Linear Technology Chronicle

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Product of the Month

100MHz Dual Op Amp is Low Power, Accurate and Low Noise—LT1813

The **LT®1813** dual operational amplifier from Linear Technology operates at very high speeds without the usual trade-off of worsened power consumption, DC accuracy or noise. Drawing just 3.6mA (maximum) of supply current per amplifier, the LT1813 features 1.5mV maximum offset voltage and 8nV/√Hz typical noise (Table 1). The LT1813 combines a 750V/µs slew rate with an easy-to-use voltage feedback topology. The LT1813 is ideal for applications where high speed and low power consumption are crucial, such as digital cameras, DVD ROMs and players, CCD imaging systems, medical instruments, test equipment and video cable drivers. Its performance makes it well-suited for high speed, high bandwidth receiver circuits, extending the frequency response of active filters and antialiasing circuits such as those found in digital subscriber line (xDSL) systems.

Table 1. LT1813: More Than Just High Speed

PARAMETER	LT1813	UNITS
Gain Bandwidth (Minimum)	100 75	MHz
Slew Rate (Minimum)	750 500	V/µs
Input Noise Voltage f = 10kHz (Typical)	8	nV/√Hz
Input Offset Voltage (Maximum)	1.5	mV
Input Bias Current (Maximum)	4	µA
Output Current ±3V Output (Minimum)	±40	mA
Input Voltage Range ±5V Supplies	±3.5	V
Supply Current (Maximum)	3.6	mA
Packages, Standard Pinout	SO-8 MSOP	

The LT1813 employs a new method of "slew boost" that achieves low distortion due to its inherent linearity with input step size. Large slew currents can be generated without increased quiescent current. The LT1813 is built with small-geometry, multi-GHz transistors that produce abundant bandwidth with meager operating currents and allow for further reduction of idling supply current (Figure 1).

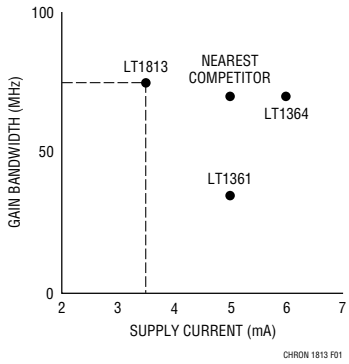

Figure 1. LT1813 Allows Lower Supply Current in High Speed Systems

Compared to current feedback amplifiers, the LT1813's true voltage feedback design and matched high impedance inputs simplify amplifier input and output configurations. As a result, the LT1813 is more tolerant of less-than-ideal layouts than other high speed amplifiers. The improved common mode range of the LT1813 adds to its utility in low supply voltage applications. It is pin compatible with other op amps for upgrades to existing products.

The LT1813 is unity-gain stable with capacitive loads of up to 1000pF making it useful as a high speed buffer or to drive coaxial cable directly. It is stable with nearly two orders of magnitude more capacitance than other high speed amplifiers. This is accomplished by sensing the load-induced output pole and adding compensation at the amplifier gain node. The LT1813 delivers a minimum ±40mA of output current and operates on supplies from ±2V to ±6V. The device is fully specified for ±5V and single 5V operation. The output drives a 100Ω load to ±3.5V with ±5V supplies. On a single 5V supply, the output swings from 1.1V to 3.9V with a 100Ω load connected to 2.5V.

The LT1813 is available now in the 8-lead small outline package and also in the 8-lead micro SO package (MSOP).

4-Quadrant, True 16-Bit DAC Combines Precision with Speed—LTC1599

The **LTC®1599** is a 2-byte parallel input, multiplying, current output 16-bit digital-to-analog converter that guarantees 16-bit accuracy over the industrial temperature range and includes the precision resistors required for bipolar output applications. The LTC1599 has an ultralow glitch impulse of 2nV•s (typical) and when used

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Dual 500mA/50MHz Amplifier for ADSL—LT1795

The **LT1795** contains two high speed current feedback amplifiers that combine high slew rate (900V/µs), high output current (500mA) and high power handling in a small 20-lead SO package. The ability to deliver high power with low distortion in the 50kHz to 2MHz range makes the LT1795 ideal for use as a central office line driver in high speed data transmission systems such as ADSL (Asymmetrical Digital Subscriber Line), G.Lite ADSL and HDSL2. The amplifiers are designed to drive low impedance loads such as twisted-pair transmission lines with excellent linearity.

The ADSL standard requires that digital data be transmitted at high speed over distances of up to 3 miles with the low bit-rate error of less than 10^{-7}. To support this, the line driver must be able to supply large peak signals. Full rate ADSL in a typical central office application (Figure 1) has a calculated peak current requirement of approximately 360mA. Because designs and conditions vary, the LT1795 will supply a guaranteed 500mA.

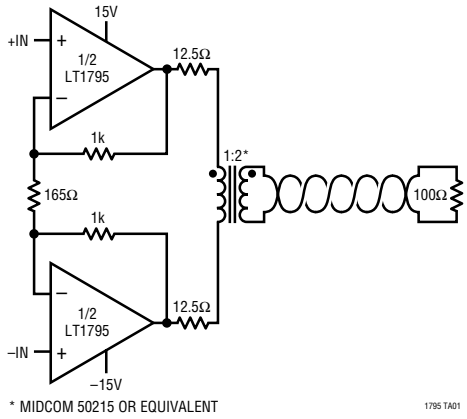

Figure 1. Central Office ADSL Line Driver

The driver in xDSL systems must be capable of dissipating a large amount of power. The LT1795 employs a thermally enhanced small outline (SO) package that is smaller than other 20-pin power packages. The LT1795 has an adjustable supply current capability that allows the user to trade off bandwidth against supply current and quiescent power dissipation by varying a single resistor.

With its maximum rating of ±18V, the LT1795 performs with supply voltages of ±5V to ±15V. Short-circuit protection and thermal shutdown enhance the ruggedness of the amplifier. The LT1795 is stable with large capacitive loads and can easily supply the large currents required by capacitive line loads. A shutdown function switches the LT1795 into a high impedance, low current mode, minimizing power dissipation when the device is not in use. Switching time in both directions between the active and shutdown states is about 1.5µs.

The LT1795 amplifiers are also useful for digital loop carriers, port switches, test equipment, video amplifiers and cable drivers. Other xDSL line drivers are the LT1497, with 125mA output and the 250mA LT1207.

LTC1599 from page 2

with the LT1468 precision amplifier, settles to 0.0015% (16-bit) accuracy in less than 2µs for a 10V step. This combination of speed and 16-bit accuracy makes the LTC1599 suitable for digital waveform generation as well as automatic test equipment, process control, motor control and industrial automation. The new DAC is very low power, typically consuming 10µW.

On-chip precision resistors simplify the connection to external op amps for multiplying applications and for creating up to a ±10V analog output. The resistor connections allow 0V to 10V, 0V to –10V and ±10V output ranges, enabling precision systems to achieve true 16-bit accuracy in rugged, industrial environments. An asynchronous clear pin resets the LTC1599 to zero or mid-scale, allowing both unipolar and bipolar applications to reset to 0V. The device is double-buffered with two 16-bit registers, permitting the update of several DACs simultaneously.

The LTC1599 has INL and DNL linearity of less than ±1LSB over the commercial and industrial temperature ranges in both 2- and 4-quadrant multiplying modes. This guarantees true 16-bit performance and eliminates external calibration. The sensitivity of the converter's INL and DNL to op amp offset has been dramatically reduced compared to previous generations of multiplying DACs. The LTC1599 is offered in a compact 24-pin SSOP package.

Additional 16-bit current output DACs in this family include the LTC1597 with 16-bit parallel interface in a 28-pin SSOP package and serial interface versions, LTC1595 and LTC1596 in 8- and 16-lead SO packages.

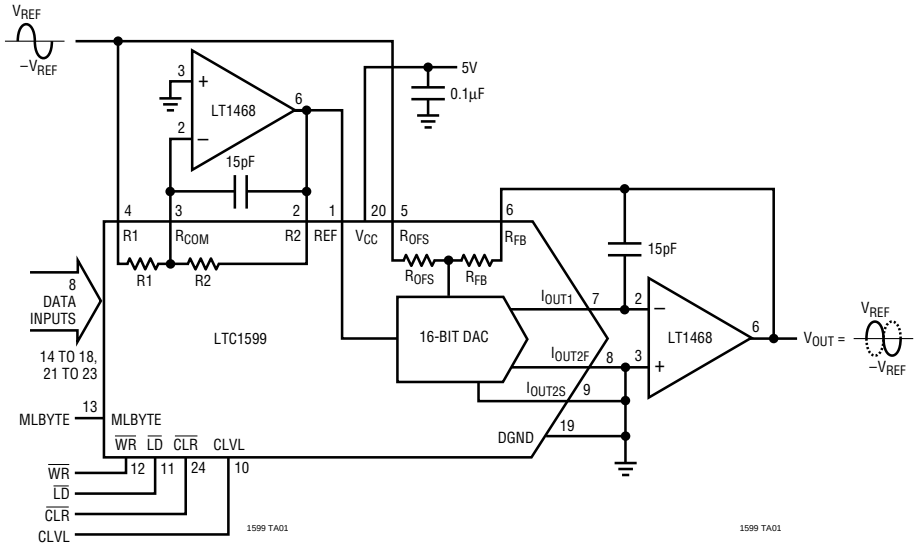

Figure 1. 16-Bit, 4-Quadrant Multiplying DAC with a Minimum of External Components

Application of the Month

Class AB Automatic Bias Control

Class AB amplifiers provide "near Class A" performance yet operate on considerably less quiescent current than Class A. They are easy to construct, rugged and reliable. However, biasing can be difficult since their low quiescent current is poorly controlled and needs to be set precisely. Set too low, the amplifier exhibits crossover distortion; too high, the amplifier dissipates a lot of power. Figure 1 shows the sensitivity of the Class AB amplifier to proper biasing.

The LT1166 controls a Class AB output stage by means of two independent control loops that act together to provide a device and temperature insensitive simple bias network. The LT1166 removes all excess crossover distortion while significantly reducing the distortion caused by the effects of nonlinear transconductance in the output transistors.

A "slice" of power is constructed by connecting the LT1166 to two power MOSFETs, two current sense resistors and two current sources. The power slice shown in Figure 2 will deliver 300W of sine wave power into 16Ω when powered from ±100V. To provide more or less output power or to operate on lower voltages, the MOSFETs can be resized and the sense resistors can be increased or decreased in value. These slices can be easily paralleled to put out a cool, clean output of 600W to 1800W that can be used to drive a shaker table, for example or an audio amplifier.

The same basic power slice can be used for other applications. Used with the LT1684 ring tone generator, the LT1166 provides power to ring a very large number of phones. Used with an adjustable reference IC (LT1431), a ±1A reference can be created (Figure 3). For schematics and more information, see the data sheet, DN126 and *Linear Technology* Magazine, December 1995.

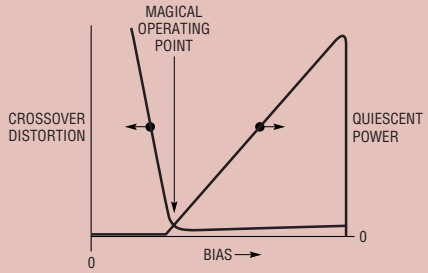

Figure 1. Operating Point of Class AB Amplifier

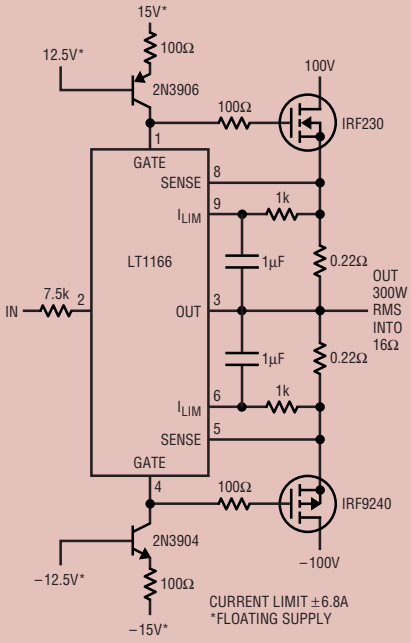

Figure 2. ±100V/6A "Power Slice" May Be Paralleled for 1800W or More

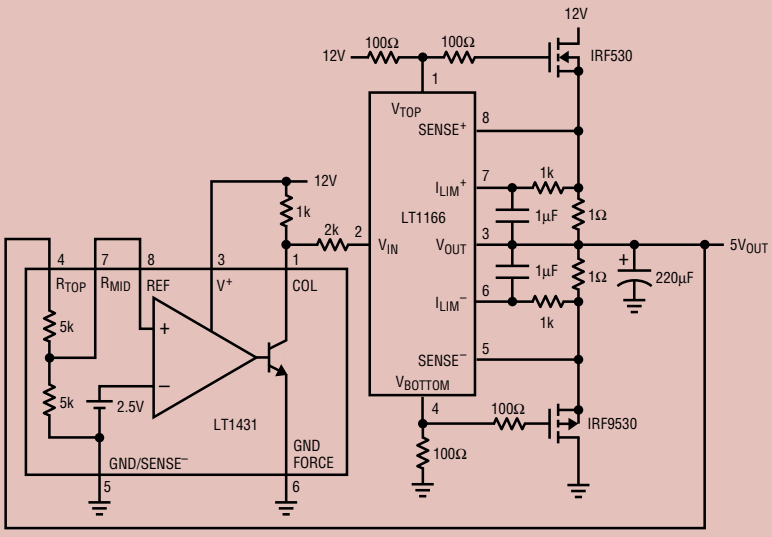

Figure 3. "The Rock," a 5V, ±0.4% Tolerance, ±1A Low Noise Voltage Source

Smart Battery Charger is 100% SMBus Compliant—LTC1759

The new **LTC1759** greatly simplifies construction of a high performance, fully-compliant SMBus charging system for portable equipment such as computers and instruments. It combines a high efficiency charger, two 10-bit DACs for precise charger control, a battery thermistor decoder, an SMBus controller and an SMBus accelerator in one narrow SSOP package (Figure 1). By monitoring the current from the AC adapter and adjusting the charging current, the LTC1759 avoids overloading the adapter while powering the system and providing the maximum possible charge current.

The LTC1759 will charge four Li-Ion cells in series from a standard 18V DC output AC adapter. Instead of a diode, a MOSFET blocks reverse current flow from the battery to the input. This results in a lower input-output voltage differential and in power savings. With its 99.5% maximum duty cycle and input P-channel MOSFET, the LTC1759 circuit can operate with a dropout voltage as low as 0.5V.

The high efficiency, synchronous current mode switching charger sources up to 8A of current. The LTC1759 also generates a gate bias voltage of 8.9V to boost the current drive for high efficiency even in very low dropout applications.

The SMBus interface allows the charger to be programmed by the host processor or by the smart battery. The high noise immunity thermistor decoder in the LTC1759 monitors the Li-Ion battery for temperature, connectivity and battery type information. Based on the information monitored, the charging current and voltage produced by the LTC1759 are maintained within preset limits. The underrange detection scheme is an important benefit of the LTC1759. It allows proper detection despite ground offset between the battery and the thermistor circuitry. An offset of 100mV is not uncommon at normal charging currents.

The SMBus accelerator portion of the LTC1759 greatly improves rise times, especially with normal capacitive loading (150pF). This allows the circuit to be compliant with SMBus specifications. The LTC1759 will respond to smart battery critical warning messages without host intervention. The built-in, low power overrange detector is always active to support battery-present interrupts.

The LTC1759 charger soft starts at a controlled rate and provides an initial 80mA of "wake-up" current when the battery is inserted or the AC adapter is connected. It charges autonomously or under control by the host and ceases to charge if communication fails. The voltage accuracy of the LTC1759 is 1% and the current accuracy is 5%.

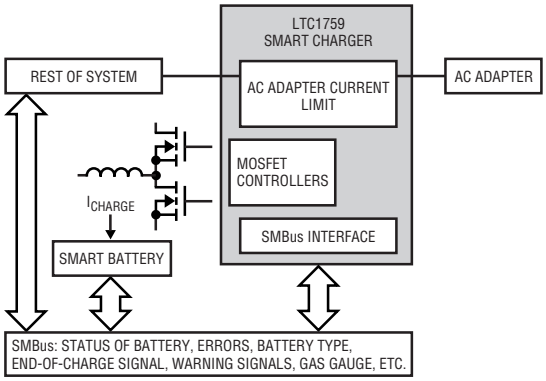

Figure 1. Function of the LTC1759 in a Smart Battery System

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