

# DESIGN NOTES

## New 500ksps and 600ksps ADCs Match Needs of High Speed Applications – Design Note 88

Kevin R. Hoskins

### Introduction

Combining high speed analog-to-digital conversion with low power dissipation, the 500ksps LTC<sup>®</sup>1278 and 600ksps LTC1279 12-bit ADCs solve major challenges confronting designers of high speed systems: conversion performance, power dissipation, circuit board real estate, complexity, and cost. Applications for the LTC1278/LTC1279 include telecom, communication, PC data acquisition board, and high speed and multiplexed data acquisition systems. In addition to requiring no external references, crystals, or clocks the LTC1278/LTC1279 offer system designers the following significant system-enhancing improvements:

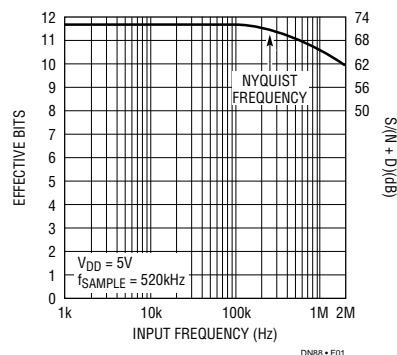
- Power Shutdown: 5mW
- Wakes Up in a Scant 300ns
- Single 5V or  $\pm 5V$  Supply Voltage Operation
- Low Power Dissipation: 150mW (Max), 75mW (Typ)
- Small 24-Pin SO or 24-Pin Narrow DIP Packages

The LTC1278/LTC1279's DC performance includes  $\pm 1$ LSB INL and DNL, no missing codes, and an internal voltage reference with a full-scale drift of only 25ppm/ $^{\circ}$ C.

The AC performance includes 70dB (Min) SINAD,  $-78$ dB (Max) THD, and  $-82$ dB (Max) spurious-free dynamic range. These specifications were measured at  $f_S = 500$ ksps (LTC1278) or  $f_S = 600$ ksps (LTC1279),  $f_{IN} = 100$ kHz, and are guaranteed over the operating temperature range. The plot of effective-number-of-bits (ENOB) shown in Figure 1 clearly indicates that the LTC1278/LTC1279 can accurately sample signals that contain spectral energy beyond the Nyquist frequency.

### Newest High Speed ADC Family Members

The LTC1278/LTC1279 are self-contained ADC systems composed of a fast capacitively-based charge redistribution Successive Approximation Register (SAR) sampling ADC, internal reference, power shutdown, and internally generated and synchronized conversion clock. The digital



**Figure 1. The LTC1278 Can Accurately Digitize Input Signals Up to the Nyquist Frequency and Beyond**

interface's flexibility eases connection to external latches, FIFOs, and DSPs. Table 1 shows more members of the high speed 12-bit ADC family.

**Table 1. LTC's High Speed ADC Family Includes 5V and 3V Devices**

Device	Sampling Frequency	S/(N + D) @ Nyquist	Input Range	Power Supply	Power Dissipation
LTC1272	250kHz	65dB	0V to 5V	5V	75mW
LTC1273	300kHz	70dB	0V to 5V	5V	75mW
LTC1275	300kHz	70dB	$\pm 2.5V$	$\pm 5V$	75mW
LTC1276	300kHz	70dB	$\pm 5V$	$\pm 5V$	75mW
<b>LTC1278</b>	<b>500kHz</b>	<b>70dB</b>	<b>0V to 5V or <math>\pm 2.5V</math></b>	<b>5V or <math>\pm 5V</math></b>	<b>75mW 5mW*</b>
<b>LTC1279</b>	<b>600kHz</b>	<b>70dB</b>	<b>0V to 5V or <math>\pm 2.5</math></b>	<b>5V or <math>\pm 5V</math></b>	<b>75mW 5mW*</b>
LTC1282	140kHz	68dB	0V to 2.5V or $\pm 1.25V$	3V or $\pm 3V$	12mW

\*5mW power shutdown with instant wake-up

The LTC1278/LTC1279 convert input signals in the 0V to 5V or  $-2.5V$  to  $2.5V$  ranges at full speed when operating on a 5V or  $\pm 5V$  supply voltage, respectively. The  $\pm 2.5V$  input range complements the new generation of operational amplifiers that operate on  $\pm 5V$ .

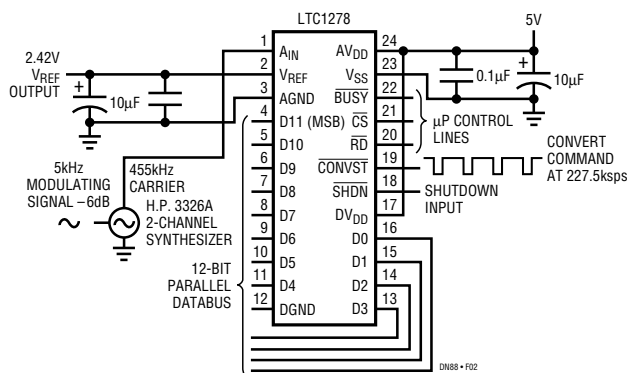
LT and LTC are registered trademarks and LT is a trademark of Linear Technology Corporation.

## Important Applications

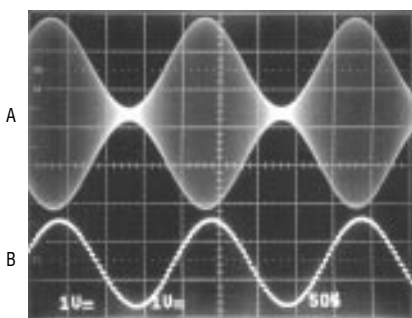
The LTC1278's features benefit at least four different application areas: telecom, communication, PC data acquisition boards, and high speed and multiplexed data acquisition.

Telecom digital-data transmission applications such as High-bit-rate Digital Subscriber Line (HDSL) with its high speed T1 data rate benefit from the LTC1278's low power dissipation since these telecom systems usually derive their power from the phone line. While the LTC1278's 500ksps conversion rate easily covers T1 data rates, the LTC1279's 600ksps is ideal for HDSL's faster E1 data rates. Further, these applications use noise and echo cancellation that require excellent dynamic performance from the ADC's sample-and-hold. The LTC1278 satisfies this requirement as indicated by the device's excellent dynamic performance shown in Figure 1.

Communication applications also benefit from the LTC1278/LTC1279's wide input bandwidth and undersampling capability. The application shown in Figure 2 uses the LTC1278 to undersample (at 227.5ksps) a 455kHz I.F. amplitude-modulated by a 5kHz sine wave. Figures 3A and 3B show, respectively, the 455kHz I.F. carrier and the recovered 5kHz sine wave that results from a 12-bit DAC reconstruction.



**Figure 2. The LTC1278 Undersamples the 455kHz Carrier to Recover the 5kHz Modulating Signal**

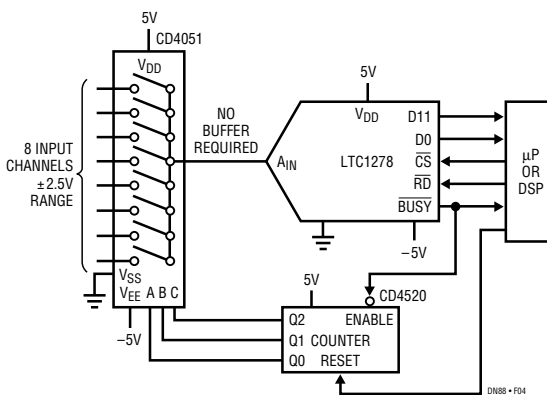


**Figure 3. Demodulating an I.F. by Undersampling**

Figure 2 also shows that by taking advantage of surface mount devices, this simple configuration occupies only 0.43IN<sup>2</sup> of circuit board real estate.

PC data acquisition cards are another broad application area. The LTC1278's high sampling rate, simple and complete configuration, small outline package, and low cost make this converter ideal for these applications. Additionally, the LTC1278's synchronized internal conversion clock minimizes conversion noise that results when the conversion clock and the sampling command are not synchronized. This internal clock and sampling synchronization overcomes what, in PC environments, can be a cumbersome task.

Both single channel and multiplexed high speed data acquisition systems benefit from the LTC1278/LTC1279's dynamic conversion performance. The 1.6µs and 1.4µs conversion and 200ns and 180ns S/H acquisition times enable the LTC1278/LTC1279 to convert at 500ksps and 600ksps, respectively. Figure 4 shows a 500ksps 8-channel data acquisition system. The LTC1278's high input impedance eliminates the need for a buffer amplifier between the multiplexer's output and the ADC's input.



**Figure 4. The High Input Impedance of the LTC1278 Allows Multiplexing Without a Buffer Amplifier**

## Conclusion

The LTC1278/LTC1279's new features simplify, improve, and reduce the cost of high speed data acquisition systems. This makes them the converters of choice for telecom, communication, PC data acquisition board, and high speed and multiplexed data acquisition system designers.

For literature on our A/D Converters, call **1-800-4-LINEAR**. For applications help, call (408) 432-1900, Ext. 525