Resistors - Electronic Components Cheatsheet

A comprehensive guide to resistors, covering types, color codes, calculations, and applications. This cheat sheet provides essential information for understanding and working with resistors in electronic circuits.

Resistor Basics

Resistor Definition

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors are used to reduce current flow, adjust signal levels, divide voltages, bias active elements, and terminate transmission lines, among other uses.

Key Parameters

Resistance (R)	Measured in ohms (Ω). 1 Ω = 1 V/A
Tolerance	The percentage by which the actual resistance may vary from the stated value (e.g., ±5%).
Power Rating (P)	The maximum power the resistor can dissipate without being damaged, measured in watts (W).
Temperature Coefficient	Indicates how much the resistance changes with temperature, measured in ppm/°C.

Resistor Symbols

European/International Symbol

American Symbol

Resistor Color Codes

4-Band Resistor Color Code

Most common type. Bands represent:

1. First digit
2. Second digit
3. Multiplier
4. Tolerance

5-Band Resistor Color Code

High precision resistors. Bands represent:

1. First digit
2. Second digit
3. Third digit
4. Multiplier
5. Tolerance

Color Code Table

Color	Digit	Multiplier	Tolerance (%)
Black	0	10^0	
Brown	1	10^1	±1
Red	2	10^2	±2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	±0.5
Blue	6	10^6	±0.25
Violet	7	10^7	±0.1
Gray	8	10^8	±0.05
White	9	10^9	
Gold		10^-1	±5
Silver		10^-2	±10
None			±20

Resistor Types

Fixed Resistors

Resistors with a single, unchangeable resistance value.

Carbon Composition: Oldest type, low cost, high noise.
Carbon Film: Better tolerance and lower noise than carbon composition.
Metal Film: High precision, low temperature coefficient, low noise.
Wirewound: High power rating, but inductive; used in high-current applications.

Variable Resistors

Resistors whose resistance value can be adjusted.

Potentiometers: Three terminals, used to provide a variable voltage divider.
Rheostats: Two terminals, used to control current in a circuit.
Trimmers: Small potentiometers used for infrequent adjustments.

Special Resistors

Resistors with resistance that changes based on external factors.

Thermistors: Resistance changes with temperature. NTC (Negative Temperature Coefficient) and PTC (Positive Temperature Coefficient).
Photoresistors (LDR): Resistance changes with light intensity.
Varistors (MOV): Voltage-dependent resistors used for surge protection.

Resistor Applications & Calculations

Series and Parallel Resistors

Series Resistors	Total resistance is the sum of individual resistances: `R_total = R_1 + R_2 + ... + R_n`
Parallel Resistors	The reciprocal of the total resistance is the sum of the reciprocals of individual resistances: `1/R_total = 1/R_1 + 1/R_2 + ... + 1/R_n` For two resistors: `R_total = (R_1 * R_2) / (R_1 + R_2)`

Ohm's Law

Defines the relationship between voltage (V), current (I), and resistance (R):

`V = I * R`
`I = V / R`
`R = V / I`

Power Dissipation

Power dissipated by a resistor can be calculated using:

`P = V * I`
`P = I^2 * R`
`P = V^2 / R`

Where P is power in watts, V is voltage in volts, I is current in amperes, and R is resistance in ohms.