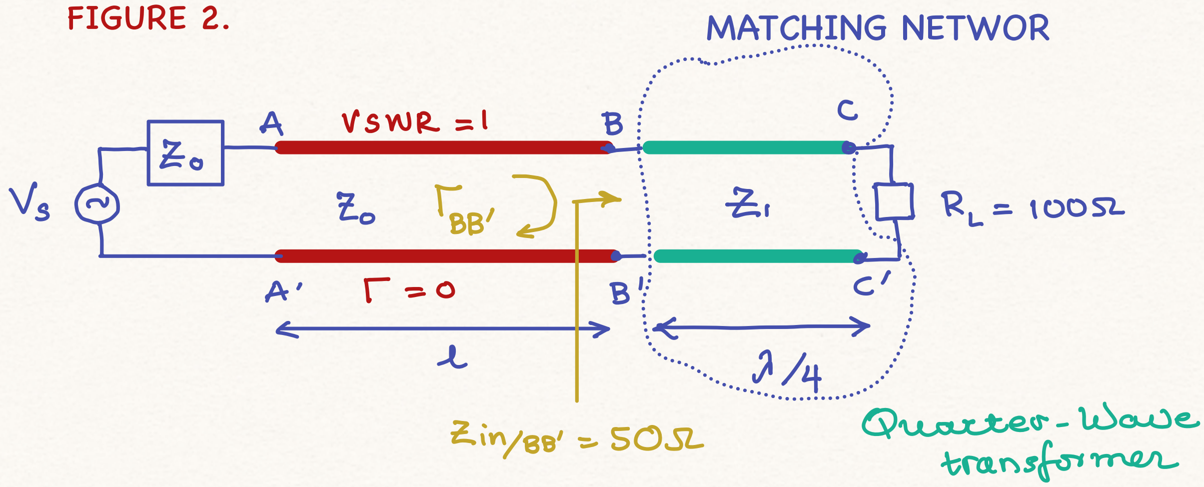
$$\ell = \lambda/4$$

(1B) if Z_1 above $= Z_0$ then you add a transformer between BB' and load

SOLUTION

To match R_L to Z_0 we need a matching network between R_L and BB' as shown below:

FIGURE 2.



where $\boxed{Z_1 = \sqrt{R_L \cdot Z_0}}$

With this network in place:

$$Z_{in/BB'} = Z_0 \quad \text{and} \quad \Gamma_{BB'} = \frac{Z_{in/BB'} - Z_0}{Z_{in/BB'} + Z_0} = 0$$

As a result the reflection coefficient at any point of the T.L. AA'–BB' is zero $\Rightarrow$ VSWR $= 0$

2) SERIES STUB

You can match any complex impedance on a transmission line with a series stub

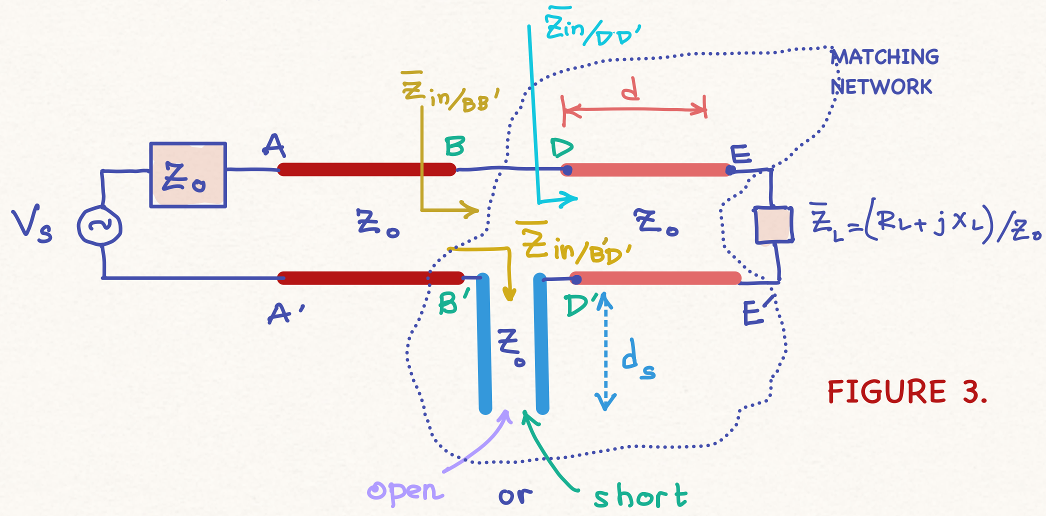


FIGURE 3.

Example :

Assume $\boxed{Z_L = (80 - j20)\Omega}$, $\boxed{Z_o = 50\Omega}$

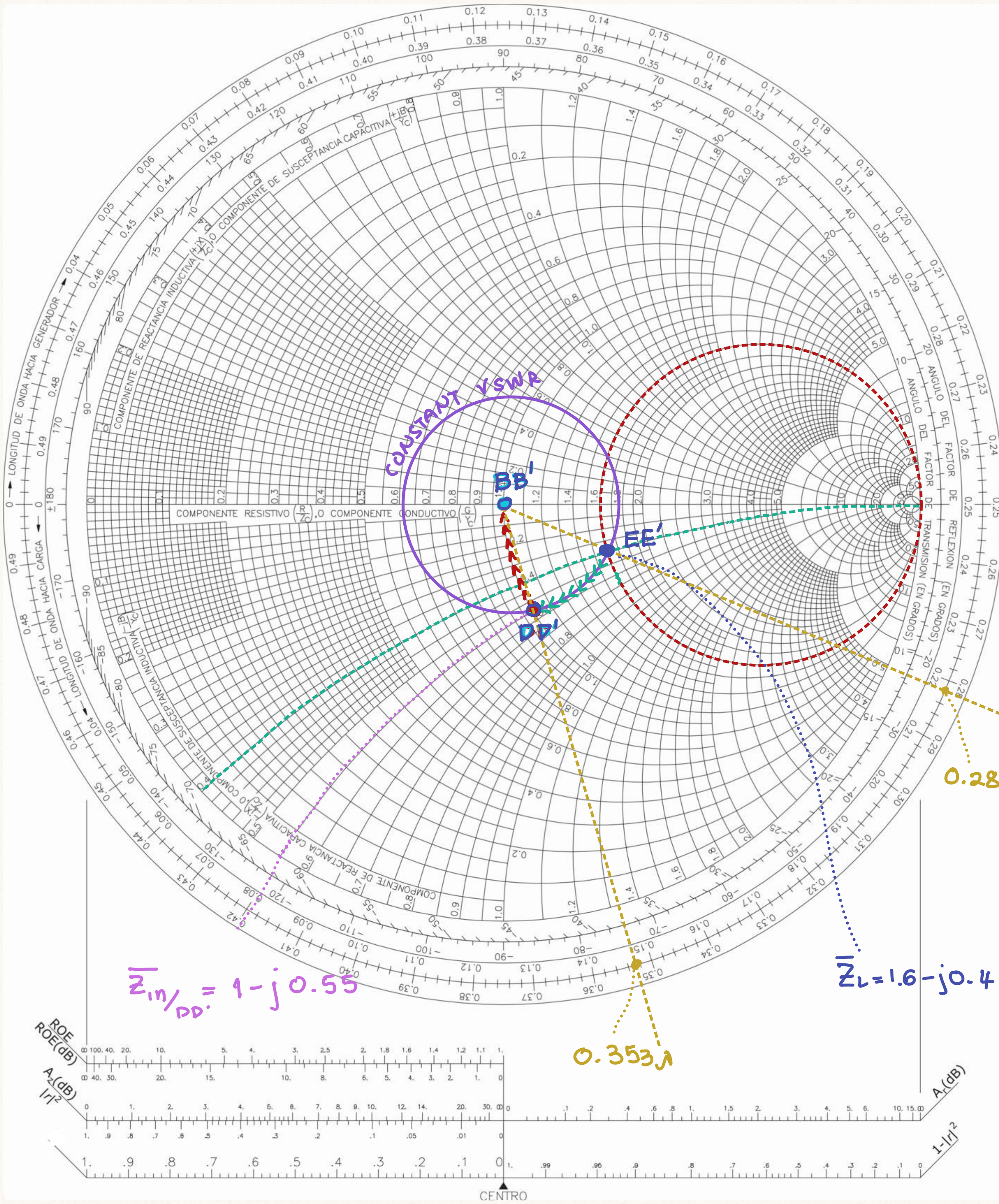
Find d and d_s so that the input impedance at BB' $\Rightarrow$ $Z_{in/BB'} = Z_o$

> To Solve this problem we need to use the Smith we need to use the Smith Chart.

To use the Smith Chart we need to normalize the load with respect to the characteristic impedance of the line Z_o.

$$\bar{Z}_L = \frac{Z_L}{Z_o} = \frac{80 - j20}{50} = 1.6 - j0.4$$

$$\boxed{\bar{Z}_L = 1.6 - j0.4}$$



Distance between EE' and DD':

$$d = 0.353\lambda - 0.282\lambda = 0.071\lambda \qquad \boxed{d = 0.071\lambda}$$

Figure 3 then becomes:

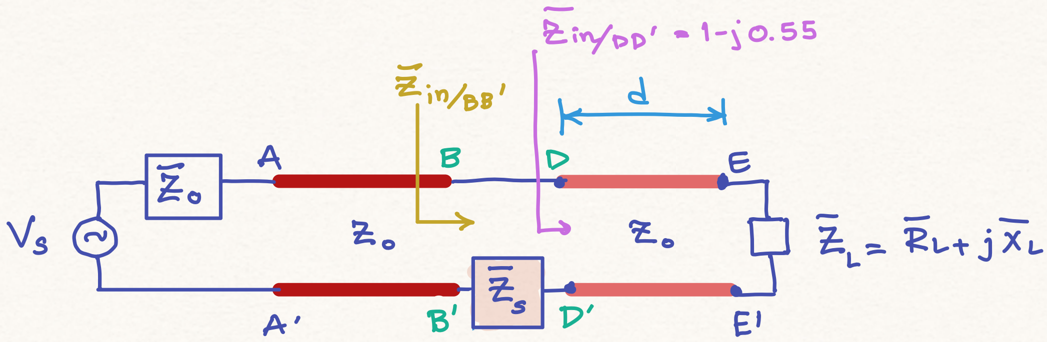


FIGURE 4

where $\bar{Z}_s = \bar{Z}_{in/B'D'} = j0.55$

As a result: $\bar{Z}_{in/BB'} = \bar{Z}_{in/DD'} + \bar{Z}_{s/B'D'}$

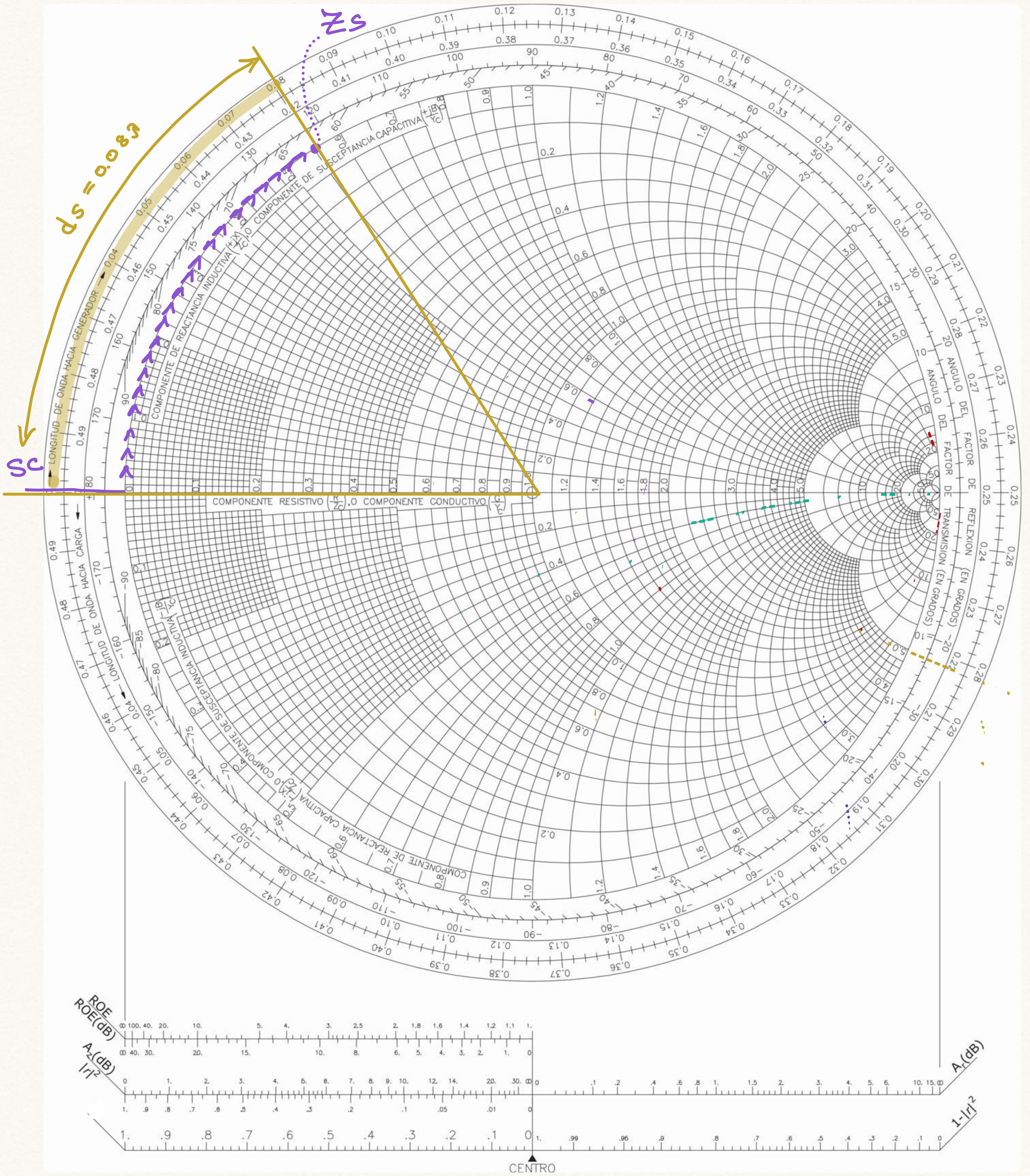
$$= 1$$

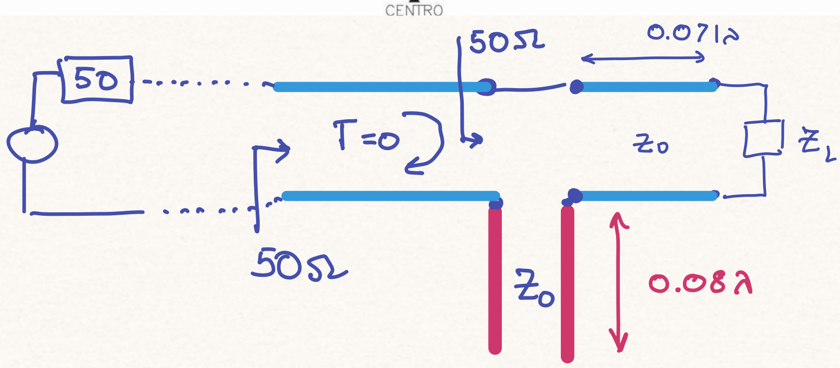
To find the lenth of the stub and its termination we go back to the Smith Chart.

At first we find the stub impedance

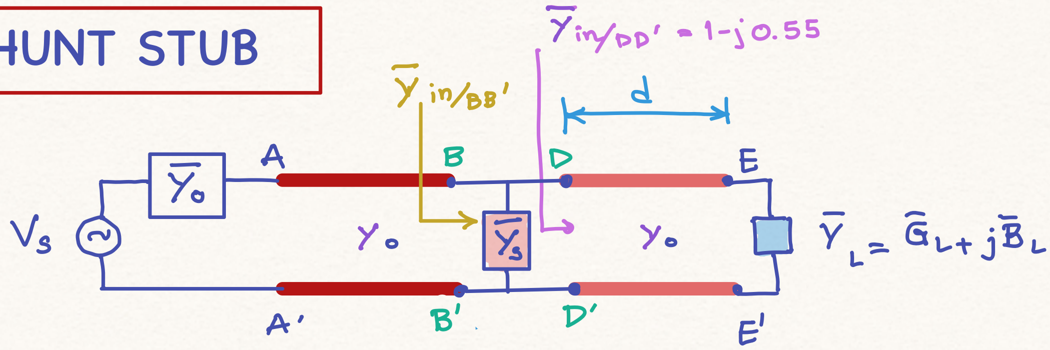
$$\bar{Z}_s = j\,0.55$$

From the S.C. we conclude that a SHORT-CIRCUITED stub of length $d_s = 0.08\lambda$ can match the line at DD' to $\boxed{50\Omega = Z_o}$

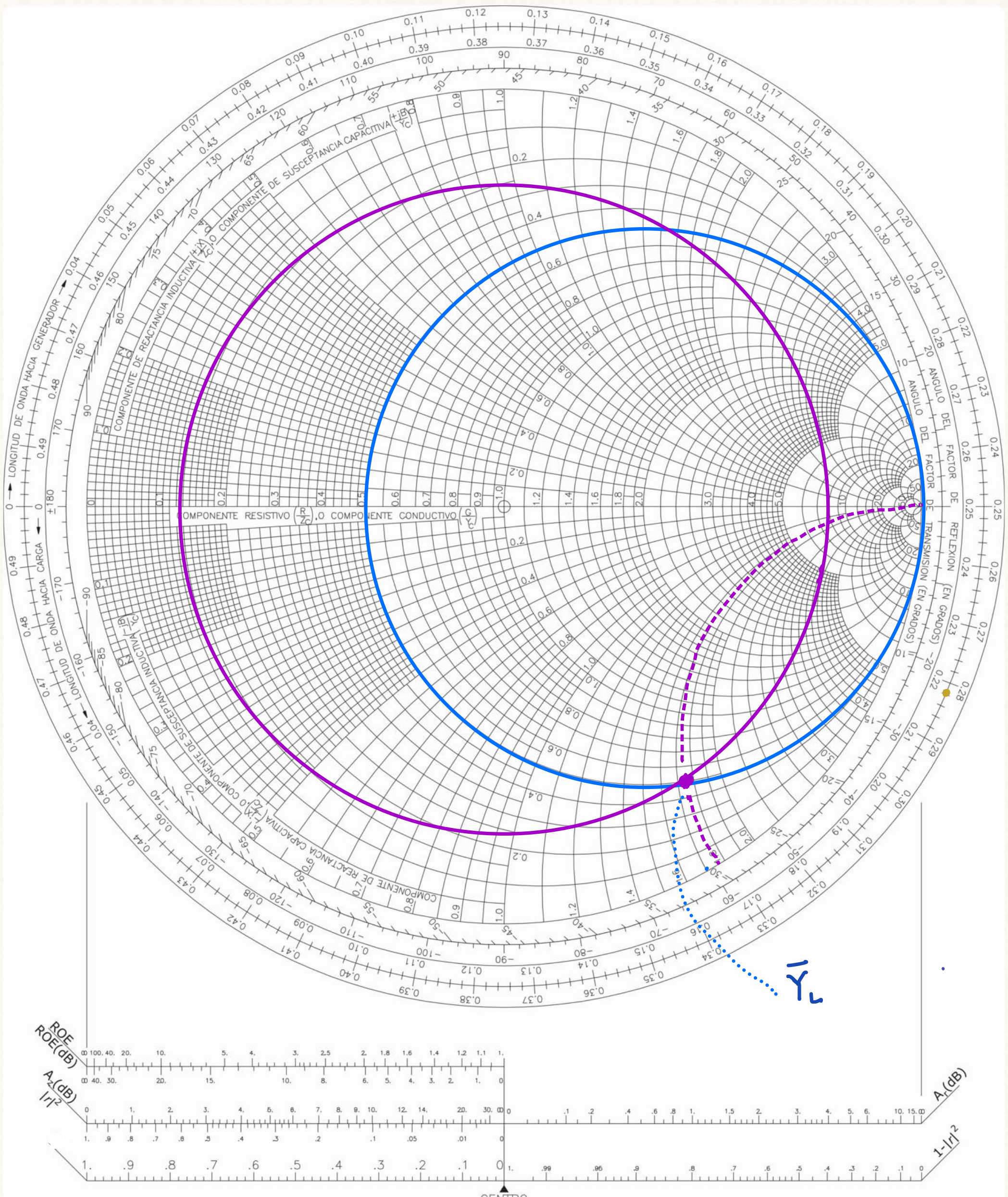

Zs
ds = 0.08λ
SC
LONGITUD DE ONDA HACIA GENERADOR
LONGITUD DE ONDA HACIA CARGA
COMPONENTE DE REACTANCIA INDUCTIVA
COMPONENTE DE SUSCEPTANCIA CAPACITIVA
COMPONENTE DE SUSCEPTANCIA INDUCTIVA
COMPONENTE DE REACTANCIA CAPACITIVA
COMPONENTE RESISTIVO
COMPONENTE CONDUCTIVO
ANGULO DEL FACTOR DE REFLEXION (EN GRADOS)
ANGULO DEL FACTOR DE TRANSMISION (EN GRADOS)
ROE
ROE(dB)
CENTRO


50
50Ω
0.071λ
T=0
Z0
ZL
50Ω
Z0
0.08λ

3) SHUNT STUB



$\bar{Y}_{in/DD'} = 1 - j0.55$
$\bar{Y}_{in/BB'}$
d
A
B
D
E
V_s
$\bar{Y}_0$
Y_0
$\bar{Y}_s$
Y_0
$\bar{Y}_L = \bar{G}_L + j\bar{B}_L$
A'
B'
D'
E'



$\bar{Y}_L$
COMPONENTE RESISTIVO
COMPONENTE CONDUCTIVO
LONGITUD DE ONDA HACIA GENERADOR
LONGITUD DE ONDA HACIA CARGA
ANGULO DEL FACTOR DE REFLEXION (EN GRADOS)
ANGULO DEL FACTOR DE TRANSMISION (EN GRADOS)
ROE
ROE(dB)
CENTRO

Assume that $\boxed{Y_L = (0.01 - j\,0.035)\,\Omega^{-1}}$

and $Y_0 = \frac{1}{Z_0} = \frac{1}{50}\,\Omega^{-1} \Rightarrow Y_0 = 0.02\,\Omega^{-1}$

We normalize Y_L and $\boxed{\overline{Y}_L = (0.5 - j1.75)}$