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RESISTORS

What a resistor does, the standard E-series values you can actually buy (IEC 60063), tolerance, and power rating. With real board examples.

ONE THOUSAND DRONES ENGINEERING TEAM · VERIFIED 2026-07

A resistor is a part built to have a chosen, stable resistance, and almost every board is covered in them. What they do, the standard values you can actually buy, and how to read one off a schematic, is most of what you need.

WHAT DOES A RESISTOR DO?

A resistor limits current, sets a voltage when paired with another resistor as a divider, pulls a signal line to a known level, or senses a current by the small voltage it drops. Each use is the same part chosen for a different value.

THE STANDARD VALUES: THE E-SERIES

You cannot buy just any resistance. Manufacturers make a fixed set of values in each decade, spaced so their tolerance bands overlap, and this set is the E-series defined by IEC 60063. The E24 series has 24 values per decade for 5 percent parts; the E12 series has 12 for 10 percent parts. So you compute the value you want, then pick the nearest standard one.

- IEC 60063:2015. Preferred number series for resistors and capacitors (the E-series). `webstore.iec.ch`

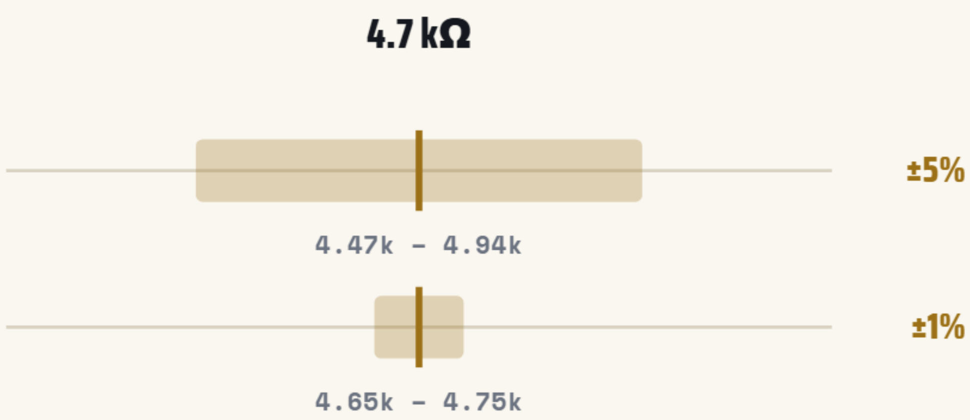
TOLERANCE AND POWER RATING

Tolerance is how close the real value sits to the printed one, commonly 1 or 5 percent. The power rating is how much heat the part can shed before it drifts or fails, so size it above the power it dissipates. On a small board these are surface-mount chips in `0402` and `0603` sizes.

- Vishay. D/CRCW e3 Standard Thick Film Chip Resistors datasheet (E-series values, tolerance, ratings). `vishay.com`

▸ FUNDAMENTALS · RESISTORS

RESISTOR TOLERANCE



The marking is the centre of a band; tolerance is its width. Same 4.7 kΩ, but ±5% wanders five times further than ±1%.

THE E-SERIES: THE STANDARD VALUES YOU CAN ACTUALLY BUY, SPACED SO THEIR TOLERANCES OVERLAP.

A One Thousand Drones board's bill of materials is mostly `0402` and `0603` chip resistors at E24 values, `5.1 kΩ`, `10 kΩ`, `330 Ω`, chosen because they are standard and in stock.

CHECKPOINT

1. Why can't you buy a resistor of any exact value?

- a. Manufacturers make a fixed set of standard values per decade
- b. Resistors are only made in whole ohms
- c. Only round numbers are physically possible

ANSWER · A

The E-series (IEC 60063) fixes the standard values; you pick the nearest one.

2. A resistor's tolerance tells you what?

- a. How much power it can dissipate
- b. How close its real value is to the printed value
- c. How fast it responds to a signal

ANSWER · B

Tolerance is the value spread, commonly 1 or 5 percent; the power rating is separate.

3. The E24 series has how many standard values per decade?

a. 12

b. 100

c. 24

ANSWER · C

E24 has 24 values per decade (5 percent parts); E12 has 12 (10 percent).

- Prerequisite: Ohm's law
- Next: voltage dividers