CircuitClarity RESOURCE

# Selecting an op-amp from the signal envelope

https://circuitclarity.com/resources/op-amp-selection-workflow/

## The decision this guide supports

Supply, common-mode range, output swing, load, speed, noise, offset, bias, stability, and package context must be checked as one envelope.

A useful calculation is not the finish line. It becomes useful when its method, units, source conditions, and omitted effects fit the actual design question. Use this reference to identify that boundary before treating a nominal result as an implementation decision.

DECISION MAP

## From first estimate to defensible next step

1. **Define the signal's voltage range, source impedance, and required accuracy.**
   Start by naming the physical quantity, operating condition, and decision at stake. A number without that context cannot establish a design margin.

2. **Check supply, common-mode range, and output swing against that signal envelope.**
   Keep this check explicit. It separates a useful first-pass model from an answer that only looks precise.

3. **Verify speed (GBW, slew rate) and noise against the bandwidth and resolution needed.**
   Keep this check explicit. It separates a useful first-pass model from an answer that only looks precise.

4. **Confirm stability with the actual load and the selected device's guidance.**
   Treat this as the handoff point. Compare the result with selected-part evidence, the real layout or assembly, and a measurement method that can reveal the remaining uncertainty.

## Worked design review

Consider a designer using this method to make a first selection. The initial estimate establishes the nominal target, but it should not silently absorb a rating, curve, parasitic, temperature condition, or measurement setup from a different scenario. The correct outcome is often not a single chosen value: it is a short list of conditions that must be satisfied together.

Begin with the first two steps above, then ask whether the value still fits when the most consequential real-world condition changes. If it does, the estimate has earned a more detailed check. If it does not, the discrepancy identifies the design variable that deserves attention before a board, part, or test plan is committed.

> **Practical interpretation**
>
> This funnel narrows candidates by envelope fit; it does not replace a specific device's full datasheet review or bench validation. That is not a weakness in the method. It is the cue to use the correct next source of evidence.

## Questions to take into a design review

Has the device's supply, common-mode range, and output swing been checked against the actual signal envelope before comparing speed or noise?

Were common-mode range and output swing checked as two separate constraints, not assumed to track together?

Was gain-bandwidth product checked against the specific closed-loop gain and required bandwidth of this circuit, not just compared as a standalone number between devices?

These questions prevent a common failure mode: moving a correct equation into a context where its assumptions no longer hold. They also make it easier for another engineer to reproduce the reasoning and identify which condition needs more evidence.

## Common ways this reasoning goes wrong

**Optimizing for noise or speed before confirming the device can handle the signal's voltage envelope at all**

A device with excellent noise or speed specs is disqualified immediately if its supply, common-mode range, or output swing cannot accommodate the actual signal; envelope fit should be checked first.

**Checking common-mode range but not output swing, or vice versa**

These are two independent limits at two different points in the circuit; a device can satisfy one and violate the other for the same signal.

**Comparing gain-bandwidth product between devices without checking it against the actual required closed-loop gain and bandwidth**

A high gain-bandwidth product does not guarantee adequate bandwidth at a specific closed-loop gain; the two must be checked together for the specific circuit configuration.

## Where this guide stops

This funnel narrows candidates by envelope fit; it does not replace a specific device's full datasheet review or bench validation.

For a consequential design, preserve the inputs and conditions used here, then compare them with the selected component or system evidence. That makes the follow-up review faster and keeps a useful first estimate from becoming an unsupported claim.

## Frequently asked questions

▶ **Which limit should I check first when selecting an op-amp?**

▶ **How do common-mode range and output swing interact in a real circuit?**

▶ **When do gain-bandwidth product and slew rate become the binding constraint instead of DC accuracy?**

## Related engines

- **Non-inverting op-amp designer**
- **Inverting op-amp designer**
- **Instrumentation amplifier gain and range**
- **Op-amp integrator designer**
- **Op-amp dynamic-performance planner**
- **Analog level-shift and bias designer**
- **Wien-bridge oscillator designer**
- **Sallen-Key low-pass designer**
- **Multiple-feedback filter designer**
- **State-variable filter designer**

## Method authorities and source conditions

Use this guide alongside the engine-specific method and selected component or system data. The underlying reference families are Analog Devices precision references, TI analog design references. Those sources establish condition-specific behavior; CircuitClarity uses them to frame the decision and its limits.