Name: ________________________

Series Resistor Networks

Discussion Overview

A series circuit is defined as a single loop in which all components are arranged in a daisy-chain fashion. The current in a series circuit is the same for all the branches in the loop. This property can be arrived at intuitively by observing that if the current exiting a branch is different than the current entering the next branch, it would mean that the current is either “pooling up” at the node between the branches, or it is leaking out. As this is clearly not the case, the currents in each branch of a series circuit must be the same.

The current in the series circuit may be found by dividing the total voltage applied across the entire circuit by the total resistance. The total or equivalent resistance for a series resistive circuit is, of course, the sum of the individual resistances in the circuit. Therefore,

$$I = \frac{V_{source}}{\sum_{i=1}^{n} R_i} \qquad \text{Eq. 1}$$

The voltage drops across each individual resistor may then be found using Ohm’s Law and by multiplying the current flowing in the series circuit by the resistor’s value.

$$V_j = IR_j$$

Substituting Eq. 1 for I above, we have

$$V_j = V_{source} \frac{R_j}{\sum_{i=1}^{n} R_i}$$

The technique used above to find the voltage drop across an individual resistor is called the voltage divider rule. The voltage divider rule states that the voltage across any resistor (or combination of resistors) is equal to the voltage source times the ratio of the resistance of interest to the total resistance.

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Schematics

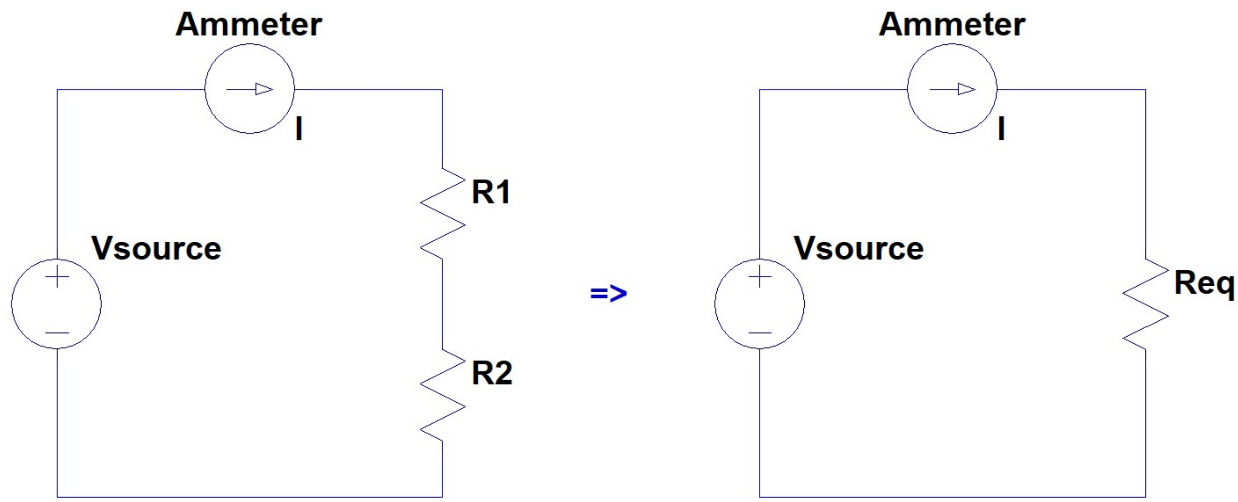

Figure 1 - Series Resistive Network

Procedure

A. Given the circuit shown in Figure 1, determine the equivalent resistance of the circuit for R_1 and R_2 with the values given in Table 1 below. (Note that for the cases where R_2 is either a photo-resistor or a thermistor, you will need to measure the resistance of R_2 under the conditions given in the table.)

B. Given the equivalent resistance, using Ohm's law ($I = \frac{V}{R}$) and V_{source} = 9V, determine the theoretical current in the circuit and record it in Table 1 below.

C. Given the calculated current in step B and using Ohm's law ($V = IR$), determine the voltage across R1 and R2. Record the values in Table 1.

D. Construct the resistor network on a breadboard. **Do not connect the voltage source at this point!** **Before** connecting the voltage source, measure the value of each resistor and that of the equivalent resistance. Record the equivalent resistance value in Table 1 and compare it to the theoretical value determined in step A.

E. Connect the source and multi-meter to measure the current. Record the value in Table 1 and compare it to the theoretical value determined in step B.

F. With another multi-meter measure the voltage across only R1 and then across only R2. Record the values in Table 1 and compare them to the theoretical values determined in step C.

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Table 1 - Calculated and Measured Circuit Values

		Calculated				Measured						
R1 (Ω)	**R1 (Ω)**	**Req (Ω) = R1 + R2**	**I (A) = V_{source} / Req**	**V_{R1} (V) = I x R1**	**V_{R2} (V) = I x R2**	**R1 (Ω)**	**R2 (Ω)**	**Req (Ω) = R1 + R2**	**I (A)**	**V_{R1} (V)**	**V_{R2} (V)**	**V_{R1} + V_{R2} (V)**
1K	5.1K											
1K	Photo-resistor No Light											
1K	Photo-resistor Direct Light											
1K	Thermistor Ambient Temp											
1K	Thermistor Body Temp											