

Generating a $\pm 10.24\text{V}$ True Bipolar Input for an 18-Bit, 1Mps SAR ADC

Design Note 522

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Introduction

The **LTC[®]2338** is an 18-bit fully differential SAR ADC that is remarkably easy to drive. This 1Mps ADC operates from a single 5V supply and achieves $\pm 4\text{LSB}$ INL maximum with -111dB THD and 100dB SNR. Its fully differential $\pm 20.48\text{V}$ true bipolar input range minimizes the need for range scaling, and its $2\text{k}\Omega$ resistive input greatly reduces the charge kickback from the internal sampling capacitor.

ADCs claiming similar performance require scaling to exceed what is typically a 0V to V_{REF} input range, resulting in low impedance inputs or an additional buffer stage requirement. To band limit noise and minimize disturbances reflected into the buffer from sampling transients, other ADCs require filter circuitry composed of expensive film or COG capacitors at the driver output. In contrast, the simple driver circuit presented here requires only a dual precision op amp and two resistors to drive the LTC2338-18. Layout strategies for this circuit are also shown.

Simple Driver Circuit

The circuit of Figure 1 uses only the **LT[®]1469** dual precision op amp and two metal film resistors to form a single-ended to differential driver for the LTC2338-18. This circuit takes a single-ended $\pm 10.24\text{V}$ input voltage and converts it to the $\pm 20.48\text{V}$ fully differential signal, which is required for proper operation of the LTC2338-18.

Typical offset for the driver portion of this circuit is less than the equivalent of 1LSB ($156\mu\text{V}$) for the LTC2338-18. Typical AC performance for this circuit includes THD of -110dB and SNR of 100dB . This performance can be seen in the FFT of Figure 2. The THD and SNR performance are similar to the typical performance numbers found in the LTC2338-18 data sheet—this simple driver produces negligible performance degradation.

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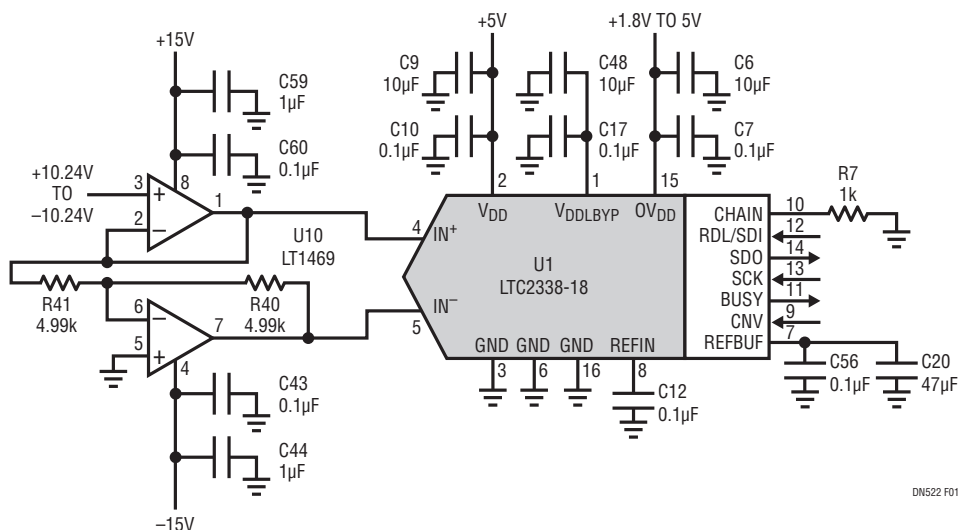


Figure 1. Single-Ended to Differential Driver for LTC2338 18-Bit SAR ADC with a $\pm 10.24\text{V}$ Input Range

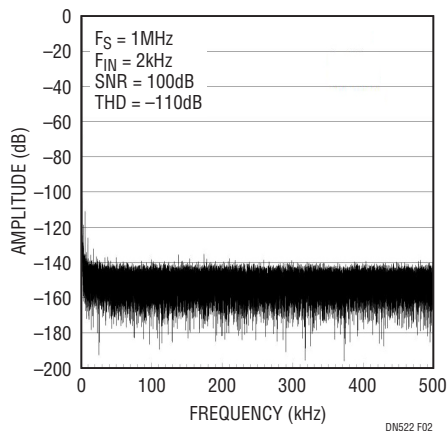


Figure 2. 131072-Point FFT Using the Circuit of Figure 1

Layout Is Important

PC board layout can have a significant effect on the performance of a high speed 18-bit ADC. When considering layout, keep the following in mind:

- A ground plane should always be used—a solid ground plane just below the component layer is recommended.
- Keep traces as short as possible.
- Keep bypass capacitors as close to the supply pins as possible, and each bypass capacitor should have its own low impedance return to ground.

- The analog input traces should be screened by ground.
- The layout involving the ADC analog inputs should be as symmetrical as possible, so that parasitic elements cancel each other out.
- The reference bypass capacitors should be as close to the REFBUF and REFIN pins as possible.

Figure 3 shows a close up of the layout connecting the LT1469 and the LTC2338-18 on a demonstration board. Device, pin and component numbers shown in the photograph of Figure 3 correspond to the numbers shown in the schematic of Figure 1. See the DC1908 demo board manual and PCB files available at www.linear.com/demo/ for the complete DC1908 schematic and layout.

Conclusion

The LTC2338-18, with its large true bipolar input voltage range and resistive input, greatly simplifies the task of driving an 18-bit fully differential SAR ADC. Using the simple driver circuit presented here, consisting of only a dual precision op amp and two resistors, it is possible to maintain the good AC and DC specifications of this ADC. PCB layout is an important consideration in achieving this level of performance. Proper use of a ground plane, keeping bypass capacitors near pins being bypassed and symmetrical layout around the analog inputs help ensure a high level of performance.

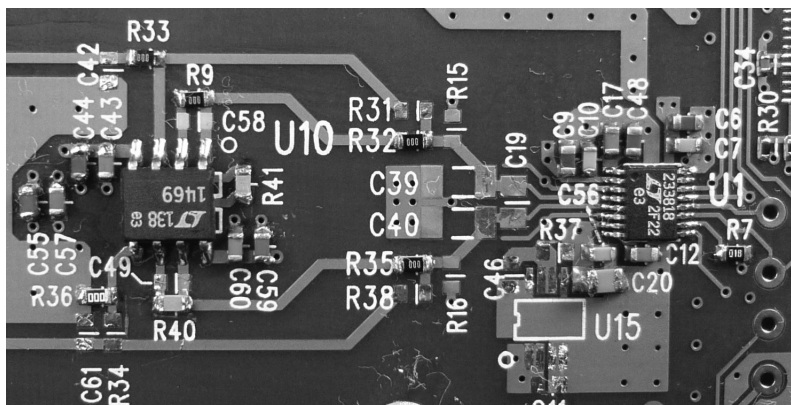


Figure 3. Close Up of Demonstration Circuit DC1908 Shows Important Layout Considerations to Achieve High Level Performance

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