



Standard Resistor Values

E12, E24, and E96 quick-reference tables for circuit design, prototyping, sourcing, and PCBA review.

Series	Values per decade	Common tolerance	Typical use
E12	12	±10%	Basic and non-critical circuits
E24	24	±5%	General commercial electronics
E96	96	±1%	Precision analog and control circuits

How to use an E-series table

Each table lists preferred numbers within one decade. Multiply a base number by a power of 10 to obtain the required resistance range. For example, the base value 4.7 represents 4.7Ω, 47Ω, 470Ω, 4.7kΩ, 47kΩ, 470kΩ, or 4.7MΩ.

Base	×1	×10	×100	×1,000	×100,000
1.0	1Ω	10Ω	100Ω	1kΩ	100kΩ
2.2	2.2Ω	22Ω	220Ω	2.2kΩ	220kΩ
4.7	4.7Ω	47Ω	470Ω	4.7kΩ	470kΩ
6.8	6.8Ω	68Ω	680Ω	6.8kΩ	680kΩ

Most commonly stocked values

10Ω, 22Ω, 47Ω, 100Ω, 220Ω, 330Ω, 470Ω, 1kΩ, 2.2kΩ, 4.7kΩ, 10kΩ, 47kΩ, 100kΩ, and 1MΩ.

Important: A common value is not automatically suitable. Confirm tolerance, power rating, working voltage, temperature coefficient, pulse load, and package availability before approving the part.



E12 and E24 Standard Values

The base values below repeat in every decade. The tolerance associations are common industry practice, but the actual tolerance and available resistance range depend on the manufacturer and resistor series.

E12 - 12 values per decade (commonly ±10%)					
1.0	1.2	1.5	1.8	2.2	2.7
3.3	3.9	4.7	5.6	6.8	8.2

E24 - 24 values per decade (commonly ±5%)							
1.0	1.1	1.2	1.3	1.5	1.6	1.8	2.0
2.2	2.4	2.7	3.0	3.3	3.6	3.9	4.3
4.7	5.1	5.6	6.2	6.8	7.5	8.2	9.1

Common E12 values from 100Ω to 1kΩ

100Ω	120Ω	150Ω	180Ω	220Ω	270Ω
330Ω	390Ω	470Ω	560Ω	680Ω	820Ω

Common E24 values from 1kΩ to 10kΩ

1.0kΩ	1.1kΩ	1.2kΩ	1.3kΩ	1.5kΩ	1.6kΩ	1.8kΩ	2.0kΩ
2.2kΩ	2.4kΩ	2.7kΩ	3.0kΩ	3.3kΩ	3.6kΩ	3.9kΩ	4.3kΩ
4.7kΩ	5.1kΩ	5.6kΩ	6.2kΩ	6.8kΩ	7.5kΩ	8.2kΩ	9.1kΩ

Selection rule: Use E12 or E24 when the circuit can tolerate wider value spacing. Use a finer series when resistance error directly affects amplifier gain, sensor scaling, feedback voltage, filter frequency, or measurement accuracy.



E96 Standard Values

E96 contains 96 preferred numbers per decade and is commonly used for $\pm 1\%$ resistors. Move the decimal point to obtain the required range.

1.00	1.02	1.05	1.07	1.10	1.13	1.15	1.18
1.21	1.24	1.27	1.30	1.33	1.37	1.40	1.43
1.47	1.50	1.54	1.58	1.62	1.65	1.69	1.74
1.78	1.82	1.87	1.91	1.96	2.00	2.05	2.10
2.15	2.21	2.26	2.32	2.37	2.43	2.49	2.55
2.61	2.67	2.74	2.80	2.87	2.94	3.01	3.09
3.16	3.24	3.32	3.40	3.48	3.57	3.65	3.74
3.83	3.92	4.02	4.12	4.22	4.32	4.42	4.53
4.64	4.75	4.87	4.99	5.11	5.23	5.36	5.49
5.62	5.76	5.90	6.04	6.19	6.34	6.49	6.65
6.81	6.98	7.15	7.32	7.50	7.68	7.87	8.06
8.25	8.45	8.66	8.87	9.09	9.31	9.53	9.76

Base number	Example resistance	Equivalent notation
1.91	191 Ω	0.191k Ω
4.87	4.87k Ω	4,870 Ω
9.76	97.6k Ω	0.0976M Ω

Do not confuse nominal series with tolerance. A manufacturer may offer an E24 nominal value with $\pm 1\%$ tolerance. Always read the complete part specification rather than inferring tolerance from the nominal number alone.

Selection and Design Quick Reference

Nearest Standard Value	LED Current-Limiting Resistor
Error (%) = (Selected - Calculated) / Calculated × 100 Example target: 193Ω 180Ω: -6.74% 200Ω: +3.63% 191Ω: -1.04% 196Ω: +1.55% Choose by circuit limits, not only by the smallest numerical error.	$R = (V_S - V_F) / I$ Example: 5V supply, 2V LED, 10mA $R = (5 - 2) / 0.01 = 300\Omega$ Practical standard choice: 330Ω Actual current: about 9.1mA Verify LED forward-voltage range and resistor power.

Resistor Power

Formula	Use when known
$P = V \times I$	Voltage and current
$P = I^2 \times R$	Current and resistance
$P = V^2 / R$	Voltage and resistance

Apply derating for ambient temperature, enclosure heat, copper area, pulse load, and manufacturer limits. Avoid operating continuously at the absolute rated power.

Pull-Up and SMD Starting Points

Application / package	Typical starting point	Check before release
Push-button or slow GPIO pull-up	10kΩ	Leakage, noise, debounce
General I ² C pull-up	4.7kΩ	Bus capacitance, rise time, sink current
Faster or higher-capacitance bus	2.2kΩ	Static current and device limits
0402 SMD	About 0.063W	Assembly yield, voltage, thermal margin
0603 SMD	About 0.10W	Actual series rating
0805 SMD	About 0.125W	Board temperature and pulse load
1206 SMD	About 0.25W	Voltage and pad heat spreading

BOM and Quotation Checklist

Specify nominal resistance, tolerance, package, power rating, temperature coefficient when relevant, working-voltage or pulse requirement, and approved manufacturers or alternatives. This information helps a PCBA supplier avoid unsuitable substitutions during sourcing.

For PCB fabrication, component sourcing, prototype assembly, or production PCBA review, contact EBest Circuit (Best Technology) at sales@bestpcbs.com.