

EE101 Laboratory 1

(SP03)

Name _____

Date _____

Partner's name _____

Instructional Objectives (at the end of this lab you should be able to:)

- Use a circuit breadboard to construct simple circuits.
- Identify series and parallel connections of circuit components.
- Determine the nominal values of resistors by using the color codes.
- Measure resistance values using a multimeter.
- Be able to calculate the equivalent resistance of series and parallel resistor circuits.

Description and Background

Resistors are commonly used in electronic circuits, along with other components such as capacitors, inductors, and active devices such as transistors and integrated circuits (commonly called ICs). Resistors may be connected in series and/or parallel for many reasons, such as to reduce a voltage to a convenient value (as in a voltage divider) or to provide a value different from one that is commercially available. You therefore need to be able to find the effective resistance of various combinations of individual elements.

Resistors have a nominal value indicated by colored bands or other labeling. Refer to a color-code chart to interpret the nominal value indicated by the colored bands. The actual (measured) resistance will vary from the nominal value due to subtle mechanical and chemical differences that occur during manufacturing. The manufacturer specifies the maximum deviation from the nominal value as a \pm percentage. This range of deviation is called the *tolerance* of the resistor family. Typical tolerance values are $\pm 1\%$, $\pm 5\%$, or $\pm 10\%$. The resistors in your lab kit are 5%, which is indicated by a fourth band that is gold in color. We will observe the variation in measured resistance values for the class and prepare a *histogram* of the measured values.

Equipment

Your own circuit prototype board, your own lab kit containing resistors (and other components), your own resistor color code chart, alligator clips from your lab kit, lab multimeter and banana cables furnished in the lab for connecting to the multimeter.

Procedures

P1. Both you and your partner should get all the resistors from your lab kits. You should each have 5 resistors in your kit.

Using the resistor color code chart, fill out the table on the next page for all the resistors in both your lab kit and your partner's lab kit. You will record:

- the sequence of color bands and the nominal resistance value this represents
- the measured value of each resistor,
- the percent difference between the nominal value and the measured value

The percentage difference between the nominal value (indicated by the color code) and the measured value is calculated using the equation:

$$\text{percent difference} \equiv \frac{|\text{nominal value} - \text{measured value}|}{\text{nominal value}} \times 100\%$$

No.	Color bands on the resistor (Use three letter abbreviations for color names, e.g. Blk for black, Blu for blue)	Resistance value from color codes, ohms	Measured resistance using multimeter (Be sure that the decimal point and units are correct)	Percent difference of measured value relative to color code value, in percentage
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

P2. Select two resistors from your kit that have a third color band that is RED. Using your prototype board, connect these two resistors in *parallel* and then measure the combination resistance using the multimeter.

Resistor 1 nominal value: _____ Resistor 2 nominal value: _____

Measured resistance of parallel combination: _____

Now draw a simple schematic diagram of this parallel circuit, including nominal and measured value labels.

Show the mathematical formula for how the equivalent resistance for a parallel combination of two resistors can be calculated. Also, compare the equivalent resistance *calculated* using the nominal values to the *measured* resistance and explain your results in a brief and concise manner using complete sentences.

P3. Select two other resistors from your partner's lab kit that have a third color band that is RED. Connect these two other resistors in *series* and use the multimeter to measure the combination resistance of this series arrangement.

Resistor 3 nominal value: _____ Resistor 4 nominal value: _____

Measured resistance of series combination: _____

Draw a simple schematic diagram of this series circuit, including nominal and measured value labels.

Show how to calculate the overall resistance for the series combination of the two resistors. Compare the measured resistance to the value calculated from the nominal values and explain your results in a brief and concise manner using complete sentences.

P4. Using your prototype board, now create a four-resistor circuit by joining the combination of two parallel resistors from P2 in a series connection with the two series resistors from P3. In other words, you will now have two parallel resistors, connected to a sequence of two series resistors.

Measure the total resistance of this 4 resistor circuit and record your results along with a sketch of your circuit with nominal labels for all four resistances.

Measured resistance of parallel + series combination: _____

Show how to calculate the overall resistance for the four-resistor circuit. Compare the nominal value calculated to the measured value and explain your results in a brief and concise manner using complete sentences.

P5. Think about how you calculate the equivalent resistance of three resistors in series, and think about how you calculate the equivalent resistance of three resistors in parallel. Based on your knowledge of series and parallel resistor combination, can you conclude that it is possible to calculate the equivalent resistance of a network of many resistors? Explain.

P6. Attach the resistance histogram (handed out in class) and your answers for the 4.7k Ω resistor values.