

# Optimize input voltage drops caused by inrush current in the legacy TLV1117/LV family with the soft-start feature of the new LDO family TLV761xx



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The TLV1117/LV family LDO is a classic, long-standing and positive-voltage-output low-dropout linear regulator capable of delivering up to 800mA output current that is used in a wide variety of application circuits. However, due to the outdated architecture and technology, input voltage drops caused by inrush current may occur in practical applications.

Figure 1 illustrates an application case where a 3.3V input power supply is converted to a 1.8V output. Because the input voltage rises very slowly, a surge current occurs at the load, causing the input voltage sag. This can have adverse effects on the customer's application, such as triggering undervoltage faults in other power modules sharing the same 3.3V input rail.

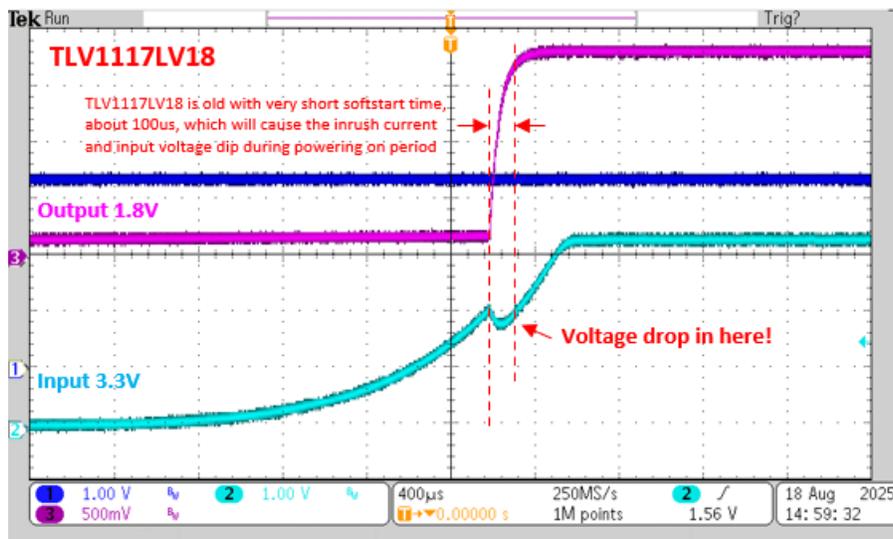


Figure 1. Input voltage sag caused by surge current during power-up

LDO inrush current is the instantaneous high current generated when the LDO is first powered on, mainly caused by the fast charging of the output capacitor. This inrush current can lead to voltage fluctuations, component damage or system instability.

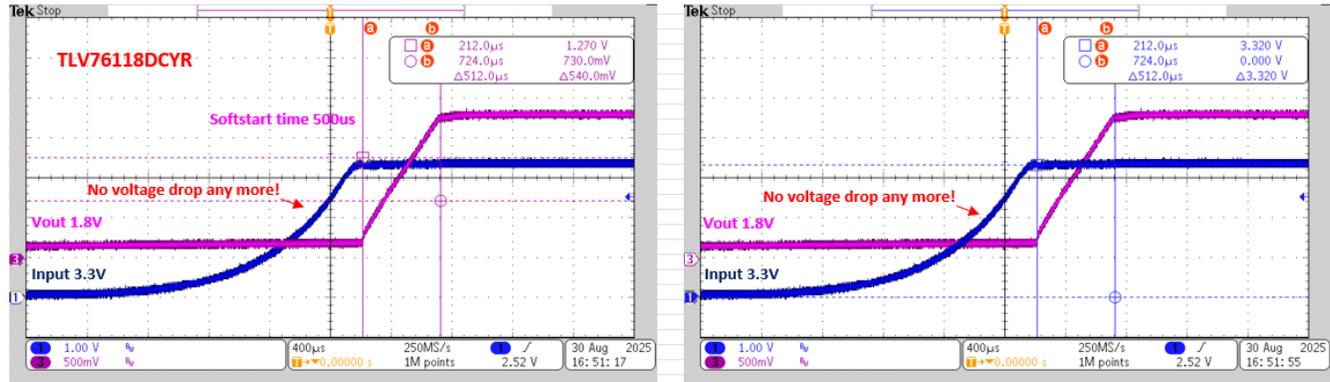
LDO inrush current is mainly caused by the following points:

- Output capacitor charging: The main reason is that the output capacitor is not initially charged, effectively acting as a short circuit. Charging it to the operating voltage generates a significant current.
- Large capacitance: Larger output capacitors require longer charging time and higher currents, resulting in larger and longer-lasting inrush currents.
- The voltage rises quickly and the output voltage settles too quickly: The faster the input voltage rises, the higher the inrush current peak.
- LDO internal characteristics: The design of the LDO, including its feedback loop and regulation components, also affects the inrush current.

Improper handling of shock inrush currents at power-up can lead to various application issues such as:

- Voltage sag: Sudden current surges can cause a significant drop in the input supply rail voltage, which in turn affects other components on the same supply rail.
- Component damage: High current and the stress it impose can exceed the safe operating limits of low-dropout linear regulator (LDO), PCB trace and connector, resulting in component damage or failure.
- System instability: Voltage fluctuations can cause reset or malfunction of sensitive integrated circuits.

There are several ways to avoid such issues, such as using soft-start function to step up the output voltage or adding external components (For example, series resistors or NTC thermistors) to control the inrush current. The simplest solution described here is to upgrade an older TLV1117/LV family device to a newer TLV761 family device that offers sufficient soft-start time and is pin-compatible for direct replacement. As shown in Figure 2, the power-up behavior is compared between the two devices in the same circuit.



**Figure 2. By using the appropriate soft-start time optimized for TLV761 family of devices, no input voltage sag occurred in the same application circuit**

## Conclusion

Many new LDOs (For example, TLV761 family), integrate a soft-start feature that allows sufficient time to control the output voltage settling, thus limiting the start-up current. This is highly beneficial for customers' actual applications, as it helps avoid inrush current and voltage sag issues in certain scenarios. So, if you experience this type of issue, upgrade your old TLV1117/LV family LDO to the new TLV761 family LDO.

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