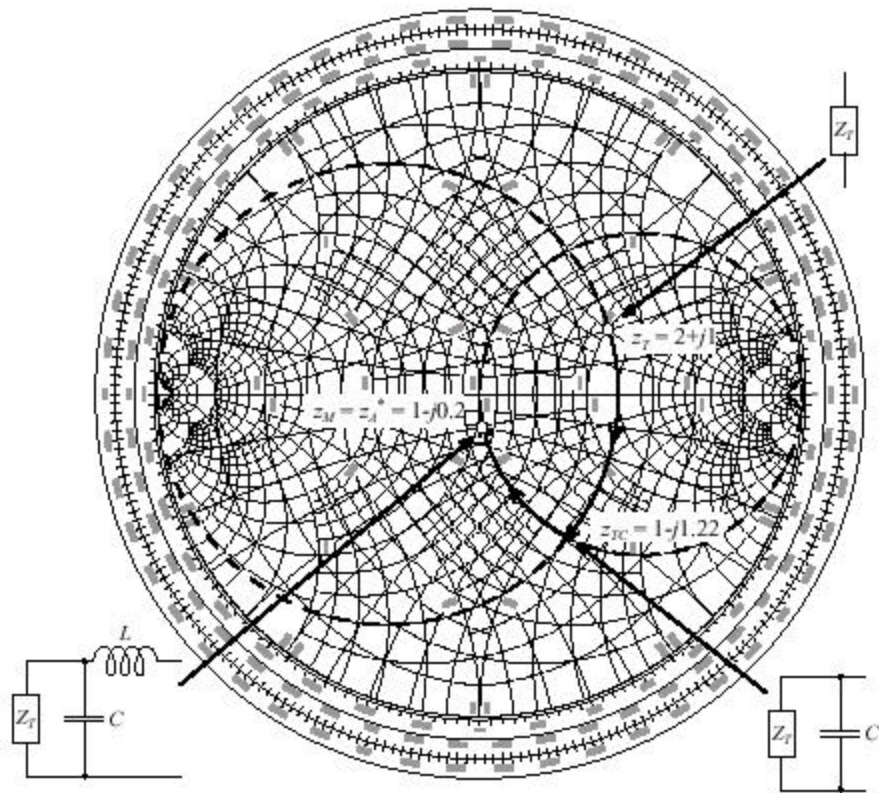


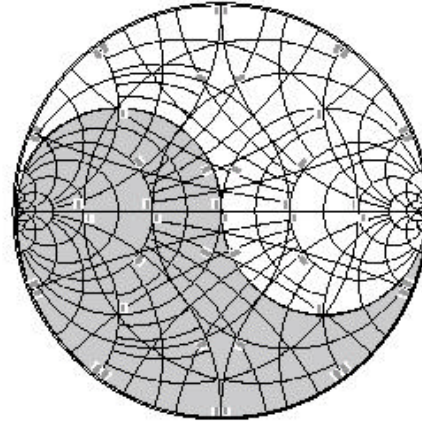
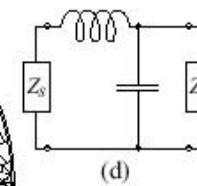
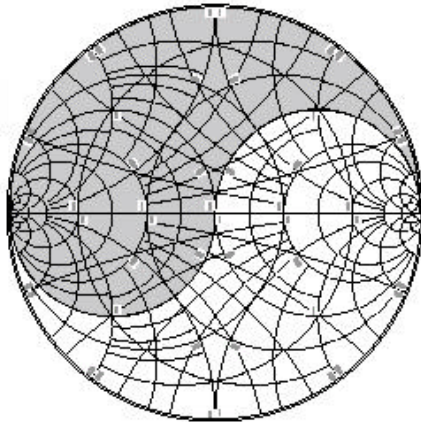
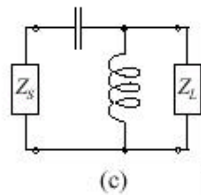
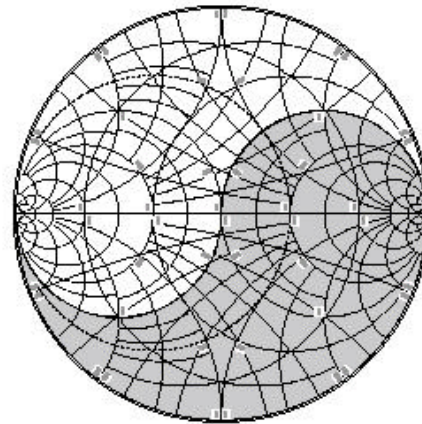
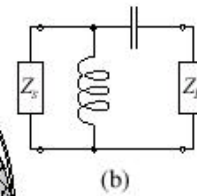
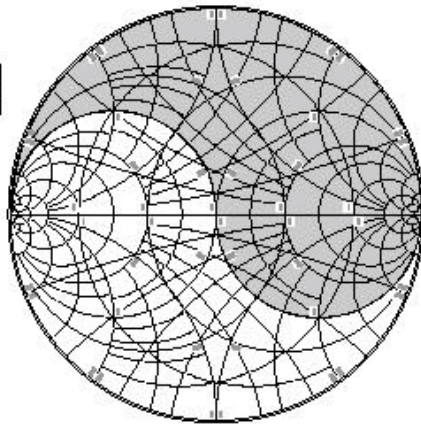
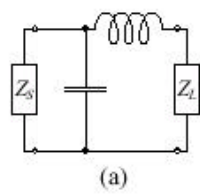
# General 2 Element Approach

Source impedance  
transformation to  
conj. comp. load

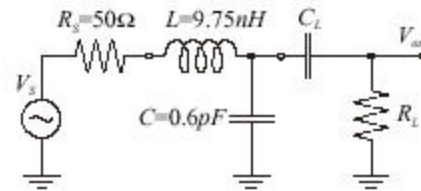
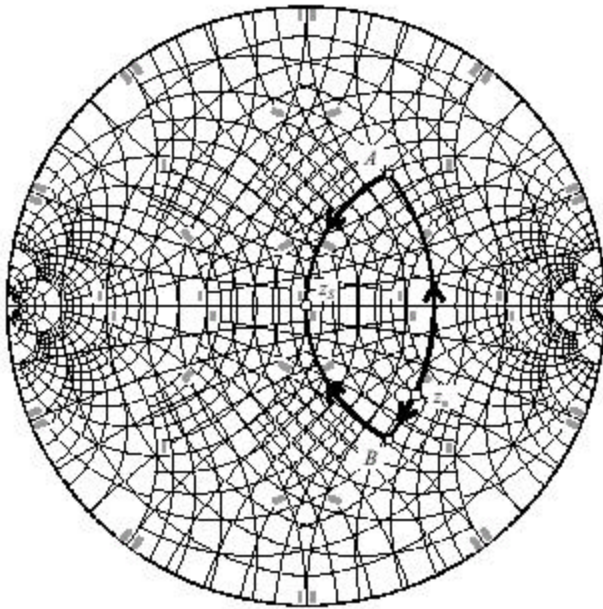


# Load Impedance To Complex Conjugate

$$\text{Source } Z_s = Z_s^* = 50 \, \Omega$$

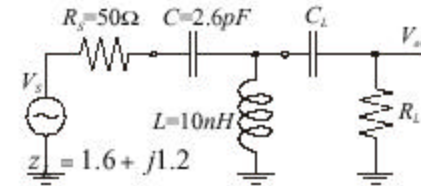


# Art of Designing Matching Networks

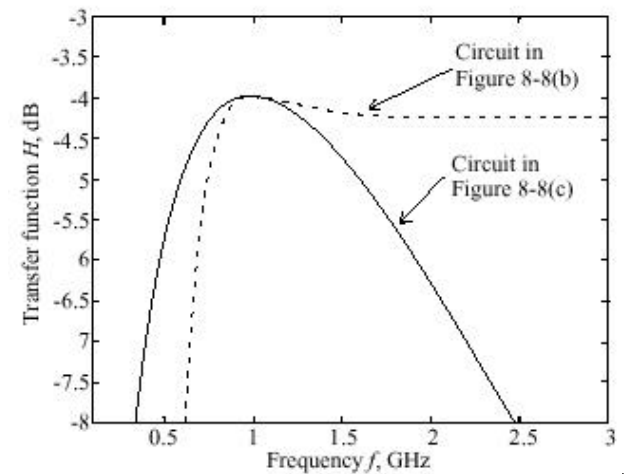
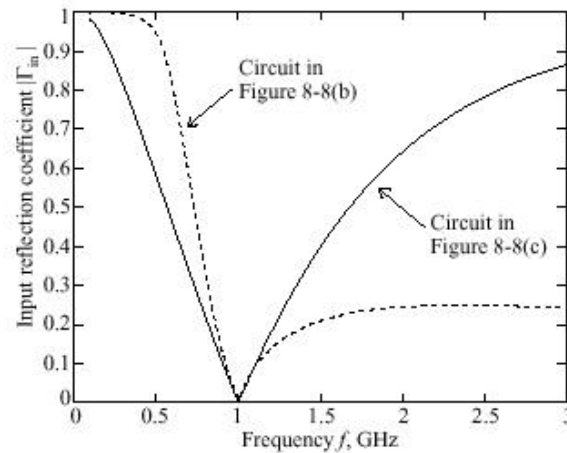


(b)

$$z_L = 1.6 + j1.2$$



(c)



# More Complicated Networks

- Three-element Pi and T networks permit the matching of almost any load conditions
- Added element has the advantage of more flexibility in the design process (fine tuning)
- Provides quality factor design (see Ex. 8.4)

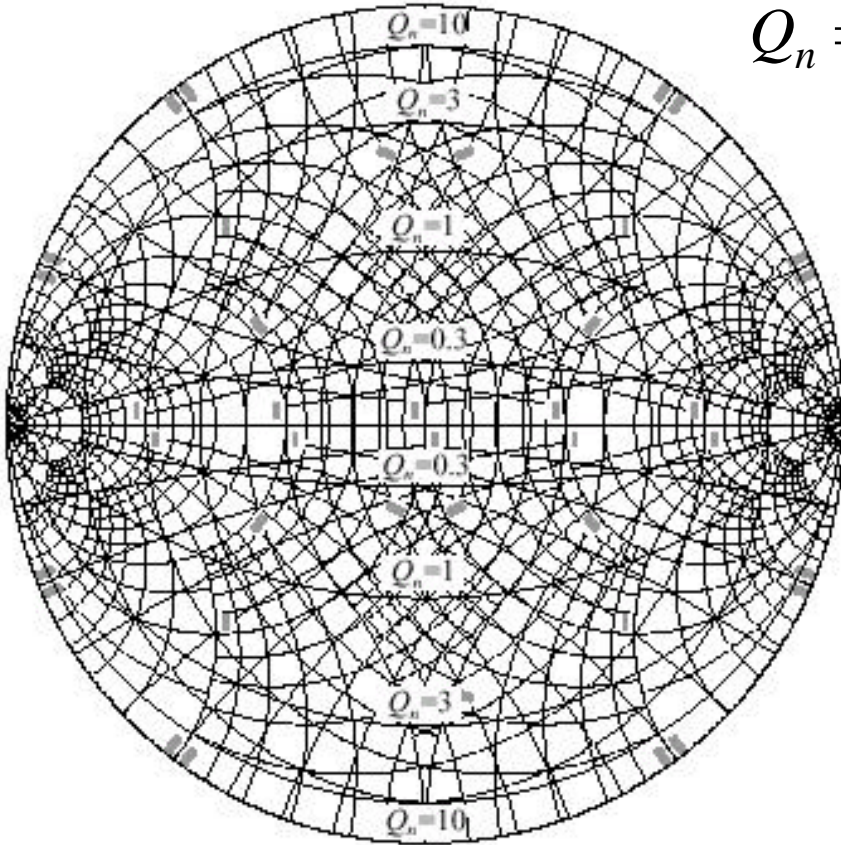
# Quality Factor

- Resonance effect has implications on design of matching network.
- Loaded Quality Factor:  $Q_L = f_o/BW$
- If we know the Quality Factor  $Q$ , then we can find BW
- Estimate  $Q$  of matching network using Nodal Quality Factor  $Q_n$
- At each circuit node can find  $Q_n = |X_s|/R_s$  or  $Q_n = |B_p|/G_p$  and
- $Q_L = Q_n/2$  true for any L-type Matching Network

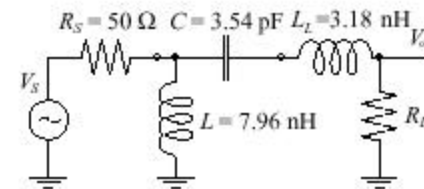
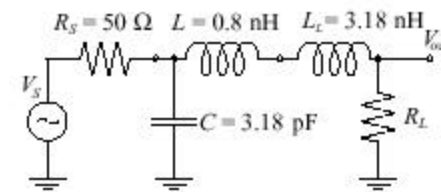
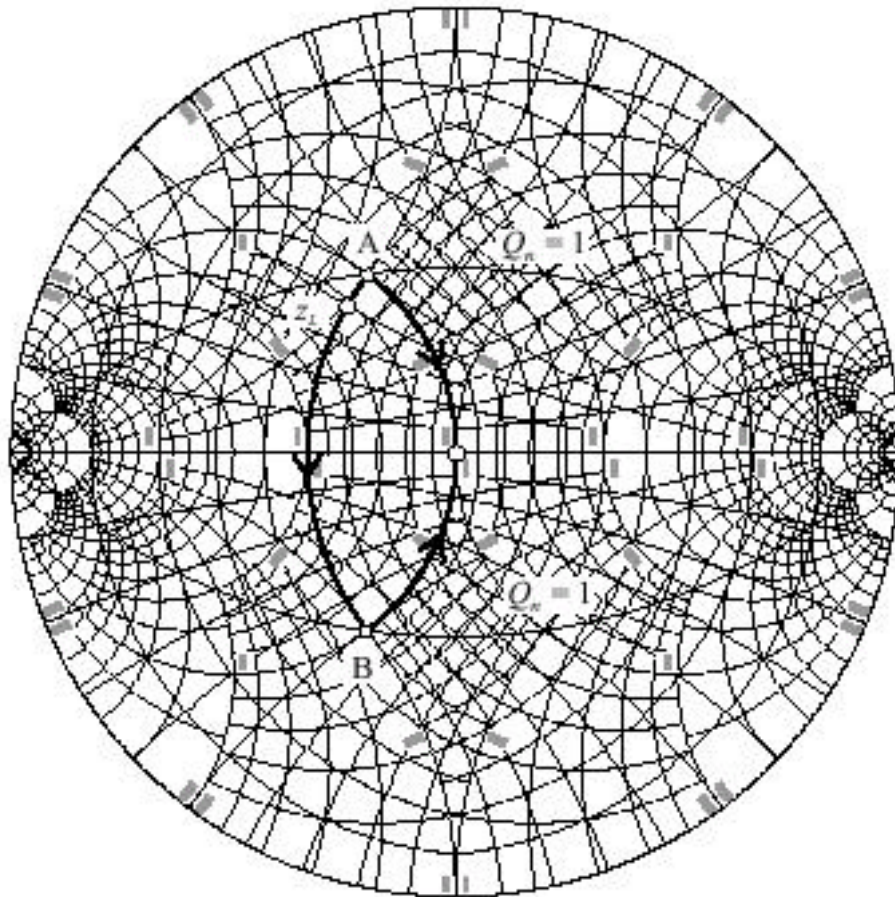


# Nodal Quality Factors

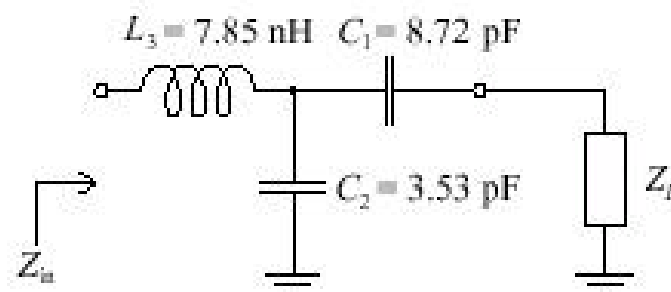
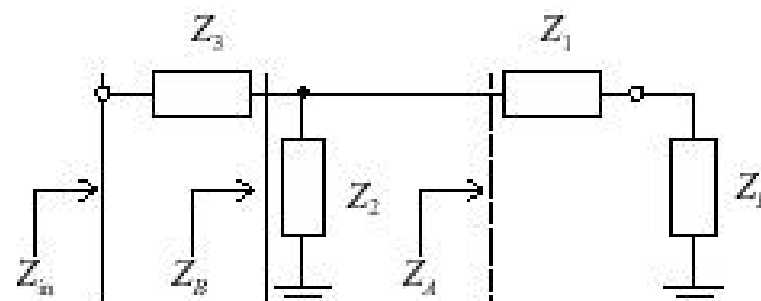
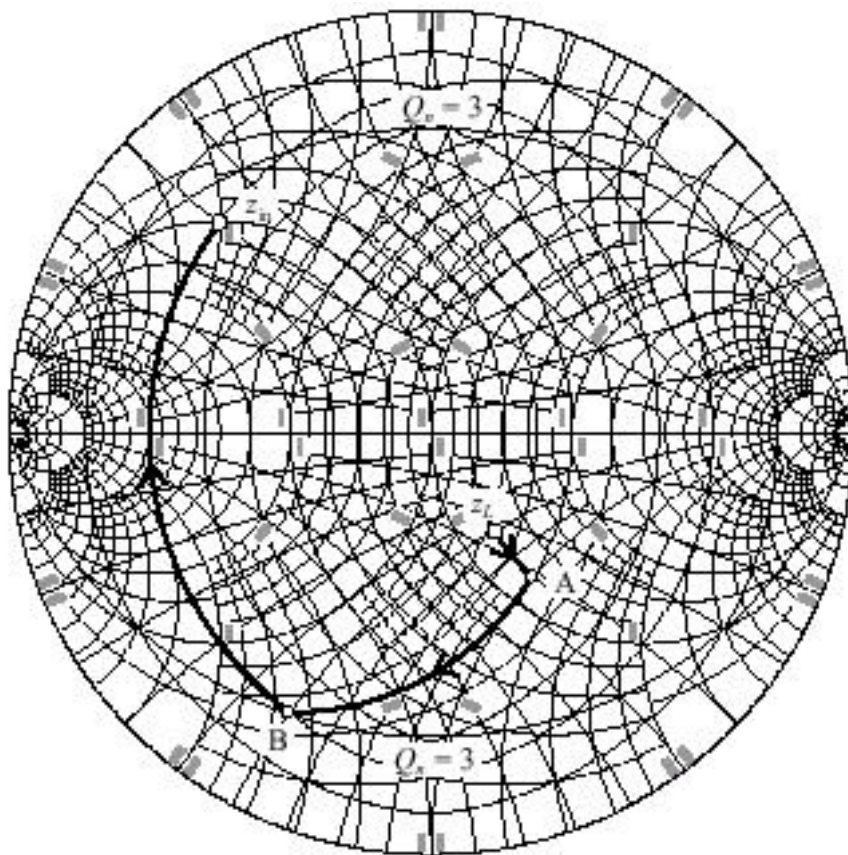
$$Q_n = |x|/r = 2|\Gamma_i| / [(1 - \Gamma_r)^2 + \Gamma_i^2]$$



# Matching Network Design Using Quality Factor

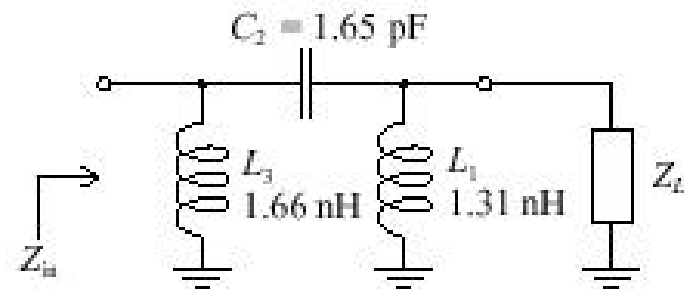
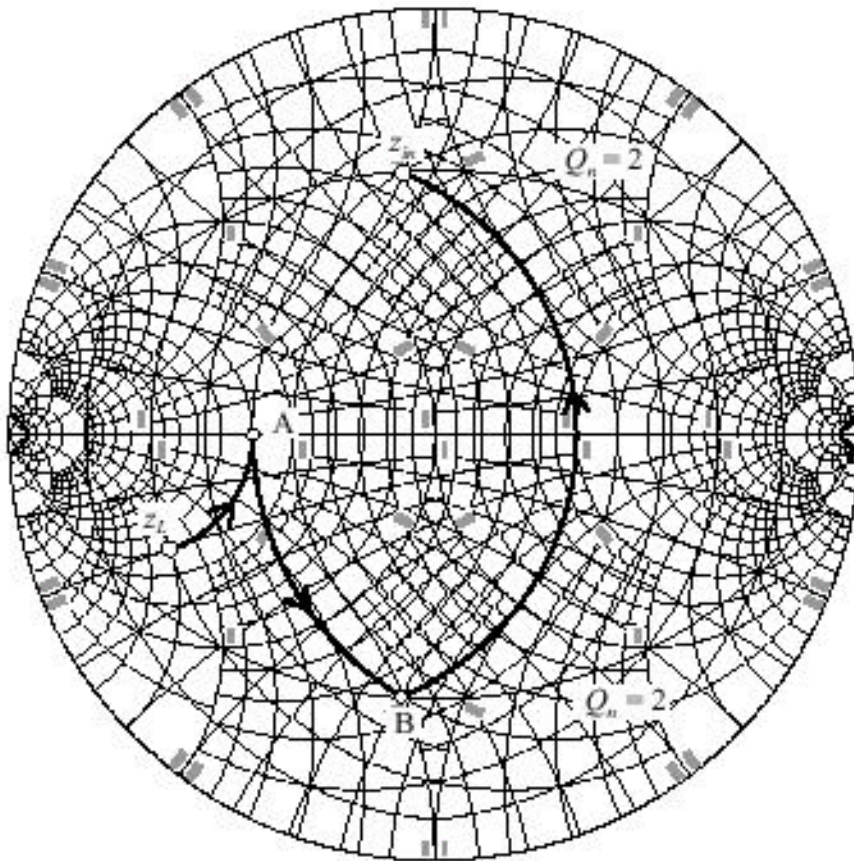


# T-Type Matching Networks



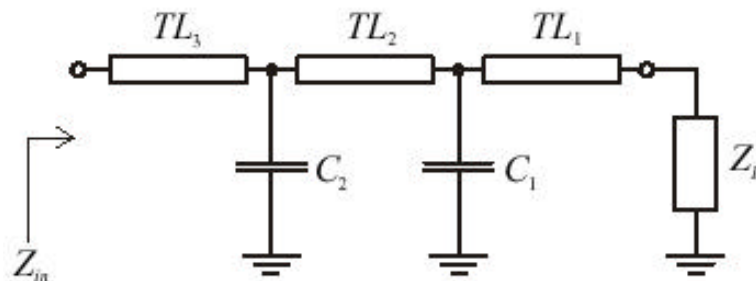


# Pi-Type Matching Network

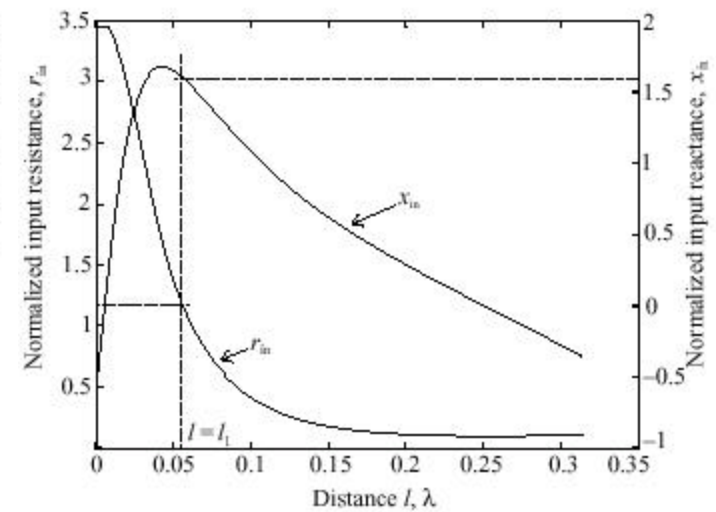
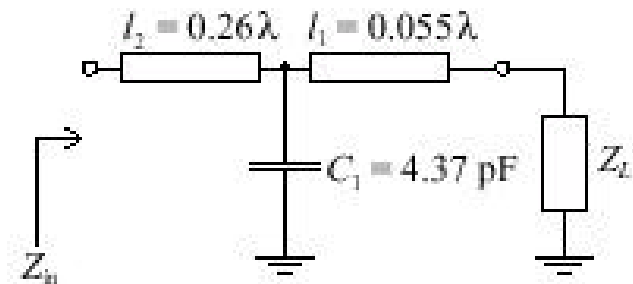
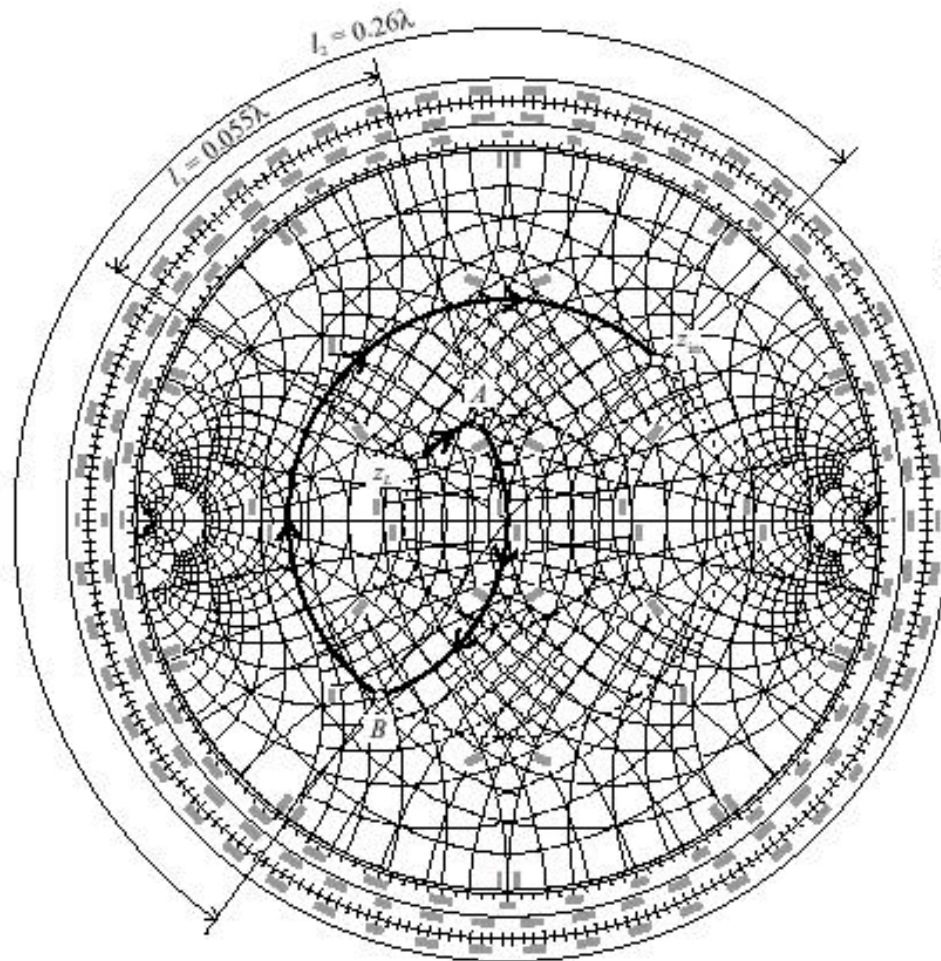


# Microstripline Matching Network

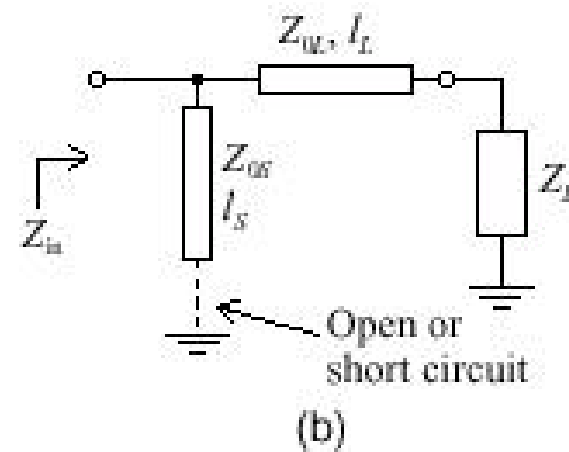
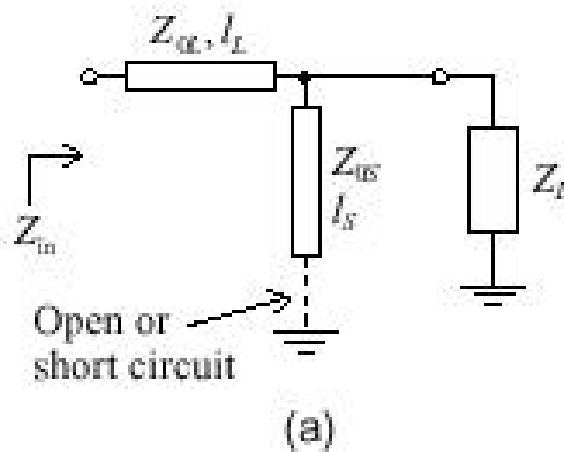
- Distributed microstrip lines and lumped capacitors
- less susceptible to parasitics
- easy to tune
- efficient PCB implementation
- small size for high frequency



# Microstripline Matching Design



# Two Topologies for Single-Stub Tuners



## Balanced Stubs

- Unbalanced stubs often replaced by balanced stubs

$$l_{SB} = \frac{l}{2p} \tan^{-1} \left( 2 \tan \frac{2pl_s}{l} \right) \quad l_{SB} = \frac{l}{2p} \tan^{-1} \left( \frac{1}{2} \tan \frac{2pl_s}{l} \right)$$

Open-Circuit Stub

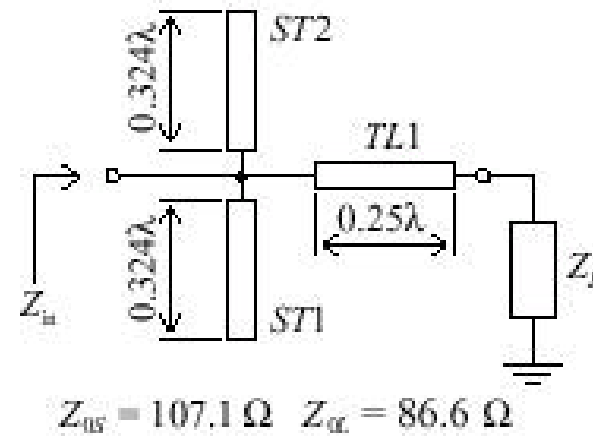
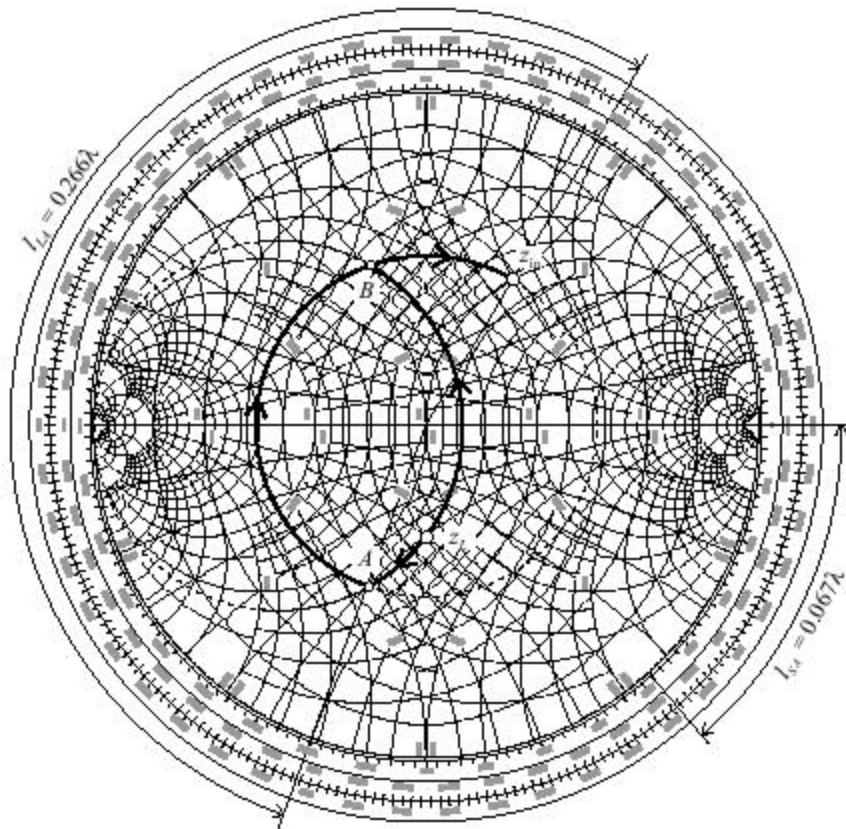
Short-Circuit Stub

$l_s$  is the unbalance stub length and  $l_{SB}$  is the balanced stub length.

Balanced lengths can also be found graphically using the Smith Chart



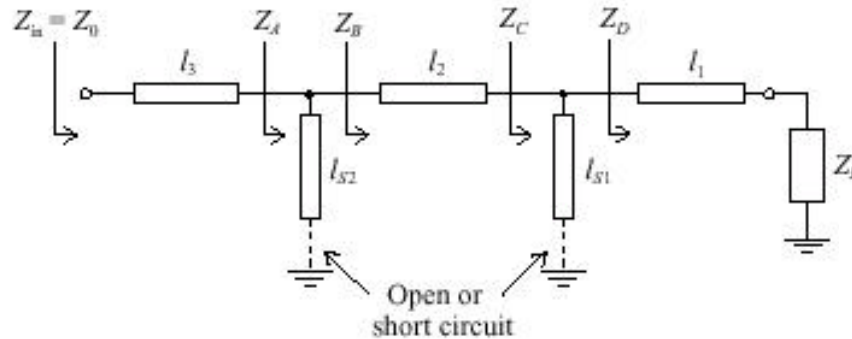
# Balanced Stub Example



Balanced Stub Circuit

Single Stub Smith Chart

# Double Stub Tuners



- Forbidden region where  $y_D$  is inside  $g = 2$  circle

