

# JUAS 2018 – Computer Exercises

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## Navigating in the Smith chart

These exercises are intended to be solved with the “Smith V4.0” tool by Fritz Dellsperger. It can be downloaded for free from: <http://www.fritz.dellsperger.net/downloads.htm>

- Use R, L and C elements in series to match the impedances at 500 MHz to  $Z_0 = 50 \Omega$ . Use only 2 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. 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
$Z = (50 + j25) \Omega$			
$Z = (50 - j25) \Omega$			
$Z = (4 + j21) \Omega$			
$Z = (20 - j50) \Omega$			

- Use R, L and C elements in parallel to match the impedances at 500 MHz to  $Z_0 = 50 \Omega$ . Use only 2 components for each matching circuit.  
Hint: You will only need the Y-plane for this exercise

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

- Match the impedances at 500 MHz to  $Z_0 = 50 \Omega$ . Use only 2 reactive components (in series or parallel) to create a lossless matching circuit.

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

Enter the  $C_{\text{shunt}}$  and  $L_{\text{shunt}}$  values from the LC circuit of the first exercise in the Smith chart and verify its resonant frequency.

- 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 the impedances of  $50 \Omega$  and  $25 \Omega$  in a series configuration. What is the electrical length of the two lines? (multiple solutions possible!)

## Interesting Weblinks

<a href="http://www.microwaves101.com/">http://www.microwaves101.com/</a>	The basic concepts of microwave design theory. Very practical information for the RF engineer
<a href="http://www2.rohde-schwarz.com/en/service_and_support/Downloads/Application_Notes/">http://www2.rohde-schwarz.com/en/service_and_support/Downloads/Application_Notes/</a>	Application notes from Rhode & Schwarz
<a href="http://www.home.agilent.com/agilent/facet.jsp?t=79831.g.1&amp;pageType=k&amp;pageMode=TM&amp;cc=CH&amp;lc=ger&amp;sm=g">http://www.home.agilent.com/agilent/facet.jsp?t=79831.g.1&amp;pageType=k&amp;pageMode=TM&amp;cc=CH&amp;lc=ger&amp;sm=g</a>	Application notes from Agilent
<a href="http://www.anritsu.com/search/en-gb/downloadssearch.aspx?Id=D29%252fD1">http://www.anritsu.com/search/en-gb/downloadssearch.aspx?Id=D29%252fD1</a>	Application notes from Anritsu
<a href="http://www.amanogawa.com/">http://www.amanogawa.com/</a>	Electrical engineering applets
<a href="http://www.ecalc.com/">http://www.ecalc.com/</a>	Online scientific calculator
<a href="http://wcalc.sourceforge.net/cgi-wcalc.html">http://wcalc.sourceforge.net/cgi-wcalc.html</a>	Calculate microstrip components online
<a href="http://www.falstad.com/mathphysics.html">http://www.falstad.com/mathphysics.html</a>	Physics applets (3D waves, dispersion, antennas, etc.)
<a href="http://www.radartutorial.eu/index.en.html">http://www.radartutorial.eu/index.en.html</a>	This page provides a detailed overview of radar principles and technologies, including mathematical, physical and technical explanations. "Radartutorial" explains the fundamentals of radar
<a href="http://www.ece.rutgers.edu/~orfanidi/ewa/">http://www.ece.rutgers.edu/~orfanidi/ewa/</a>	Complete RF theory book online