

AN-1241 APPLICATION NOTE

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Simplified 16-Bit Voltage Output and 4 mA-to-20 mA Output Solution Using the AD5422

CIRCUIT FUNCTION AND BENEFITS

This circuit provides unipolar/bipolar voltage and 4 mA-to-20 mA outputs using the AD5422, a single channel, 16-bit, serial input, unipolar/bipolar voltage, 4 mA-to-20 mA current source DAC. This circuit utilizes only the AD5422 product. The only external components needed are decoupling capacitors on the supply pins and reference input and a pull-up resistor for the opendrain FAULT output, which alerts to a loss of compliance voltage on the current output or an overtemperature of the AD5422. This solution offers a level of integration that leads to savings in both cost and board space. This circuit is well suited for both programmable logic controllers (PLCs) and distributed control systems (DCSes) in industrial control applications.

CIRCUIT DESCRIPTION

The AD5422 is a low cost, precision, highly integrated, 16-bit digital-to-analog converter offering a programmable current source and a programmable voltage output designed to meet the requirements of industrial process control applications. The voltage output range can be programmed at 0 V to +5 V, 0 V to +10 V, -5 V to +5 V, or -10 V to +10 V. The current output, which is accessed from a separate pin, can be programmed with the ranges of 4 mA to 20 mA, 0 mA to 20 mA, or 0 mA to 24 mA. The AD5422 contains an internal 5 V, 10 ppm/°C maximum voltage reference. This leads to further savings in both cost and board space. Operation is specified with an AV_{DD} supply up to 24 V and an AVss supply up to -24 V. However, the AD5422 is capable of operating with an AV_{DD} supply of up to 40 V. The AD5422 contains an on-chip regulated 4.5 V output (DV_{CC} pin) capable of sourcing up to 5 mA. This can be used as a termination for pull-up resistors or to power digital circuitry, thereby eliminating the need to generate a logic power supply voltage.

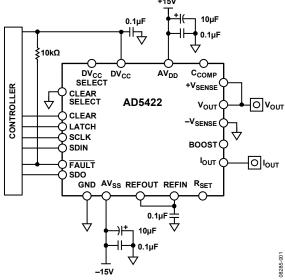


Figure 1. Basic Connections of the AD5422 (Simplified Schematic)

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Figure 2 and Figure 3 show that the typical accuracy of this circuit at 25°C ambient temperature is 0.016% for current output and 0.012% for voltage output.

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 Tutorial MT-031, *Grounding Data Converters and Solving the Mystery of "AGND" and "DGND"* and Tutorial MT-101, *Decoupling Techniques*).

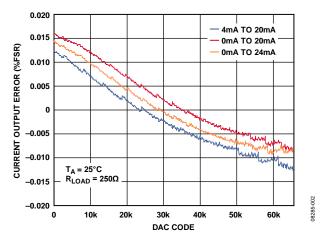


Figure 2. Current Output Accuracy

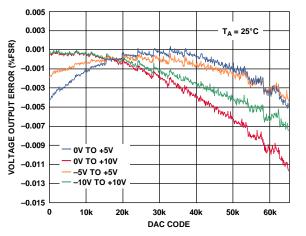


Figure 3. Voltage Output Accuracy

LEARN MORE

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

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

AD5422 Data Sheet.

AD5422 Evaluation Board.

REVISION HISTORY

4/13-Rev. 0 to Rev. A

7/09—Revision 0: Initial Version