

## Evaluation Board for the **AD5326** 12-Bit, Quad Channel, Voltage Output Digital-to-Analog Converter (DAC)

### FEATURES

Full featured evaluation board in conjunction with *nanoDAC* motherboard (**EVAL-MBnanoDAC-SDZ**)

On-board references

Various link options

PC control in conjunction with Analog Devices, Inc., **system demonstration platform (SDP)**

### PACKAGE CONTENTS

**EVAL-AD5326DBZ** evaluation board

**EVAL-MBnanoDAC-SDZ** motherboard

### SOFTWARE REQUIRED

**EVAL-AD5326DBZ** evaluation software

### HARDWARE REQUIRED

**EVAL-SDP-CB1Z** board (**SDP-B** controller board), must be purchased separately

### GENERAL DESCRIPTION

This user guide details the operation of the evaluation board for the **AD5326** quad channel, voltage output DAC.

The evaluation board is designed to help users quickly prototype new **AD5326** circuits and reduce design time. The **AD5326** operates from a single 2.5 V to 5.5 V supply.

Full data is available in the **AD5326** data sheet, which must be consulted in conjunction with this user guide when using the evaluation board.

The evaluation board interfaces to the USB port of a PC via the **SDP-B** controller board (**EVAL-SDP-CB1Z**). Software is supplied with the evaluation board to allow the user to program the **AD5326**.

This evaluation board requires **SDP-B** controller board (**EVAL-SDP-CB1Z**), which is available for order on the Analog Devices website at [www.analog.com](http://www.analog.com).

### **EVAL-AD5326DBZ, EVAL-MBnanoDAC-SDZ, AND SDP-B** BOARDS

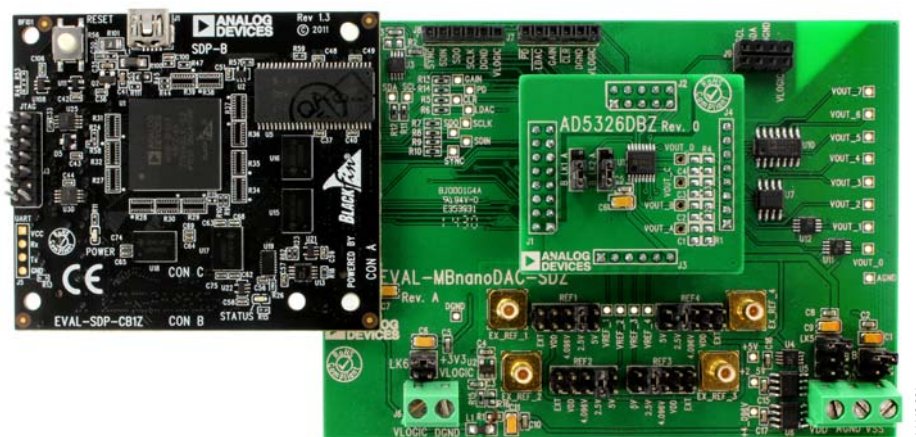


Figure 1.

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REVISION HISTORY

3/2017—Revision 0: Initial Version

## EVALUATION BOARD HARDWARE

### POWER SUPPLIES

The *nanoDAC*® [EVAL-MBnanoDAC-SDZ](#) motherboard supports single and dual power supplies.

The [EVAL-AD5340DBZ](#) evaluation board can be powered either from the [SDP-B](#) port or externally by the J5 and J6 connectors, as described in Table 1.

Both AGND and DGND inputs are provided on the board. The AGND and DGND planes are connected at one location on the [EVAL-MBnanoDAC-SDZ](#). It is recommended that AGND and DGND not be connected elsewhere in the system to avoid ground loop problems.

All supplies are decoupled to ground with 10  $\mu$ F tantalum and 0.1  $\mu$ F ceramic capacitors.

**Table 1. Power Supply Connectors**

| Connector No.    | Label  | Voltage                                                                 |
|------------------|--------|-------------------------------------------------------------------------|
| J5, Pin 1 (J5-1) | VDD    | Analog positive power supply, $V_{DD}$<br>Single and dual supply, 5.5 V |
| J5, Pin 2 (J5-2) | AGND   | Analog ground                                                           |
| J5, Pin 3 (J5-3) | VSS    | Analog negative power supply, $V_{SS}$<br>Dual supply, -5.5 V           |
| J6, Pin 1 (J6-1) | VLOGIC | Digital supply from 1.8 V to $V_{DD}$                                   |
| J6, Pin 2 (J6-2) | DGND   | Digital ground                                                          |

**Table 4. Link Functions**

| Link Number            | Function                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| REF1, REF2, REF3, REF4 | These links select the reference source.<br>Position EXT selects an off board voltage reference via the appropriate EXT_REF connector.<br>Position VDD selects $V_{DD}$ as the reference source.<br>Position 4.096V selects the on-board 4.096 V reference as the reference source.<br>Position 2.5V selects the on-board 2.5 V reference as the reference source.<br>Position 5V selects the on-board 5 V reference as the reference source. |
| LK5                    | This link selects the positive DAC analog voltage source.<br>Position A selects the internal voltage source from the <a href="#">SDP-B</a> board.<br>Position B selects the internal voltage source, 3.3 V from the <a href="#">ADP121</a> on the motherboard.<br>Position C selects the external supply voltage, $V_{DD}$ .                                                                                                                  |
| LK6                    | This link selects the $V_{LOGIC}$ voltage source.<br>Position 3.3V selects the digital voltage source from the <a href="#">SDP-B</a> board (3.3 V).<br>Position VLOGIC selects an external digital supply voltage ( $V_{LOGIC}$ ).                                                                                                                                                                                                            |
| LK7                    | This link selects the negative DAC analog voltage source.<br>Position A selects $V_{SS}$ .<br>Position B selects AGND.                                                                                                                                                                                                                                                                                                                        |

### MOTHERBOARD LINK OPTIONS

Various link options are incorporated in the [EVAL-MBnanoDAC-SDZ](#) and must be set for the required operating conditions before using the board. Table 2 describes the positions of the links to control the evaluation board via the [SDP-B](#) board using a PC and external power supplies. The functions of these link options are described in detail in Table 4.

The positions listed in Table 2 and Table 4 match the evaluation board imprints (see Figure 12).

**Table 2. Link Options Setup for [SDP-B](#) Control (Default)**

| Link Number | Position |
|-------------|----------|
| REF1        | 2.5V     |
| REF2        | EXT      |
| REF3        | EXT      |
| REF4        | EXT      |
| LK5         | C        |
| LK6         | +3.3V    |
| LK7         | B        |

### DAUGHTER BOARD LINK OPTIONS

The [EVAL-AD5340DBZ](#) daughter board has two link options. These links set the least significant bits (LSBs) of the I<sup>2</sup>C addresses of the DAC. Table 3 describes the function of these links. Set LK1 and LK2 to Position B for proper device operation.

**Table 3. Link Options for Daughter Board**

| Link Number | Label | Position                     |
|-------------|-------|------------------------------|
| LK1         | A0    | B (low, default)<br>A (high) |
| LK2         | A1    | B (low, default)<br>A (high) |

## EVALUATION BOARD SOFTWARE QUICK START PROCEDURES

### INSTALLING THE SOFTWARE

The [AD5326](#) evaluation software is compatible with Windows® Vista (64-bit/32-bit) and Windows 7 (64-bit/32-bit).

Install the software before connecting the [SDP-B](#) board to the USB port of the PC to ensure that the [SDP-B](#) board is recognized when it connects to the PC.

To install the [AD5326](#) evaluation software, take the following steps:

1. Start the Windows operating system.
2. Download the installation software from the [EVAL-AD5326DBZ](#) evaluation board page.
3. Run the **setup.exe** file from the installer folder if it does not open automatically.
4. After the installation is complete, power up the evaluation board as described in the Power Supplies section.
5. Connect the [EVAL-AD5326DBZ](#) evaluation board to the [SDP-B](#) controller board and connect the [SDP-B](#) board to the PC using the USB cable included in the evaluation kit.
6. When the software detects the [EVAL-AD5326DBZ](#), proceed through any dialog boxes that appear to finalize the installation.

### RUNNING THE SOFTWARE

To run the program, do the following:

1. Connect the evaluation board to the [SDP-B](#) board and connect the USB cable between the [SDP-B](#) board and the PC.
2. Power up the evaluation board as described in the Power Supplies section.
3. From the **Start** menu, click **All Programs, Analog Devices, AD5326 Evaluation Software**.

If the [SDP-B](#) board is not connected to the USB port when the software is launched, a connectivity error displays (see Figure 2). Simply connect the evaluation board to the USB port of the PC and wait a few seconds. When the [SDP-B](#) board is detected, the display is updated (see Figure 3).

Alternatively, the software can be used without an evaluation board. The software runs in simulation mode displaying expected outputs based on the input data. The main window of the [AD5326](#) evaluation software then opens, as shown in Figure 4.

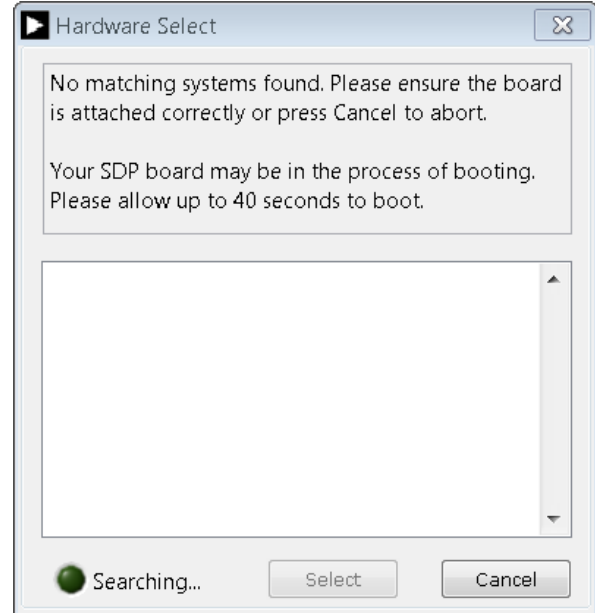


Figure 2. Connectivity Error

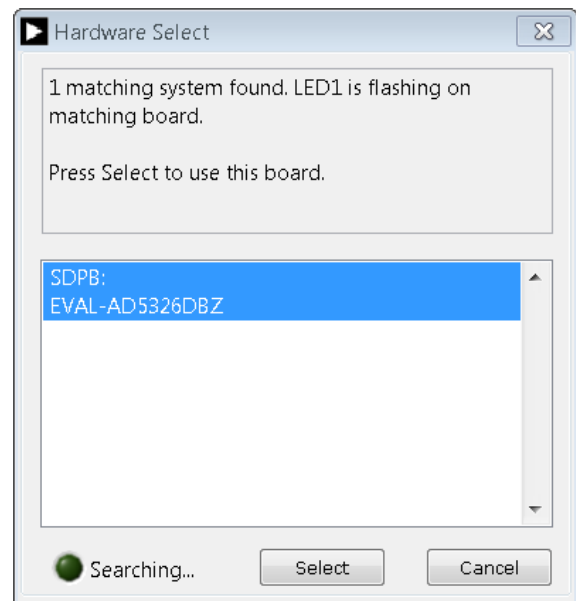


Figure 3. Hardware Select

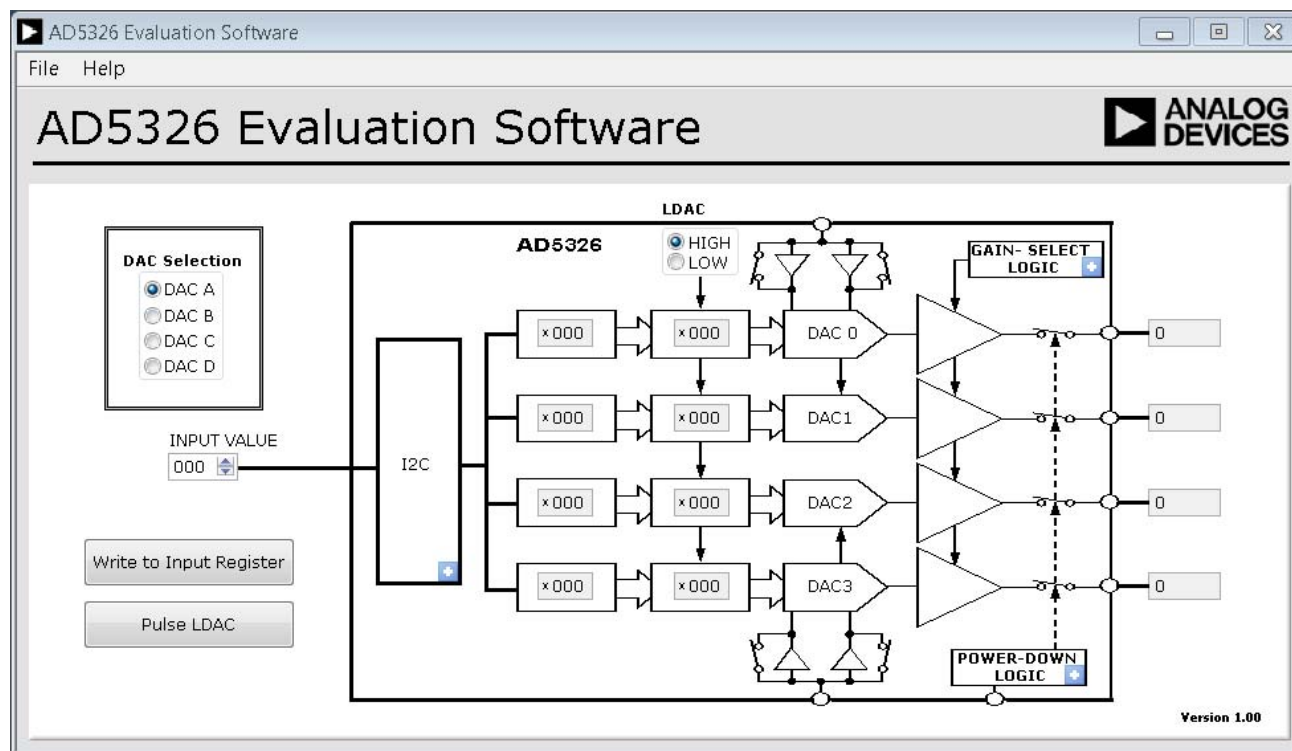


Figure 4. AD5326 Evaluation Board Software Main Window

## SOFTWARE OPERATION

The software for the AD5326 allows the user to program values to the input and DAC registers of each DAC individually.

### Write to Input Register

Click **Write to Input Register** to load the code of the input data control to the input register of the selected DAC in the **DAC Selection** box.

### LDAC Control

Click **Pulse LDAC** to bring the  $\overline{\text{LDAC}}$  pin low and then back to high. Doing this copies the data from the input registers to the DAC registers, and the outputs update accordingly. The  $\overline{\text{LDAC}}$  pin can also be set high or low by clicking **HIGH** or **LOW** in the **LDAC** box.

### Power-Down Control

All of the DACs can be powered down simultaneously. A selection box allows the device to operate in normal mode or power-down mode. Click the blue progressive disclosure button in the **Power-Down Logic** block to access the **Powerdown Configuration** window, as shown in Figure 5. Click **OK** to write the appropriate values to the AD5326 when the power-down setting for the DAC is selected.

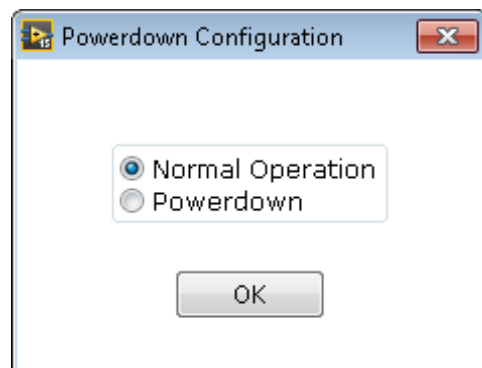


Figure 5. Powerdown Configuration Window

### Gain Control

The gain control of each of the DACs can be set individually. Click the blue progressive disclosure button in the **Gain-Select Logic** block to access the **Gain Control** window, as shown in Figure 6. Click **X1** to set a full-scale output of 2.5 V or click **X2** to set a full-scale output of 5 V.

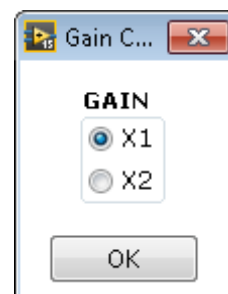


Figure 6. Gain Control Window

**Buffer Control**

The reference buffer of each of the DACs can be set individually. Click the blue progressive disclosure button in the **I2C** box to access the **Buffer Config** window, as shown in Figure 7. Select the buffer setting and click on **OK** to apply the DAC configuration.

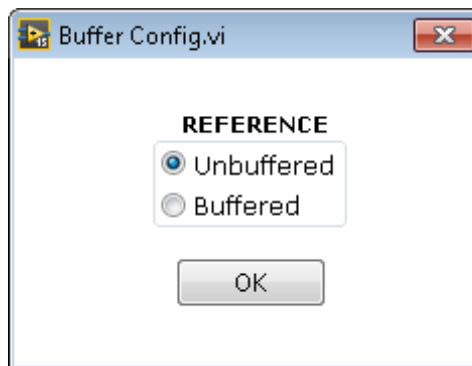


Figure 7. Buffer Configuration Window

## EVALUATION BOARD SCHEMATICS AND ARTWORK

## EVAL-MBnanoDAC-SDZ MOTHERBOARD

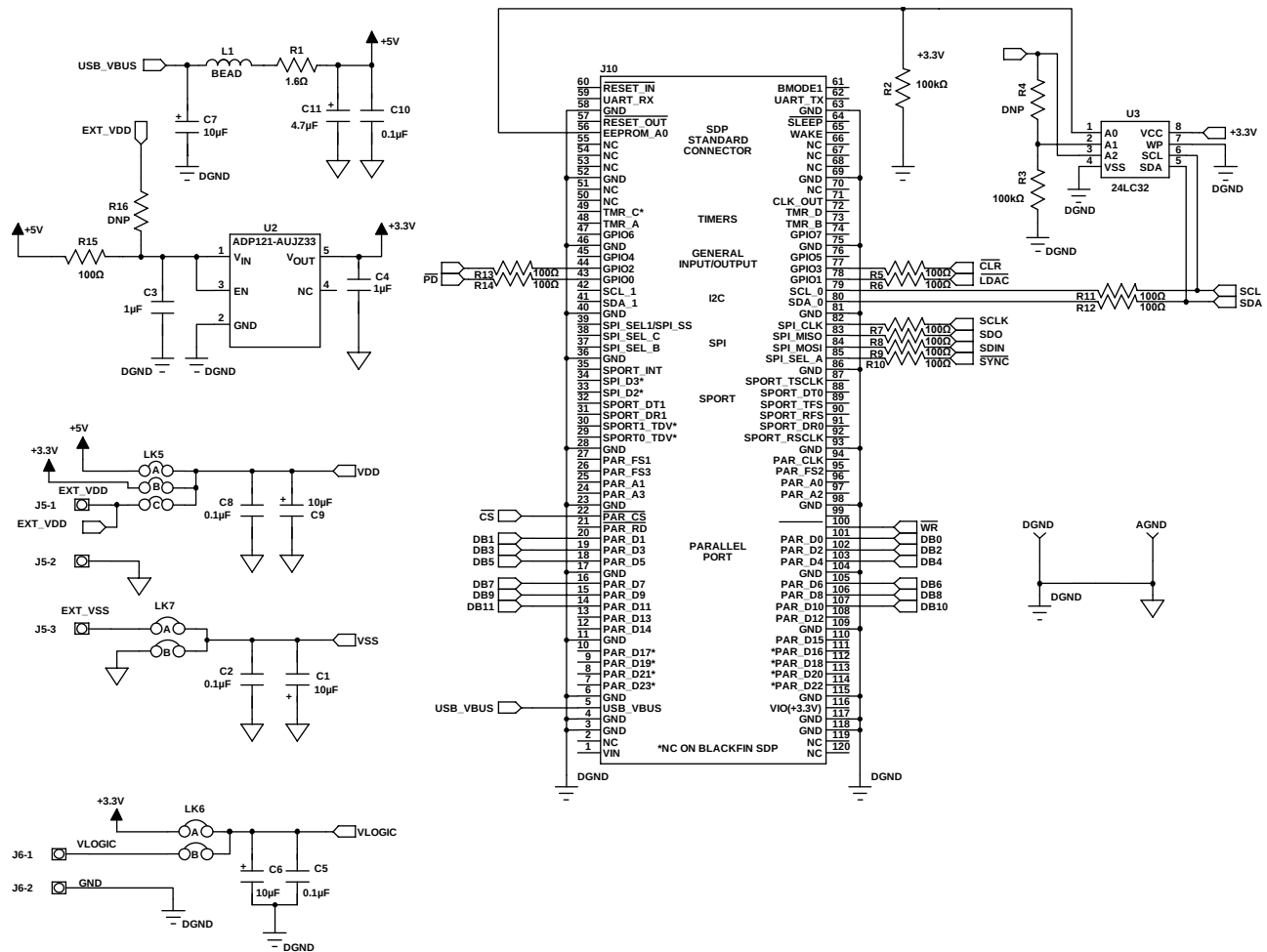


Figure 8. Motherboard SDP-B Connector and Power Supply

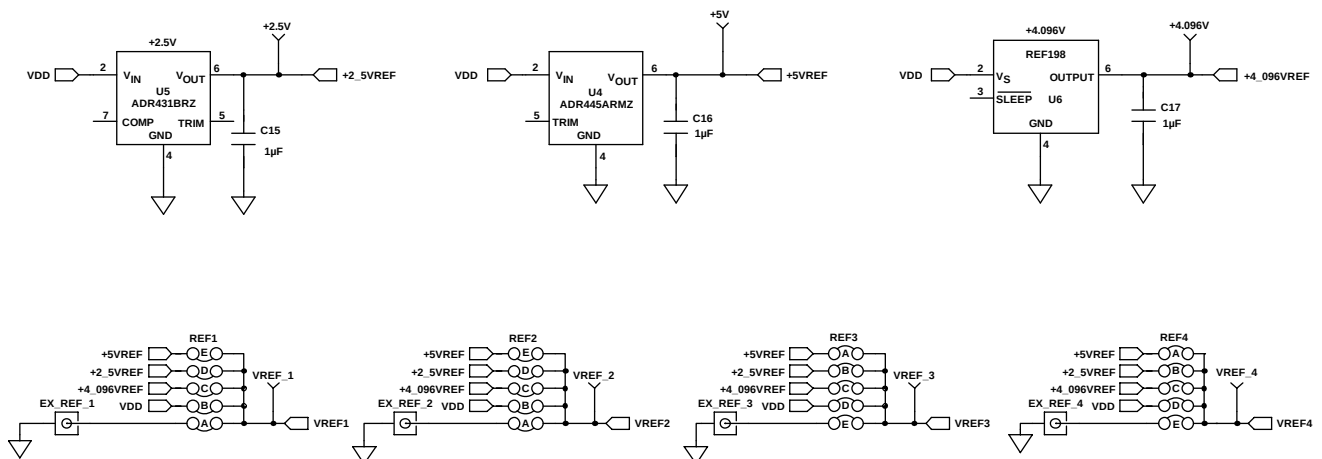


Figure 9. Motherboard Reference Voltage Selector Circuit

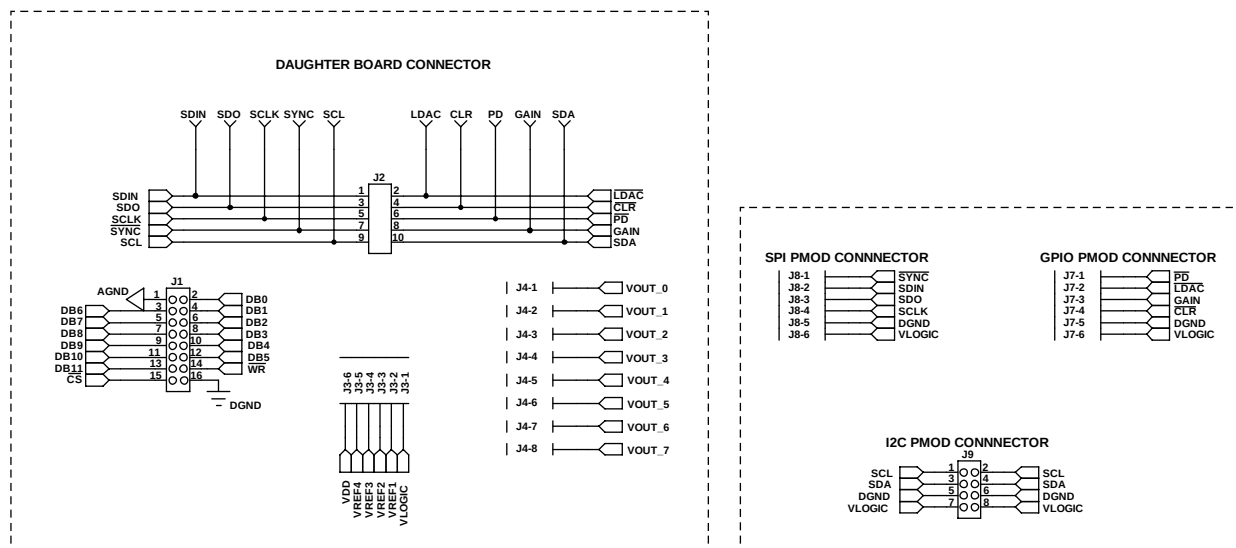


Figure 10. Motherboard Connectors to Daughter Board and Serial Interface

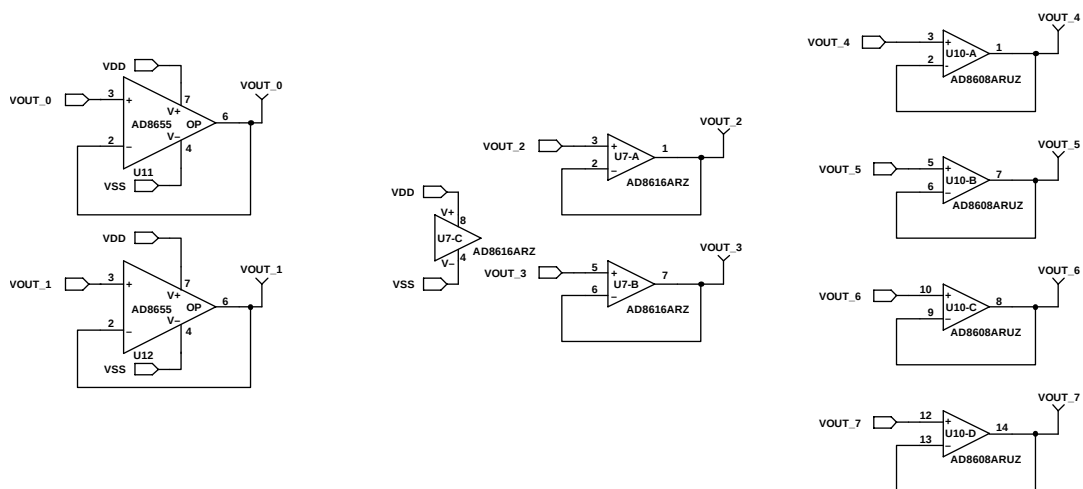


Figure 11. Motherboard Output Amplifier Circuit



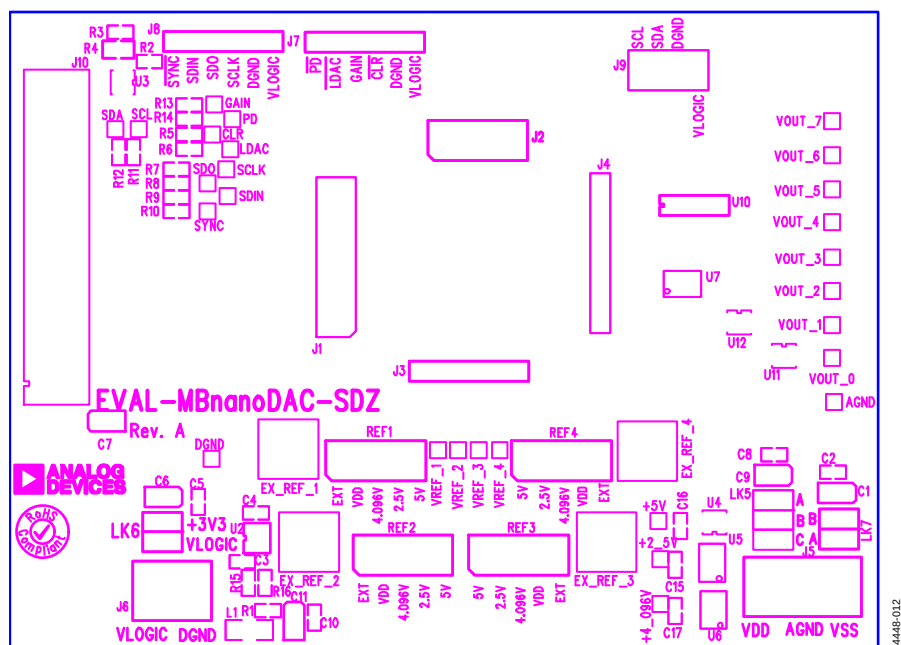


Figure 12. Motherboard Component Placement

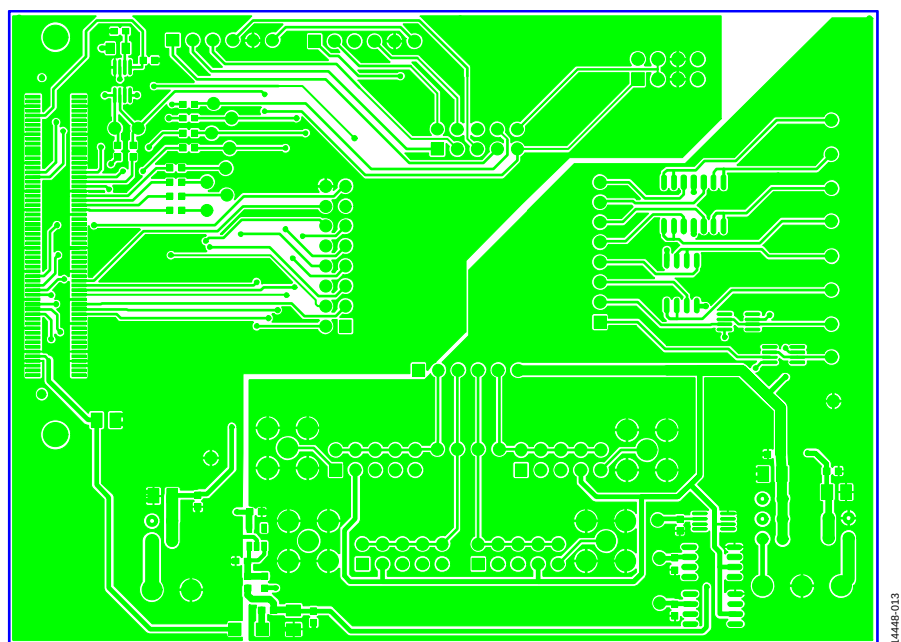


Figure 13. Motherboard Top Side Routing

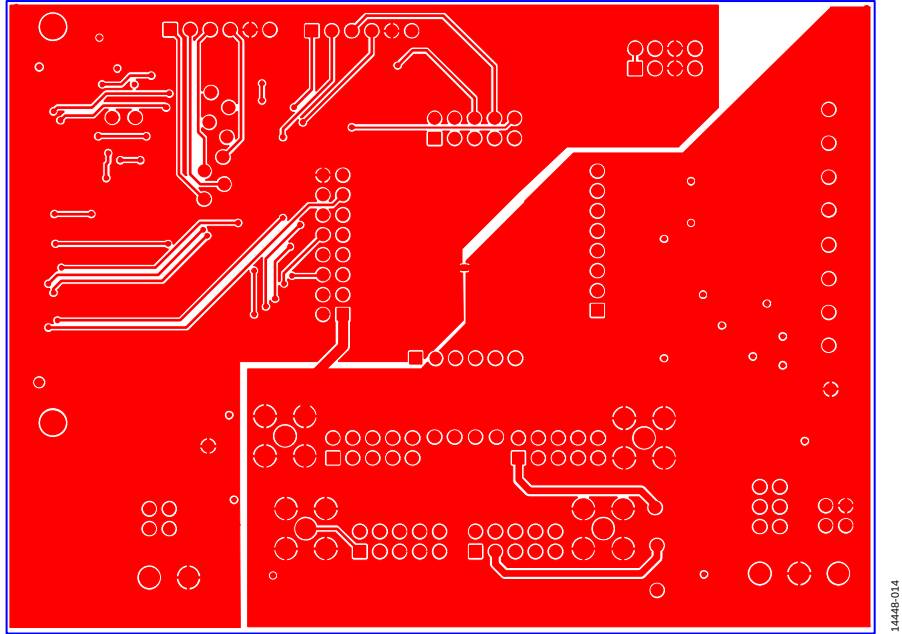


Figure 14. Motherboard Bottom Side Routing

## EVAL-AD5326DBZ DAUGHTER BOARD

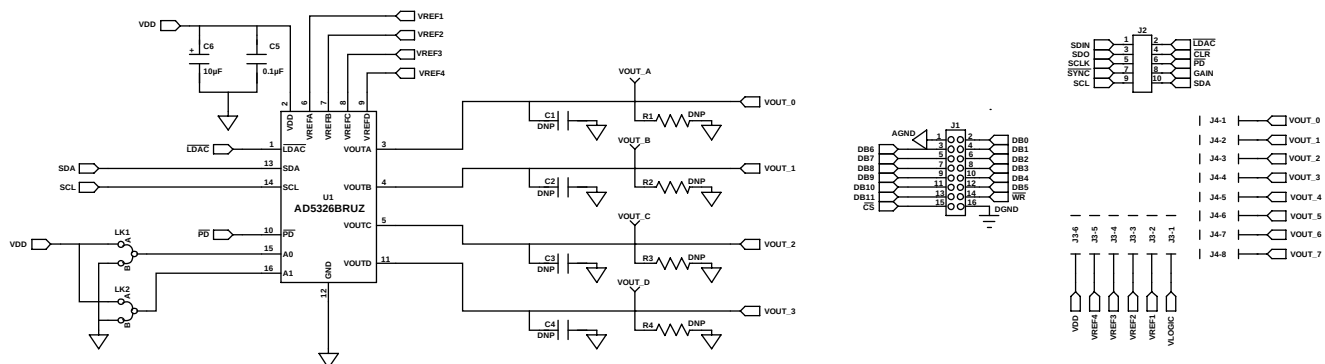


Figure 15. Daughter Board Schematics

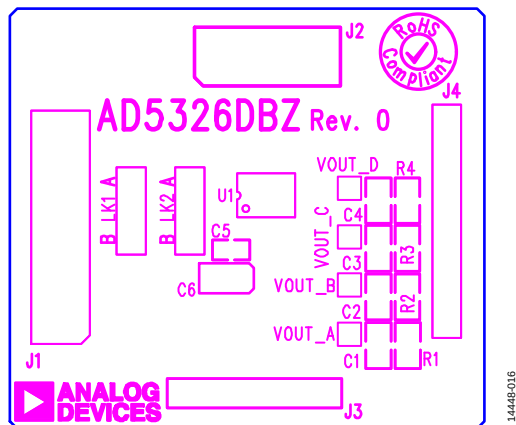


Figure 16. Daughter Board Component Placement

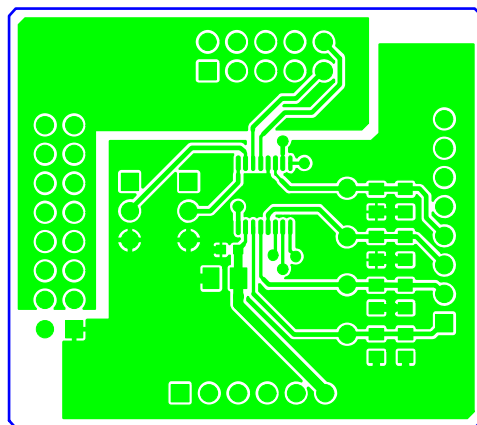


Figure 17. Daughter Board Top Side Routing

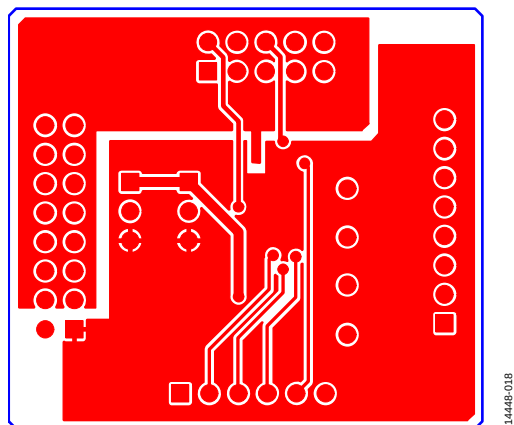


Figure 18. Daughter Board Bottom Side Routing

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 5. Components List for Motherboard

| Qty | Reference Designator        | Description                                                | Stock Code/Part Number <sup>1, 2</sup>         |
|-----|-----------------------------|------------------------------------------------------------|------------------------------------------------|
| 4   | C1, C6, C7, C9              | 6.3 V, tantalum capacitor (Case A), 10 $\mu$ F, $\pm$ 20%  | FEC 1190107                                    |
| 7   | C2, C5, C8, C10, C15 to C17 | 50 V, X7R, ceramic capacitor, 0.1 $\mu$ F, $\pm$ 10%       | FEC 1759122                                    |
| 2   | C3, C4                      | 10V, X5R, ceramic capacitor, 1 $\mu$ F, $\pm$ 10%          | GRM188R61A105KA61D                             |
| 1   | C11                         | 6.3 V, tantalum capacitor (Case A), 4.7 $\mu$ F, $\pm$ 20% | FEC 1432350                                    |
| 4   | EXT_REF_1 to EXT_REF_4      | Straight PCB mount, SMB jack, 50 $\Omega$                  | FEC 1206013                                    |
| 1   | J1                          | Header, 2.54 mm, 2 $\times$ 8-way                          | FEC 2308428                                    |
| 1   | J2                          | Header, 2.54 mm, 2 $\times$ 5-way                          | FEC 9689583                                    |
| 3   | J3, J7, J8                  | Header, 2.54 mm, 1 $\times$ 6-way                          | FEC 9689508                                    |
| 1   | J4                          | Header, 2.54 mm, 1 $\times$ 8-way                          | FEC 1766172                                    |
| 1   | J5                          | 3-pin terminal block                                       | FEC 1667472                                    |
| 1   | J6                          | 2-pin terminal block                                       | FEC 151789                                     |
| 1   | J9                          | Header, 2.54 mm, 2 $\times$ 4-way                          | FEC 1667509                                    |
| 1   | J10                         | 120-way connector                                          | FEC 1324660                                    |
| 1   | L1                          | Inductor, SMD, 600 $\Omega$                                | FEC 9526862                                    |
| 1   | LK5                         | 6-pin (3 $\times$ 2), 0.1 inch header and shorting block   | FEC 148-535 and 150-411 (36-pin strip)         |
| 2   | LK6, LK7                    | 4-pin (2 $\times$ 2), 0.1 inch header and shorting block   | FEC 148-535 and 150-411 (36-pin strip)         |
| 4   | REF1, REF2, REF3, REF4      | 10-pin (5 $\times$ 2), 0.1 inch header and shorting block  | FEC 1022227 and 150-411                        |
| 1   | R1                          | Resistor, surge, 1.6 $\Omega$ , 1%, 0603                   | FEC 1627674                                    |
| 2   | R2, R3                      | SMD resistor, 100 k $\Omega$ , 1%, 0603                    | FEC 9330402                                    |
| 11  | R5 to R15                   | SMD resistor, 100 $\Omega$ , 1%, 0603                      | FEC 9330364                                    |
| 1   | U2                          | 3.3 V linear regulator                                     | Analog Devices <a href="#">ADP121-AUJZ33R7</a> |
| 1   | U3                          | 32 kb I <sup>2</sup> C serial EEPROM                       | FEC 1331330                                    |
| 1   | U4                          | 5 V reference, 8-lead MSOP                                 | Analog Devices <a href="#">ADR445ARMZ</a>      |
| 1   | U5                          | Ultralow noise XFET <sup>®</sup> voltage reference         | Analog Devices <a href="#">ADR431BRZ</a>       |
| 1   | U6                          | 4.096 V reference                                          | Analog Devices <a href="#">REF198ESZ</a>       |
| 1   | U7                          | Dual op amp                                                | Analog Devices <a href="#">AD8616ARZ</a>       |
| 1   | U10                         | Quad op amp                                                | Analog Devices <a href="#">AD8608ARMZ</a>      |
| 2   | U11, U12                    | Op amp                                                     | Analog Devices <a href="#">AD8655ARMZ</a>      |

<sup>1</sup> FEC refers to Farnell electronic component distributors.<sup>2</sup> GRM refers to Murata electronic component distributors.

Table 6. Components List for Daughter Board

| Qty | Reference Designator | Description                                               | Stock Code/Part Number <sup>1</sup>       |
|-----|----------------------|-----------------------------------------------------------|-------------------------------------------|
| 1   | C1                   | Not applicable                                            | Not inserted                              |
| 1   | C2                   | Not applicable                                            | Not inserted                              |
| 1   | C3                   | Not applicable                                            | Not inserted                              |
| 1   | C4                   | Not applicable                                            | Not inserted                              |
| 1   | C5                   | 50 V, X7R, ceramic capacitor, 0.1 $\mu$ F, $\pm$ 10%      | FEC 1759122                               |
| 1   | C6                   | 6.3 V, tantalum capacitor (Case A), 10 $\mu$ F, $\pm$ 20% | FEC 1190107                               |
| 1   | J1                   | 16-pin (2 $\times$ 8) header                              | FEC 2308428 inserted from solder side     |
| 1   | J2                   | 10-pin (2 $\times$ 5) straight header, 2.54 mm pitch      | FEC 9689583 inserted from solder side     |
| 1   | J3                   | 6-pin (1 $\times$ 6) straight header, 2.54 mm pitch       | FEC 9689508 inserted from solder side     |
| 1   | J4                   | Header, 2.54 mm, PCB, 1 $\times$ 8-way                    | FEC 1766172 inserted from solder side     |
| 2   | LK1, LK2             | Jumper block using 3-pin, single in-line header           | FEC 1022248 and 150410                    |
| 1   | R1                   | Not applicable                                            | Not inserted                              |
| 1   | R2                   | Not applicable                                            | Not inserted                              |
| 1   | R3                   | Not applicable                                            | Not inserted                              |
| 1   | R4                   | Not applicable                                            | Not inserted                              |
| 1   | U1                   | DAC                                                       | Analog Devices <a href="#">AD5326BRUZ</a> |
| 1   | VOUT_A               | Red test point                                            | Do not insert                             |
| 1   | VOUT_B               | Red test point                                            | Do not insert                             |
| 1   | VOUT_C               | Red test point                                            | Do not insert                             |
| 1   | VOUT_D               | Red test point                                            | Do not insert                             |

<sup>1</sup> FEC refers to Farnell electronic component distributors

<sup>1</sup>2C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors)

**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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