Experiment 4 — Series Circuits

EL 111 - DC Fundamentals

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Objectives:

1. For the student to investigate the characteristics of a series circuit.
2. For the student to verify experimentally, using measured and calculated values, the following series circuit rules:
   a. Total circuit resistance equals the sum of the individual resistances.
   b. The current is the same at all points in a series circuit.
   c. The sum of the voltage drops equals the source voltage.
3. For the student to determine the effects of changing a resistor value, upon total resistance, current and distribution of voltage drops.

Equipment:

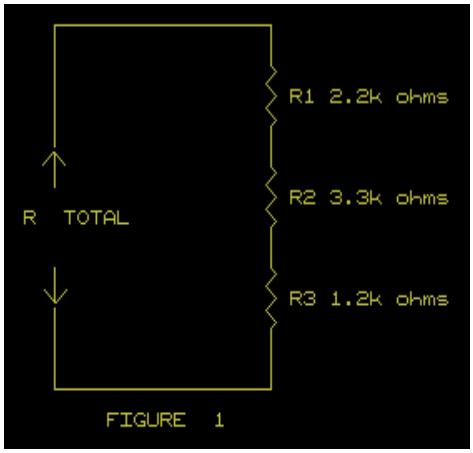
- Meters: Agilent 34401A Digital Multimeter (DMM);
  Milliammeter or Handheld MM such as the Agilent 971A
- Power Supply: Agilent E3631A DC power supply (0 to 20.0V DC)
- Resistors: 1 - 3.3 kΩ, 1 - 2.2 kΩ, 2 - 1.2 kΩ
- Misc: Component board

Information:

1. NEVER use an ohmmeter on a live circuit. Voltage from a circuit can damage an ohmmeter.
2. Always use the measured value of resistance for all calculations.
3. Always adjust the power supply voltage with the circuit connected.
4. When measuring voltage, the voltmeter must be connected across the circuit.
5. When measuring current, you must **break the circuit** and the current meter must be inserted into the circuit (in series).

Procedure:
PART ONE : Total resistance in a series circuit.

1. Measure each individual resistor and record below.



R_1=_____

R_2=_____

R_3=_____

2. Connect the circuit in Figure 1. Note that there is no applied voltage.
3. Measure the total resistance.

R_{total} =_____

4. Add the measured values of R_1, R_2, and R_3 recorded in step 1 together and record.

$R_1 + R_2 + R_3$ =_____

5. What conclusions can be made from the results of the previous procedures?

_____

_____

PART TWO: Current relationship in a series circuit.

1. Connect the circuit in Figure 2. Note that this circuit is the same as in Figure 1, except that there is now a DC supply voltage connected. Set the voltage source to 18.0 volts.

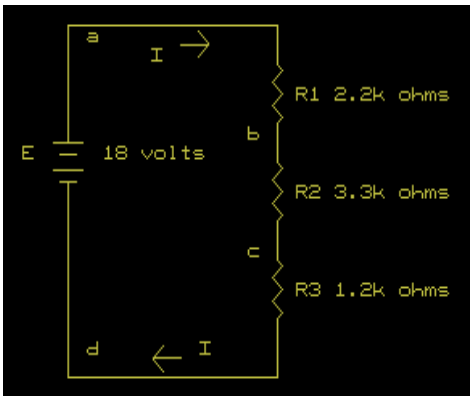


Figure 2

2. Break the circuit at point a. Insert the milliammeter or handheld and measure and record the current flow through point a.

I_a =_____

3. Break the circuit at point b. Insert the milliammeter or handheld and measure and record the current flow through point b.

I_b =_____

4. Break the circuit at point c. Insert the milliammeter or handheld and measure and record the current flow through point c.

I_c =_____

5. Break the circuit at point d. Insert the milliammeter or handheld and measure and record the current flow through point d.

I_d =_____

6. What conclusions can be made from the results of the previous procedures?

_____

_____

PART THREE: Voltage relationships in a series circuit.

1. Connect the circuit of Figure 3. Set the DC supply voltage to 15.0 volts.

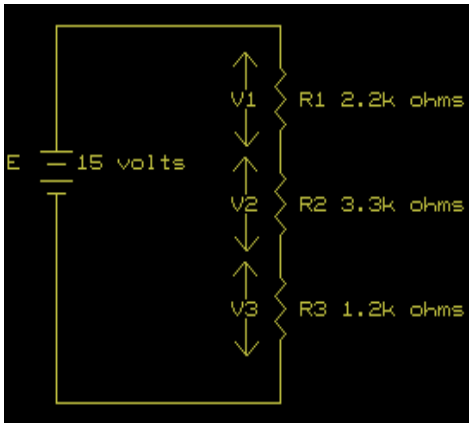


Figure 3

2. Measure the voltage drop across each resistor. Record.

V_1 = _____

V2 = _____

V3 = _____

3. Add the voltage drops together and record.

Total of voltage drops = _____

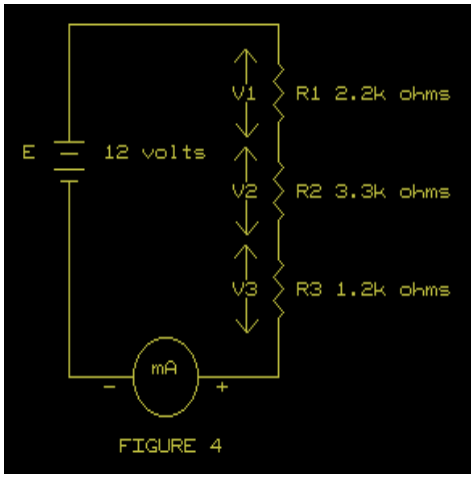
4. What conclusions can be made from the results of the previous procedures?

_____

_____

PART FOUR: Effects of changing a resistance size in a series circuit.

1. Connect the circuit in Figure 4. Set the DC supply voltage to 12.0 volts. Maintain this value even when circuit changes are made.



2. Measure the circuit current and record.

I = _____

3. Measure the voltage across each resistor and record.

V_1 =_____

V2 =_____

V3 =_____

4. Disconnect the source voltage and measure the total resistance. Record it.

R_t = _____

5. Change the size of R_1 to 1.2 kΩ. Leave R_2 and R_3 as they are in Figure 4.

6. Repeat procedures 2, 3 and 4 and record the new values below.

I =_____

V_1 = _____

V_2 = _____

V_3 =_____

R_t =_____

7. Noting that R_1 has been <u>decreased</u> in value, in step 5, answer the following questions.

a. What has happened to the total circuit resistance?_____

Why?_____

_____

b. What has happened to the circuit current?_____

Why?_____

_____

c. What has happened to the voltage drops across R_2 and R_3?_____

Why?_____

d. What has happened to the voltage drop across R_1?_____

- *Notice that you have been given far more room to answer the question below. This is because this question NEEDS a lot more thought, and explanation.*

Why?_____