Experiment 1
Verification of Superposition Theorem

Aim:

To verify Superposition theorem theoretically and practically in simple DC networks.

Experiments:

1. In the given electrical circuit (Figure.1) verify superposition theorem both theoretically and practically.
2. Make a simple electric circuit with the given 5 resistors and the two regulated power supplies to verify superposition theorem for voltage and current in any one branch of the circuit. (Precautions: Do not short circuit the power supply, do not supply more than the rated values of voltage and current of the elements)

Apparatus/Components/Tools/Software Required:

1. Regulated Power Supply 0-30V, DC -2 Nos.
2. Resistors - 1KΩ, 1.5KΩ - 3 Nos each
3. Multimeter - 1 No
4. Breadboard - 1 No
5. Digital Ammeters - 3 Nos
6. Connecting wires
7. MATLAB ®

Theory:

The superposition theorem for electrical circuits states that voltage or current in any branch of a bilateral linear circuit having more than one independent source equals to the algebraic sum of the responses caused by each independent source acting alone, where all the other independent sources are replaced by their internal impedances. A circuit whose parameters are not changed with respect to Current and Voltage is called Linear Circuit and a circuit whose characteristics are same irrespective of the direction of current through various elements of it, is called bilateral network. The internal resistance of an ideal voltage source is zero and of an ideal current source is infinite. Superposition theorem is useful in solving both DC and AC networks with more than one source. In AC circuits, RMS values of voltage and current are to be measured and the elements should be replaced with impedances.

Circuit Diagram:

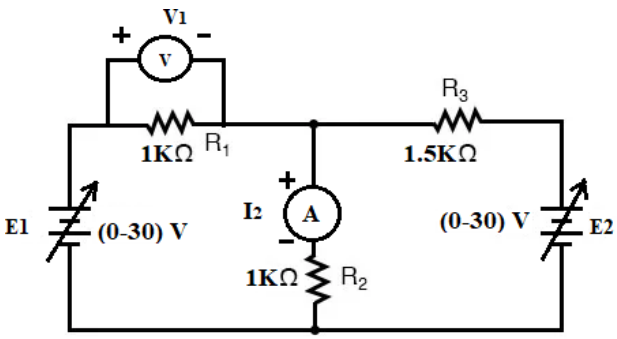


Figure 1: Circuit to verify superposition theorem

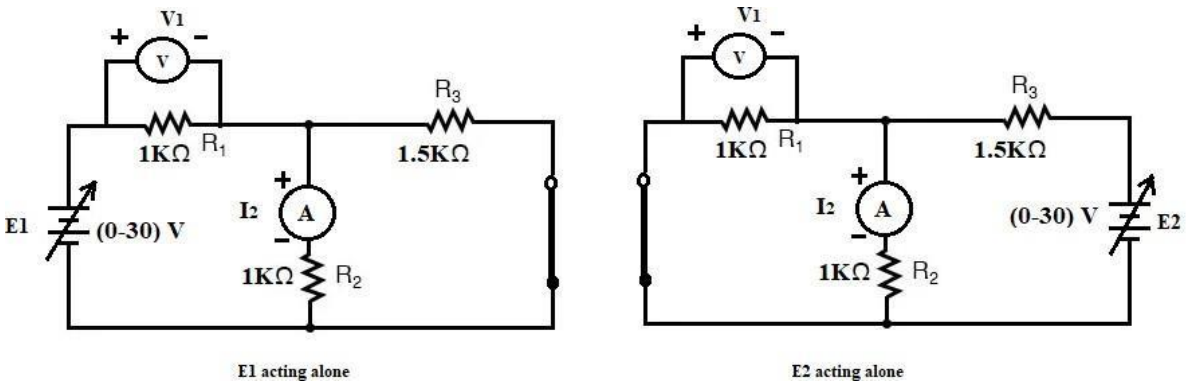


Figure 2: Circuits with only one source acting at a time

Procedure for Part 1:

1. Connect the components in a breadboard as shown in fig. 1. Connect voltmeters across the sources to measure the voltage.
2. Switch on the regulated power supplies and apply different combinations of voltage and measure V1 and I2 (Caution: Do not short circuit the power supply directly)
3. Now disconnect the source E2 from circuit and short circuit the circuit as shown in Figure 1. Apply the same voltages in E_1 as applied in step 2. Measure V_1 and I_2.
4. Now disconnect the source E1 from circuit and short circuit the terminals as shown in Figure 2. Apply the same voltages in E_2 as applied in step 2. Measure V_1 and I_2.
5. Verify the measured voltage and current values using superposition theorem.

Procedure for Part 2:

1. Design a DC circuit using 5 resistors and two regulated power supplies and get approval from the faculty.
2. Set up the circuit to measure at least one voltage and one branch current in the circuit.
3. Measure the desired voltage and current using only one source at a time.
4. Verify superposition theorem by the measured values.

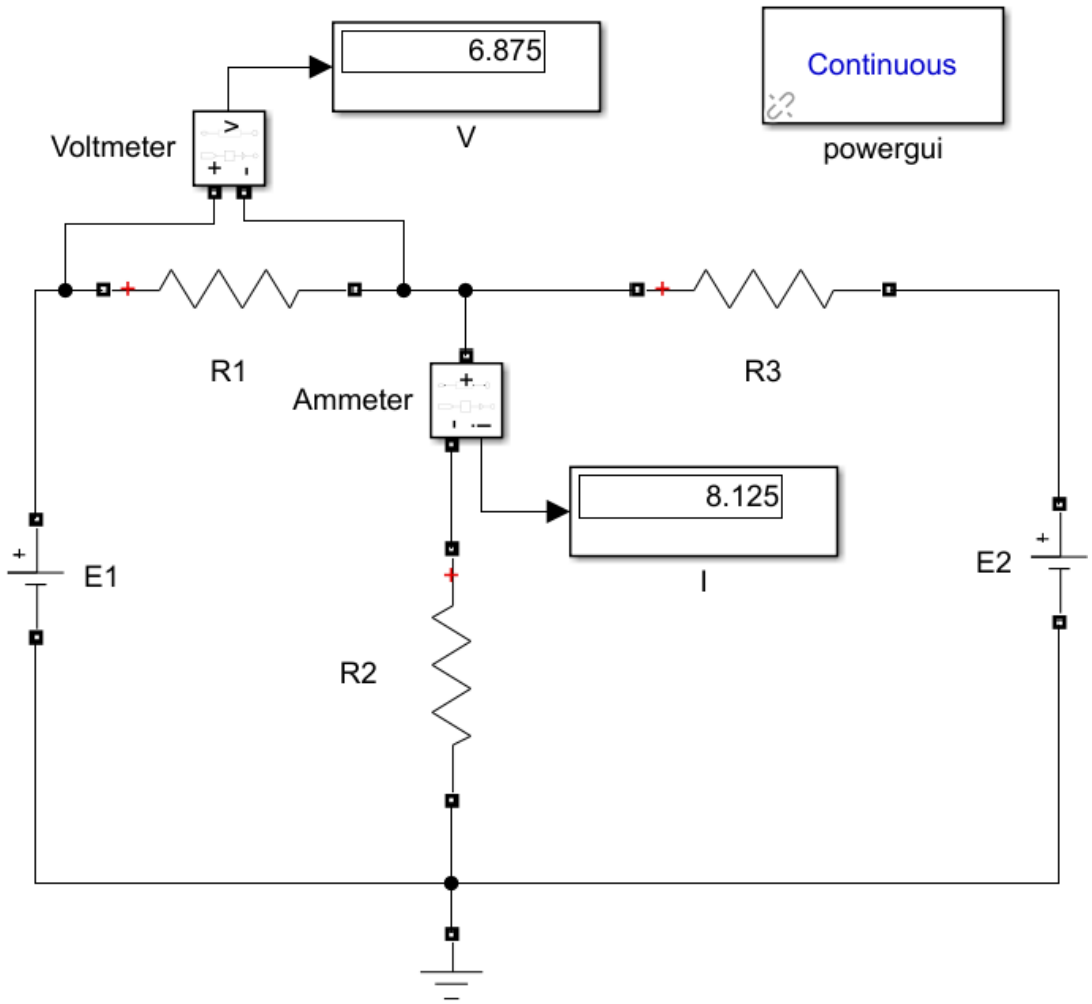
Table 1: When both sources are acting together as in Fig. 1

No.	$E_1(V)$	$E_2(V)$	$V_1(V)$	$I_2(A)$
1	5	20	-1.875	0.006875
2	10	15	2.5	0.0075
3	15	10	6.875	0.008125

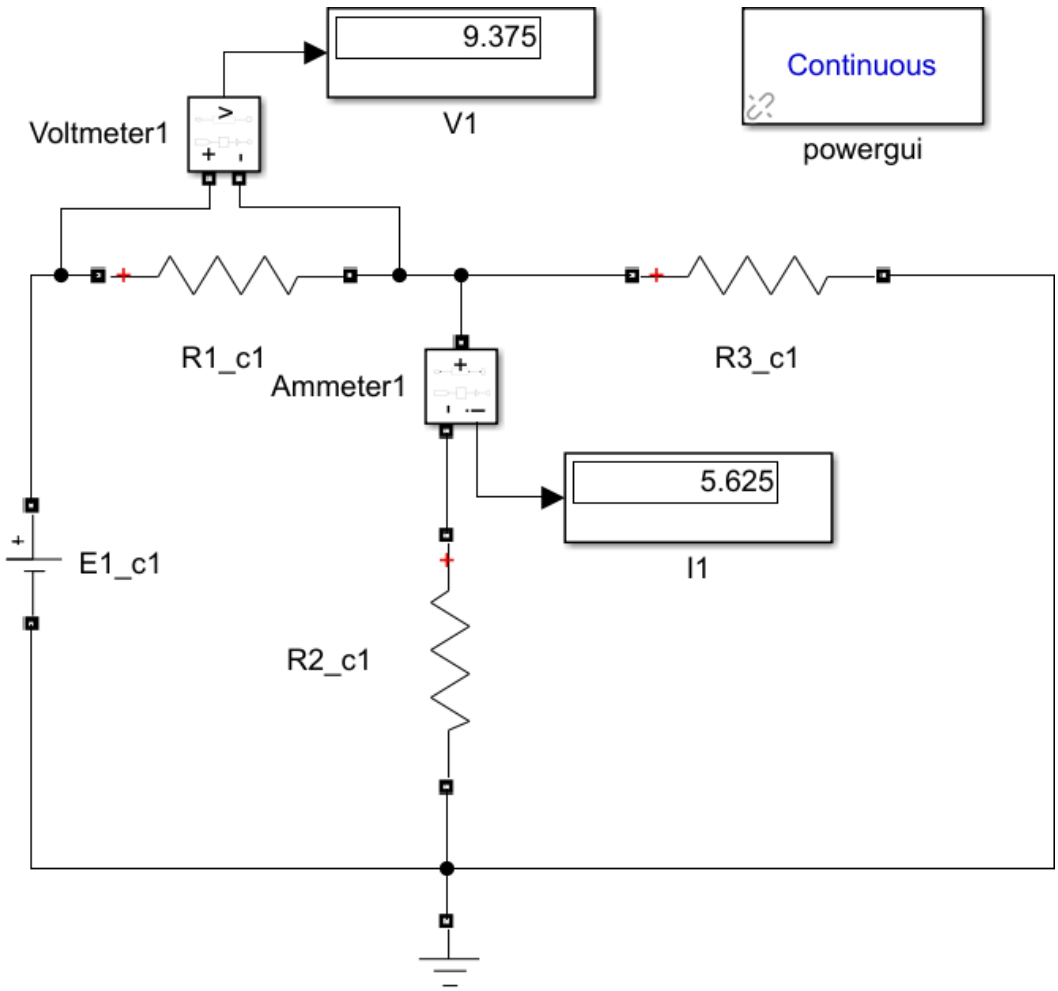
Table 2: When both sources are acting together as in Fig. 2

No.	$E_1(V)$	$E_2(V)$	$V_1(V)$	$I_2(A)$
1	5	0	3.125	0.001875
2	10	0	6.25	0.00375
3	15	0	9.375	0.005625
4	0	20	-5	0.005
5	0	15	-3.75	0.00375
6	0	10	-2.5	0.0025

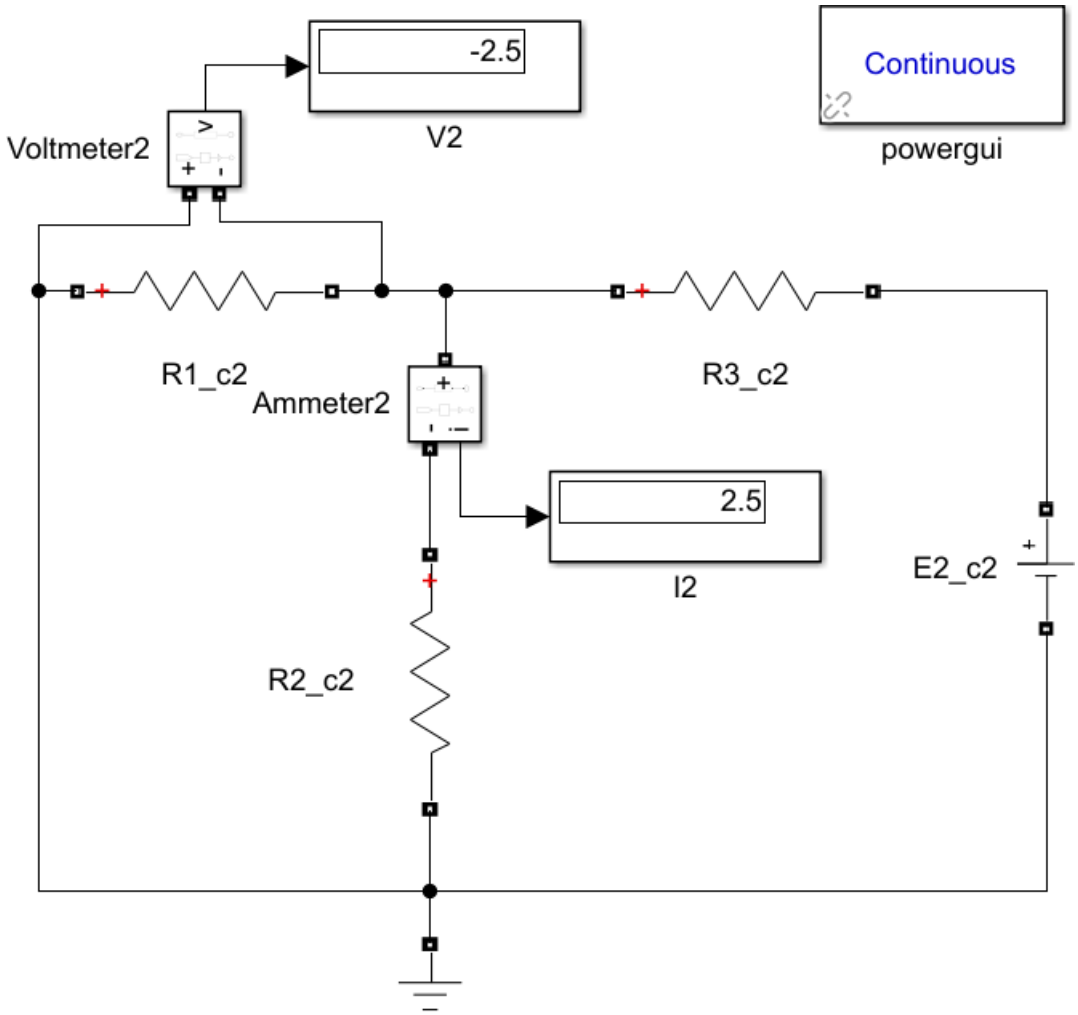
Screen shot of simulation diagram - original circuit



Screen shot of simulation diagram – circuit with source E1 alone



Screen shot of simulation diagram – circuit with source E2 alone



Result:

Superposition theorem verified in the given DC resistive circuit by simulating original circuit, circuit with source E1 alone and circuit with source E2 alone on MATLAB-Simulink platform.