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REACTIVE PARTS AND FILTERING

How capacitors and inductors react to changing signals, and how an RC filter's cutoff frequency picks what passes. With a live calculator.

ONE THOUSAND DRONES ENGINEERING TEAM · VERIFIED 2026-07

Resistors treat every frequency the same. Capacitors and inductors do not: they react to how fast a signal changes, and that lets you build a filter that passes some frequencies and blocks others.

REACTANCE

A capacitor's opposition to current falls as the frequency rises, and an inductor's opposition rises. That frequency-dependent opposition is reactance. It is why a capacitor blocks steady DC but passes a fast signal.

THE RC FILTER AND ITS CUTOFF

A resistor and a capacitor together set a cutoff frequency, the point where the filter starts to roll off. In a low-pass filter, frequencies below the cutoff pass and frequencies above it are attenuated. The cutoff comes straight from the R and C values.

$$f_c = 1 / (2 \times \pi \times R \times C)$$

CALCULATOR · RC FILTER CUTOFF FREQUENCY CALCULATOR (FIRST-ORDER)

Find a first-order RC filter's −3 dB cutoff ($f_c = 1 / 2\pi RC$) and time constant from R and C. For ADC anti-alias and noise filtering.

Interactive calculator: academy.onethousanddrones.com/tools/rc-filter-cutoff

FIND AN RC FILTER'S CUTOFF FREQUENCY AND TIME CONSTANT.

A mechanical picture makes the roll-off intuitive: an RC low-pass behaves like a shock absorber. A fast, sharp jolt gets soaked up and smoothed, while a slow, steady change passes straight through unaltered. Fast is above the cutoff and gets damped; slow is below it and gets through.

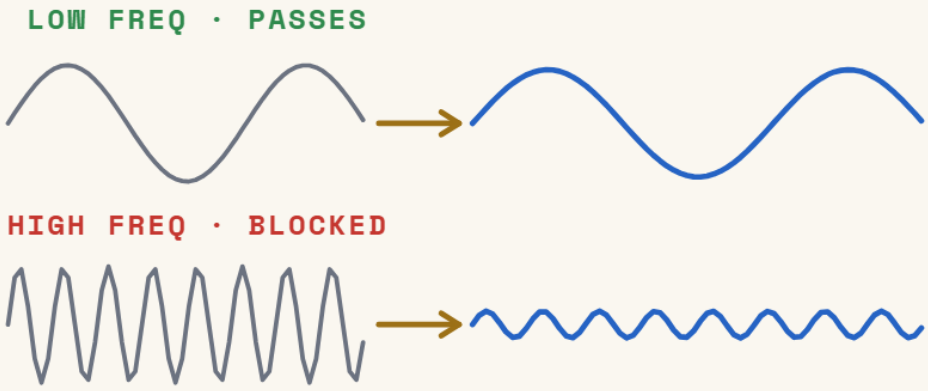
WHERE YOU MEET IT

An RC low-pass in front of an ADC is an anti-alias filter: it removes fast noise the converter would otherwise fold into the signal (Espressif ESP-IDF). The same RC also sets how fast a line settles, which is why a reset or button line often carries one.

- Espressif. ESP-IDF Programming Guide: ESP32-S3 Analog to Digital Converter (ADC). docs.espressif.com

▸ FUNDAMENTALS · REACTANCE & FILTERS

REACTIVE PARTS AND FILTERING



A cap reacts to how fast a signal changes. An RC filter passes slow signals and shrinks fast ones; the corner is fc = 1 / (2π R C).

AN RC LOW-PASS PASSES LOW FREQUENCIES AND ROLLS OFF ABOVE THE CUTOFF.

CHECKPOINT

1. Reactance is what?

a. A resistor's fixed opposition to current

b. A frequency-dependent opposition to current

c. The heat a part gives off

ANSWER · B

A capacitor's and inductor's opposition changes with frequency; that is reactance.

2. In a low-pass RC filter, which frequencies pass?

a. Those above the cutoff

b. All frequencies equally

c. Those below the cutoff

ANSWER · C

Low-pass passes below the cutoff and attenuates above it.

3. An RC filter in front of an ADC does what?

a. Removes fast noise before the converter samples it

b. Amplifies the signal

c. Stores the reading

ANSWER · A

It is an anti-alias filter: it strips high-frequency noise the ADC would otherwise fold in.

- Prerequisite: capacitors and decoupling
- Calculate it: the RC filter cutoff calculator
- Next: grounds and power rails