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.

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 LFCSPP.

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.
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REVISION HISTORY
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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

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.
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. 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.

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

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.

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

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).

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

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

EXAMPLE 3
Select the AD5443 part from the Main Window and click the OK button. The AD5443 Evaluation Software Window should appear. Enter Data 0x8000 (half scale) in the Input Data control and select Load And Update. The output shows the expected −5 V value.

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

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.

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

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.
SCHEMATICS

VIN: Use this pin to power the SDP requires 5V 200mA
VIO: USE to set IO voltage max draw 20mA
Board ID EEPROM (24LC32) must be on I2C bus 0,
BMODE1: Pull up with a 10Kresistor to set SDP to boot from a SPI FLASH on the daughter board
Main I2C bus (Connected to blackfin TWI - Pull up resistors not required)

TESTPOINTS
*NC on BLACKFIN SDP

TIMERS

INPUT/OUTPUT
GENERAL
I2C
SPI
SPORT
PORT
PARALLEL

SDP
STANDARD
CONNECTOR

120NC
119NC
118GND
117GND
116VIO(+3.3V)
115GND
114PAR_D22
113PAR_D20
112PAR_D18
111PAR_D16
110PAR_D15
109GND
108PAR_D12
107PAR_D10
106PAR_D8
105PAR_D6
104GND
103PAR_D4
102PAR_D2
101PAR_D0
100PAR_WR
99PAR_INT
98GND
97PAR_A2
96PAR_A0
95PAR_FS2
94PAR_CLK
93GND
92SPORT_RSCLK
91SPORT_DR0
90SPORT_RFS
89SPORT_TFS
88SPORT_DT0
87SPORT_TSCLK
86GND
85SPI_SEL_A
84SPI_MOSI
83SPI_MISO
82SPI_CLK
81GND
80SDA_0
79SCL_0
78GPIO1
77GPIO3
76GPIO5
75GND
74GPIO7
73TMR_B
72TMR_D
71NC
70NC
69GND
68NC
67NC
66NC
65NC
64NC
63GND
62UART_TX
61BMODE160 RESET_IN
59 UART_RX58 GND57 NC56 EEPROM_A055 NC54 NC53 NC52 GND51 NC50 NC49 TMR_C48 TMR_A47 GPIO646 GND45 GPIO444 GPIO243 GPIO042 ...
SPORT_DT232 SPORT_DT131 SPORT_DR130 SPORT_DR229 SPORT_DR328 GND27 PAR_FS126 PAR_FS325 PAR_A124 PAR_A323 GND22 PAR_CS21 PAR_RD20 PAR_D119 PAR_D318 PAR_D517 GND16 PAR_D715 PAR_D914 PAR_D1113 PAR_D1312 PAR_D1411 GND10 PAR_D179 PAR_D198 PAR_D217 PAR_D236 GND5 USB_VBUS4 GND3 GND2 NC1 VIN

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-AD5443/46/48SDZ Schematic, AD5453 DAC
EVALUATION BOARD LAYOUT

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

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

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<tr>
<th>Resource</th>
<th>Description</th>
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<td>AD5443</td>
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<td>EVAL-SDP-CB1Z</td>
<td>Product Page, System Demonstration Platform-Blackfin</td>
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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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