

## Evaluating the AD5449 Serial Input, Dual-Channel Current Output DAC

### FEATURES

- Full-featured evaluation board for the [AD5449](#)
- 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 [AD5449](#) is a CMOS, 12-bit, dual-channel, current output digital-to-analog converter. This device operates from a 2.5 V to

5.5 V power supply, making it suited to battery-powered and other applications.

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

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

This DAC uses a double-buffered, 3-wire serial interface that is compatible with SPI, QSPI™, MICROWIRE®, and most DSP interface standards. In addition, a serial data out pin (SDO) allows daisy-chaining when multiple packages are used. Data readback allows the user to read the contents of the DAC register via the SDO pin. On power-up, the internal shift register and latches are filled with 0s, and the DAC outputs are at zero scale. The [AD5449](#) DAC is available in 16-lead TSSOP packages.

The evaluation board, [EVAL-AD5415/AD5449SDZ](#), is available for evaluating the performance of the [AD5449](#) DAC.

### EVALUATION BOARD FUNCTIONAL BLOCK DIAGRAM

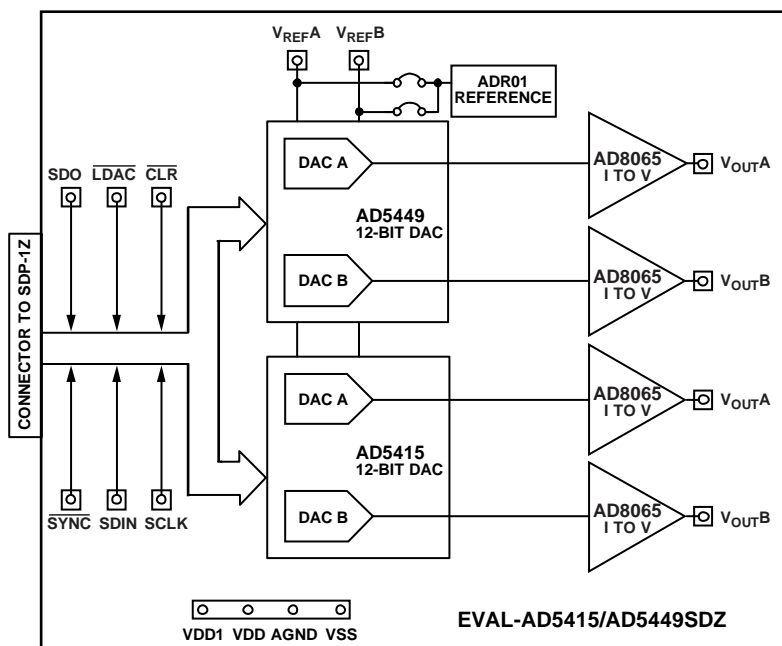


Figure 1.

## TABLE OF CONTENTS

Features .....	1	Evaluation Board Software .....	4
Applications .....	1	Installing the Software .....	4
General Description .....	1	Running the Software .....	4
Evaluation Board Functional Block Diagram .....	1	Using the Evaluation Board Software .....	5
Revision History .....	2	Evaluation Board Functions and Registers .....	5
Evaluation Board .....	3	Evaluation Board Schematics and Artwork .....	8
System Demonstration Platform .....	3	Schematics .....	8
EVAL-AD5415/AD5449SDZ to SPORT Interface .....	3	Evaluation Board Layout .....	11
Operating the Evaluation Board .....	3	Related Links .....	12
Serial Interface .....	3		
Microprocessor Interfacing .....	3		

## REVISION HISTORY

### 3/12—Rev. 0 to Rev. A

Changes to General Description Section .....	1
Replaced Evaluation Board Schematics and Artwork Section ...	8

### 6/11—Revision 0: Initial Version

## EVALUATION BOARD

The [EVAL-AD5415/AD5449SDZ](#) evaluation board consists of an [AD5449](#) DAC, an [AD5415](#) DAC, and current-to-voltage amplifiers, 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 consists of a CD-ROM with self-installing PC software to control the DAC. The software allows the user to write a code to the device.

The [EVAL-AD5415/AD5449SDZ](#) evaluation 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 [AD5449](#) 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 BF527 processor with USB connectivity to the PC through a USB 2.0 high speed port. For more information about this device, see the [system demonstration platform web page](#).

### EVAL-AD5415/AD5449SDZ TO SPORT INTERFACE

The Analog Devices SDP has one SPORT serial port. The SPORT interface is used to control the [AD5449](#), allowing clock frequencies of up to 30 MHz.

### OPERATING THE EVALUATION BOARD

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

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

### SERIAL INTERFACE

The [AD5449](#) has an interface that is compatible with SPI, QSPI, MICROWIRE, and most DSP interface standards. Data is written to the device in 16-bit words. Each 16-bit word consists of four control bits and 12 data bits for the [AD5449](#). Control bits allow control of various functions on the DAC.

### MICROPROCESSOR INTERFACING

Microprocessor interfacing to the [AD5449](#) DAC is through a serial bus that uses a standard protocol compatible with microcontrollers and DSP processors.

The system demonstration platform (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 (BF5xx) at its core.

The ADSP-BF5xx processor incorporates channel synchronous serial ports (SPORT) and general purpose input/output pins (GPIO). A serial interface between the BlackFin processor and the [AD5449](#) DAC is shown in Figure 2.

For more details about the system demonstration platform, see [EVAL-SDP-CB1Z](#).

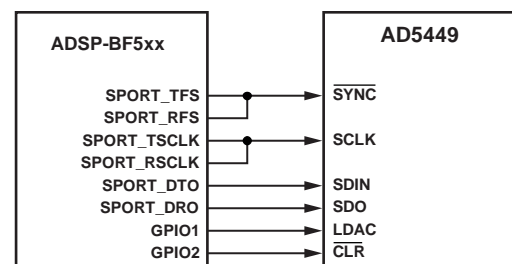


Figure 2. ADSP-BF5xx-to-AD5449 Interface

## EVALUATION BOARD SOFTWARE

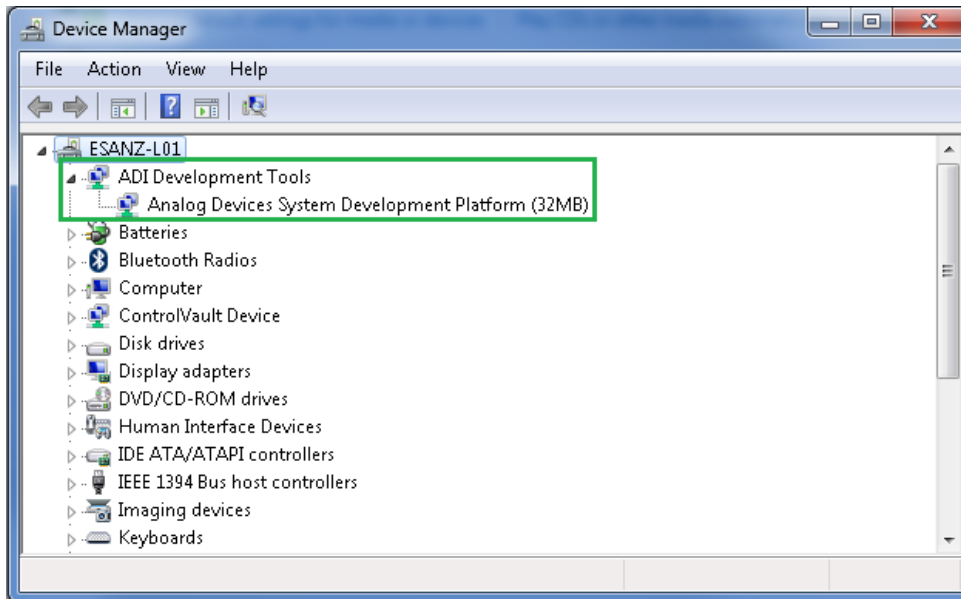


Figure 3. Device Manager Showing the SDP Board Connected

### INSTALLING THE SOFTWARE

The [EVAL-AD5415/49SDZ](#) 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-AD5415/49SDZ](#) evaluation kit CD.
3. Download the [EVAL-AD5415/49SDZ](#) 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-AD5415/49SDZ](#) 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-AD5415/49SDZ**.
2. If the SDP board is not connected to the USB port when the software is launched, a connectivity error displays (see Figure 4.). Simply connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the instructions.

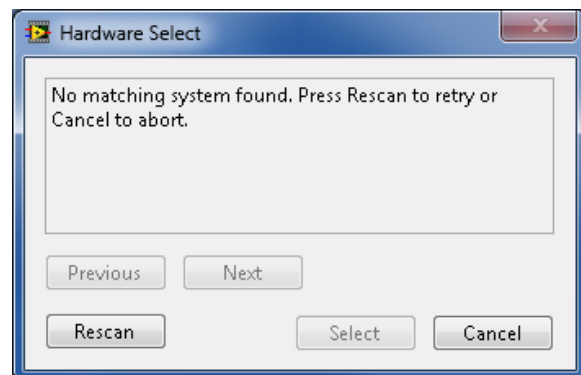


Figure 4. Connectivity Error

## USING THE EVALUATION BOARD SOFTWARE

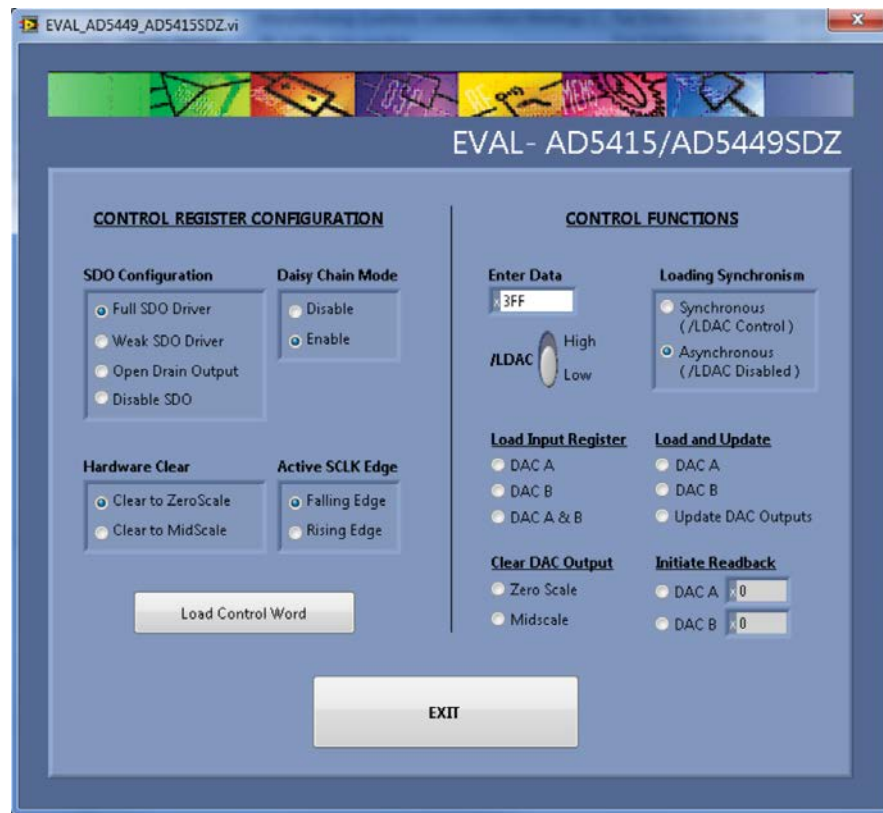


Figure 5. Evaluation Software Window

To operate the evaluation software,

1. Ensure that the USB cable connects the PC to the system demonstration platform, SDP1Z, and SDPIZ to the evaluation board.
2. Run the program file from the **Analog Devices** menu. The **EVAL -AD5449/AD5415SDZ** window is displayed, as shown in Figure 5.

### EVALUATION BOARD FUNCTIONS AND REGISTERS

From the [AD5449](#) evaluation software window, you can write a data-word to either DAC A or DAC B or both DACs. Type the 12-bit word in hexadecimal format in the **Enter Data** box of the **CONTROL FUNCTIONS** panel.

The [AD5449](#) evaluation software window allows you to evaluate all the functions of the [AD5449](#).

#### Example 1

##### Asynchronous Mode

Complete the following steps in the **CONTROL FUNCTIONS** panel of the evaluation software window:

1. Select **/LDAC High** to tie the load DAC input high for the asynchronous loading mode, specify quarter scale (0x400, 1024d) in the **Enter Data** box, and select **Load Input Register DAC A**. The value is kept in the register, and the DAC does not update until you click the **Load and Update Update DAC Outputs** button. The expected output obtained is

$$V_{OUT} = -V_{REF} \times \frac{D}{4096} = -10 \times \frac{1024}{4096} = -2.5 \text{ V}$$

2. Select **Clear DAC Output Zero Scale** to clear the DAC outputs to 0 V.

**Synchronous Mode**

1. Change **Loading Synchronism** to **Synchronous (/LDAC Control)**, write 0xC00 (3072d) in the **Enter Data** box, and select **Load Input Register DAC A** box. You do not see any change in the output until you select **/LDAC Low**. The expected output for this case is

$$V_{OUT} = -V_{REF} \times \frac{D}{4096} = -10 \times \frac{3072}{4096} = -7.5 \text{ V}$$

2. Click **Initiate Readback DAC A** to confirm that the last value loaded in the DAC A register is the same as the one read and shown in the **DAC A** numeric indicator text box.

**Example 2****Control Register Configuration**

1. Working in asynchronous mode, load and update DAC B with full scale (0xFFF). The expected output is

$$V_{OUT} = \left( V_{REF} \times \frac{D}{2^{n-1}} \right) - V_{REF} = \left( 10 \times \frac{4095}{2048} \right) - 10 = +10 \text{ V}$$

2. Select **Clear to Midscale** in the **Hardware Clear** box and **Daisy Chain Mode Disable** in the **CONTROL REGISTER CONFIGURATION** panel; then click the **Load Control Word** button. The DAC B outputs change to midscale (0x800), and the signal in the SDO pin maintains a constant value until the daisy-chain mode is enabled again.
3. Click **Exit** when you complete your evaluation.

Table 1 and Table 2 describe the control functions and control registers, respectively. The disable daisy-chain and clock data to shift register on rising edge mode functions are loaded with the control register. Although they can also be implemented loading the specified control bits for these functions, they are only available within the control word for the software provided.

**Table 1. Control Functions**

<b>Control Function</b>	<b>Description</b>
Load and Update DAC A	Loads the DAC A register with the entered data-word and updates the DAC A output, irrespective of the state of /LDAC.
Initiate Readback on DAC A	Reads the contents of the DAC A register and displays the value on screen.
Load Input Register of DAC A	Loads the DAC A input register with the entered data-word. The DAC A output is updated only if /LDAC is low.
Load and Update DAC B	Loads the DAC B register with entered data-word and updates the DAC B output, irrespective of the state of /LDAC.
Initiate Readback on DAC B	Reads the contents of the DAC B register and displays the value on screen.
Load Input Register of DAC B	Loads the DAC B input register with the entered data-word. The DAC B output is updated only if /LDAC is low.
Update Both DACs	Updates both DAC outputs with the entered data-word, irrespective of the state of /LDAC.
Load Input Registers of DAC A and DAC B	Loads the input registers of both DACs with the entered data-word. Both outputs are updated only if /LDAC is low.
Clear Both Outputs to Zero Scale	Loads both DACs and updates their outputs with zero-scale code, irrespective of the state of /LDAC.
Clear Both Outputs to Midscale	Loads both DACs and updates their outputs with midscale code, irrespective of the state of /LDAC.

**Table 2.**

<b>Control Register</b>	<b>Description</b>
SDO Configuration	The SDO bits enable you to control the SDO output driver strength, disable the SDO output, or configure the SDO as an open-drain driver. The strength of the SDO driver affects timing. A stronger SDO output driver allows a faster clock cycle to be used.
Daisy-Chain Mode	Enables or disables daisy-chain functionality.
Hardware Clear	Sets the value to which the outputs are cleared on the falling edge of the CLR signal. The value can be either zero scale or midscale.
Active SCLK Edge	Selects the edge of SCLK on which data is clocked into the input register. Data is clocked out from SDO on the opposite edge.
Load Control Word	Loads control register mode.

EVALUATION BOARD SCHEMATICS AND ARTWORK  
SCHEMATICS

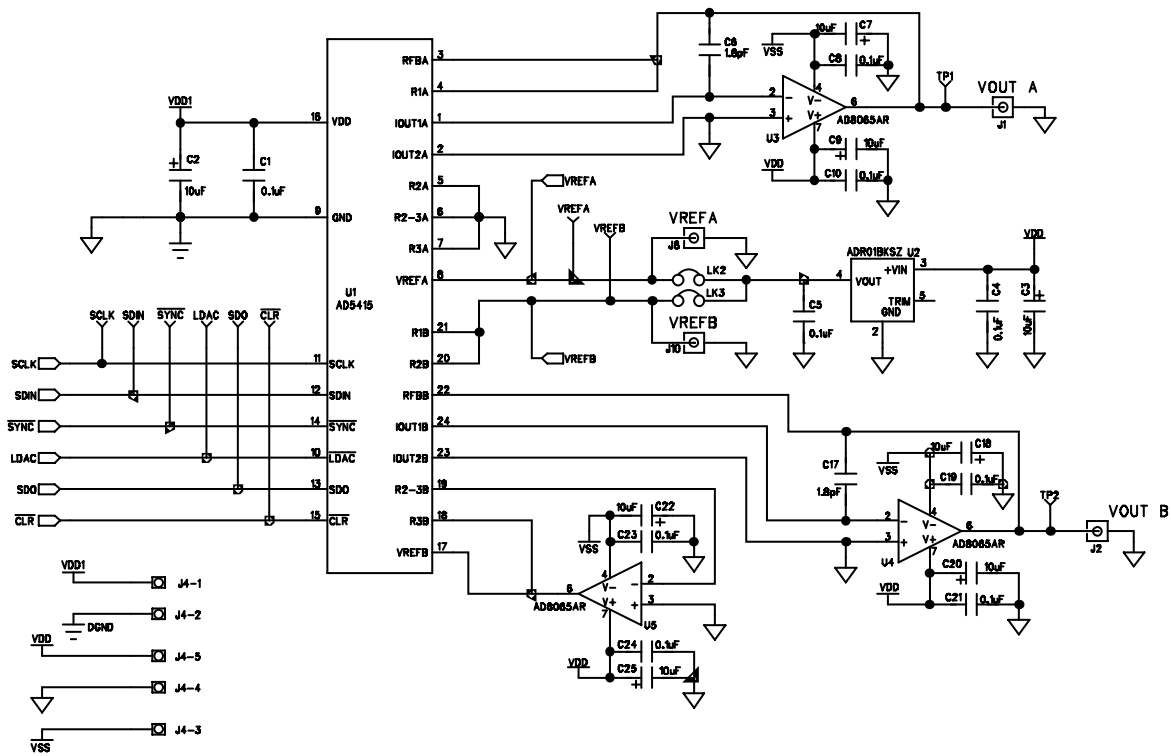


Figure 6. Evaluation Board Schematic Part A (AD5415)

06974-006



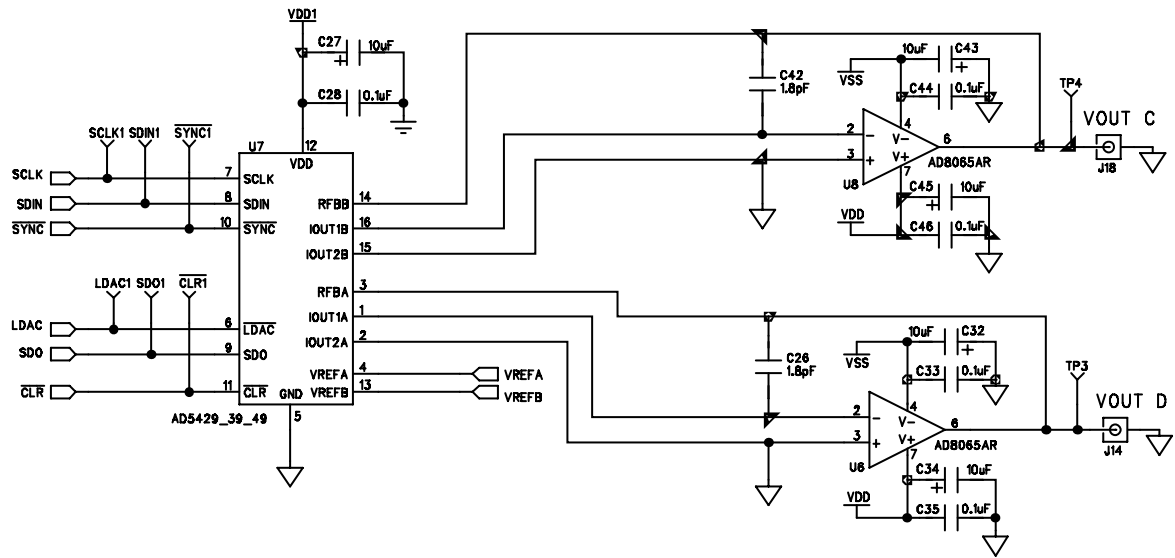


Figure 7. Evaluation Board Schematic Part B (AD5449)

08974-007

BMODE1: Pull up with a 10K resistor to set SDP to boot from a SPI FLASH on the daughter board

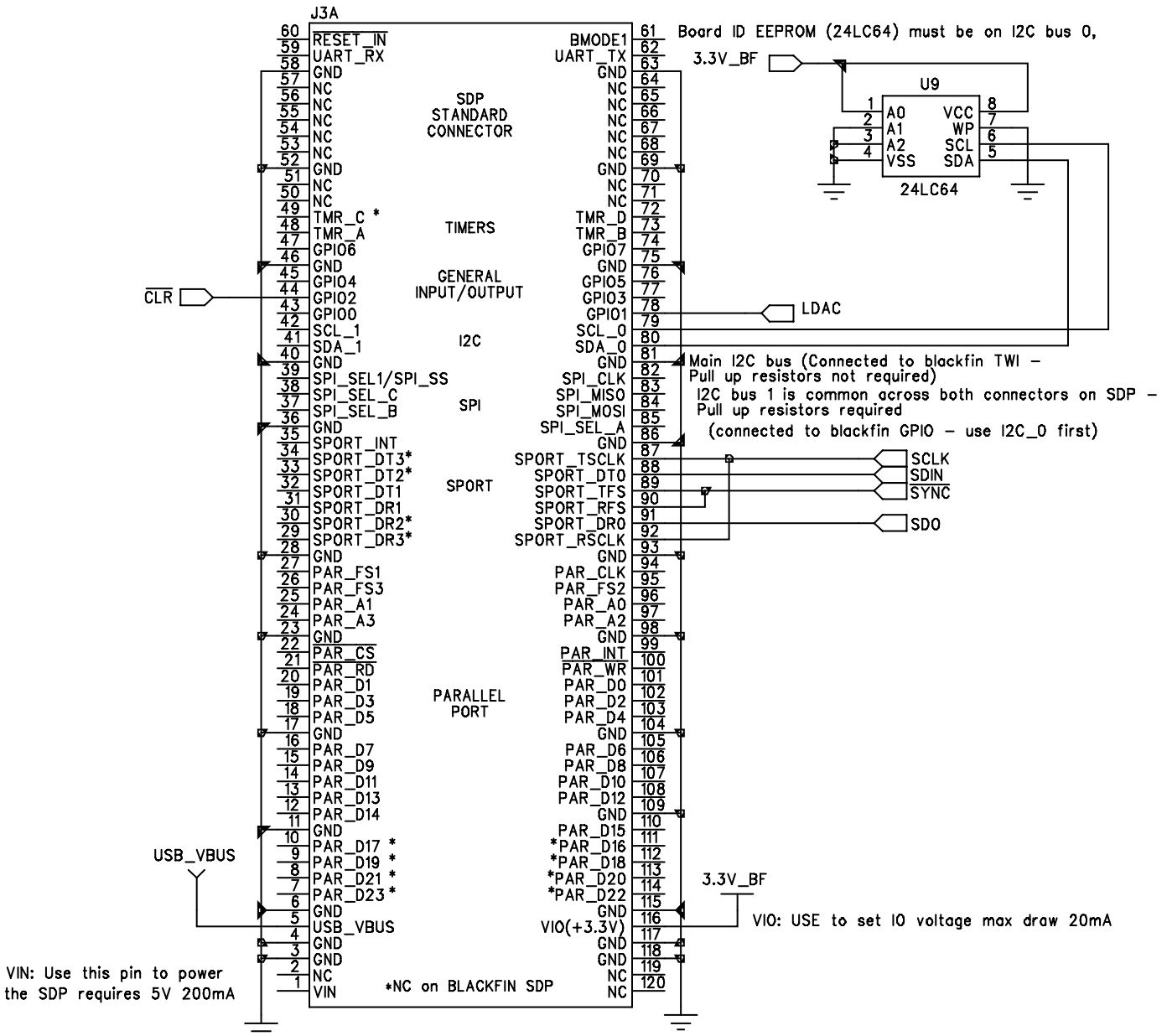


Figure 8. Evaluation Board Schematic Part C (SDP Board)

09574-008



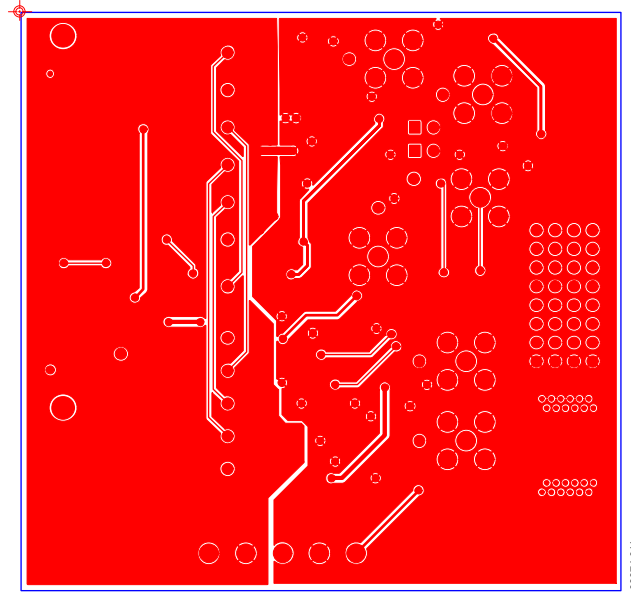


Figure 11. Solder-Side Artwork

## RELATED LINKS

Resource	Description
<a href="#">AD5415</a>	Product Page, AD5415 Dual 12-Bit, High Bandwidth, Multiplying DAC with Four-Quadrant Resistors and Serial Interface
<a href="#">AD5449</a>	Product Page, AD5449 Dual 12-Bit, High Bandwidth Multiplying DAC with Serial Interface
<a href="#">ADR01</a>	Product Page, ADR01 Ultracompact, Precision 10.0 V Voltage Reference
<a href="#">AD8065</a>	Product Page, AD8065 High Performance, 145 MHz <i>FastFET</i> ™ Op Amp

**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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