

## *Experiment 4: Resistances in Circuits*

### EQUIPMENT NEEDED:

- AC/DC Electronics Lab Board: Resistors
- Multimeter

### Purpose

The purpose of this lab is to begin experimenting with the variables that contribute to the operation of an electrical circuit. This is the first of a three connected labs.

### Procedure

- ① Choose three resistors of the same value. Enter those sets of colors in Table 4.1 below. We will refer to one as #1, another as #2 and the third as #3.
- ② Determine the coded value of your resistors. Enter the value in the column labeled “Coded Resistance” in Table 4.1. Enter the Tolerance value as indicated by the color of the fourth band under “Tolerance.”
- ③ Use the Multimeter to measure the resistance of each of your three resistors. Enter these values in Table 4.1.
- ④ Determine the percentage experimental error of each resistance value and enter it in the appropriate column.

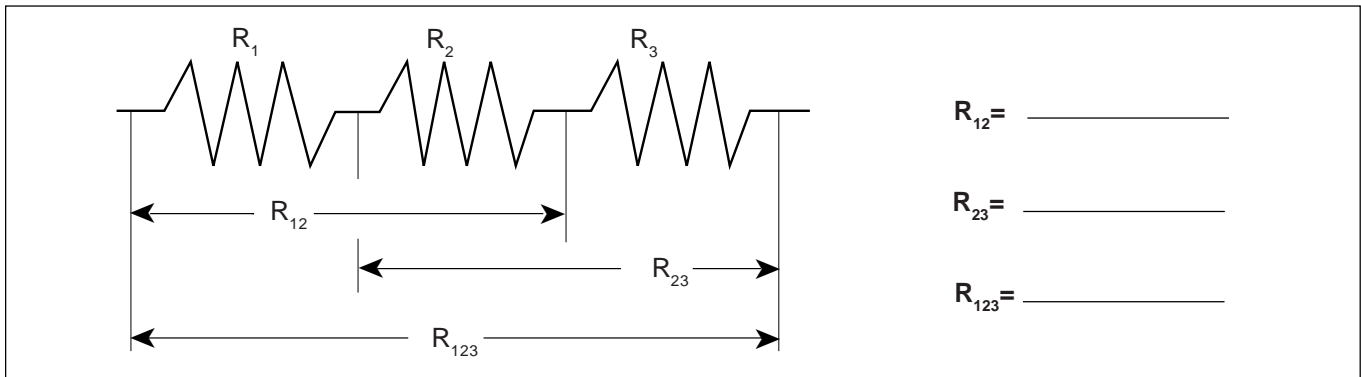
$$\text{Experimental Error} = \left[ \frac{(|\text{Measured} - \text{Coded}|)}{\text{Coded}} \right] \times 100\%.$$

**Table 4.1**

	Colors				Coded Resistance	Measured Resistance	% Error	Tolerance
	1st	2nd	3rd	4th				
#1								
#2								
#3								

- ⑤ Now connect the three resistors into the SERIES CIRCUIT, figure 4.1, using the spring clips on the Circuits Experiment Board to hold the leads of the resistors together without bending them. Measure the resistances of the combinations as indicated on the diagram by connecting the leads of the Multimeter between the points at the ends of the arrows.

**Series**



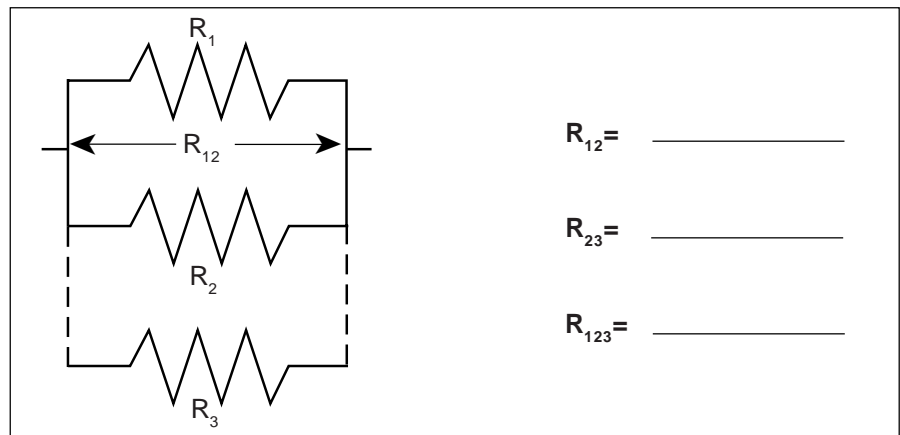
**Figure 4.1**

⑥ Construct a PARALLEL CIRCUIT, first using combinations of two of the resistors, and then using all three. Measure and record your values for these circuits.

**Parallel**

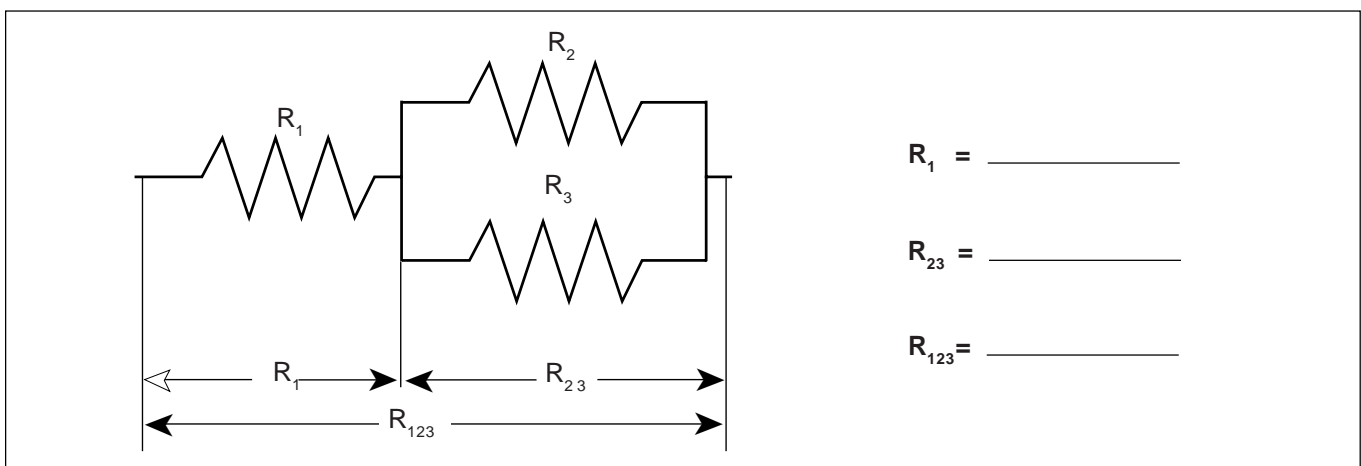
► **NOTE:** Include also  $R_{13}$  by replacing  $R_2$  with  $R_3$ .

⑦ Connect the COMBINATION CIRCUIT below and measure the various combinations of resistance. Do these follow the rules as you discovered them before?



**Figure 4.2**

**Combination**



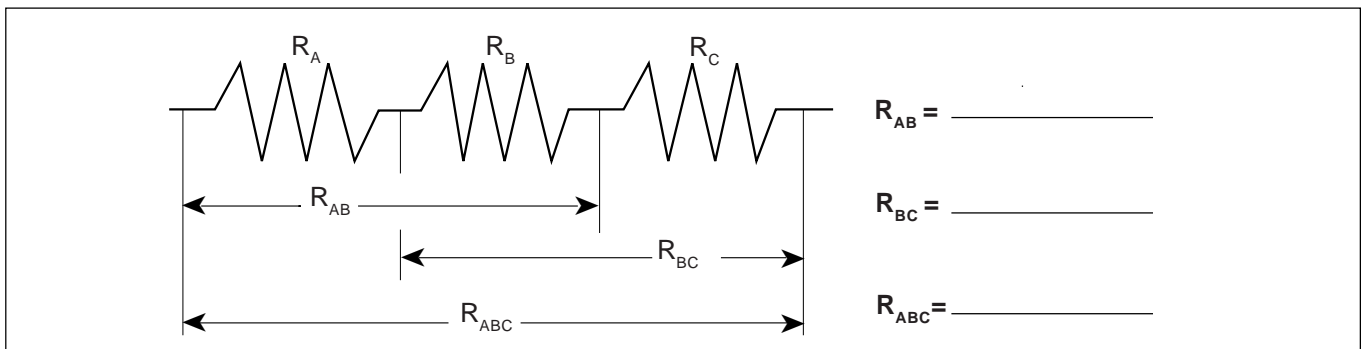
**Figure 4.3**

⑧ Choose three resistors having different values. Repeat steps 1 through 7 as above, recording your data in the spaces on the next page. Note we have called these resistors A, B and C.

**Table 4.2**

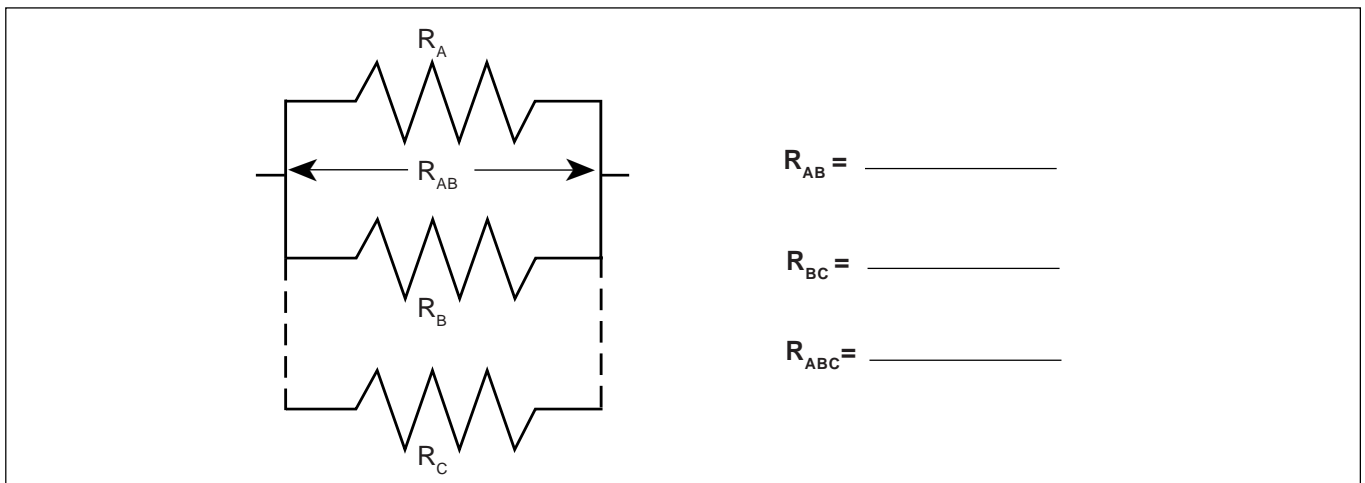
	Colors				Coded Resistance	Measured Resistance	% Error	Tolerance
	1st	2nd	3rd	4th				
A								
B								
C								

**Series**



**Figure 4.4**

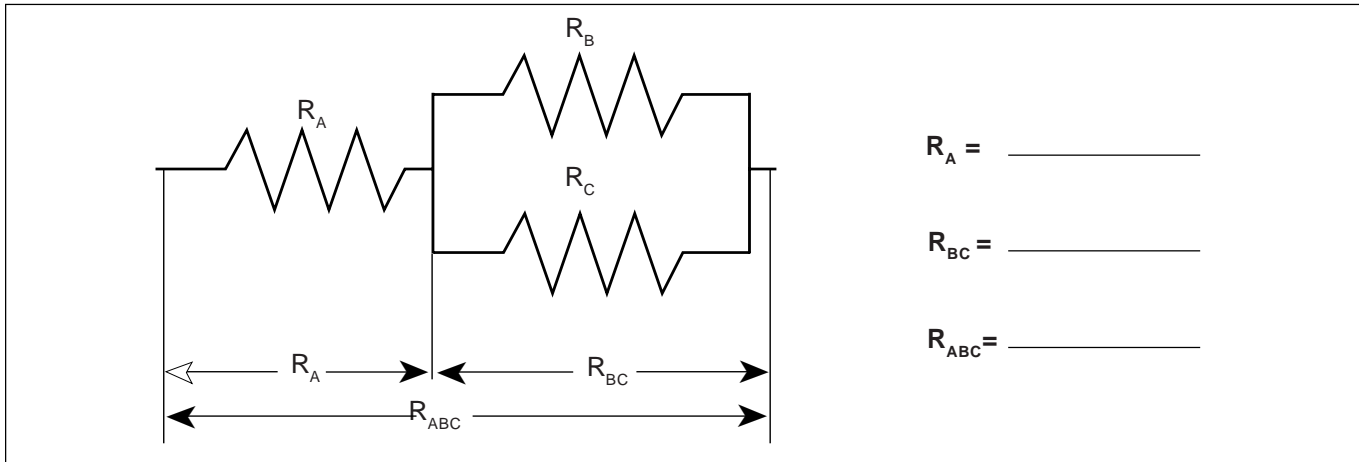
**Parallel**



**Figure 4.5**

► **NOTE:** Include also  $R_{AC}$  by replacing  $R_B$  with  $R_C$ .

### Combination



$R_A =$  \_\_\_\_\_

$R_{BC} =$  \_\_\_\_\_

$R_{ABC} =$  \_\_\_\_\_

Figure 4.6

### Discussion

- ① How does the % error compare to the coded tolerance for your resistors?
- ② What is the apparent rule for combining equal resistances in series circuits? In parallel circuits? Cite evidence from your data to support your conclusions.
- ③ What is the apparent rule for combining unequal resistances in series circuits? In parallel circuits? Cite evidence from your data to support your conclusions.
- ④ What is the apparent rule for the total resistance when resistors are added up in series? In parallel? Cite evidence from your data to support your conclusions.

### Extension

Using the same resistance values as you used before plus any wires needed to help build the circuit, design and test the resistance values for another combination of three resistors. As instructed, build circuits with four and five resistors, testing the basic concepts you discovered in this lab.

### Reference

<table border="0"> <tr><td>Black</td><td>0</td></tr> <tr><td>Brown</td><td>1</td></tr> <tr><td>Red</td><td>2</td></tr> <tr><td>Orange</td><td>3</td></tr> <tr><td>Yellow</td><td>4</td></tr> <tr><td>Green</td><td>5</td></tr> <tr><td>Blue</td><td>6</td></tr> <tr><td>Violet</td><td>7</td></tr> <tr><td>Gray</td><td>8</td></tr> <tr><td>White</td><td>9</td></tr> </table>	Black	0	Brown	1	Red	2	Orange	3	Yellow	4	Green	5	Blue	6	Violet	7	Gray	8	White	9		<table border="0"> <tr><th colspan="2"><u>Fourth Band</u></th></tr> <tr><td>None</td><td>±20%</td></tr> <tr><td>Silver</td><td>±10%</td></tr> <tr><td>Gold</td><td>±5%</td></tr> <tr><td>Red</td><td>±2%</td></tr> </table>	<u>Fourth Band</u>		None	±20%	Silver	±10%	Gold	±5%	Red	±2%
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Figure 4.7