

AD5390/AD5391/AD5392 Channel Monitor Function

CIRCUIT FUNCTION AND BENEFITS

In a multichannel digital-to-analog converter (DAC) system, the ability to monitor all outputs at a single point is a significant advantage for troubleshooting and diagnostic analysis. The circuit shown in Figure 1 provides multichannel DAC output monitoring using a single-channel successive approximation register (SAR) analog-to-digital converter (ADC).

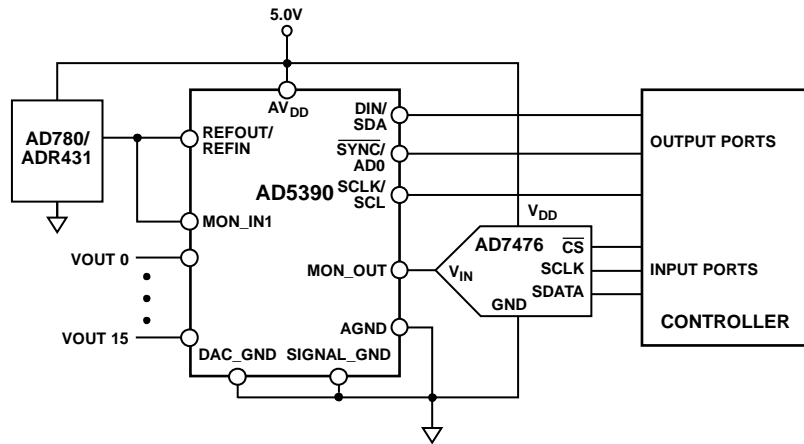


Figure 1. Efficient Channel Monitoring Circuit (Simplified Schematic)

08252-001

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REVISION HISTORY

1/2018—Rev. A to Rev. B

Changed Document Title from CN0030 to AN-1492.....	Universal
Changes to Figure 1	1
Changes to Circuit Description Section	3

6/2009—Rev. 0 to Rev. A

Updated Format.....	Universal
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11/2008—Revision 0: Initial Version

CIRCUIT DESCRIPTION

This circuit utilizes the internal multiplexer on the [AD5390/AD5391/AD5392](#) to route any of the DAC output channels to a single output pin (MON_OUT) for monitoring by the external ADC ([AD7476](#)). This approach utilizes much less circuitry than is required if each channel is monitored individually.

The [AD5390/AD5391](#) are complete, single-supply, 16-channel, 14-bit and 12-bit DACs, respectively. The [AD5392](#) is a complete, single-supply, 8-channel, 14-bit DAC. The devices are available both in 64-lead LFCSP and 52-lead LQFP packages. All channels have an on-chip output amplifier with rail-to-rail operation. The [AD5390/AD5391/AD5392](#) contain a channel monitor function that consists of a multiplexer addressed via the serial peripheral interface (SPI), allowing any channel output to be routed to the monitor output (MON_OUT) pin for monitoring using an external ADC. The channel monitor function must be enabled in the control register before any channels are routed to the MON_OUT pin. The [AD5390/AD5391/AD5392](#) also include two uncommitted inputs (MON_IN1 and MON_IN2) to the internal multiplexer that allow the user to monitor inputs from external sources such as references or power supplies. In Figure 1, the MON_IN1 pin on the [AD5390](#) monitors the reference voltage from the [AD780](#) and [ADR431](#).

The [AD7476](#) ADC is an SAR ADC that offers 12-bit resolution, single 2.35 V to 5.25 V power supply, integrated reference, low power operation, small form factor, and serial interface, with throughput rates up to 1 MSPS in a 6-lead SOT-23 package. The reference for the device is taken internally from V_{DD} , allowing the widest dynamic input range to the ADC. Therefore, the analog input range for the [AD7476](#) is 0 V to V_{DD} . The conversion rate is determined by the SCLK, allowing throughput rates up to 1 MSPS.

The combination of the [AD5390/AD5391/AD5392](#) and the [AD7476](#) provides a complete 8-channel or 16-channel analog output control solution with an efficient monitor function for system debug, as well as fault and diagnostic analysis.

The [AD5390/AD5391/AD5392](#) and the [AD7476](#) must have ample supply bypassing capacitors of 10 μF in parallel with 0.1 μF capacitors on each supply pin, located as close to the packages as possible, ideally right up against the devices (not shown in Figure 1). The 10 μF capacitors are the tantalum bead type. The 0.1 μF capacitors must have low effective series resistance (ESR)

and low effective series inductance (ESL). Common ceramic type capacitors provide a low impedance path to ground at high frequencies to handle transient currents due to internal logic switching.

The power supply traces must be as wide as possible to provide low impedance paths and reduce the effects of glitches on the power supply line. Fast switching signals, such as clocks, must be shielded with ground runs to avoid radiating noise to other parts of the board and must never be run near the analog signals. A ground line routed between the SDATA and SCLK lines helps reduce crosstalk between them (not required on a multilayer board, which has a separate ground plane; however, it is helpful to separate the lines). Avoid crossover of digital and analog signals. Run traces on opposite sides of the board at right angles to each other to reduce the effects of feedthrough on the board. A microstrip technique is recommended but not always possible with a double-sided board. In this technique, the component side of the board is dedicated to the ground plane, and signal traces are placed on the solder side. Best layout and performance is achieved with at least a 4-layer multilayer board, where there is a ground plane layer, a power supply layer, and two signal layers.

COMMON VARIATIONS

Pin-compatible versions of the [AD7476](#) are available for use in applications where lower resolution conversion is acceptable in the monitoring function. The [AD7477](#) provides 10-bit resolution, and the [AD7478](#) provides 8-bit resolution. The [ADR431](#) reference can be substituted for the [AD780](#).

REFERENCES

[ADIsimPower Voltage Regulator Design Tool](#)

Kester, Walt. Chapter 3 and Chapter 7. *The Data Conversion Handbook*. Analog Devices. 2005.

MT-015 Tutorial. *Basic DAC Architectures II: Binary DACs*. Analog Devices.

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

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

[Voltage Reference Wizard Design Tool](#)