

## Product of the Month

### Step-Down DC/DC Converter Operates from Single Li-Ion Cell

The LTC<sup>®</sup>1626 is the first step-down DC/DC converter that can operate at 100% duty cycle from an input supply as low as 2.5V. Its integrated power switch has an  $R_{DS(ON)}$  of only 0.32 $\Omega$  ( $V_{IN} = 4.5V$ ) and is capable of delivering up to 600mA of output current with a peak efficiency of 95%. Its 100% duty cycle and low dropout operation extends the life of a single cell Lithium-Ion battery while Burst Mode<sup>™</sup> operation maintains high efficiency at light loads. As shown in Figure 1, the LTC1626 achieves greater than 90% efficiency over a 20mA to 500mA load range. Quiescent current is only 160 $\mu A$  and drops down to just 0.5 $\mu A$  in shutdown. It is targeted specifically at single cell Li-Ion battery-powered applications such as PDAs, GPSs, low power DSPs, digital cameras,

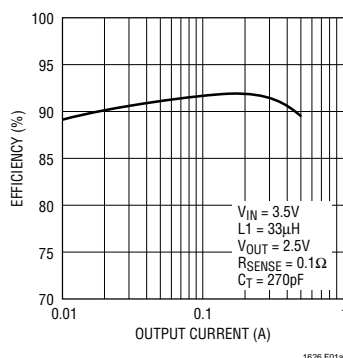


Figure 1. LTC1626 Has an Efficiency of 90% over a Load Current Range of 20mA to 500mA

GSM cellular telephones or anything that must operate from one Li-Ion cell or three to four NiCd/NiMH cells.

The LTC1626 is a cost effective monolithic solution that operates over the entire voltage range of a Li-Ion cell (2.7V to 4.2V) with a maximum input voltage of 7V (see Figure 2). It's ideal for those applications

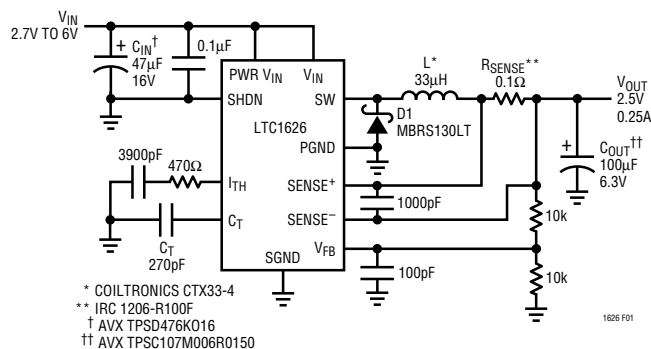


Figure 2. The LTC1626 as a High Efficiency 2.5V Step-Down Converter

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that are changing from multiple NiCd or NiMH cells to a single Li-Ion cell in order to reduce the size and weight of the end product.

The LTC1626 is offered in a 14-lead SO package. Contact your local Linear Technology sales office for a data sheet and evaluation samples. For more information, visit our web site at [www.linear-tech.com](http://www.linear-tech.com).



### Micropower Op Amp, Comparator and Reference Combined in SO-8

The LTC1541 is a micropower op amp with rail-to-rail outputs, a comparator and a 1.2V reference all combined in a single SO-8 package. It is ideal for cost conscious designs such as battery- or solar-powered systems, GSM phones and IR receivers for remote controls, where it is necessary to put as much functionality (three different building blocks) into as little space as possible. The part operates from a single 2.5V to 12.6V or dual  $\pm 1.25V$  to  $\pm 6.3V$  supply with a typical quiescent current of just 5 $\mu A$ . Both the op amp and comparator feature a common mode input voltage range that extends from the negative supply to within 1.3V of the positive supply. Figure 1 shows the LTC1541 as a pilot light flame detector.

The reference output voltage of the LTC1541 is  $1.2V \pm 1\%$  over the extended temperature range. The output sources up to 2mA, sinks up to 20 $\mu A$  and can drive a bypass capacitor of up to 0.01 $\mu F$  without any oscillations. The LTC1541's op amp is internally compensated to be unity-gain stable.

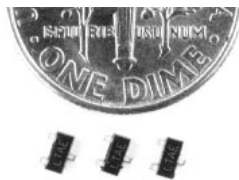
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## First SOT-23 Voltage Reference with Guaranteed $\leq 20\text{ppm}/^\circ\text{C}$ Temperature Coefficient


The **LT<sup>®</sup>1460HCS3-2.5** and **LT1460HCS3-5** precision series 2.5V and 5V bandgap references are now available in the ultrasmall SOT-23 package—the smallest package available in the industry (Figure 1). These new references are trimmed to a guaranteed initial accuracy of 0.2% and a maximum temperature drift of only  $20\text{ppm}/^\circ\text{C}$ , less than half the best drift previously available in a SOT-23 reference. They feature a low  $100\mu\text{A}$  supply current ( $125\mu\text{A}$  for the 5V version) and reverse-battery protection at the input. As shown in Figure 2, the LT1460H's typical accuracy shift is less than 0.02% after being soldered onto a PC board. No output capacitor is required for stability, saving component costs and board space. Output current of  $20\text{mA}$  also makes the LT1460 well-suited for use as a low power precision voltage regulator. It is ideal for use in portable meters, precision regula-

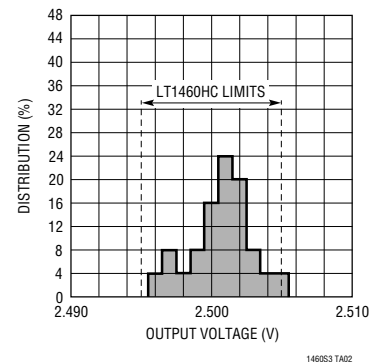
tors and in data conversion applications where space and power are limited.

Three electrical grades of the LT1460 in SOT-23 are offered. The prime grade (H) offers an initial accuracy of 0.2% along with the lowest TC available ( $20\text{ppm}/^\circ\text{C}$ ). The next grade (J) offers the same low TC with 0.4% initial accuracy. The low cost (K)



**Figure 1. The LT1460 in a SOT-23 Package Offers 0.2% Initial Accuracy and a TC of  $20\text{ppm}/^\circ\text{C}$ . SOT-23 Package Dimensions Are Approximately  $3\text{mm} \times 1.3\text{mm} \times 1\text{mm}$  High**

grade offers 0.5% initial accuracy with a TC of less than  $50\text{ppm}/^\circ\text{C}$ . In addition to the 3-lead SOT-23, the LT1460 is also offered in 8-pin PDIP, SO, MSOP and 3-lead TO-92 packages. For a data sheet and evaluation samples, contact your local Linear Technology sales office or visit our web site at [www.linear-tech.com](http://www.linear-tech.com) for more information. 



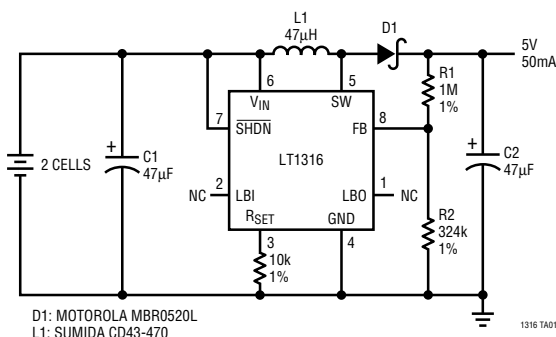
**Figure 2. Typical Distribution of SOT-23 LT1460HC  $V_{\text{OUT}}$  After IR Reflow Solder per JEDEC JESD22-A112**

## Micropower Boost Regulator with Programmable Peak Current Limit Extends Battery Life

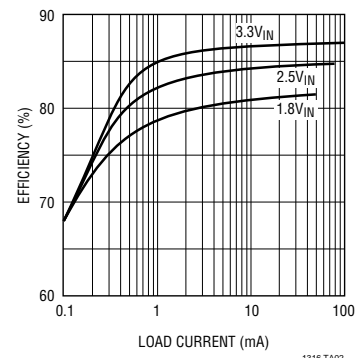
The **LT1316** is a micropower boost DC/DC converter in a tiny MSOP package that operates from an input voltage as low as  $1.5\text{V}$  and has a quiescent current ( $I_{\text{Q}}$ ) of just  $33\mu\text{A}$ . The peak switch current is user-programmable from  $30\text{mA}$  to  $500\text{mA}$  by selecting an inexpensive standard value external resistor. This reduces the peak inductor current and eases battery drain. In shutdown mode, current drops to just  $3\mu\text{A}$ . It contains an independent low-battery detector that remains active when the device is shut down. Collectively, these features

make the LT1316 an excellent solution for portable 2- to 4-cell battery-powered devices needing boost or SEPIC configurations and the longest possible battery operating lifetime.

The programmable peak switch current limit is set by a resistor from the  $R_{\text{SET}}$  pin to ground, as shown in Figure 1. This feature also allows smaller sized capacitors and inductors to be used in low current applications. Reduced peak input current further improves system operating time from a battery supply, particularly with alkaline cells.



**Figure 1. The LT1316 as a 2-Cell to 5V Step-Up Converter. It Includes a Low-Battery Detector That Is Active in Shutdown**



**Figure 2. Efficiency vs Load Current for the LT1316**

The LT1316 also has a  $30\text{V}$  switch voltage which is useful for LCD bias applications that require a  $28\text{V}$  bias supply. LCD bias supplies often operate on just milliamps of load current, so the peak switch current needed in such an application is very low. Setting the LT1316's peak switch current limit to match what is needed will greatly increase battery life. Figure 2 shows the efficiency vs load current for three input voltages— $3.3\text{V}$ ,  $2.5\text{V}$  and  $1.8\text{V}$ .

The LT1316 is available in commercial and industrial temperature range versions in 8-lead MSOP and SO packages. Contact your local Linear Technology sales office for a data sheet and evaluation samples or visit our web site at [www.linear-tech.com](http://www.linear-tech.com) for more information. 



## 1.5A Constant-Current/Constant-Voltage Battery Charger in SSOP Package Fits in Cell Phones

The 500kHz **LT1510-5** current mode PWM battery charger delivers up to 1.5A charging current from a 16-lead SSOP package and is small enough to integrate into the tight confines of a miniature cell phone. It provides the constant-voltage/constant-current profile required by Li-Ion batteries (see Figure 1) and the constant-current charging needed by NiCd and NiMH batteries. Its 500kHz operation allows use of very small inductors and just a single one-tenth watt resistor is needed to program charging current from milliamperes to 1.5A. In a 16-lead SSOP (G-package), the LT1510 has a PCB footprint equal to that of an SO-8. These features make the device ideal for very small cell phone designs that require a charger. It's also well-suited in handheld instruments and electronic organizers where space and height are very limited.

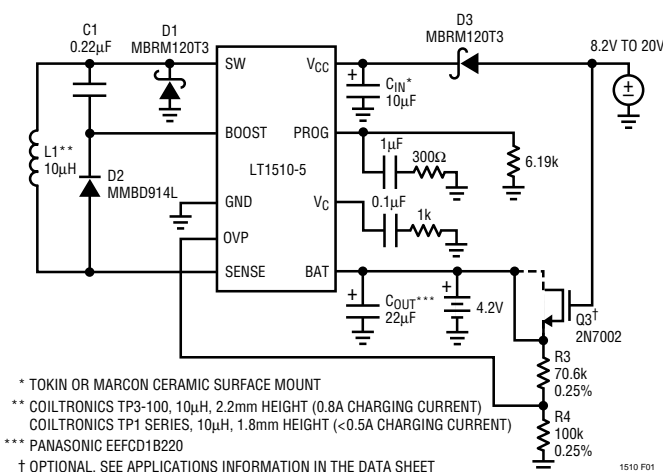
The LT1510, offered with switching frequencies of 200kHz or 500kHz (LT1510-5) and in a small outline package, keeps the total PCB solution size very small—less than 0.8in<sup>2</sup> (5.2cm<sup>2</sup>). The advantage of a 500kHz switching regulator charger IC is that the required inductor value is smaller for a given charging current, compared to the 200kHz version. New thin inductors as small as 1.8mm in height can

now be used in space restricted cell phone designs and other handheld instruments.

The LT1510's wide 8V to 28V input voltage range handles all wall adapter and automotive battery inputs. An on-chip 2A saturating power switch permits up to 90% efficiency. Current can be monitored at either battery terminal, allowing the negative terminal to be system ground. The LT1510's 0.5% accurate internal voltage reference meets the critical constant-voltage

requirements of Li-Ion cells. The normal charger-to-battery blocking diode is eliminated since the LT1510 goes into a 3μA sleep mode when the charging supply is removed. A soft start capability avoids overloading wall adapter supplies at start-up.

The LT1510 is available in 16-lead SSOP, SO and PDIP packages for constant-current/constant-voltage chargers and is also available in an SO-8 as a dedicated constant-current charger. All devices are available from stock in commercial and industrial temperature versions. Contact your local Linear Technology sales office for a data sheet and evaluation samples. Visit our web site at [www.linear-tech.com](http://www.linear-tech.com) for more information.

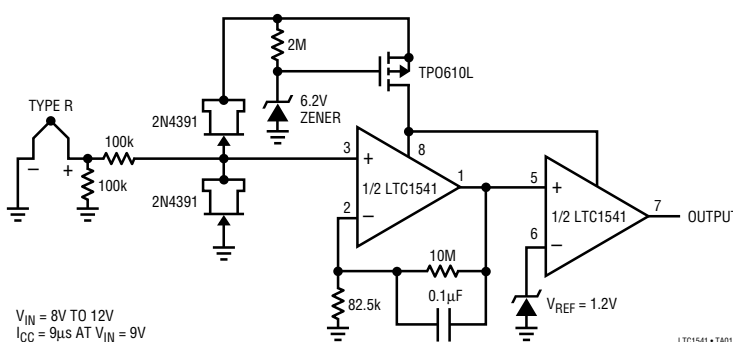


**Figure 1. The LT1510 as a Li-Ion Constant-Current/Constant-Voltage Battery Charger Uses a Single Resistor to Set the Full Charging Current (1.5A) to Within 5% Accuracy**

### LTC1541 from page 1

The comparator has  $\pm 3\text{mV}$  of hysteresis to ensure clean output switching, even with slow moving input signals. To minimize pin count, the inverting input of the LTC1541 comparator is internally connected to the reference output.

The LTC1541 is screened to the commercial and industrial temperature ranges. For a data sheet and evaluation samples, contact your local Linear Technology sales office. For more information, visit our web site at [www.linear-tech.com](http://www.linear-tech.com).



**Figure 1. In This Pilot Light Flame Detector Using an LTC1541, the Thermocouple Signal Is Amplified by the Op Amp and Compared to the Reference to Produce "Digital" Output**

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