

APPENDIX B

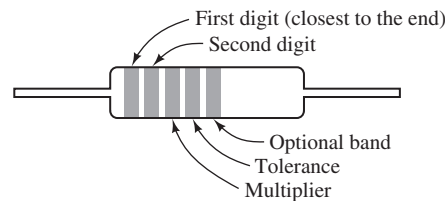
Nominal Values and the Color Code for Resistors

Several types of resistors are available for use in electronic circuits. Carbon-film and carbon-composition resistors with tolerances of 5 percent, 10 percent, or 20 percent are available with various power ratings (such as 1/8, 1/4, and 1/2 W). These resistors are used in noncritical applications such as biasing.

Metal-film 1-percent-tolerance resistors are used where greater precision is required. For example, we often choose metal-film resistors in applications such as the feedback resistors of an op amp.

Wire-wound resistors are available with high power-dissipation ratings. Wire-wound resistors often have significant series inductance because they consist of resistance wire that is wound on a form, such as ceramic. Thus, they are often not suitable for use as a resistance at high frequencies.

The value and tolerance are marked on 5-percent, 10-percent, and 20-percent-tolerance resistors by color bands as shown in Figure B.1. The first band is closest to one end of the resistor. The first and second bands give the significant digits of the resistance value. The third band gives the exponent of the multiplier. The fourth band indicates the tolerance. The fifth band is optional and indicates whether the resistors meet certain military reliability specifications.



| Digit | Color | Tolerance | Color |
|-------|--------|-----------|----------------|
| 0 | Black | 2% | Red |
| 1 | Brown | 5% | Gold |
| 2 | Red | 10% | Silver |
| 3 | Orange | 20% | No fourth band |
| 4 | Yellow | | |
| 5 | Green | | |
| 6 | Blue | | |
| 7 | Violet | | |
| 8 | Gray | | |
| 9 | White | | |

Examples

| | | | |
|--------|--------|--------|------------------------------------------|
| Yellow | Violet | Black | $= 47 \times 10^0 = 47 \Omega$ |
| Yellow | Violet | Red | $= 47 \times 10^2 = 4700 \Omega$ |
| Brown | Black | Yellow | $= 10 \times 10^4 = 100 \text{ k}\Omega$ |

Figure B.1 Resistor color code.

Table B.1. Standard Nominal Values for 5-percent-Tolerance Resistors^a

| | | | | |
|-----------|-----------|-----------|-----------|-----------|
| 10 | 16 | 27 | 43 | 68 |
| 11 | 18 | 30 | 47 | 75 |
| 12 | 20 | 33 | 51 | 82 |
| 13 | 22 | 36 | 56 | 91 |
| 15 | 24 | 39 | 62 | |

^a Resistors having tolerances of 10 percent and 20 percent are available only for the values given in boldface.

Table B.1 shows the combinations of significant figures available as nominal values for 5-percent, 10-percent, and 20-percent-tolerance resistors. Table B.2 shows the standard nominal significant digits for 1-percent-tolerance resistors.

Table B.2. Standard Values for 1-percent-Tolerance Metal-Film Resistors

| | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|
| 100 | 140 | 196 | 274 | 383 | 536 | 750 |
| 102 | 143 | 200 | 280 | 392 | 549 | 768 |
| 105 | 147 | 205 | 287 | 402 | 562 | 787 |
| 107 | 150 | 210 | 294 | 412 | 576 | 806 |
| 110 | 154 | 215 | 301 | 422 | 590 | 825 |
| 113 | 158 | 221 | 309 | 432 | 604 | 845 |
| 115 | 162 | 226 | 316 | 442 | 619 | 866 |
| 118 | 165 | 232 | 324 | 453 | 634 | 887 |
| 121 | 169 | 237 | 332 | 464 | 649 | 909 |
| 124 | 174 | 243 | 340 | 475 | 665 | 931 |
| 127 | 178 | 249 | 348 | 487 | 681 | 953 |
| 130 | 182 | 255 | 357 | 499 | 698 | 976 |
| 133 | 187 | 261 | 365 | 511 | 715 | |
| 137 | 191 | 267 | 374 | 523 | 732 | |