

## Product of the Month

### 4.5A, 500kHz Step-Down Converter in SO-8 Yields Smallest Size Power Supply

The **LT<sup>®</sup>1374-SYNC** is a current mode switching regulator that simplifies the design of high current power supplies while reducing the board area with all surface mount components. In an SO-8 package, the LT1374-SYNC offers the smallest step-down power supply available with an output current of up to 3.6A. It incorporates an efficient 4.5A internal switch with only 0.07 $\Omega$  equivalent on-resistance that eliminates the need for an external MOSFET and sense resistor. Constant frequency 500kHz operation keeps switching noise away from sensitive 455kHz IF frequencies and reduces inductor size to as low as 1.8 $\mu$ H. Adjustable and fixed 5V output versions are available which can be synchronized to a higher frequency external clock of up to 1MHz. The LT1374-SYNC is ideal for applications where small, compact power supply design

is crucial such as in automotive GPS and audio electronics, disk drives and telecom base stations.

Figure 1 shows the LT1374-SYNC as a 5V buck converter with a 6V to 25V input stepped down to a 5V output at 4.25A using a 20 $\mu$ H surface mount inductor. Full cycle-by-cycle short-circuit protection and thermal shutdown are provided.

The LT1374's current mode architecture gives excellent loop stability with fast response to load and line transients. A low power shutdown mode consumes only 20 $\mu$ A for increased battery life. Its high efficiency, up to 90% as shown in Figure 2, reduces thermal dissipation compared to other high power converters.

The LT1374-SYNC is available from stock in 8-pin SO, 7-pin DD and TO-220 packages in both commercial and industrial

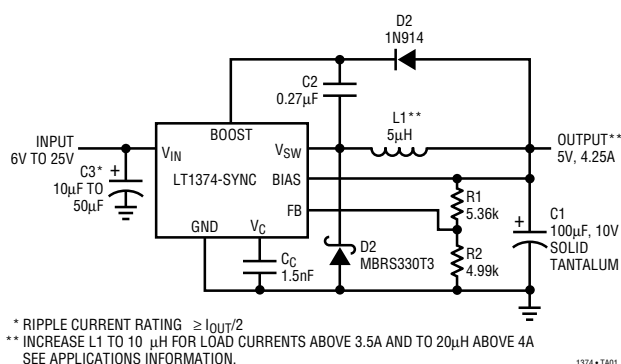


Figure 1. The LT1374-SYNC Used as a 5V Buck Converter Delivers up to 4.25A

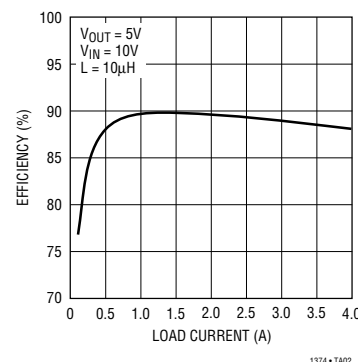


Figure 2. Efficiency for the LT1374-SYNC Approaches 90% for Load Currents from 1A to 4A

temperature ranges. 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.

### Micropower Multiplexers with SMBus Interface Draw Just 20 $\mu$ A Maximum

Linear Technology introduces two new multiplexers: the **LTC<sup>®</sup>1380**, an 8-channel single-ended analog multiplexer and the **LTC1393**, a 4-channel differential analog multiplexer. These devices can operate on a single supply as low as 2.7V and draw just 20 $\mu$ A (max) supply current. This makes them ideal for battery-powered applications where every microwatt of power that is saved extends battery life. Both devices have an SMBus (System Management Bus) compatible digital interface, as shown in Figure 1, and are also I<sup>2</sup>C<sup>™</sup> compatible. They are ideal for signal multiplexing/demultiplexing in data conversion and process control applications where the number of control lines is limited.

Continued on page 4

#### Inside This Issue:

LTC1660: Eight 10-Bit DACs Fit in Space of Single SO-8 Package .....	2
LT1534: Ultralow Noise Boost DC/DC Converter Delivers <1mV <sub>P-P</sub> Noise .....	2
LT1308: 2-Cell Digital-Camera Supply Produces 3.3V, 5V 18V, and -10V .....	3

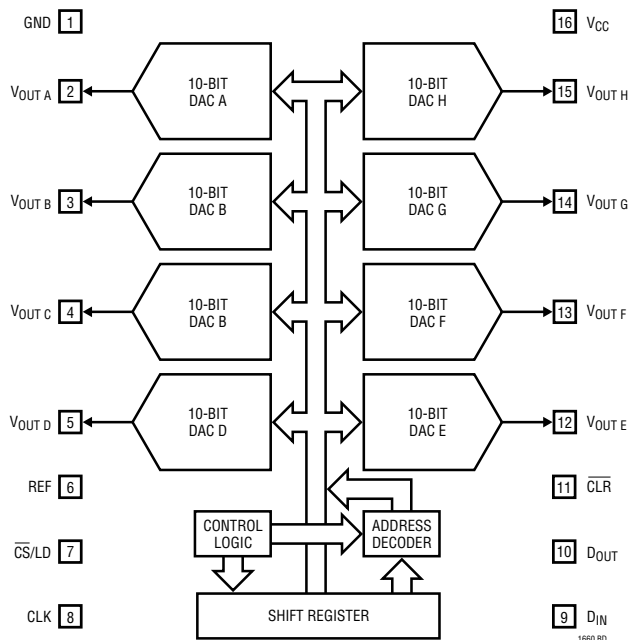
## Eight 10-Bit DACs Fit in Space of Single SO-8 Package

The **LTC1660** is a micropower octal 10-bit DAC that packs **eight** rail-to-rail voltage output DACs in a narrow 16-pin SSOP—the body size of an SO-8! Each buffered DAC is capable of supplying a DC output current in excess of 5mA and reliably driving capacitive loads up to 1000pF. The LTC1660, shown in Figure 1, operates from a single 3V or 5V supply and typically consumes only 450mA of current—just 56mA per DAC. In sleep mode, the LTC1660's supply current drops to 1μA. Each rail-to-rail buffered voltage output can swing to within millivolts of either supply rail and reliably drive capacitive loads up to 1000pF. These features make it ideal for micropower trim applications and for use in portable/battery-powered equipment.

The LTC1660 is designed for customers who need to upgrade to 10-bit resolution but have very limited space on the PC board to do so. Its rail-to-rail buffered voltage output eliminates the need for external op amps further reducing board space requirements and allows trimming where potentiometers cannot fit.


The LTC1660's maximum DNL of 0.75LSB guarantees 10-bit monotonic performance, critical in trim and control loop applications. Each DAC is addressable over the SPI/MICROWIRE™ compatible serial port. The LTC1660 also has a daisy-chain output pin that allows multiple packages to be connected on the same serial bus. It also has an asynchronous clear input that resets

**Figure 1. The LTC1660 Octal 10-Bit DAC Has a 3-Wire Serial Interface with Schmitt Trigger Inputs. Its Daisy-Chain Output Pin Allows Multiple Packages to Be Connected on the Same Serial Bus. It also Has an Asynchronous Clear Input Which Resets the Output to Zero Scale**



the output to zero scale. The rail-to-rail amplifiers have improved capacitive load handling over competing devices and swing to 4.095V full scale, even when driving a 5mA load from a 4.5V power supply.

The LTC1660 is offered in 16-lead SSOP and PDIP packages and delivery is

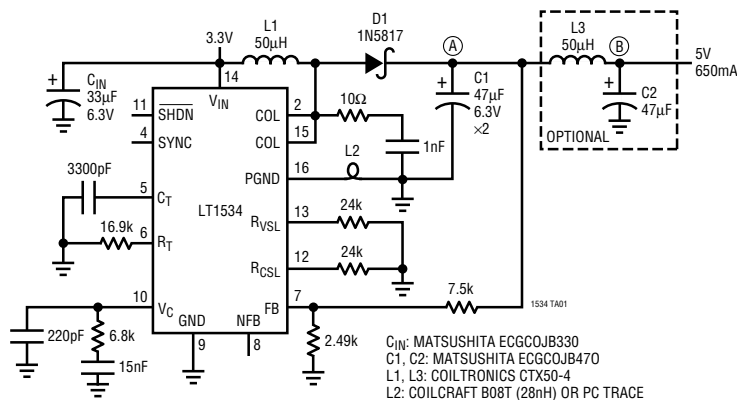
from stock. A data sheet and evaluation samples are available by contacting your local Linear Technology sales office. Visit our web site at [www.linear-tech.com](http://www.linear-tech.com) for more information. 

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## Ultralow Noise Boost DC/DC Converter Delivers < 1mV<sub>p-p</sub> Noise

The **LT1534** is a DC/DC converter that dramatically reduces both conducted and radiated noise by accurately controlling the voltage and current slew rates of its internal power switch. Using this unique control method, high frequency harmonic noise is significantly reduced over typical switching regulators, with only a minor reduction in efficiency. Because the voltage and current slew rates are independently adjustable using external resistors, the designer can select the optimum noise versus efficiency operating

*Continued on page 4*




**Figure 1. The LT1534 Is a Complete Ultralow Noise Current Mode Switching Regulator That Includes an Oscillator, Error Amplifier, Protection Circuitry and a 2A Power Switch. A 12V Output Has Less Than 1mV<sub>p-p</sub> Ripple and High Frequency Noise**

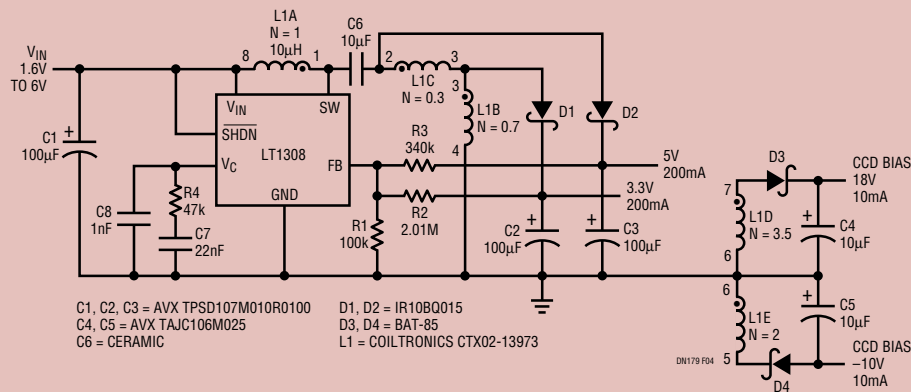
# Application of the Month

## 2-Cell Digital-Camera Supply Produces 3.3V, 5V, 18V and -10V

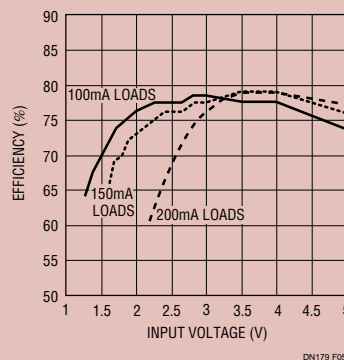
Power supplies for digital cameras must be small and efficient while generating several voltages. The DSP and logic need 3.3V, the ADC and LCD display need 5V and biasing for the CCD element requires 18V and -10V. The power supplies must also be free of low frequency

noise, so that post filtering can be done easily. The obvious approach, to use a separate DC/DC converter IC for each output voltage, is not cost effective. A single LT1308, along with an inexpensive transformer, generates 3.3V/200mA, 5V/200mA, 18V/10mA and -10V/10mA from a pair of AA or AAA cells (see Figure 1). A coupled-flyback scheme is used, actually an extension of the SEPIC (single ended primary inductance converter) topology. The addition of capacitor C6 clamps the SW pin, eliminating a snubber network.

Both the 3.3V and 5V outputs are fed back to the LT1308 FB pin, a technique known as split feedback. This compromise results in better overall line and load regulation. The 5V output has more influence than the 3.3V output, as can be seen from the relative values of R2 and R3. Transformer T1 is available from Coiltronics, Inc. (561-241-7876). Efficiency vs input voltage for several load currents on both 3.3V and 5V outputs is pictured in Figure 2. The CCD bias voltages are loaded with 10mA in all cases. 



**Figure 1. This Digital-Camera Power Supply Delivers 5V/200mA, 3.3V/200mA, 18V/10mA and -10V/10mA from Two AA Cells**



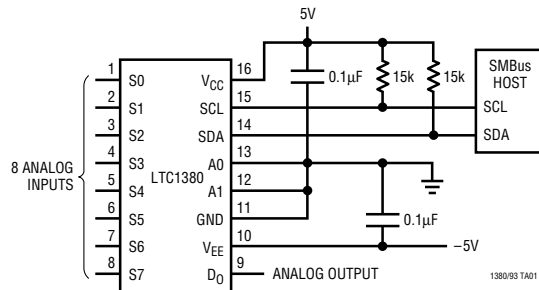
**Figure 2. Efficiency vs Input Voltage for 100mA, 150mA and 200mA Loads on 3.3V and 5V Outputs**

The LTC1380 operates on either dual or single supplies and features a low on-resistance of only  $35\Omega$  with  $\pm 5V$  supplies (see Figure 2). The LTC1393 has a  $70\Omega$  switch resistance and operates from a single  $5V$  supply. The switches have guaranteed break-before-make action and the residual charge transferred to the output (charge injection) is just 10 picocoulombs ( $\pm 10pC$ ). Maximum channel leakage, the current lost as a signal

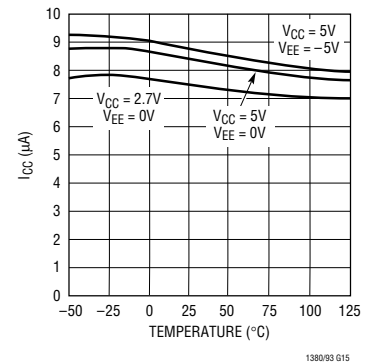
passes through a selected channel, is just  $\pm 5nA$  for the LTC1380 and  $\pm 50nA$  for the LTC1393.

The LTC1380 and LTC1393 are immediately available in volume in 16-pin SO and SSOP packages which, when combined with the 2-wire SMBus serial interface, make for a very compact design. Commercial and industrial temperature versions are also available from stock. Contact your local

Linear Technology sales office for a data sheet and evaluation samples or for more information visit our web site at [www.linear-tech.com](http://www.linear-tech.com). 



**Figure 1. LTC1380 Single-Ended 8-Channel Multiplexer Has a 2-Wire SMBus Digital Interface**

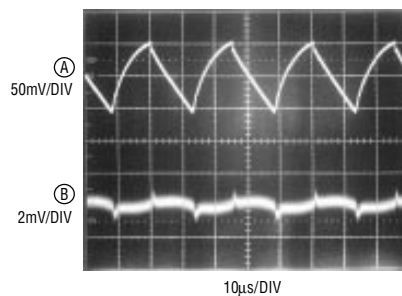


**Figure 2. The LTC1380 Analog Switches Feature a Typical  $R_{ON}$  Resistance as Low as  $35\Omega$  with  $\pm 5V$  Supplies**

point for any application. A typical boost conversion application, such as shown in Figure 1, produces a  $5V$  output from  $3.3V$  with less than  $1mV_{P-P}$  ripple and high frequency noise.


PWM controllers usually drive the power transistors with fast transitions, producing large switching harmonics that can interfere with critical system signals. The LT1534 allows the user to carefully control the rise and fall times of the power transistor drive signals, thus reducing switching harmonics. Its ability to provide high efficiency voltage conversion with very low noise makes it ideal in such noise-sensitive applications as precision instrumentation, wireless communications and data acquisition. Figure 2 shows the LT1534's  $5V$  output noise over a  $100MHz$  bandwidth.

The LT1534 is a complete current mode switching regulator that includes an oscillator, error amplifier, protection circuitry and a  $2A$  current limited power switch. Unique error amp circuitry can regulate both positive and negative output voltages in low noise step-up and SEPIC DC/DC converter topologies using standard off-the-shelf inductors. The LT1534 operates from an input supply voltage of  $2.7V$  to  $23V$  and



**Figure 2. Scope Photo: 5V Output Noise of the LT1534 over a  $100MHz$  Bandwidth**

draws just  $12\mu A$  quiescent current in shutdown, making the part suitable for portable, battery-powered applications. Its internal oscillator may be synchronized to an external clock. Protection features include cycle-by-cycle current limiting, undervoltage lockout and thermal shutdown.

The LT1534 is available in a 16-lead narrow SO package from stock in both commercial and industrial temperature versions. 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). 

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