Lab 22: Resistors

Goals

1. To become familiar with an electronic breadboard

2. To gain experience with a breadboard by making simple circuits

3. To become familiar with the color code for resistors

Materials and Equipment

Breadboard
Multimeter
Needle nose pliers
Resistors: 2.2 kΩ, 4.7 kΩ, 10.0 kΩ
Note: k = X 1 thousand, m = X 1 million

Introduction

A **resistor** is a device that impedes the flow of an electrical current. Resistors are used in essentially all electronic devices. The value of many common resistors can be determined by their color code. Table 1 gives the common color code scheme.

Table 1

Color	Digit	Multiplier
Black	0	X 1
Brown	1	X 10
Red	2	X 100
Orange	3	X 1000
Yellow	4	X 10,000
Green	5	X 100,000
Blue	6	X 1,000,000
Violet	7	X 10,000,000
Gray	8	X 100,000,000
White	9	X 1,000,000,000

With a four band color code, the first and second color band indicates the first two digits and the third band is the multiplier. The fourth band gives the tolerance with silver indicating 10 %, gold indicating 5 %, and red indicating 2 %. If it is difficult to read the colors, the resistance should be checked with a multimeter.

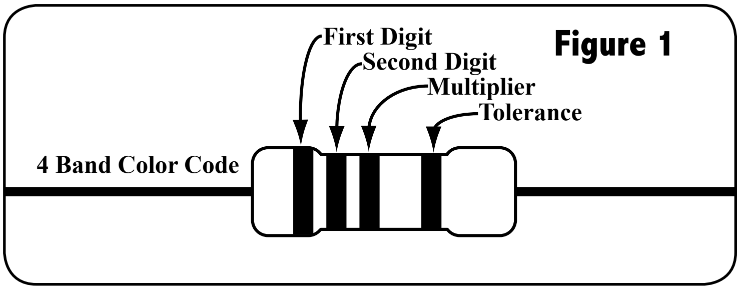


Figure 1

In a series circuit, the current has only one path and must flow through several resistors in succession. The current will be the same through each resistor. However, the voltage across the resistors may not be the same. Figure 2 gives an example of a circuit diagram of a series circuit.

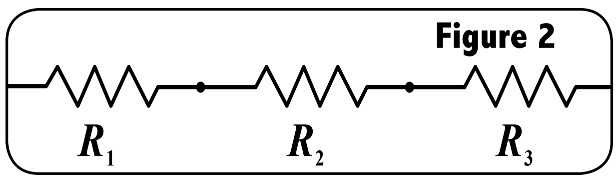


Figure 2

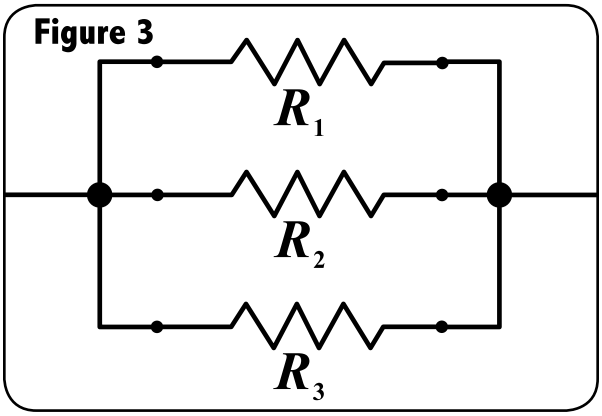
The sum of several resistors in series is found by simply adding their values. That is:

(1) $R_{total} = R_1 + R_2 + ...R_n$

If the values of R_1, R_2, and R_3 are 47Ω, 75Ω, and 163Ω, respectively, the sum is:

$$47\Omega + 75\Omega + 163\Omega = 285\Omega$$

Parallel resistors are arranged so that the current splits and is divided between several resistors. The total current is thus the sum of the currents through each resistor. The voltage will be the same across each resistor. Figure 3 shows a circuit diagram of parallel resistors.



The sum of a set of parallel resistors is the reciprocal of the sum of the reciprocals of the resistor values:

(2) $$\frac{1}{R_{total}} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots \frac{1}{C_n}$$

where R_{total} is the sum of the resistors and R_1, R_2, etc. are the values of the individual resistors. If the values of these resistors are 47Ω, 75Ω, and 163Ω, respectively, the total is:

$$\frac{1}{R_t} = \frac{1}{47\Omega} + \frac{1}{75\Omega} + \frac{1}{163\Omega} = 0.0407\Omega\text{-1}$$

The reciprocal of this is:

$$R_{total} = 24.6\Omega$$

This is easier done on a calculator that has a reciprocal function.

Devotionals

"For he chose us in him before the creation of the world to be holy and blameless in his sight. In love he predestined us to be adopted as his sons through Jesus Christ, in accordance with his pleasure and will…" Ephesians 1:4-5

Principle: An organized life is a life lived better.

An electric breadboard is a helpful tool to organize and put together electric circuits. In fact, electronic circuit boards, like the breadboard used in this lab, are used everywhere in the electronics industry to make electronic controls and functions. The boards organize the components and give a far greater variety of functions than the individual components can achieve on their own.

Organizational tools are helpful in all of life. If you want to know where your money goes, you can make a budget. It you want to know when you will graduate from high school, you make a schedule of courses you need. If you want to get your homework done on time, you schedule your work.

God himself is a planner. He planned history. He planned for you to exist. Believers are told that God thought about us before the beginning of world. God has future plans for us to purify us and bring us to be with him.

Planning does take time. But the benefits completely outweigh the cost of time. Organizing and planning is useful. It is God's way to do things and he has set an example for us. To be successful, as God is successful, you need to plan.

Procedure

Note: If you have not done Lab 20: Capacitors yet, please read the section Introduction to the Breadboard at the beginning of that lab.

1. Take a 2.2 kΩ, a 4.7 kΩ, and a 10.0 kΩ resistor out of their respective packages. Use pliers to shorten the leads on these resistors to about 10 mm.

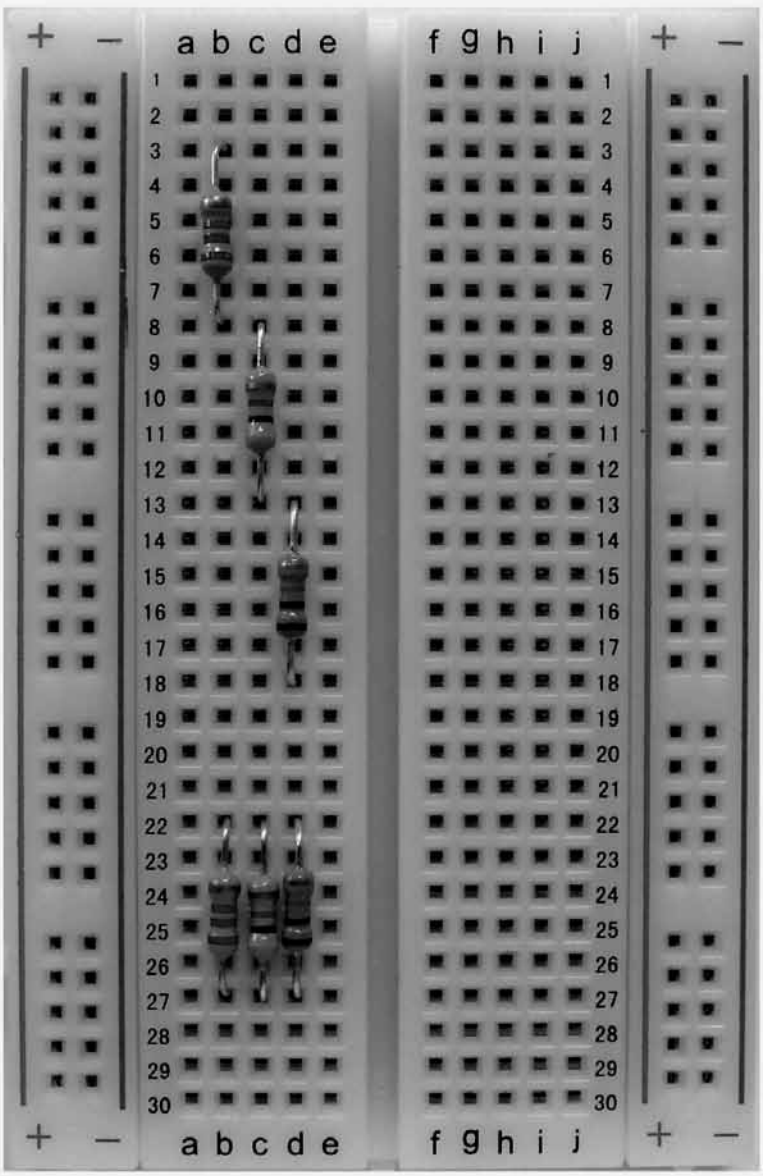
2. The 2.2 kΩ resistor has three red bands and a gold band. From the color code, the first two red bands indicate 22 and the third band indicates X 100. This gives a 2200 Ω or 2.2 kΩ resistance. Examine the two other resistors and fill in Table 2 in the questions section.

3. Bend the leads of the first resistor and insert them in the 3b and 8b positions. Insert the leads of the second resistor in the 8c and the 13c positions. Since there is a bus under the 8a through the 8e positions, these positions are connected electrically and two resistors are in series. Put the leads of the third resistor in the 13d and the 18d sockets. Again, there is an electrical bus under the 13a through the 13e sockets and the second and third resistors are in series with the first resistor. See the upper portion of Figure 4.

4. Take a second set of 2.2 kΩ, 4.7 kΩ, and 10.0 kΩ resistors and shorten the leads like you did in Procedure 1. Put the first of these in the 22b and 27b sockets, the second in the 22c and 27c sockets, and the third in the 22d and 27d sockets. The board should look like the lower portion of Figure 4. The ends of the resistors in row 22 a through e will be connected and the ends of the resistors in row 27 will similarly be connected. These resistors are in parallel.

5. Fill in the answer in the questions section. Save the wired breadboard for Lab 22.

Figure 4



Lab 22

Questions for Resistors

Table 1

Resistor	Band colors	Digits	Multiplier	Resistance value
R1	Red, red,red, gold	22	X 100	2200 Ω or 2.2 kΩ
R2				
R3				

Table 2

Circuit	Measured sum, Ω	Calculated sum, Ω	Difference, %
Series			
Parallel			

1. Use the multimeter to measure the resistance of this series combination. Turn the meter on and turn the control to the ohms (Ω) position. Touch one meter probe to the lead in the 3b position and the other probe to the lead in the 18d position. Record this in table 2.

2. Use equation 1 to calculate the resistance of the series circuit. Does the meter (Procedure 4) agree with the calculated value? Calculate the percent difference. The resistors have a 5% tolerance. Is the difference within 5%?

3. Measure the sum of these resistors by touching one probe to a lead in row 22 and the other probe to a lead in row 27. Record this in Table 2.

4. Calculate the resistance of the parallel circuit. Calculate the percent difference between the measured value and the calculated value. Is this within 5%?