

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

GENERAL DESCRIPTION

The **AD5443**, **AD5446**, and **AD5453** are CMOS 12-bit, 14-bit, and 14-bit, respectively, 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.

FUNCTIONAL BLOCK DIAGRAM

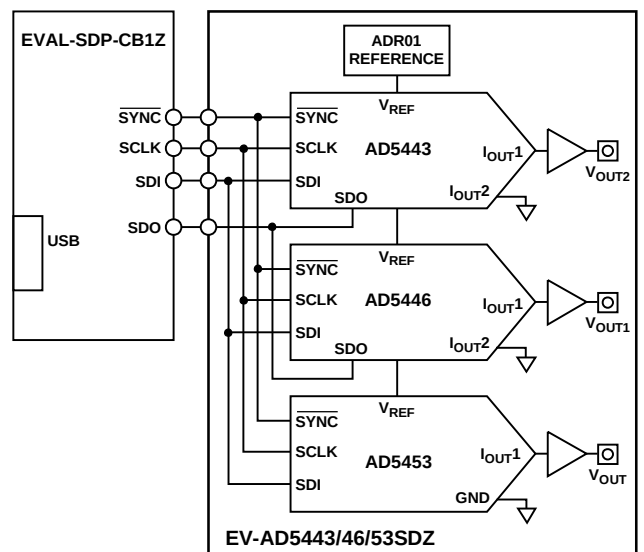


Figure 1.

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 EV-AD5443/46/53SDZ 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

Features	1	Using the Evaluation Board Software	4
Applications.....	1	Example 1	5
Functional Block Diagram	1	Example 2	5
General Description	1	Example 3	5
Revision History	2	Evaluation Board Schematics and Artwork.....	6
Evaluation Board Software	3	Schematics	6
Installing the Software	3	Evaluation Board Layout.....	10
Running the Software	3	Related Links.....	11

REVISION HISTORY

5/2016—Rev. A to Rev. B	
Changes to Figure 1	1
 6/2013—Rev. 0 to Rev. A	
Changed EVAL-AD5443SDZ/EVAL-AD5446SDZ/ EVAL-AD5453SDZ to EV-AD5443/46/53SDZ.....Universal	
 4/2012—Revision 0: Initial Version	

EVALUATION BOARD SOFTWARE

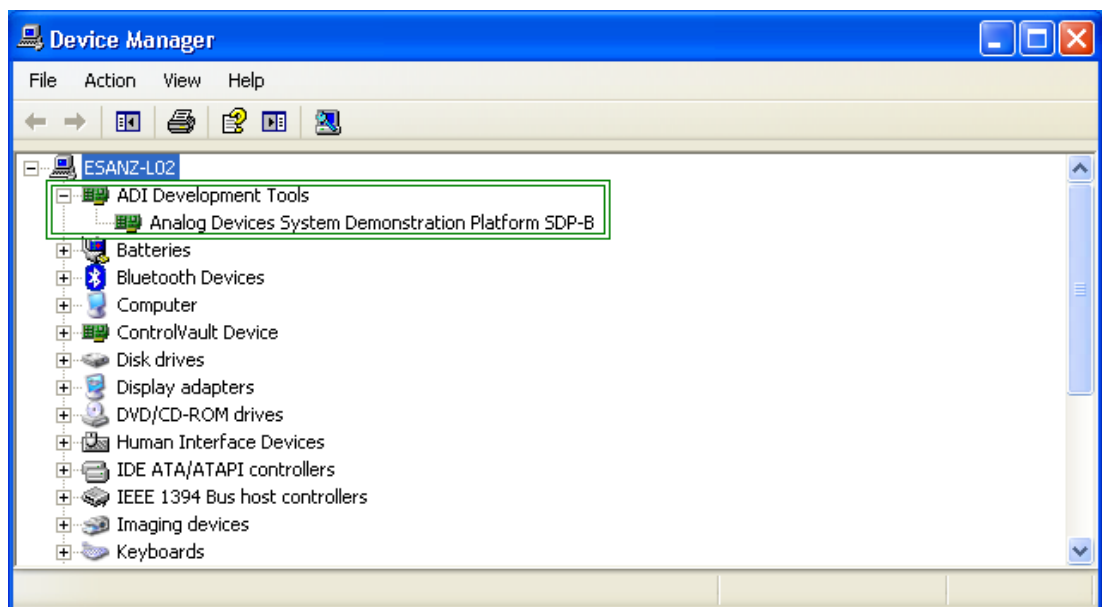


Figure 2. Device Manager Showing the SDP Board Connected

INSTALLING THE SOFTWARE

The EV-AD5443/46/53SDZ 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 EV-AD5443/46/53SDZ evaluation kit CD.
3. Download the EV-AD5443/46/53SDZ LabVIEW™ software. The correct driver, SDPDriversNET, for the SDP board should download automatically after LabVIEW is downloaded, supporting both 32-bit 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 EV-AD5443/46/53SDZ 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/EV-AD5443/46/53SDZ**.
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.

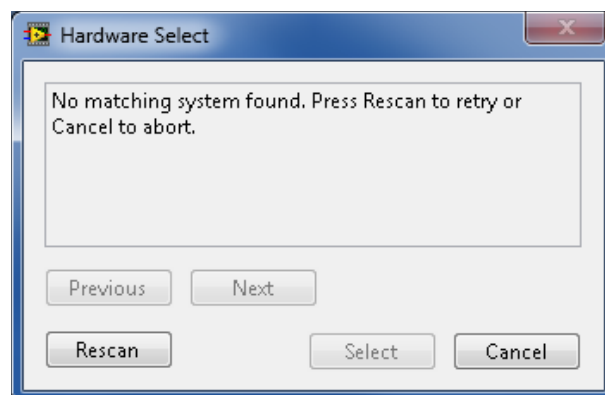


Figure 3. Connectivity Error (See Step 2)

USING THE EVALUATION BOARD SOFTWARE

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

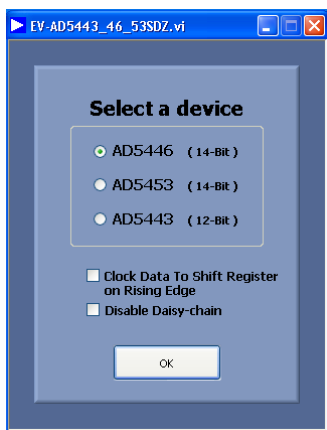


Figure 4. Main Window

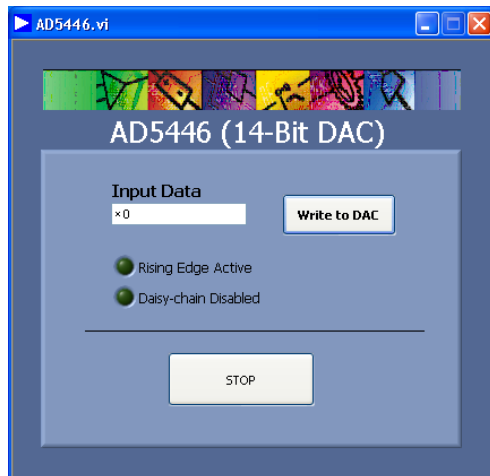


Figure 6. AD5446 Evaluation Software Window

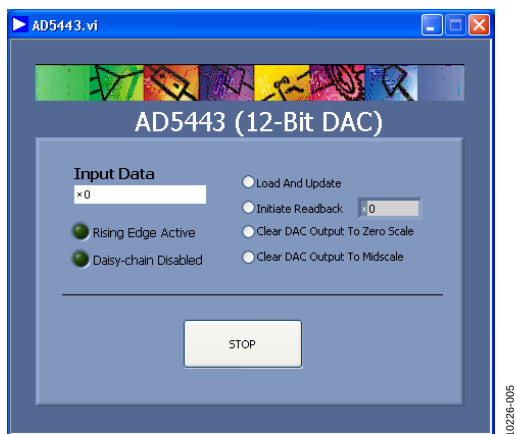


Figure 5. AD5443 Evaluation Software Window

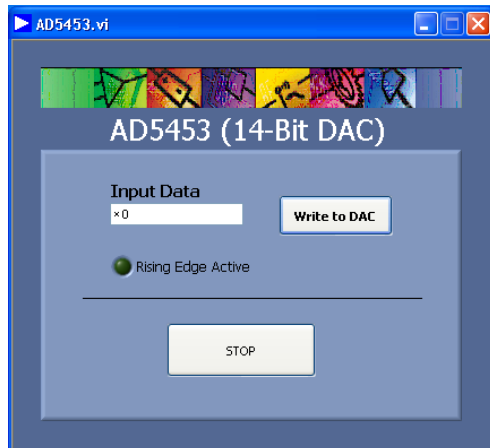


Figure 7. AD5453 Evaluation Software Window

EXAMPLE 1

Select the **AD5453** part from the main window. Check 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 lit 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.

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

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).

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

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

To disable daisy-chain mode, check 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 is lit, 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.

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

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**.

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

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

SCHEMATICS



Figure 8. EV-AD5443/46/53SDZ Schematic, SDP Connector

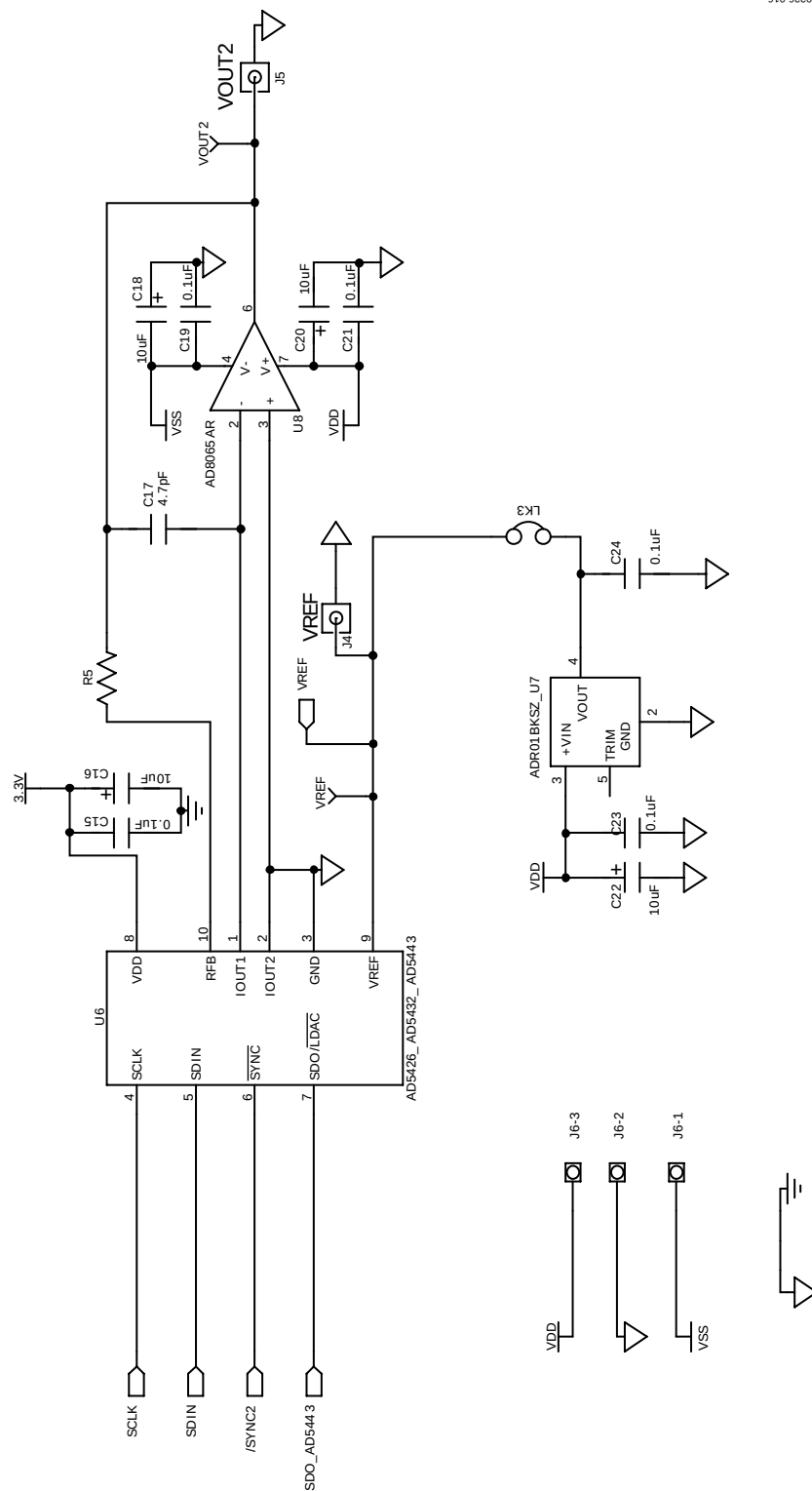


Figure 9. EV-AD5443/46/53SDZ Schematic, [AD5443](#) DAC

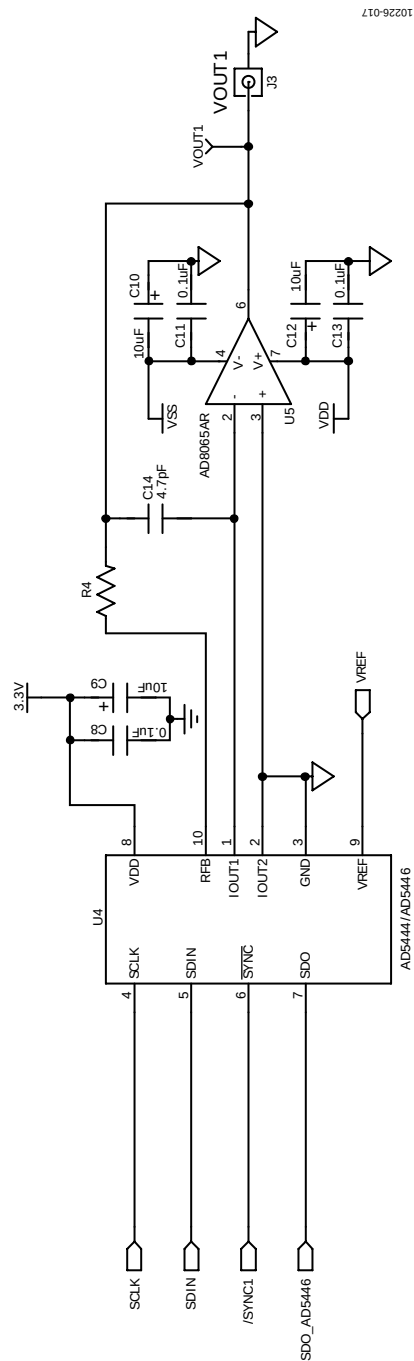


Figure 10. EV-AD5443/46/53SDZ Schematic, [AD5446](#) DAC

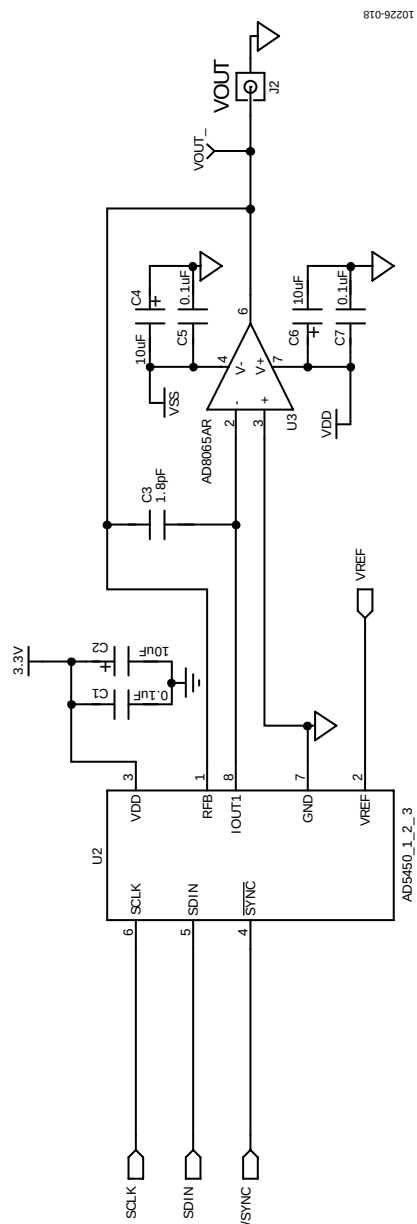


Figure 11. EV-AD5443/46/53SDZ Schematic, [AD5453](#) DAC

EVALUATION BOARD LAYOUT

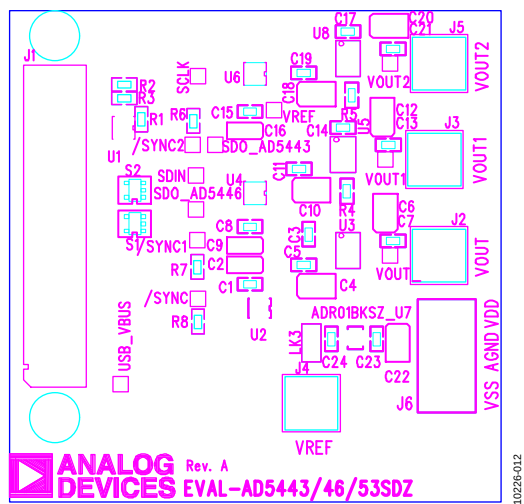


Figure 12. EV-AD5443/46/53SDZ Silkscreen

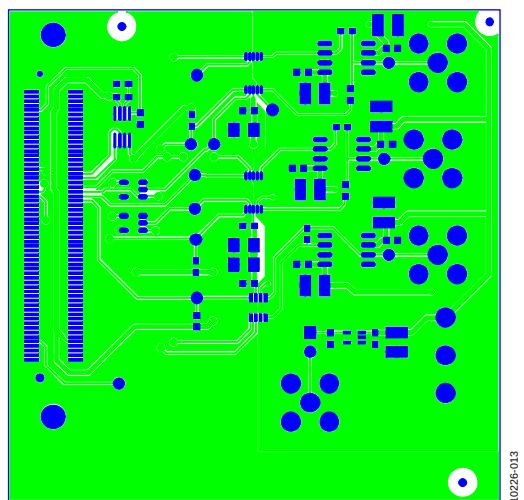


Figure 13. EV-AD5443/46/53SDZ Component Side

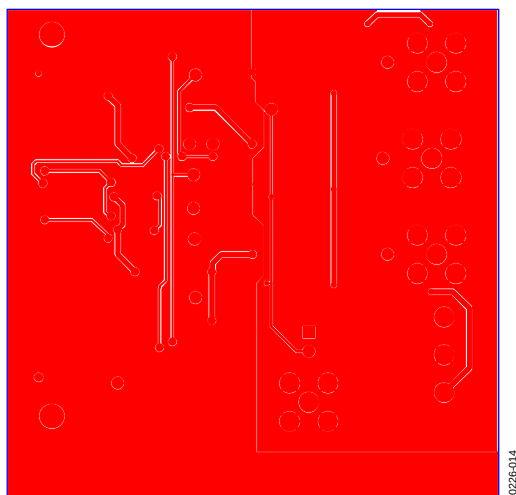


Figure 14. EV-AD5443/46/53SDZ Solder Side

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

**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.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. **CONFIDENTIALITY.** This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. **ADDITIONAL RESTRICTIONS.** Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. **TERMINATION.** ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. **LIMITATION OF LIABILITY.** THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). **EXPORT.** Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. **GOVERNING LAW.** This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.



Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Analog Devices Inc.:](#)

[EVAL-AD5443SDZ](#) [EVAL-AD5446SDZ](#) [EVAL-AD5453SDZ](#) [EV-AD5443SDZ](#) [EV-AD5453SDZ](#) [EVAL-AD5443-DBRDZ](#) [EV-AD5443/46/53SDZ](#)