6.334 Power Electronics
Spring 2007

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.334 Power Electronics — Issued: April 13, 2007
Problem Set 8 — Due: April 20, 2007

Reading: KSV Chapter 9.1–9.5, 9.7.1, matching network paper, KSV Chapter 11 through 11.3.2.
Note: Work on the design project!

Problem 8.1 KSV Problem 9.5

Problem 8.2

Consider the system with matching network shown in Fig. 1.

(a) Select L and C such that the input impedance Z_{in} is 50 Ohms resistive at the Industrial, Scientific, and Medical (ISM) band frequency of 27.12 MHz.

(b) Find the efficiency of the matching network, assuming that it operates with purely sinusoidal waveforms. For this calculation, please assume that the inductor quality factor $Q_L = 100$ at the operating frequency, and that the capacitor quality factor is sufficiently high that capacitor loss is negligible. *(Note: Recall that inductor quality factor $Q = \omega L/R$, where R is the equivalent series resistance of the inductor.)*

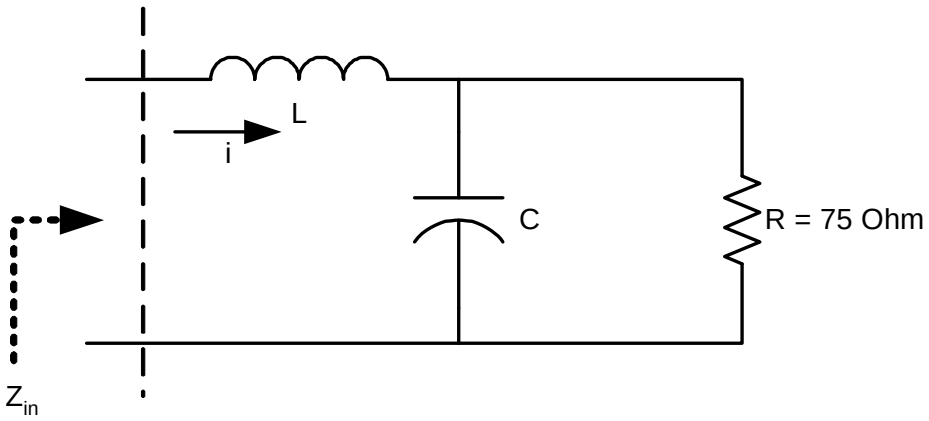

Figure 1 A matching network with a resistive load of 75 Ohms.

Problem 8.3

Consider the full-bridge resonant converter of KSV Fig. 9.19(a). Assuming the rectified output voltage is constant at a voltage V_R, please find an equivalent ac-side resistance for the bridge rectifier R_{eq} as a function of V_R and the ac current magnitude I_A. This can be done with a *describing function approach*, in which one only considers the fundamental ac component of voltage v'_R. Demonstrate that this expression for resistance correctly models power transfer from the dc sources to the rectifier, under the assumption that the inductor current is a pure sinusoid.