

## Driver for 14-Bit, 4.5MSPS ADC Operates Over a Wide Gain Range

Design Note 526

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### Introduction

The [LTC®2314-14](#) is a 14-bit, 4.5MSPS, serial output ADC with an integrated high performance reference. The single-ended input of the LTC2314-14 is easy to drive and in many instances does not require a buffer. A driver, such as the [LT6236](#) op amp, may be required for a signal that is small or has high output impedance. The LT6236 is a 215MHz gain bandwidth product, rail-to-rail output op amp/SAR ADC driver that features 1.1nV/√Hz input-referred noise voltage density and draws only 3.5mA of supply current with a typical offset of only 100μV. The LT6236 is a good choice for these applications because of its high bandwidth, low noise, low supply current and low offset.

The driver presented here is characterized over a range of gains, sampling frequencies and input frequencies to establish its application suitability.

### Driver Operation

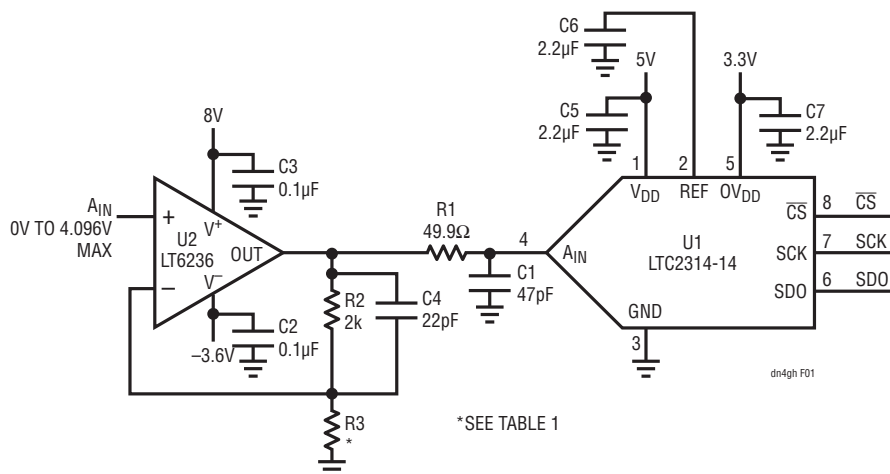
Figure 1 shows a non-inverting amplifier driving the LTC2314-14. The driver has a gain between one and

ten depending on the value of R3, as shown in Table 1. Capacitor C1 and resistor R1 limit the input bandwidth to 68MHz. C1 also acts as a charge reservoir for the ADC sample-and-hold capacitor and helps to isolate the LT6236 from the transient that occurs at A<sub>IN</sub> when the ADC goes into sample mode. R1 is also used to help isolate the op amp from the ADC sampling transient.

**Table 1. Gain and Input Range Settings for Various Values of R3**

R3 (Ω)	GAIN	A <sub>IN</sub> RANGE (V)
∞	1	0 to 4.096
2k	2	0 to 2.048
499	5	0 to 0.8192
221	10	0 to 0.4096

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**Figure 1. Single-Ended ADC Driver with Up to 0V to 4.096V Input Range**

## Driver Performance

The FFT in Figure 2 shows that with a gain of one this circuit has an SNR of 77dB and a THD of  $-84$ dB, with a sampling rate of 4.5MSPS and a 600kHz input frequency. These numbers are close to the typical data sheet performance specifications for the LTC2314-14 alone, indicating that there is minimal performance degradation of the ADC when using this driver. Figure 3 shows SINAD performance vs sampling rate for gains of one through ten. The SINAD remains about the same for all gains at approximately 75dB to 76dB, with sampling rates from 1MSPS to 4.5MSPS, which is the maximum rated sampling frequency for this part.

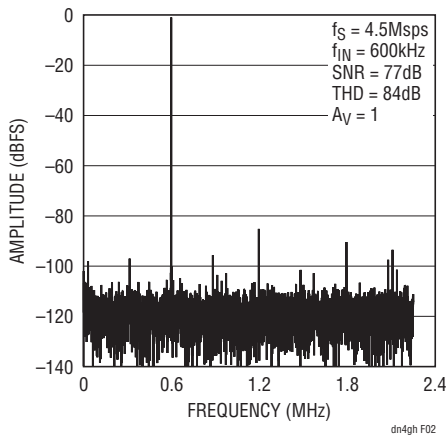


Figure 2. 16k-Point FFT for the Circuit of Figure 1

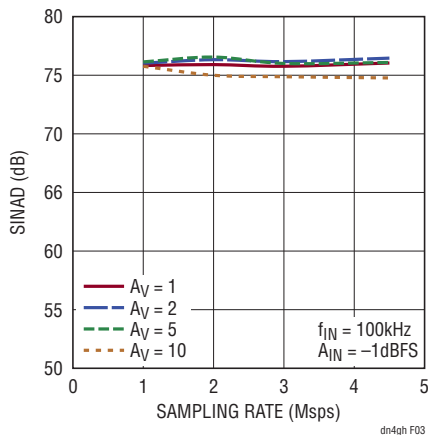


Figure 3. SINAD vs Sampling Rate

Figure 4 shows SINAD performance vs input frequency for gains of one through ten. The SINAD starts at 75dB to 76dB for an input frequency of 100kHz but falls as the input frequency and gain rises. For most applications a drop in SINAD of 3dB should be acceptable. At a gain of one, SINAD is reduced to 73dB beyond 2.2MHz. At a gain of two, SINAD is reduced to 73dB at approximately 1.2MHz. At a gain of five, SINAD is reduced to 73dB at approximately 600kHz. At a gain of ten, SINAD is reduced to 73dB at approximately 250kHz.

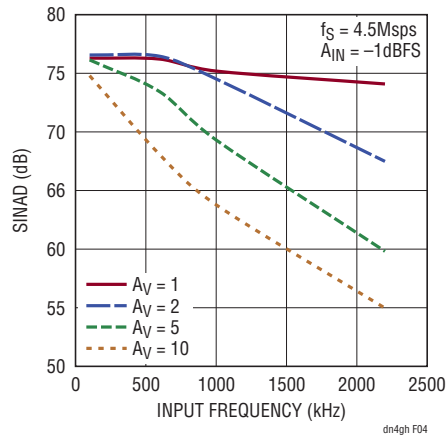


Figure 4. SINAD vs Input Frequency

## Conclusion

The LTC2314-14, 4.5MSPS, 14-bit serial sampling ADC can be driven by the LT6236 rail-to-rail output, 215MHz low noise op amp/SAR ADC driver with gains ranging from one through ten, sample rates from 1MSPS to 4.5MSPS and input frequencies ranging from 100kHz to 2.2MHz. This driver circuit is appropriate for small or high output impedance signals. The results shown in Figures 3 and 4 can be used to assess the suitability of this driver for an application with a particular input signal bandwidth and gain.

Data Sheet Download

[www.linear.com/LTC2314-14](http://www.linear.com/LTC2314-14)

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