

# Synchronous Boost Converter with Output Disconnect Delivers 4W from Two Cells

by Dongyan Zhou

## Introduction

Portable, battery-powered devices require power supplies that are efficient and small. The LTC3421 synchronous boost converter offers both. It features a low, 12 $\mu$ A quiescent current in Burst Mode operation, greatly improving battery life in applications that spend much of their time in low power mode. The LTC3421 itself is small, available in a small 4mm  $\times$  4mm QFN package, and its oscillator frequency can be programmed or synchronized up to 3MHz, which minimizes the size of external components. It can drive power hungry circuits with its 3A guaranteed switch current—up to 4W output power from two NiCd or NiMH cells.

In a conventional synchronous boost converter, the internal body diode of the synchronous rectifier connects the input supply through the inductor to the load. The peak inrush current when the input supply is first applied to the boost converter is only limited by the resistance in the loop consisting of the input source, inductor, diode, and output capacitor. The large surge current during initial plug-in can cause sufficient input voltage drop to possibly trigger a low-battery detector. The direct path from the input to the output also leaves the load connected to the input even when the boost converter is in shutdown. This can cause additional power loss due

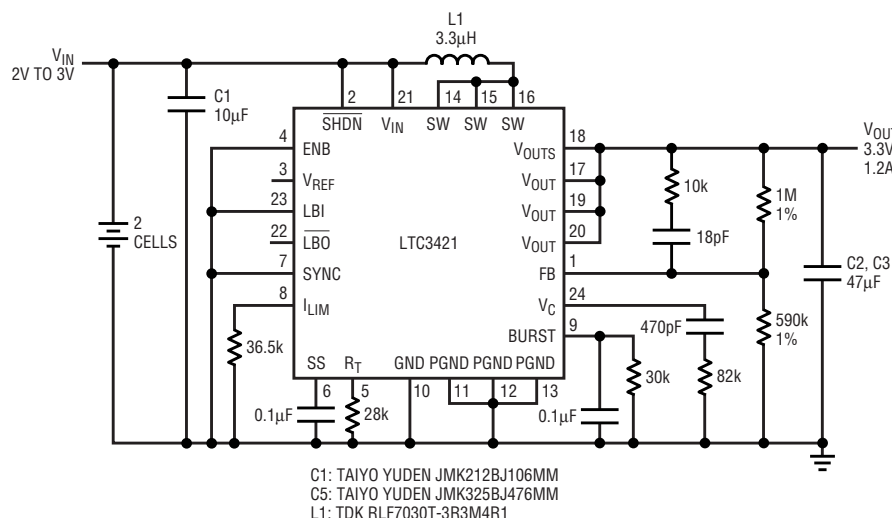


Figure 1. A 1MHz, 2-cell to 3.3V at 1.2A boost converter

to leakage current. With true output disconnect, by eliminating body diode conduction of the internal PMOS rectifier, the LTC3421 eliminates these problems.

## 2-Cell to 3.3V/1.2A Synchronous Boost Converter

The circuit in Figure 1 shows a 2-cell to 3.3V converter that can provide up to 1.2A of load current. The switching frequency is set at 1MHz by having

28k $\Omega$  at  $R_T$  pin. This gives a good trade-off between efficiency and circuit size. The footprint of this converter is about 0.35in<sup>2</sup>, as shown in Figure 2. The LTC3421 has a bottom metal pad to improve thermal performance. The entire metal pad can be soldered directly to the PC board copper area and through multiple thermal vias to internal and backside copper layers to optimize efficiency and thermal performance.

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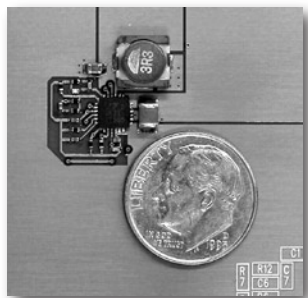


Figure 2. The circuit of Figure 1 fits in a mere 0.35in<sup>2</sup>

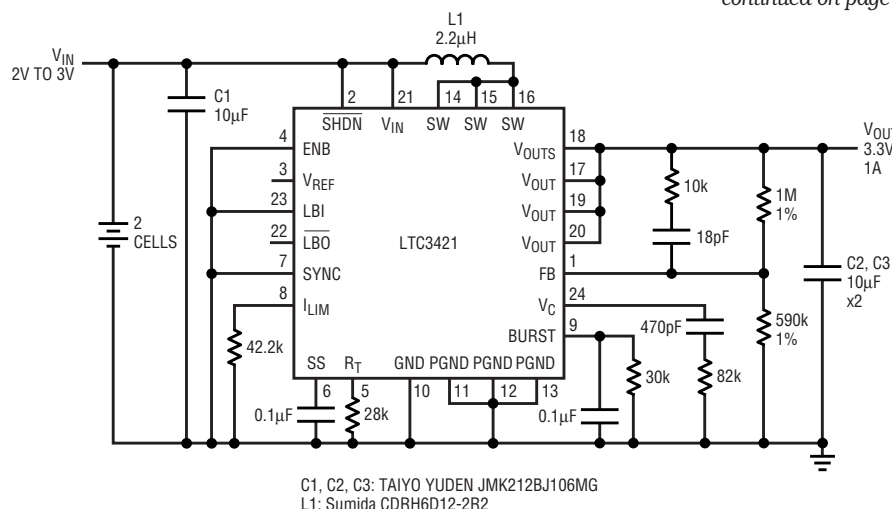


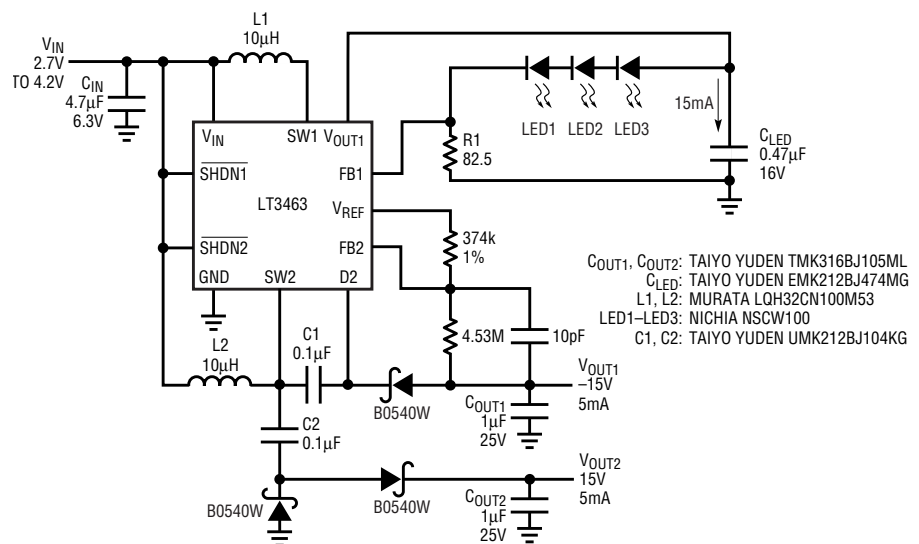
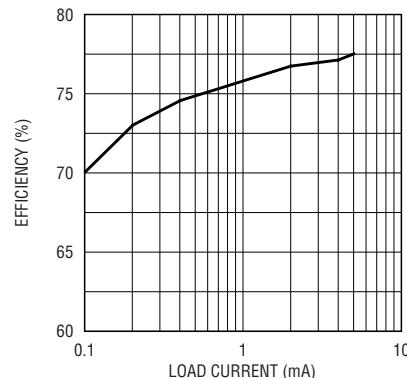
Figure 3. A 1.5mm height, 1MHz, 2-cell to 3.3V at 1A boost converter

# LCD Power Supply Provides $\pm 15\text{V}$ Plus LED Driver


by Mike Shriver

A typical LCD application requires both a positive and a negative voltage to drive the glass and, in some cases, a means of illuminating the back panel. The LT3463 circuit shown in Figure 1 provides all three. The outputs of this circuit are 15V, -15V and a 15mA LED driver. The -15V rail is generated from an inverting charge pump regulated by channel 2 of the LT3463. A quasi-regulated charge pump tapped from the switch node of channel 2 forms the 15V rail. Channel 1 is configured as current source boost converter and supplies current to the LEDs. The advantages offered by this circuit are low quiescent current and minimal parts count.

The on-demand power delivery provided by the Burst Mode operation of the LT3463 allows the  $\pm 15\text{V}$  rails to have a no-load quiescent current of 76 $\mu\text{A}$  and an efficiency of over 73% from 5% load to 100% load for an input voltage of 3.6V. The full load efficiency is 77% at 3.6V. (See Figure 2.) Because a charge pump is used for both the positive and negative output, the load is disconnected from the output during shutdown which increases battery run time. The slave charge pump for the +15V rail does require more parts

Figure 1.  $\pm 15\text{V}$  converter plus LED driverFigure 2. Total efficiency of  $\pm 15\text{V}$  converter at  $V_{IN} = 3.6\text{V}$ 

than a slave boost converter, but the extra parts are offset by the internal Schottky diodes of the LT3463.

The LED driver is best suited for applications that require only a single level of backlighting or partial dimming. The time constant formed by  $C_{LED}$  and  $R1$  does not allow PWM dimming over the entire range of brightness. The LED driver has an efficiency of 76% at an input voltage of 3.6V. During shutdown, less than 1 $\mu\text{A}$  flows through the LEDs from  $V_{IN}$ . 

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## 1.5mm Height, 2-Cell to 3.3V/1A Converter

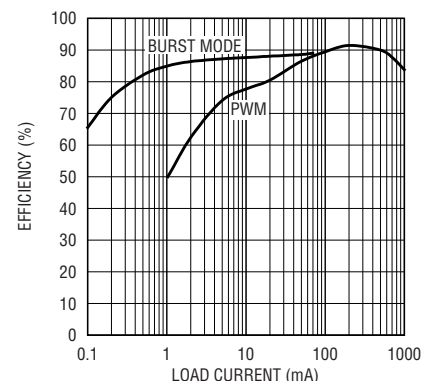
Low-profile is required in many handheld devices, such as cellular phones, and MP3 players. Figure 3 shows how to make a 2-NiCd, or 2-NiMH cell to 3.3V output converter with 1.5mm maximum height by using a lower profile inductor and output capacitor. This circuit can provide up to 1A load current for 2V minimum input battery voltage and 900mA load if the battery cutoff voltage is 1.8V. Figure 4 shows the efficiency of this circuit. With Burst Mode enabled, the

efficiency stays above 85% over three decades of load current.

## Conclusion

With output disconnect, inrush current limiting and 12 $\mu\text{A}$  quiescent current, the LTC3421 synchronous boost converter is an ideal fit for many portable applications. Its guaranteed 1V start-up input voltage works with a large variety of battery configurations. It is available in a small 4mm  $\times$  4mm QFN package with exposed copper on the backside, making it possible to provide up to 1.2A at 3.3V from

2-cell input without taking much space. 

Figure 4. Efficiency curves for the converter in Figure 3 ( $V_{IN} = 2.4\text{V}$ )