

Lab 2 – Ohm’s Law and Resistor Combinations

Objectives:

The objective of this lab is to examine Ohm’s law and relationships of current, voltage, and resistance in series and parallel DC circuits.

Theory:

Ohm’s law states that the value of the electrical current (I) in a conductor is equal to the voltage (V) across the conductor divided by the resistance (R).

$$V = IR \quad (\text{Eq. 1})$$

**Series Circuits**

**Parallel Circuits**

The current through each component is equal to the total current	$I_1 = I_2 = I_{\text{total}} = V/R_{\text{total}}$	The total current is equal to the sum of the currents through each component	$I_1 + I_2 = I_{\text{total}} = V/R_{\text{total}}$
The total resistance equals the sum of the individual resistances	$R_{\text{total}} = R_1 + R_2$	Resistances add inversely	$1/R_{\text{total}} = 1/R_1 + 1/R_2$
The sum of the individual voltage drops equals the total voltage	$V_{\text{total}} = V_1 + V_2$	The voltages across each component are equal	$V_1 = V_2 = V$
Individual voltage drops may be found using Ohm’s Law for each resistance	$V_1 = I_1 R_1 = I_{\text{total}} R_1$ $V_2 = I_2 R_2 = I_{\text{total}} R_2$	Ohm’s Law still applies	$V_1 = I_1 R_1$ and $V_2 = I_2 R_2$

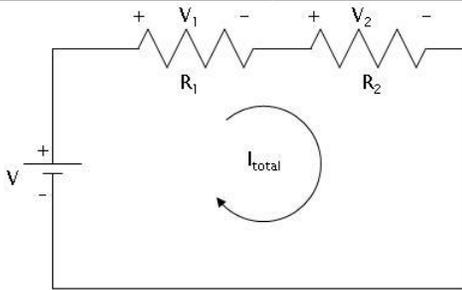


Figure 1: Series Circuit

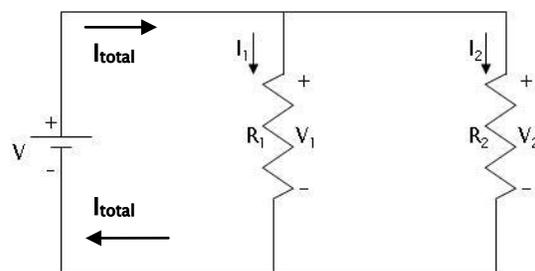


Figure 2: Parallel Circuit

Procedure:

Caution: Do not switch on power at any time during this experiment until your lab instructor has approved your circuit.

Do not exceed 12.0 V operating voltage.

1. Set up the circuit shown in Figure 3. Set the resistance to  $100\ \Omega$ . Turn the voltage control knob completely counterclockwise. Have your circuit approved by your instructor.

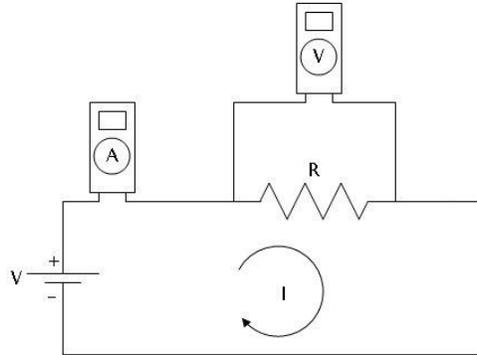


Figure 3: Series circuit with ammeter and voltmeter connections

2. Switch on the power. Measure and record the current through the circuit and the voltage across each resistor for each of 11 values of voltage in the range from 2.0 V to 12.0 V.
3. Set up the circuit shown in Figure 4. Set one resistance box ( $R_1$ ) to  $50\ \Omega$  and the other ( $R_2$ ) to  $50\ \Omega$ . Have your circuit approved by your instructor.

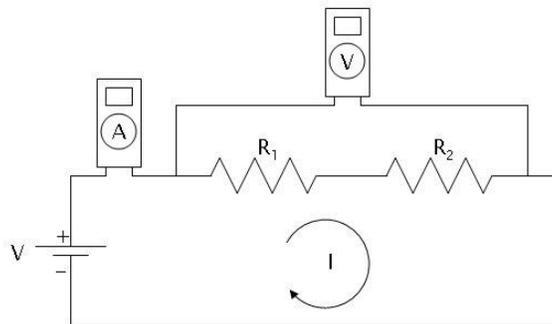


Figure 4: Series circuit with ammeter and voltmeter connections

4. Switch on the power and adjust the voltage to 6 V. Record the current and voltage values.
5. Reconnect the voltmeter across the two ends of  $R_1$  without disturbing the rest of the circuit. Record the voltage drop across  $R_1$  and the current through the circuit.
6. Repeat Step 5 for resistor  $R_2$ .

7. Switch off the power. Set up the circuit shown in Figure 5, placing the ammeter at point A. Set  $R_1$  to  $100\ \Omega$  and  $R_2$  to  $200\ \Omega$ . Have your circuit approved by your instructor.

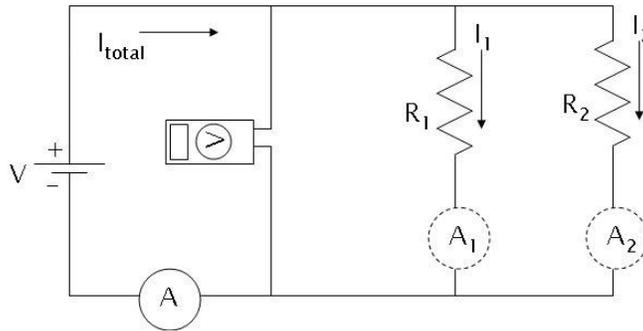


Figure 5: Parallel circuit with ammeter and voltmeter connections

8. Switch on the power and adjust the voltage to 6 V. Record the total current and voltage values.
9. Switch off the power. Reconnect the ammeter at point  $A_1$  and have the circuit approved. Switch on the power and adjust the voltage to 6 V. Record the current through  $R_1$  and voltage across  $R_1$ .
10. Repeat Step 9 with the ammeter at point  $A_2$ . Record the current through and voltage across  $R_2$ .

Calculations:

1. Plot the values obtained in Procedure Step 2 in Excel or other graphical analysis program with voltage (in volts) on the ordinate (y axis) and current (in amps, not milliamps) on the abscissa (x axis). Calculate a linear regression fit and compute the resistance from the slope of the line.
2. From the data obtain in Procedure Steps 3–6, discuss clearly how your experimental data agrees with theoretical expectations of series resistance circuits (analyze the circuit theoretically using Ohms Law and resistor combinations).
3. From the data obtained in Procedure Steps 7–10, discuss clearly how your experimental data agrees with theoretical expectations of parallel resistance circuits analyze the circuit theoretically using Ohms Law and resistor combinations).