AN-1503
APPLICATION NOTE

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Using the AD8599 Op Amp as an Ultralow Distortion Driver for the AD7995 4-Channel, 10-Bit ADC

CIRCUIT FUNCTION AND BENEFITS

The circuit described in this application note provides an ultralow distortion driver circuit for the AD7995 10-bit, 4-channel analog-to-digital converter (ADC), which is designed to achieve optimum ac and dc performance. The circuit uses the ultralow distortion, ultralow noise AD8599 dual-supply op amp and ultrahigh precision AD780 band gap voltage reference to ensure that the maximum AD7995 performance is achieved, by providing a low impedance driver with adequate settling time and a highly accurate reference voltage. The AD8599 is a dual operational amplifier that operates with supplies from ±4.5 V to ±18 V. The AD7995 has an I²C-compatible serial interface and is offered in an 8-lead SOT-23 package.

CIRCUIT DESCRIPTION

It is always recommended to buffer analog input signals before applying them to ADCs with switched capacitor inputs such as the AD7995. This buffering is particularly important in applications where the signal source has high source impedance and where low distortion and high signal-to-noise ratio is important. The circuit shown in Figure 1 shows how the AD8599, an ideal choice for high accuracy designs, can be used to buffer the analog input channels.

The AD7995 can be operated as a 4-channel input device using V_{DD} as a reference (the input voltage range is 0 V to V_{DD}) or as a 3-channel input device with the fourth channel used as an external reference input, V_{REF} (the input range is 0 V to V_{REF}). These options are programmable via the I²C-compatible interface.

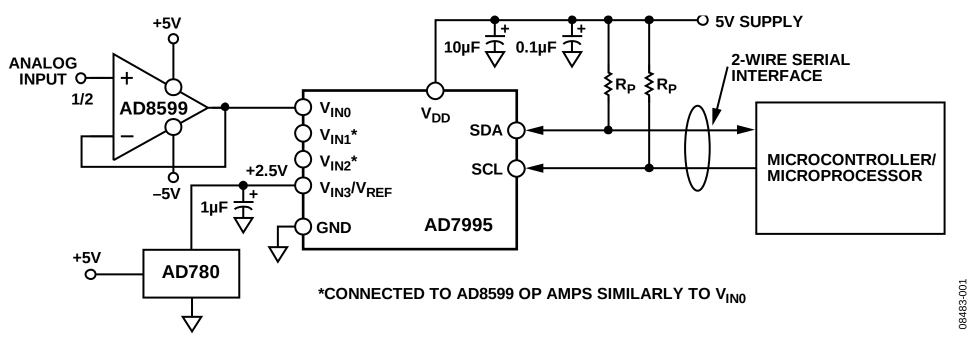

Figure 1. AD7995 ADC with the AD8599 Low Distortion Driver and AD780 Ultrahigh Precision Reference (Simplified Schematic: Decoupling and All Connections Not Shown)

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REVISION HISTORY

11/2017—Rev. A to Rev. B
Document Title Changed from CN0044 to AN-1503 .... Universal
Changes to Circuit Description Section 3
Changes to References Section 3

9/2009—Rev. 0 to Rev. A
Updated Format .... Universal

10/2008—Revision 0: Initial Version

The AD780 is a 2.5 V/3.0 V ultrahigh precision, band gap voltage reference and is recommended for use with AD7995. A 1 µF decoupling capacitor is recommended on the V_{IN3}/V_{REF} signal for best performance.

Take care to ensure that the analog input signal to the ADC does not exceed the supply rails by more than 300 mV. If the signal does exceed this level, the internal electrostatic discharge (ESD) protection diodes become forward-biased and start conducting current into the substrate. Each diode can conduct a maximum current of 10 mA without causing irreversible damage to the device. The MT-036 Tutorial discusses methods to protect the input circuits of op amps and ADCs against such damage.

In addition, the circuit must be constructed on a multilayer printed circuit board (PCB) with a large area ground plane. Proper layout, grounding, and decoupling techniques must be used to achieve optimum performance (see the MT-031 Tutorial, the MT-101 Tutorial, and the EVAL-AD7995EBZ evaluation board layout).

COMMON VARIATIONS

If single-supply op amp operation is required for buffering the input signal, the AD8605 is a suitable choice. Note that the output of the AD8605 operating on a single 5 V supply can only go to approximately 20 mV above ground; therefore, the AD7995 input range from 0 V to 20 mV cannot be exercised (see the MT-035 Tutorial).

The AD7995 can accept a reference input voltage from 1.2 V to V_{DD}; therefore, different voltage reference sources can be used.

REFERENCES

MT-031 Tutorial, *Grounding Data Converters and Solving the Mystery of "AGND" and "DGND."* Analog Devices, Inc.

MT-035 Tutorial, *Op Amp Inputs, Outputs, Single-Supply, and Rail-to-Rail Issues*. Analog Devices.

MT-036 Tutorial, *Op Amp Output Phase-Reversal and Input Over-Voltage Protection*. Analog Devices.

MT-101 Tutorial, *Decoupling Techniques*. Analog Devices.

I[2]C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

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