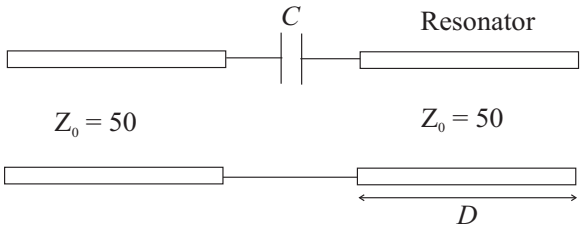
ECE 3065 Homework 7: Resonator Design

Due Date: 2 April 2009 (Thursday)

1. How long must a transmission line be to have resonance frequencies both at 2.4 GHz and at 4.0 GHz? Assume that the velocity of propagation on the line is 8×10^7m/s and choose the smallest possible dimension that satisfies this condition. Perform this calculation for a) two open-circuit loads, b) an open and a short load, and c) a ring structure. (6 points)

2. **Transmission Line Resonator:** You must design a critically-coupled stripline resonator at 8 GHz coupled to a 50Ω line. The velocity of propagation on the stripline is 1.3×10^8 m/s. (14 points)



   (a) The ohmic loss of the transmission line results in an attenuation of 0.25 dB/m. What is the value of α in Np/m for this line?

   (b) What length D (in centimeters) should the stripline resonator be?

   (c) What should the value of the coupling capacitor C be?

   (d) How much larger or smaller (by percentage) is the resonant length in part (b) compared to the resonant length of the *unloaded* resonator?

   (e) If this whole circuit is used as a filter, what will be its bandwidth in MHz?

   (f) Liquid helium is poured onto the transmission line resonator. The metallic walls become super-cooled, turning the material into a superconductor. What happens to the bandwidth of the filter?