Buck DC/DC Controller Achieves High Efficiency over Four Decades of Load Current

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Introduction

The impressive efficiency of a buck DC/DC regulator at the upper end of the load current range often overshadows its low- or no-load current performance. Efficiency numbers at the lower end of the load spectrum can be misleading. Zero load current means zero power out and therefore zero efficiency, but if the output voltage must remain in regulation even at no load, then the no-load quiescent current—not efficiency—of the regulator is the important limiting factor in battery life. Burst Mode operation makes it possible for the LTC3801 buck DC/DC controller to achieve high efficiency over a wide range of load currents (greater than 10,000:1), and yet it consumes only 16µA of input DC supply current under no-load conditions.

The LTC3801 includes many of the features expected in a high-performance switcher: high efficiency (up to 94%), wide V_{IN} range (2.4V to 9.8V), high constant frequency operation (550kHz), and current mode control for excellent AC and DC line and load regulation. The LTC3801 provides ±1.5% output voltage accuracy. It consumes only 195µA of quiescent current in normal operation (dropping to 16µA under no-load conditions) and only 6µA in shutdown. The device incorporates a fixed internal soft start to limit in-rush currents. The LTC3801 is offered in a tiny low-profile (1mm) SOT-23 package.

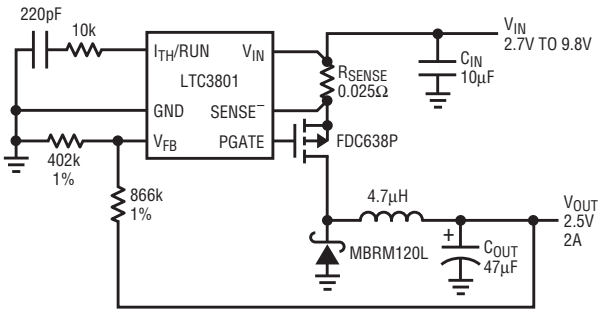

Figure 1. Compact 2.5V, 2A buck regulator

2.5V/2A High Efficiency Micropower Step-Down DC-DC Regulator

Figure 1 shows the LTC3801 regulating a 2.5V/2A output. Figure 2 shows the efficiency of this circuit at various input voltages. Efficiencies up to 93% are achieved at higher currents while still maintaining good efficiency at lighter currents. Even at a load current of only 200µA, a full four decades below the maximum load current of 2A, the LTC3801's efficiency beats an "ideal" linear regulator with the same input voltage.

Powered from a Li-Ion battery, the circuit of Figure 1 sips a mere 17.5µA of input current at 4.2V. This is significantly less than the self-discharge rate of a typical Li-Ion battery of standard capacity. This feature allows for continuous operation from a Li-Ion battery without the need to shut down and start up (as load conditions change) to save battery life. This is critical in handheld applications where the device may be idle, but not off, for much of the time, and calls for several amps when active.

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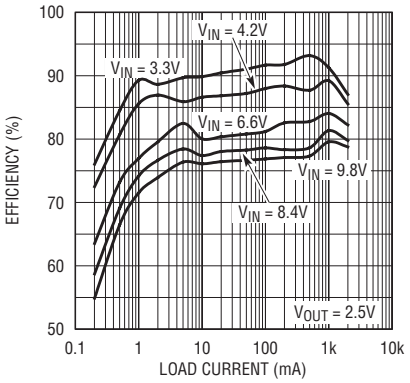

Figure 2. The regulator shown in Figure 1 achieves high efficiency over four decades of load current—an important feature for conserving batteries in portable applications.