University of Victoria

ELEC 250

Linear Circuits I

Lab 3 - Transient Analysis

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1 Object

This lab will study the transient response of an RC and an RL circuit.

2 Results

An Agilent 33220A signal generator was used to create the momentary single pulse excitation, while an Agilent DSOX-2012A oscilloscope was used to analyze transient responses of the RC and RL circuits.

2.1 RC Circuit

The circuit was constructed as shown in Figure 1 and excited using a 5 V_{pp} single pulse source for a duration of 5ms.

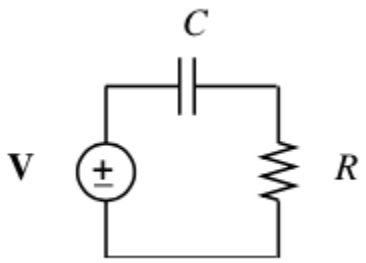


Figure 1: RC circuit driven by a source. $R = 4.7$ kΩ and $C = 100$ nF.

Measured values of the change in voltage across the capacitor and resistor in this circuit were recorded on the oscilloscope and are displayed in Figure 3. In order to measure v_R, it was necessary to switch the order of R and C.

The expected value of the time constant τ is given by

$$\tau = RC \tag{1}$$

Using (1), the expected value of τ is 480μs. By measuring the time it took for v_C to decay to 37.25% of its original value in Figure 3.c, τ was determined to be 480μs.

2.2 RL Circuit

The circuit was constructed as shown in Figure 2 and excited using a 5 V_{pp} single pulse source for a duration of 23.53μs.

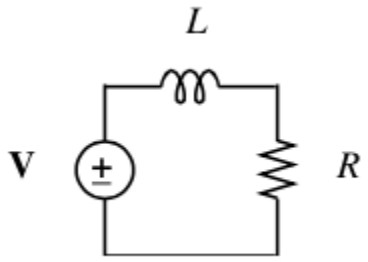


Figure 2: RL circuit driven by a source. $R = 680\ \Omega$ and $L = 1.00$ mH.

Measured values of the change in voltage across the inductor and resistor in this circuit were recorded on the oscilloscope and are displayed in Figure 4. In order to measure v_R, it was necessary to switch the order of R and L.

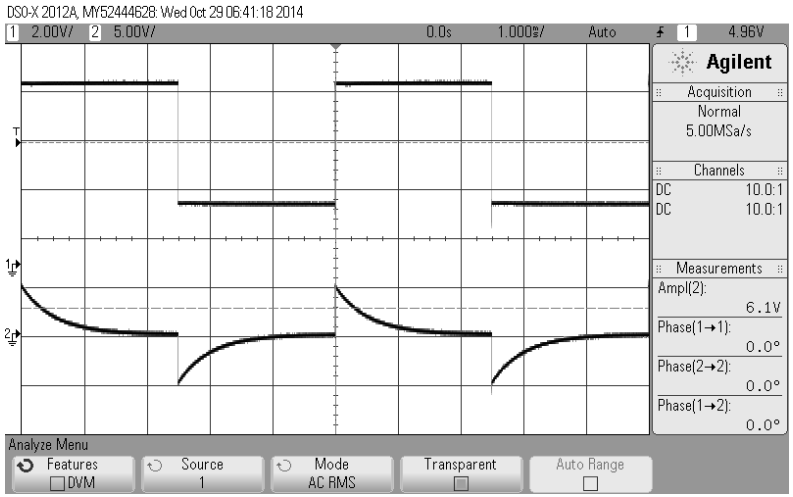
The expected value of the time constant τ is given by

$$\tau = \frac{L}{R} \tag{2}$$

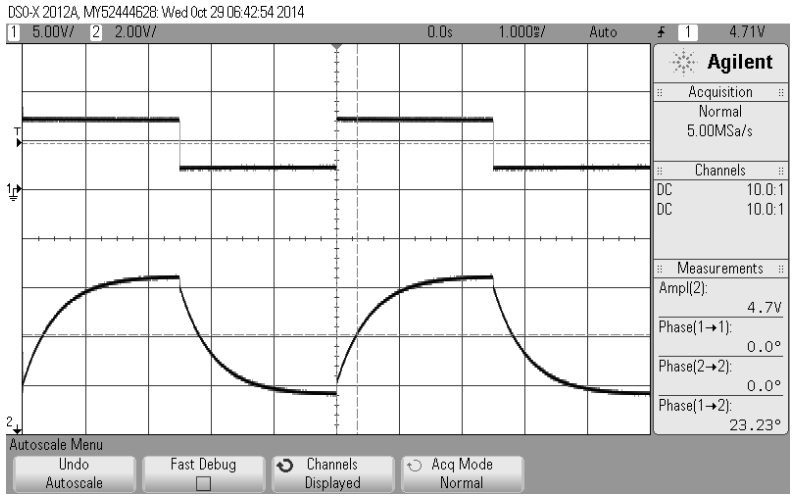
Using (2), the expected value of τ is 1.4μs. By measuring the time it took for v_R to rise to 67.75% of its final value in Figure 4.c, τ was determined to be 1.4μs. The time for v_L to decay to 37.25% of its original value in Figure 4.d yielded a τ of 1.34μs.

3 Discussion and Conclusion

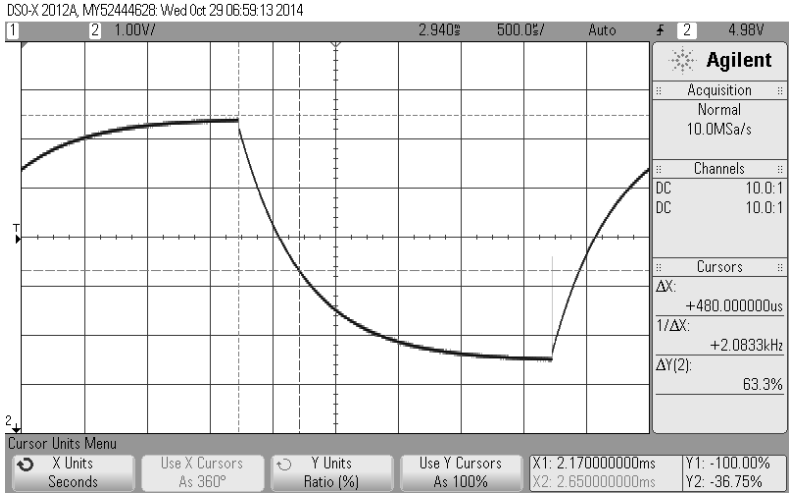
The discussion and conclusion should answer the questions that are posed in the procedure section of the experiment. Any special observations made by the student can be recorded here.



(a) v_s and v_R

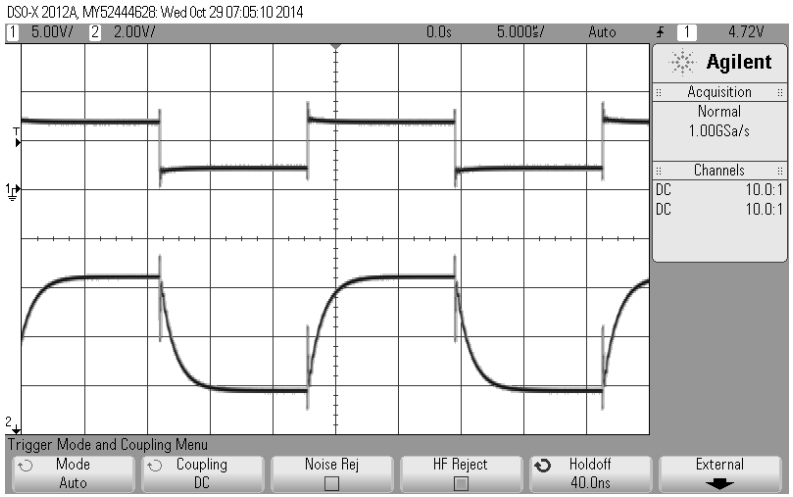


(b) v_s and v_C

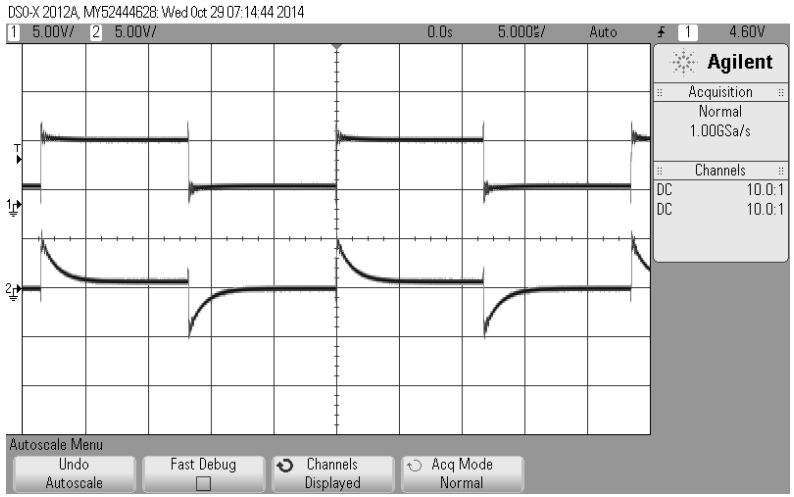


(c) Decay of v_C used to find τ

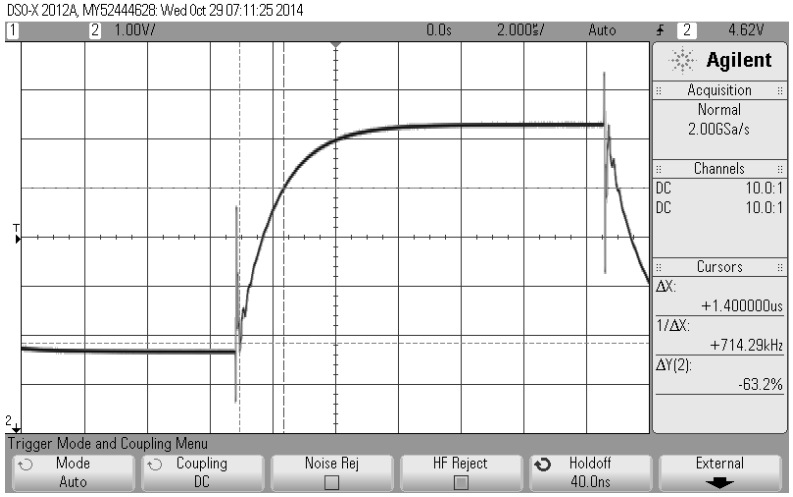
Figure 3: Transient response of the RC circuit



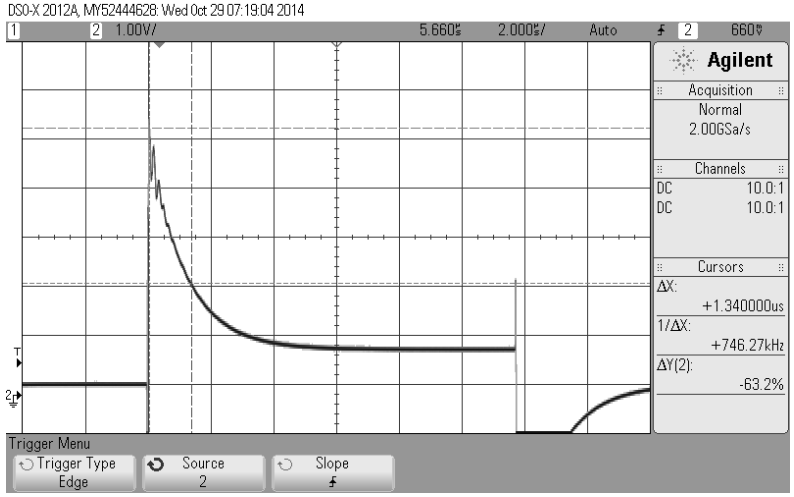
(a) v_s and v_R



(b) v_s and v_L



(c) Rise of v_R used to find τ



(d) Decay of v_L used to find τ

Figure 4: Transient response of the RL circuit