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LDO VS SWITCHER: PICKING ONE

Choose a regulator by the drop, the current, and the noise budget. When an LDO wins on simplicity and quiet, when a buck or boost wins on efficiency, and the hybrid that gets both.

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There is no universally best regulator, only the right one for the job. Three questions decide it: how big is the voltage drop, how much current flows, and how clean must the output be. Answer those and the choice is usually obvious.

THE TRADE-OFF

A linear regulator is simple, cheap in parts, and quiet, but it wastes the dropped voltage as heat. A switching regulator is efficient and handles big conversions, but it is more parts, more layout care, and a noisier output. You are trading efficiency against simplicity and noise.

WHEN EACH ONE WINS

REGULATOR	BEST AT	REACH FOR IT WHEN
LDO	Simplicity, low noise, tiny drops	A small drop, low current, or a clean analog rail
Buck	Efficient step-down at high current	A big drop or high current, where an LDO would cook
Boost	Making a higher rail from a lower one	The supply sits below the rail you need

READING THE NUMBERS

The math is the same as in the earlier guides. An LDO's loss is the dropped voltage times the current, so a small drop at low current is nearly free, while a large drop at high current is a furnace. A switcher's loss is roughly a fixed efficiency percentage of the power it moves, so it stays reasonable even for a big conversion. Put your numbers in and the winner shows itself.

$$P_{LDO} = (V_{in} - V_{out}) \times I_{load}$$

THE HYBRID: SWITCHER THEN LDO

The two combine well when you need both efficiency and quiet. A common pattern steps a battery down efficiently with a buck to just above the target, then feeds a small LDO that scrubs the switching noise off and delivers a clean analog rail. You pay a little efficiency at the LDO for a low-noise output. Precision sensor front-ends use exactly this.

PICK BY DROP, CURRENT, AND NOISE; COMBINE A BUCK AND AN LDO WHEN YOU NEED EFFICIENCY AND QUIET.

DEEP DIVE · QUIESCENT CURRENT: THE NUMBER THAT DECIDES A SLEEPING BOARD

For a board that spends its life asleep on a battery, the regulator's own idle draw, its quiescent current, can matter more than its efficiency at full load. A switcher that is efficient at `500 mA` may burn more just idling than a tiny LDO does, draining the cell while the board sleeps. This is why a low-power design often chooses a regulator on its quiescent current first, and why the datasheet figure to compare is not always the peak efficiency.

- Diodes Incorporated. AP2112 600mA CMOS LDO Regulator datasheet (low-noise linear regulation). `diodes.com`
- Texas Instruments. Basic Calculation of a Buck Converter's Power Stage (SLVA477): switcher efficiency. `ti.com`

CHECKPOINT

1. You need a quiet `3.3 V` analog rail from a `3.6 V` input. Which regulator?

a. A boost

b. A high-power buck

c. An LDO, for the small drop and low noise

ANSWER · C

A small drop and a noise-sensitive rail is exactly where an LDO wins.

2. A switching regulator's main advantage over an LDO is what?

a. Efficiency, especially for a big conversion or high current

b. A quieter output

c. Fewer parts on the board

ANSWER · A

A switcher keeps efficiency high where an LDO would waste the drop as heat.

3. What does the buck-then-LDO hybrid achieve?

a. A higher output than either alone

b. Twice the current rating

c. Efficient step-down plus a clean, low-noise final rail

ANSWER · C

The buck moves the bulk power efficiently; the LDO scrubs the switching noise off it.

- Prerequisite: linear regulators (LDO)
- See also: buck regulators (step-down)
- Next: reverse-polarity and inrush protection