

TPS65320C-Q1 Auto-Source Feature

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ABSTRACT

This application report provides a summary of the auto-source feature of the TPS65320C-Q1 device.

1 TPS65320C-Q1 Auto-Source Feature

In a variety of applications, during normal operation a supply current in the ampere-range is required, while during stand-by, only minimal current is needed. For efficiency and thermal reasons, the normal operation calls for a Buck-converter, while the switching losses (even in low-power mode) are undesired. However, operating a linear regulator straight off the battery is very inefficient and creates high power-dissipation. This application note discusses how the TPS65320C-Q1 device addresses this controversy with the auto-source function.

The TPS65320C-Q1 device is a combination of a 36-V, 3.2-A, DC-DC step-down converter and a low-dropout (LDO) regulator. The DC-DC step-down converter, referred to as Buck, has an integrated high-side MOSFET.

A typical configuration uses the buck-converter to drive the power-hungry domains and peripherals, while the LDO supports the real-time-functions, which generally need very low-supply currents. During normal operation, the LDO uses the output of the buck-converter as an input supply (Figure 1, left side). Due to the reduction in supply voltage by the buck, the drop-out of the linear regulator is reduced and thus the losses are minimized. In case of standby, the domains driven by the buck regulator may not be required and potentially can remain unpowered. Hence, the buck will be disabled. Without an auto-source feature, the LDO would therefore be unsupplied and cannot serve its purpose to keep the real-time domains alive. The auto-source feature, however, will automatically change the LDO-supply from the Buck output (connected to VIN_LDO) to VIN as soon as the buck is disabled (or out of regulation) (Figure 1, right side).

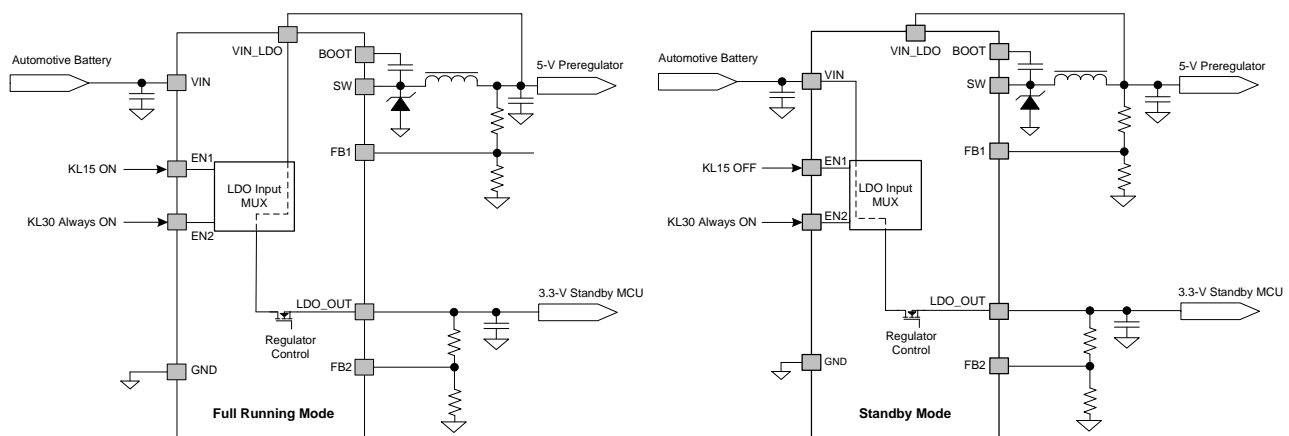


Figure 1. LDO Sourced by Buck-Output (Left), LDO Sourced by VIN (Right)

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In this mode of operation, the LDO has to drop the entire voltage difference between the battery voltage and the output voltage, but this concern is minimal as the stand-by current is typically very low. Furthermore, since the buck-regulator is disabled, there will be no switching losses and associated dissipation during this operation mode, so the entire thermal dissipation path is available to the linear regulator and its losses.

The LDO also features a tracking function: At low input voltages, the regulator drops out of regulation and the output voltage tracks input minus a drop-out voltage. This feature allows for a smaller input capacitor and possibly can eliminate the need to use a boost converter during cold-crank conditions.

One intrinsic short-coming of the cascading configuration of the buck supplying the LDO is that the buck output voltage needs to be higher than the LDO output voltage. In the given example, this is the case and no issue. However, in different scenarios, customers may want to use the buck to supply 3.3-V domains, while using the LDO, for example, to supply the CAN-transceiver with 5 V, and the approach/solution with TPS65320C-Q1 does not satisfy the system requirements. For such applications, TI developed the TPS65321-Q1, which does not have the auto-source feature, but has a fully 36-V rated VIN_LDO input that may attach directly to the battery. In this configuration, the buck and the linear regulator are likely operating simultaneously and the LDO potentially has a high drop-out voltage, so the thermal consideration is essential.

The TPS65320C-Q1 device is an ideal solution for applications that demand a high power-rail (up to 3.2 A) at a higher voltage and a low-power rail (up to 280 mA) at a lower voltage, in particular if the high-power rail may not be available at all times. In case the high-power rail has a lower voltage than the LDO-output, the TPS65321-Q1 device can support those applications.

Revision History

DATE	REVISION	NOTES
July 2016	*	Initial release

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