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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



## Evaluation Board for the **AD5310R** 10-Bit, Single-Channel, Voltage Output DAC

### FEATURES

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

On-board references

Various link options

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

### PACKAGE CONTENTS

**EVAL-AD5310RDBZ** board

**EVAL-MBnanoDAC-SDZ** motherboard

### SOFTWARE REQUIRED

**EVAL-AD5310RDBZ** evaluation software

### HARDWARE REQUIRED

**EVAL-SDP-CB1Z (SDP-B)** board or **EVAL-SDP-CS1Z (SDP-S)** board, must be purchased separately

### DOCUMENTS REQUIRED

Electronic version of the **EVAL-AD5310RDBZ** user guide

Electronic version of the **AD5310RDBZ** data sheet

### GENERAL DESCRIPTION

This user guide details the operation of the evaluation board for the **AD5310R** single-channel, voltage output, digital-to-analog converter (DAC).

The **EVAL-AD5310RDBZ** evaluation board is designed to help users quickly prototype **AD5310R** circuits and reduce design time. The **AD5310R** operates from a single 2.7 V to 5.5 V supply.

For full data, see the **AD5310R** data sheet, which must be used 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 board. Software is available for download from the **EVAL-AD5310RDBZ** evaluation board page to allow the user to program the **AD5310R**.

This evaluation board requires the **EVAL-SDP-CB1Z** board (**SDP-B** controller board) or the **EVAL-SDP-CS1Z** board (**SDP-S** controller board), which are available for order on the Analog Devices website.

### **EVAL-AD5310RDBZ, EVAL-MBnanoDAC-SDZ, AND SDP-B EVALUATION BOARDS PHOTOGRAPH**

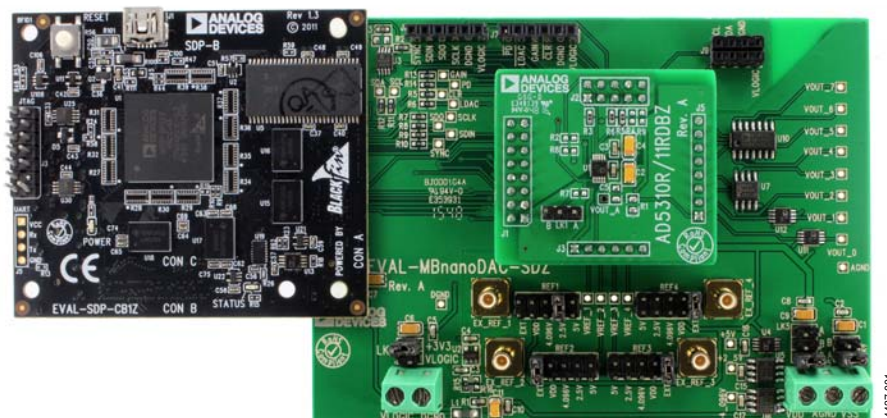


Figure 1.

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**REVISION HISTORY**

**3/2017—Revision 0: Initial Version**



## EVALUATION BOARD HARDWARE

### MOTHERBOARD POWER SUPPLIES

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

The [EVAL-AD5310RDBZ](#) evaluation board can be powered from the SDP 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 connect at one location on the [EVAL-MBnanoDAC-SDZ](#). The AGND and DGND inputs must not be connected elsewhere in the system, because this causes ground loop problems.

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

**Table 1. Power Supply Connectors**

Connector No.	Label	Voltage
J5, Pin 1 (J5-1)	VDD	Analog positive power supply, $V_{\text{DD}}$ 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, $V_{\text{SS}}$ dual supply, $-5.5\text{ V}$ .
J6, Pin 1 (J6-1)	VLOGIC	Digital supply from 1.8 V to $V_{\text{DD}}$ of the daughter board DAC.
J6, Pin 2 (J6-2)	DGND	Digital ground.

### MOTHERBOARD LINK OPTIONS

A number of link options are incorporated in the [EVAL-MBnanoDAC-SDZ](#) and must be set to the required operating

**Table 3. Motherboard Link Functions**

Link No.	Function
REF1 to REF4	These links select the reference source. Position EXT selects an off-board voltage reference via the appropriate EXT_REF_x connector. Position VDD selects $V_{\text{DD}}$ as the reference source. Position 4.096V selects the on-board 4.096 V reference as the reference source. Position 2.5V selects the on-board 2.5 V reference as the reference source. Position 5V selects the on-board 5 V reference as the reference source.
LK5	This link selects the positive DAC analog voltage source. Position A selects the internal voltage source from the <a href="#">SDP-B</a> or <a href="#">SDP-S</a> board. Position B selects the internal voltage source 3.3 V from the <a href="#">ADP121</a> on the motherboard. Position C selects an external supply voltage, $V_{\text{DD}}$ .
LK6	This link selects the VLOGIC voltage source. Position 3.3V selects the digital voltage source from the <a href="#">SDP-B</a> or <a href="#">SDP-S</a> board, 3.3 V. Position VLOGIC selects an external digital supply voltage, $V_{\text{LOGIC}}$ .
LK7	This link selects the negative DAC analog voltage source. Position A selects $V_{\text{SS}}$ . Position B selects AGND.

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 3. The positions listed in Table 2 and Table 3 match the evaluation board imprints (see Figure 11).

**Table 2. Default Link Options Setup for SDP-B Control**

Link No.	Position
REF1	2.5V
REF2	EXT
REF3	EXT
REF4	EXT
LK5	C
LK6	3.3V
LK7	B

### EVAL-AD5310RDBZ DAUGHTER BOARD LINK OPTIONS

The [EVAL-AD5310RDBZ](#) daughter board shares the same printed circuit board (PCB) layout with the [EVAL-AD5311RDBZ](#). To configure the board for [AD5310R](#) evaluation, LK1 must be removed to ensure that the SCLK pin is not directly connected to  $V_{\text{DD}}$ .

## EVALUATION BOARD SOFTWARE

### SOFTWARE INSTALLATION

The [EVAL-AD5310RDBZ](#) evaluation software is compatible with Windows® Vista (64-bit/32-bit), and Windows 7 (64-bit/32-bit).

The software must be installed before connecting the [SDP-B](#) or [SDP-S](#) board to the USB port of the PC to ensure that the [SDP-B](#) or [SDP-S](#) board is recognized when it connects to the PC.

To install the software, take the following steps:

1. Start the Windows operating system. Download the installation software from the [EVAL-AD5310RDBZ](#) evaluation board page.
2. Run the setup.exe file from the installer folder if it does not open automatically.
3. After installation is completed, power up the evaluation board as described in the Motherboard Power Supplies section.
4. Connect the evaluation board to the [SDP-B](#) or [SDP-S](#) board and plug the [SDP-B](#) or [SDP-S](#) board into the PC using the USB cable included in the evaluation kit.
5. When the software detects the evaluation board, proceed through any dialog boxes that appear to finalize the installation.

### LAUNCHING THE SOFTWARE

To launch the software, take the following steps:

1. Connect the evaluation board to the [SDP-B](#) or [SDP-S](#) board and connect the USB cable between the [SDP-B](#) or [SDP-S](#) board and the PC.
2. Power up the evaluation board as described in the Motherboard Power Supplies section.
3. From the **Start** menu, click **All Programs, Analog Devices, AD5310R Evaluation Software**.
4. If the [SDP-B](#) or [SDP-S](#) board is not connected to the USB port when the software is launched, a connectivity error displays (see Figure 2). Connect the evaluation board to the USB port of the PC and wait a few seconds. When the [SDP-B](#) or [SDP-S](#) 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 [AD5310R](#) evaluation software then opens, as shown in Figure 4.

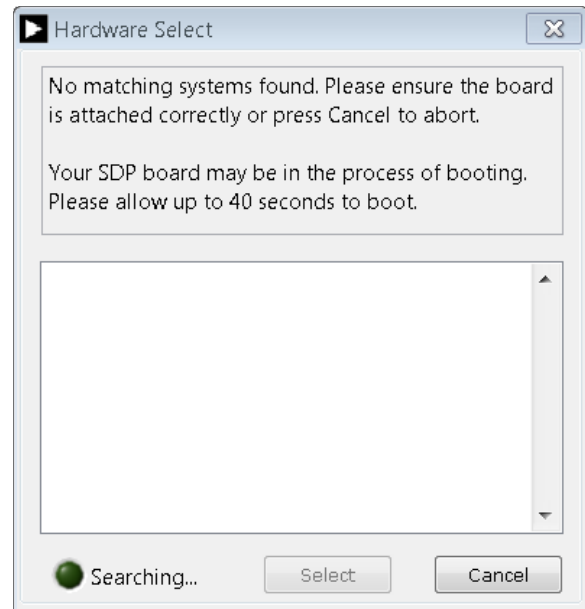


Figure 2. Connectivity Error

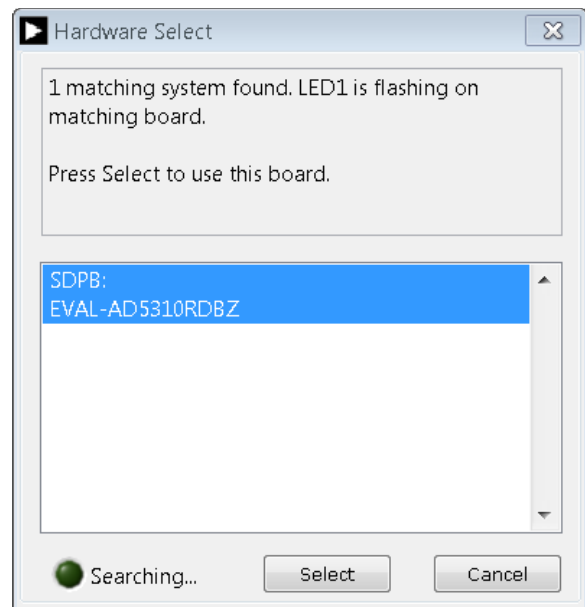


Figure 3. Hardware Select window

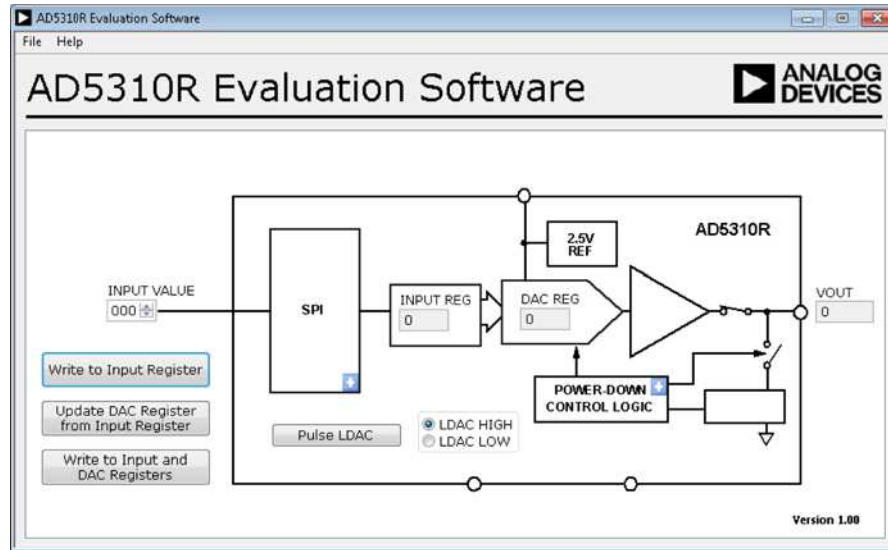


Figure 4. AD5310R Evaluation Software Main Window

**SOFTWARE OPERATION**

The software for the AD5310R allows the user to program values to the input and DAC registers of each DAC individually or collectively.

**Write to Input Register**

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

**Update DAC Register from Input Register**

Click **Update DAC Register from Input Register** to copy the value in the input register to the DAC register. The DAC output automatically updates with the appropriate voltage.

**Write to Input and DAC Registers**

Click **Write to Input and DAC Registers** to load the code of the input data control to the input register and DAC register of the DAC. The DAC output automatically updates with the appropriate voltage.

**LDAC Control**

Click **Pulse LDAC** to bring the LDAC pin low and then back high. Doing this copies the data from the input register to the DAC register, and the output updates accordingly.

The LDAC pin can also be set high or low by clicking **LDAC HIGH** or **LDAC LOW**.

**Power-Down Control**

The DAC has a selection box allowing the device to operate in normal mode or three different power-down modes, as shown in Figure 5. Click the blue expand button on the **POWER-DOWN CONTROL LOGIC** block to access the selection box (see Figure 4). When the power-down setting for the DAC is selected, click **OK** to write the appropriate values to the AD5310R.

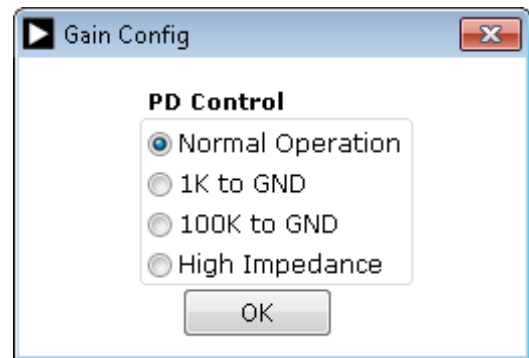


Figure 5. PD Control Selection Box in the Gain Config Window

**GAIN Control**

The GAIN pin can also be set high or low by clicking the blue expand button on the **SPI** block (see Figure 4). In the **GAIN** selection box of the **Gain Config** window, select **X1** for a full-scale output of 2.5 V or select **X2** for a full-scale output of 5 V, as shown in Figure 6.

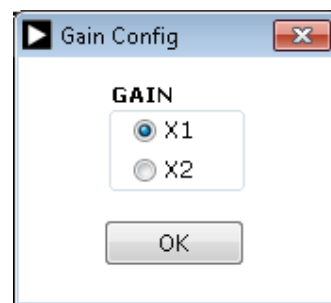


Figure 6. GAIN Selection Box in the Gain Config Window

**EVALUATION BOARD SCHEMATICS AND ARTWORK**  
**EVAL-MBnanoDAC-SDZ MOTHERBOARD**

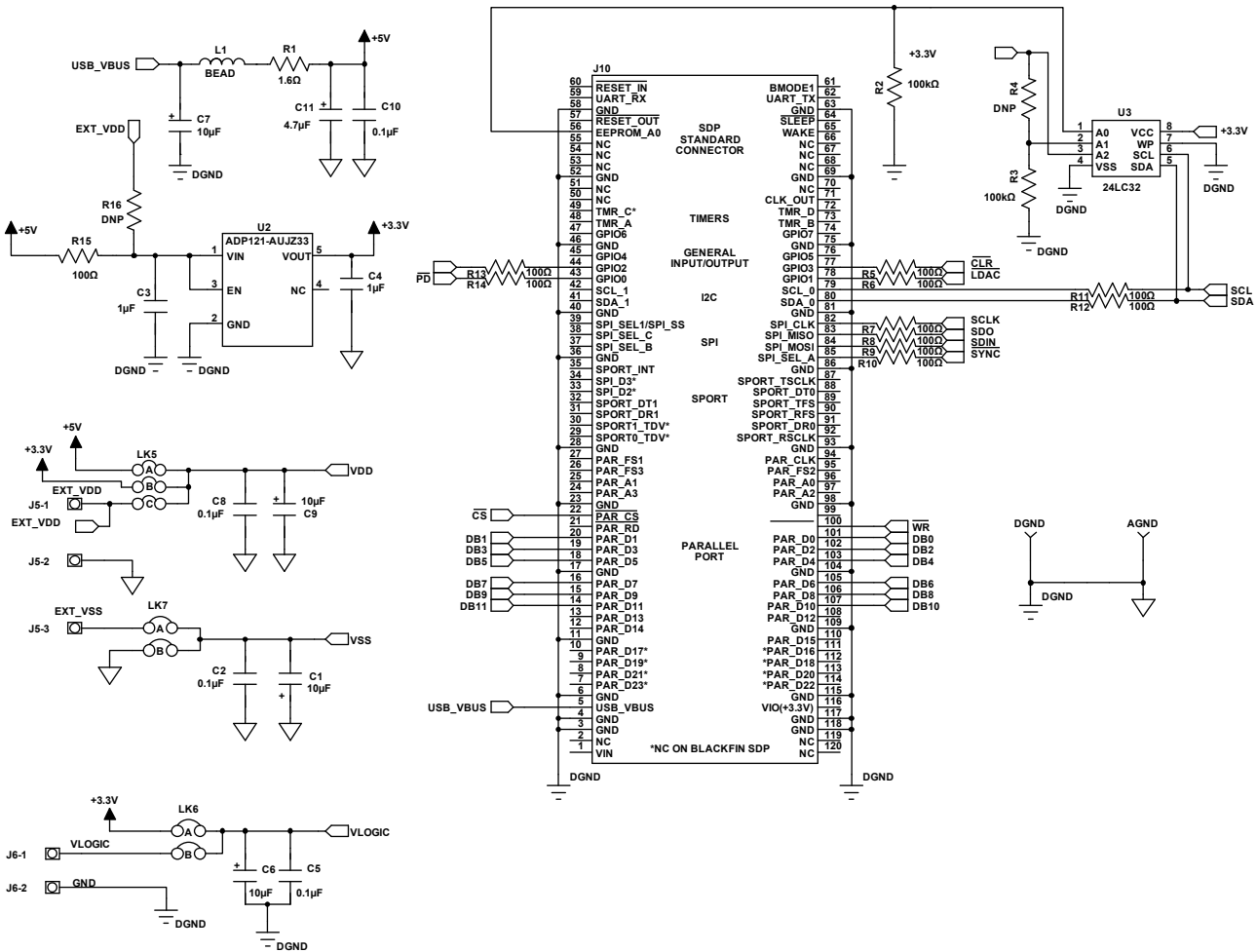


Figure 7. EVAL-MBnanoDAC-SDZ Motherboard, SDP-B Connector, and Power Supply

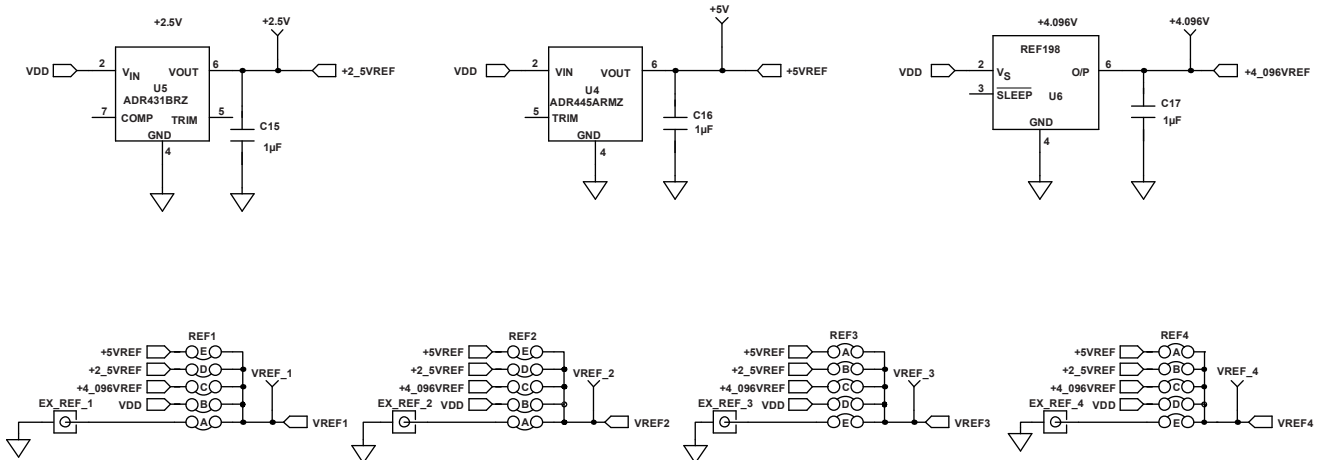


Figure 8. EVAL-MBnanoDAC-SDZ Motherboard Reference Voltage Selector Circuit

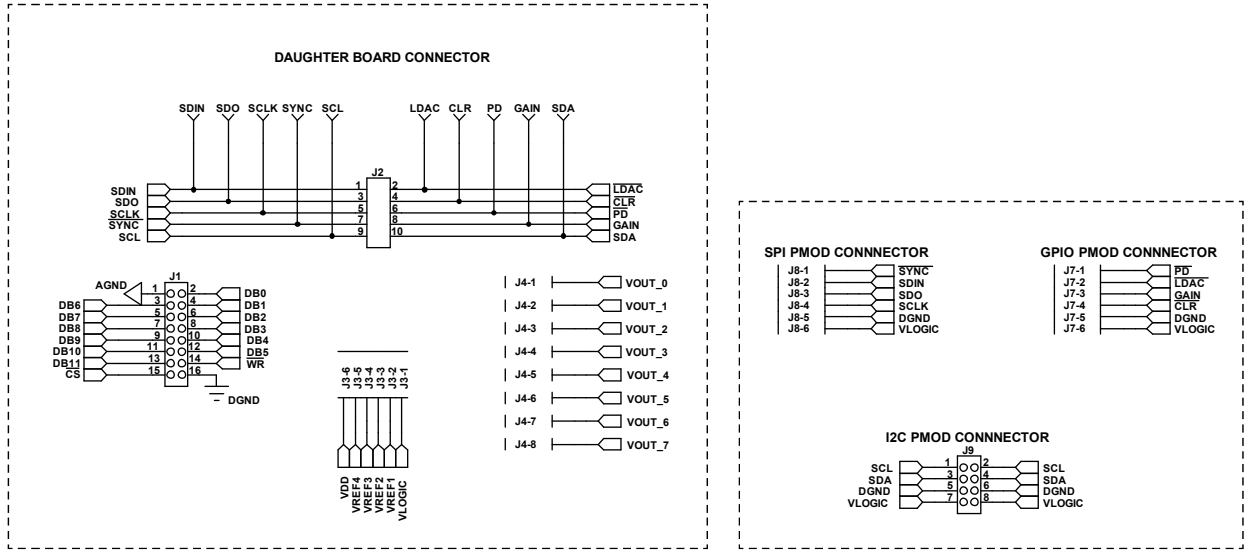


Figure 9. EVAL-MBnanoDAC-SDZ Motherboard Connectors to Daughter Board and Serial Interface

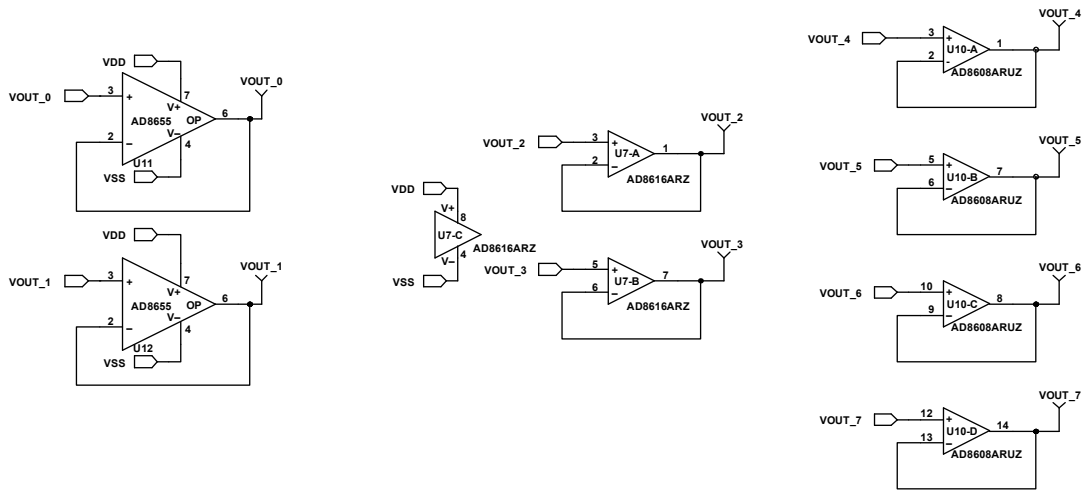


Figure 10. EVAL-MBnanoDAC-SDZ Motherboard Output Amplifier Circuit



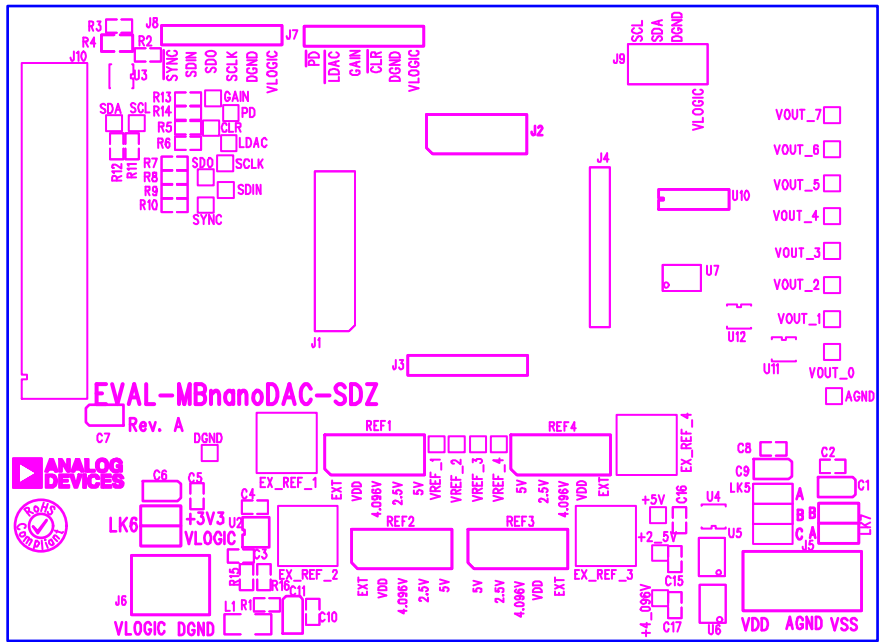


Figure 11. EVAL-MBnanoDAC-SDZ Motherboard Component Placement

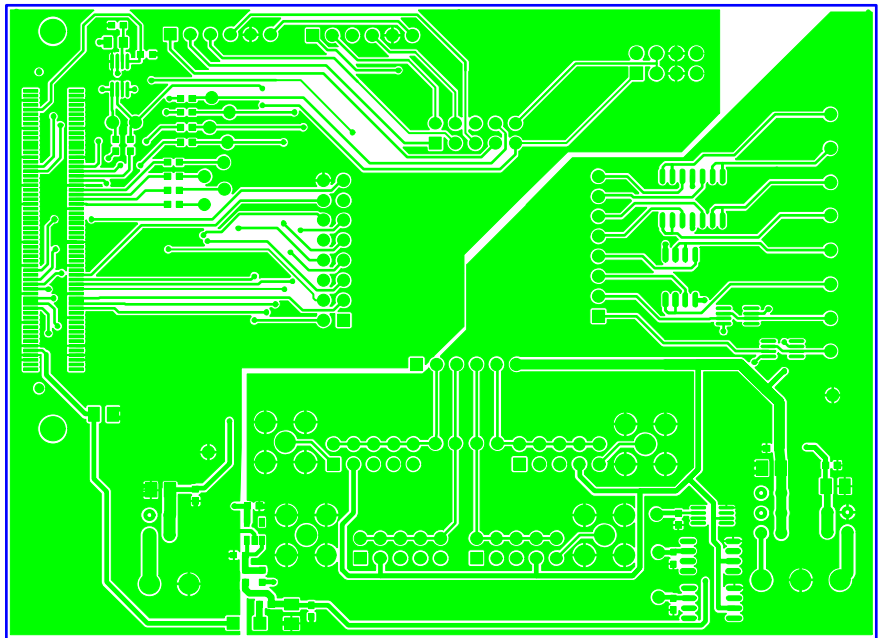


Figure 12. EVAL-MBnanoDAC-SDZ Motherboard Top Side Routing

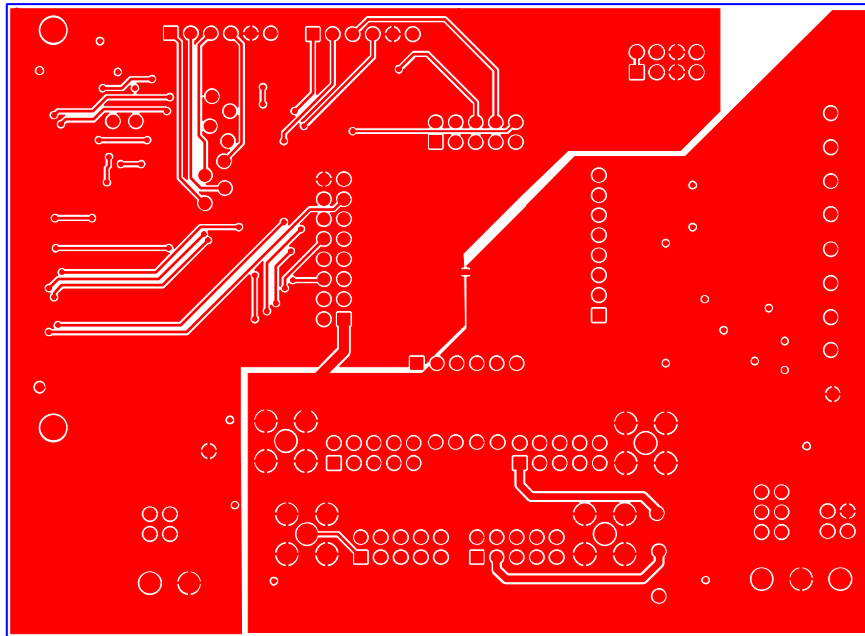


Figure 13. EVAL-MBnanoDAC-SDZ Motherboard Bottom Side Routing

**EVAL-AD5310RDBZ DAUGHTER BOARD**

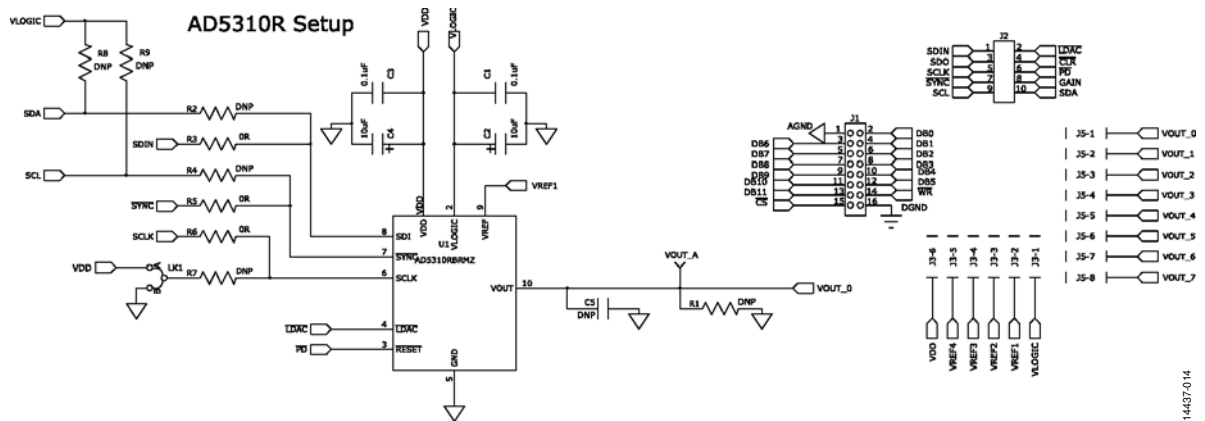


Figure 14. EVAL-AD5310RDBZ Daughter Board Schematics

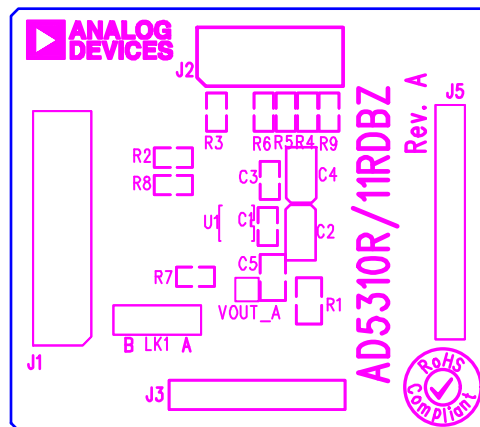
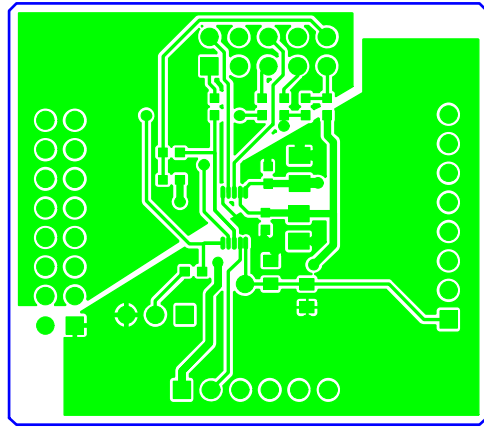
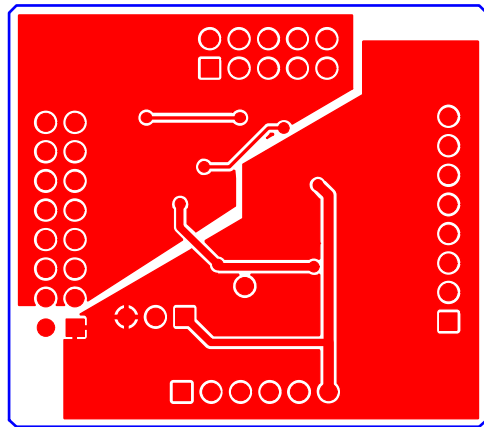


Figure 15. EVAL-AD5310RDBZ Daughter Board Component Placement



14437-016

Figure 16. EVAL-AD5310RDBZ Daughter Board Top Side Routing



14437-017

Figure 17. EVAL-AD5310RDBZ Daughter Board Bottom Side Routing

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 4. EVAL-MBnanoDAC-SDZ Motherboard

Qty	Reference Designator	Description	Supplier/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, C16, C17	50 V, X7R, ceramic capacitor, 0.1 $\mu$ F, $\pm$ 10%	FEC/1759122
2	C3, C4	10 V, 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", header and shorting block	FEC/148-535 and 150-411 (36-pin strip)
2	LK6, LK7	4-pin (2 $\times$ 2) 0.1", header and shorting block	FEC/148-535 and 150-411 (36-pin strip)
4	REF1 to REF4	10-pin (5 $\times$ 2) 0.1", 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 MSOP	Analog Devices/ <a href="#">ADR445ARMZ</a>
1	U5	Ultralow noise XFET 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 Manufacturing Company.

Table 5. EVAL-AD5310RDBZ Daughter Board

Qty	Reference Designator	Description	Supplier/Part Number <sup>1</sup>
2	C1, C3	50 V, X7R, ceramic capacitor, 0.1 $\mu$ F, $\pm$ 10%	C0603C104K5RAC-TU
2	C2, C4	6.3 V, tantalum capacitor (Case A), 10 $\mu$ F, $\pm$ 20%	MCCTA106M006
1	C5	Not applicable	Not applicable
1	J1	16-pin (2 $\times$ 8) header	BCS-108-L-D-TE
1	J2	10-pin (2 $\times$ 5) straight header, 2.54 mm pitch	1241050-5
1	J3	6-pin (1 $\times$ 6) straight header, 2.54 mm pitch	1241150-6
1	J5	Header, 2.54 mm, PCB, 1 $\times$ 8-way	BBS-108-T-A
1	LK1	Jumper block using 3-pin SIP header	M20-9990345 and M7567-05
1	R1	Not applicable	Not applicable
3	R2, R4, R7	Resistor, 0603, 1%, 0 $\Omega$	FEC/9331662
3	R3, R5, R6	Resistor, 0603, 1%, 0 $\Omega$	Do not insert
2	R8, R9	SMD resistor, 0603, 1%, 2.2 k $\Omega$	Do not insert
1	U1	10-bit DAC	Analog Devices/ <a href="#">AD5310BRMZ</a>
1	VOUT_A	Red test point	20-313137

<sup>1</sup> FEC refers to Farnell Electronic Component Distributors.

## NOTES

I<sup>2</sup>C 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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