

White Paper

Keeping Pace with Power Hungry Mobile Devices

Battery life and thermal budget are two of the most critical factors challenging engineers designing mobile power management systems. As mobile device hardware and software capabilities have increased with the addition of web browsing, higher resolution cameras, larger HD screens, faster processors and 4G, so have the peak power requirements from the voltage regulators that supply power to these systems. Load currents add up quickly with multiple processes running concurrently, which places enormous electrical and thermal stress on the power management system.

Systems engineers have come up with creative solutions to increase battery life, and while most power requirements are already integrated into a smartphone and tablet's power management IC (PMIC), there is also the requirement for discrete power solutions to keep pace with the next round of mobile system innovations. These critically important and very specialized discrete solutions enhance the capabilities of the PMIC and maximize the mobile device's power efficiency.

This article discusses the challenges of increasing a mobile product's power efficiency, and shows power system designers how to use next generation buck-boost converters to increase the life of lithium-ion (Li-ion) or Li-polymer batteries, and reduce power dissipation to meet increasingly stringent thermal budgets.

Buck-Boost as a Pre-Regulator

Buck-boost converters can play a major role in improving overall system efficiency and enhancing battery life. An application where they have been particularly successful is their use as a pre-regulator for PMIC low dropout regulators (LDOs). Mobile system PMICs can use up to 30 LDOs dedicated to specific subsystems, such as Bluetooth®, SD memory and RF transceivers, with LDO output voltages ranging from 1.2V to 3.3V. The Li-ion batteries typically used in these systems can have a voltage range of 4.35V down to 2.5V, in the case of dynamic line and load transients, even though the VBAT is generally maintained at 3.7V.

The problem is that a large LDO voltage drop causes excessive efficiency loss, and line voltage disturbances may cause temporary brown-out issues in these downstream subsystems. This can be resolved by providing a well regulated output at, say, 3.3V, which also makes the LDO system design easier with more predictable operation under heavy transients. The key improvement, however, is due to the reduced headroom and drop out voltage for all of the LDOs. In fact, the efficiency advantage can be quite substantial. The thermal budget also benefits because of the reduced power dissipation within the PMIC—this reduces die temperature and the power MOSFET on-resistance of all PMIC device functions.

There are two approaches to supplying power to PMIC LDOs: either directly from the battery, or through a buck-boost regulator (see Figure 1).

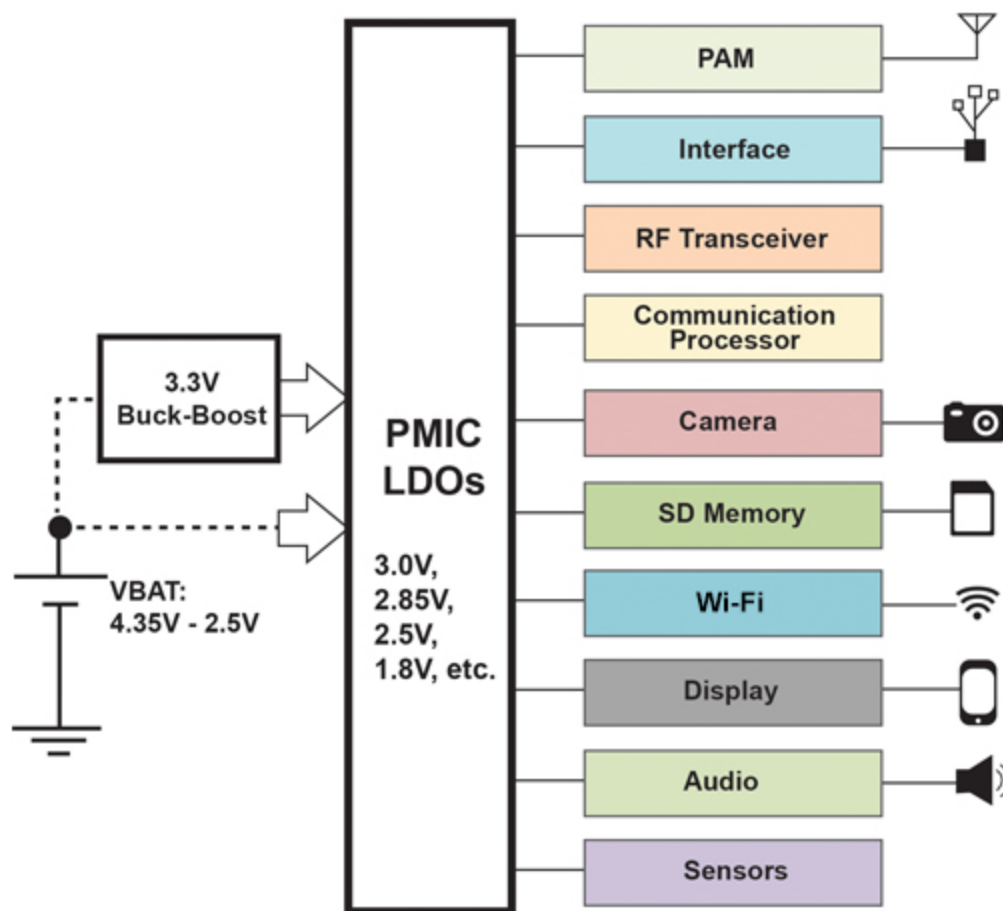


Figure 1. Typical Mobile Power System with Two Different Approaches for LDO Supply Voltage

Engineers at Intersil ran an experiment to compare the impact of the two aforementioned approaches on battery life. The setup emulated common use cases such as streaming video over Wi-Fi and read/write operations to an SD memory card. In this case, it was found that the approach using the buck-boost regulator increased battery life by more than 8%. Figure 2 illustrates the drop in battery voltage as it is discharged to the exact same load profile used in both the direct battery to LDO experiment and the Li-ion battery to buck-boost to LDO experiment.

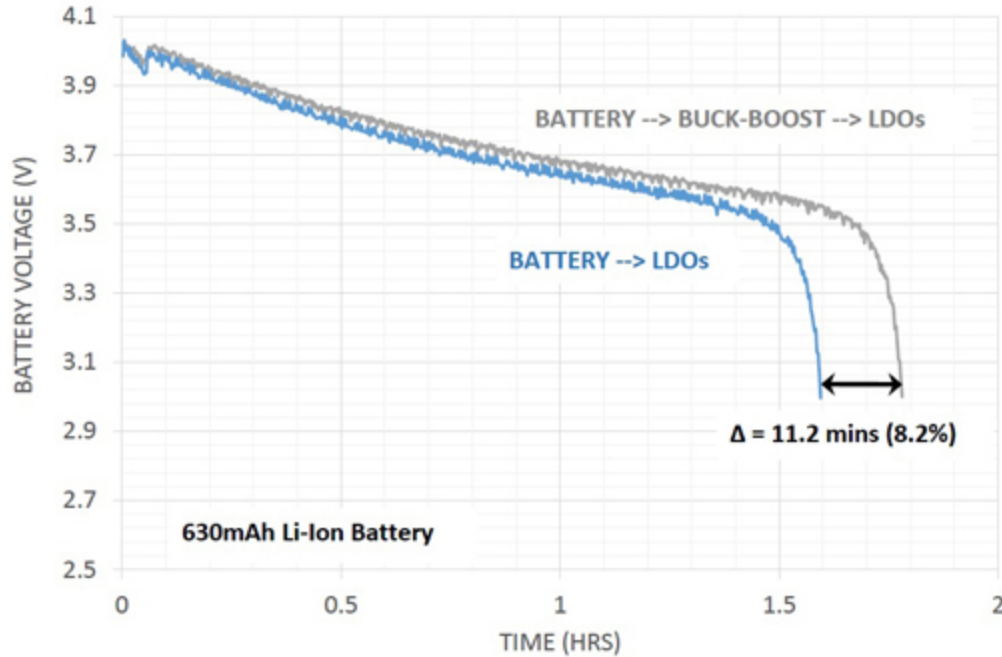


Figure 2. Battery Discharge Test With and Without a Buck-Boost Regulator

Reducing No-load Quiescent Current

In addition to the power savings achieved during regular operation, switching converters can benefit greatly from the low power bypass mode integrated in the ISL91106 buck-boost converter used in the experiment, and shown in Figure 3. With the low power bypass mode, the output of the converter is directly connected to the input. This feature helps reduce the no-load quiescent current of the converter by up to 98%, while sustaining sleep-mode or “keep-alive” functions of downstream subsystems like the PMIC, SoC, audio, display, camera and interface peripherals.

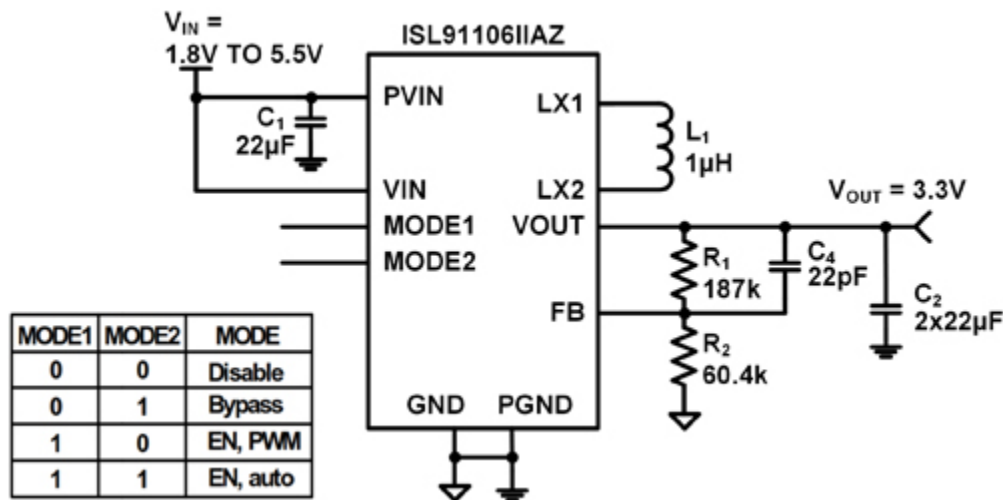


Figure 3. Buck-Boost Converter Providing a Pin-Controlled Bypass Function

This logic enabled bypass function can provide a level of flexibility to system engineers that traditional switching converters cannot. Once the bypass function is disabled, the converter can transition back to a well regulated output voltage.

Next generation buck-boost converters, such as Intersil's ISL91106 and ISL91107, use an H-bridge architecture that provides high efficiency of up to 96% with a total solution size of less than 20mm², while still delivering up to 9 Watts of output power using a typical Li-ion/Li-polymer battery.

Next Steps

- [Find out more about the ISL91106 and ISL91107 buck-boost converters](#)
- [Get the ISL91106 data sheet](#)
- [Get the ISL91107 data sheet](#)

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