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Simplified 12-Bit Voltage and 4 mA-to-20 mA Output Solution Using the AD5412

CIRCUIT FUNCTION AND BENEFITS

This circuit provides unipolar/bipolar voltage and 4 mA-to-20 mA outputs using the AD5412, a single channel, 12-bit, serial input, unipolar/bipolar voltage and 4 mA-to-20 mA current source DAC. This circuit utilizes only the AD5412 product. The only external components needed are decoupling capacitors on the supply pins and reference input and a pull-up resistor for the open-drain $\overline{\text{FAULT}}$ output, which alerts to a loss of compliance voltage on the current output or an overtemperature of the AD5412 device. 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 AD5412 is a low cost, precision, highly integrated 12-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 AD5412 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 AV_{SS} supply up to −24 V. However, the AD5412 is

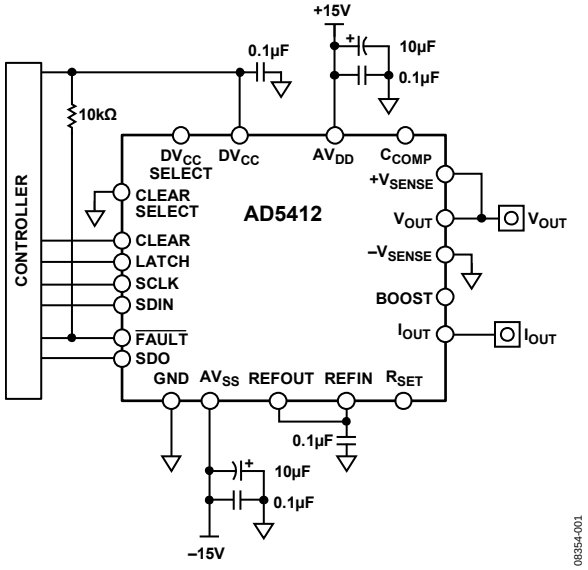

Figure 1. Configuration of the AD5412 (Simplified Schematic)

capable of operating with an AV_{DD} supply of up to 40 V. The AD5412 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, eliminating the need to generate a logic power supply.

Figure 2 and Figure 3 show that the typical accuracy of this circuit at 25°C ambient temperature is better than 0.011% for both current and voltage outputs.

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*).

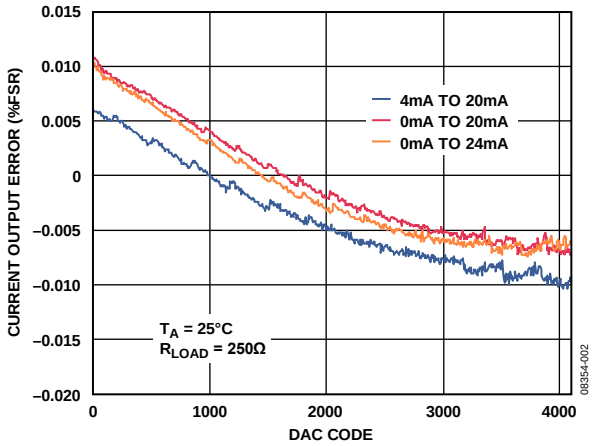

Figure 2. Current Output Accuracy

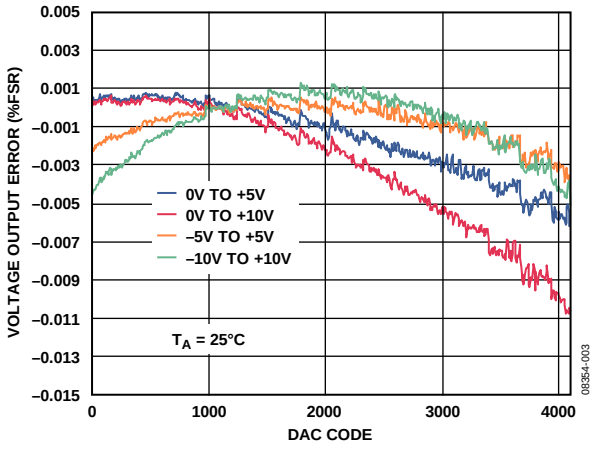

Figure 3. Voltage Output Accuracy

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 and Evaluation Boards

AD5412 Data Sheet.

AD5422 Evaluation Board (Compatible with AD5412).

REVISION HISTORY

4/13—Rev. 0 to Rev. A

Changed Document Title from CN-0097 to AN-1202 ..... Universal

7/09—Revision 0: Initial Version

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