Lab Final: Part 1

Brandon Eidson
Revised by Elizabeth Devore
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You may not collaborate with other students on this project. If it is discovered that you gave assistance to or received assistance from another student, <u>you will automatically receive a grade of 0</u> for part 1 and part 2 of the lab final.

A client has hired you to design a power supply that can serve as a DC voltage reference for their product. The ability to switch between two different voltage references (V_{REF}), V_1 and V_2, is required. The product will not tolerate near instantaneous changes in reference, so some kind of switching transient is necessary.

The circuit to be used for this design is shown in Figure 1. V_s is the supply voltage available to you, and V_{REF} is the voltage you must design to switch between V_1 and V_2 (see Figure 2). The client's product will draw negligible current from the reference, so it can be treated as an open circuit connected across V_{REF} (i.e. you can ignore the product in the design of the reference circuit).
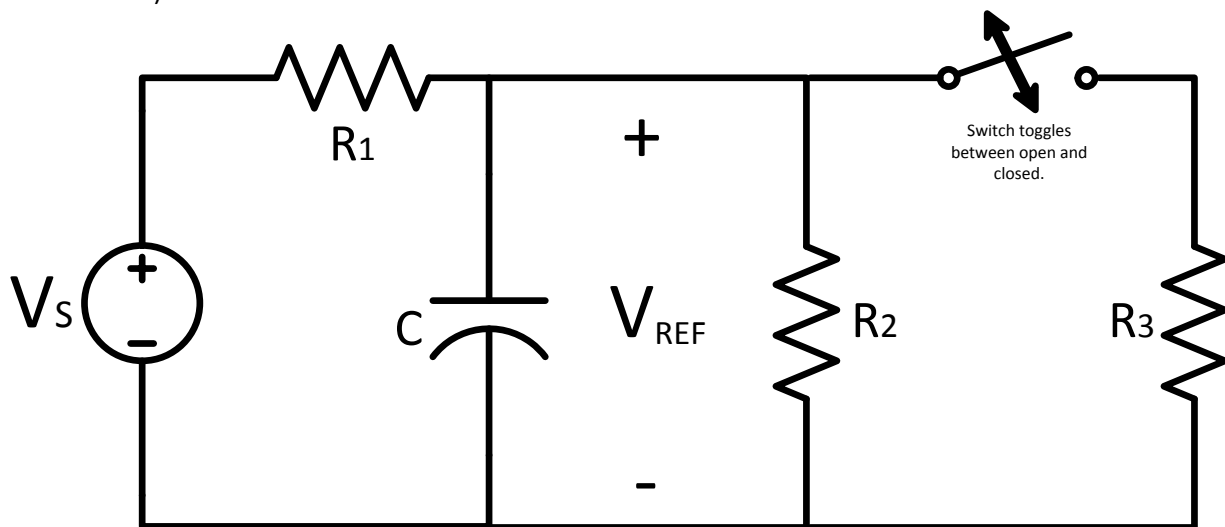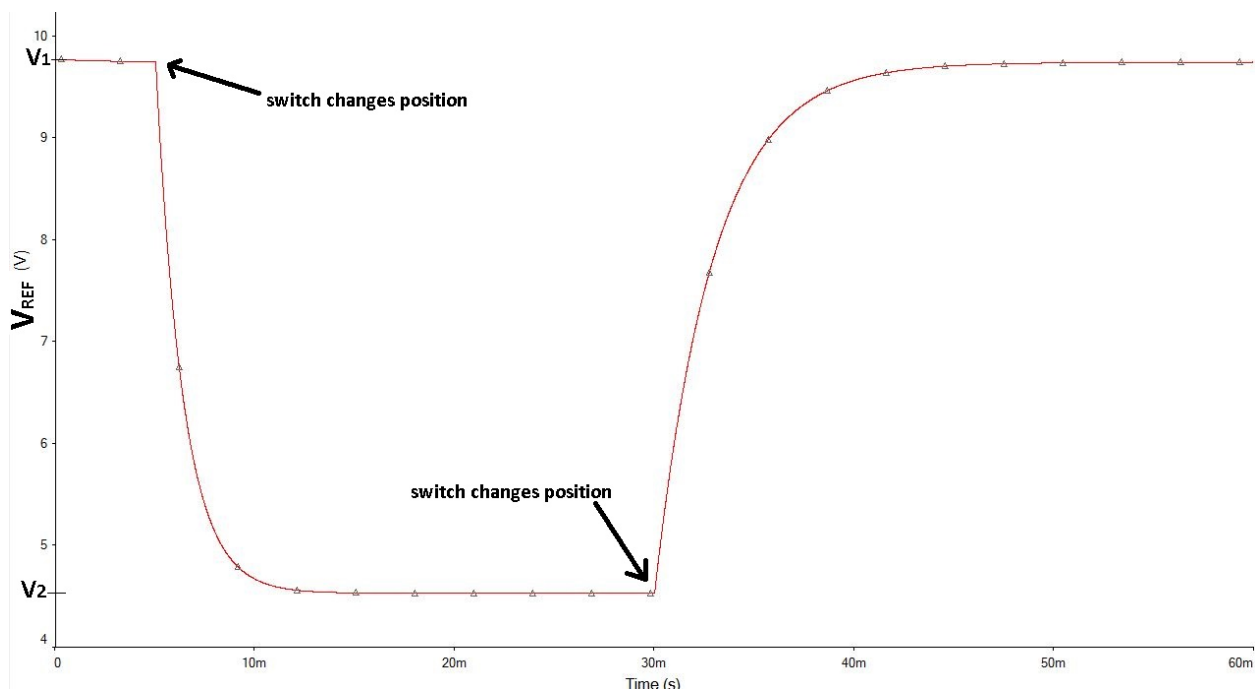

Figure 1:Transient Circuit Design

Figure 2: V_{REF} Switching between V_1 AND V_2

Your job is to design R_1, R_2, R_3, and C to meet the following specifications:
- $V_S \approx 15.6$ V (use the 15 V supply on the NI ELVIS prototyping board)
- 9 V $\leq V_1 \leq 10$ V
- 4 V $\leq V_2 \leq 5$ V
- 1 ms $\leq \tau \leq 4$ ms
- $40\ \Omega \leq R_1, R_2, R_3 \leq 5$ kΩ

where τ represents the time constant of the switching transients. The switch opening time constant and switch closing time constant do not have to be equal, but they must both fall within the specified range.

Your grade is dependent on the following (no lab report is required):
- Successful <u>design</u> of R_1, R_2, R_3, and C.
- Successful <u>justification</u> to the T.A. your selection of R_1, R_2, R_3, and C (via mathematics, simulation, and/or answering your T.A.'s verbal questions - DO NOT USE MULTISIM AS A TRAIL AND ERROR ONLY).
- Successful <u>construction</u> of your design using the NI ELVIS lab equipment.
- Successful <u>demonstration</u> of the operation of your design using the NI ELVIS oscilloscope, proving you've met the requirements for V_1, V_2, and the time constants.

Design Hints:
- Design V_{REF} to equal V_1 when the switch is open and V_2 when the switch is closed.
- Draw the steady-state circuits for the switch in the open position and for the switch in the closed position. Use these two circuits to design your resistors.
- Consider the resistors and capacitors available in lab when designing your circuit. You may connect multiple resistors in series and/or parallel to build one or more of your designed resistors: R_1, R_2, and/or R_3, but <u>do not use more than **four** resistors to build any one of your designed resistors</u>.