Procedure

1.) Construct the circuit shown in Figure 3. Set the Discovery 2 Arbitrary Waveform Generator to a 4.5 Vac peak sine wave and connect it to the circuit.

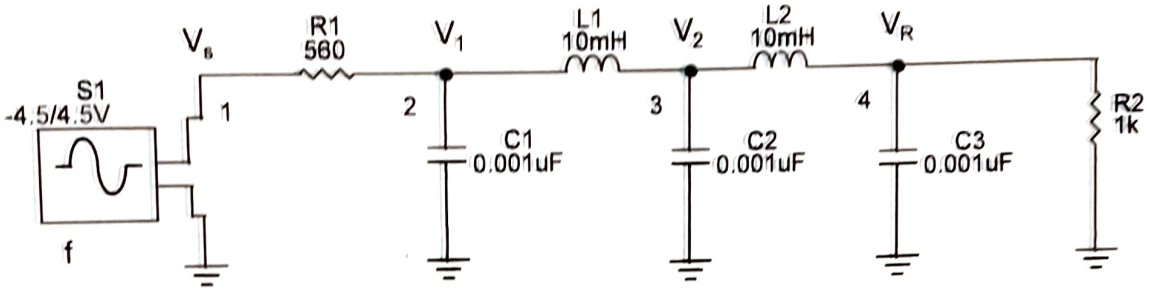

Figure 3. Transmission Line Approximation Circuit Excluding Resistance.

2.) Set the source frequency of the Analog Discovery 2 (AD2) Arbitrary Waveform Generator to a 5000 Hz sine wave and measure the magnitude and phase angles of the voltages V_s, V_1, V_2, and V_R using the scope function of the AD2. Record these values in Table 1 of the data sheet.

3.) Set the source frequency to 10 kHz and repeat step 2 entering the values in Table 2 of the data sheet.

4.) Set the source frequency to 20 kHz and repeat step 2 entering the values in Table 3 of the data sheet.

5.) Solve for the voltages in Figure 3 with f=5000 Hz using nodal analysis. Enter these values into Table 4. Note the differences in the measured and calculated voltages and try to explain the differences in the assessment discussion.

6.) Enter the schematic of Figure 3 into the Pspice simulation software provided (CircuitMaker Student Version) and find the magnitudes and phase angles of V_s, V_1, V_2, and V_R. Find the phase angles from the transient analysis plots by measuring the time difference between the positive going zero crossing of V_S and the other voltage waveforms. Use the formula presented above to calculate the phase angle. Enter these values in Tables 5-7 for each of the test frequencies.

7.) For each of the test frequencies, print transient analysis plots that show both the voltage V_S and V_R waveforms. Note the phase shift and change in magnitude between the sending and receiving voltages. Note the effect that frequency had on these results in lab assessment. Include these three printouts in your lab assignment.

8.) Measure the dc resistance of the inductors using a multimeter. Modify the Pspice model to include the coil resistance of the inductors. The resulting schematic should look like Figure 4.

9.) Simulate the circuit of Figure 4 for f=5000 Hz only. Find the magnitudes and phase angles of the voltages. Record the results in Table 8 for later use.

10.) Calculate the percentage error between the voltages in Table 4, the hand calculations, and the measured values for Table 1 using the following formula:

$$\%error = \frac{V_{hand} - V_{measured}}{V_{hand}} \cdot 100\%$$