Lab 7: Transient Response of a 2nd Order Circuit

ECEN 214 - 517

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Date Performed: October 30, 2020

Due Date: November 4, 2020

Procedure

Task 1

The purpose of this lab is to be able to develop an understanding of a simple op-amp circuit that creates 2nd order responses. For the first part of this lab I simulated the circuit where $Q = 0.5$, which is critically damped. I used the values from my prelab, and created a simulation, and then ran the simulation. Then saved the the schematic and waveform, and repeat for the rest of the cases: $Q = 0.25$ (slightly overdamped), $Q = 0.1$ (overdamped), $Q = 1$ (slightly underdamped), $Q = 2.5$ (underdamped)**.**

Data and Results

Theoretical

$$V_{out}(t) = B_1 e^{-at}\cos(w_d t) + B_2 e^{-at}\sin(w_d t)$$

Q = 0.5 (critically damped)

$$(-1)e^{-(-625)t}\cos(0) + 0 = -e^{625t}$$

Q = 0.25 (slightly over damped)

$$(-1)e^{-(1277.5)t}\cos(1102.5t) + B_2 e^{-(1277.5)t}\sin(1102.5t)$$

Q = 0.1 (over damped)

$$(-1)e^{-(3147.16)t}\cos(3082.5t) + B_2 e^{-(3147.16)t}\sin(3082.5t)$$

Q = 1 (slightly under damped)

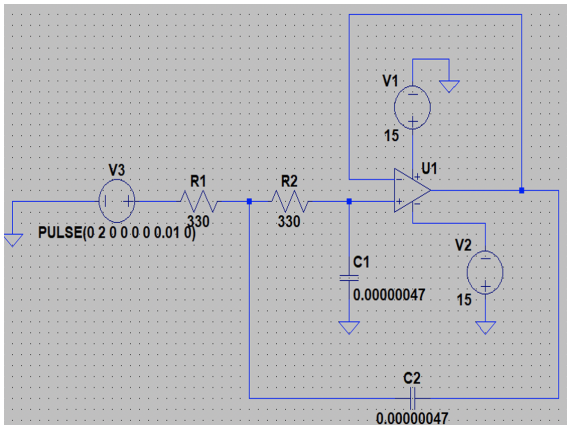
$$(-1)e^{-(212.4)t}\cos(603t) + B_2 e^{-(212.4)t}\sin(603t)$$

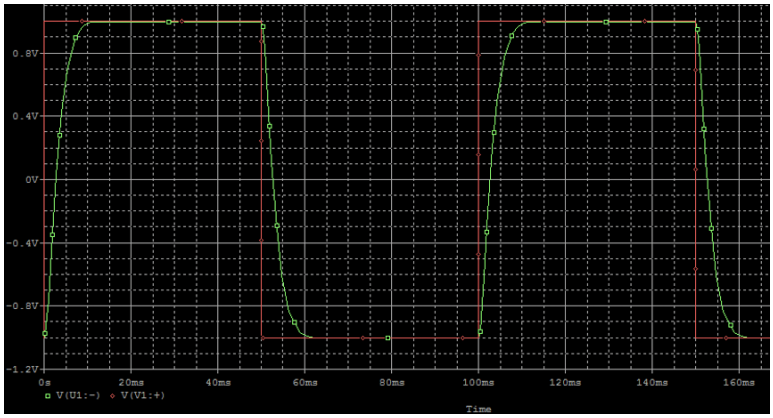
Q = 2.5 (under damped)

$$(-1)e^{-(127.8)t}\cos(632.4t) + B_2 e^{-(127.8)t}\sin(632.4t)$$

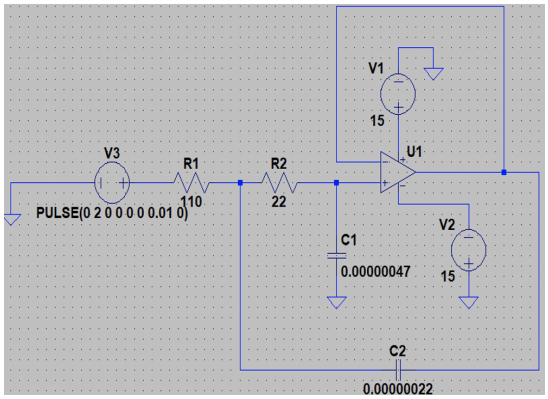
Simulations / Measured

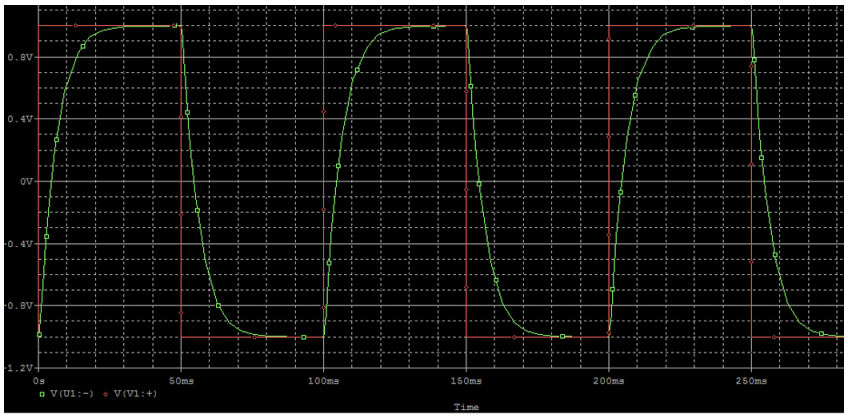
Q = 0.5 (critically damped)



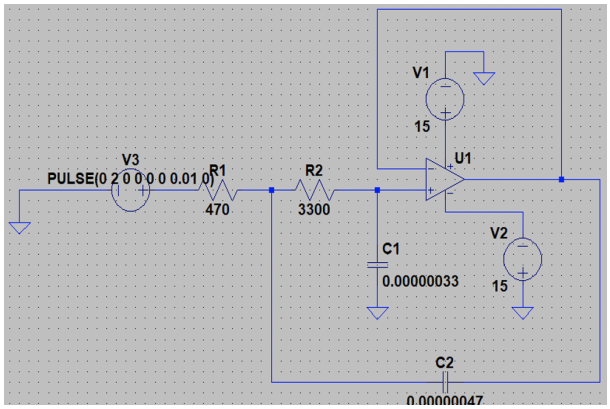


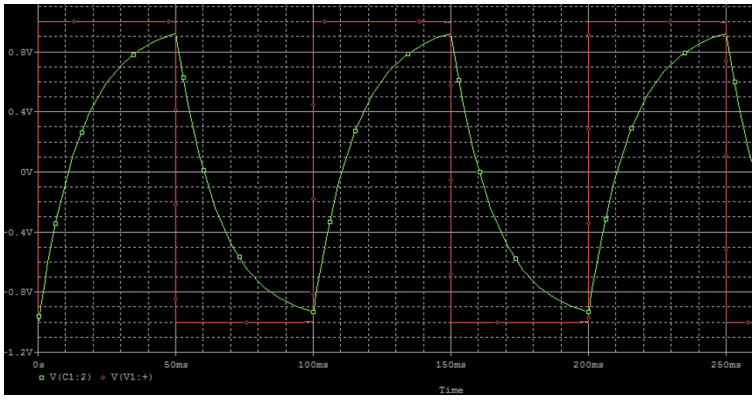
Q = 0.25 (slightly over damped)



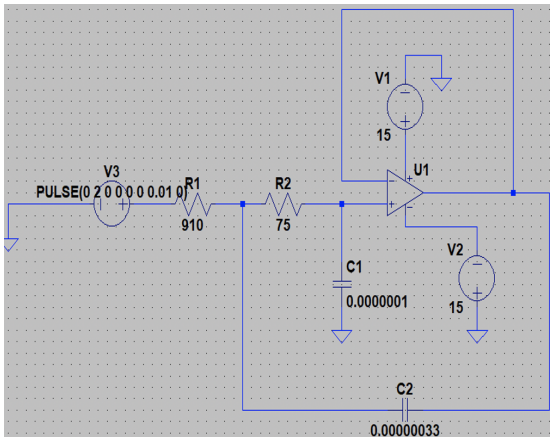


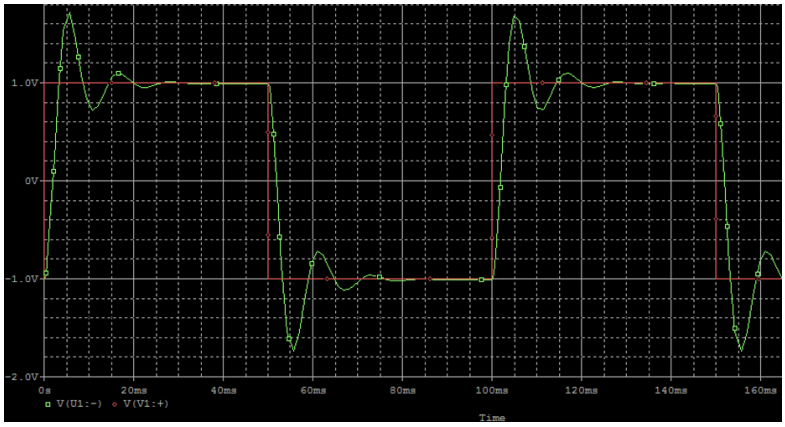
Q = 0.1 (over damped)



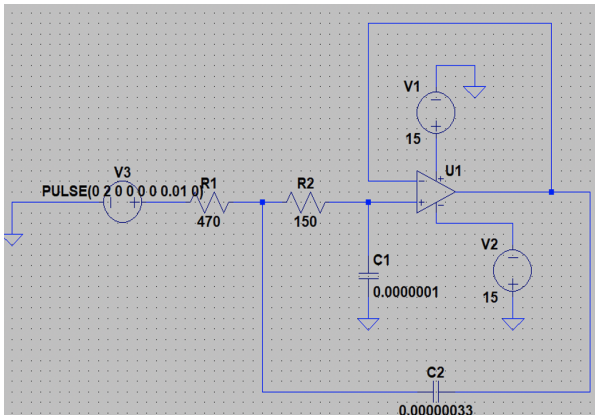


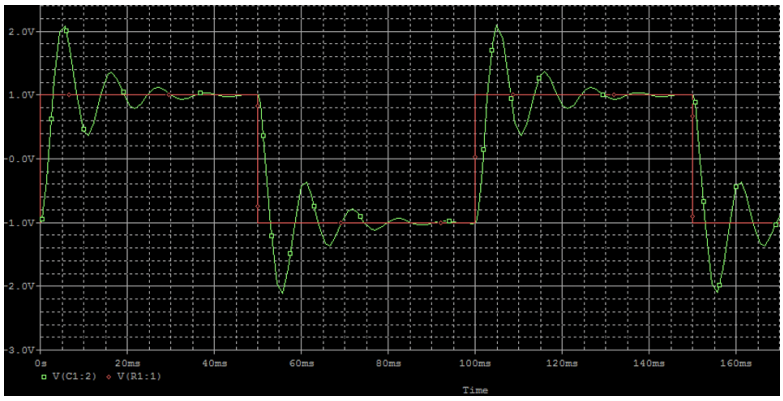
Q = 1 (slightly under damped)





Q = 2.5 (under damped)





Discussion

For all cases, Q = 0.5, Q = 0.25 (slightly overdamped), Q = 0.1 (overdamped), Q = 1 (slightly underdamped), and Q = 2.5 (underdamped), the simulations and measured values are the same, as we had to run simulations for the measured values as well. The simulations stay consistent in both cases and so did the results, however, this may not necessarily be true if we had built the circuit and had utilized an AD2.

Given this lab was done in person, utilizing more resistor and capacitor values would give more accurate results. In terms of the equations, we could not determine the values of B_2 because we didn't know the second order of the RLC circuits relationship. Knowing these values could be useful if this lab was done all over again.