

Micropower SOT-23 Inverting DC/DC Converter Extends Battery Life in Space-Sensitive Applications

by Eric Young

Introduction

Low power negative bias supplies are commonly used in many of today's handheld products for imaging and display modules. As is the case with all portable products, small size and efficient operation are top requirements. The LT3483 steps in to fill this need with a minimum footprint, low profile negative supply that yields long battery life.

One of the strengths of the LT3483 is its versatility. It can be used for inverting step-up (boost) or for inverting step-down applications. It features an input range of 2.5V to 16V, so the device works well with a range of battery types and configurations. Its internal 40V switch and integrated 40V Schottky rectifier allow it to generate output voltages to $\pm 38V$.

The LT3483 also includes features to maximize battery run time. At no load conditions, the device draws only 36 μA of battery current to maintain the output or outputs in regulation. The current limited fixed off-time control scheme delivers power-on-demand to achieve high efficiency operation over a wide range of load currents. A shutdown pin disables the device and reduces quiescent current to less than 1 μA . During operation, the shutdown pin draws only 5 μA from a 3.6V supply.

Simple, Accurate Negative Regulators

It is easy to set the negative output voltage of the LT3483 inverting converter, because there is no need to compensate for a variable FB input bias current. The FB input is referenced to GND and features a 2% accurate, temperature compensated 10 μA reference source current. An external resistor between FB and the negative output sets the output voltage within 2% plus resistor tolerances. By

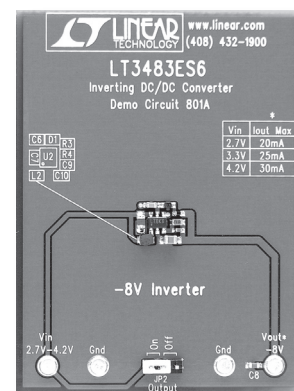
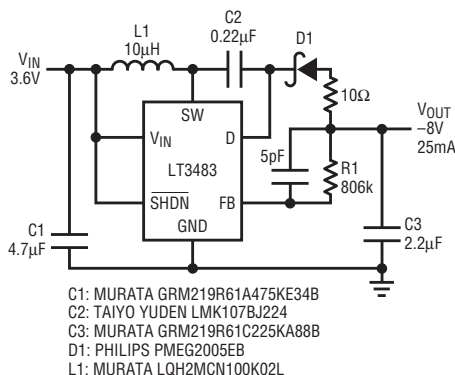


Figure 1. Low profile 3.6V to -8V inverting converter in 50mm²

eliminating the untrimmed current sourced by the negative FB (NFB) pin of other inverting regulators, calculation of the feedback resistor has been simplified as follows:

$$V_{OUT} = -10\mu A \cdot R$$

The resulting output voltage is therefore more accurate and less current flows into the feedback divider.

-8V at 25mA in 50mm²

The 200mA current limit and 300ns off-time allow the use of tiny low profile inductors and low profile ceramic capacitors. Figure 1 shows a bias supply useful for CCD and OLED applications that produces a well regulated -8V supply at up to 25mA from 3.6V using as little as 50mm² of board space. All components in this design are less than 1mm in height. While the inductor usually dominates board area and pro-

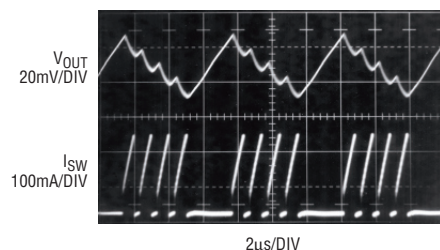


Figure 2. Output ripple of the 3.6V to -8V inverter at 15mA is 40mV.

file, regulators built with the LT3483 are able to take maximum advantage of smaller size low profile inductors such as the Murata LQH2 series—with minor reductions in output power capability and efficiency. The resulting converter circuits squeeze the most performance out of the smallest spaces. The -8V converter also uses low profile ceramic capacitors for the input, output and flying capacitors. Figure 2 shows that the output voltage ripple of the -8V converter at 15mA is about 40mV. Switching at no load, the converter circuit draws 79 μA from the battery.

±15V at 5mA in 90mm²

A typical LCD application requires both a positive and a negative voltage. The LT3483 circuit shown in Figure 3 provides a 15V and a -15V output from a 3.6V supply. The -15V rail is generated using an inverting charge pump and is regulated through the feedback resistor. The quasi-regulated 15V is generated by a charge pump tapped from the switch node.

With this circuit configuration, it is straightforward to generate other complementary pairs of regulated outputs besides $\pm 15V$. All components in this design are low profile (<1mm) and the circuit makes efficient use of

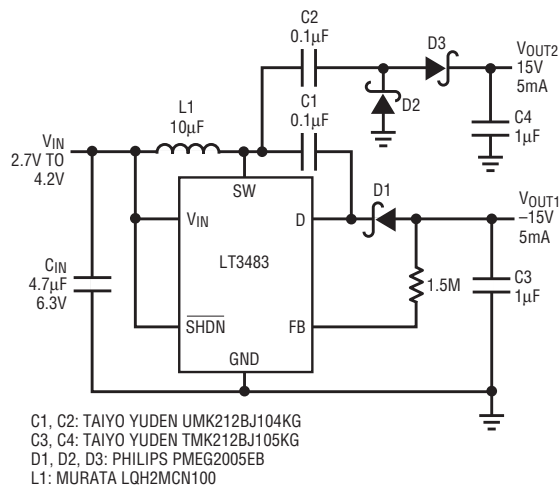


Figure 3. Compact, high efficiency LCD power supply yields 5mA at $\pm 15V$ in less than 90mm².

board space. The additional components for the charge pump are offset by the internal feedback resistor and integrated Schottky diode. During shutdown, both the positive and negative loads are disconnected from the battery, which increases battery run time. Switching with no load, the circuit draws 135µA from a 3.6V supply. The advantages offered by this circuit are low quiescent current, low parts count, and small footprint.

-5V at 100mA from 12V

The LT3483 can also regulate a negative output voltage that is smaller in magnitude than the input voltage, useful for systems that employ a 12V

lead-acid battery as a standby power supply. Figure 5 shows the LT3483 in a robust step-down backup supply, which uses a small, low profile 1:1 coupled inductor in an inverting fly-back configuration.

One of the strengths of the LT3483 is its versatility. It can be used for inverting step-up or for inverting step-down applications.

The LT3483 can be always active, ready if primary power fails, drawing only 45µA from the battery. If the normal power supply fails, the backup

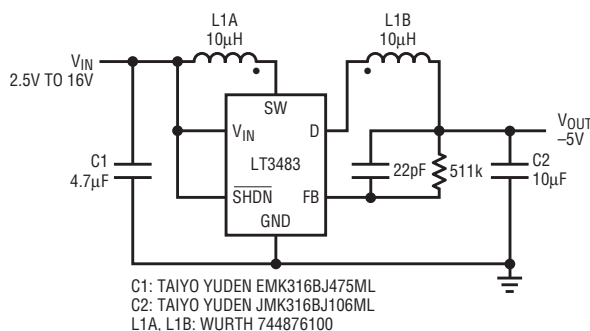


Figure 5. -5V step-up/step-down converter

LTC4060, continued from page 37

Lithium Ion batteries that exhibit very little temperature rise when charging, Nickel based batteries will heat up during the charge cycle, especially NiMH batteries. Minimizing the length of time the battery is exposed to elevated temperature extends battery lifetime.

Conclusion

NiCd and NiMH batteries are ideal sources of rechargeable power for many portable products and backup applications. This article helps to familiarize the user with some of the charging characteristics of nickel

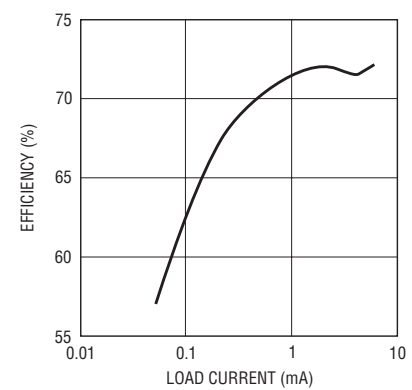


Figure 4. Efficiency of $\pm 15V$ converter at $V_{IN} = 3.6V$.

circuit using the LT3483 immediately delivers up to 100mA at -5V. In the dual inductor configuration, the LT3483 is also protected against grounding of the output. A proprietary current limiting scheme prevents the buildup of excessive switching currents which could cause damage to components in the power path.

Conclusion

The LT3483 provides a very compact, low quiescent current step-up or step-down DC/DC inverter solution for a wide input voltage range of 2.5V to 16V and outputs to -38V, making it a good fit for a variety of portable or battery backup applications.

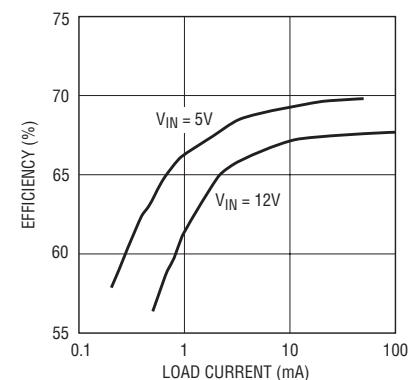


Figure 6. Efficiency of -5V step-up/step-down converter

based batteries and how they apply to the LTC4060 charger. Charging NiCd and NiMH batteries correctly and safely is simplified using the LTC4060 linear battery charger controller.