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
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** 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 (VREF) determines the full-scale output current. An integrated feedback resistor (RFB) 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 LFCS and TSOP packages.

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

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**EVALUATION BOARD FUNCTIONAL BLOCK DIAGRAM**

![Evaluation Board Functional Block Diagram](image)

*Figure 1.*

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1 U.S Patent No. 5,689,257.

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**PLEASE SEE THE LAST PAGE FOR AN IMPORTANT WARNING AND LEGAL TERMS AND CONDITIONS.**
TABLE OF CONTENTS

Features .............................................................................................. 1
Applications....................................................................................... 1
General Description ......................................................................... 1
Evaluation Board Functional Block Diagram............................... 1
Revision History ............................................................................... 2
Evaluation Board .............................................................................. 3
System Demonstration Platform................................................ 3
Operating the Evaluation Board.................................................... 3
Microprocessor Interfacing............................................................... 3
Evaluation Board Software...............................................................4
Installing the Software ..................................................................4
Running the Software ...................................................................4
Using the Evaluation Board Software .......................................... 5
Evaluation Board Functions and Registers................................. 5
Evaluation Board Schematics and Artwork................................. 6
Schematics ......................................................................................6
Evaluation Board Layout ...............................................................8
Related Links..................................................................................9

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 ±12 V and +5 V supplies. The +12 V VDD and -12 V VSS supplies are used to power the output amplifier; the +5 V supply is used to power the DAC (VDD1) and transceivers (VCC).

Both supplies are decoupled to their respective ground plane using 10 µF tantalum and 0.1 µF 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](image-url)
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.
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](image)

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 V, based on the following formula:

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

**Example 2**

Type 0xBFD (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 V, based on the following formula:

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

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 0xBFD.
EVALUATION BOARD SCHEMATICS AND ARTWORK

SCHEMATICS

VIN: USE THIS PIN TO POWER THE SDP
REQUIRES 5V 200mA

BOARD ID EEPROM (24LC32) MUST BE ON I2C BUS 0
I2C BUS 1 IS COMMON ACROSS BOTH CONNECTORS ON SDP– PULL UP RESISTORS REQUIRED (CONNECTED TO BLACKFIN GPIO - USE I2C_0 FIRST)

MAIN I2C BUS (CONNECTED TO BLACKFIN TWI – PULL UP RESISTORS NOT REQUIRED)

VIO: USE TO SET IO VOLTAGE MAX DRAW 20mA

CONNECTOR
STANDARD
SDP
PARALLEL
PORT
SPORT
SPI
I2C
GENERAL
INPUT/OUTPUT
TIMERS

*NC ON BLACKFIN SDP
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_C*48 TMR_A47 GPIO646 GND45 GPIO444 GPIO243 GPIO042 ...
SPORT_DT2*32 SPORT_DT131 SPORT_DR130 SPORT_DR2*28 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_D17*9 PAR_D19*8 PAR_D21*7 PAR_D23*6 GND5 USB_VBUS4 GND3 GND2 NC1 VIN

J3
1 A02 A13 A24 VSS
8VCC 7WP 6SCL 5SDA
U3
24LC32
R3 DNP
R4
100kΩ
R2
100kΩ

Figure 6. Evaluation Board Schematic, SDP Board (EVAL-SDP-CB1Z)
Figure 7. Evaluation Board Schematic, AD5445
EVALUATION BOARD LAYOUT

![Figure 8. Silkscreen](image1)

![Figure 9. Component Side](image2)

![Figure 10. Solder Side](image3)
<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD5445</td>
<td>Product Page—12-Bit, High Bandwidth Multiplying DAC with Parallel Interface</td>
</tr>
<tr>
<td>EVAL-SDP-CB1Z</td>
<td>Product Page—SDP-B: System Demonstration Platform-Blackfin</td>
</tr>
<tr>
<td>AD7545</td>
<td>Product Page—CMOS 12-Bit Buffered Multiplying DAC with On-Board Data Latches</td>
</tr>
<tr>
<td>AD8065</td>
<td>Product Page—High Performance, 145 MHz FastFET™ Op Amp</td>
</tr>
<tr>
<td>ADR01</td>
<td>Product Page—Ultracompact, Precision 10.0 V Voltage Reference</td>
</tr>
<tr>
<td>ADSP-BF527</td>
<td>Product Page—Low Power Blackfin Processor with Advanced Peripherals</td>
</tr>
</tbody>
</table>
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.

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