Basics of Electrical and Electronic Circuits

Experiment 03 **Spring 2025**

Verification of Kirchoff's Law and Superposition Principle

Superposition Principle:

The objective of this experiment is to learn how Superposition Principle can simplify the analysis of linear circuits. The circuit consisting of two resistors, one inductor and one capacitor, along with the connections of the two independent DC voltage sources, is shown in **Fig. 1**.

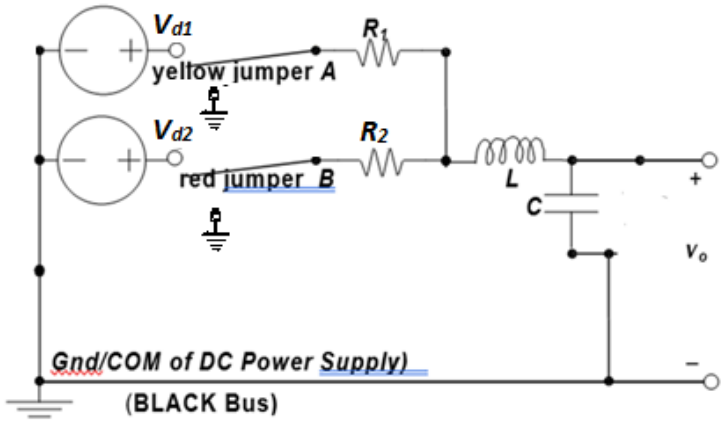
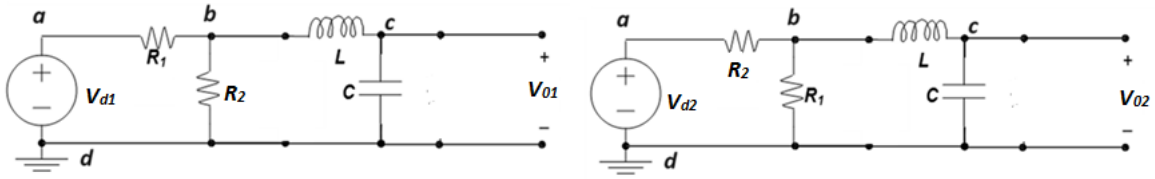


Fig. 1 Circuit with Two Independent DC Voltage Sources

Superposition Principle says that the response of the circuit of **Fig. 1** to the two voltage sources V_{d1} and V_{d2} acting together is given by the algebraic sum of the responses obtained from two separate circuits obtained by keeping only one of the two sources and replacing the other voltage source by wires (**short circuit**). These two circuits, each having only one source, have the same structure, as shown in **Fig. 2**, where the output voltage is denoted by V_{o1}/V_{o2} depending on the applied source V_{d1}/V_{d2} respectively.



(a) **(b)**

Fig. 2 Equivalent Circuit for one Source

1. Note the connections already brought out to the breadboard from the D-C Power Supply, which can provide multiple d-c voltages. **Red** and **black** wires have been used to connect an adjustable positive d-c voltage V_{d1}, and the common (**COM**/***Gnd***) terminal of the D-C Power Supply to the **red**, and **black buses** respectively on the breadboard. The D-C Power Supply has been adjusted to give V_{d1} = **+ 4 V**. **Do not disturb** these settings or the connections of the d-c power supply.
2. Similarly prepare second source for DC supply of V_{d2} = **- 3 V.**
3. Using R_1 = R_1 = 3.00kΩ, L = 1mH and C = 0.001μF, assemble the circuit given in **Fig. 1** on the breadboard. In this experiment, each of the two points ***A*** and ***B*** of the circuit will have to be connected **either** to **Gnd** or to the respective source (V_{D1}, V_{D2}). This will be done with the help of two short **jumper** wires: a **yellow** wire for point ***A*** and a **red** wire for point ***B***. As shown in **Fig. 1**, one end of each **jumper** wire will remain connected to the corresponding point ***A*** or ***B*** while

the other end will be connected **either** to ***Gnd*** or to the respective source (***V_{D1}***, ***V_{D2}***) just by shifting the other end of the wire refer **Fig.2**.

4. Connect ***A***, ***B*** to ***V_{d1}***, ***V_{d2}*** respectively by placing the **jumper** wires appropriately. The output voltage ***V_o*** is now due to **both** (two) inputs applied together. Display the output voltage ***V_o*** of the circuit on DSO/ multimeter. Note the measured voltage levels of ***V_o*** .

Table:1

V_{d1} (DC source1)	V_{d2} (DC source2)	V_o

5. Leaving ***A*** connected to ***V_{d1}***, move the **jumper** wire of ***B*** to disconnect it from ***V_{d2}*** (RED bus), and connect it to ***Gnd***. This replaces the sources ***V_{d2}*** by short-circuits, as shown in **Fig.2(a)**. Note the voltage levels of ***V_{o1}***, due to ***V_{d1}*** alone.

Table:2.

V_{d1} (DC source1)	V_{d2}(short circuit)	V_{o1}
	0 V	

6. Disconnect ***A*** from ***V_{d1}*** and connect it to ***Gnd***, thereby replacing ***V_{d1}*** by a short-circuit. Disconnect ***B*** from ***Gnd*** and connect it to ***V_{d2}***, as shown in **Fig.2(b)**. Note the resulting values of the output voltage ***V_{o2}***, due to ***V_{d2}*** alone.

Table:3

V_{d1} (short circuit)	V_{d2} (DC source2)	V_{02}
0		

7. Verify Superposition Principle by comparing the values of the output voltage ***V_o***, as measured in **step 4** with **both** sources present, with (***V_{o1}*** + ***V_{o2}***) calculated from the measurements made in **steps 5 and 6**. As well as verify superposition principle of the circuit by theoretical analysis and compare this value with the experimentally measured value.

Table:4

	V_{01}	V_{02}	V_0	$V_{01} + V_{02}$
Practical				
Theoretical				

KVL and KCL Verification using DC voltage source:

1. Modify the circuit as given in Fig.2(a) by adding R_3 = 1K Ohm and using DC source V_d= 4 V fill the observation Tables using multimeter in proper mode of operation (Ammeter/voltmeter).

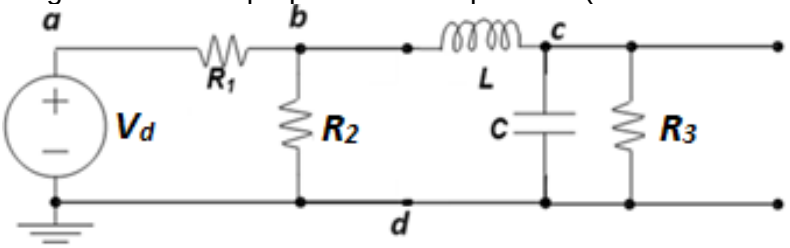


Fig.3 Circuit diagram for KVL and KCL verification using DC voltage source

Table:5 for KVL: Measured V_d =……V using multimeter

V_{ab}	V_{bc}	V_{cd}	V_{db}	V_{da}

2. **Write KVL** for the following loops and **verify** it from the readings taken in Table 5**.**
i. abcda, ii. abda, iii. bcdb,

Table:6 for KCL

I_{ab}	I_{bc}	I(C)	I(R3)	I_{bd}

3. **Write KCL** for the node ‘b’ and ‘c’ and **verify** it using the readings of Table-6.
4. **Observe and identify** the short circuit and open circuit behavior of capacitor and inductor.

Results:

Conclusion: It must be in your words and be based on your understanding/ learning in the experiment.