Physics 410/510

Experiment C-8

Dummy Transmission Lines

This experiment is designed to illustrate some of the properties of transmission lines without encountering the chief difficulties inherent in most transmission line experiments. In place of a transmission line we have a series of low-pass LC filters. Driven at frequencies near the cut-off frequency, they exhibit properties of filters; but at low frequencies, they resemble transmission lines to a striking degree.

The purpose of this experiment is to examine these networks in both of these states as well as in the transitional state, comparing the observed result with theory (assuming L = 0.1 henry, C = 0.01 ufd).

1. Using the 12 section line, determine the cutoff frequency experimentally and compare with theory.

2. Determine (experimentally) the frequencies for the first few resonant modes of the line with the line both open-circuited and short-circuited. Sketch the standing wave patterns of these modes.

3. Plot the voltage vs. tap number for the 1/4 and 1/2 wavelength modes with both open-circuit and short circuit termination.

4. Consider a transmission line on which waves are propogated with the velocity of light. What length of such a line is equivalent to one lumped constant line? What frequencies would be required to duplicate parts 2 and 3 on such a line of physical length equal to that of a lumped constant line?

5. At the frequency of 114 or 1/2 wave resonance, determine, experimentally, the terminating impedance which gives no standard waves on the line. Plot voltage vs. tap number with the line so terminated. At what frequency will this resistance deviate by 10% from the low frequency approximation?

6. Terminating the line with the characteristic impedance, find the total phase shift for the frequencies up to 315 of the cutoff. Plot these results and the theoretical