

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.

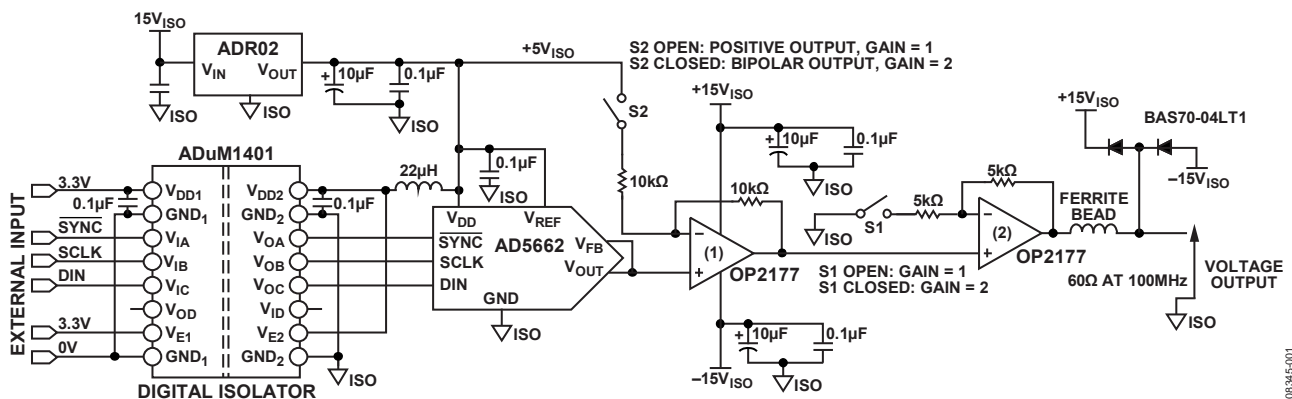


Figure 1. 16-Bit Isolated Industrial Control Voltage Output Module (Simplified Schematic)

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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 *iCoupler*® 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.

See “PLC Evaluation Board Simplifies Design of Industrial Process Control Systems,” (Slattery et. al., *Analog Dialogue*, April 2009) for more discussion of external protection technique.

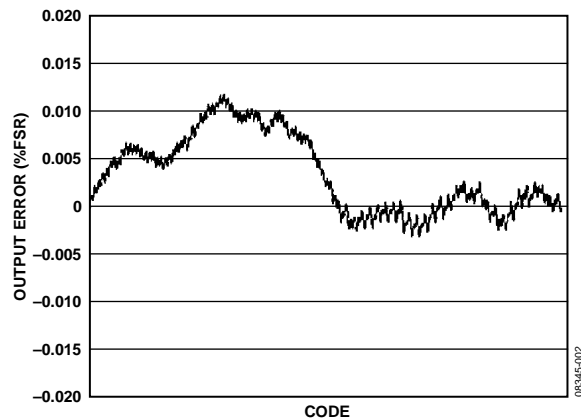


Figure 2. INL Accuracy Plot, 0 V to +10 V Output Range

REFERENCES

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- MT-016 Tutorial, *Basic DAC Architectures III: Segmented DACs*. Analog Devices.
- Slattery, Colm, Derrick Hartmann, and Li Ke. “PLC Evaluation Board Simplifies Design of Industrial Process Control Systems.” *Analog Dialogue* (April 2009).
- Wayne, Scott. “*iCoupler*® Digital Isolators Protect RS-232, RS-485, and CAN Buses in Industrial, Instrumentation, and Computer Applications.” *Analog Dialogue* (October 2005).