One Technology Way • P.O. Box 9106 • Norwood, MA 02062-9106, U.S.A. • Tel: 781.329.4700 • Fax: 781.461.3113 • www.analog.com

# Evaluating the AD5443, AD5446, and AD5453 Current Output/Serial Input DACs

## FEATURES

- Full-featured evaluation board for the AD5443, AD5446, and AD5453
- Graphic user interface software for board control and data analysis
- Connector to EVAL-SDP-CB1Z system demonstration platform board
- Various power supply options

## APPLICATIONS

- Automatic test equipment
- Instrumentation
- Digitally controlled calibration
- Digital waveform generation

## FUNCTIONAL BLOCK DIAGRAM

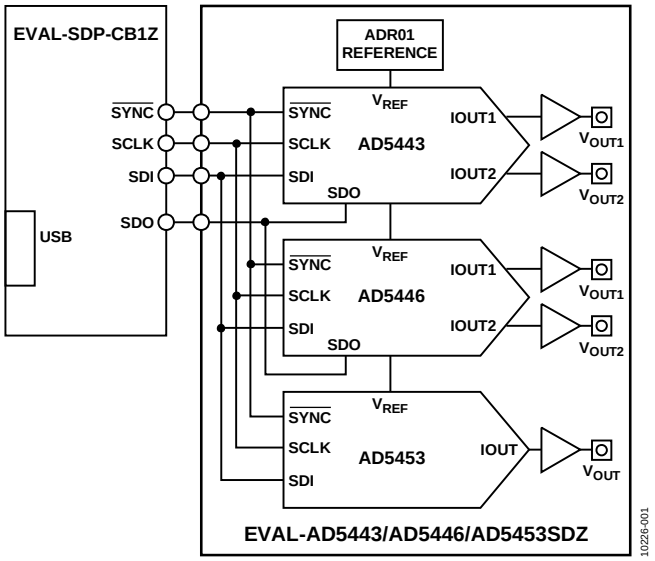


*Figure 1.*

## GENERAL DESCRIPTION

The AD5443, AD5446 and AD5453[1] are CMOS 12-, 14-, and 14-bit, current output, digital-to-analog converters (DACs). The AD5443 operates from a 3 V to 5.5 V power supply, while the AD5446 and AD5453 operate from a single 2.5 V to 5.5 V power supply. These devices are well suited for portable battery-powered and applications such as waveform generation and analog processing.

Because of the CMOS submicron manufacturing process, these parts offer excellent 4-quadrant multiplication characteristics of 10 MHz for the AD5443 and up to 12 MHz for the AD5446 and AD5453 DACs.

These DACs use a double-buffered, 3-wire serial interface that is compatible with SPI, QSPI™, MICROWIRE™, and most DSP interface standards. On power-up, the internal shift register and latches are filled with 0s, and the DAC output is at zero scale. In addition for the AD5443 and AD5446, a serial data out pin (SDO) allows for daisy-chaining when multiple packages are used. Data readback allows the user to read the contents of the DAC register via the SDO pin.

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.

The AD5443 and AD5446 are available in small 10-lead MSOP packages, while the AD5453 is available in small 8-lead TSOT, MSOP packages, also comes in 8-lead LFCSP.

The EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ board is used in conjunction with the EVAL-SDP-CB1Z system demonstration platform (SDP) board available from Analog Devices, Inc., which is purchased separately from the evaluation board. The USB-to-SPI communication to the DAC is completed using this Blackfin®-based demonstration board.

# TABLE OF CONTENTS



## REVISION HISTORY

**4/12—Revision 0: Initial Version**

# EVALUATION BOARD SOFTWARE

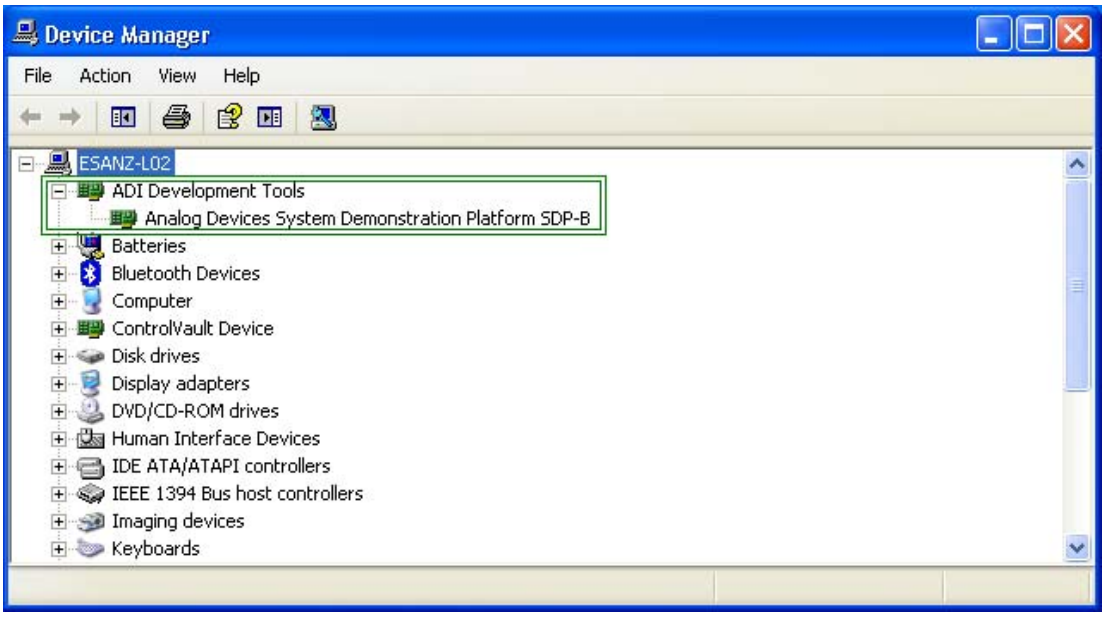


*Figure 2. Device Manager Showing the SDP Board Connected*

## INSTALLING THE SOFTWARE

The EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ evaluation kit includes the software and drivers on CD. 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 EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ evaluation kit CD.
3. Download the EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ 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 drivers do not download automatically, the driver executable file can also be found in the **Program Files/Analog Devices** folder. Follow the on-screen prompts to install it.
4. After installation of the software and drivers is complete, plug the EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ into the SDP board and the SDP board into the PC using the USB cable included in the box.
5. When the software detects the evaluation board, proceed through any dialog boxes that appear to finalize the installation (**Found New Hardware Wizard/Install the Software Automatically** and so on).

## RUNNING THE SOFTWARE

To run the evaluation board program, do the following:

1. Click **Start/All Programs/Analog Devices/EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ)**.
2. If the SDP board is not connected to the USB port when the software is launched, a connectivity error displays (see Figure 3). Simply connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the instructions.

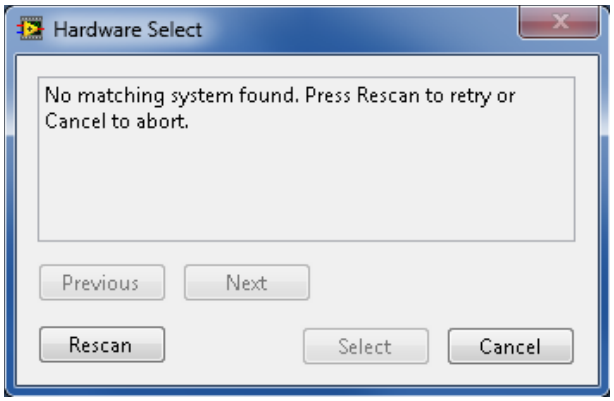


*Figure 3. Connectivity Error (see Step 2)*

# USING THE EVALUATION BOARD SOFTWARE

Once the software is launched, the main window pops up (see Figure 4).

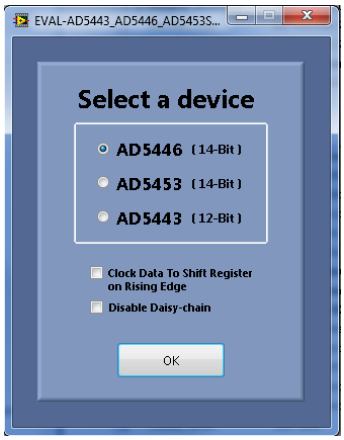


*Figure 4. Main Window*

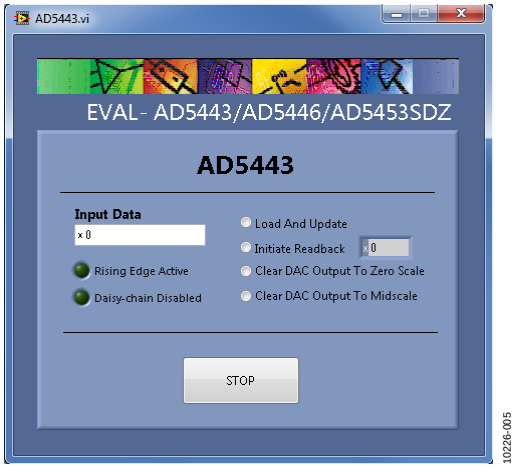


*Figure 5. AD5443 Evaluation Software Window*


*Figure 6. AD5446 Evaluation Software Window*

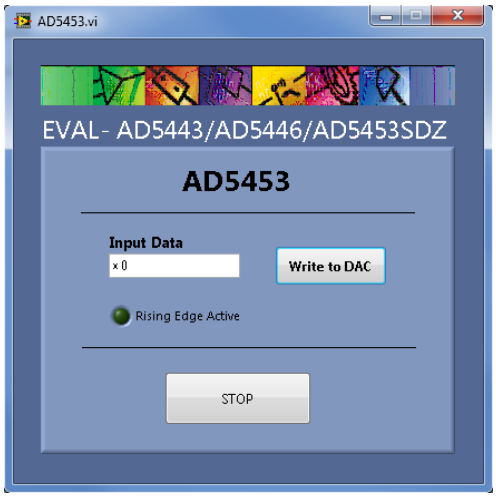


*Figure 7. AD5453 Evaluation Software Window*

## EXAMPLE 1

Select the AD5453 part from the main window. Tick the **Clock Data To Shift Register on Rising Edge** box, and click the **OK** button. The **AD5453 Evaluation Software Window** should appear. The LED indicator with the **Rising Edge Active** label should be light indicating the actual functionality mode (see Figure 5).

Enter Data 0x2000 (half scale) in the **Input Data** control and click the **Write to DAC** button. Data is clocked on the rising edge instead of the falling edge (by default). There is no loss of data; therefore, the output shows the expected −5 V value. The only change is the way the data is clocked.

$$V_{OUT} = -V_{REF} \times \frac{D}{2^n} = -10 \times \frac{8,192}{16,384} = -5\ \text{V}$$

## EXAMPLE 2

Select the AD5446 part from the main window and click the **OK** button. The **AD5446 Evaluation Software Window** should appear. Enter Data 0x3FFF (full scale) in the **Input Data** control and click the **Write to DAC** button. The output shows −10 V, and because this write was the first action on the DAC after powering up, the data on the SDO pin is not taken into account because the data is not given any information.

$$V_{OUT} = -V_{REF} \times \frac{D}{2^n} = -10 \times \frac{16,383}{16,384} = -10\ V$$

Write Data 0x1000 (quarter scale) to the DAC. The output changes its voltage from −10 V to −2.5 V, and the previous data written to the part will appear on the SDO pin (in this example, −10 V).

$$V_{OUT} = -V_{REF} \times \frac{D}{2^n} = -10 \times \frac{16,383}{16,384} = -10\ V$$

To finish evaluating the part, push the **STOP** button.

To disable daisy-chain mode, tick the **Disable Daisy-chain** box in the **Main Window** after launching the application and before clicking the **OK** button. The LED indicator with the **Daisy-chain Disabled** label will be light indicating the functionality mode.

### EXAMPLE 3

Select the AD5443 part from the **Main Window** and click the **OK** button. The **AD5443 Evaluation Software Window** should appear. Enter Data 0x800 (half scale) in the **Input Data** control and select **Load And Update**. The output shows the expected −5 V value.

$$V_{OUT} = -V_{REF} \times \frac{D}{2^n} = -10 \times \frac{2{,}048}{4{,}096} = -5\ V$$

Select **Clear DAC Output To Zero Scale** to get a voltage value of 0 V on the output.

To put the part in three-quarter scale, write 0xBFD in the **Input Data** control and select **Load And Update**.

$$V_{OUT} = -V_{REF} \times \frac{D}{2^n} = -10 \times \frac{3{,}069}{4{,}096} = -7.5\ V$$

To verify the data in the DAC register is correct, select **Initiate Readback** and the indicator window beside this option shows −7.5 V.

# EVALUATION BOARD SCHEMATICS AND ARTWORK

## SCHEMATICS

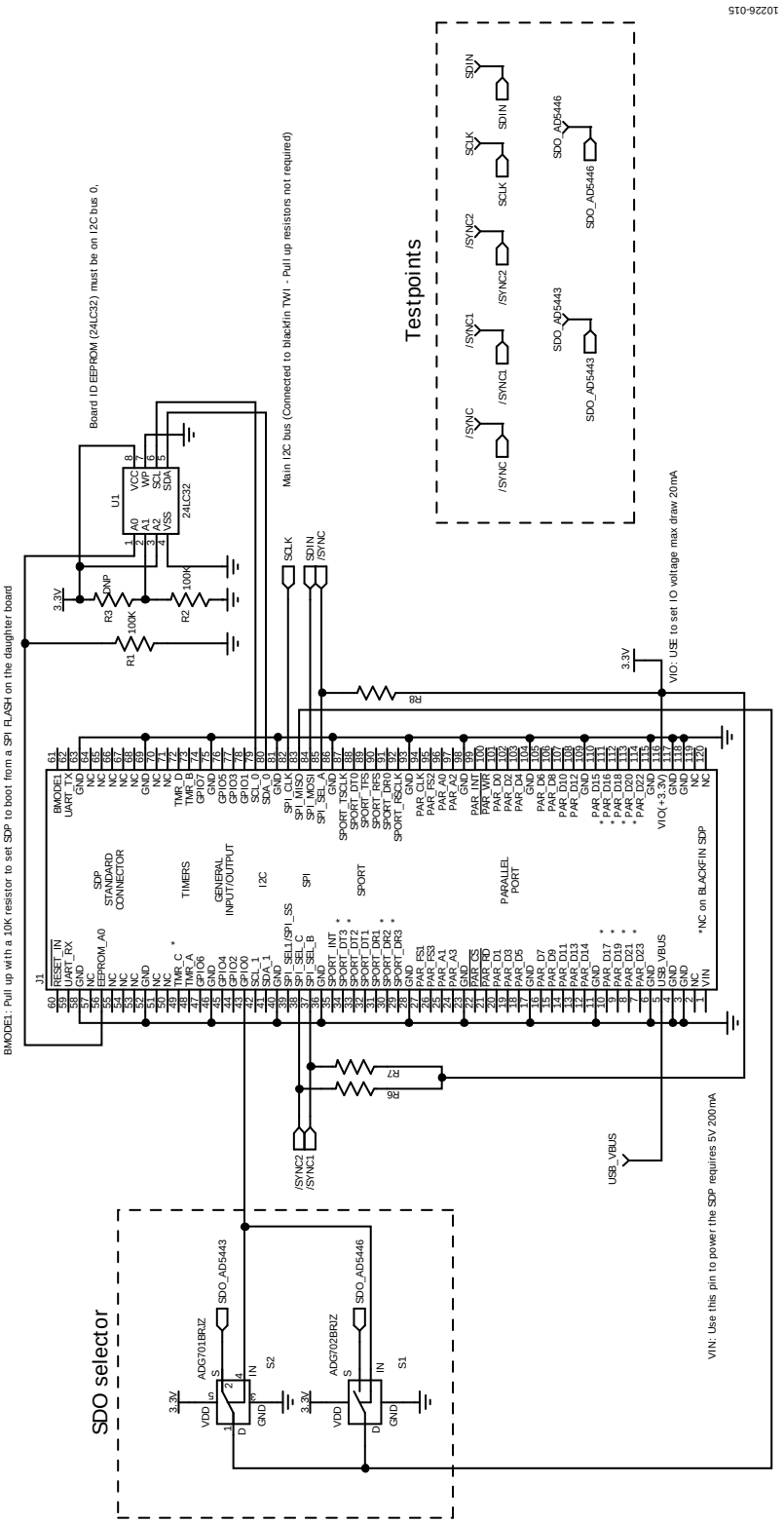


*Figure 8. EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ Schematic, SDP Connector*

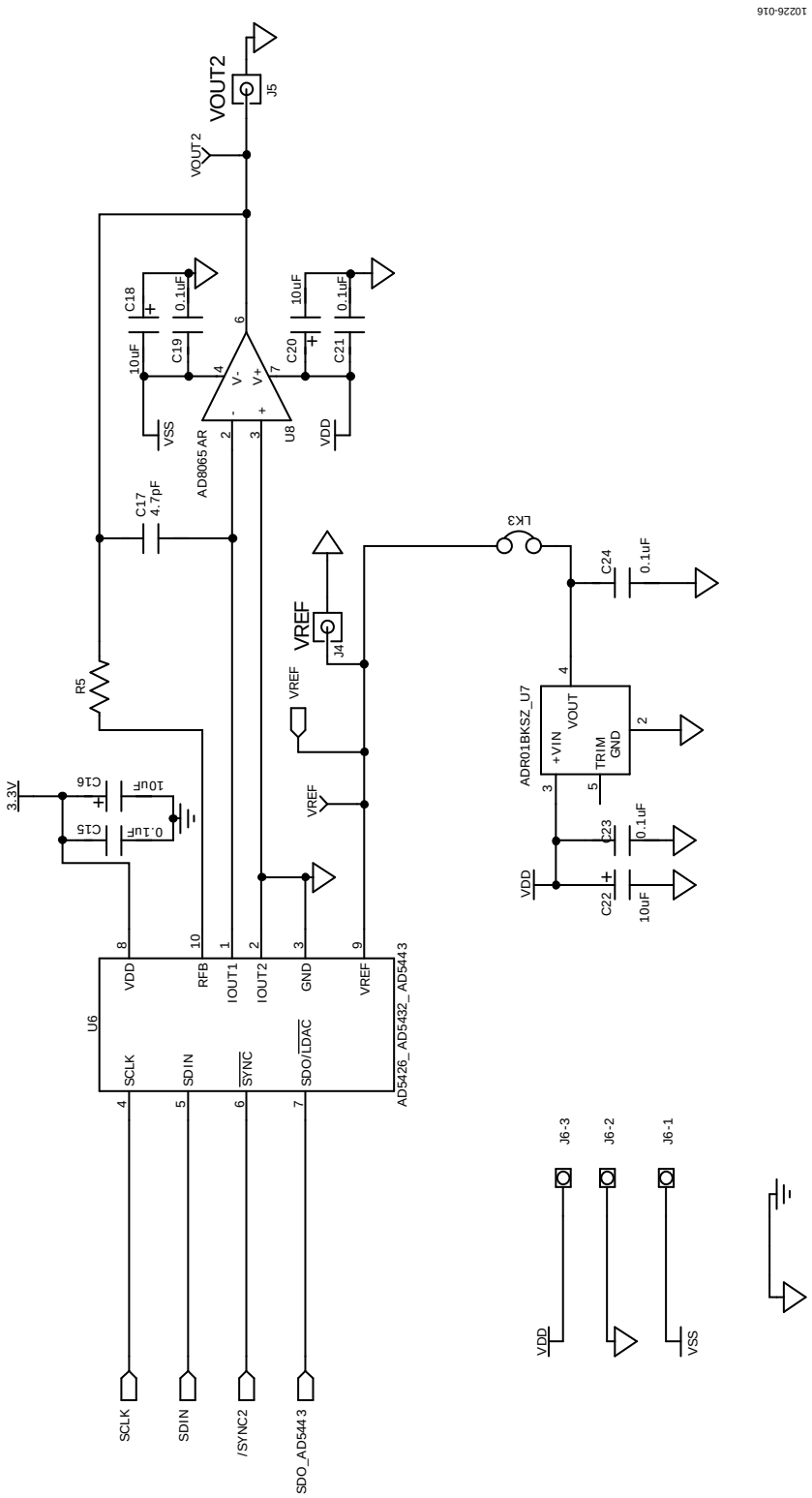


*Figure 9. EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ Schematic, AD5443 DAC*

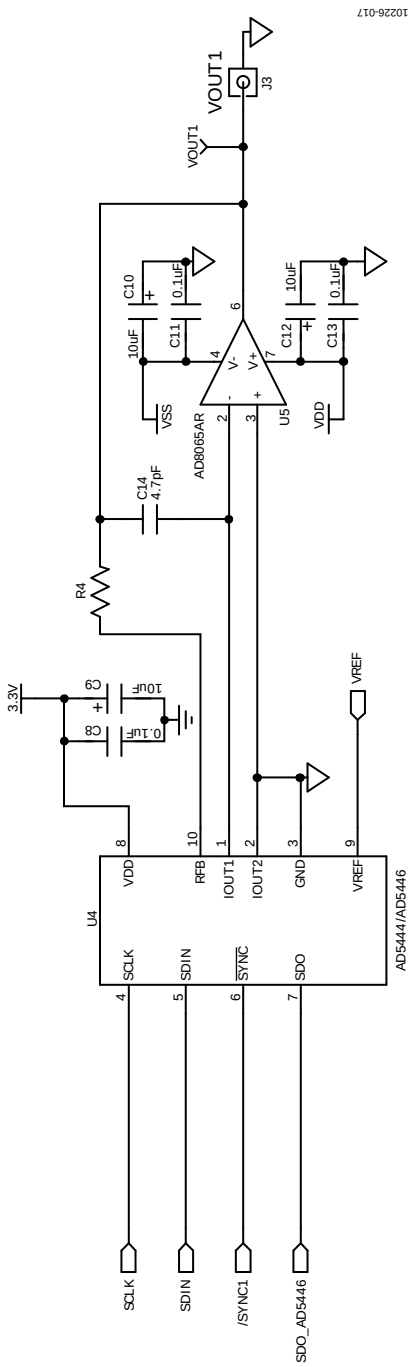


*Figure 10. EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ Schematic, AD5446 DAC*

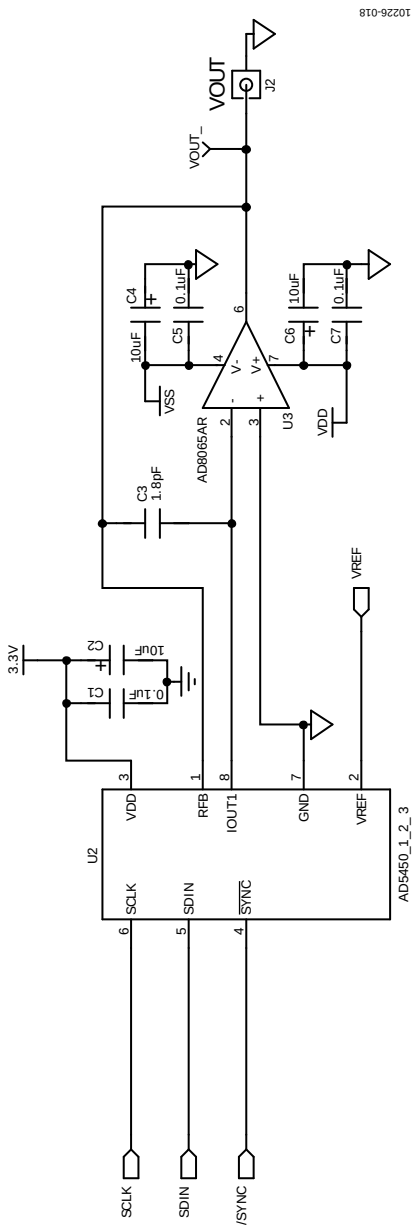


*Figure 11. EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ Schematic, AD5453 DAC*

## EVALUATION BOARD LAYOUT

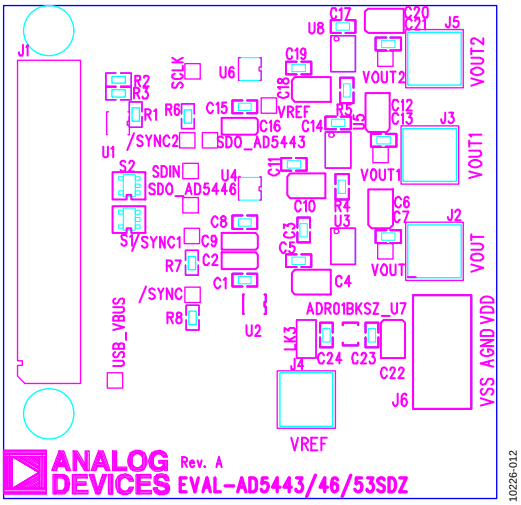


*Figure 12. EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ Silkscreen*

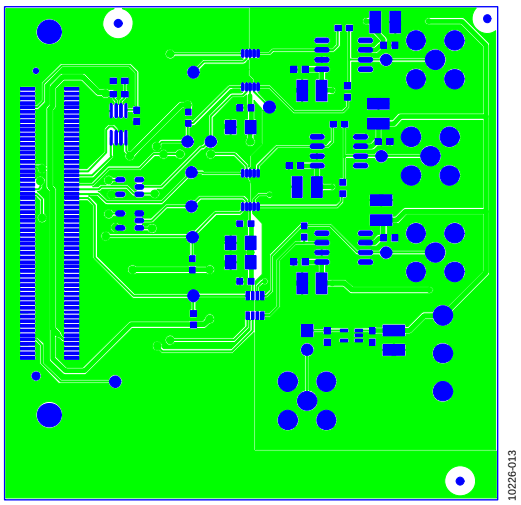


*Figure 13. EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ Component Side*

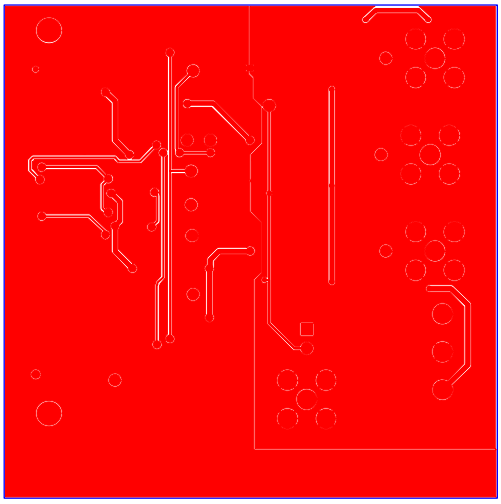


*Figure 14. EVAL-AD5443SDZ/EVAL-AD5446SDZ/EVAL-AD5453SDZ Solder Side*

## RELATED LINKS

| Resource | Description |
|---|---|
| AD5443 | Product Page, AD5443 High Bandwidth CMOS 12-Bit Serial Interface Multiplying D/A Converter |
| AD5446 | Product Page, AD5446 14-Bit High Bandwidth Multiplying DAC with Serial Interface |
| AD5453 | Product Page, AD5453 14-Bit High Bandwidth Multiplying DACs with Serial Interface |
| ADR01 | Product Page, ADR01 Ultracompact, Precision 10.0 V Voltage Reference |
| AD8065 | Product Page, AD8065 High Performance, 145 MHz FastFET™ Op Amp |
| EVAL-SDP-CB1Z | Product Page, System Demonstration Platform-Blackfin |

# NOTES




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