

## Software Configurable 12-Bit Quad Channel Unipolar/Bipolar Voltage Output Using the **AD5724R** DAC

### CIRCUIT FUNCTION AND BENEFITS

This circuit provides unipolar and bipolar data conversion using the **AD5724R**, a quad, 12-bit, serial input, unipolar/ bipolar voltage output DAC. The only external components needed for this 12-bit DAC are decoupling capacitors on the supply pins and reference input, leading to savings in cost and board space. This circuit is well suited for closed-loop servo control applications.

### CIRCUIT DESCRIPTION

The **AD5724R** is a digital-to-analog converter (DAC) that offers guaranteed 12-bit monotonicity, integral nonlinearity (INL) of  $\pm 0.5$  LSB, 0.1% total unadjusted error (TUE), and 10  $\mu$ s settling time. The **AD5724R** also integrates a 2.5 V, 5 ppm/ $^{\circ}$ C voltage reference, reference buffers, and output amplifiers, which provide further savings in both cost and board space. Performance is guaranteed over the following supply voltage ranges:  $AV_{DD}$  supply range from +4.5 V to +16.5 V, and  $AV_{SS}$  supply range from -4.5 V to -16.5 V. The  $AV_{SS}$  supply can be connected to 0 V if only unipolar outputs are required. The output range can be individually programmed for each of the four output channels. The options are 0 V to +5 V, 0 V to +0 V, 0 V to +10.8 V, -5 V to +5 V, -10 V to +10 V, and -10.8 V to +10.8 V. The input coding is user selectable twos complement or offset binary for a bipolar output (depending on the state of the BIN/2sCOMP pin). Coding is straight binary for a unipolar output. Figure 2 shows that the typical output error of this circuit at 25 $^{\circ}$ C ambient temperature is less than 0.07 %FSR.

The circuit must be constructed on a multilayer PC board with a large area ground plane. Proper layout, grounding, and decoupling techniques must be used to achieve optimum performance (see [MT-031 Tutorial](#) and [MT-101 Tutorial](#)).

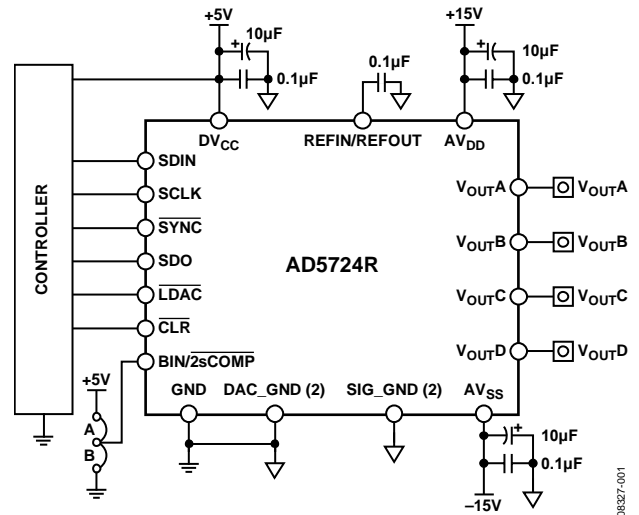


Figure 1. Unipolar/Bipolar Configuration for the **AD5724R** DAC (Simplified Schematic)

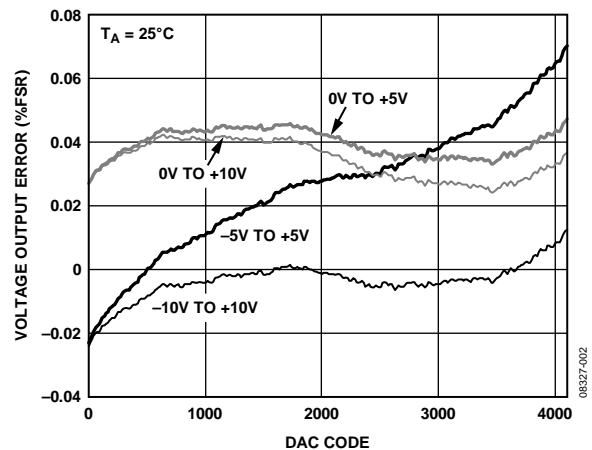


Figure 2. Voltage Output Error

**LEARN MORE**

[Kester, Walt. 2005. \*The Data Conversion Handbook\*, Chapter 3 and Chapter 7. Analog Devices.](#)

[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.](#)

**Data Sheets and Evaluation Boards**

[AD5724R Data Sheet.](#)

[AD5754R Evaluation Board \(Compatible with AD5724R\).](#)

**REVISION HISTORY**

**04/13—Rev. 0 to Rev. A**

Changed Document Title from CN-0085 to AN-1245 ..... Universal

**07/09—Revision 0: Initial Version**