

TITLE - MEASURING RESISTANCE

OBJECTIVES:

1. To understand the quantity of resistance for a material.
2. Learn how to use a VOM, DMM, and HP-DMM to the resistance of a resistor.
3. Learn how to use a color-code table to determine resistance of a resistor.

THEORY:

1. i = current = time-rate of flow of charges through the cross-sectional area of a conductor
 $i = dq/dt$
2. The SI unit of the current is the ampere (A): $1A = 1C/s$
3. Resistance = a measure of the opposition that a material (resistor) presents to the flow of charge.
4. Materials that have a large resistance are called resistors. They are used to limit the flow of current along a circuit. Common resistors are made of carbon and nichrome.
5. Materials with very small resistance are called conductors and materials with very large resistance are called insulators.
6. The SI units of resistance is the ohm (Ω).

Using a Resistance Color Code Table

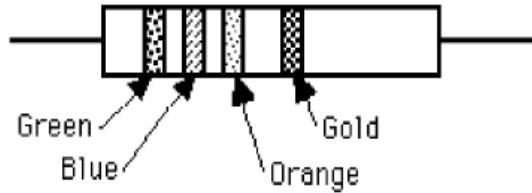
A **Resistance Color Code** is used by resistor manufacturers to specify the **Resistance** and **Tolerance** of their resistors. These two characteristics are usually identified by four (or five) color bands, where each color represents a number. When resistors have 4 color bands, the first two bands, reading from left to right, represent the first two digits of the resistance value and the third band represents the multiplier, which is expressed as a power (n) of 10 (i.e., 10^n), and the 4-th band indicates the % tolerance.

| [RESISTANCE COLOR CODE] | | | [TOLERANCE COLOR CODE] | |
|-------------------------|-------|-------|------------------------|-----------|
| COLOR | DIGIT | MULTR | COLOR | TOLERANCE |
| Black | 0 | 0 | None | 20% |
| Brown | 1 | 1 | Silver | 10% |
| Red | 2 | 2 | Gold | 5% |
| Orange | 3 | 3 | Orange | 3% |
| Yellow | 4 | 4 | Red | 2% |
| Green | 5 | 5 | Brown | 1% |
| Blue | 6 | 6 | Green | 0.50% |
| Violet | 7 | -2 | Blue | 0.25% |
| Grey | 8 | -1 | Violet | 0.10% |
| White | 9 | | Grey | 0.05% |

• **Fig.1.1 Resistor Color Code and Tolerance Table**

A typical color-coded resistor is shown in Fig. 1.2. Holding the resistor so that the colored bands are located to the left end of the resistor, the first and second colored bands represent the first two

significant figures of the resistance value. The third band gives the power of 10 and the fourth colored band is the tolerance value. The manufacturer color-coded this resistor stating that the resistance is within the range of $56,000 \pm 2800$ [Ohms].



• Fig. 1.2 Color-coded Resistor [$56,000 \pm 5\%$ Ohm]

EQUIPMENT

1. VOM, DMM, HP-DMM
2. 3 different resistors
3. 2 leads, 2 alligator clips

PROCEDURE

1. Determine the resistance of all 3 resistors using the color-code table.
2. Measure the resistance of all 3 resistors using the VOM, DMM, and HP-DMM. Refer to Appendix II in Physics 4B lab classic Manual.
3. Compare measured resistance values to color-code table values (calculate % error) and also determine if they are within tolerance.