

# DESIGN NOTES

## The LT1304: Micropower DC/DC Converter with Independent Low-Battery Detector – Design Note 120

Steve Pietkiewicz

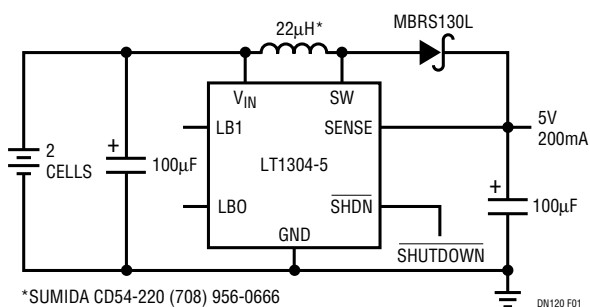
In the expanding world of low power portable electronics, a 2- or 3-cell battery remains a popular power source. Designers have many options for converting the 2V to 4V battery voltage to 5V, 3.3V and other required system voltages using low voltage DC/DC converter ICs. The LT<sup>®</sup>1304 offers users a micropower step-up DC/DC converter featuring Burst Mode<sup>™</sup> operation and a low-battery detector that stays alive when the converter is shut down. The device consumes only 125 $\mu$ A when active, yet can deliver 5V at up to 200mA from a 2V input. High frequency operation up to 300kHz allows the use of tiny surface mount inductors and capacitors. When the device is shut down the low-battery detector draws only 10 $\mu$ A. An efficient internal power NPN switch handles 1A with a drop of 500mV. Up to 85% efficiency is obtainable in 2-cell to 5V converter applications. The fixed output LT1304-5 and LT1304-3.3 versions have internal resistor dividers that set the output voltage to 5V or 3.3V, respectively.

### A 2-Cell to 5V Converter

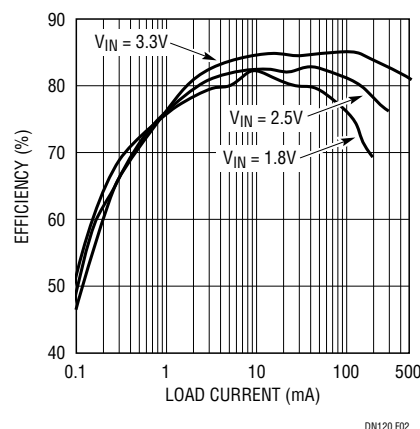
A compact 2-cell to 5V converter can be constructed using the circuit of Figure 1. The LT1304-5 fixed output device eliminates the need for external voltage setting resistors, lowering component count. As the battery voltage drops, the circuit continues to function until the LT1304's under-voltage lockout disables the part at approximately  $V_{IN} = 1.5V$ . Up to 200mA output current is available at a battery voltage of 2V. As the battery voltage decreases below 2V,

cell impedance starts to quickly increase. End-of-life is usually assumed to be around 1.8V, or 0.9V per cell. Burst Mode micropower operation keeps efficiency above 70% even for load current below 1mA. Efficiency, detailed in Figure 2, reaches 85% for a 3.3V input. Load transient response is illustrated in Figure 3. Since the LT1304 uses a hysteretic comparator in place of the traditional linear feedback loop, the circuit responds immediately to changes in load current. Figure 4 details start-up behavior. After the device is enabled, output voltage reaches 5V in approximately 2ms while delivering 200mA.

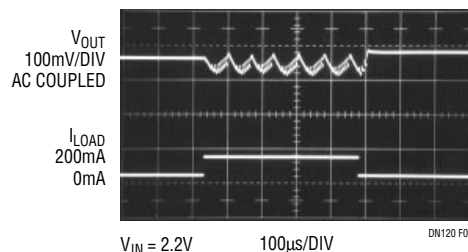
LT, LTC and LT are registered trademarks of Linear Technology Corporation. Burst Mode is a trademark of Linear Technology Corporation.



**Figure 1. 2-Cell to 5V/200mA Boost Converter Requires Only Four External Parts**



**Figure 2. 2-Cell to 5V Converter Efficiency**



**Figure 3. Boost Converter Load Transient Response**



**Figure 5. Super Burst Mode Operation 2-Cell to 5V DC/DC Converter Draws Only 15 $\mu$ A Unloaded. Two AA Alkaline Cells Will Last for Years**

For literature on our DC/DC Converters,  
call **1-800-4-LINEAR**. For applications help,  
call (408) 432-1900, Ext. 361