Step Response Design

By: John Getty
Laboratory Director
Engineering Department
University of Denver
Denver, CO

Purpose:

Design a circuit to meet specified step response parameters.

Equipment Required:

- 1 - Agilent 54622A Deep Memory Oscilloscope or Agilent 54600B Oscilloscope
  (Replacement model: Agilent DSO6012A Oscilloscope or Agilent DSO5012A 5000 Series Oscilloscope)
- 1 - Agilent 33120A Function Generator
  (Replacement model: Agilent 33220A Function / Arbitrary Waveform Generator)
- 1 - Protoboard
  Resistors, Inductors and Capacitors available in your lab

Prelab:

Review Chapter 8 in the text*.

1. Determine your design project

   Select a partner. Add the last digit of your student number to your partner's student number. The last digit of this sum determines which design project your partnership must accomplish.

Last Digit of Sum	Template
0, 5 or 9	A
1 or 8	B
2, 4 or 7	C
3 or 6	D

2. Circuit design

   Design a circuit that will provide a step response which fits neatly inside the unshaded areas of your assigned oscilloscope template. The templates are located on the last page of this laboratory exercise.

   The circuit response may not touch any of the shaded areas of the template. The trace must enter the template through the left edge into the corner box, and exit through the right edge in the corner box.

   Draw a schematic diagram of your design that includes the required source parameters, including partial descriptors for the amplitude V_A, the DC offset V_{avg}, and the frequency f.

Procedure

1. Build your design

   Obtain the required components and build the circuit.

   a. Set the frequency, DC offset and amplitude of the function generator (set in the square wave mode) as predicted in the Prelab.

   b. Fine tune the oscilloscope and function generator settings so that the oscilloscope trace falls inside the unshaded area of the template. Document the final settings of the function generator , including the signal amplitude V_A, the DC offset (V_{avg}), the frequency f and the final oscilloscope settings.

   c. If a modification to the circuit was required to meet the design criteria, record the new circuit in your journal.

2. Submit the circuit for design review

   a. Draw an accurate sketch of the output waveform in your lab journal.

   b. Underneath the sketch of the output waveform, enter the following statement into your lab journal:

   "The above sketch is an accurate representation of the solution waveform as observed on the oscilloscope, which meets the requirements of the specified design.

   _____."

   c. Demonstrate the resulting waveform to a lab instructor on the oscilloscope. Ask your instructor to sign the statement entered into your journal, verifying compliance with the design specifications.

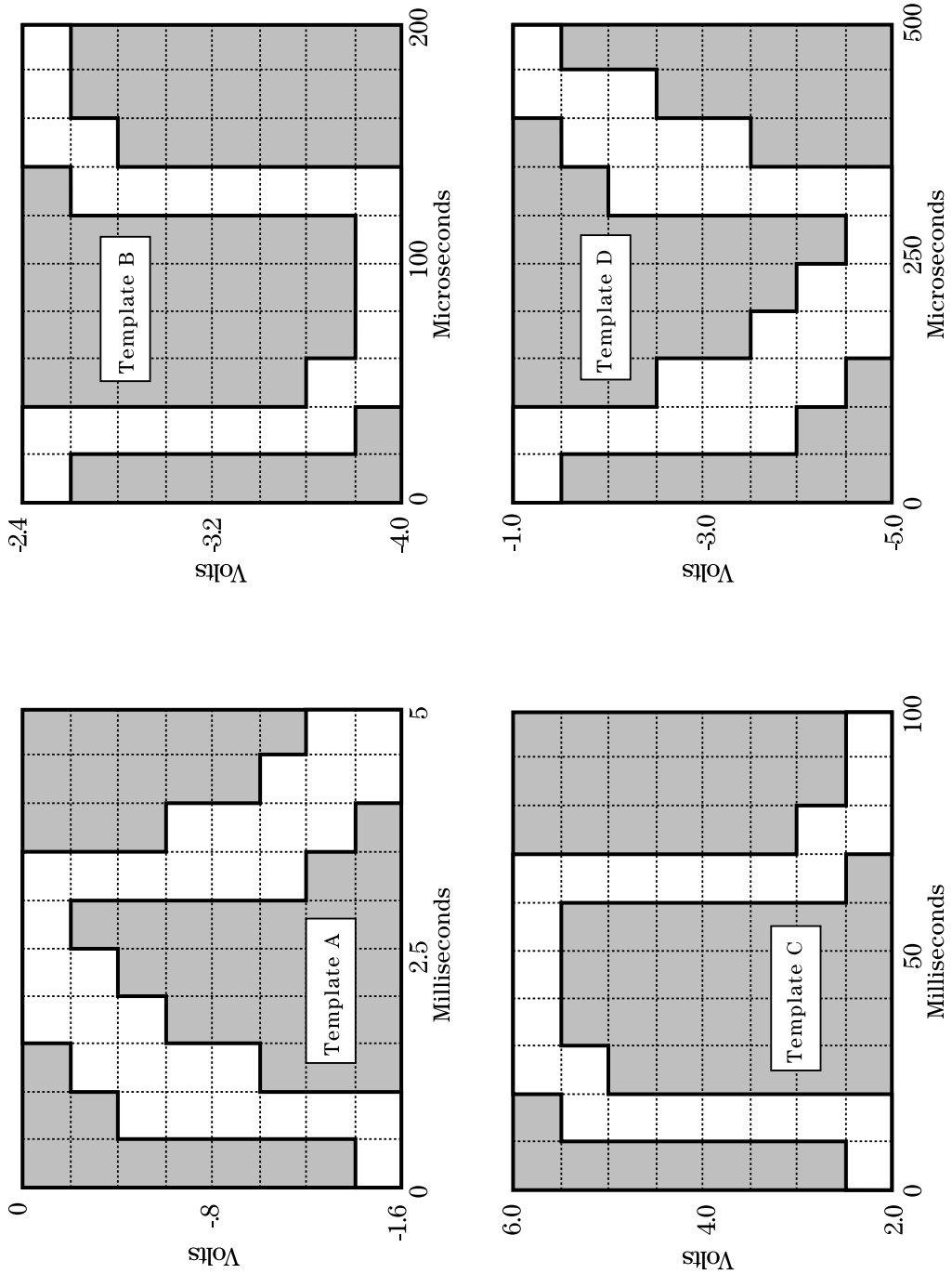
Conclusion

a. Explain how you arrived at the Prelab circuit design.

b. Discuss any changes made to the Prelab circuit in order to meet the design criteria.

- Discuss the differences between the function generator and oscilloscope settings predicted in the Prelab and the settings actually in use during the design review at the end of the lab exercise. Explain why the final function generator and oscilloscope settings are a better choice than those predicted in the Prelab.

Oscilloscope Templates



*Roland E. Thomas and Albert J. Rosa, The Analysis and Design of Linear Circuts, Prentice Hall, (New Jersey, 1994)