Experiment 1

Familiarization

Name	Group	Grade
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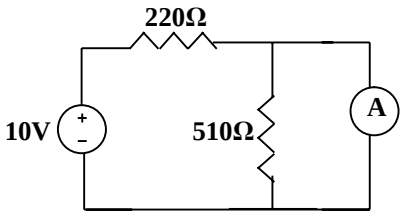
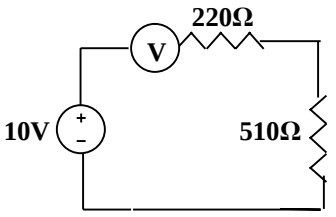
Objectives

1. To learn how to use the instruments for measuring DC voltages;
2. To learn how to adjust power supplies.

Pre-Lab

1. Find the mistake in connecting the meters (if any) in each of the circuits 1,2 and 3.
2. What will be the reading of the voltmeter in circuit 4.





(1)…….

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(2)……

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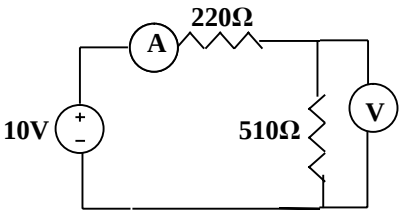

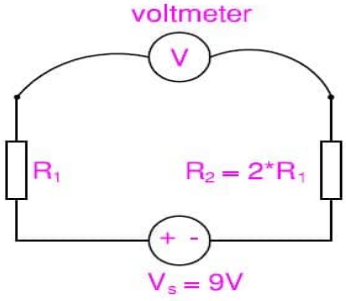

(3)…….

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(4) (a) 2.5 V

(b) 9 V

(c) 7.5 V

(d) 0 V

Procedure

1. Identify the power supply unit.

- There is a **fixed** 5V power supply. Identify it. What colors are its outputs?

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- There are two **variable** power supplies. Identify them. What colors are their outputs? What are their ranges?

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- Identify the multimeter. What can it measure?

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2. Connect the multimeter to the 5V power supply using **banana to banana** wires. Set the multimeter to **DC-volts** and a **scale** that gives you a good reading . Turn on the power supply. What is the voltage reading? …… What is the scale you have used?……
3. The variable power supplies have ranges 0-20V and –20-0 volts, respectively. There is a reference in the middle (not connected to ground). Each supply has a control made of two **knobs** one inside the other. The outside knob is called the **fine control** and the one inside is called the **coarse control**. The fine control adjusts the voltage source **more accurately**.

- Connect the power supply on the right to the multimeter (**red to red** and **black to black**) and set its scale to 20VDC. Set the fine control to zero (completely **counterclockwise**).
- Use the scale of the power supply to set the coarse control at the following voltage values. At each voltage, record the voltmeter reading.

Coarse control	Voltmeter reading
2	
4	
6	
8	
12	
14	
16	
18	
20	

4. Connect now the power supply on the left to the multimeter (**green to black** and **black to red**). Again, turn the fine control completely to zero. Repeat the previous measurement using this power supply.

Coarse control	Voltmeter reading
2	
4	
6	
8	
12	
14	
16	
18	
20	

Conclusion

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Experiment 2
Resistance and Ohm's law

Name	Group	Grade
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Objectives:

1. Learn how to measure resistance using various ways.
2. Verify Ohm's law experimentally

Pre-Lab

1. A voltage of 110 V is across a 5 percent, 20-kΩ resistor. What range must the current be?
2. What is the greatest voltage that can be applied across a 1/8W, 2.7-MΩ resistor without causing it to overheat?

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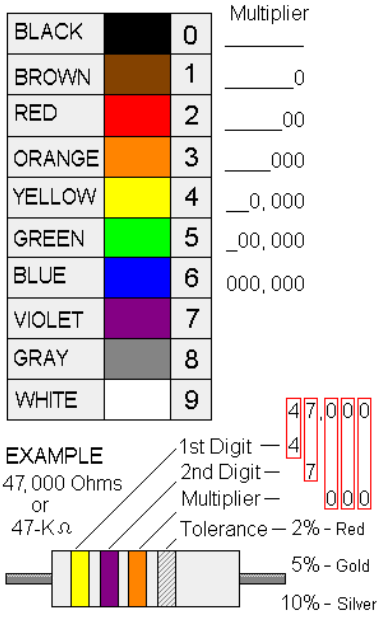
Experiment

The opposite figure shows how to read the color codes to find the value of resistance.

1. You are given three resistors. Identify the different band colors in each resistor. What is the value of the resistance of each resistor. Record the data in table 1.
2. Using the multimeter, measure the resistance of each resistor and record the values in the last column of table 1.
3. Now you are given another resistor, find its resistance using the band colors and the multimeter measurement.
4. Connect the circuit shown. Adjust the controls to produce the voltages indicated in table 2 and measure the corresponding currents.



5. Make a graph of the data recorded (plot the voltages **versus** the currents in the next page). Draw the best **straight line** that passes through most of the points.

6. From the graph, find the resistance of the resistor using **the slope** of the line. Record your results in table 3

Table 1

Resistor	Color of Band 1	Color of band 2	Color of band 3	Color of band 4	Nominal value	Percent error	Multimeter measurment
1							
2							
3							

Table 2

Voltage (Volts)	Current (mA)
2	
4	
6	
8	
10	
12	
14	
16	

Table 3

Resistance using color code	Resistance using multimetrer	Resistance using the gragh

Write a conclusion on the different methods of finding resistance and Ohm's law.

Conclusion

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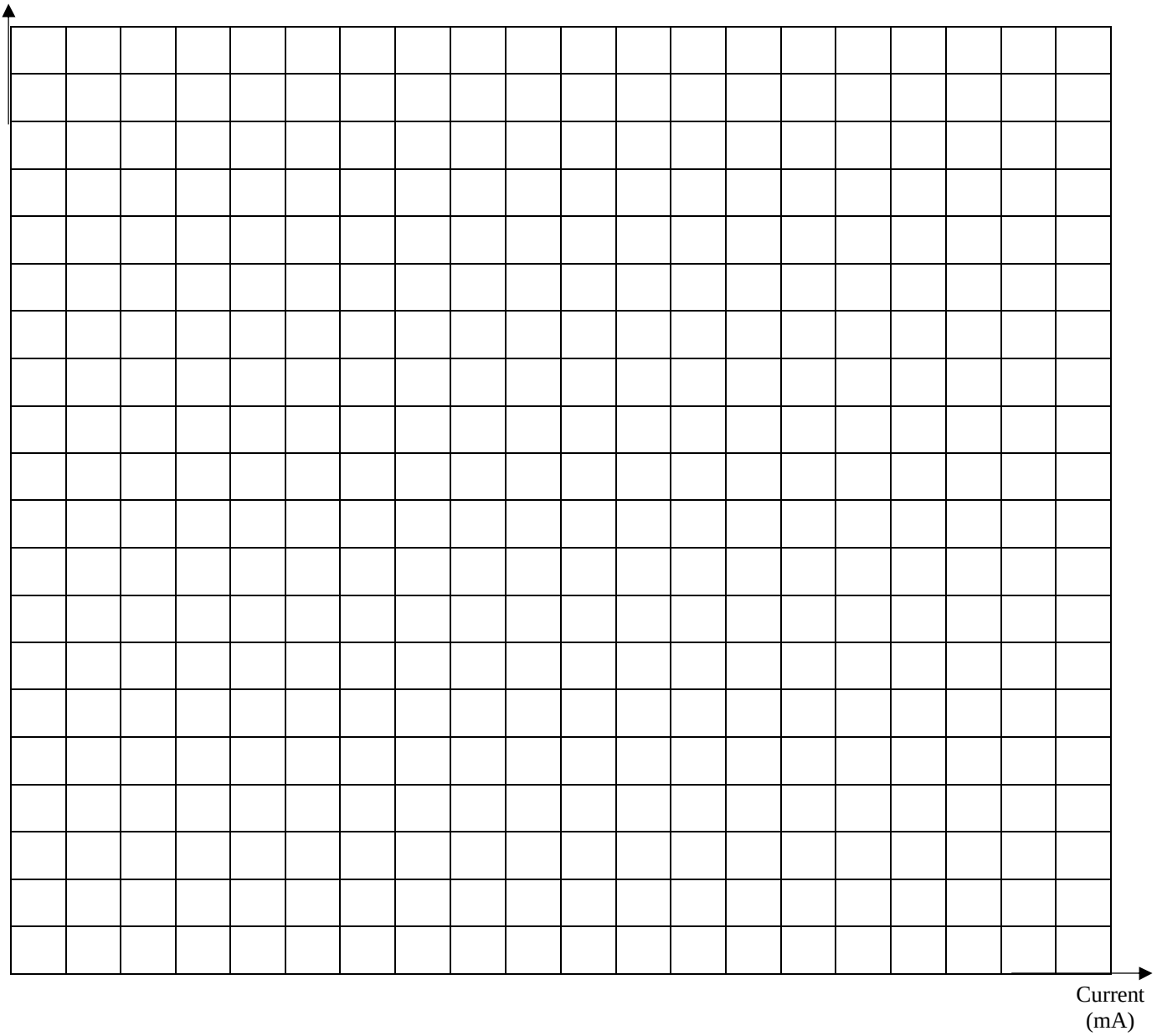
Voltage (V)



Current (mA)

IGEE/L02/EE102-LAB.

Experiment 3
Series circuits

Name	Group	Grade
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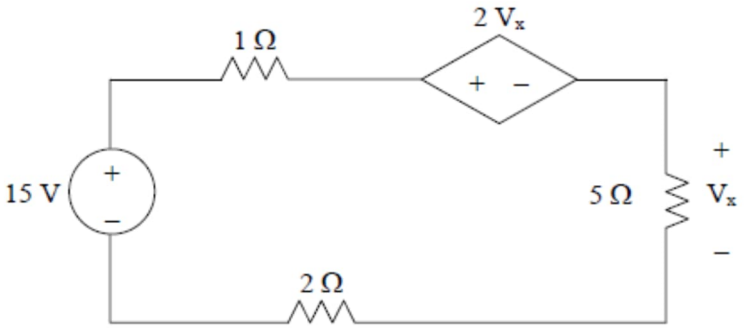
Objectives:

1. To measure voltages and currents of series circuits and compare them with calculated results.
2. To verify the notions of voltage division in series circuits.

Pre-Lab

Find V_x in the circuit shown.



Solution:

The experiment

1. You are given four resistors. Measure the resistance of each resistor. The smallest resistor is labeled R_1, the next resistor is R_2 and the largest is R_4.
2. Using the circuit of Figure 1 with E = 10 volts. Determine the theoretical value of the current and record it in Table 1. Construct the circuit. Set the multimeter to read DC current and insert it in the circuit at point A. Remember, ammeters are **connected in series** and require the circuit to be opened for proper measurement. Record this current in Table 1. Repeat the current measurements at points B and C.
3. Using the theoretical current found in Step 1, apply Ohm's law to determine the expected voltage drops across R_1, R_2, and R_3. Record these values in the Theory column of Table 2.
4. Set the multimeter to measure DC voltage. Remember, voltage is measured **across components**. Record this value in Table 2. Repeat this process for the voltages across R2 and R3. Determine the percent deviation (as shown in the equation below) between theoretical and measured for each of the three resistor voltages and record these in the final column of Table 2.

$$Deviation = \frac{|V_{calculated} - V_{measured}|}{V_{calculated}} \times 100$$

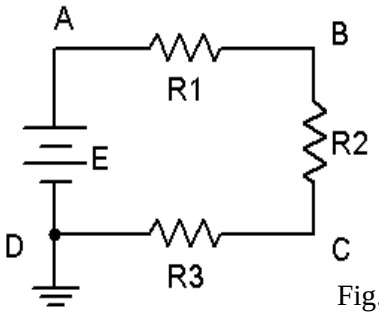


Fig. 1

Table 1

Theory	*Point A*	*Point B*	*Point C*

Table 2

Voltage	*Theory*	*Measured*	*Deviation*
R1			
R2			
R3			

Calculations:

5. Consider the circuit of Figure 2 with E = 20 volts. Using the voltage divider rule, determine the voltage drops across each of the four resistors and record the values in Table 3 under the Theory column. Also determine the voltages V_{AC} and V_B, again using the voltage divider rule.
6. Construct the circuit of Figure 2. Set the multimeter to measure DC voltage. Place the multimeter probes across R1 and measure its voltage. Record this value in Table 3. Also determine the deviation. Repeat this process for the remaining three resistors.
7. To find V_{AC}, place the red probe on point A and the black probe on point C. Similarly, to find V_B, place the red probe on point B and the black probe on ground. Record these values in Table 3 with the deviations.

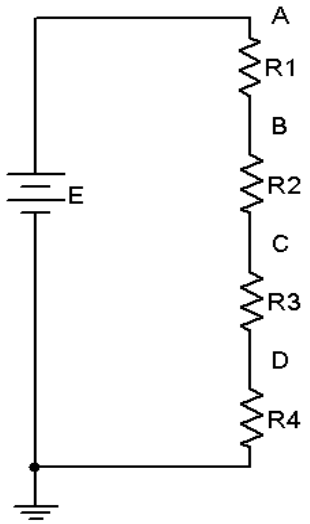


Fig. 2

Table 3

Voltage	*Theory*	*Measured*	*Deviation*
R1			
R2			
R3			
R4			
V_{AC}			
V_B			

** Using the measured voltages, is KVL satisfied in Tables 2 and 3?.....

Conclusion

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Experiment 4
Parallel circuits

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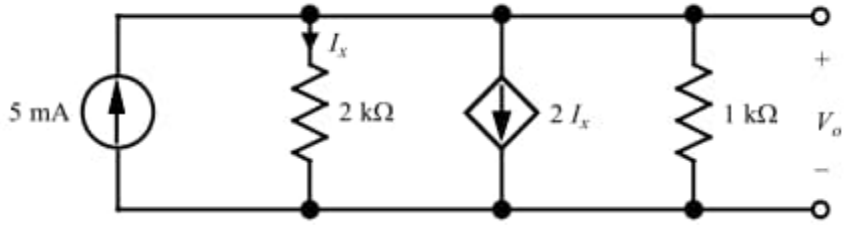
Objectives:

1. To measure voltages and currents of parallel circuits and compare them with calculated results.
2. To verify the notion of current division in parallel circuits.

Pre-Lab

Find V_o in the circuit shown.



Solution:

The experiment

1. You are given four resistors. Measure the resistance of each resistor. The smallest resistor is labeled R_1, the next resistor is R_2 and the largest is R_4.
2. Using the circuit of Figure 1 with E = 8 volts, determine the theoretical voltages at points A, B, and C with respect to ground. Record these values in Table 1. Construct the circuit. Set the multimeter to read DC voltage and apply it to the circuit from point A to ground. Record this voltage in Table 1. Repeat the measurements at points B and C.
3. Apply Ohm's law to determine the expected currents through R_1 and R_2. Record these values in the Theory column of Table 2. Also determine and record the total current.
4. Set the multimeter 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 multimeter between points A and B. Record this value in Table 2. Repeat this process for the currents through R_1 and R_2. Determine the percent deviation (as below) between theoretical and measured for each of the currents and record these in the final column of Table 2.

$$Deviation = \frac{\left|I_{calculated} - I_{measured}\right|}{I_{calculated}} \times 100$$

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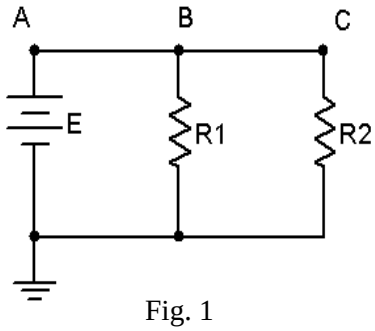

Fig. 1

Table 1

Voltage	Theory	Measured
V_A		
V_B		
V_C		

Table 2

Current	Theory	Measured	Deviation
R1			
R2			
Total			

Calculations:

5. Consider the circuit of Figure 2 with E = 10 volts. Using the Ohm's law, determine the currents through each of the four resistors and record the values in Table 3 under the Theory column. Also determine and record the total supplied current.
6. Construct the circuit of Figure 2. Set the multimeter to measure DC current. Place the multimeter probes in series with R_1 and measure its current. Record this value in Table 3. 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.

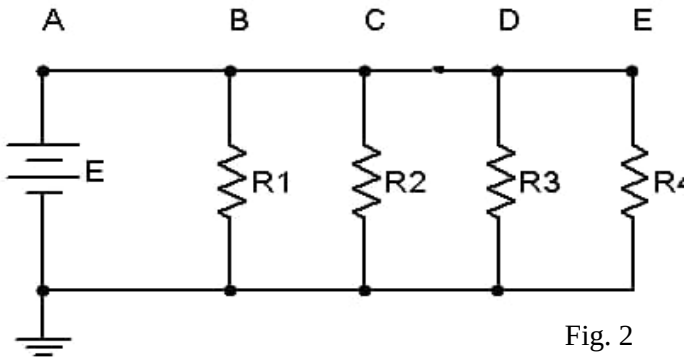

Fig. 2

Table 3

Current	Theory	Measured	Deviation
R1			
R2			
R3			
R4			
Total			

** Using the measured voltages, is KCL satisfied in Tables 2 and 3?

Conclusion

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