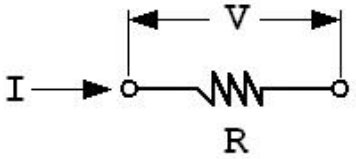
Department of Mechanical and Aerospace Engineering
Electronics Lab, Electronic Components

Resistors

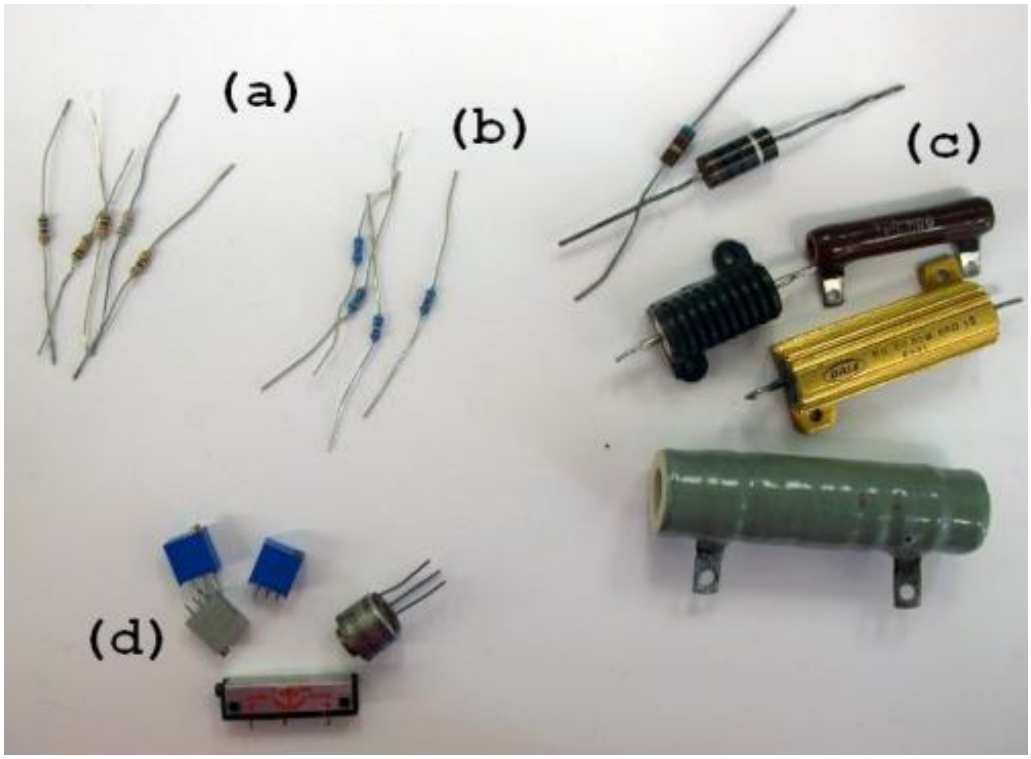


$$V = \frac{I}{R}$$

Resistors are one of the most common components you will run across. They are designed to dissipate electrical power in the form of heat (i.e. Ohmic heating) according to

$$P = I^2 R$$

Resistors are used as loads for active devices, in power circuits to reduce voltage by dissipating power, as a means of measuring and establishing current, to provide accurate voltage ratios, to set gain values, and many other applications besides.



Resistor Varieties

Some of the many types of resistors you may encounter are pictured above:

- **(a) ¼ watt resistors, 5% precision:** These resistors are available in many different resistances in the student electronics lab. They are the most common type of resistor that you will encounter and work well for many applications.

(b) 1% precision resistors: These resistors are available in the ME Department electronics shop in W298 (ask one of the staff).

(c) Resistors for higher-wattage applications: Particularly in higher-current applications, you may encounter situations where a resistor will be required to dissipate more than ¼ watt. If one of your ¼ watt resistors starts smoking, this is certainly true. A variety of resistors are available in W298 that are rated for higher wattages. Ask a staff member for assistance.

(d) Potentiometers: These devices allow you to adjust resistances during operation of your circuit. They are described in greater detail below.

Potentiometers

Potentiometers (or pots) are very useful devices that allow you to vary resistance using a dial. Note that the potentiometers shown above have three pins each. The outer pins (1 and 2 in the figure below) are connected across a resistor whose value is marked on the outer case of the pot. The middle pin is connected to a wiper that can be moved by turning the screw on top of the pot. Depending on how they are connected, pots can be used in two different ways:

1. **Pot used as a voltage divider:** If all three pins of the potentiometer are connected, it can be used as a voltage divider. A voltage divider is a very useful circuit element and is pictured below. It can be used to set an input voltage to a certain level by adjusting the ratio between the two resistors R_1 and R_2. When a pot is used as a voltage divider, pin 1 is connected to ground, pin 3 to power and pin 2 corresponds to V_A. As the screw in the top of the pot is turned and the wiper is moved, the ratio R_1/R_2 is changed and the output voltage V_A changes accordingly.
2. **Pot used as a variable resistor:** Suppose you simply connect pins 1 and 2 (or pins 2 and 3). Then, as you turn the screw and move the wiper, the pot will act as a variable resistor. Just be sure not to connect the two outside pins (1 and 3), because then the value of R will simply be equal to the value printed on the outer casing of the pot and will not change no matter how much you move the wiper.

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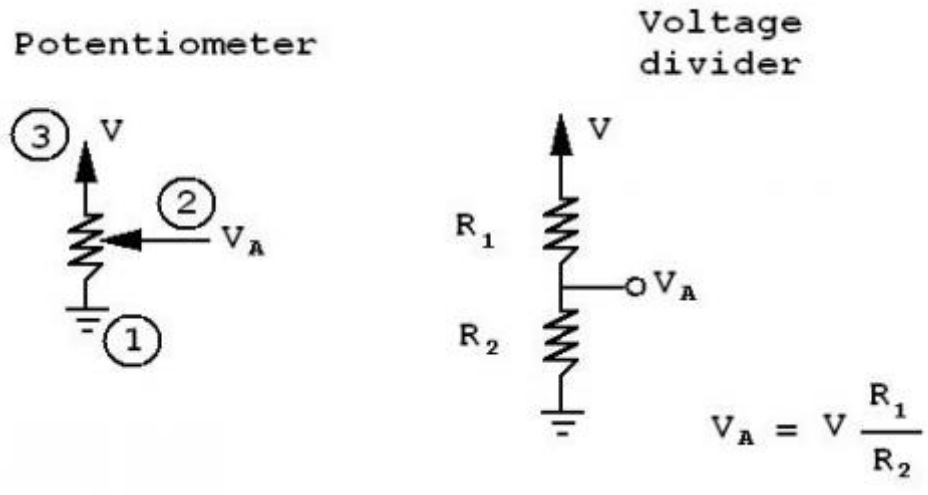

How to read color codes on resistors
Since you have a multimeter, the best way to determine the resistance of an unknown resistor is to connect it to a multimeter and read off the Ohms. However, if you don't have a multimeter handy, read the color code (i.e. striped color bands on the resistor) using the following rules:

- A gold band on the right side of the resistor indicates an accuracy of 5%. That means that if the resistor has a resistance of 10 W, its resistance is 10 W ± 0.5 W.
- A silver band on the right side of the resistor indicates an accuracy of 10%.
- The last colored band shows the last digit, which represents how many zeros must be added to the numbers represented by the previous bands.Read left to right, the following values are associated with the corresponding colors:

0	1	2	3	4	5	6	7	8	9
Black	Brown	Red	Orange	Yellow	Green	Blue	Violet	Gray	White

Example:
Suppose a resistor has three stripes, green, blue, brown, read left to right. What is the resistance? Green Þ 5; Blue Þ 6; Brown Þ 1; The first two bands yield 56. The last band, brown, represents how many zeros must be added to this number to obtain the resistance. Since Brown has the value of 1, one zero must be added to the 56, so that the resistance of this resistor is 560 W.

- Resistors also have another color code sometimes. For example, the label "1213F" on a resistor signifies 121,000 W or 121 kW.
- When in doubt, connect the resistor to a multimeter and measure the resistance!