Experiment 6 — Parallel Circuits

EL 111 - DC Fundamentals

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Objectives:

1. For the student to investigate the characteristics of a parallel circuit.
2. For the student to verify experimentally, using measured and calculated values, the following parallel circuit rules:
    a. The voltage is the same across each branch of a parallel circuit.
    b. The sum of the individual branch currents equals the total current in a parallel circuit.
    c. The reciprocal of the total resistance equals the sum of the reciprocals of the individual branch resistances.
    d. For the student to determine, for a parallel circuit, the effects of changing a single resistor value, upon total resistance, total current and the distribution of branch currents.

Equipment and parts:

- Meters: Agilent 34401A DMM;
  Milliammeter or Handheld MM such as the Agilent 971A
- Power Supply: Agilent E3631A DC power supply
- Resistors: 330 Ω, 1.2 kΩ, 5.6 kΩ, 2.2 kΩ, 33 kΩ, two 3.3 kΩ
- Misc: Component Board

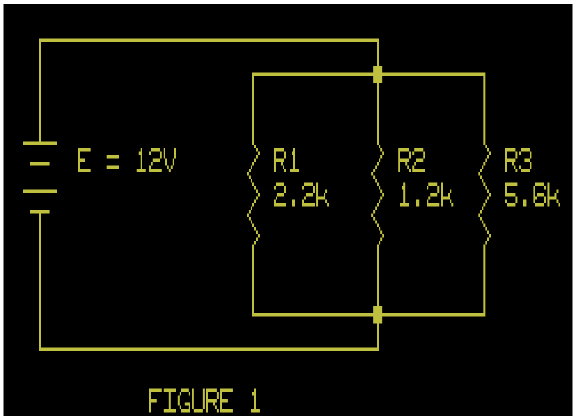
Information:

1. Always use the measured value of resistance for all calculations.
2. Always adjust the power supply voltage with the circuit connected.
3. When measuring voltage, the voltmeter must be connected across the circuit element of interest.
4. When measuring current, the current meter must be inserted into the “break” in the circuit (in series).

Procedure:

PART ONE-Voltage characteristic in a parallel circuit.

1. Connect the circuit in Figure 1. Adjust the voltage source to a value of 12 volts (with the circuit connected).
2. Using the DMM, measure the voltage across each resistor. Record below.



V_{R1} =______________

V_{R2} ______________

V_{R3} ______________

3. What conclusion can be made from these procedures?

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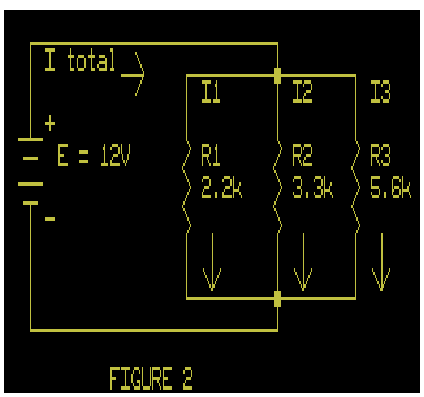
PART TWO: Current relationships in a parallel circuit.

1. Connect the circuit in Figure 2. Make sure that the source voltage is properly set to 12 volts with the circuit connected.
2. Using a current meter, measure the current through each resistor and the total current. Record below.



I_{R1} = ______________

I_{R2} = ______________

I_{R3} = ______________

I_{total} = ______________

3. Add the measured currents through R_1, R_2, and R_3 together and compare with the measured total current. Record the sum of measured currents.

I_{total} ______________

4. What conclusions can be made from the above procedures?

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PART THREE: Resistance relationship in a parallel circuit.

1. Connect the circuit in Figure 3. Note that there is no source voltage connected.

2. Using a DMM, measure the total resistance. Record.

R_t ____________

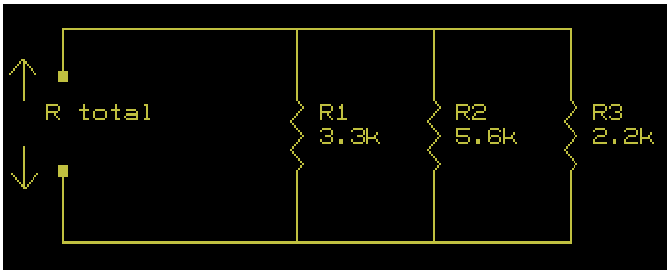

FIGURE 3

3. Remove each resistor from the circuit. Using the DMM, individually measure, R_1, R_2, and R_3. Record each value below.

R_1 = ____________

R_2 =____________

R_3 = ____________

4. Using one of the relationships for resistors connected in parallel solve for the total resistance in Figure 3. Show calculation(s).

5. What conclusion can be made from the preceding procedures?

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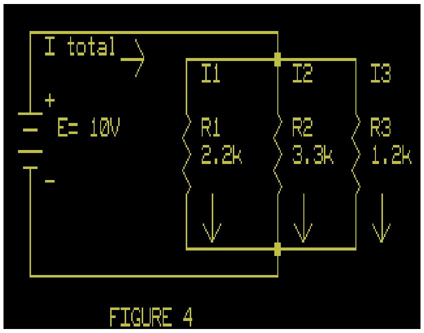
PART FOUR: Effect of changing a resistor in one branch of a parallel circuit.

1. Connect the circuit in Figure 4. Set the source voltage to 10 volts with the circuit connected.

2. Measure the current through each resistor, and the total current, and record below.



I_1 = _______________

I_2 = _______________

I_3 = _______________

I_t = _______________

3. Change the value of R_2 to 5.6 kΩ. Again measure the current through each resistor, and the total current, and record below.

I_1 = _______________

I_2 = _______________

I_3 = _______________

I_t = _______________

PART FOUR Continued: Effect of changing a resistor in one branch of a parallel circuit.

4. Compare the results of procedure 3 with procedure 2. What conclusions can be made?

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PART FIVE: Measuring the effect on circuit parameters as the ratio of resistance values are changed in a two branch parallel circuit.

1. Connect the circuit of Figure 5. Note that R_1 and R_2 are equal. In succeeding procedures, R_1 will be always be 3.3 kΩ, but R_2 will be changed.

2. Measure the current through each resistor, and the total current. Then measure the total circuit resistance with the voltage source removed. Record.

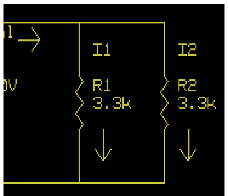

FIGURE 5

I_1 = ________________

I2 = ________________

I_t = ________________

R_t = ________________

3. Change R_2 to 330 Ω. Repeat procedure 2 and record.

I_1 = ________________

I_2 = ________________

I_t = ________________

R_t = ________________

4. Change R_2 to 33 kΩ. Repeat procedure 2 and record.

I_1 = ________________

I_2 = ________________

I_t = ________________

R_t = ________________

5. Compare the results of procedures 2,3, and 4. What conclusions can be made concerning the ratio of the two individual resistance values upon circuit parameters R_{total}, I_{total}, and the current through R_1.

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