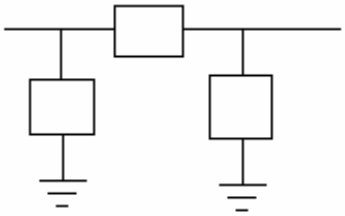
ECE 6130 Pi-Matching Networks

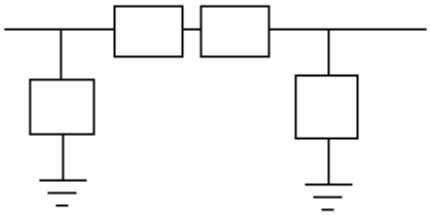
Portfolio Question: How do you design a pi-matching network.

Reference: Bowick, RF Circuits, pp. 70-71

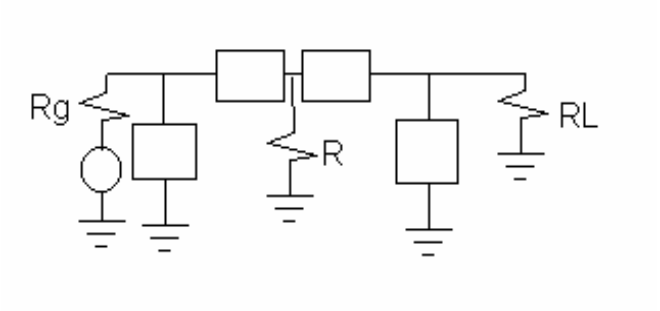
The basic Pi-Network is shown below:



This network will be NARROWER BAND than the L-network (will have a higher Q), and the Q will be adjustable.
This is designed as a set of Two L-Matching Networks:



An artificial impedance R is placed between them.
R< Rg,RL
Choice of R defines Q.

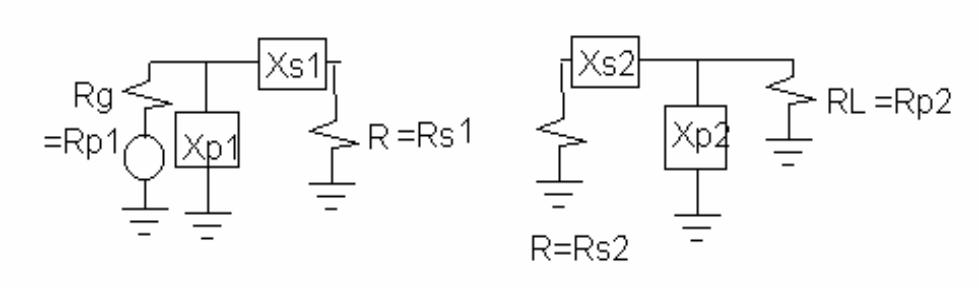


$$Q = \sqrt{\frac{\max(Rg, RL)}{R} - 1}$$

OR

$$R = \frac{\max(Rg, RL)}{Q^2 + 1}$$

Now we design the TWO L-Networks:



First find R:
Use same example as for single L-network:
RL = 100 ohms, Rg = 50 ohms
Define Q = 15 (given)

Then: R = max (100,500 / (15^2 +1) = 0.44 ohms

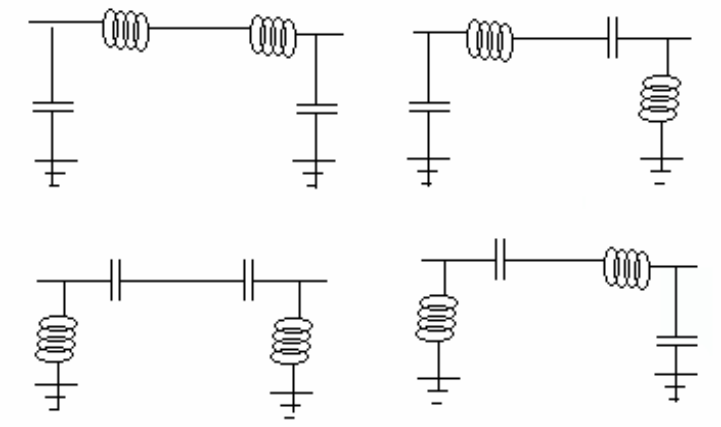
Now design Network 2:
Xp2 = Rp2/Q = 100 / 15 = 6.67 ohms
Xs2 = Q Rs2 = (15) (0.44) = 6.6 ohms

Next design Network 1:
Q1 = sqrt (Rp1/Rs1 -1) = sqrt (50 / 0.44 -1) = 10.6
Xp1 = Rp1/Q1 = 50 / 10.6 = 4.72 ohms
Xs1 = Q1 Rs1 = (10.6) (0.44) = 4.664 ohms

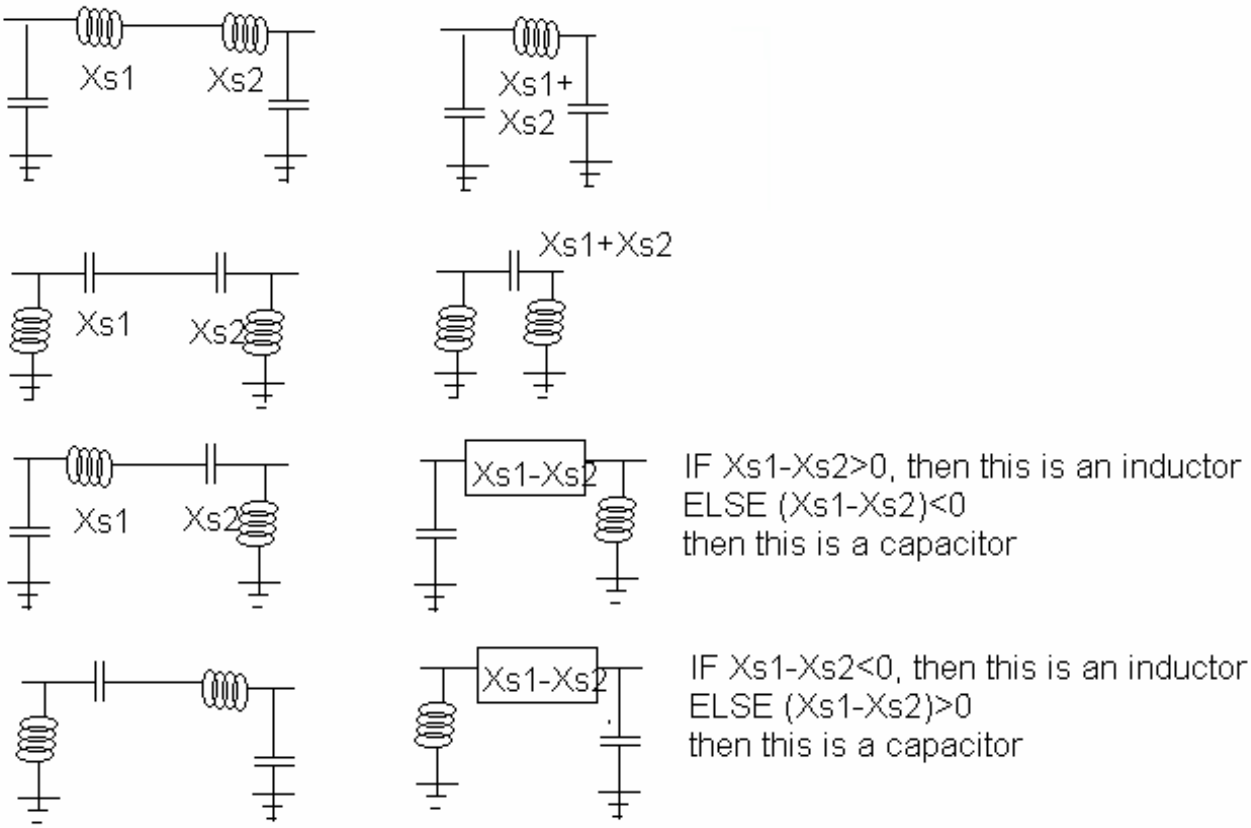
Now define elements to be used in the design:
Xs1,Xp1 must be opposite types
Xs2,Xp2 must be opposite types

Remember X_capacitor = 1/ ωC
X_inductor = ωL

This gives four choices:



The series elements can be combined:



What if the Load has an imaginary part?

Either ABSORB it into the matching network

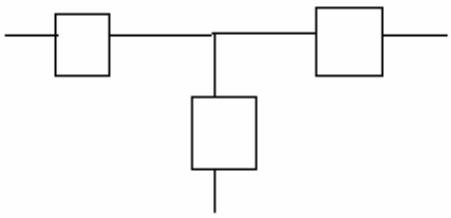
If the imaginary part of the load is smaller than the associated value of the matching network, Use the imaginary part of the load as PART of the matching X.

OR Resonate it

Choose ω = sqrt(LC) to define L or C.

ADD this value of L or C to the matching network to determine the necessary value of installed component.

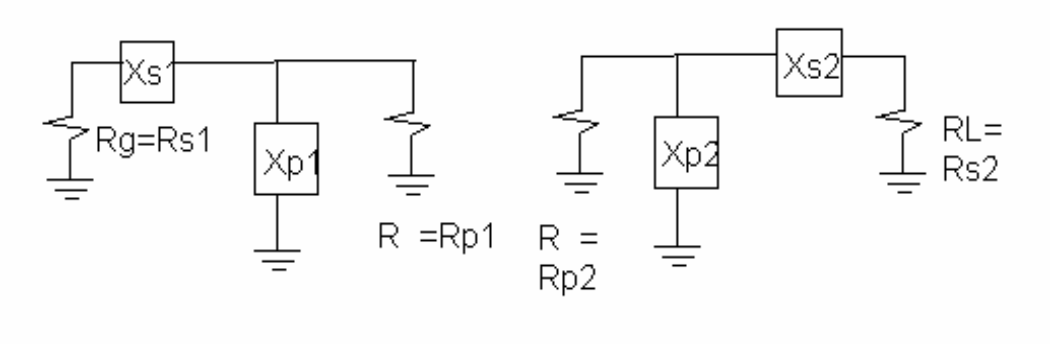
The T-Network:



Design is the same as for the Pi-network, except the artificial impedance at the center of the arms(R) will be less than either Rg or RL:

$$Q = \sqrt{\frac{R}{\min(Rg, RL)} - 1}$$

Then design two L-networks:



Note different placement of Xs and Xp than before.

After the Xs1,Xp1,Xs2,Xp2 have been defined,
Remove R (it was artificial anyway), combine Xp1 and Xp2.
If ZL has an imaginary part, either absorb it into the matching network or resonate it.