Laboratory Manual

EE-153L – Introduction to Electrical Engineering

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Instructor

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Experiment 6

Parallel Resistive Circuit

6.1 Objective

The focus of this exercise is an examination of basic parallel DC circuits with resistors. A key element is Kirchhoff's Current Law which states that the sum of currents entering a node must equal the sum of the currents exiting that node. The current divider rule will also be investigated.

6.2 Theory Overview

A parallel circuit is defined by the fact that all components share two common nodes. The voltage is the same across all components and will equal the applied source voltage. The total supplied current may be found by dividing the voltage source by the equivalent parallel resistance. It may also be found by summing the currents in all of the branches. The current through any resistor branch may be found by dividing the source voltage by the resistor value. Consequently, the currents in a parallel circuit are inversely proportional to the associated resistances. An alternate technique to find a particular current is the current divider rule. For a two resistor circuit this states that the current through one resistor is equal to the total current times the ratio of the other resistor to the total resistance.

6.2.1 Pre-Lab Task

Before performing the experiment in the laboratory, complete the following tasks in **LTspice** to demonstrate your understanding of the theoretical concepts. These preparatory tasks will help you predict circuit behavior and verify your results during the lab session.

6.3 Equipment

- Adjustable DC Power Supply
- Digital Multimeter
- 1 kΩ, 2.2 kΩ, 3.3 kΩ, 6.8 kΩ

6.4 Schematics

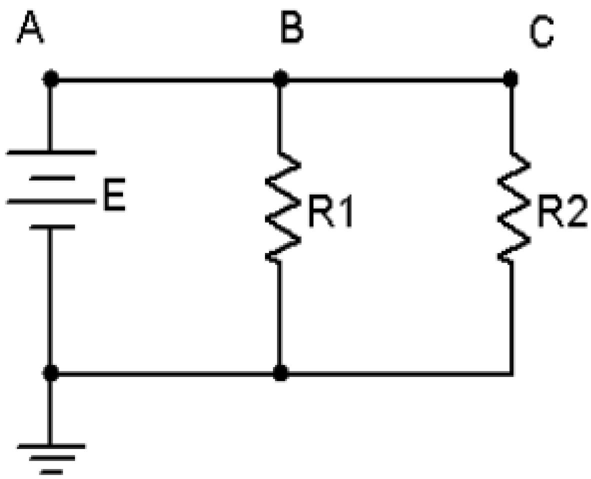

Fig 6.1

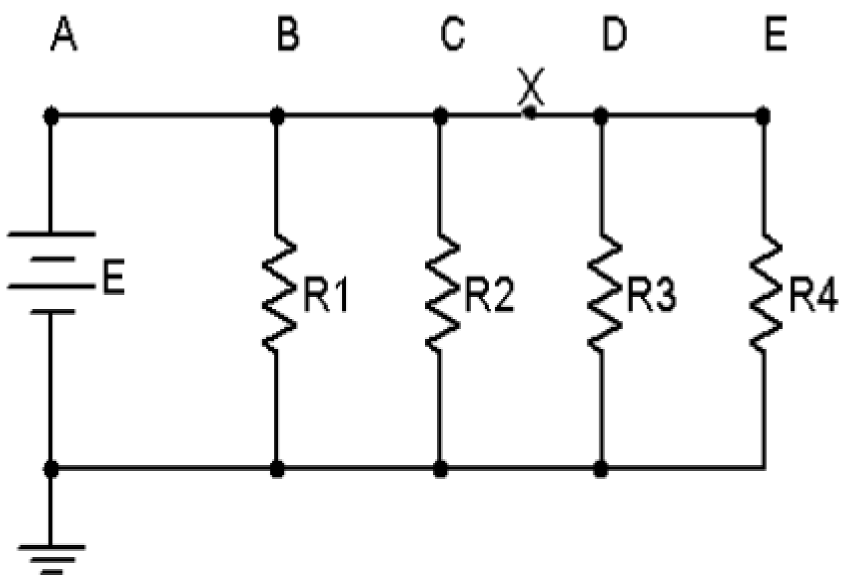

Fig 6.2

6.5 Procedure

1. Using the circuit of Figure 6.1 with R1 = 1 k, R2 = 2.2 k and E = 8 volts, determine the theoretical voltages at points A, B, and C with respect to ground. Record these values in Table 6.1. Construct the circuit. Set the DMM to read DC voltage and apply it to the circuit from point A to ground. The red lead should be placed at point A and the black lead should be connected to ground. Record this voltage in Table 6.1. Repeat the measurements at points B and C.
2. Apply Ohm's law to determine the expected currents through R1 and R2. Record these values in the Theory column of Table 6.2. Also determine and record the total current.

3. Set the DMM to measure DC current. Remember, current is measured at a single point and requires the meter to be inserted in-line. To measure the total supplied current place the DMM between points A and B. The red lead should be placed closer to the positive source terminal. Record this value in Table 6.2. Repeat this process for the currents through R1 and R2. Determine the percent deviation between theoretical and measured for each of the currents and record these in the final column of Table 6.2.
4. Crosscheck the theoretical results by computing the two resistor currents through the current divider rule. Record these in Table 6.3.
5. Consider the circuit of Figure 6.2 with R1 = 1 k, R2 = 2.2 k, R3 = 3.3 k, R4 = 6.8 k and E = 10 volts. Using the Ohm's law, determine the currents through each of the four resistors and record the values in Table 6.4 under the Theory column. Note that the larger the resistor, the smaller the current should be. Also determine and record the total supplied current and the current ***Ix***. Note that this current should equal the sum of the currents through R3 and R4.
6. Construct the circuit of Figure 6.2 with R1 = 1 k, R2 = 2.2 k, R3 = 3.3 k, R4 = 6.8 k and E = 10 volts. Set the DMM to measure DC current. Place the DMM probes in-line with R1 and measure its current. Record this value in Table 6.4. Also determine the deviation. Repeat this process for the remaining three resistors. Also measure the total current supplied by the source by inserting the ammeter between points A and B.
7. To find ***Ix***, insert the ammeter at point **X** with the black probe closer to R3. Record this value in Table 6.4 with deviation.

6.6 Data Tables

Voltage	**Theory**	**Measured**
V_A		
V_B		
V_C		

Table 6.1

Current	**Theory**	**Measured**	**Deviation**
R1			
R2			
Total			

Table 6.2

Current	**CDR Theory**
R1	
R2	
Total	

Table 6.3

Current	**Theory**	**Measured**	**Deviation**
R1			
R2			
R3			
R4			
Total			
I_x			

Table 6.4

6.7 Questions

1. For the circuit of Figure 6.1, what is the expected current entering the negative terminal of the source?

2. For the circuit of Figure 6.2, what is the expected current between points B and C?

3. In Figure 6.2, R4 is approximately twice the size of R3 and about three times the size of R2. Would the currents exhibit the same ratios? Why/why not?

4. If a fifth resistor of 10 kΩ was added to the right of R4 in Figure 6.2, how would this alter $\boldsymbol{I_{Total}}$ and $\boldsymbol{Ix}$? Show numerically.

5. Is KCL satisfied in Tables 6.2 and 6.3?

6.8 Conclusion

Assessment

Sr. No.	Specific Course Learning Outcomes	Knowledge Domains	Performance indicator
	Upon completion of this course, the students will be able to		
1	**USE** electronic lab instruments including the digital multi-meter, function generator, oscilloscope and electronic circuit trainer.	P1	• Proper wiring of the circuit • Correct use of instruments (signal generator, oscilloscope) • Data recorded in table
2	**CONSTRUCT** and **ANALYZE** basic circuits.	P2	• Relate experiment with theoretical concept discussed in class. • Describe relevant mathematical equations • Discuss discrepancies between theoretical, simulation and experimental results • Possible sources of discrepancies and ways to improve
3	**COMMUNICATE** clearly and effectively through presentation and/or report.	A2	• Report is structured properly • Figures and Graphs annotated • Language is clear
4	**DEMONSTRATE** teamwork and show commitment to the group in achieving the objectives of laboratory.	A2	• Does his/her part in the group • Listen to other's ideas • Does not argue
5	**DEMONSTRATE** punctuality, dress appropriately and comply with the standard safety procedures of the lab.	A2	• Wear proper dress to perform the tasks and Follow lab timing • Follow safety instructions for handling the instruments.