

Experiment 6

Superposition Theorem

Introduction

If there is more than one source in an electric network, the response (voltage or current) can be determined by considering one source at a time. The total response is the algebraic sum of the individual responses. This is known as the superposition principle. While determining the responses with a particular source, all other sources have to be deactivated (voltage sources replaced by short circuits and current sources by open circuit).

Objectives

1. To verify superposition principle using *Multisim Electronics Workbench*.
2. To verify superposition with hardwired components.

Materials

Two dc power sources
One multimeter
Assorted resistors

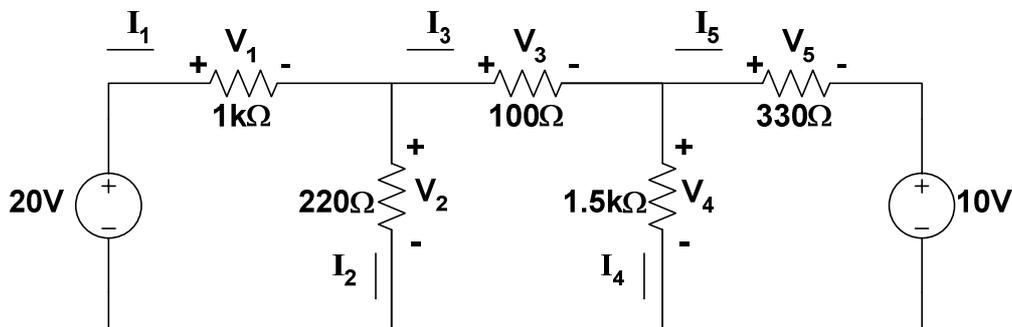


Figure 1: Resistive circuit with two sources

Procedure

Simulation

1. Construct the circuit in Figure 1 on *Multisim Electronics Workbench*. Put the meters in the appropriate places to read voltages across and currents through each resistor.
2. Run the simulation. Record all the voltages and currents in the circuit and enter them in Table 1. You can use ammeters for current measurements, voltmeter for voltage measurements or multimeter for both.
3. Note the current directions and voltage polarities shown in Figure 1.

Table 1: Simulation results for voltage and current with both sources

	10 K Ω	22 K Ω	1 K Ω	47 K Ω	33 K Ω
Voltage					
Current					

4. Remove the 5-V source from the circuit. Replace it by a short circuit.
5. Run the simulation. Measure the voltages and currents and record in Table 2.

Table 2: Simulation results for voltage and current with the 10-V source only

	10 K Ω	22 K Ω	1 K Ω	47 K Ω	33 K Ω
Voltage					
Current					

6. Put the 5-V source back to the circuit. Remove the 10-V source and replace it by a short circuit.
7. Run the simulation. Record all the voltages and currents in the circuit. Enter them in Table 3.

Table 3: Simulation results for voltage and current with the 5-V source only

	10 K Ω	22 K Ω	1 K Ω	47 K Ω	33 K Ω
Voltage					
Current					

Question: Check for superposition principle. Enter your observations here.

Hardwired Experiment

8. Repeat the procedure with hardwired circuit elements. Enter your results in below.

Table 4: Experimental results with both the sources

	10 K Ω	22 K Ω	1 K Ω	47 K Ω	33 K Ω
Voltage					
Current					

Table 5: Experimental results with 10-V source only

	10 K Ω	22 K Ω	1 K Ω	47 K Ω	33 K Ω
Voltage					
Current					

Table 6: Experimental results with 5-V source only

	10 K Ω	22 K Ω	1 K Ω	47 K Ω	33 K Ω
Voltage					
Current					

Questions:

1. Compare the results obtained with Workbench with those from hardware circuit, and comment.

2. Superposition theorem applies for only certain types of circuit. State what is the type?

3. Superposition applies to only some variables or quantities like current and voltage. It does not apply to, for example, power. State why not.

Any other observations or comments