Passive Two Element Element Impedance Matching Circuits

I. OBJECTIVE

Design using software and by hand (Smith Chart) RF impedance matching circuits using passive elements *L* and *C*.

II. INTRODUCTION

IMPEDANCE MATCHING USING DISCRETE L'S AND C'S

Passive *LC* networks are used to match impedances between the source (generator) and a load. These matching networks are designed using combinations of inductors and capacitors. Two simple *LC* impedance matching networks are shown: two element *LC* high-pass and *LC* low-pass networks can be used. Smith charts can be used as a tool to design of these networks.

On a Smith Chart, transmission lines are depicted using a constant SWR circle with its arc equal to the fractional wavelength corresponding to the operational frequency of the circuit. Series resistors and shunt resistors are shown on a Smith Chart as following constant resistance or conductance circles. Constant reactance X or susceptance B lines of the Smith Chart are followed for capacitors and inductors.

Unfortunately, simple two element *LC* impedance matching networks cannot be used for all possible load impedances, Z_L . The limitation of the two element *LC* impedance matching networks are shown as *forbidden regions*. Impedances that lie in the forbidden area cannot be matched to the source impedance, Z_O, using the simple two element *LC* impedance matching networks discussed in this handout.

Two Element *LC* Low-Pass Impedance Matching Network

Two-element *LC* impedance matching networks are shown in Figure 1. In all four configurations shown in Figure 1, source is to the left of the LC circuit. LC impedance matching circuits can either be high pass or low pass circuits. Clockwise from the top left of Figure 1, the circuits configurations are low pass, low pass, high pass, and high pass. The Smith chart is used to determine the component values for *L* and *C*. As is customary, the impedances of *L* and *C* are normalized to the source impedance of Z_O.

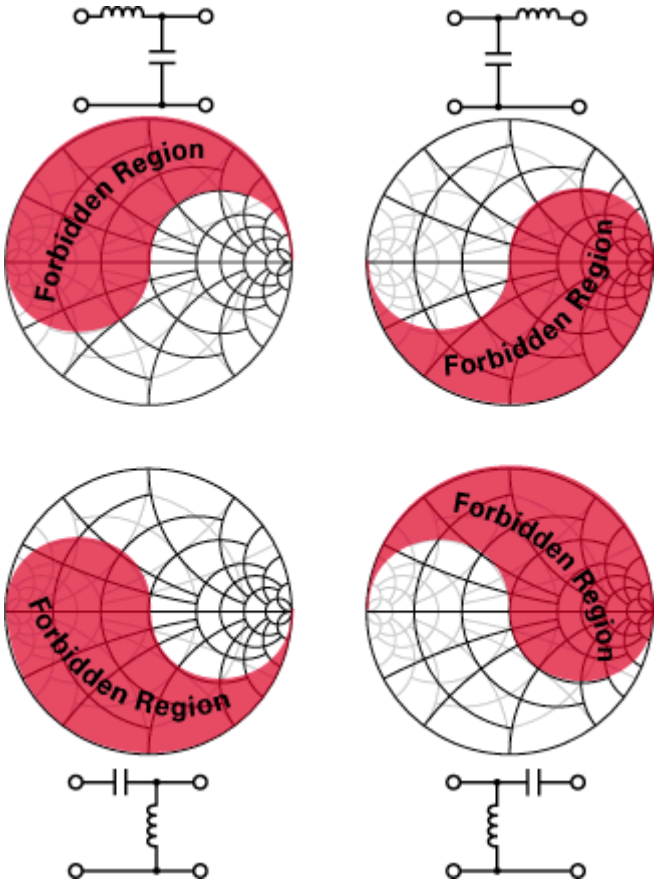

Figure 1. Two Element LC Impedance Matching Circuits and Their Forbidden Regions.

III. PROCEDURE

A. Various Impedance Matching Circuits for $Z_{source} = 50\ \Omega$

Use the Smith Chart (Berner Smith V2.01) to determine *C* and *L* to match a 50 Ω generator to the following loads: 25 + *j* 100 Ω and 25 - *j* 25 100 Ω.

(1) Determine the appropriate configurations that can be used for matching the specified loads.
(2) For an operational frequency of 1 GHz, determine the values of *L* and *C* for each circuit
(3) Perform two of these designs using both hand analysis with *Z*-*Y* Smith Charts confirmed with Berner Smith Software.

B. Impedance Matching Circuits Off Design Frequency

For the two designs in Part (a), alter the operational frequency to 1.5 GHz. Use either the Berner Smith Chart of by hand analysis (*Z*-*Y* Smith Chart) to determine the Z_{in} of the matching circuit. What is the resulting SWR when connected to $Z_{source} = 50\ \Omega$?

C. Comment On Your Results