

## Evaluating the **AD5445** Parallel Input, Current Output DAC

### FEATURES

- Full-featured evaluation board for the **AD5445**
- Graphic user interface software for board control and data analysis
- Connector to **EVAL-SDP-CB1Z** system demonstration platform board
- Various power supply options

### APPLICATIONS

- Portable battery-powered applications
- Waveform generators
- Analog processing
- Instrumentation applications
- Programmable amplifiers and attenuators
- Digitally controlled calibration
- Programmable filters and oscillators
- Composite video
- Ultrasound
- Gain, offset, and voltage trimming

### GENERAL DESCRIPTION

The **AD5445**<sup>1</sup> is a CMOS, 12-bit, current output digital-to-analog converter (DAC). This device operates from a 2.5 V to 5.5 V power supply, making it suitable for battery-powered applications and

many other applications. For evaluation purposes, however, the voltage is limited to 3.3 V due to **EVAL-SDP-CB1Z** restrictions.

This DAC utilizes data readback, allowing the user to read the contents of the DAC register via the DB pins. Upon power-up, the internal register and latches are filled with 0s, and the DAC outputs are at zero scale.

As a result of manufacturing with a CMOS submicron process, this part offers excellent four-quadrant multiplication characteristics, with large-signal multiplying bandwidths of up to 10 MHz.

The applied external reference input voltage ( $V_{REF}$ ) determines the full-scale output current. An integrated feedback resistor ( $R_{FB}$ ) provides temperature tracking and full-scale voltage output when combined with an external current-to-voltage precision amplifier.

Although compared with the **AD7545**, the **AD5445** is an upgrade in terms of the multiplying bandwidth performance, the **AD5445** has a latched interface and cannot be used in transparent mode.

The **AD5445** DAC is available in small, 20-lead LFCSP and TSSOP packages.

The evaluation board, **EVAL-AD5445SDZ**, is available for evaluating the performance of the **AD5445** DAC.

### EVALUATION BOARD FUNCTIONAL BLOCK DIAGRAM

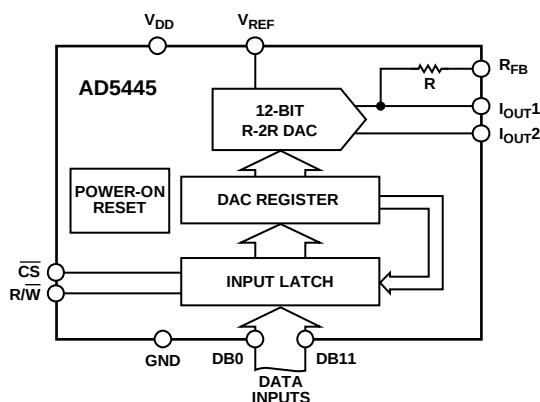


Figure 1.

<sup>1</sup> U.S. Patent No. 5,689,257.

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REVISION HISTORY

8/12—Revision 0: Initial Version

## EVALUATION BOARD

The [EVAL-AD5445SDZ](#) evaluation board consists of an [AD5445](#) DAC and a current-to-voltage amplifier, the [AD8065](#). Included on the evaluation board is a 10 V reference, the [ADR01](#). An external reference can also be applied via an SMB input. The evaluation kit includes a CD-ROM with self-installing PC-based software to control the DAC. The software allows the user to write a code to the device and to read a code from the device.

The [EVAL-AD5445SDZ](#) evaluation board is used in conjunction with the [EVAL-SDP-CB1Z](#) board, which is available from Analog Devices, Inc., and must be purchased separately from the evaluation board. The USB-to-SPI communication to the [AD5445](#) is completed using this Blackfin®-based demonstration board. The software offers a waveform generator.

### SYSTEM DEMONSTRATION PLATFORM

The system demonstration platform (SDP) is a hardware and software evaluation tool for use in conjunction with product evaluation boards. The SDP board is based on the Blackfin [ADSP-BF527](#) processor with USB connectivity to the PC through a USB 2.0 high speed port. For more information about this device, see the [SDP-B](#) Web page.

### OPERATING THE EVALUATION BOARD

The board requires  $\pm 12$  V and +5 V supplies. The +12 V  $V_{DD}$  and -12 V  $V_{SS}$  supplies are used to power the output amplifier; the +5 V supply is used to power the DAC ( $V_{DD1}$ ) and transceivers ( $V_{CC}$ ).

Both supplies are decoupled to their respective ground plane using 10  $\mu$ F tantalum and 0.1  $\mu$ F ceramic capacitors.

### MICROPROCESSOR INTERFACING

The SDP is a hardware and software platform that provides a means to communicate from the PC to Analog Devices products and systems that require digital control and/or readback. The SDP has a Blackfin processor ([ADSP-BF5xx](#)) at its core.

The [ADSP-BF5xx](#) processor incorporates an asynchronous parallel port. An asynchronous parallel interface between the Blackfin processor and the [AD5445](#) DAC is shown in Figure 2.

For more information about the system demonstration platform, see the [SDP-B](#) Web page.

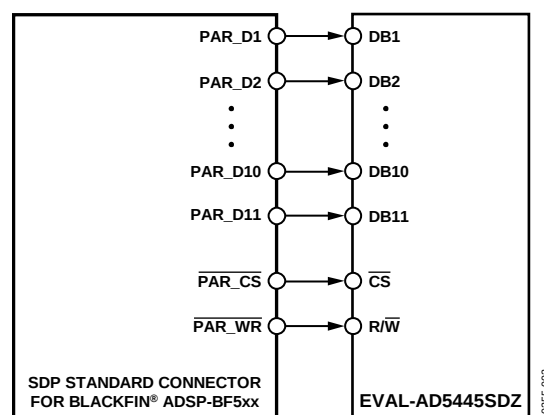


Figure 2. [ADSP-BF5xx](#)-to-[AD5445](#) Interface

## EVALUATION BOARD SOFTWARE

### INSTALLING THE SOFTWARE

The [EVAL-AD5445SDZ](#) evaluation kit includes a CD containing the software and drivers. To install the software, follow these steps:

1. Install the software before connecting the SDP board to the USB port of the PC.
2. Start the Windows® operating system, and insert the CD included in the [EVAL-AD5445SDZ](#) evaluation board kit.
3. Download the [EVAL-AD5445SDZ](#) LabVIEW® software. The correct driver, SDPDriversNET, for the SDP board should download automatically after LabVIEW is downloaded, supporting both 32- and 64-bit systems. However, if the driver does not download automatically, the driver executable file can also be found in the **Analog Devices** folder (from the **Start** menu, point to **All Programs** and then click **Analog Devices**). Follow the on-screen prompts to install the driver.
4. After installation of the software and drivers is complete, plug the [EVAL-AD5445SDZ](#) into the SDP board and plug the SDP board into the PC using the USB cable included in the evaluation board kit.
5. When the software detects the evaluation board, proceed through any dialog boxes that appear to finalize the installation (such as **Found New Hardware Wizard/Install the Software Automatically**).

### RUNNING THE SOFTWARE

To run the evaluation board program,

1. From the **Start** menu, point to **All Programs** and then click **Analog Devices** and **EVAL-AD5445SDZ**.
2. If the SDP board is not connected to the USB port when the software is launched, a connectivity error displays (see Figure 3.). If this message appears, connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the on-screen instructions.

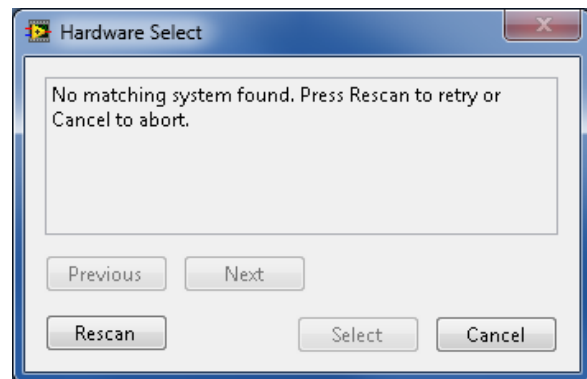


Figure 3. Connectivity Error

10255-004

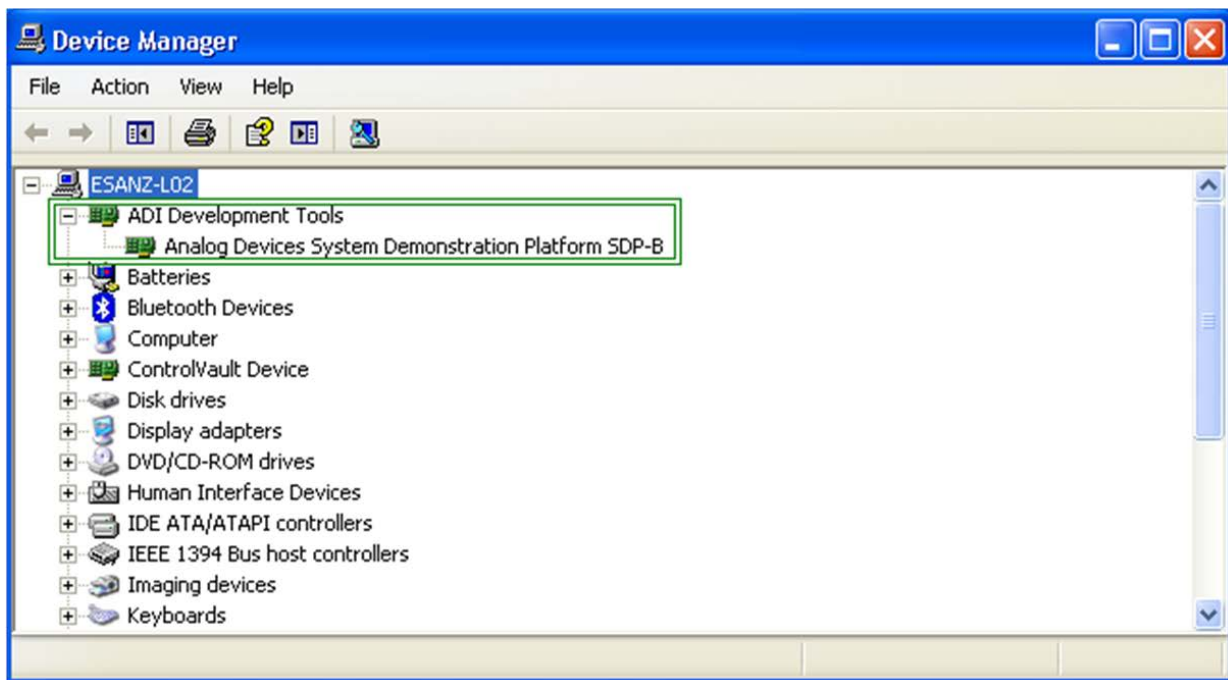


Figure 4. Device Manager Showing the SDP Board Connected

10255-003

## USING THE EVALUATION BOARD SOFTWARE

To operate the evaluation board software,

1. Ensure that the USB cable connects the PC to the system demonstration platform (SDP1Z) and the SDPIZ to the evaluation board.
2. Run the program file from the **Analog Devices** menu. The **EVAL-AD5445SDZ** window is displayed, as shown in Figure 5.



Figure 5. Evaluation Software Window

## EVALUATION BOARD FUNCTIONS AND REGISTERS

The [AD5445](#) evaluation software window allows you to write a data-word to or to read a data-word from the DAC.

### Example 1

Type 0x800 (the 12-bit midscale data value) in the **Input Data** box, and click **Write DAC**. The output should then show a voltage of  $-5\text{ V}$ , based on the following formula:

$$V_{OUT} = -V_{REF} \times \frac{D}{2^n} = -10 \times \frac{2048}{4096} = -5\text{ V}$$

### Example 2

Type 0xBFDD (the three quarter scale data value) in the **Input Data** box, and then click **Write DAC**. The output should then show a voltage of  $-7.5\text{ V}$ , based on the following formula:

$$V_{OUT} = -V_{REF} \times \frac{D}{2^n} = -10 \times \frac{3069}{4096} = -7.5\text{ V}$$

Click **Read DAC**. The **Output Data** indicator should then show the 12-bit data value of the last data written to the part. Therefore, for this example, the indicator would show a value of 0xBFDD.

## EVALUATION BOARD SCHEMATICS AND ARTWORK

## SCHEMATICS

900-95201

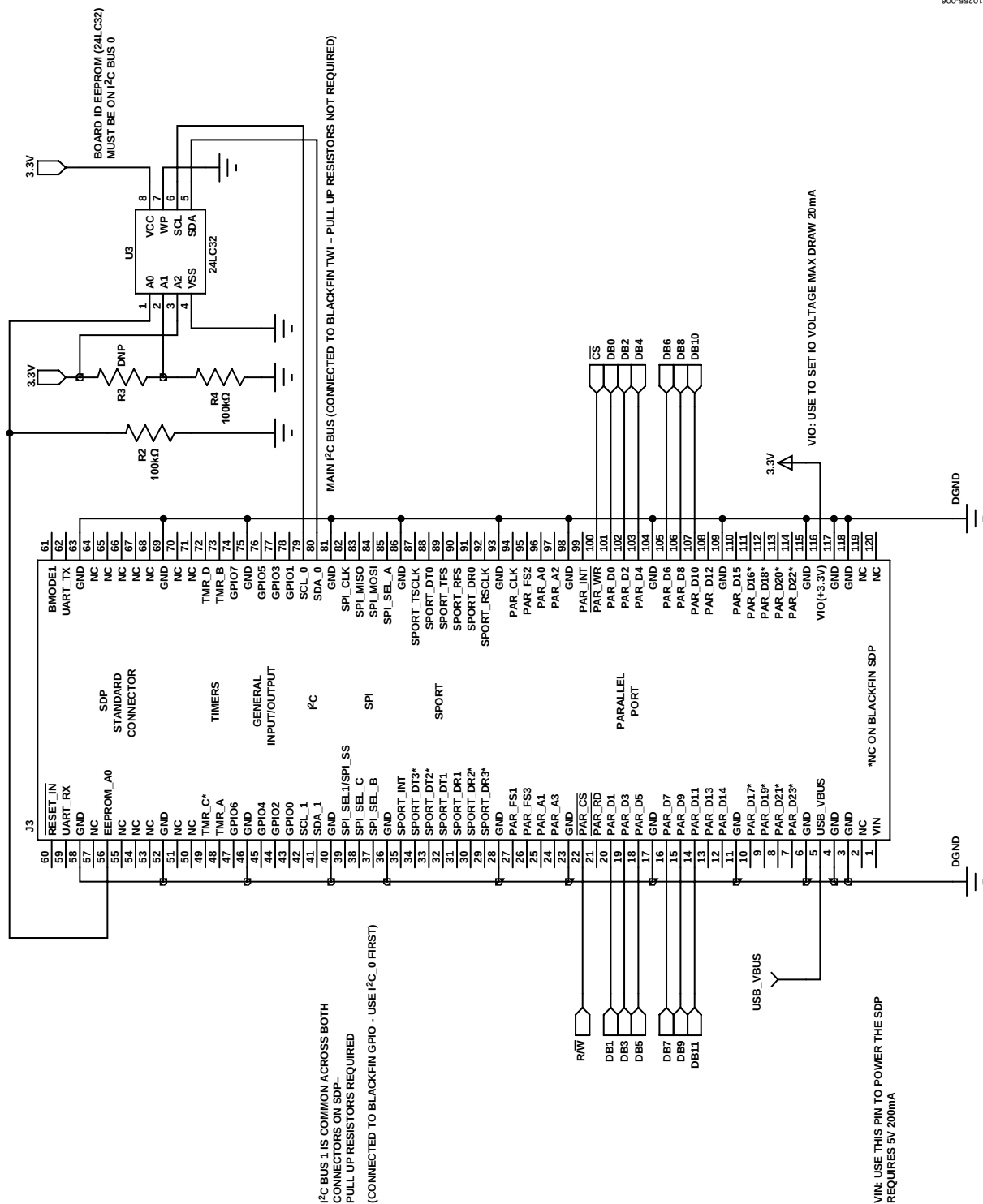


Figure 6. Evaluation Board Schematic, SDP Board (EVAL-SDP-CB1Z)

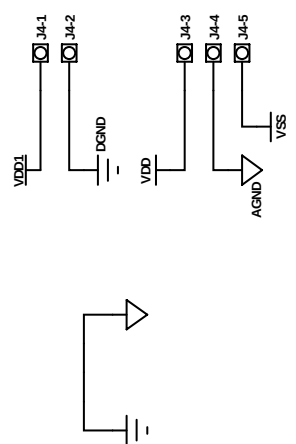


Figure 7. Evaluation Board Schematic, AD5445

## EVALUATION BOARD LAYOUT

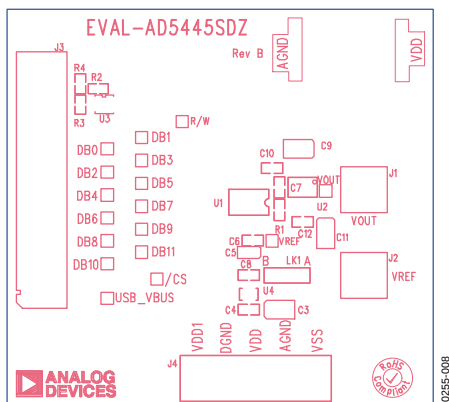


Figure 8. Silkscreen

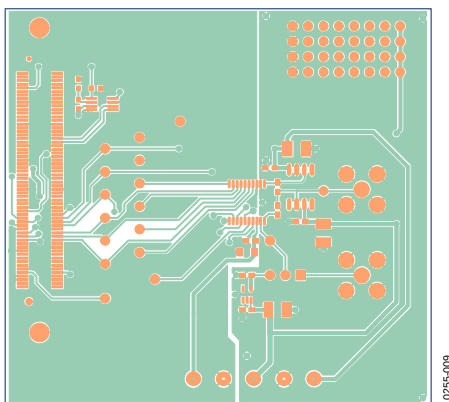


Figure 9. Component Side

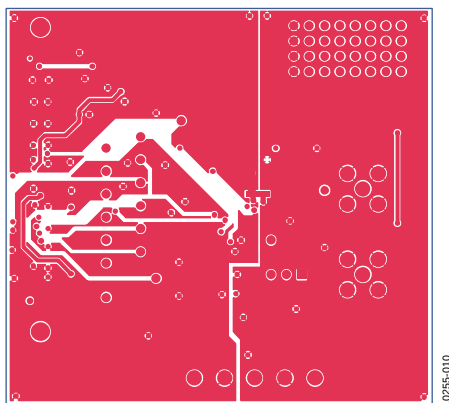


Figure 10. Solder Side

**RELATED LINKS**

| Resource                      | Description                                                                  |
|-------------------------------|------------------------------------------------------------------------------|
| <a href="#">AD5445</a>        | Product Page—12-Bit, High Bandwidth Multiplying DAC with Parallel Interface  |
| <a href="#">EVAL-SDP-CB1Z</a> | Product Page—SDP-B: System Demonstration Platform-Blackfin                   |
| <a href="#">AD7545</a>        | Product Page—CMOS 12-Bit Buffered Multiplying DAC with On-Board Data Latches |
| <a href="#">AD8065</a>        | Product Page—High Performance, 145 MHz <i>FastFET™</i> Op Amp                |
| <a href="#">ADR01</a>         | Product Page—Ultracompact, Precision 10.0 V Voltage Reference                |
| <a href="#">ADSP-BF527</a>    | Product Page—Low Power Blackfin Processor with Advanced Peripherals          |

**NOTES**

## NOTES

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**ESD Caution**

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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