

# DESIGN NOTES

## New 14-Bit, 800ksps ADC Upgrades 12-Bit Systems with 81.5dB SINAD, 95dB SFDR – Design Note 159

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### Higher Dynamic Range ADCs

The new 14-bit, 800ksps LTC<sup>®</sup>1419 enhances new communications, spectral analysis, instrumentation and data acquisition applications by providing an upgrade path to users of 12-bit converters. It provides outstanding 81.5dB SINAD (signal-to-noise and distortion ratio) and 95dB SFDR (spurious-free dynamic range) for frequency-domain applications, and excellent DNL with no missing codes performance for time-domain applications.

### LTC1419 Features

- Complete 14-Bit, 800ksps ADC
- $\pm 1$ LSB DNL and  $\pm 1.25$ LSB INL (Max)
- 81.5dB SINAD and 95dB SFDR
- Low Power: 150mW on  $\pm 5$ V Supplies
- Nap/Sleep Power-Down Modes
- Small Footprint: 28-Pin SO or SSOP

### The LTC1419's Big Brother

The new LTC1419 is a 14-bit derivative of the 12-bit LTC1410. It has a similar pinout and function, as shown in the block diagram in Figure 1. The wideband differential sample-and-hold (S/H) has a 20MHz bandwidth and can sample either differential or single-ended signals. Unlike

some converters, which must be driven differentially to perform well, this ADC operates equally well with single-ended or differential signals.

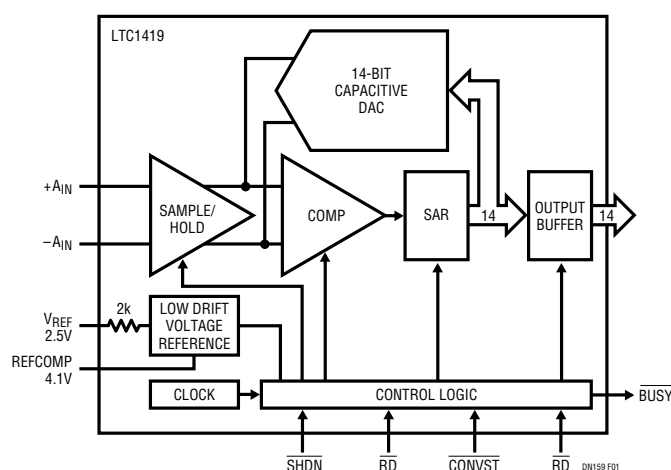
The switched capacitor SAR architecture yields excellent DC specifications and stability. It is clean, simple to use and delivers an 800ksps conversion rate on just 150mW with  $\pm 5$ V supplies.

The ADC's flexible parallel I/O connects easily to a DSP, microprocessor, ASIC or dedicated logic. Conversions can be started under command of a DSP or microprocessor or from an external sample clock signal. An output disable allows the outputs to be three-stated.

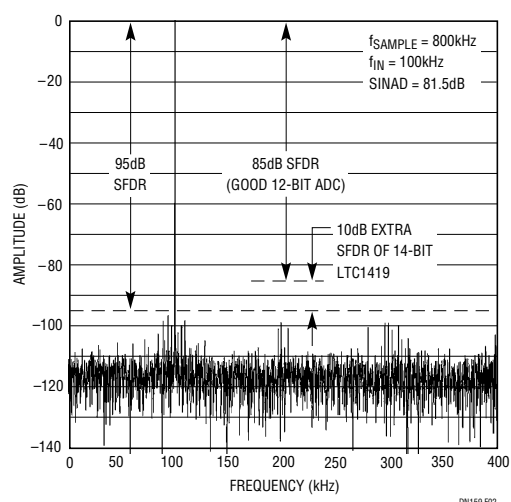
### 10dB Extra Dynamic Range for Signal Applications

Even though the LTC1410 is the cleanest 12-bit ADC on the market (its 72dB SINAD and 85dB SFDR approach the theoretical limit for 12 bits) improvements are possible with the LTC1419 (see Figure 2). The 14-bit device achieves 81.5dB SINAD and 95dB SFDR. This gives the converter roughly

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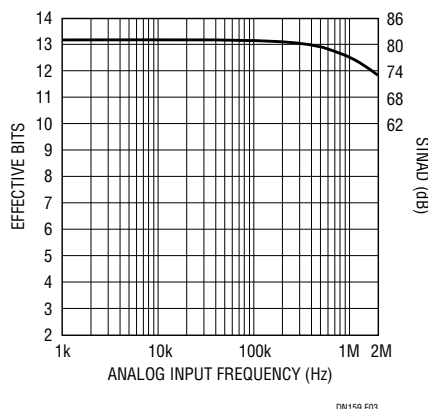


**Figure 1. The LTC1419 Complete 800ksps, 14-Bit ADC Has a Fast S/H that Cleanly Samples Wideband Input Signals**



**Figure 2. The LTC1419 Gives a 10dB Improvement in Spectral Purity over the Best 12-Bit Devices. This FFT Shows the LTC1419's Outstanding 81.5dB SINAD and 95dB SFDR**

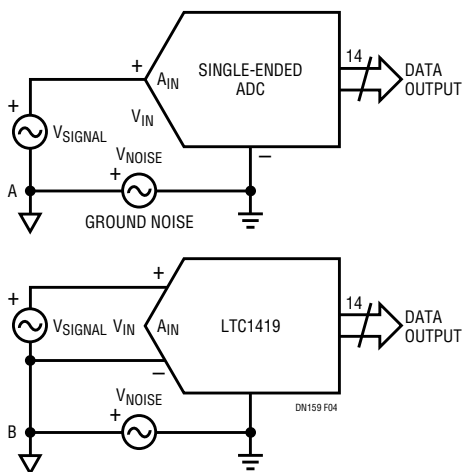
10dB more resolving power to pick out small signals in communication and spectrum analysis applications. This clean sampling capability is maintained even for wideband inputs. Figure 3 shows high effective bits and SINAD for inputs beyond Nyquist.



**Figure 3. The LTC1419's Essentially Flat SINAD and ENOBs Ensure Spectral Purity at Frequencies to Nyquist and Achieve 12-Bit Performance when Sampling 2MHz Inputs**

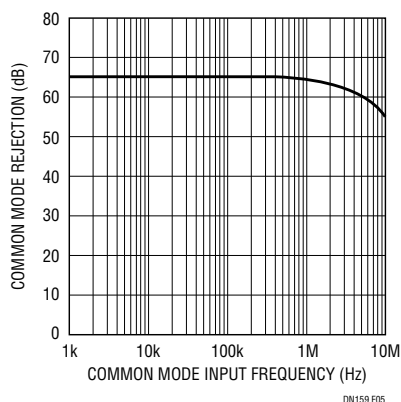
### Noise Rejecting Differential Inputs

As the converter's resolution increases and its noise floor drops, other system noises may show up unless they are eliminated. The LTC1419's differential input provides a way to keep noise out. Noise can be introduced in a number of ways including ground bounce, digital noise and magnetic and capacitive coupling (see Figure 4a). All of these sources can be reduced dramatically by sampling differentially from the signal source, as in Figure 4b. The high CMRR of the dif-



**Figure 4. A) In High Resolution ADC Systems, Noise Sources Such as Ground Noise and Magnetic Coupling can Contaminate the ADC's Input Signal. B) The LTC1419's Differential Inputs can be Used to Reject This Noise, Even at High Frequencies**

ferential input (Figure 5) allows the LTC1419 to reject resulting common mode noise by over 60dB and maintain a clean signal.



**Figure 5. The Common Mode Rejection of the Analog Inputs Rejects Common Mode Input Noise Frequencies to Beyond 10MHz**

### Other Nice Features

- Both analog inputs have infinite DC input resistance, which makes them easy to multiplex or AC couple.
- The separate convert-start input pin allows precise control over the sampling instant. The S/H aperture delay is less than 2ns and the aperture jitter is below 5ps RMS.
- Conversion results are available immediately after a conversion and there is no latency in the data (no pipeline delay). This is ideal for both single shot and repetitive measurements.
- The low 150mW power dissipation can be reduced further using the ADC's Nap and Sleep power-down modes. Wake up from Nap mode is instantaneous. Sleep mode wake-up time is several milliseconds.
- The LTC1419 is the industry's smallest high speed 14-bit converter and is packaged in a 28-pin wide SSOP.

### Time to Upgrade?

The new, low cost LTC1419 is the ideal converter to upgrade 12-bit, high performance designs to 14 bits. Its exceptional dynamic performance gives a 10dB improvement in dynamic range compared to the best 12-bit devices. Low power and flexibility make it useful in a variety of time- and frequency-domain applications. Low cost and ultrasmall size make it the ideal candidate for designers who need the next step in ADC performance.

For literature on our A/D Converters, call **1-800-4-LINEAR**. For applications help, call (408) 432-1900, Ext. 2453

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