LinearTechnologyChronicle

September 1996 **A Showcase of Linear Technology's Focus Products** Vol. 5 No. 9

Products of the Month

Micropower 8-Channel 12-Bit ADCs with MUX Offer ±0.75LSB Max DNL

The **LTC®1598/LTC1598L** are 8-channel multiplexed 12-bit micropower ADCs for single 5V and 3V supply applications. The 5V LTC1598 typically draws just 320µA at 16.8ksps sampling rates while the 3V LTC1598L draws only 250µA at 10.5ksps. Both save power by automatically powering down to a mere 1nA when not converting. Each has an 8-channel high impedance input and are packaged in a 24-pin SSOP. Maximum differential linearity error of ±0.75LSB guarantees a true 12-bit no-missing codes resolution. They are ideal for such space conscious, power sensitive applications as pen screen interface, remote process control, battery monitoring and portable data acquisition.

These ADCs have a multiplexer output that is separate from the ADC input, allowing one signal conditioning circuit for all channels. This improves channel matching characteristics and reduces component count. For example, a filter can be implemented once and used for all four channels. Separate control of the multiplexer and ADC allows continuous sampling of a single channel without addressing prior to each conversion.

The 3-wire serial interface reduces I/O lines in remote or isolated applications. All devices are SPI, QSPI and MICROWIRE™ compatible. The LTC1598/LTC1598L are screened to the commercial and industrial temperature ranges. Contact your local Linear Technology sales office for data sheets and evaluation samples.

MICROWIRE is a trademark of National Semiconductor Corp.

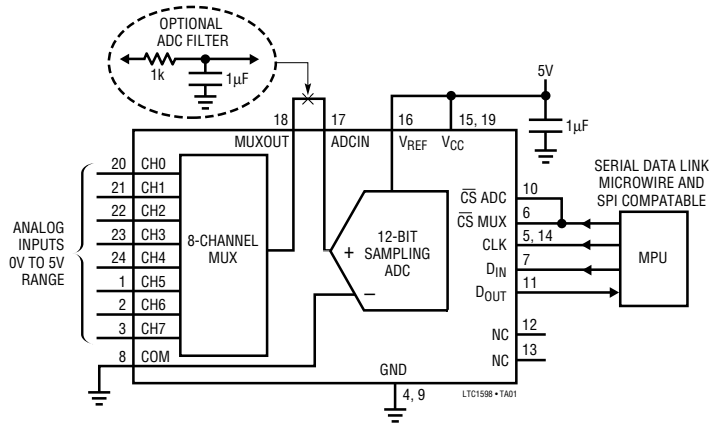


Figure 1. LTC1598 24µW, 8-Channel, 12-Bit ADC Samples at 200Hz and Runs Off a 5V Supply

Adaptive Frequency Boost Converters Provide Low Noise and High Efficiency Over a Wide Range of Loads

The **LT®1500/LT1501** are low noise micropower DC/DC converters for battery applications using two or more cells or a supplied voltage of 1.8V minimum. The current mode architecture monitors the switch current to produce a well controlled peak switch and battery current. These high efficiency converters provide low noise 5V to 12V conversion at 200mA or can deliver 300mA at 3.3V from just two cells (2V minimum). Operating quiescent current is just 200µA and only 8µA (typ) in shutdown. They are capable of operating with supply voltages from 1.8V to 15V. The LT1500/LT1501 are ideal for communications applications, such as wireless modems, which require good efficiency and fairly constant frequency operation with low switching noise over a wide range of load currents.

The LT1500 requires only four external surface mount components to implement a current mode boost converter—input and output capacitors, an inductor and a diode. The switching frequency is determined by the input and output voltages and inductor value, so it will vary somewhat as the input voltage changes. In contrast to pulse skipping switching regulators, the current mode operation of the LT1500/LT1501 causes the operating frequency to linearly increase as the load current decreases. This keeps the switching frequency out of the audio band at most load currents. The LT1500 has an advantage over other variable frequency methods which can cause the switching frequency to vary into the audio range.

Continued on page 2

Inside This Issue:

LT1500/LT1501 from page 1

The LT1500 is offered in a 14-lead SO package with two options available for fixed output (3.3V or 5V) or adjustable operation and includes a synchronization function. The LT1501 is in an 8-lead SO package and is not synchronizable. Both devices include a low-battery detector which is alive in shutdown. Contact your local Linear Technology sales office for a data sheet and evaluation samples.

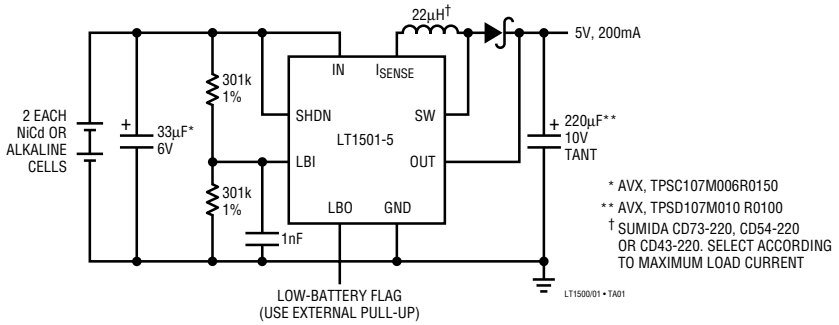


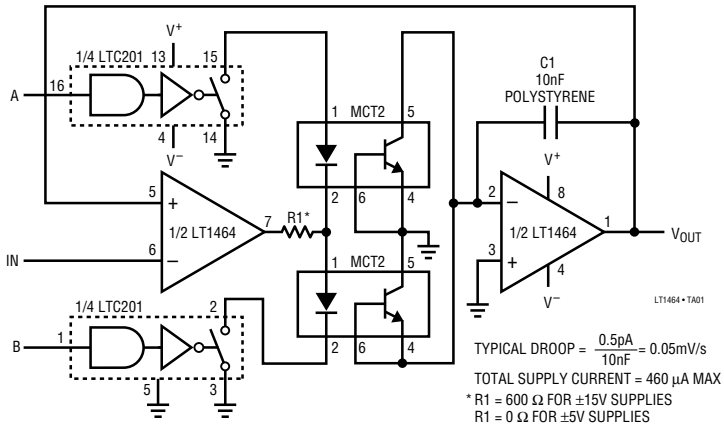
Figure 1. LT1501 Used as a 2-Cell to 5V Converter

World's Only Dual, Micropower, C-Load, JFET Op Amps

The **LT1462** and **LT1464** are dual JFET input amplifiers that consume only 45µA and 200µA of supply current per amplifier, respectively. The LT1462 has a slew rate of 0.13V/µs and 175kHz bandwidth. The LT1464 has a slew rate of 0.9V/µs and 1MHz bandwidth. These low power JFET amplifiers offer tremendous power savings—extending battery life and maintaining low bias currents by running cooler than other JFETs. They are ideally suited for battery-powered systems, photo current amplifiers and as low frequency, micropower active filters.

The LT1462 and LT1464 are micropower op amps that draw only 45µA and 200µA max respectively, yet they are still capable of driving large capacitive loads. Both of these C-Load stable op amps require just picoamperes of input bias current (0.5pA typical) and are unity-gain stable for capacitive loads up to 10,000pF. Their outputs can swing a 10k load to within 1.5V of either supply while their input common mode range can swing to and include the positive rail.

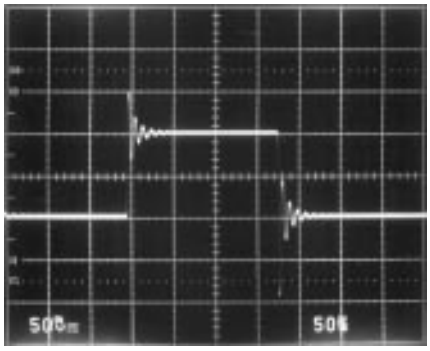
The LT1462 and the LT1464 are offered in standard 8-pin DIP and SO packages. The quad versions, LT1463 and LT1465, will soon join this family of micropower JFET amplifiers. Contact your local Linear Technology sales office for data sheets and evaluation samples.



FUNCTION	MODE	IN A	IN B	MODE	IN A	IN B
Track-and-Hold	Track	0	0	Hold	1	1
Positive Peak Detector	Reset	0	0	Store	0	1
Negative Peak Detector	Reset	0	0	Store	1	0

LTC201 switch is open for logic "1."

Figure 1. LT1464 JFET Input Op Amp as a Micropower Low Droop Track-and-Hold/Peak Detector



A_V = 1
V_S = ±5V, ±15V
C_L = 10nF

Figure 2. Small-Signal Response, C_{LOAD} = 10nF

Application of the Month

Driving the Analog Input of High Performance A/D Converters

The inputs to switched capacitor ADCs are easy to drive if you allow for the fact that they draw a small input current transient at the end of each conversion. This happens when the internal sampling capacitors switch back onto the input to acquire the next sample. For accurate results, the circuitry driving the analog input must settle from this transient before the next conversion is started.

There are two ways to accomplish this. One is to drive the ADC with an op amp that settles from a load transient in less than the acquisition time of the ADC. Fortunately, most op amps settle much more quickly from a load transient than from an input step, so meeting this requirement is not too difficult. The LT1363, for example, is a good choice for driving the LTC1410 input.

A second solution to handling the input transient is to use an input RC filter with a capacitor much larger than the ADC input capacitance. This larger capacitor provides the charge for the sampling capacitor, which eliminates the voltage transient altogether. Figure 1 shows such a filter for the LTC1410. The 1000pF capacitor provides the input charge for the ADC's sampling capacitor. The LT1363's capacitive load driving capability makes it a good choice for use with this filter.

Filter Wideband Noise from the Input Signal

Many new converters have wide S/H input bandwidths. This is great for capturing high frequency input signals, but for lower input bandwidth applications the converter will pick up any wideband noise that may be in the input signal. To avoid this, use a filter at the ADC input to pass only your desired signal bandwidth.

The simple filter in Figure 1 bandlimits the input signal to 3MHz and still allows clean sampling up to the Nyquist frequency (625kHz). Figure 2 shows the Nyquist performance of the LTC1410 using this filter. The signal to noise and distortion ratio (SINAD) is 71.5dB and total harmonic distortion (THD) is –84dB.

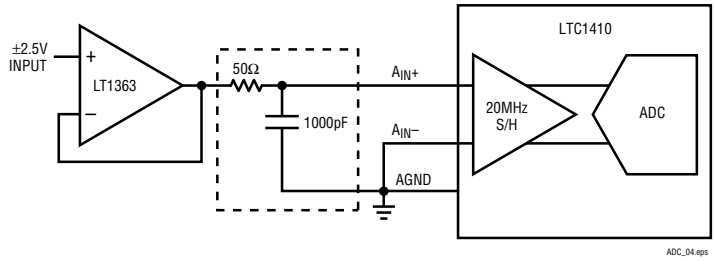


Figure 1. Many New ADCs Have Wide Bandwidth Sample-and-Holds. In Lower Bandwidth Applications, a Simple RC Filter Will Remove Wideband Noise That May Be Present in the Signal

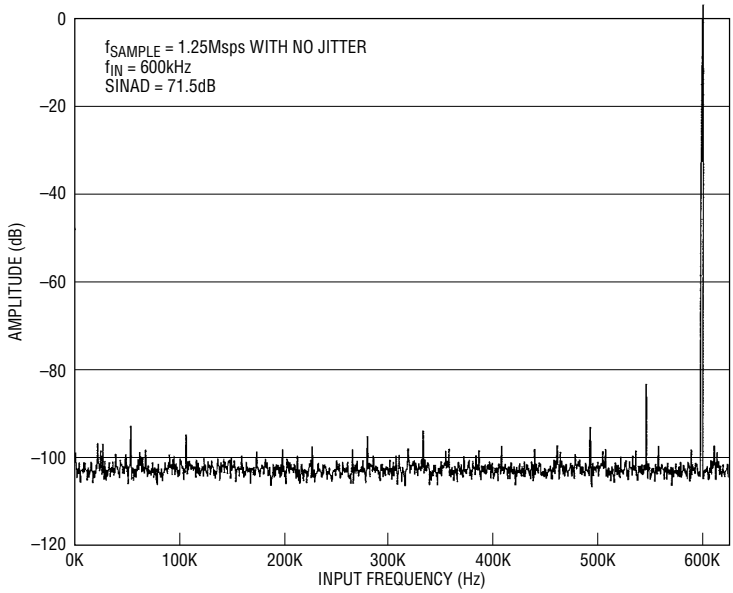


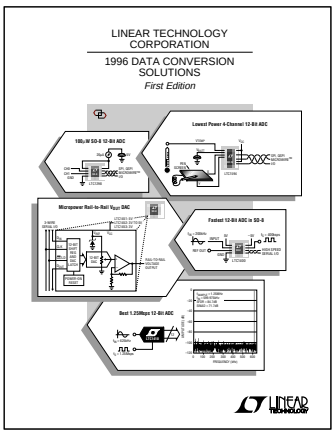
Figure 2. With a Low Jitter Source, the LTC1410 Will Give 71.5dB SINAD When Sampling a Nyquist Input Signal

New Data Conversion Solutions Brochure

The *1996 Data Conversion Solutions* brochure has just been published and is now available. This 52 page booklet contains practical tips on how to apply LTC's growing line of data conversion products, namely our A/D converters and DACs as well as multiplexer/switches and references. Each product section cross-references the entire product line, highlights new products for the year and then describes various applications of individual devices, complete with schematic and a description on how the circuit works.

The Analog-to-Digital Converter section has tables that list the entire product line in descending sample rates, starting with the 1.25Msps LTC1410 and ending with low power converters under 10ksps. Other tables break out the A/D product line in terms of output (parallel or serial), micropower, 3V supply and those devices offered in the popular SO-8 package. This is then followed by several new product cameos where features of recently introduced products are presented along with a block diagram.

The heart of each section is the application notes, where practical design examples are described along with a schematic. There are 60 products described and 24 application notes for you to review. Additional application notes and design notes on data conversion solutions are also referenced. The brochure concludes with a glossary of terms, including frequently used abbreviations. To receive a copy, contact your local Linear Technology sales office.



First Edition of *1996 Data Conversion Solutions* Brochure Is Now Available

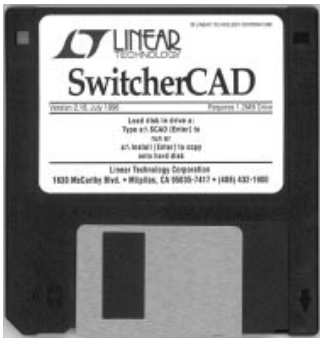
SwitcherCAD Update

New software for automated power management designs now supports high frequency DC/DC converters.

A new version of SwitcherCAD is now available for designing high frequency distributed power control circuits.

SwitcherCAD accepts inputs for power supply requirements and returns the circuit topology, such as the external component values and the power ICs required to implement a design. Included in the component data base are new high frequency PWM switchers, such as the LT137X family, as well as new surface mount components (coils, capacitors and diodes) required for high frequency PWM operation.

The program disk runs on IBM or compatible computers and is available on a 3.5-inch floppy disk. SwitcherCAD is supplied with a 6-chapter user's manual which includes instructions on how to input data fields and what formulas to use. Vendor sources for purchasing external components are also provided.



The new converter IC data base now includes the 500kHz step-down converters LT1375, LT1376, LT1507 and 250kHz to 1MHz boost converters LT1371, LT1372, LT1373 and LT1377. The original LT107X, LT117X, LT127X and LT1082 converter families are also in the data base.

SwitcherCAD Version 2.18 is available free of charge from your local LTC sales representative.

Linear Technology Products Are Distributed By:

Almac/Arrow
Arrow/Schweber
Arrow/Zeus
Digi-Key
Electrosonic
Gerber Electronics
Farnell Electronics
Marshall Industries
Phase 1