

High Efficiency Synchronous Boost Converter Provides Output Load Disconnect and Soft-start in ThinSOT Package

by Ashish Kirtania

Introduction

In a typical boost converter architecture, the inductor and the Schottky diode or the body-diode of the PMOS rectifier constitute a forward conduction path from input to output whenever the output is lower than the input (e.g., during start-up and shutdown). As a result, the output capacitor usually draws a heavy inrush of current from the input supply during start-up. Likewise, in shutdown, the output capacitor holds the output at a potential equal to the input supply voltage minus a forward diode drop.

Linear Technology's new LTC3429 solves both of these problems by eliminating any forward conduction through the body diode of the synchronous PMOS switch. This enables the part to achieve output load disconnect by allowing the output voltage to go to zero during shutdown, drawing no current from the input source. It also allows for inrush current limiting at start-up, minimizing surge currents seen by the input supply.

Features

The LTC3429 is a high efficiency (up to 96%), fixed frequency, synchronous step-up DC/DC converter with true output load disconnect, soft-start, and automatic Burst Mode® operation in a low profile 6-lead SOT-23 package. The device has a wide input voltage range,

from 0.9V to 4.4V, and the output voltage range is from 2.5V to 5V, making it suitable for applications which require 3.3V or 5V output from a single or dual AA cell or a Li-Ion battery.

At 3.3V output, it is capable of supplying 100mA from a single AA cell or 250mA from a 2-cell AA battery making it ideal for portable electronics. At light load, the LTC3429 automatically switches to Burst Mode operation, which draws only 20µA of quiescent current. In shutdown, the part draws less than 1µA of quiescent current and disconnects the output from the supply. A switching frequency of 500kHz minimizes overall solution footprint by allowing the use of tiny, low profile inductors and ceramic capacitors. Also the internal compensation of the current mode PWM control loop reduces the number of external parts required, thereby saving critical board real estate.

Low Voltage Start-Up and Soft-Start

The LTC3429 includes an independent start-up oscillator designed to start up at input voltages as low as 0.9V. This feature makes it suitable for applications using a single-cell battery. The frequency and duty cycle are internally set to 150kHz and 67%, respectively. Soft-start and inrush current limiting

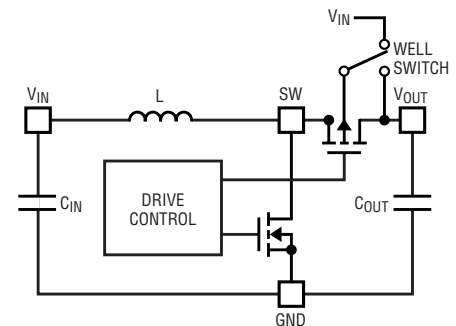


Figure 1. Switch configurations for the LTC3429

are provided during start-up as well as normal mode operation. An internal soft-start capacitor slowly ramps the peak inductor current from zero to a maximum value of 850mA over a period of 1.5ms. Once the output voltage exceeds 2.3V, the start-up circuitry is disabled and normal fixed-frequency PWM operation is initiated. In this mode, the LTC3429 operates independent of the input, allowing extended operating time as the battery can droop to about half a volt without affecting the output voltage regulation. The only limiting factor in the application is the ability of the battery to supply sufficient energy to the output.

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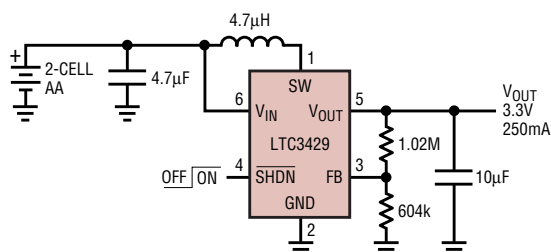


Figure 2. 2-cell to 3.3V synchronous boost converter

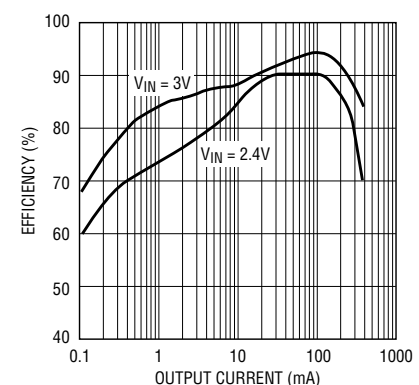


Figure 3. Efficiency of the circuit in Figure 2

A Compact and Power Efficient CCFL Controller for Handheld Devices


by David Canny

Cold Cathode Fluorescent Lamps (CCFLs) offer the highest available efficiency for backlighting an LCD display, making them a popular

choice for handheld devices. The CCFL controller must also be efficient to conserve battery power, and small, to fit in the tight spaces required by

the latest handheld electronic devices. Figure 1 shows a compact and efficient 1W CCFL controller using the LTC1697 synchronous current mode controller.

To control the CCFL brightness, the LTC1697 implements an internal PWM dimming scheme on the CCFL current—a method that is both efficient and offers the widest dimming range. A single capacitor, C5, determines the PWM frequency and the LTC1697 controller can implement a smooth transition from zero to full brightness without any hysteresis or “pop-on.” The dimming input is simply a 1V to 2V signal at V_{DIM} , corresponding to 0% to 100% CCFL brightness, where the maximum CCFL current (100% brightness) is set by R3. The dimming control input can also be a digital PWM signal.

The circuit runs off a single Li-Ion battery (2.7V–5.5V) and the LTC1697 consumes less than 1 μ A when in Shutdown mode. The LTC1697 also incorporates Open Lamp detection to protect the CCFL transformer, T1, from excessively high voltages. 

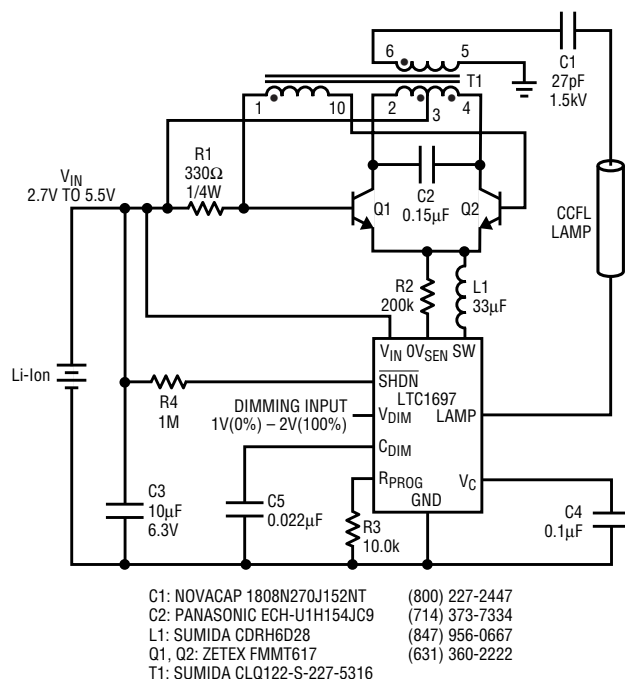


Figure 1: 1W CCFL controller

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Output Load Disconnect and Inrush Current Limiting

The LTC3429 includes circuitry that switches the n-well body of the internal PMOS rectifier to either the input supply or to the output depending on whichever is higher (see Figure 1). Thus, during start-up and shutdown, when the output voltage is less than the input supply, the n-well is switched to the input making the body diode reverse-biased. As a result, in shutdown, no current can flow to the output, and the output capacitor can be completely discharged to zero. Likewise, during start-up, the reverse-biased body diode prevents the inrush of current typically seen by the input supply.

Burst Mode Operation

Portable devices frequently spend extended time in low power or standby mode, only switching to high power consumption when specific functions are enabled. To improve battery life in these types of products, it is important to maintain a high efficiency over a wide output power range. The LTC3429 provides automatic Burst Mode operation to increase efficiency of the power converter at light loads. Burst Mode operation is initiated if the output load current falls below an internally programmed threshold. In this mode, most of the device is turned off, reducing the quiescent current to only 20 μ A. When the output

voltage droops by about 1% from its nominal value, the part wakes up and commences normal PWM operation. The output capacitor recharges and causes the part to re-enter the idle mode if the output load remains less than the Burst Mode threshold. The frequency of this intermittent PWM or burst operation is proportional to load current; that is, as the load current drops further below the burst threshold, the LTC3429 turns on less frequently. When the load current increases above the burst threshold, the LTC3429 seamlessly resumes continuous PWM operation. 