Low Dropout Regulators

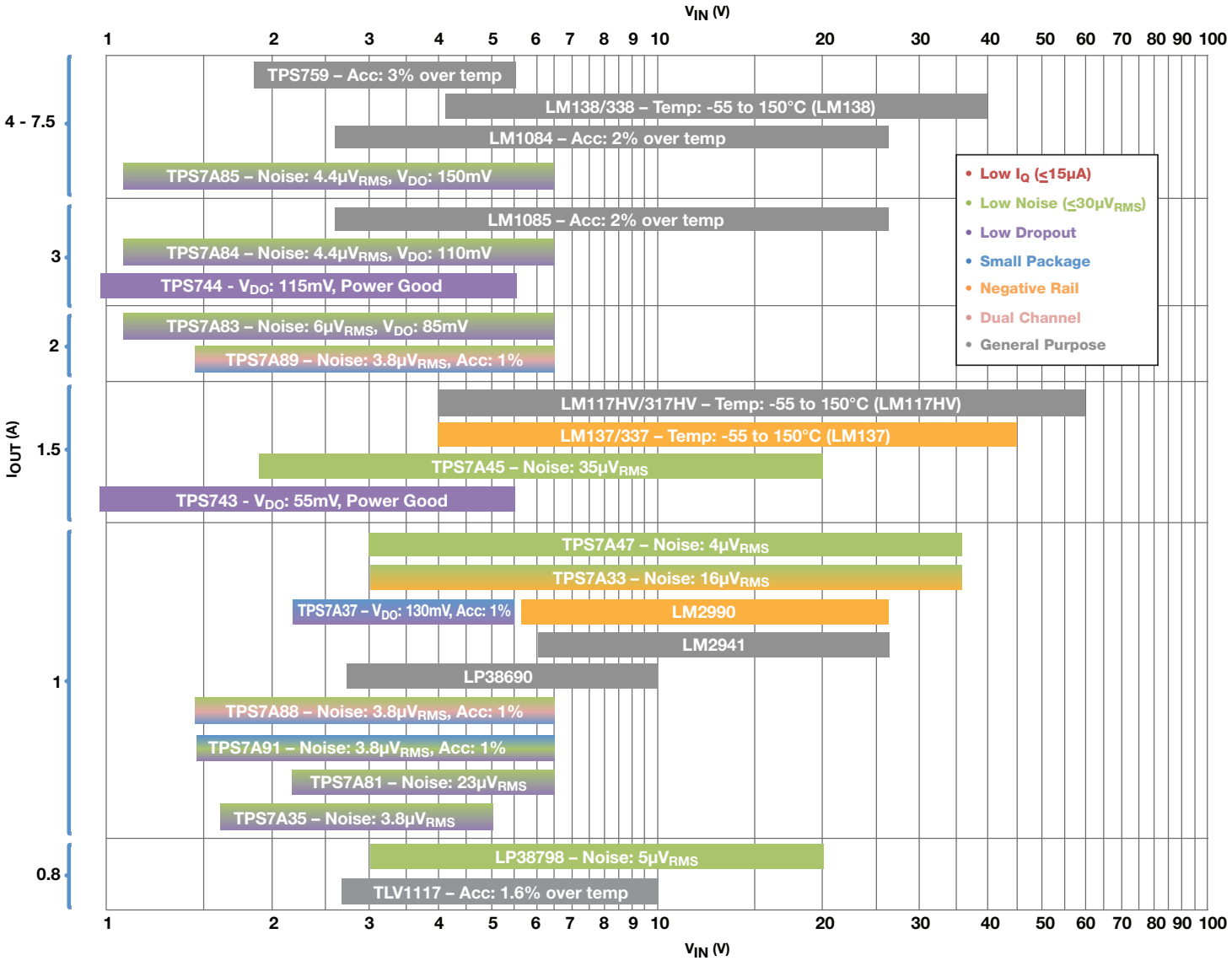
Quick Reference Guide

Texas Instruments

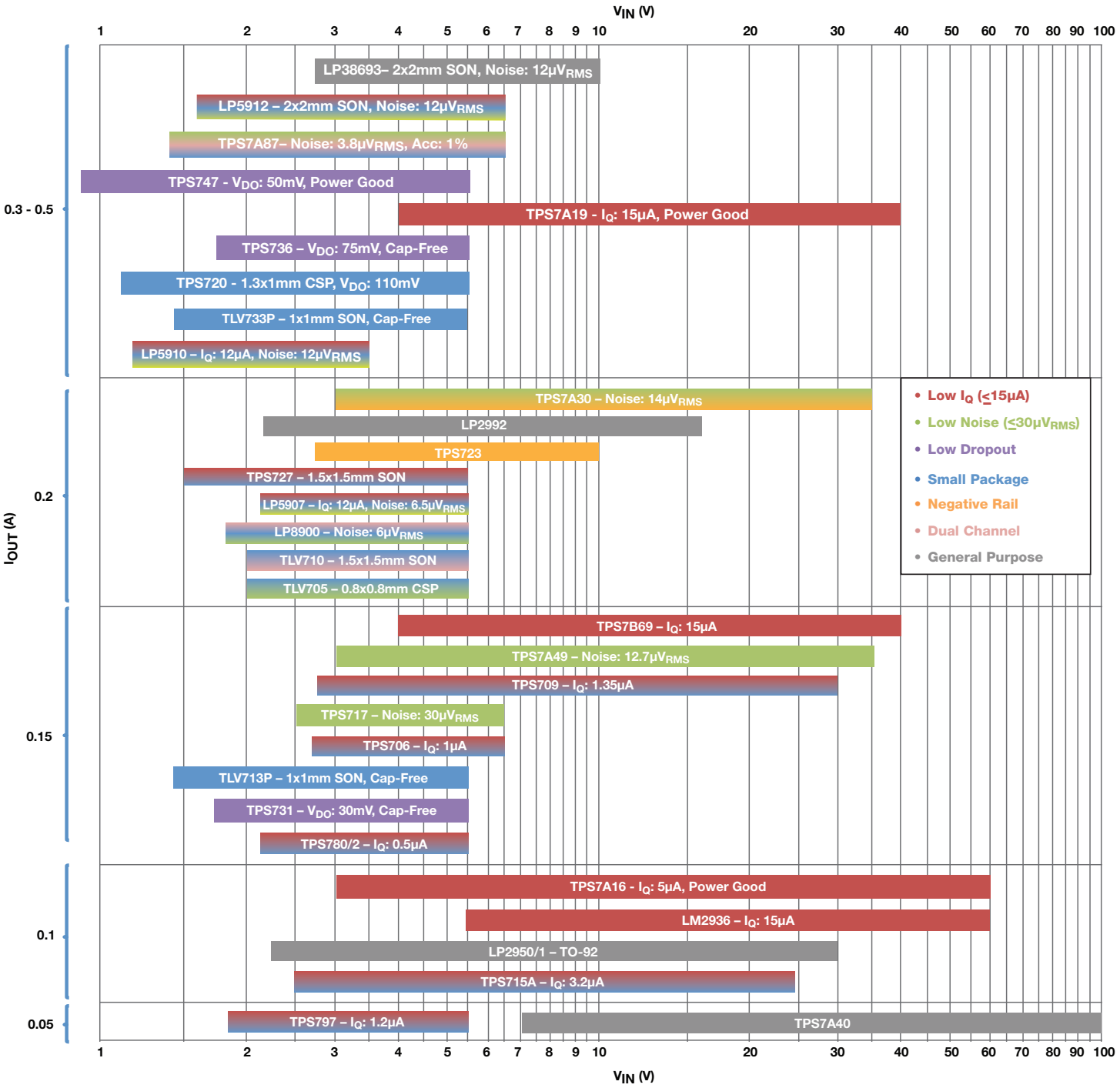
Low dropout linear regulators (LDOs) are a simple, effective way to regulate an output voltage powered from a higher input voltage. The most critical LDO parameters are input voltage range, output voltage, output current, dropout voltage, packaging size, power dissipation capability, and noise. In this quick reference guide you will find TI's most popular LDOs and linear voltage regulators for any kind of application, including industrial, personal electronics, communications equipment and automotive.

To see the complete LDO portfolio:
www.ti.com/ldo

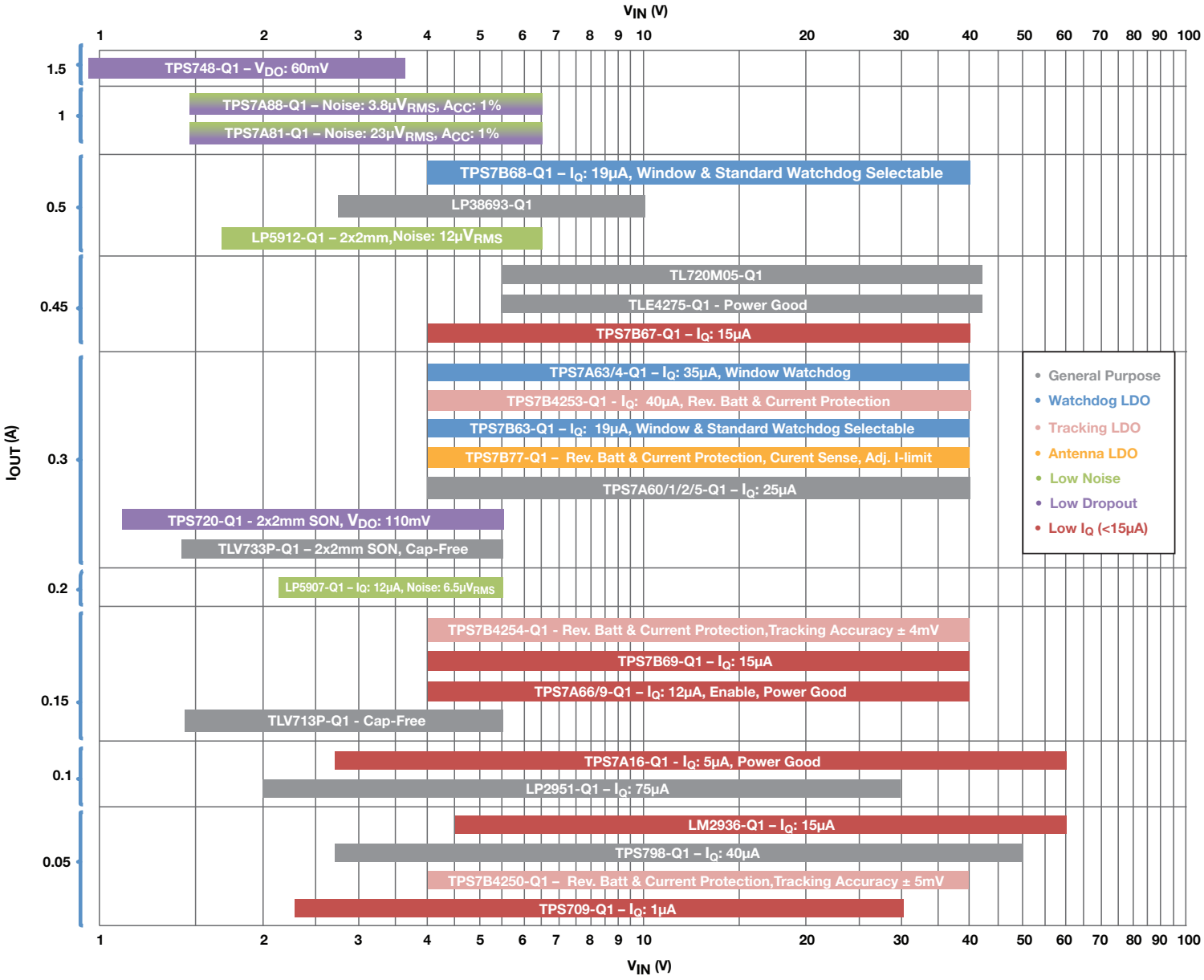
LDOs for Industrial, Personal Electronics, Communications Equipment and more



LDOs for Industrial, Personal Electronics, Communications Equipment and more (continued)



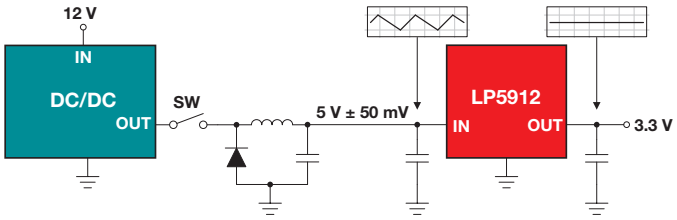
Automotive (AEC-Q100) LDOs



Why LDOs?

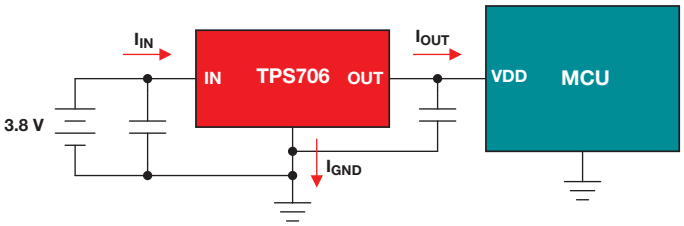
Low noise and high PSRR

LDOs are able to filter ripple and power supply noise in addition to voltage regulation. A low-noise, high-PSRR LDO generates a clean DC rail that prevents the rest of the power supply from compromising the performance of signal conditioning, clocking, and other analog loads.



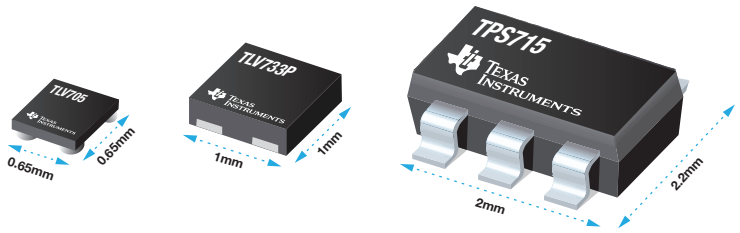
Low quiescent current (I_Q)

A low I_Q LDO allows for regulation from the battery while minimizing current draw and maximizing battery life. Low I_Q LDOs are often paired with low-power microcontrollers.



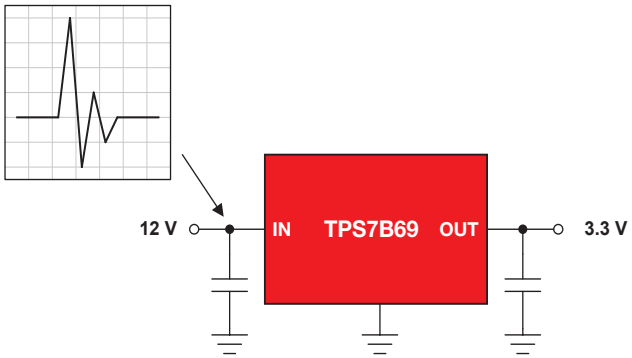
Small package size

TI LDOs come in a variety of sizes and types of packages, including chip-scale, unleaded, leaded and wettable-flank packages. A small solution size allows for optimal board density.



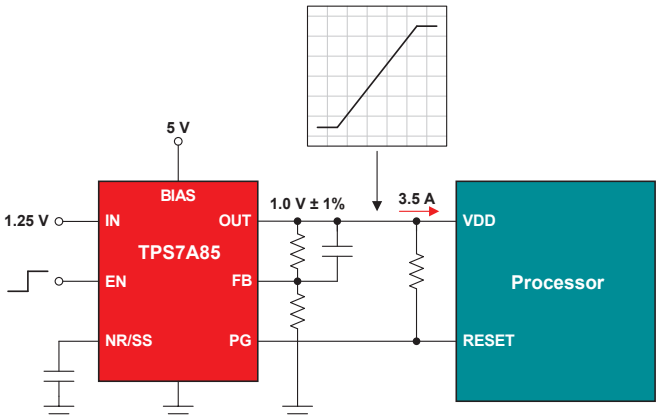
Wide input voltage (V_{IN}) range

Many voltage rails are prone to transient spikes during startup or normal operation. TI's wide V_{IN} LDOs are able to accommodate these transient voltages without additional protection or external circuitry.



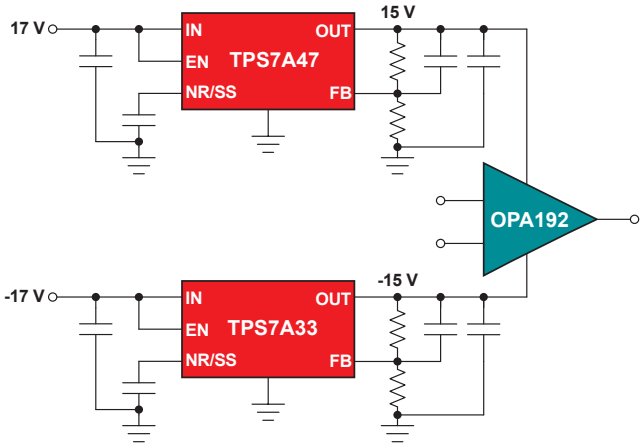
Powering processors and FPGAs

Accurate power supplies with good transient response characteristics are required for many processors and FPGAs. TI's LDOs satsify these requirements while also offering high current capability, ultralow dropout and monotonic startup.



Powering signal conditioning circuits

Many signal-conditioning devices, like amplifiers, require dual supply (±) voltages. Many TI LDOs are available in complementary pairs for generating low-noise positive and negative supply rails.



Design factors

- **Dropout voltage (V_{DO})** – The minimum differential V_{IN} must maintain above V_{OUT} for proper regulation. Dropout determines how efficiently an LDO may operate while still maintaining output voltage regulation.
- **Package** – TI's LDOs are available in chip-scale, leaded (ex. SOT23-3), and unleaded (ex. X2SON) packages. The smallest LDOs in TI's portfolio are 0.65 mm x 0.65 mm.
- **Ground current (I_{GND})** – The current the LDO consumes as part of operation. When there is a light load, or none at all, this is referred to as quiescent current (I_Q). Minimizing ground current is critical to extending battery life and ensuring more efficient system operation.
- **Output noise** – The internal noise generated by the LDO that manifests at the output. A low-noise output is critical to ensuring optimal performance for analog and clocking circuitry.
- **Power supply rejection ratio (PSRR)** – The measurement of an LDO's ability to reject AC elements like ripple voltage. High PSRR over a wide bandwidth is critical to attenuating switching noise and generating a clean DC rail.
- **Output accuracy** – The output voltage deviation. Accuracy is affected by temperature, the input voltage, the output current, and manufacturing variations.
- **Enable (EN)** – Enables or disables the output of the LDO. Also known as Shutdown (SHDN), disabling the device minimizes ground current when regulation is not required.
- **Power good (PG)** – An open-drain output that signals the output voltage has almost reached its target value. A PG output can be used to keep a microcontroller in reset or to sequence additional power supplies.
- **Transient response** – The output response to a change in input voltage or load current. Having the output voltage respond quickly to changes in load or line voltage with minimal ringing is critical when powering sensitive analog and digital loads.
- **Soft-start (SS)** – Controls the slew rate of the output during startup. A controlled, monotonic startup is required to combat inrush current stemming from capacitive loads.
- **Noise-reduction (NR)** – Reduces the noise emanating from the internal reference voltage. Adding a capacitor at this pin forms a low-pass filter that reduces output noise.
- **Bias voltage** – An auxiliary rail for achieving lower dropout. LDOs with an NMOS architecture require a bias voltage or an internal charge pump to achieve low dropout at low output voltages.
- **Thermal resistance (θ_{JA})** – The relationship between power dissipation and the resultant junction temperature increase. Low thermal resistance is key to avoiding entering thermal shutdown as a result of regulation. Packages with a thermal pad or heat slug typically have the lowest θ_{JA} values.
- **Thermal shutdown** – An internal protection circuit that disables the output of the LDO when junction temperature becomes too high. Thermal shutdown is triggered by excess dissipation across the LDO and/or hot ambient temperatures.
- **AEC-Q100 qualification** – Many of TI's LDOs are qualified for use in automotive applications. This is indicated by a "-Q1" suffix. Other devices can be qualified upon request.

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