EET 150
Introduction to EET
Lab Activity 3
Series & Parallel Circuits with Solderless Boards

Required Parts, Software and Equipment

Parts

Figures 1 and 2 Circuits	
Component /Value	Quantity
Resistor 1000 Ω, ¼ Watt, 5% Tolerance	1
Resistor 10 kΩ, ¼ Watt, 5% Tolerance	2
Resistor 2.2 kΩ, ¼ Watt, 5% Tolerance	1

Equipment

Required
Solderless Experimenters' Board
Dc power supply
Digital Multimeter
Hookup wire (22 AWG)
Wire cutter/stripper

Optional
Alligator clip leads
3 Banana jack leads red/black

Software
MS Word

Introduction

Electronics circuits are comprised of combinations of series and parallel systems. Series circuits have all parts connected in a row. There is only one path for current to travel through the circuit. The voltage drops across each component will equal to the total voltage applied to the circuit. Figure 1 shows a simple series circuit comprised of a single battery and four resistors. The current can only flow in one path around the circuit. The black dots at the ends of the components are called nodes. A node in circuit theory connects two or more circuit components together.

The voltage drops across each resistor will add up to the supply voltage, which is 10 V in this example. Stated as an equation this would be:

$$VR1+VR2+VR3+VR4=10V$$

In circuit theory this is called Kirchhoff's Voltage Law (KVL). The total resistance of the circuit will equal all the resistances added together. The mathematical formula for this is:

$$RT=R1+R2+R3+R4.$$

This formula applies to all series connected resistors. The only difference is the number of resistor values summed on the right hand side of the equation.

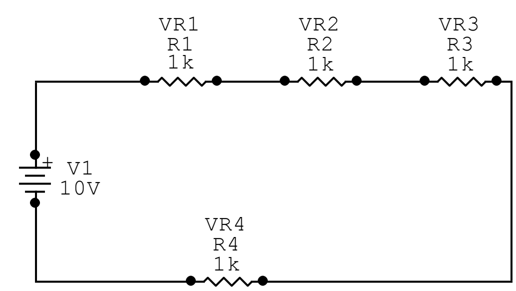

Figure 1. Simple Series Circuit with Resistances

Parallel circuits share a common voltage and the current is divided through the multiple parallel paths. Figure 2 shows a simple parallel circuit comprised of resistors and a dc source shown as a battery. Notice how each resistor has a common node from the positive part of the supply and a common node with the negative/ground of the power supply. The total current entering the circuit will equal the summation of all the parallel branch currents. This can be stated mathematically as:

$$IT = I1+I2+I3+I4$$

The fact that all current that enters a node must leave a node through the other paths is called Kirchhoff's Current Law (KCL). These two laws along with Ohm's law are the foundation of electric circuit theory and analysis.

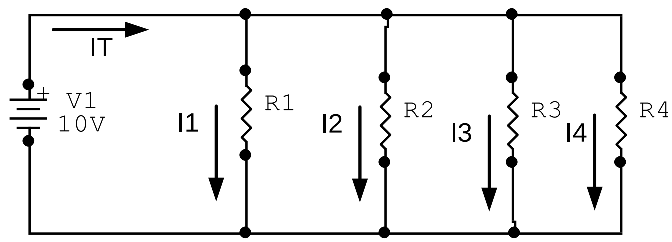

Figure 2. Simple Parallel Circuit with Resistors and Battery Source.

In parallel circuits, the value of total circuit resistance approaches the smallest resistance in the parallel combination. For example, if there is a parallel circuit that contains two resistors, one 1 kΩ and one 10 kΩ resistors, the total resistance will approach 1 kΩ. This can be stated in the formula that follows for the four resistor circuit shown in Figure 2.

$$RT = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \frac{1}{R4}}$$

This can be generalized to any number of parallel resistors by adding or removing the reciprocal terms in the denominator of the equation. The general equation for n many parallel resistors is:

$$RT = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + ... \frac{1}{Rn}}$$

Objective

The objective of this lab is to familiarize students with solderless experiment boards (SEB), series circuits, and parallel circuits. Student will assemble series and parallel circuits using the SEB, a voltage source, and resistor values. Students will measure the voltage drops in a series circuit, total resistances of both series and parallel circuits. They will compare the measured values to the calculated values using the series and parallel total resistance formulas and the labeled values of resistances.

Procedure:

1. Construct circuit below. **On-Campus Students**: Use the dc supply found in the lab for the 10 volt source. **On-line Students**: Use the dc supply specified in the equipment list for the program. Measure the values of each resistor while constructing the circuit and place the readings in Table 1.

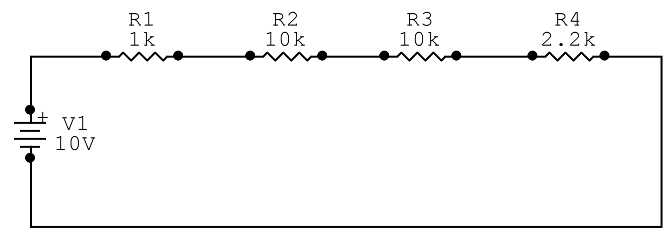

Figure 3. Series Circuit

2. Remove the dc source and measure the total resistance of the circuit. Place the value in Table 1. Use the series resistance formula to compute the total resistance using the labeled resistor values.
3. Measure the voltage drop across each resistor, place the values in the table
4. Construct circuit below. **On-Campus Students**: Use the dc supply found in the lab for the 10 volt source. **On-line Students**: Use the dc supply specified in the equipment list for the program.

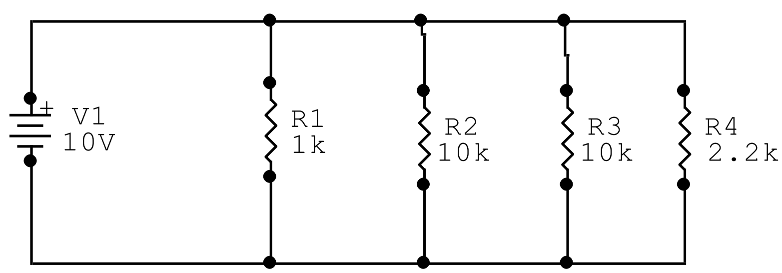

Figure 4. Parallel Circuit

5. Remove the dc source and measure the total resistance of the circuit. Place the value in Table 2. Use the parallel resistance formula and the labeled resistor values to compute the total circuit resistance. Place this value in Table 2 also.
6. Measure the voltage drops across each resistor and place the readings in Table 2.

Discussion Points

What is the sum of the voltage for the series circuit? Does this validate Kirchhoff's voltage law? What is the sum of the individual resistances in the series circuit? How does this compare to the measured value? How does the computed total resistance compare to the measured resistance of the parallel circuit? Does the total resistance of the parallel circuit approach lowest resistance value in the circuit?

Table 1- Figure 3 Series Circuit Measurements

	Resistances (Ohms)		Resistor Voltages (Volts)	
	Measured	Labeled/Computed		Measured V
R1			VR1	
R2			VR2	
R3			VR3	
R4			VR4	
RT			Sum	

Table 2-Figure 4 Parallel Circuit Measurements

	Resistances (Ohms)		Resistor Voltages (Volts)	
	Measured	Labeled/Computed		Measured V
R1			VR1	
R2			VR2	
R3			VR3	
R4			VR4	
RT				