LinearTechnologyChronicle

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Product of the Month

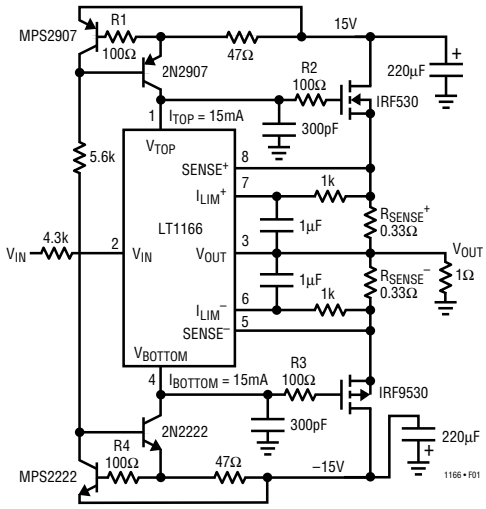
New IC Provides Automatic Bias for Power Amplifier Circuits

The **LT®1166** is a bias generating circuit for controlling class AB output current in high powered amplifiers. When connected with external transistors, the circuit becomes a unity-gain voltage follower. The LT1166 is ideally suited for driving power MOSFET devices because it eliminates all quiescent current adjustments and critical transistor matching. Multiple output stages using the LT1166 can be paralleled to obtain higher output current. Figure 1 shows a typical LT1166 unity-gain buffer application.

The LT1166 can be biased from a pair of resistors or current sources. A high speed regulator loop controls the amount of drive applied to each power device. The device does not require heat sinking or mounting on a heat sink to provide thermal tracking because the bias system senses current in each power transistor. Overvoltage protection is provided by internal clamp diodes that turn on when the voltage exceeds ±12V. These diodes serve to provide ESD protection and protect the LT1166 when used with large power MOS devices that produce high V_{GS} voltage. The LT1166 can operate on any supply voltage, due to the fact that it operates on whatever drive voltage is provided to the output transistors.

The LT1166 combines a number of discrete components into one IC while adding reliability and flexibility to power amplification designs. The LT1166 is ideal for biasing both MOS and bipolar transistors in high power amplifier circuits, such as audio power amplifiers and shaker table amplifiers.

The LT1166 is available in 8-lead plastic dual-in-line and surface mount packages specified for operation from 0°C to 70°C and guaranteed from –40°C to 85°C. Contact your local Linear Technology sales office for a data sheet and evaluation samples of the LT1166.



LT1166 Unity Gain Provides Current Limit

Inside This Issue:

500mA Micropower Negative Linear Regulator Has Less Than 0.4V Dropout

The **LT1175** is a micropower negative low dropout regulator. It features a 45µA quiescent current, dropping to 10µA in shutdown. A new reference amplifier topology gives precision DC characteristics along with the ability to maintain good loop stability with an extremely wide range of output capacitors. Very low dropout voltage and high efficiency are obtained with a unique power transistor antisaturation design. Adjustable and fixed 5V versions are available. Figure 1 shows the dropout voltage versus output current of the LT1175. Dropout voltage under 200mV is achieved when load current is at 100mA.

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Several new features make the LT1175 very user-friendly. The shutdown pin can interface directly to either positive or negative logic levels. Current limit is user selectable at 200mA, 400mA, 600mA and 800mA. The output can be forced to a positive voltage without damage or latch-up. Unlike some earlier designs, the increase in quiescent current in dropout is actively limited. Figure 2 shows a typical LT1175 circuit. The dashed lines highlight the easy-to-implement selectable current limit connections.

The LT1175 has complete blowout protection with current limiting, power limiting and thermal shutdown. Special attention was given to the problem of high temperature operation with micropower operating currents, preventing output voltage rise under no load conditions.

The LT1175 is available in 8-lead ceramic dual-in-line, PDIP and SO packages, as well as 5-pin surface mount DD and through hole TO-220 packages. The 8-lead surface mount package is specially constructed for low thermal resistance. Contact your local Linear Technology sales office for a data sheet and free evaluation samples of the LT1175 negative low dropout linear regulator.

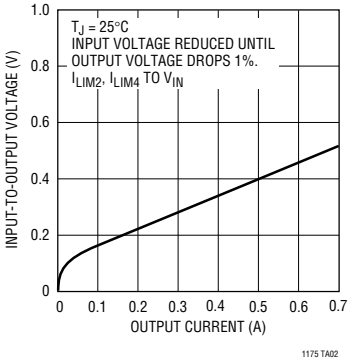

Figure 1. LT1175 Negative Linear Regulator—Dropout Voltage vs Output Current

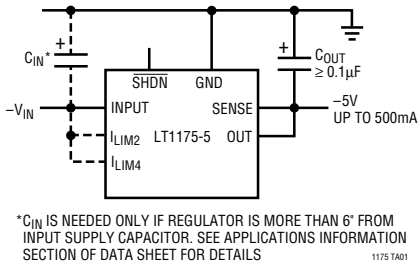

Figure 2. Low Parts Count and Easy Adjustable Current Limit

12-Bit, 100ksps A/D Converters Consume Only 10mW

The **LTC®1274/LTC1277** are 8µs sampling 12-bit analog-to-digital converters which consume only 10mW from a single 5V or ±5V supply. These easy-to-use A/D converters come complete with a 2µs sample-and-hold, a precision reference and an internally trimmed clock. Unipolar and bipolar conversion modes add to the flexibility of the ADCs. The LTC1274 has a single-ended input while the LTC1277 offers a differential input which helps to isolate ground loops and rejects common mode noise.

The LTC1274 and LTC1277 feature a guaranteed maximum ±0.5LSB INL, ±0.75LSB DNL and excellent AC specifications. The devices sample inputs well beyond Nyquist with a 71dB signal-to-noise plus distortion ratio and provide a minimum 77dB total harmonic distortion at an input frequency of 100kHz. Figure 1 shows these performance characteristics versus frequency for the LTC1274 and LTC1277. The devices convert 0V to 4.096V unipolar inputs from a single 5V supply or ±2.048V bipolar inputs from ±5V supplies.

Two power down modes are available in the LTC1277. In Sleep mode, only 1µA will be drawn and wake-up time is 4ms. A REFRDY signal is used to show the ADC is ready to sample after waking up from Sleep mode. In Nap mode, the LTC1277 draws 160µA and wake-up time is improved to 2µs, allowing the device to be powered down even during brief inactive periods.

Figure 2 shows a typical LTC1277 application. Pins 5, 6 and 7 are the control pins for the various power down modes offered by the LTC1277. In contrast, the LTC1274 provides the Sleep mode and REFRDY signal but not the Nap mode. This ADC provides a 12-bit parallel data bus interface. A separate logic supply pin is also provided that allows connection to 3V logic systems.

These new A/D converters are ideal for battery-powered portable or computer-based data acquisition applications including PCMCIA cards. They are also intended to be used in audio signal processing, telecom signal processing and spectrum analysis applications. The LTC1274 and LTC1277 are packaged in the 24-lead plastic 300 mil wide surface mount package. Commercial grade devices are specified for operation from 0°C to 70°C and industrial grade devices are specified for operation from –40°C to 85°C. Please contact your local Linear Technology sales office for a data sheet and free evaluation samples of the LTC1274 and LTC1277.

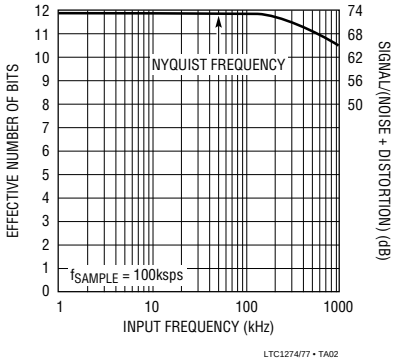

Figure 1. LTC1274/LTC1277 Performance Extends Far Beyond Nyquist

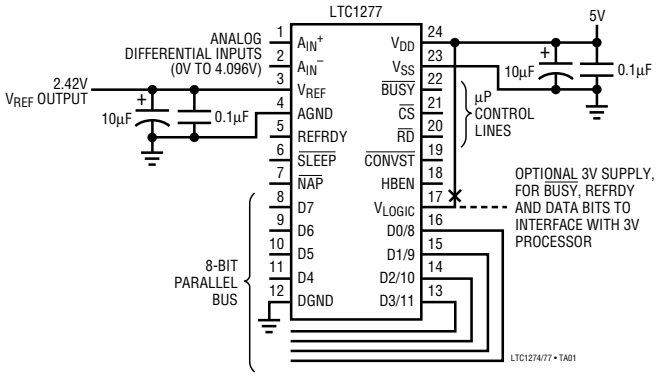

Figure 2. LTC1277 Provides Three Power Down Modes and Differential Inputs

Application of the Month

Battery Charger Draws Constant Current from Power Limited Sources

DC/DC converters make very efficient constant current sources for charging NiCd batteries. Unfortunately, the input of a switcher exhibits a negative impedance, and this can cause problems in systems where the source is power or current limited. Various schemes are used to preclude input foldback. Undervoltage lockout works well with power limited sources, keeping the converter OFF until the input voltage has risen to the point where it can develop adequate power.

Undervoltage lockout does not work with current limited sources. A better approach is to control the converter's input current to match the current available from the source. The circuit shown in Figure 1 does just that, while charging two NiCd cells. Input current is sensed by a PNP transistor and applied as feedback to an LTC1174 step-down converter. The Burst Mode™ converter draws just enough power to hold the input current at 50mA, matching the abilities of the wall adapter.

Output current into two cells is nominally 180mA, but climbs to over 300mA when the batteries are completely discharged. Efficiency is about 78% at 3V output. If the batteries are removed from the charging circuit, the output voltage could climb to levels destructive to the load. To prevent this, a second feedback path is applied to Pin 1 via a diode, limiting the output voltage to approximately 3.7V.

Another condition that can spell trouble for simple circuits such as this one is the loss of input power while the batteries are still connected in circuit. An extra Schottky diode placed in series with the switch (Pin 5) blocks reverse current flow into the LTC1174 and prevents damage. The output can also be short circuited without damage to the device. Shutdown (Pin 8) allows logic control of the charger, so the charging current can be interrupted without disconnecting the source supply.

Burst Mode is a trademark of Linear Technology Corporation.

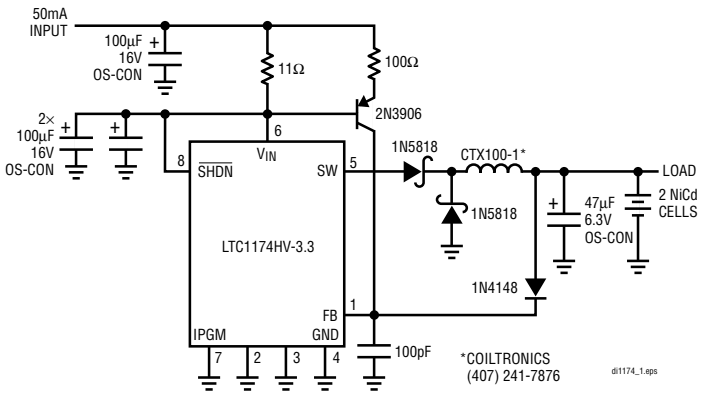

Figure 1. Schematic Diagram of Constant Current Battery Charger

500kHz High Efficiency, 1.25A, Synchronizable Step-Down Switching Regulator in 8-Lead Surface Mount Package

The **LT1375** is the smallest solution available for high performance step-down voltage conversion to 5V from inputs as high as 25V. This new 500kHz regulator IC contains a low loss 1.5A switch and all the necessary oscillator, control and logic circuitry in an 8-lead surface mount package. The fast switching frequency allows a considerable reduction in the size of external components. This new IC also features a Sync pin that allows the device to be externally synchronized from 580kHz to 900kHz with logic level inputs. Both fixed output voltage and adjustable parts are available with an input voltage range of 6V to 25V. Figure 1 shows a simple 25V to 5V converter using the LT1375.

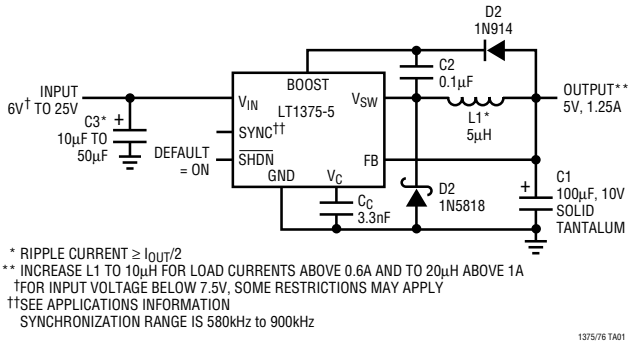

Figure 1. LT1375-5 All Surface Mount 5V Step-Down Regulator Has High Frequency Synchronization Pin

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The LT1375 is a current mode PWM, providing a fast transient response and superior loop stability. A special high speed bipolar process, and new design techniques used to implement a low loss 0.3Ω switch, allow the LT1375 to provide high efficiency at high switching frequency. Efficiency is maintained over a wide output current range. A Shutdown pin is also provided that can be used to reduce supply current to 20µA. Figure 2 shows the LT1375 efficiency over a wide range of load current. Full cycle-by-cycle short-circuit protection and thermal shutdown are also provided.

The combination of wide input voltage range, high efficiency and small circuit size make the LT1375 an ideal regulator for a wide variety of general purpose applications, such as portable computing products, distributed power systems and many other battery-powered systems. A similar device, the LT1376, substitutes a Bias pin in place of the Synchronization pin of the LT1375, which provides approximately 10% higher efficiency at higher input-to-output voltage differentials when lower output currents are required.

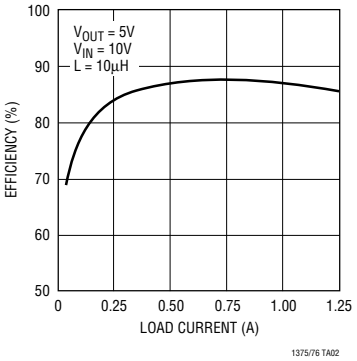

Figure 2. LT1375 Efficiency vs Load Current

The LT1375 is available in an 8-lead plastic dual-in-line and an 8-lead surface mount package. Standard surface mount external parts are used, including the inductor and capacitors. Devices are available with a fixed 5V output or user adjustable output voltage. Operating junction temperature is 0°C to 125°C and an industrial grade –40°C to 125°C version is offered as a standard product. Contact your local LTC sales office for a data sheet and free evaluation samples of the LT1375.

Backup Battery Management System Provides Memory Power and Backup Battery Charging

The **LT1239** is a micropower device which combines the components to build a backup battery system for portable computers and instrumentation. The device contains two regulators, an error amplifier, a comparator and power monitoring circuitry. The LT1239 automatically switches from the main DC power of a portable computer to backup Li-Ion or NiCd battery power to keep critical memory chips alive. The device uses only 20µA of quiescent current and is available in a 16-lead narrow body surface mount package. Figure 1 shows a block diagram of the LT1239 used in a typical portable computing system.

The first regulator provides a constant charge voltage for the backup batteries. The output of regulator #1 is adjustable from 3.75V up to 20V. The second regulator, with a 4.85V output, regulates the backup battery voltage during discharge and isolates the backup battery from the main 5V system supply during normal operation. The LT1239 also contains an error amplifier which is used to equalize the cell voltages in a 2-cell lithium-ion system. A comparator is included which provides automatic switchover from the main 5V power to the backup power insuring uninterrupted power for the backup memory and power monitoring circuitry. A low-battery detector with a 5V threshold powers down regulator #2 and the error amplifier to limit the discharge voltage of the backup cells. The regulators also have independent shutdown, current monitor functions and thermal and current limiting.

The LT1239 is an ideal device to eliminate multicomponent approaches to backup battery management in portable computers. The device is available in a 16-lead narrow body surface mount package specified for operation from 0°C to 70°C. For a data sheet and evaluation samples of the LT1239, contact your local Linear Technology sales office.

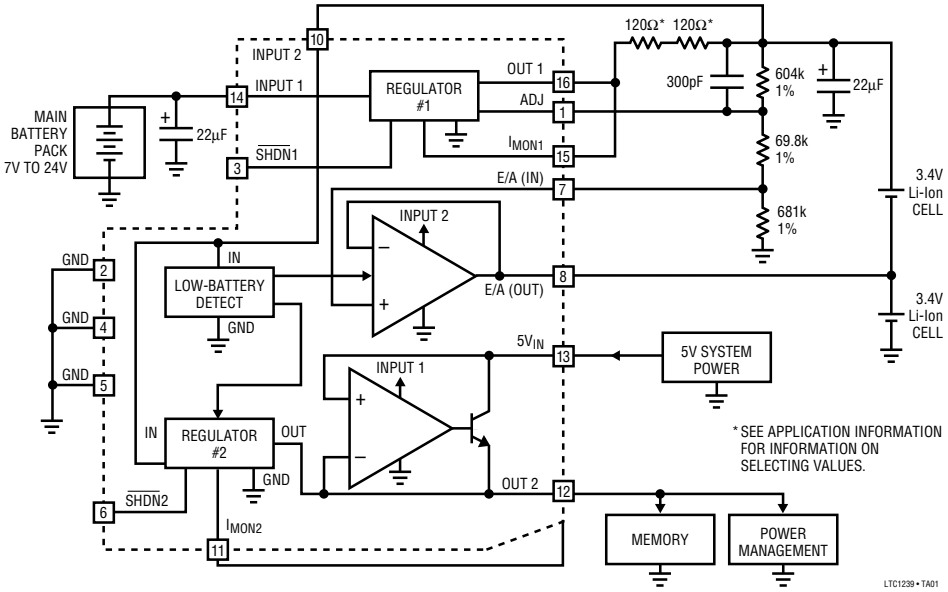

Figure 1. LT1239 Provides Switchover/Recharge Functions for Backup Batteries