Ohm's Law, Kirchhoff's Voltage Law and Kirchhoff's Current Law

Materials:

- Direct current (DC) power supply: 2230 High Power Programmable Power Supply
- Digital multimeter (DMM): DMM6500
- Resistors (3)
- Breadboard
- Jumper wires

Procedure:

Task 1: Exploring the Relationship Between Voltage, Current and Resistance using Ohm's Law
Use the corresponding resistor values for Task 1 R = 200Ω, 500Ω, 1 kΩ.

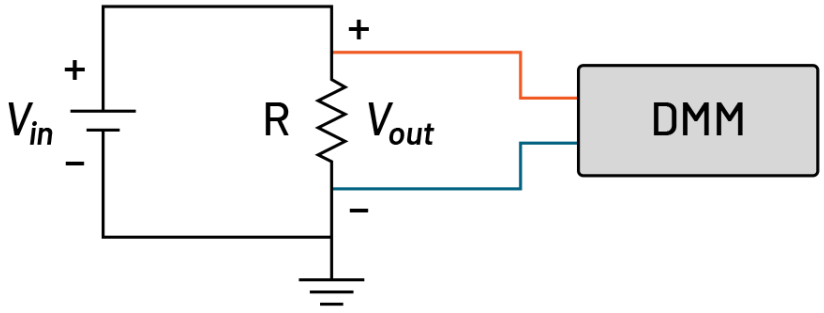

Figure 1. Using a DMM to measure voltage across a resistor circuit diagram.

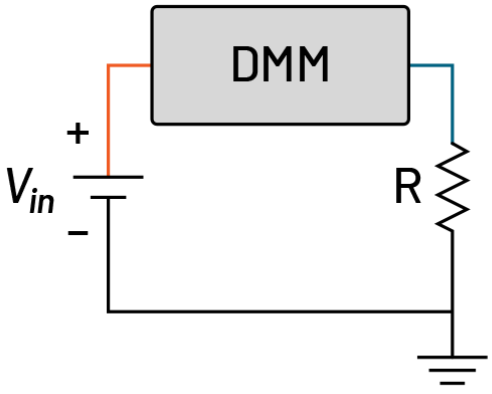

Figure 2. Using a DMM to measure current through a resistor circuit diagram.

1. Construct the resistor circuit in Figure 1. by using a DC power supply and a DMM. Set the power supply to 1 V output and use the first resistor value. To measure the voltage across the resistor, the DMM must be in parallel with the resistor. Measure the voltage across the first resistor and record the measurement in Table 1. Repeat this step for the next two resistor values. Does the voltage across the second and third resistor values change?

2. Next, measure the current of the circuit by placing the DMM in series with the resistor shown in Figure 2. Use the same three resistor values used in Step 1 and keep the power supply outputting 1 V to the circuit. Record the current values for each resistor in Table 1. Does the current change when varying the resistance?

3. Compare your results using the following Ohm's law formula where *V* is voltage, *I* is current, and R is resistance:

$$V = I * R$$

Calculate the current for each resistor value you used in Steps 1-2 using 1 V for the voltage value. Do the calculated current values match up with the measurements from Step 2?

Resistor Value (Ω)	Measured Voltage (V)	Measured Current (A)

Table 1. Measured values from Task 1.

Task 2: Understanding Circuit Behavior with Kirchoff's Voltage Law (KVL)
Use the corresponding resistor values for this part of the lab: R_1 = 200 Ω, R_2 = 1 kΩ

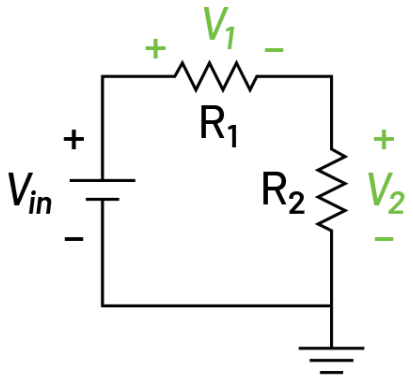

Figure 3. Voltage divider circuit diagram

1. Build the voltage divider circuit in Figure 3 with the corresponding resistor values. Use the DC power supply to supply 1 V to input of the circuit (V_{in}). Make sure the resistors are in **series**.

2. Measure the voltage drop across the resistors R_1 and R_2 and record those voltages in Table 2. Make sure to place the DMM in parallel to the resistor to measure the voltage drop. Notice which resistor has a larger voltage drop. Next, place the DMM in series with the resistors to measure the current. Notice how despite where the DMM is in series with the resistors, the current measurement stays the same because the circuit is one loop.

3. Kirchoff's voltage law states that voltages around a loop should equal 0 V. Use the following formula to verify your measurements:

$$V_{in} = V_1 + V_2$$

The current measurement of the circuit can also be used to verify the measurements and calculate the voltage drop across each resistor. Use the following formula to calculate V_{in} using the measured current, then compare the results to the actual input to the circuit.

$$V_{in} = I(R_1 + R_2)$$

Resistor Value (Ω)	Measured Voltage (V)	Measured Current (A)
R_1:	V_1:	I:
R_2:	V_2:	I:

Table 2. Measured values from Task 2.

Task 3: Understanding Circuit Behavior with Kirchoff's Current Law (KCL)
Use the corresponding resistor values for this part of the lab: R_1 = 200 Ω R_2 = 1 kΩ

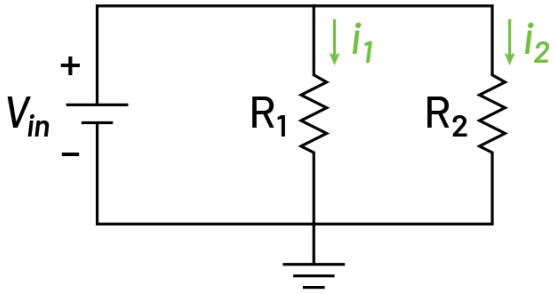

Figure 4. Current divider circuit diagram.

1. Build the current divider circuit in Figure 4 with the same resistor values used in Task 2. Use the DC power supply to supply 1 V to input of the circuit (V_{in}). Make sure the resistors are in **parallel** and the grounds are tied together.

2. Measure the current through each resistor branch (i_1 and i_2) by placing the DMM in series with the corresponding resistor. Measure the total current of the circuit by placing the DMM in series with the power input and resistor branches. Record these measurements in Table 3. Next, measure the voltage drop across each resistor and record the measurement. Compare the measurements to Task 2. What measurements are different between the voltage divider and current divider circuit? Which resistor pulls more current in this circuit?

3. Kirchoff's current law states that the sum of currents entering and leaving a junction should equal zero. Use the following formula to validate your current measurements in Step 2:

$$I = i_1 + i_2$$

The total current can also be calculated by substituting in Ohm's law for i_1 and i_2:

$$I = V(\frac{1}{R_1} + \frac{1}{R_2})$$

Resistor Value (Ω)	Measured Voltage (V)	Measured Current (A)
R_1:	V:	i_1:
R_2:	V:	i_2:

Table 3. Measured values from Task 2: Kirchoff's Voltage Law.