16-Bit, Fully Isolated, Voltage Output Module Using the AD5662 DAC, ADuM1401 Digital Isolator, and External Amplifiers

CIRCUIT FUNCTION AND BENEFITS

The circuit shown in Figure 1 provides a complete solution for an industrial control output module. This design is suitable for process control programmable logic controllers (PLCs) and distributed control systems (DCSs) that require bipolar output voltage ranges. The AD5662 nanoDAC® is a 5 V, 16-bit digital-to-analog controller (DAC) in a SOT-23 package. The ADuM1401 4-channel digital isolator provides all the necessary signal isolation between the microcontroller and the DAC.

CIRCUIT DESCRIPTION

For industrial control modules, analog output voltage ranges are typically ±5 V, ±10 V, 0 V to 5 V, or 0 V to 10 V. The AD5662 provides a 0 V to 5 V output, which passes through two gain and offset stages to provide 16-bit resolution in each of the previously mentioned ranges. Jumpers (shown in Figure 1 as switches) are used to switch between output ranges. The OP2177 was chosen for this design, primarily due to its low noise and offset performance, as well as bipolar voltage capability.

The ADR02 was chosen as the reference for this circuit. The ADR02 has excellent parts per million drift specifications at 9 ppm/°C maximum. It is also often used in industrial applications due to its high input range of up to 36 V.

Figure 1. 16-Bit Isolated Industrial Control Voltage Output Module (Simplified Schematic)
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REVISION HISTORY

12/2017—Rev. A to Rev. B
Document Title Changed from CN0063 to AN-1517 .... Universal

3/2011—Rev. 0 to Rev. A
Changes to Circuit Function and Benefits .................................... 1
Changes to Circuit Description ...................................................... 2

7/2009—Revision 0: Initial Version
The ADuM1401 is a 4-channel digital isolator based on Analog Devices' Coupler® technology. It is used to provide isolation between the AD5662 and the system microcontroller, with an isolation rating of 2.5 kV rms. Three wires are used to connect the standard serial peripheral interface (SPI) connections to the AD5662: SYNC, SCLK, and DIN.

Figure 2 shows an output error plot (integral nonlinearity) of the output of the circuit when the AD5662 is used with the ADR02 external reference. Results are shown in percent full-scale range (%FSR) as a function of input code.


![Figure 2. INL Accuracy Plot, 0 V to +10 V Output Range](image)

REFERENCES


MT-014 Tutorial, Basic DAC Architectures I: String DACs and Thermometer (Fully Decoded) DACs. Analog Devices.

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

