# Low-dropout (LDO) linear voltage regulators - Quick Reference Guide



Low-dropout (LDO) linear voltage regulators are vital components in almost every circuit. They provide engineers with a simple and design-effective method to reduce an input voltage to one suitable for the application at hand.

This guide provides developers with an overview of our most commonly used low-dropout regulators and will help them identify the most appropriate solution for each type of application.

## – How do I pick the right LDO for an application?

While some applications may require more attention to specific characteristics, a generalized approach to selecting an LDO is to match criteria in the following order:

- Input voltage range
- Output voltage (fixed or adjustable)
- Current requirement of the load
- Dropout voltage
- Output accuracy, in relation to line, load and temperature
- Power supply rejection ratio and output noise voltage
- Quiescent current
- Extra features (Enable, Soft-start, Power Good, etc.)

## – What are the main benefits of LDOs?

### Ease of use

Using LDOs to regulate voltage is always easy. Adding an LDO to any circuit requires only two capacitors and two resistors at the most. Most of ST's LDOs are available in fixed-output configurations, allowing the engineer to omit the resistors, and some even operate without any external capacitors at all.

### Small size

New technologies and innovative solutions allow for producing LDOs in smaller sizes, such as our bumpless ST STAMP™ (0.47 x 0.47 mm) packages.

### High PSRR and Low Noise

Devices for RF applications, data conversion, healthcare and signal processing are often susceptible to noise. While the primary purpose of the LDO is to regulate voltages, the way LDOs operate also makes them efficient at filtering power supply noise, allowing noise-sensitive loads to perform optimally.

### Low quiescent current

Low self-consumption is ideal for portable and battery-powered applications where a small quiescent current can make a large difference in regards to the application's battery lifetime. ST's ultra-low quiescence LDOs retain excellent dynamic performance and are available in a variety of small footprint packages.

### Powering sensitive loads

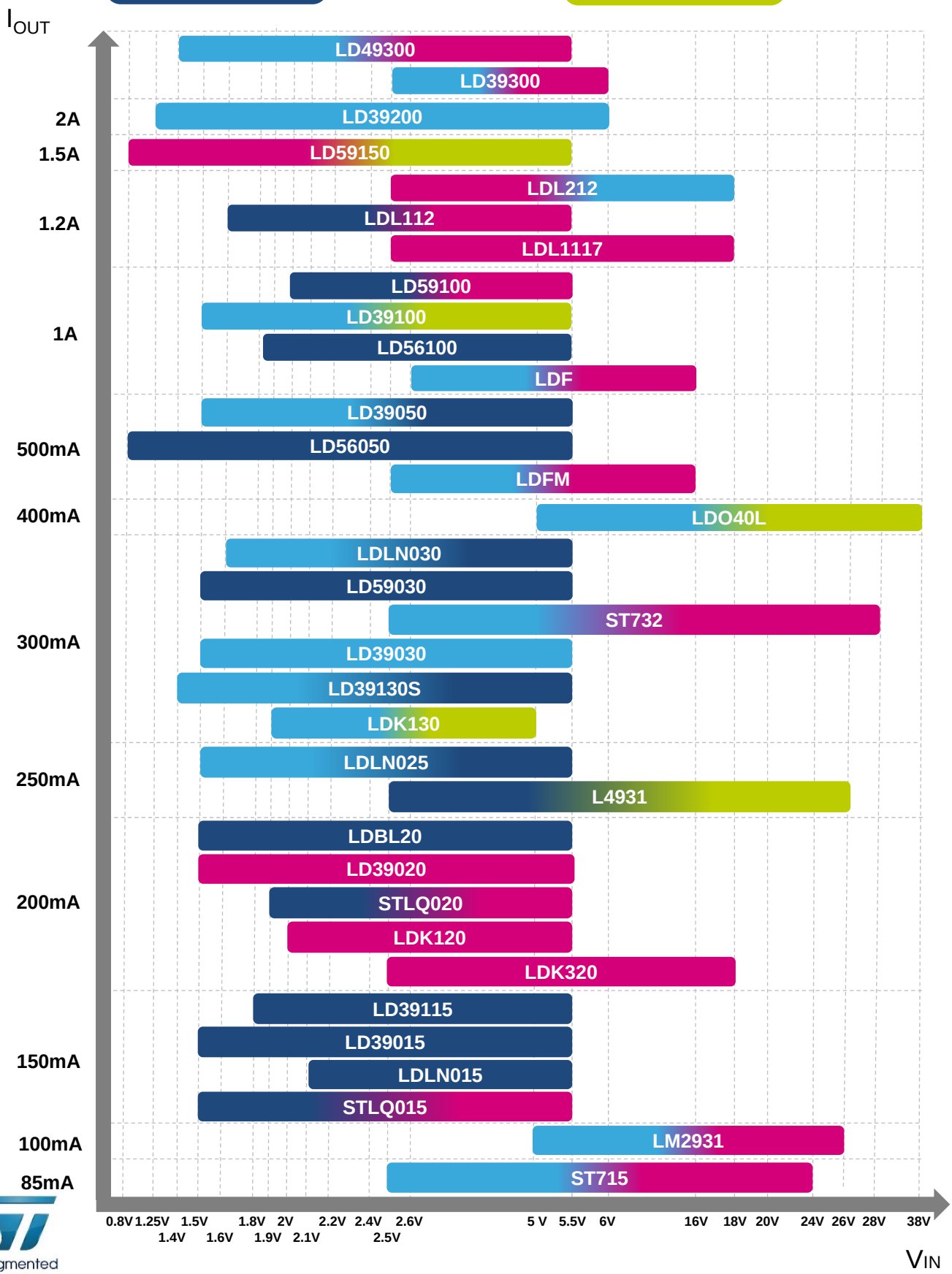
The supply requirements of digital circuits, such as microprocessors, embedded memories and digital signal processing devices, are constantly being pushed to lower voltage levels, while the tolerances are tightening. Maintaining an accurate output voltage, while also retaining other essential features is key when selecting an LDO for these applications.

Industrial

Smart City and Home

Portable/IoT

Automotive

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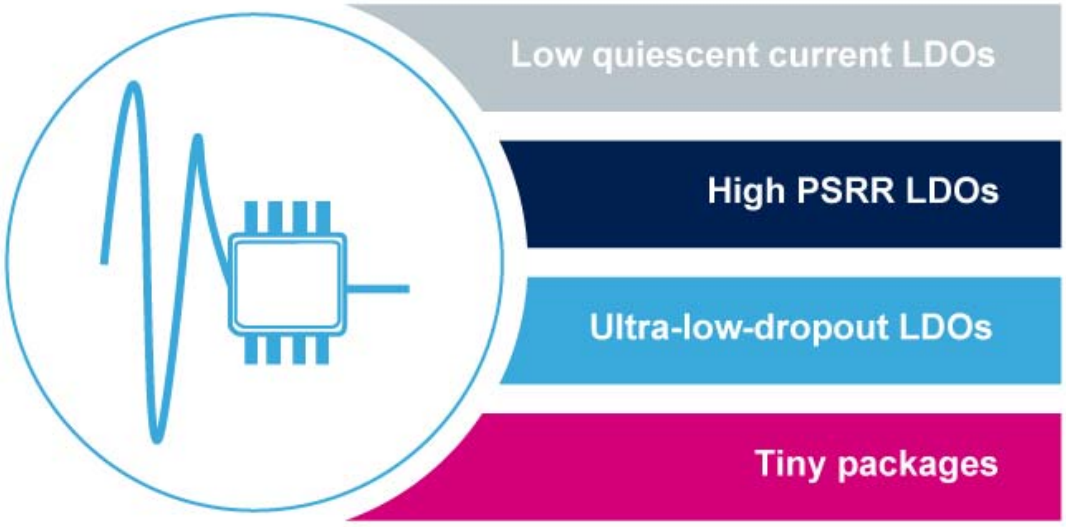


## Ultra-low dropout

The dropout voltage is the defined minimum difference between the input voltage and the desired output voltage at a specified output current. An ultra-low-dropout voltage extends the lifetime of battery-operated devices, as it allows the LDO to maintain a high current output even when the battery voltage is reduced as the battery is discharged.
Furthermore, it reduces power dissipation.

- ST1L08
- LDL112
- LD39200
- LD39115J
- LDCL015

## Low quiescent current

Quiescent current is the current used to power an LDO's internal circuitry. LDOs with low quiescent current are essential for maintaining efficient operation and prolonging battery life, and are a natural choice for applications with extended standby times.

- STLQ50/015/020
- ST715/LDK715
- LD39100
- LD39115J
- LDLN025

## High PSRR/Low noise

PSRR is a measure of the LDO’s ability to endure a changing input voltage without letting it affect the output, while low noise LDOs are designed to minimize the intrinsic noise.
Maintaining the expected output voltage with high precision and low noise is vital when powering sensitive devices or when the supply voltage is derived from a noisy source.

- LDLN030
- LD39015/020/030
- LD3985
- LDBL20
- LD59015

# – Glossary



**Accuracy** – The maximum deviation from the specified output. Nominal accuracy can be affected by factors such as low tolerance components, temperature and load variations. Commonly cited across temperature ranges, it is sometimes specified as Tolerance.

**AEC-Q100** – Any integrated circuit needs to be tested for compliance with the failure modes/stress tests as described in AEC-Q100 before it can be marketed as an automotive-grade device.

**Bias voltage (Vbias)** – An external power rail required by some LDOs. Associated with low dropout voltages and excellent noise characteristics.

**Dropout voltage** – The dropout voltage is a measure of the smallest difference between input and output voltages. A lower dropout allows for more effective regulation and can be used to prolong the lifetime of battery-powered devices.

**Enable/Inhibit (EN/INH)** – Externally enabling (or disabling) the internal circuitry when the regulator isn't required reduces the consumed current and can prolong battery lifetime.

**Feedback network** – Resistors are used to set the desired output voltage in a linear regulator. In fixed output regulators, these are already embedded inside the chip itself**.**

**Line Regulation** – Line regulation describes how well the regulator can maintain its intended output voltage given a change in the input voltage.

**Load Regulation** – Load regulation describes the regulator's ability to maintain the specified output given a change in the load (output) conditions.

**Noise** – Specifically the noise generated by the LDO's internal bandgap reference, which is amplified in the feedback network. Good noise figures are critical in circuits for wireless communication or that rely on high-speed clock signals.

**Package** – The packaging size is a compromise between size and thermal properties. The smaller a package, the more susceptible it is to self-heating. Some larger packages have exposed metal pads to facilitate thermal dissipation into the PCB, allowing for improved passive cooling.

**Pass Element** – The voltage regulation is performed by applying a variable voltage to a MOSFET gate, making it act in a similar way to a variable resistor. This transistor is commonly referred to as the Pass Element.

**Power Dissipation** – When a voltage is regulated, excess power is dissipated as heat. As heat can affect the LDO and other parts negatively, and eventually cause a malfunction or thermal shutdown, thermal management is important.

**Power Good (PG)** – This signal indicates that the output is in regulation. It is useful for power-sequencing, reset triggering, and more.

**PSRR** – Power Supply Rejection Ratio, measure of the LDO's ability to filter out noisy ripples in the input voltage. It is always specified in dB, and always over a range of frequencies.

**Quiescent current** – The current consumed by the regulator to operate the internal circuitry. Lowering the quiescent current is especially important for battery-powered solutions.

**Soft Start (SS)** – Soft Start is a controlled gradual increase of the power throughput, which prevents large inrush currents that can overload the power supply.

**Thermal shutdown** – A protective function that shuts down the device to prevent damage from overheating.

**Transient response** – A description of the regulator's ability to resist fast changes, known as transients, in the load and supply conditions. See Line Regulation and Load Regulation.

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