

8-channel data-acquisition system uses single ADC driver

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The principal factors that affect data acquisition systems are: speed, accuracy, power dissipation, package size, and component cost, with varying factors becoming critical depending upon the application. This article shows how a single op amp can be used to drive the ADC in an 8-channel data-acquisition system, reducing the cost and size of the overall system.

The [AD7329](#) eight-channel, 12-bit plus sign, 1-MSPS ADC has true bipolar inputs with four independently programmable software-selectable input ranges: $\pm 4 \times V_{REF}$, $\pm 2 \times V_{REF}$, $\pm V_{REF}$, and 0-to- $4 \times V_{REF}$. Boasting a flexible design, it can be configured to suit a wide variety of application requirements. As shown in Figure 1, the AD7329 comprises an 8-channel multiplexer followed by a track-and-hold and successive-approximation ADC, a channel sequencer, a 2.5-V reference, and an SPI-compatible interface.

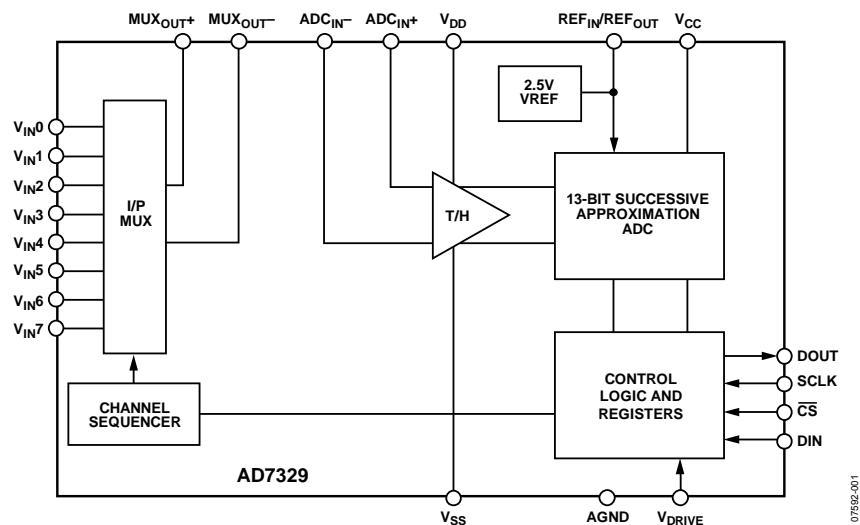


Figure 1. AD7329 Functional Block Diagram

The analog input channels are routed through the multiplexer to the MUX_{OUT+} and MUX_{OUT-} pins. The ADC_{IN+} and ADC_{IN-} pins connect to the track-and-hold input switch (R1) and sampling capacitor (C2), as shown in Figure 2. Note that the input source must provide the current required to drive the ADC input, settling to the required accuracy within the ADC's 300-ns acquisition time. When the track-and-hold switch goes from hold to track, the transient kick back from the ADC can affect the input source. Applications operating at the maximum sampling rate may require an input buffer amplifier to drive the ADC, isolating the source from the track-and-hold switch.

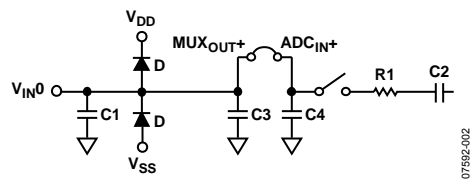


Figure 2. AD7329 Analog Input Structure—Single-Ended Mode

The flexible design on the AD7329 allows an op amp to be placed between the MUX_{OUT+} and ADC_{IN+} pins. In Figure 3, the [AD797](#) ultralow-noise, ultralow-distortion op-amp, isolates the input source from the AD7329's input structure, increasing the input impedance and reducing the current required to drive the ADC. This configuration also allows a single op-amp to drive eight analog input channels at the maximum sampling frequency, leading to reduced component count, board area, and system cost.

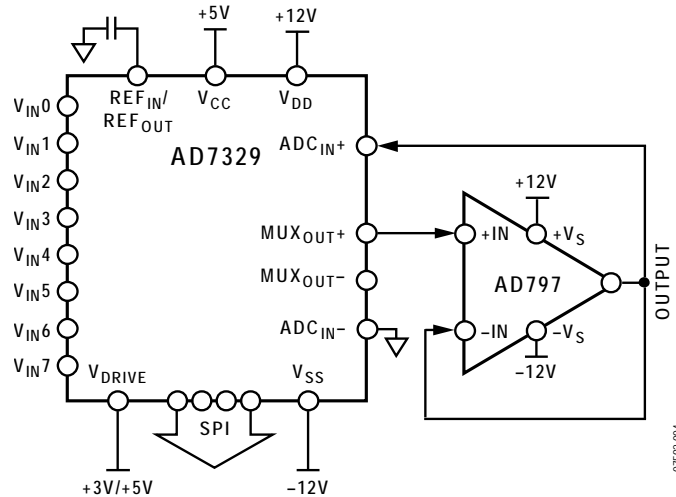


Figure 3. Buffer Between MUX_{OUT} and ADC_{IN} Increases Input Impedance

Configuring the op-amp for gain, as shown in Figure 4, allows the AD7329 to accommodate signals in the millivolt range while maintaining high performance. Small signals are amplified by the AD797 with the amplified signal applied to ADC_{IN+} . To maximize performance, the gain is chosen such that the full-scale input signal uses the full dynamic range of the ADC.

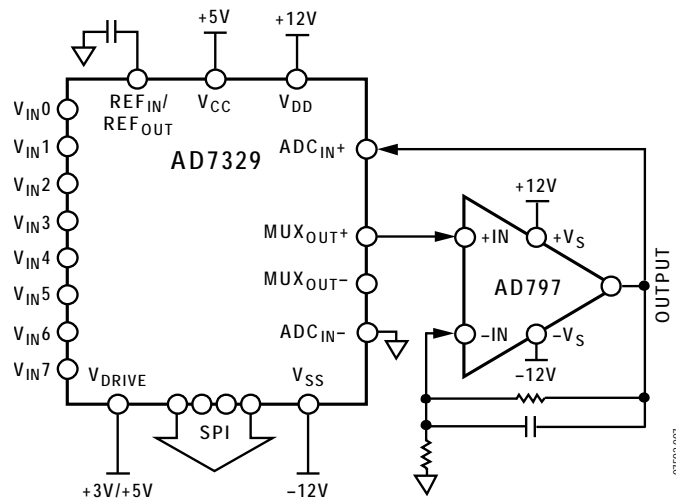


Figure 4. Gain Stage Between MUX_{OUT} and ADC_{IN} Facilitates Millivolt Inputs

Table 1 shows the performance vs. gain achieved on the ± 10 -V range with a 10-kHz input and a 1-MSPS sampling rate. Note that the converter can still achieve greater than 11 effective bits (ENOB) at a gain of 1000, thus achieving a dynamic range equivalent to that of a 21-bit ADC. In addition, all of the advantages offered by the configuration presented in Figure 3 also apply to this application.

Gain (V/V)	SNR (dB)	THD (dB)	ENOB (dB)
1	73.57	-80.80	11.93
20	73.00	-79.91	11.83
50	72.34	-79.90	11.72
100	72.28	-79.81	11.71
200	71.66	-78.99	11.61
500	71.48	-78.46	11.58
1000	69.94	-75.38	11.32

Table 1. AC Performance vs. Gain

Some applications require the gain to be changed to accommodate input channels with different signal amplitudes. In these cases, a programmable-gain instrumentation amplifier (PGIA), such as the [AD8250](#), [AD8251](#), or [AD8253](#), can be used in place of the op-amp.

Reference: AN-0972, [How the AD7329 Helps Reduce Costs](#)