Linear Technology Chronicle

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Product of the Month

16-Bit, 333ksps ADC Breaks Speed/Power Barriers

Linear Technology Corporation introduces the **LTC®1604**. At 333ksps maximum throughput, it represents the fastest monolithic 16-bit sampling analog-to-digital converter (ADC) in the industry—33% faster than any competing sampling ADC. The LTC1604 draws only 220mW from ±5V supplies and provides 90dB SINAD—world-class performance. Previously, this kind of ADC performance was only available in hybrid form at substantially higher price and power levels. The LTC1604 gives designers of 16-bit data acquisition systems unprecedented affordable performance.

The LTC1604 is complete with a precision voltage reference, high dynamic range sample-and-hold and a high speed 16-bit parallel output, as shown in Figure 1. Its 90dB signal-to-noise and distortion (SINAD) and –100dB total harmonic distortion (THD) allow it to digitize wideband signals with outstanding spectral purity. The full-scale input range is ±2.5V, simplifying the connection to precision signal conditioning circuitry. The LTC1604 can acquire single-ended or differential input signals up to its 5MHz input bandwidth. An internal 2.5V precision reference with a 10ppm/°C typical temperature coefficient is included on chip. This reference can be overridden by an external source for improved temperature and time characteristics or connected to a system reference for improved channel-to-channel tracking.

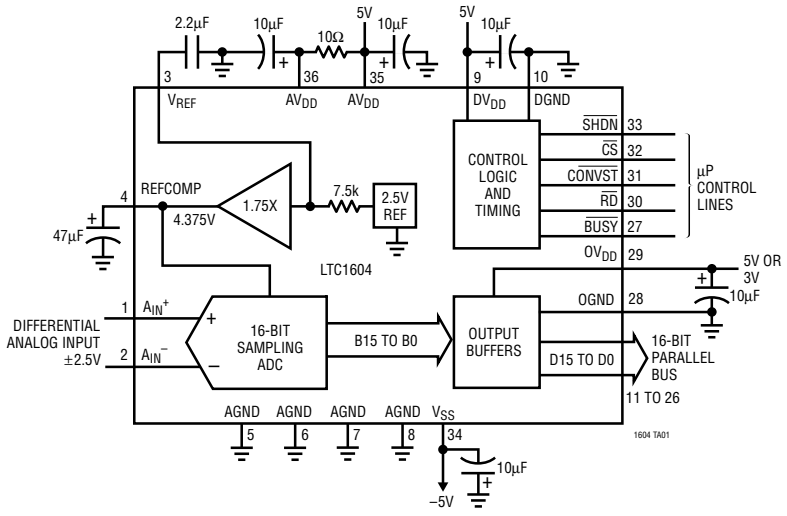

Figure 1. The LTC1604 Has a Unique Differential Input Sample-and-Hold That Can Acquire Single-Ended or Differential Input Signals up to 10MHz Power Bandwidth

Two digitally selectable power shutdown modes reduce power. Nap mode allows instant wake-up while using only 7.5mW. Sleep mode powers down to only 10µW but requires time for the reference to settle before sampling. The easy-to-use interface includes a separate convert start input, data ready signal ($\overline{BUSY}$) and a three-state, high speed parallel output.

The LTC1604 is offered in a new 36-pin SSOP "G" package that is 50% smaller than competitive ICs. It is available in commercial and industrial versions 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** for more information.

Universal Battery Chargers Offer Simple Constant-Current Programmability

The **LT®1513** and **LT1513-2** are 500kHz current mode switching regulators that provide constant-current and constant-voltage battery charging in a flyback or SEPIC (Single-Ended Primary Inductance Converter) topology—where the input voltage can vary above and below the battery voltage. They can charge single cell as well as multicell batteries at voltages up to 25V for a 15V input. The LT1513-2 can switch from a constant-current charge to a trickle charge—about 1/30th to 1/50th the full charge current rate—thus allowing a peak charge condition to be achieved in nickel-based batteries. Charging current is easily programmed with a DC voltage source or equivalent PWM signal. The LT1513-2 regulates at the I_{FB} pin at 0mV to provide a programmable current limit. It is ideal for charging NiMH and NiCd cells in portable and mobile applications using such charging

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Inside This Issue:

14-Bit, 200ksps ADC with 81.5dB SINAD at Nyquist Consumes Only 15mW

The **LTC1418** is a 14-bit analog-to-digital converter (ADC) in a 28-pin SSOP package that draws only 15mW while converting at 200ksps from a single 5V supply. It includes an onboard high performance sample-and-hold, precision reference and internal clock and timing circuits as shown in Figure 1. Typical AC performance is 81.5dB SINAD, 95dB SFDR and –95dB total harmonic distortion at the Nyquist frequency of 100kHz. DC specifications include maximum DNL of ±1LSB and INL of ±1.25LSB over temperature (Figure 2). The LTC1418 offers both parallel and serial outputs and is ideally suited for space conscious, power-sensitive applications such as remote data acquisition and process control.

The LTC1418 converts 0V to 4.096V unipolar inputs from a single 5V supply and ±2.048V bipolar inputs from ±5V supplies. The internal 25ppm/°C reference can be overridden by an external source for improved temperature or time stability. Power dissipation can be minimized with two user-selectable power-down modes. Nap mode reduces power consumption to under 3mW with instant wake-up while sleep mode cuts power consumption to just 10µW.

The LTC1418's flexible I/O eases the connection to the interface of microprocessors and microcontrollers and simplifies transmitting through isolation barriers or to remote locations. In parallel mode, separate conversion start and read pins allow connection to a variety of fast and slow bus schemes. In serial mode, the LTC1418's internal I/O clock can act as a master output or it can accept a system I/O clock to synchronize data transfer over a DC to 10MHz rate. A separate convert start input and a data ready signal ($\overline{BUSY}$) allow easy control of conversion start and data transfer.

The LTC1418 is available in 28-pin PDIP and SSOP packages and is specified over industrial and commercial temperature ranges. Contact your local Linear Technology sales office for a data sheet and evaluation samples. Visit our web site at **www.linear-tech.com** for more information.

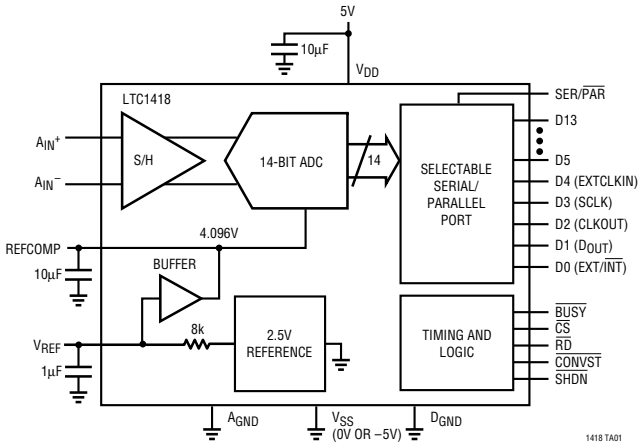

Figure 1. LTC1418 14-Bit, 200ksps ADC Includes Selectable Parallel and Serial I/Os, a Precision 2.5V Reference, a Sample-and-Hold and Timing / Logic Circuits. Its 28-Pin SSOP Offers a Small Footprint and Shutdown Modes Extend Battery Life

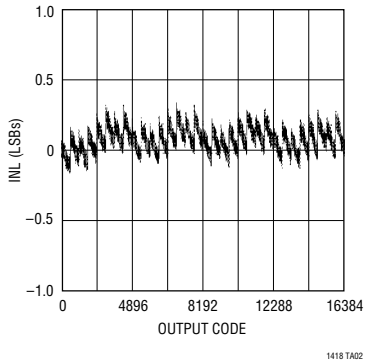

Figure 2. The LTC1418 Guarantees ±1.25LSB INL (Max) and as Shown Here Is Typically Less Than ±0.5LSB

LT1513/LT1513-2 from page 1

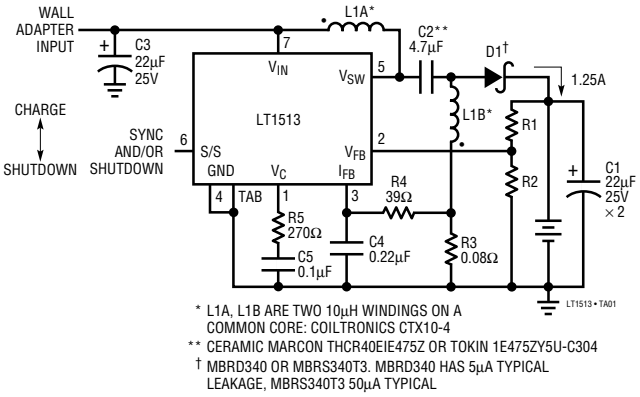

Figure 1. The LT1513 Maintains the Proper Charging Conditions While the Output Voltage Varies Widely. Its 500kHz Switching Frequency Minimizes Inductor Size for Compact Circuits

sources as a desktop docking station, an unregulated wall socket or an automotive supply. The LT1513 with its 1% accuracy in constant-voltage mode is best suited for charging lead-acid or Li-Ion battery systems where a constant-current charge automatically changes to constant-voltage and the charging current tapers down naturally, making it unnecessary to go to a trickle charge or to achieve charge current cutoff. Figure 1 shows the LT1513 as a SEPIC charger with a 1.25A output current.

As SEPIC battery charger ICs, the LT1513 and LT1513-2 automatically select step-up or step-down conversion. The SEPIC configuration uses a standard off-the-shelf 2-winding inductor to service widely varying input voltages and enables charging of batteries with voltages from 1V to 25V, as

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Application of the Month

100V, 2A, Constant-Voltage/Constant-Current Bench Supply

Most engineering labs are well stocked with low voltage, moderate current power supplies, but higher voltage supplies capable of several amperes of output current are hard to find. The lab supply shown in Figure 1 addresses this problem.

The circuit is based on U1, an LT1270 high efficiency switching regulator configured in a SEPIC topology, which allows the output to be adjusted higher or lower than the input voltage. Operation is similar to that of a flyback converter, but the primary and secondary windings are coupled together by capacitor C1. This allows the primary and secondary windings to share current, reducing copper loss; it also eliminates the snubbing circuitry and losses found in flyback converters.

The converter is designed to operate from an input of 40V to 60V, supplied by a line transformer, diode bridge and filter capacitor (not shown). Output voltage is linearly adjustable from zero to 100V via potentiometer R20.

The current is limited by two independent loops. The first current limit loop is user controlled over a range of zero to 8A by setting potentiometer R21. This setting does not interact with changes in output voltage. A second current limit loop limits the maximum available current as a function of voltage (components R1-R5 and U2), minimizing component stress. Under any given operating condition, the lower of the two loops takes control. Maximum available output current is highest at low output voltage settings (about 8A) and decreases to 2A at 100V output.

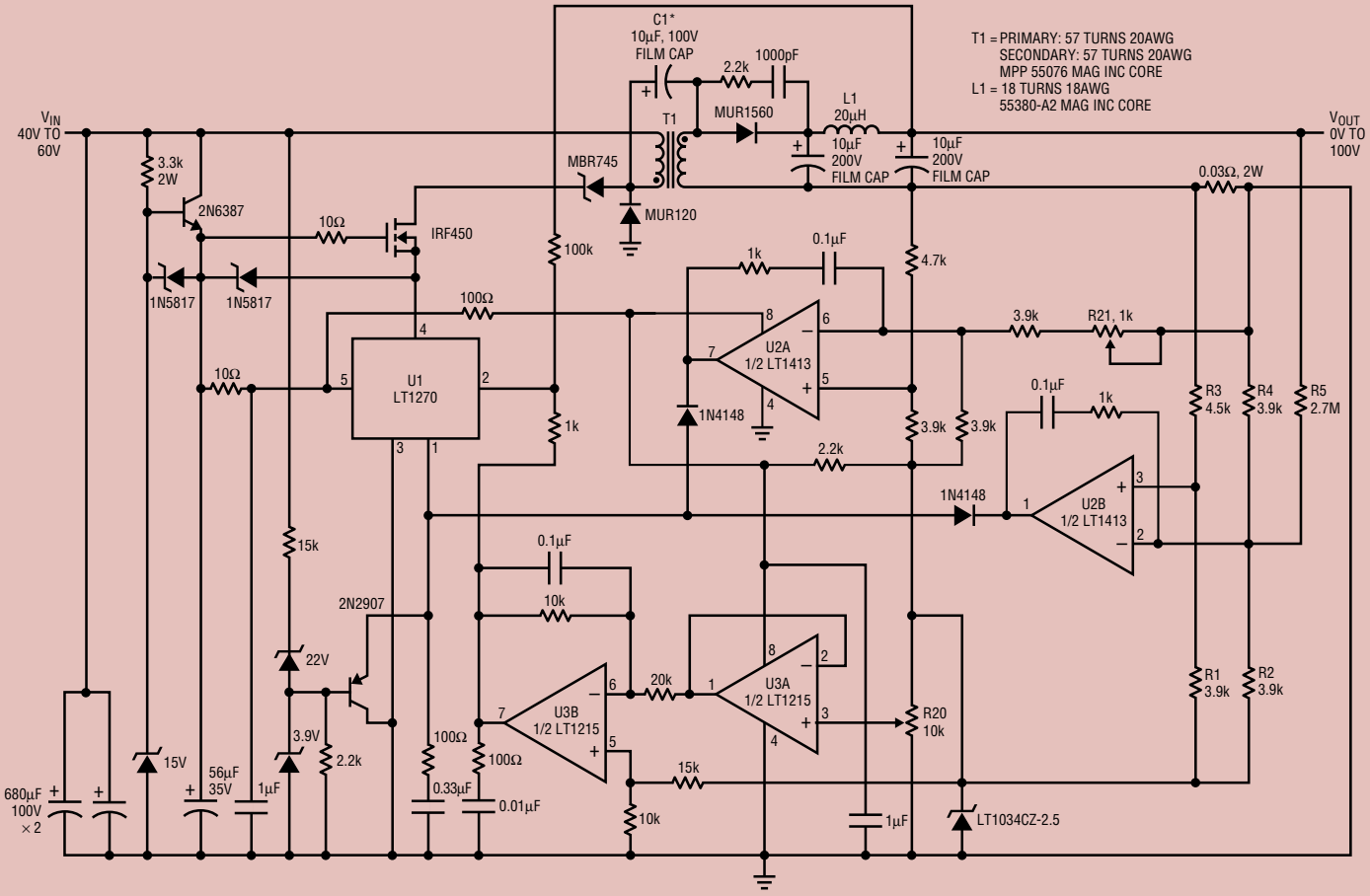

Figure 1. 100V/2A Constant-Voltage/Constant-Current Bench Supply

6A, 500kHz Boost Converter Shrinks Power Supplies

The **LT1370** is a high power, current mode switching regulator that simplifies the design of high current step-up DC/DC converters. Operating at a 500kHz switching frequency and a synchronization range of 600kHz to 800kHz, the LT1370 can use small 4.7µH inductors, resulting in the smallest footprint, 6A switching regulator solutions available. It incorporates a robust 6A high efficiency switch with 0.065Ω on-resistance and all oscillator, control and protection circuitry necessary for a complete switching regulator. The LT1370 can have an input as low as 2.7V, a voltage level where controllers with external MOSFETs don't operate efficiently. The LT1370's switch can safely handle 35V and a high voltage version, the LT1370HV, has a switch breakdown voltage of 42V. Its high efficiency (up to 90%) reduces thermal dissipation compared to other high power converters and a low power shutdown mode consumes only 12µA for increased battery life. The LT1370 can be used in a wide range of output voltage and current applications such as portable computer power supplies, boost regulators and multiple output supplies where board space is at a premium.

Figure 1 shows the LT1370 as a 5V to 12V boost converter, combining the convenience and low parts count of a monolithic solution with the switching capabilities of a controller and a discrete power device. Its current-mode architecture gives excellent loop stability, with fast response to load and line transients. Figure 2 illustrates its efficiency (up to 90%) for various load currents.

The LT1370 has a special error amplifier circuit for regulating positive or negative outputs with minimal external parts count. Its nonlinear transconductance reduces output overshoot on start-up or overload recovery. The switching frequency can be synchronized from 600kHz to 800kHz for improved management of switching harmonics. The LT1370 will operate in all the standard switching configurations, including boost, buck, flyback, forward, inverting and SEPIC.

The LT1370 is offered in both commercial and industrial temperature ranges and is available from stock in 7-pin surface mount DD or TO-220 packages. 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**.

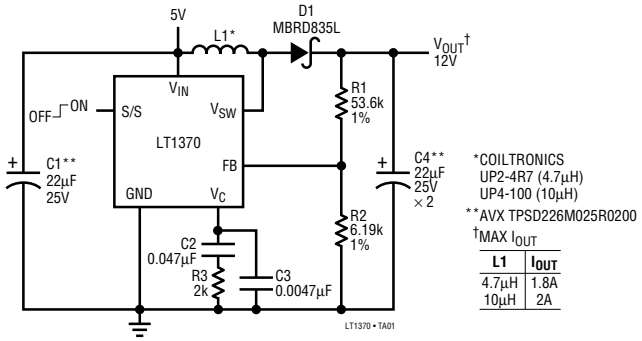

Figure 1. LT1370 as a 5V to 12V Boost Converter Delivers 2A Output in a Small Footprint

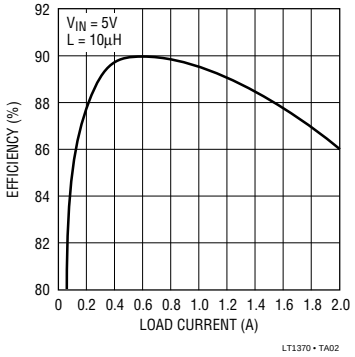

Figure 2. 12V Output Efficiency for Circuit in Figure 1

LT1513/LT1513-2 from page 2

shown in Figure 2. (The sum of the input and output voltages cannot exceed 40V.) The maximum switch current of the LT1513/LT1513-2 is 3A which allows battery charging currents of up to 2A in step-down mode. The SEPIC topology has a relatively low input ripple current compared to other topologies and higher frequency harmonics are especially low. The LT1513 can also be used in non-battery charge applications. For example, it can drive a CCFL Royer converter with high efficiency in floating or grounded mode. The 500kHz switching frequency minimizes inductor and capacitor size for minimal space.

The LT1513 and LT1513-2 are offered in 7-lead DD and TO-220 packages over the commercial and industrial 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** for more information.

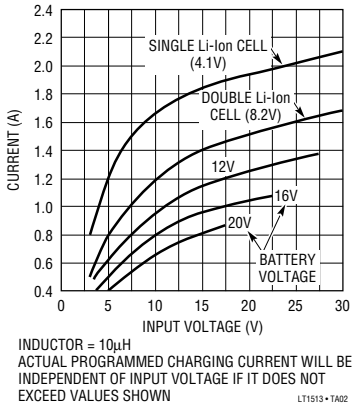

Figure 2. The LT1513/LT1513-2 Are Capable of Delivering up to 2A Charging Current for Voltages of 1V to 25V

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