Linear Technology Chronicle

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Products of the Month

High Speed Parallel 12-Bit ADCs Deliver on Performance While Consuming Only Milliwatts

The 1.25Msps **LTC®1415** and 800ksps **LTC1409** are 12-bit ADCs with wideband sample-and-holds and precision references that consume minimal amounts of power. The LTC1415 has 72dB signal-to-(noise + distortion) ratio (SINAD) and 80dB THD at an input frequency of 100kHz. It operates off a single 5V supply and dissipates only 55mW (typ) while converting at 1.25Msps. The LTC1409 has a guaranteed AC performance of 71dB SINAD and 82dB THD at the Nyquist input frequency of 400kHz over temperature. It accepts ±2.5V inputs and dissipates only 80mW (typ) while converting at 800ksps. In sleep mode, these ADCs consume just 10µW and in nap mode only 7.5mW and 4mW, respectively. They recover from nap mode in 200ns allowing reduced power consumption during brief inactive periods. DC specifications include a maximum INL and DNL of ±1LSB over temperature. Figure 2 shows the excellent typical DNL performance for the LTC1415.

The LTC1409 and LTC1415 excel in applications that must digitize fast moving signals with outstanding spectral purity. The sample-and-hold has a high impedance differential input that rejects wideband common mode noise by 60dB, simplifying front-end signal conditioning design. The internal precision references can be used for external circuitry or overridden by an external source to improve temperature or time stability. The three-state parallel interface easily connects to popular DSP and microprocessor parallel ports.

The LTC1409 and LTC1415 do not have a pipeline delay such as found with multistep architectures. Each conversion cycle yields results that correlate to the analog input at the time the sample command was issued. This is a big advantage for multiplexed process control and robotics applications or for event capture systems. They are also ideally suited for demanding telecom, IF down conversion, undersampling and high speed data acquisition applications. Low power dissipation permits use in battery-powered and portable applications.

The LTC1415 joins the 1.25Msps LTC1410, introduced last year as LTC's fastest 12-bit high speed parallel A/D converter. This growing family of ADCs is offered in 28-lead SW packages and has similar pinouts, allowing a single layout to accommodate any of the three devices. For a data sheet and evaluation samples of each of these high performance ADCs, contact your local Linear Technology sales office.

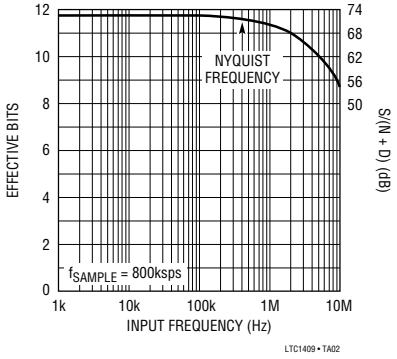

Figure 1. LTC1409 Has 71dB SINAD at the Nyquist Input Frequency of 400kHz

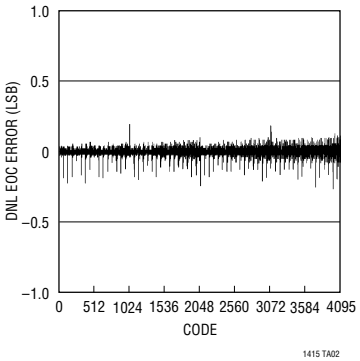

Figure 2. LTC1415 Has a Typical Differential Nonlinearity (DNL) of Only 0.25LSB

Low Power 8th Order Elliptic Lowpass Filter in SO-8 Needs Only 3V Supply

The **LTC1069-6** is a low power 8th order, elliptic lowpass filter optimized for single 3V or 5V supply operation. The low supply voltage operation of the LTC1069-6 does not penalize dynamic range. It achieves a 79dB signal-to-noise ratio (S/N) and a cutoff frequency of 20kHz under 5V operation, while drawing just 1.2mA (typ) of supply current. With a single 3V supply, it has a 14kHz cutoff frequency, a 72dB S/N and typically draws just 1mA of supply current. No external components are required except for power supply bypass capacitors.

Cutoff frequency is clock tunable and equals the clock frequency divided by 50. The input signal is sampled twice per clock cycle to lower the risk of aliasing. The stopband attenuation has a progressive elliptic response reaching 42dB attenuation at $1.3 \times f_{CUTTOFF}$, 66dB at $2.0 \times f_{CUTTOFF}$, and over 70dB at $2.1 \times f_{CUTTOFF}$. The gain at f_{CUTOFF} is –0.07dB and typical passband

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ripple is only ±0.1dB. Figure 1 shows the 3V frequency response of the LT1069-6 for a 500mV$_{RMS}$ input. Figure 2 shows the dynamic range under 5V operation. These features make it a good choice for precision telecommunications and antialiasing applications, or other filter applications where a compact solution is required.

The LTC1069-6 is immediately available in volume from stock in an SO-8 surface mount package over the commercial and industrial temperature ranges. Contact your local Linear Technology sales office for a data sheet and evaluation samples.

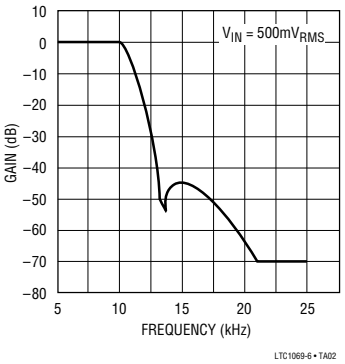

Figure 1. Frequency Response of LTC1069-6 10kHz Elliptic Lowpass Filter with Single 3V Supply

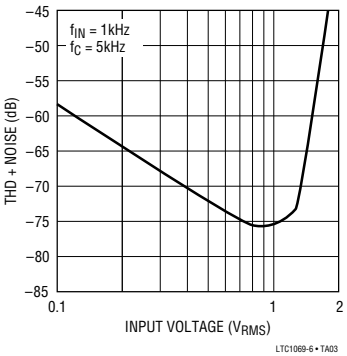

Figure 2. THD + Noise Characteristics of LTC1069-6 with 5V Supply

Low Power Quad 12-Bit Rail-to-Rail DACs Have DNL of Only ±0.5LSB

The **LTC1458/LTC1458L** are quad 12-bit DACs, complete with rail-to-rail amplifiers and references for single 5V and 3V supply applications. They have a maximum differential nonlinearity (DNL) of only ±0.5LSB for guaranteed 12-bit monotonic performance. The 5V LTC1458, shown in Figure 1, typically draws just 1100µA while the 3V LTC1458L draws only 800µA. They are ideal in feedback loops of digital control systems, such as calibration DACs in industrial control systems and for large distributed power supplies, where multiple inexpensive D/A devices are required. Their low power consumption also make them suitable in portable battery-powered digitally controlled instruments where minimal power dissipation is key.

The LTC1458/58L include an output buffer amplifier with variable gain (×1 or ×2) and 3-wire serial interface, which is SPI, QSPI and MICROWIRE™ compatible. The serial interface eases the connection to microcontrollers and microprocessors with built-in SPI ports and reduces I/O lines in remote or isolated applications. The rail-to-rail amplifiers ensure an accurate full-scale output even when driving heavy loads on reduced supply voltages and have improved capacitive load handling when compared to competing devices. Power-on reset ensures that the outputs are at zero scale when powered up.

The on-chip reference (2.048V for the LTC1458; 1.220V for LTC1458L) is brought out, allowing it to be used for external circuitry and is not internally connected. This allows a user specified external reference to be used for all DACs. The asynchronous Clear pin resets all DACs to zero scale on command. This can be useful in system initialization and interrupt processing schemes. The ability to select the output amplifiers gain and output ground reference allows virtually any output range within the constraints of the power supply. Figure 2 shows the DNL characteristics of the LTC1458.

The LTC1458/58L are offered in 28-pin SO and SSOP packages. Both devices are available from stock screened to the commercial and industrial temperature. Call your local Linear Technology sales office for a data sheet and evaluation samples.

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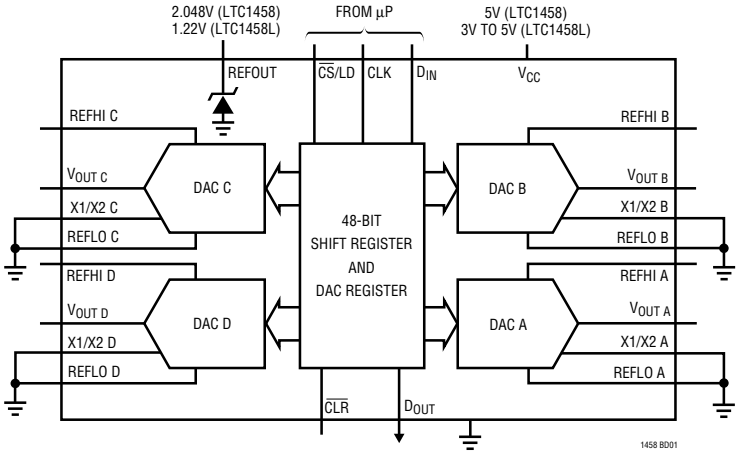

Figure 1. Functional Block Diagram: Quad 12-Bit Rail-to-Rail DAC

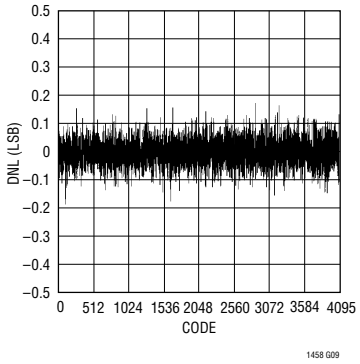

Figure 2. Differential Nonlinearity vs Input Code for LTC1458—Max DNL is Less Than ±0.5LSB

Application of the Month

An Open-Architecture Ring-Tone Generator

When a phone rings, it rings with a cadence, a sequence of rings and pauses. The standard cadence is one second ringing followed by two seconds of silence. We use the first 1/4 of an LT®1491 as a cadence oscillator, whose output is at V_{CC} for one second and then at V_{EE} for two seconds. This sequence repeats every three seconds, producing the all-too-familiar pattern. The actual ringing of the bell is done by a 20Hz AC sine wave signal at a signal level of $87V_{RMS}$ superimposed on –48VDC. The 20Hz signal is implemented with the second amplifier in the LT1491 which acts as a gated 20Hz oscillator (see Figure 1).

The third amplifier in the LT1491, which is configured as a lowpass filter, converts the square wave output of the oscillator to a sine wave by filtering out unwanted harmonics. Finally, the $87V_{RMS}$ and the –48VDC parts are handled by the fourth amplifier in the LT1491 and its steering of two external 15V regulators.

The rest of what we do, the part that is most difficult to follow, involves the output amplifier. In the output amplifier, the $6V_{P-P}$ signal from the waveform synthesizer is imposed across R12 (see Figure 2) into a virtual ground, creating a sine wave signal current. This current is added to the DC current flowing through R15 and the resulting current is imposed across R13. This stage amplifies the sine wave and offsets it to become an $87V_{RMS}$ sine wave imposed on a –48VDC bias. The trick here is that the voltage gain is in the ±15V regulators, not the LT1491 which is merely steering currents.

This complete circuit (Figure 2) includes the ring-trip sense circuit to detect when the phone receiver is picked up. This circuit is fully protected for output shorts to any voltage within the power supply window of –180V to 60V.

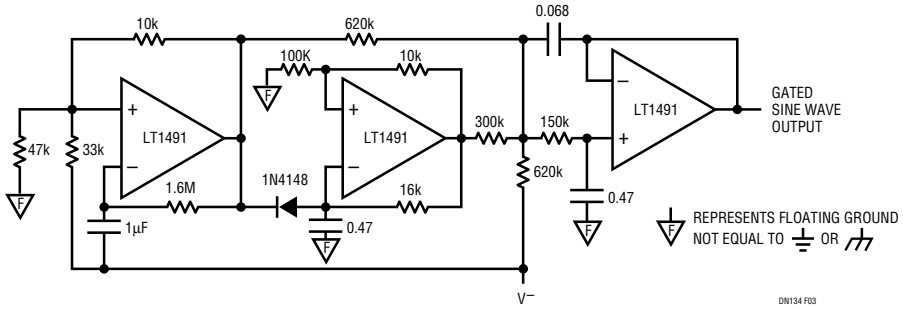

Figure 1. Waveform Synthesizer

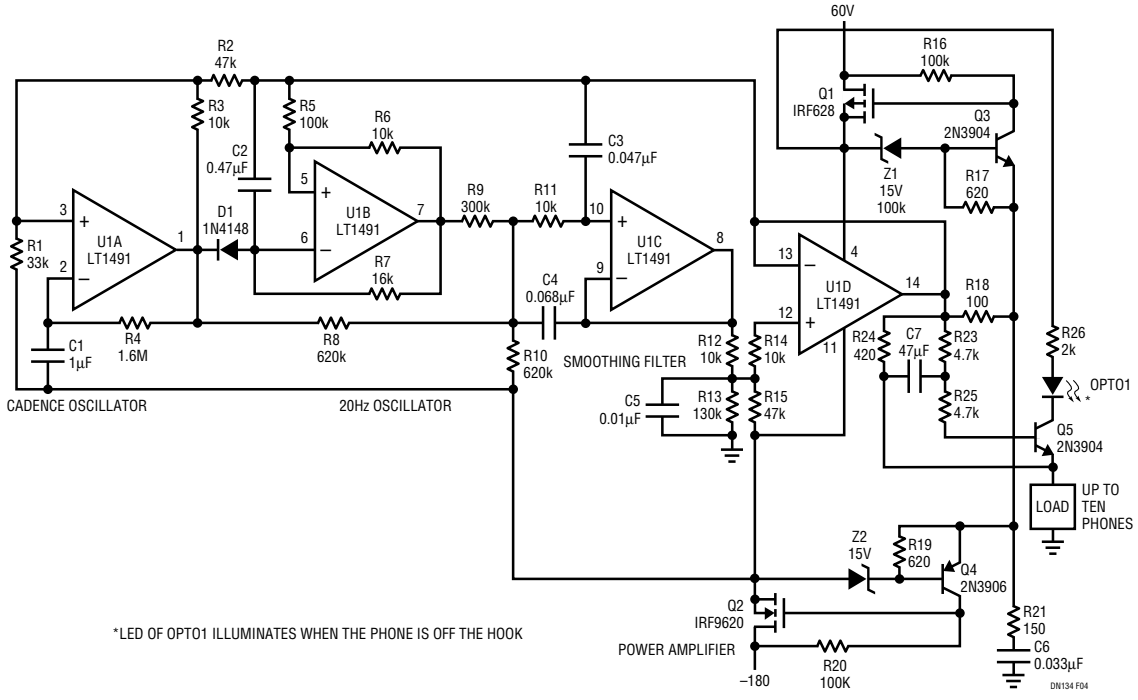

Figure 2. Complete Ring-Tone Generator Circuit

Inductorless Switched Capacitor Converter Delivers 60mA at 12V from 5V Source

The **LTC1263** is a switched capacitor charge pump converter which converts a 4.75V to 5.5V input to a regulated 12V output voltage without using inductors. It delivers up to 60mA of output current at 5V with 76% efficiency. The LTC1263 typically draws only 300µA of supply current while converting, and just 1mA max under quiescent conditions. A shutdown pin further reduces the supply current to less than 1µA, making it suitable for portable and battery-operated applications. It is ideal for 12V flash memory supplies in PCMCIA cards, as well as for amplifier or data conversion supplies in portable, handheld devices and instruments.

The LTC1263 uses a charge pump tripler, clocked by an internal oscillator, to generate the 12V output. Figure 1 shows the output voltage vs load current for a 5V input. It packs this conversion power into an SO-8 package and requires only four external components (see Figure 2), all of which are small ceramic capacitors (two 0.47µF and two 10µF). Usually an inductor is required to boost a 5V source to a 12V output with a current of over 30mA—greatly increasing the physical size of the DC/DC converter.

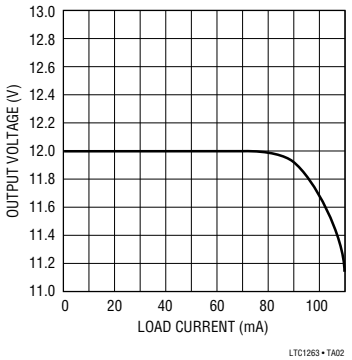

Figure 1. Output Voltage vs Load Characteristics for LTC1263

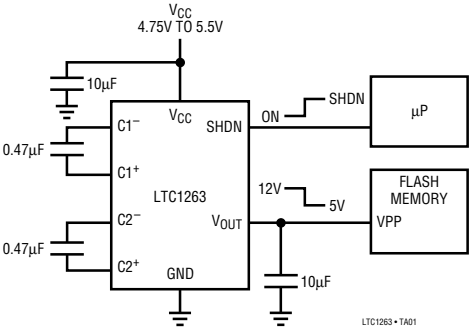

Figure 2. Flash Memory Programming Supply Using the LTC1263

The LTC1263's low shutdown current and lack of a DC current path from input to output are additional battery-saving advantages over inductor-based micropower boost switchers.

The LTC1263 is available in an SO-8 package. For a data sheet and evaluation samples, contact your local Linear Technology sales office.

Quad C-Load JFET Op Amps Offer Power Savings and Picoampere Inputs

The **LT1463** and the **LT1465** are quad JFET input amplifiers that represent an important addition to LTC's family of low power JFETs. These new JFET op amps are quad versions of the LT1462 and LT1464 duals introduced last month in *Linear Technology Chronicle*. The LT1463 has a slew rate of 0.13V/µs and 175kHz bandwidth. The LT1465 has a slew rate of 0.9V/µs and a bandwidth of 1MHz. Figure 1 shows the small-signal response of the LT1465.

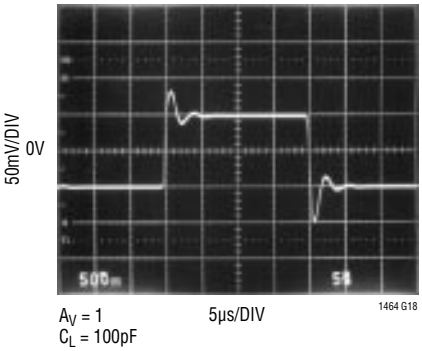

Figure 1. Small-Signal Response, V_S = ±5V, ±15V, C_{LOAD} = 1000pF

These amplifiers are stable while driving capacitive loads up to 10nF (10,000pF). In addition, the input common mode range includes the positive rail. These quad JFET amplifiers offer tremendous power savings—extending battery life and allowing more compact designs by running cooler than other JFETs. They are ideally suited for battery-powered systems, photo current amplifiers and as low frequency, micropower active filters. Figure 2 shows the LT1465 configured as a Chebyshev lowpass filter.

The LT1463 and the LT1465 are offered in standard 14-pin PDIP and SO packages. For a data sheet and evaluation samples, get in touch with your local Linear Technology sales office.

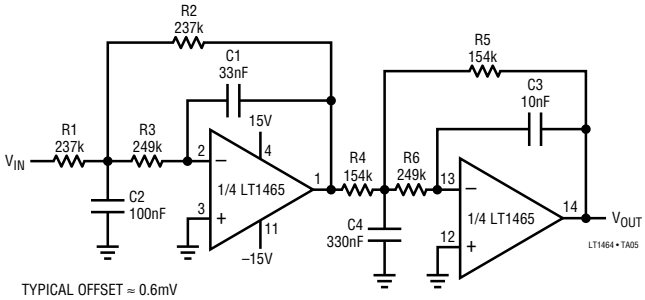

Figure 2. LT1465 JFET Input Op Amp as a 10MHz 4th Order Chebyshev Lowpass Filter (0.01dB Ripple)

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