RF Engineering
Exercises with Dellsperger Smith

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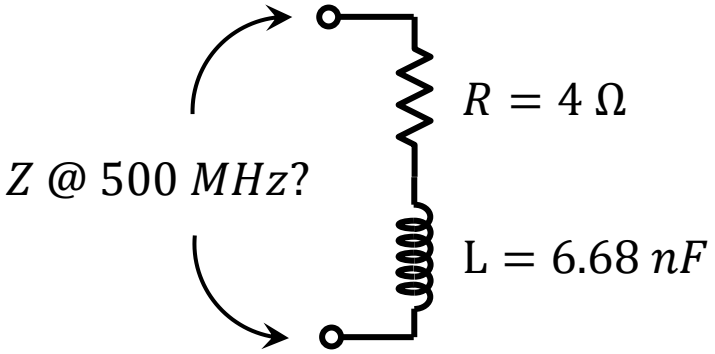
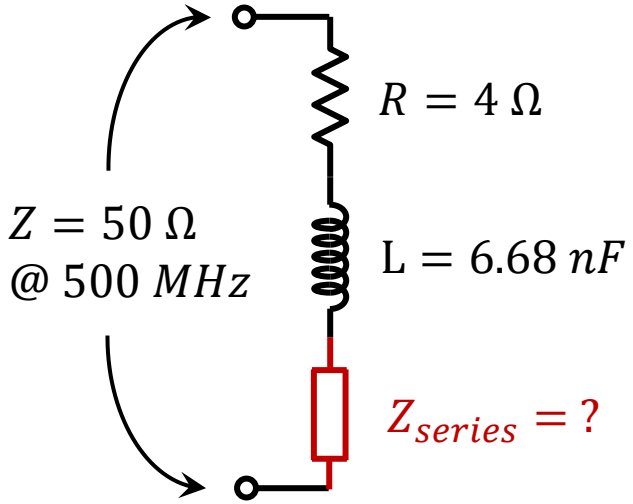
Impedance Matching

- **Example of a simple impedance matching for a single frequency**



$$Z = R + j\omega L = (4 + j21)\ \Omega$$

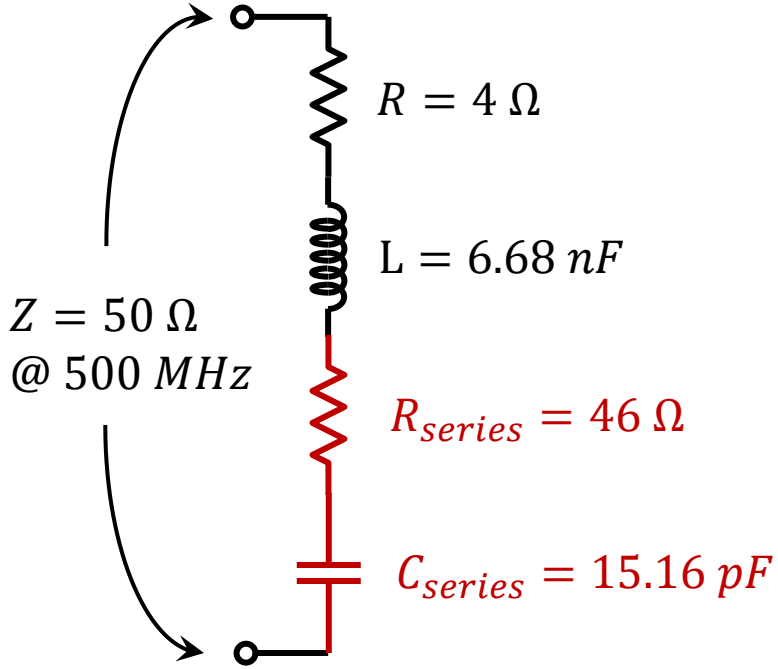


$$Z = R + j\omega L + Z_{series} = 50\ \Omega$$

$$Z_{series} = R_{series} + jX_{series} = 50\ -(4 + j21)\ \Omega$$

$$\Rightarrow\ R_{series} = 46\ \Omega$$

$$X_{series} = 21\ \Omega = \frac{1}{\omega C_{series}}\ \Rightarrow\ C_{series} = 15.16\ pF$$



Matching Network Exercises with “Smith V4.1” (1)

- **Download the freeware tool “Smith V4.1”by *Fritz Dellsperger* from https://www.fritz.dellsperger.net/smith.html**
  - **Requires a MS-Windows compatible computer**

1. **Use R, L and C elements in series to match the impedances at $500\ MHz$ to $Z_0 = 50\ \Omega$. Use only two components for each matching circuit.**
   - **You should enter Z_L as the first data point in the smith chart by clicking on the “Mouse” or “Keyboard” buttons at the top. You may have to switch from “polar” to “cartesian” coordinates. Then design your matching circuit from there.**
   - **You will only need the Z-plane for this exercise; the Y-plane can be turned off in the program “Settings”.**

Z_L	C Series	L Series	R Series
$Z = (50 + j25)\ \Omega$			
$Z = (50 - j25)\ \Omega$			
$Z = (4 + j21)\ \Omega$			
$Z = (20 - j50)\ \Omega$			

Matching Network Exercises with “Smith V4.1” (2)

2. Use R, L and C elements in parallel to match the impedances at $500\ MHz$ to $Z_0 = 50\ \Omega$. Use only two components for each matching circuit.

- **Hint: You will only need the Y-plane for this exercise**
- **Another hint: Make use of “Undo” if something goes wrong or restart the program.**

Z_L	C Shunt	L Shunt	R Shunt
$Z = (50 + j25)\ \Omega$			
$Z = (50 - j25)\ \Omega$			
$Z = (4 + j21)\ \Omega$			
$Z = (20 - j50)\ \Omega$			

Matching Network Exercises with “Smith V4.1” (3)

3. **Match the impedances at $500\ MHz$ to $Z_0 = 50\ \Omega$. Use only two reactive components (in series or parallel) to create a lossless matching circuit.**
   - **Multiple solution are possible!**

Z_L	C Series	L Series	C Shunt	L Shunt
$Z = (32 - j66)\ \Omega$				
$Z = (13 - j9)\ \Omega$				
$Z = (37 + j34)\ \Omega$				
$Z = (78 + j78)\ \Omega$				

4. **The input impedance $Z_L = (17 - j18)\ \Omega$ of an amplifier shall be matched to $Z_0 = 50\ \Omega$ at $500\ MHz$. Use only two coaxial lines with characteristic impedances of $50\ \Omega$ and $25\ \Omega$ in a series configuration.**
   What is the electrical length of the two lines?
   - **Multiple solutions are possible!**