# Parallel Resistor Network

## Objective

The focus of this exercise is an examination of basic parallel DC circuits with resistors. A key element is Kirchhoff’s Current Law which states that the sum of currents entering a node must equal the sum of the currents exiting that node. The current divider rule will also be investigated.

## Theory Overview

A parallel circuit is defined by the fact that all components share two common nodes. The voltage is the same across all components and will equal the applied source voltage. The total supplied current may be found by dividing the voltage source by the equivalent parallel resistance. It may also be found by summing the currents in all of the branches. The current through any resistor branch may be found by dividing the source voltage by the resistor value. Consequently, the currents in a parallel circuit are inversely proportional to the associated resistances. An alternate technique to find a particular current is the current divider rule. For a two resistor circuit this states that the current through one resistor is equal to the total current times the ratio of the other resistor to the total resistance.

## Schematics

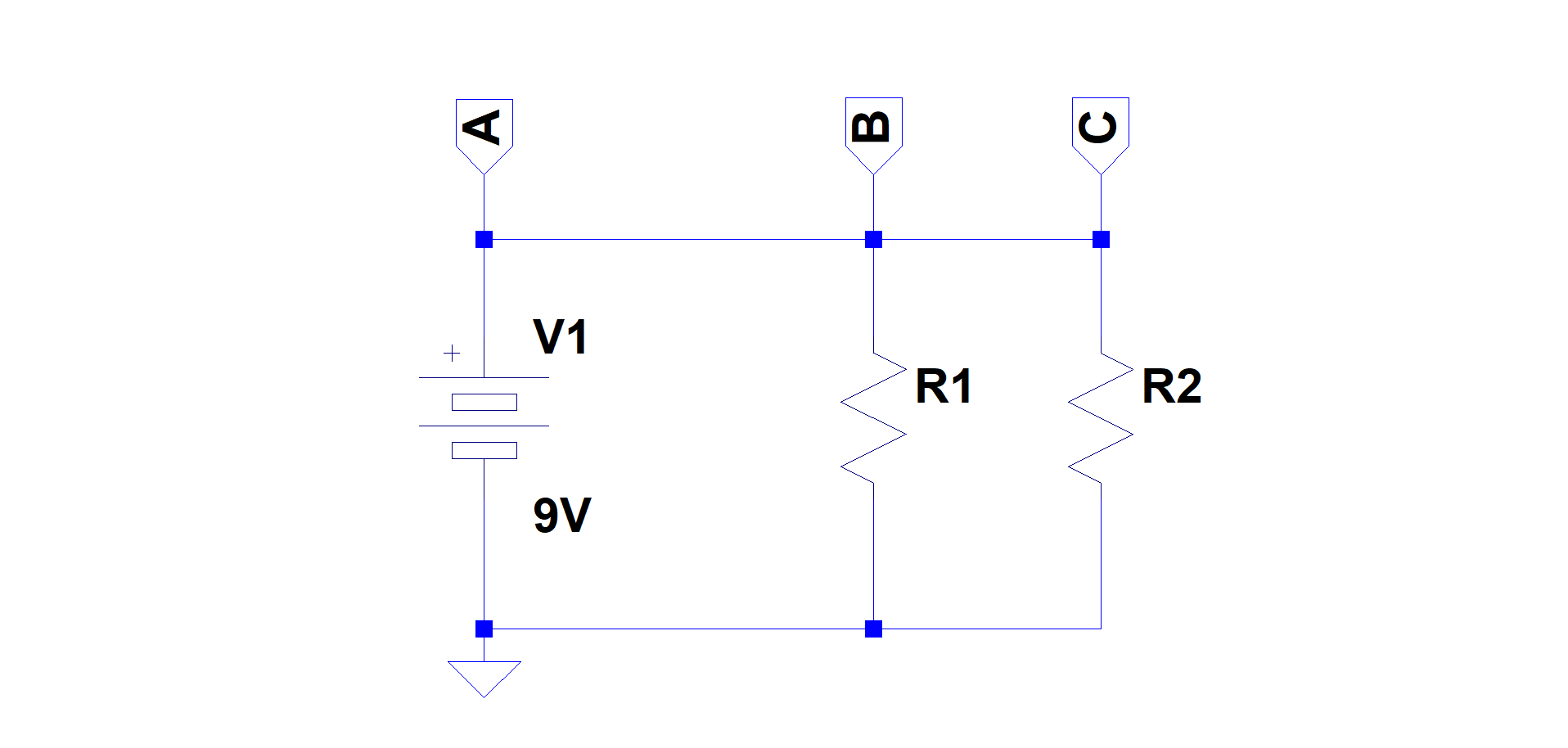


Figure 1 - Parallel Resistor Network

## Procedure

1. Given the circuit shown in Figure 1, determine the equivalent resistance of the circuit for and values given in Table 1 below. (Note that for the cases where is either the photoresistor or thermistor, you will need to measure the resistance under the conditions given in the table.)
2. Given the equivalent resistance, using Ohm’s law () and VB1 = 9V, determine the theoretical current in the circuit and record it in Table 1 below.
3. Given the calculated current in step B and using Ohm’s law (), determine the voltage across R1 and R2. Record the values in Table 1.
4. Construct the resistor network on a breadboard. **Do not connect the battery at this point!** **Before** connecting the battery, measure the value of each resistor and the equivalent resistance. Record the equivalent resistance value in Table 1 and compare it to the theoretical value determined in step A.
5. Connect the battery and multimeter to measure current. Record the value in Table 1 and compare it to the theoretical value determined in step B.
6. With another multimeter 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.

Table 1 - Calculated and Measured Circuit Values

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Calculated** | | | | **Measured** | | |
| **R1 ()** | **R2 ()** | **Req () =**  **R1 + R2** | **I (A) =**  **VB1 / Req** | **VR1 (V) =**  **I x R1** | **VR2 (V) =**  **I x R2** | **I (A)** | **VR1 (V)** | **VR2 (V)** |
| 1K 1% | 5.1K 5% |  |  |  |  |  |  |  |
| 1K 1% | Photoresistor  No Light |  |  |  |  |  |  |  |
| 1K 1% | Photoresistor  Ambient Light |  |  |  |  |  |  |  |
| 1K 1% | Photoresistor  Direct Light |  |  |  |  |  |  |  |
| 1K 1% | Thermistor  Ambient Temp |  |  |  |  |  |  |  |
| 1K 1% | Thermistor  Iced |  |  |  |  |  |  |  |

1. For extra credit, determine an equation for VR2 based on VB1, R1 and R2. (This is known as the ***voltage divider*** equation.)

We know that

*Eq. 1*

*Eq. 2*

Substituting Eq. 2 into Eq. 1, we have

*Eq. 3*

We also know that

*Eq. 4*

Therefore, substituting Eq. 3 for I in Eq. 4, we have

*Eq. 5*

Or

1. Repeat G for VR1.