LINEAR TECHNOLOGY

DESIGN NOTES

Dual Monolithic Ideal Diode Manages Multiple Power Inputs

Design Note 356

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Introduction

The LTC®4413 dual monolithic ideal diode helps reduce the size and improve the performance and reliability of handheld battery-operated devices. The LTC4413 is a single-chip solution that can automatically select between and isolate up to three power sources; such as a wall adapter, an auxiliary supply and a battery. It provides a low loss automatic PowerPath™ management solution for demanding applications that may require short-circuit protection, thermal management and system-level power management and control.

The LTC4413 contains two isolated low voltage (2.5V to 5.5V) monolithic ideal diodes. Each ideal diode channel provides a low forward voltage drop (typically as low as 40mV when conducting low current) and a low $R_{DS(ON)}$ (below 100mΩ) when conducting high current—features that are important to extend battery life and reduce heat in portable applications. Furthermore, each channel is capable of providing up to 2.6A of continuous current from a small 3mm × 3mm, 10-pin DFN package. Current-limit and thermal shutdown features further enhance system reliability.

Triple Supply Power Management

Figure 1 shows a schematic with the LTC4413 configured to automatically switchover from a battery to either a USB supply or to a wall adapter. This circuit provides uninterrupted power to the load—while isolating all three power sources—allowing the user to remove the battery without affecting load voltage when either of the two other supplies is present. This circuit exploits the LTC4413 to provide low loss uninterrupted power while automatically prioritizing which source should be connected to the load.

Referring to Figure 1, if a wall adapter is applied in the absence of a USB supply, the body diode in MP1 forward biases, pulling the output voltage above the battery voltage and turning off the ideal diode connected between INA and OUTA. This causes the STAT voltage to fall, turning on MP1. The load then draws current from the wall adapter and the battery is disconnected from the load. If the USB is present when the wall

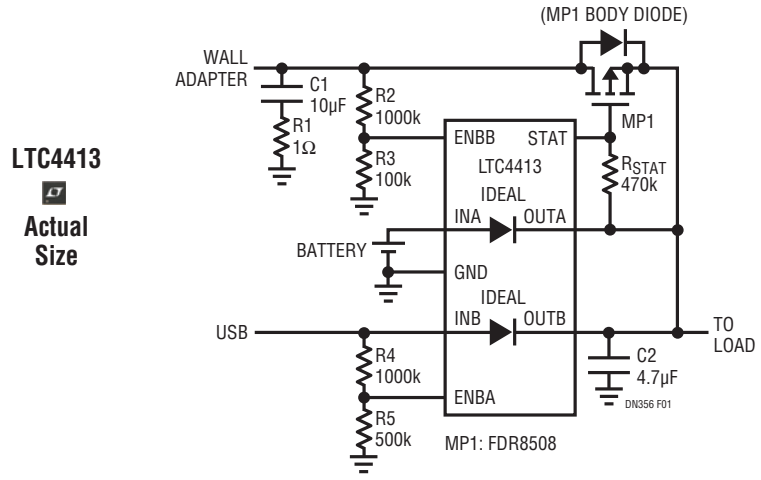

Figure 1. Automatic Switchover from a Battery to a USB Supply or Wall Adapter

adapter is removed, the output voltage falls until the USB voltage exceeds the output voltage causing the STAT voltage to rise, disabling the external PFET; the USB then provides power to the load. In the absence of a USB supply when the wall adapter is removed, the load voltage droops until the battery voltage exceeds the load voltage, likewise causing the STAT voltage to rise and disabling MP1; the battery then provides the load power.

When a USB supply is applied, the voltage divider at ENBA disables the power path from battery to OUT. The USB then provides load current, unless a wall adapter is present as described above.

Automatic Switchover Between a Battery and a Wall Adapter with a Battery Charger

Figure 2 illustrates an application where the LTC4413 performs the function of automatically switching a load over from a battery to a wall adapter, while controlling an LTC4059A battery charger. When no wall adapter is present, the LTC4413 connects the load to the Li-Ion battery. In this configuration, the STAT voltage is high, thereby disabling the battery charger. If a wall adapter is connected, the load voltage rises as the ideal diode from INB to OUTB conducts. As soon as the load voltage exceeds the battery voltage, the battery is disconnected from the load and the STAT voltage falls, turning on the LTC4059A battery charger and beginning a charge cycle.

When the wall adapter is removed, the load voltage collapses until it is below the battery voltage. The battery reverts to supplying power to the load and the STAT pin falls disabling the battery charger.

Conclusion

The LTC4413 performs automatic PowerPath management functions in high performance battery-powered applications. The applications described herein have the added benefit that while an alternate supply powers the load, the battery may be replaced without disturbing load voltage. This feature demonstrates the benefit of the LTC4413 as compared with alternative solutions that do not allow the battery to be replaced without impacting load power.

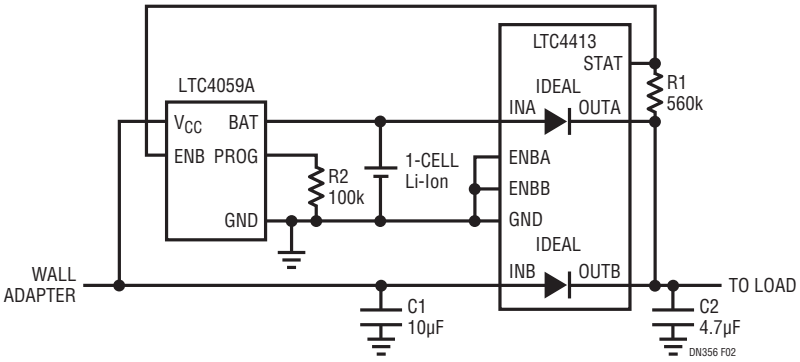

Figure 2. Automatic Switchover from a Battery to a Wall Adapter with a Battery Charger

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