ELECTRICAL · CHEAT SHEET

Capacitor *markings decoder*.

Three-digit codes, tolerance letters, microfarad/nanofarad/picofarad — **every common capacitor marking** decoded. The companion to the resistor color codes sheet.

The chart

MARKING FORMAT	EXAMPLE	DECODED VALUE	WHERE
Direct (with units)	100 µF, 0.1 µF, 4n7	Reads exactly as printed. '4n7' = 4.7 nF (European notation: position of unit letter is the decimal point).	Electroly
3-digit code (pF)	104	10 × 10⁴ pF = 100,000 pF = 100 nF = 0.1 µF	Ceramic c
3-digit code (pF)	473	47 × 10³ pF = 47,000 pF = 47 nF = 0.047 µF	Ceramic c
3-digit code (pF)	222	22 × 10² pF = 2,200 pF = 2.2 nF	Ceramic c
3-digit + tolerance letter	104K	100 nF ±10%	Most comm
3-digit + tolerance letter	472J	4.7 nF ±5%	Tighter-t
4-digit (precision pF)	1002	100 × 10² pF = 10,000 pF = 10 nF	Precisior
4-digit (precision pF)	4992	499 × 10² pF = 49.9 nF	Precisior
µF marked directly	.1, .47, 1, 4.7, 10, 100, 470	Value in microfarads — usually electrolytic.	Electroly
nF marked directly	100n, 220n	100 nF = 0.1 µF, 220 nF	European
Voltage rating	100V, 25V, 6.3V	DC voltage rating (always shown alongside capacitance)	Critical
Tolerance code letters	B = ±0.1 pF, F = ±1%, J = ±5%, K = ±10%, M = ±20%, Z = +80/−20%	—	Reading c
Temp coefficient (ceramic)	NP0/C0G, X7R, Y5V	NP0 = best (low drift), X7R = mid, Y5V = worst (high drift but cheap)	All ceram
Polarity (electrolytic)	Stripe on case, − terminal	Reversed polarity destroys electrolytic caps quickly	Always ob

> **How the 3-digit code works.** First two digits = the significant figures, third digit = the multiplier (number of zeros). Result is always in **picofarads**. So '104' = 10 followed by 4 zeros = 100,000 pF = 100 nF = 0.1 µF. The 'KP' or 'K' suffix is the tolerance (±10%).

Common applications

APPLICATION	TYPICAL CAPACITANCE	TYPE
Bypass cap on IC power pin	100 nF (0.1 µF)	Ceramic X7R

APPLICATION	TYPICAL CAPACITANCE	TYPE
Power supply bulk filter	100-4700 µF	Aluminum electrolytic
Audio coupling (DC blocking)	1-10 µF	Film or electrolytic (non-polar preferred)
RC low-pass filter	1 nF to 1 µF	Film or ceramic (depending on frequency)
Crystal oscillator load	10-30 pF	NP0/C0G ceramic
Snubber across switch	10-100 nF	Film (X1/Y1 safety rated for mains)
Motor start (single phase)	30-200 µF	Polypropylene film, motor-run rated
Switched-mode supply output	100-1000 µF	Low-ESR aluminum or polymer
RF tuning	5-100 pF	Variable or NP0 ceramic

Common pitfalls

- **'µ' and 'u' mean the same thing.** µF (microfarad) is often written as uF in ASCII-only contexts. Both equal 10^{-6} farads.
- **nF is rarely printed on US caps.** US capacitor catalogs traditionally use only pF (small) and µF (large). 100 nF is often listed as 0.1 µF or 100000 pF, but rarely as 100 nF. European catalogs use nF freely.
- **The 4 in '4n7' is the integer and 7 is the decimal — the letter is the decimal point.** So '4n7' = 4.7 nF. Common in European electronics. Similarly '2u2' = 2.2 µF, 'R47' = 0.47 Ω (for resistors, same convention).
- **Electrolytic capacitors have polarity.** Connecting them backwards causes them to fail violently (vented top, sometimes explosion). The stripe on the case marks the negative terminal. Non-polar 'NP' electrolytics exist for AC circuits.
- **Capacitance drifts with temperature, voltage, age.** Y5V ceramic loses 60-80% of capacitance at the edges of its temperature range. NP0/C0G is stable within 0.5%. Always check the dielectric type for precision work.
- **'105' is not 105 pF.** It's 10 × 10^5 pF = 1 µF. The third digit is a multiplier, not part of the number. This trips up beginners constantly.

Common questions

What does '104' mean on a ceramic capacitor?

It's the EIA 3-digit code: first two digits are significant figures (10), third is the multiplier (×10^4 pF). So 104 = 10 × 10^4 pF = 100,000 pF = 100 nF = 0.1 µF. This is the most common decoupling capacitor value in electronics.

How do I tell µF from nF on a capacitor?

Modern small ceramic caps use 3-digit pF codes (104 = 100 nF). Larger electrolytic and tantalum caps print microfarad values directly (e.g. '10μF' or '47μF'). When in doubt: anything ≥ 1 μF is almost always electrolytic or tantalum and marked directly; anything in pF/nF is usually 3-digit coded ceramic.

What's a 'Y5V' or 'X7R' ceramic code?

Those are EIA dielectric class codes for ceramic capacitors. X7R means -55°C to +125°C operating range with ±15% capacitance variance — stable, predictable. Y5V means -30°C to +85°C with +22%/-82% — extreme variation, only suitable for non-critical coupling. NP0/C0G is the most stable (±30 ppm/°C); use it for precision timing.

Why doesn't my 'tolerance' letter J mean ±10%?

Capacitor tolerance letters are standardized: F = ±1%, G = ±2%, J = ±5%, K = ±10%, M = ±20%, Z = +80/-20%. People confuse them with resistor tolerance letters which use different codes. Always check whether the marking is per IEC 60062 (capacitor) or EIA RS-279 (resistor).

What's the difference between voltage rating and working voltage?

Voltage rating (sometimes called WVDC) is the maximum continuous DC voltage. Real circuits often have transient spikes — for reliability, derate to 50-70% of rated voltage. A 16V cap should see no more than ~10V continuous in a critical design. Aluminum electrolytics lose lifetime exponentially with voltage stress.

Sources

- **Three-digit code:** IEC 60062 — Marking codes for resistors and capacitors.
- **Tolerance letters:** EIA-198 — Standard for ceramic capacitor classes and tolerances.
- **Temperature coefficients (ceramic):** EIA-RS-198 (Class I — NP0, etc.) and EIA-RS-198 (Class II — X7R, Z5U, etc.).