

California State University, Fresno

Department of Electrical and Computer Engineering

ECE 90L Principles of Electronic Circuits Laboratory

Experiment No. 8: Natural Response of RC and RL Circuits

Objective

The objective of this laboratory is to study the natural response of simple RC and RL circuits.

Prelab

1.) Derive the theoretical expressions for the voltage versus time in Parts 1, 2, and 3. Plot the results on graph paper. There should be five final expressions plotted, each on a separate page.

Procedure

1.) Set-up the RC circuit shown in Figure 1 and adjust the power supply so that the capacitor voltage is 10 V. With $R_L = 100\text{ k}\Omega$, close the switch and observe, tabulate, and sketch the capacitor voltage waveform. Use the storage capabilities of the 2221A digital oscilloscopes to help you with your data collection. Repeat the experiment when $R_L = 10\text{ k}\Omega$.

Note: In all waveform sketches, label all scales and indicate all pertinent values.

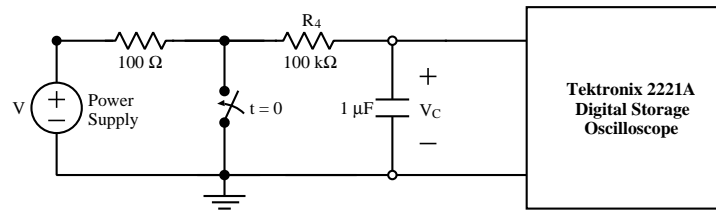


Figure 1: RC Circuit

2.) Measure the resistance of the inductor to be used in the circuit shown in Figure 2 before setting it up. Adjust the power supply so that 1 V appears across R_L . Close the switch and observe, tabulate, and sketch the waveform of the voltage across R_L . Repeat when $R_L = 100\ \Omega$. Why are you measuring the voltage across the inductor when you care about the current through it?

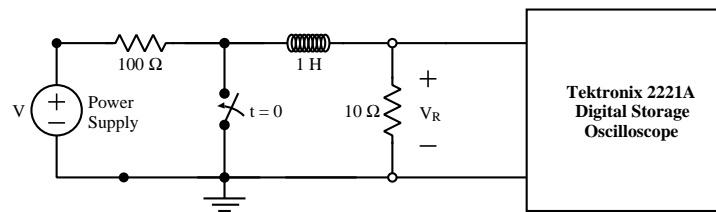


Figure 2: RL Circuit

3.) Connect the circuit shown in Figure 3 and adjust the power supply so that 14 V appears across the switch. Close the switch and observe, tabulate, and sketch the waveform of the voltage across the 60 kΩ resistor.

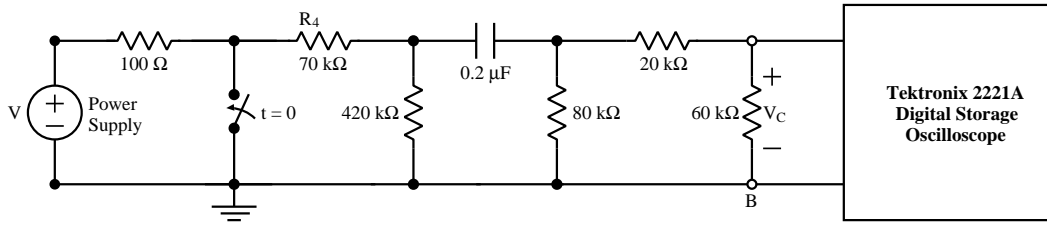


Figure 3: RC Ladder Circuit

4.) Connect the circuit shown in Figure 4. With S_1 closed and S_2 open, adjust the power supply so that 10 V appear across C_1 . Now open S_1 and immediately close S_2 . Observe, tabulate, and sketch the waveform of the voltage across C_2 .

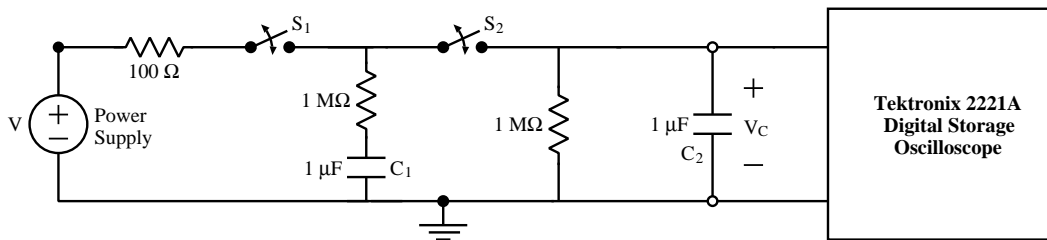


Figure 4: Multiple Time Constant RC Circuit

Conclusion

What conclusions can you draw about the natural responses of RC and RL circuits? What differences (if any) did you observe between an RC circuit and an RL circuit? How does the time constant affect the circuit's operation, especially with regard to Part 4 of the Procedure?

Group Report

- 1.) On the same paper that you used to graph your theoretical expressions in the Prelab, plot the empirical data obtained in Parts 1, 2, and 3. The graphs should show the voltage before, during, and after the transient. Compare and explain any differences between your theoretical and experimental results.
- 2.) Account for the shape of the waveform obtained in Part 4 of the procedure by explaining the physical behavior of the circuit.