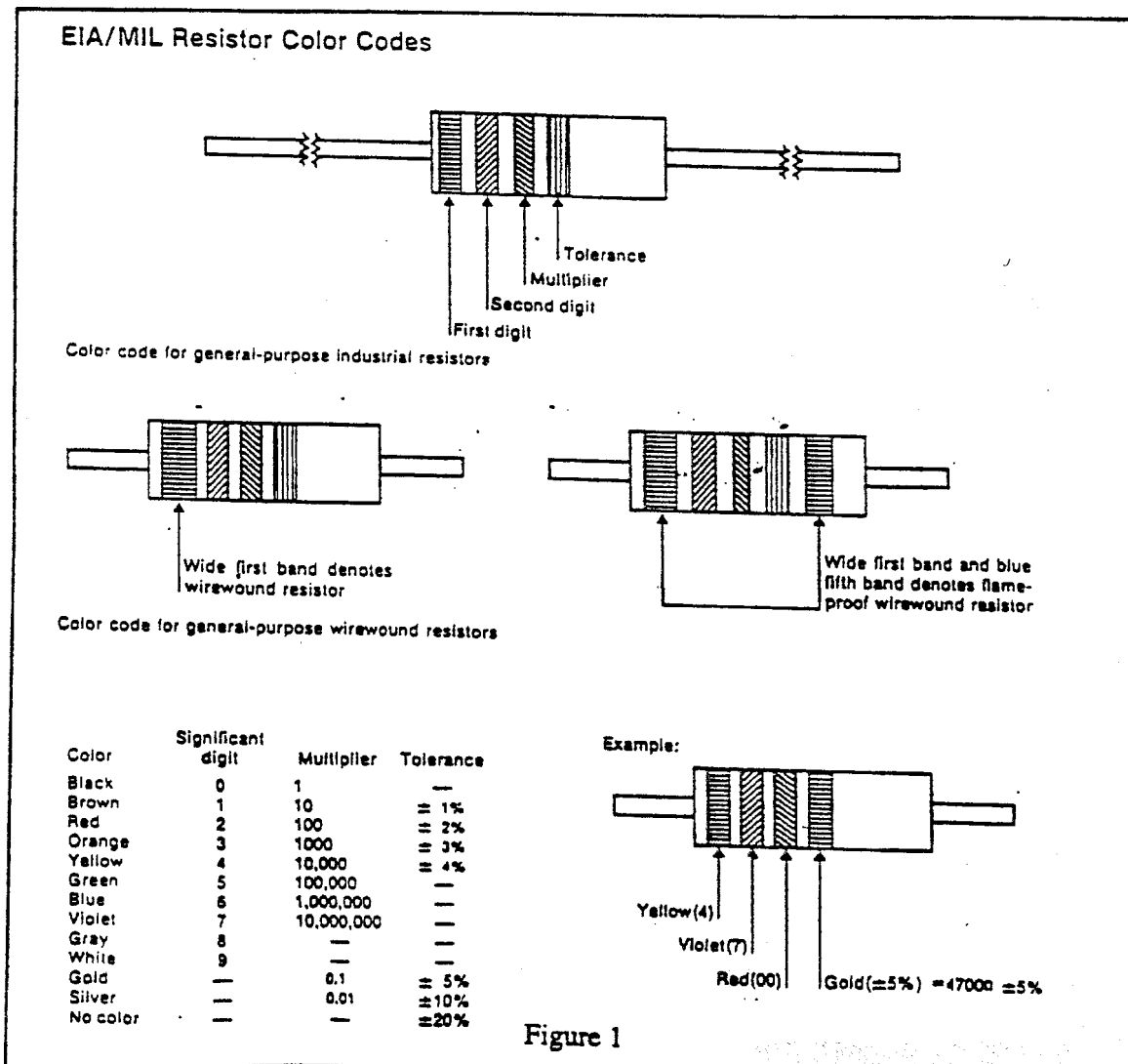# Appendix 1: Resistors

Figure 1 shows how to read resistor values. The color code contains two digits, a multiplier, and a tolerance value. The bands represent a number in a modified scientific notation: the first two bands represent the number and the third band represents the power of 10 (i.e., the number of 0's to be placed after the first two numbers). The fourth band indicates the tolerance value, the percentage amount by which the value may vary from the rated value.

Examples:

brown, black, red is $10 \times 10^2 = 1000 = 1\ k\Omega$

yellow, violet, orange is $47 \times 10^3 = 47000 = 47\ k\Omega$

yellow, violet, red is $47 \times 10^2 = 4700 = 4.7\ k\Omega$

EIA/MIL Resistor Color Codes

Color code for general-purpose industrial resistors

Wide first band denotes wirewound resistor

Color code for general-purpose wirewound resistors

Wide first band and blue fifth band denotes flame-proof wirewound resistor

Color	Significant digit	Multiplier	Tolerance
Black	0	1	—
Brown	1	10	± 1%
Red	2	100	± 2%
Orange	3	1000	± 3%
Yellow	4	10,000	± 4%
Green	5	100,000	—
Blue	6	1,000,000	—
Violet	7	10,000,000	—
Gray	8	—	—
White	9	—	—
Gold	—	0.1	± 5%
Silver	—	0.01	±10%
No color	—	—	±20%

Example:

Yellow(4)
Violet(7)
Red(00)   Gold(±5%) =47000 ±5%

Figure 1

The size of the resistor indicates its power rating as is shown in Fig. 2. The power rating is the maximum power that the resistor can tolerate without being ruined.
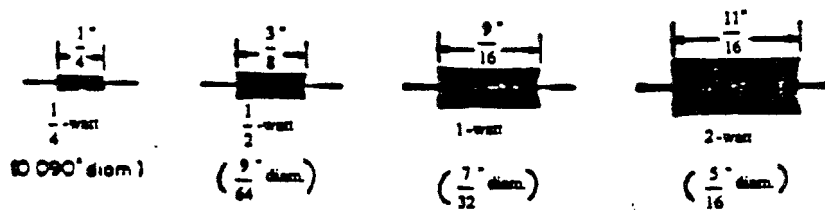

Figure 2

In Fig. 3A, a potentiometer is shown, and in Fig. 3B its common circuit symbol is given. It is important to connect the leads between one of the outer terminals and the center one. Otherwise it functions as a constant resistor and not as a potentiometer, as can be seen in the figure.
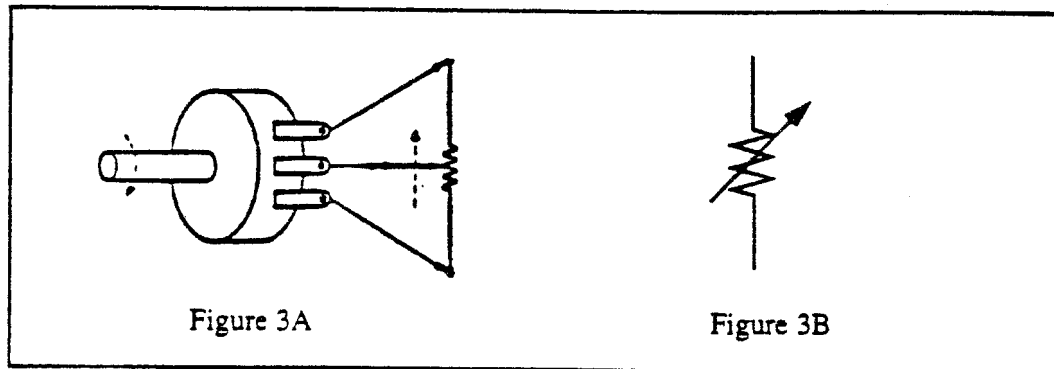

Figure 3A   Figure 3B