IC160P-Electrical Systems Around Us Lab

Verification of Superposition theorem using MATLAB/Simulink

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1.Objectives

To Verify Superposition Theorem from the given circuit.

2.Theory

The superposition theorem states that in a linear network containing two or more sources, the response in any element is equal to the algebraic sum of the responses caused by individual sources acting alone, while the other sources are non-operative. By non-operative, it is meant that, ideal voltage sources and ideal current sources in the network are replaced zero voltage (short circuit) and zero current (open circuit) across their terminals.

The above statement describes the so-called additive property of linear systems. In addition, if all sources are multiplied by a constant, the response also gets multiplied by the same constant, which is the so-called homogeneity property. Mathematically, the property of superposition implies additivity and homogeneity.

3.Procedure and Verification

1. Connect the circuit as given in Fig. 1. Measure current I3 for different values of V1 and V2.

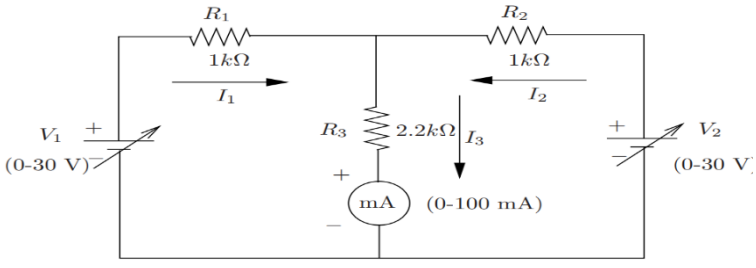
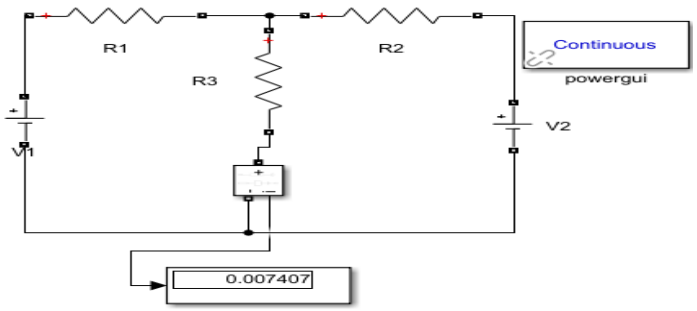


Fig. 1: A network with two sources



2. Remove source V2 from the circuit and short the points in the circuit where the source was connected as shown in Fig. 2. Measure the current for the same values of V1 as done earlier.

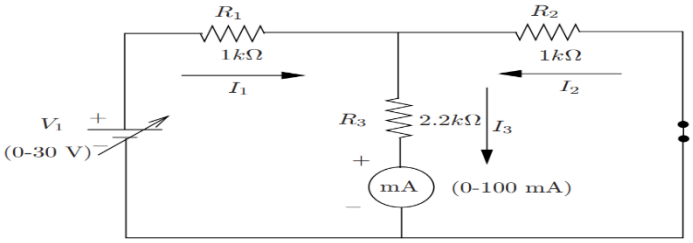
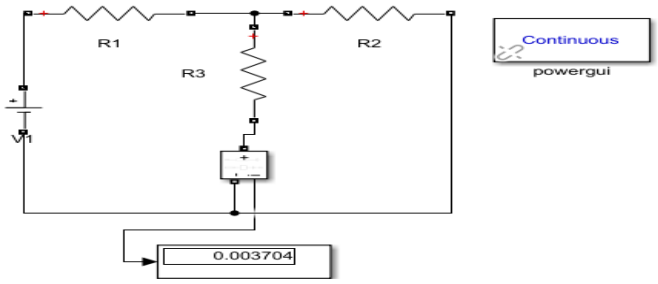


Fig. 2: Network with only Source 1 present



3. Similarly, repeat the procedure for only source V2 in the circuit as shown in Fig. 3.

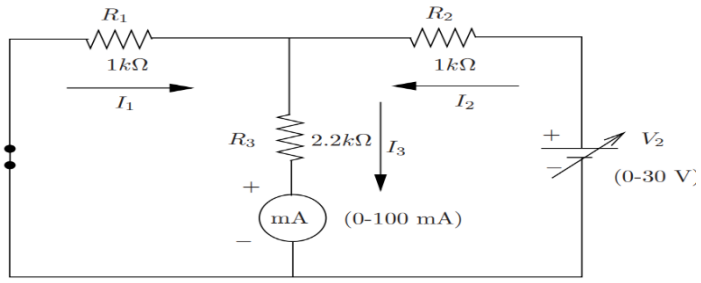
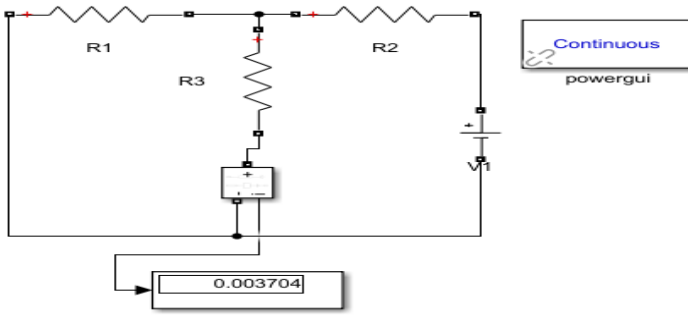


Fig. 3: Network with only Source 2 present



4. Present your results in a tabular form as shown in Table 1 and Table 2 (Table 2 is shown for the case when only source V1 is present, draw a similar table for the case wherein only source V2 is present). Here, I3 1 is the current through R3 due only to source V1, similarly I3 2 represents the current through R3 due only to source V2.

Table 1:

V1 (V)	V2 (V)	I3 (A)	
		Measured	Theoretical
20	20	0.007407	0.007407
10	20	0.005556	0.005556
30	20	0.009259	0.009259

Table 2:

V1 (V)	I3_1 (A)	
	Measured	Theoretical
20	0.003704	0.003704
10	0.001852	0.001852
30	0.005556	0.005556

5. From the values of I3_1, I3_2 and I3, verify if the Superposition theorem is valid for this circuit.

Conclusion:

From the above observations, we always get sum of I3_1 and I3_2 equals to I3. This is Superposition Theorem which is valid in all the circuits. Hence, Superposition Theorem is verified.

4.Questions

1. Consider the circuit shown in Fig. 1 and replace resistance R2 with a diode. Can you apply superposition theorem to this network? Justify your answer.

Soln:No, Superposition Theorem is an extension combination of KVL & KCL. Hence, can only be valid for linear elements and diode is non-linear so it fails.

2. How will you modify the statement of superposition theorem for non-ideal independent sources?

Soln:For non-ideal independent sources, current through an element is algebraic sum of all the contributions of individual sources. This is being modified for non-ideal independent sources.

3. Are inductors and capacitors linear elements? Explain.

Soln:Yes, capacitors and inductors are linear elements as their I-V curve have scaling and additative properties.

4. Give two examples of nonlinear elements, justifying your answer.

Soln:Diode and Transistor are two examples of non-linear elements as their I-V curve doesn’t have scaling and additative properties.