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## Evaluating the **AD5664R** 16-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-AD5664RDBZ** daughter board

**EVAL-MBnanoDAC-SDZ** motherboard

### SOFTWARE REQUIRED

**EVAL-AD5664RDBZ** 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 **AD5664R** quad-channel, voltage output digital-to-analog converter (DAC).

The **EVAL-AD5664RDBZ** evaluation board helps users quickly prototype new **AD5664R** circuits and reduce design time. The **AD5664R** operates from a single 2.7 V to 5.5 V supply.

For full data, see the **AD5664R** data sheet, which must be used in conjunction with this user guide when using the **EVAL-AD5664RDBZ** evaluation board.

The **EVAL-AD5664RDBZ** evaluation board interfaces to the USB port of a PC via the **SDP-B** controller board. Software that allows users to program the **AD5664R** can be downloaded via the **EVAL-AD5664RDBZ** product page.

The **EVAL-AD5664RDBZ** evaluation board requires the **EVAL-SDP-CB1Z** board (**SDP-B** controller board).

### **EVAL-AD5664RDBZ, EVAL-MBnanoDAC-SDZ, AND EVAL-SDP-CB1Z** BOARDS

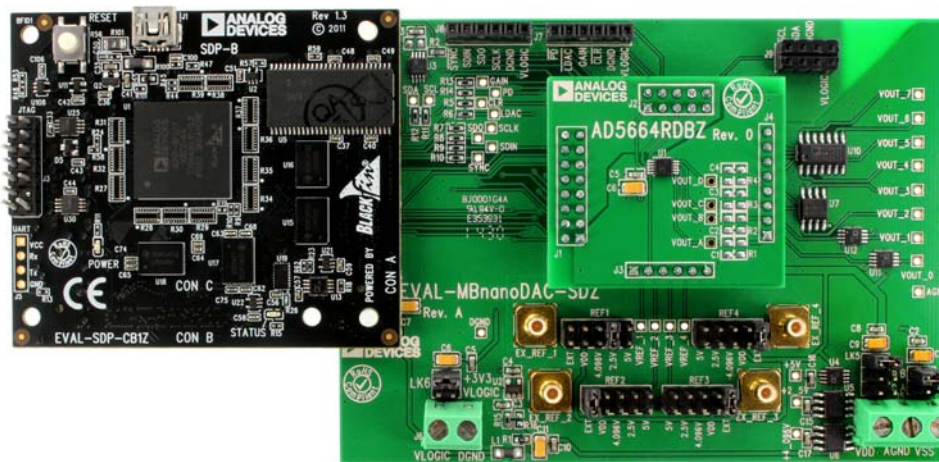


Figure 1.

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**REVISION HISTORY**

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

## EVALUATION BOARD HARDWARE

### POWER SUPPLIES

The [EVAL-AD5664RDBZ](#) evaluation board can be powered either from the [SDP-B](#) port or externally by the J5 and J6 connectors, as described in Table 1.

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

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 µF tantalum and 0.1 µF ceramic capacitors.

**Table 1. Power Supply Connectors**

Connector No.	Label	Voltage
J5-1	VDD	Analog positive power supply, $V_{DD}$ ; 5.5 V single and dual supply
J5-2	AGND	Analog ground
J5-3	VSS	Analog negative power supply, $V_{SS}$ ; -5.5 V dual supply
J6-1	VLOGIC	Digital supply from 1.8 V to $V_{DD}$
J6-2	DGND	Digital ground

### LINK OPTIONS

Various link options are incorporated in the [EVAL-MBnanoDAC-SDZ](#) and must be set for the required operating conditions before using the [EVAL-AD5664RDBZ](#) 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. Link Options Setup for SDP-B Control (Default)**

Link Number	Position
REF1	2.5V
REF2	EXT
REF3	EXT
REF4	EXT
LK5	C
LK6	+3V3
LK7	B

**Table 3. Link Functions**

Link Number	Function
REF1, REF2, REF3, REF4	These links select the reference source. Position EXT selects an off board voltage reference via the appropriate EXT_REF connector. Position VDD selects $V_{DD}$ 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> board. Position B selects the internal voltage source, 3.3 V from the <a href="#">ADP121</a> on the motherboard. Position C selects the external supply voltage, $V_{DD}$ .
LK6	This link selects the $V_{LOGIC}$ voltage source. Position +3V3 selects the digital voltage source from the <a href="#">SDP-B</a> board (3.3 V). Position VLOGIC selects an external digital supply voltage ( $V_{LOGIC}$ ).
LK7	This link selects the negative DAC analog voltage source. Position A selects $V_{SS}$ . Position B selects AGND.

## EVALUATION BOARD SOFTWARE QUICK START PROCEDURES

### INSTALLING THE SOFTWARE

The [EVAL-AD5664RDBZ](#) 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](#) board to the USB port of the PC to ensure that the [SDP-B](#) board is recognized when it connects to the PC.

1. Start the Windows operating system. Download the installation software from the [EVAL-AD5664RDBZ](#) evaluation board page at [www.analog.com/EVAL-AD5664R](http://www.analog.com/EVAL-AD5664R).
1. Run the **setup.exe** file from the installer folder if it does not open automatically.
2. Power up the [EVAL-AD5664RDBZ](#) evaluation board as described in the Power Supplies section after installation is completed.
3. Connect the [EVAL-AD5664RDBZ](#) evaluation board to the [SDP-B](#) board and the [SDP-B](#) board to the PC using the USB cable included in the box.
4. Proceed through any dialog boxes that appear to finalize the installation when the software detects the [EVAL-AD5664RDBZ](#) evaluation board.

### RUNNING THE SOFTWARE

To run the program, complete the following steps:

1. Connect the [EVAL-AD5664RDBZ](#) 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. Click **Start > All Programs > Analog Devices > AD5664R 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 [AD5664R](#) evaluation software then opens, as shown in Figure 4.

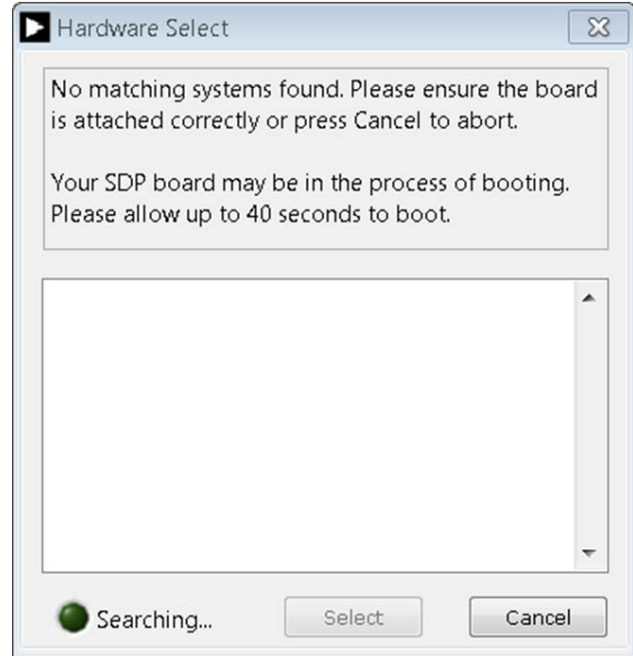


Figure 2. Connectivity Error

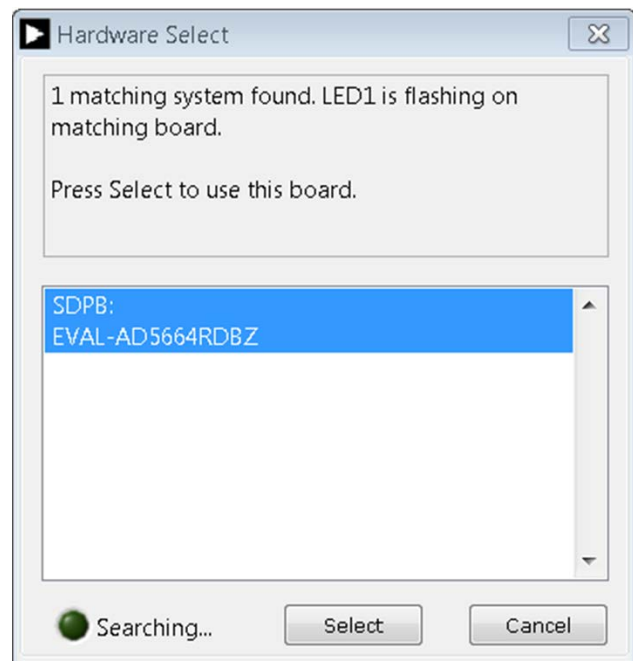


Figure 3. Hardware Select

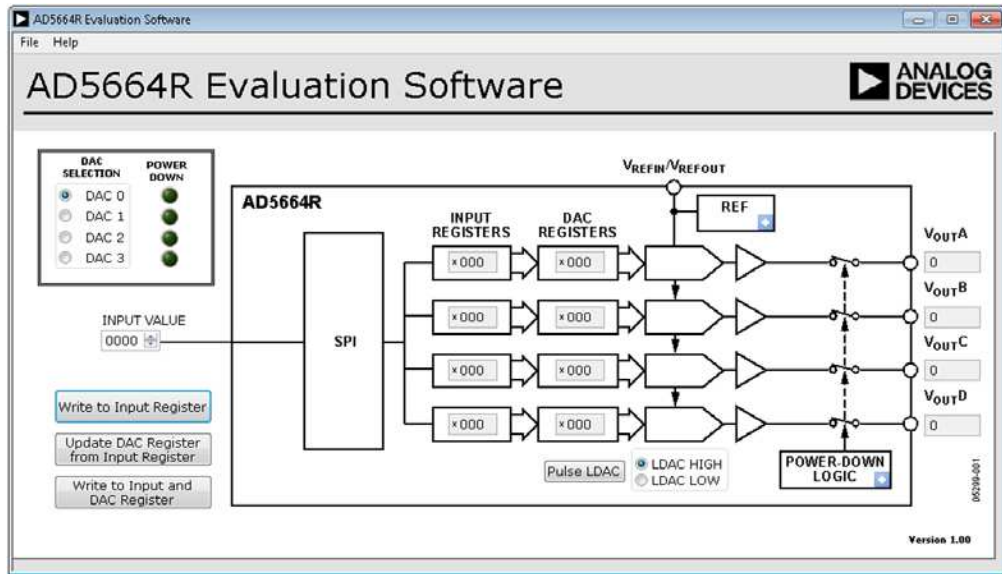


Figure 4. AD5664R Evaluation Board Software Main Window

**SOFTWARE OPERATION**

The software for the AD5664R 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 selected DAC in the **DAC Selection** box

**Update DAC Register from Input Register**

Click **Update DAC Register from Input Register** to copy the value in the input register to the corresponding DAC register. DAC outputs are automatically updated with the appropriate voltage.

**Write to Input and DAC Register**

Click **Write to Input and DAC Register** to load the code of the input data control to the input register and DAC register of the selected DAC. The DAC outputs are automatically updated with the appropriate voltage.

**LDAC Control**

Click **Pulse LDAC** to bring the LDAC register high and then back low. Doing this copies the data from the input registers to the DAC registers, and the outputs update accordingly.

The LDAC register can also be set high or low by clicking the appropriate radio button.

**Power-Down Control**

All of the DACs can be powered down simultaneously. The DACs have a selection box allowing the device to operate in normal mode or three different power-down modes. Click the blue progressive disclosure button on the **POWER-DOWN LOGIC** block to access the selection box. A window opens that allows the user to select the appropriate setting for the DAC. A drop down box allows the user to select the termination at the output of the selected DAC, as shown in Figure 5. Click **OK** to write the appropriate values to the AD5664R.

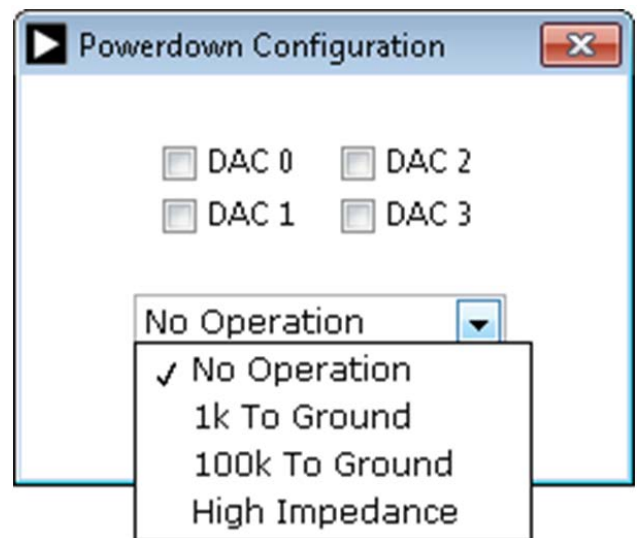


Figure 5. Powerdown Configuration Window

**Reference Control**

The DAC references can be set to operate as internal or external. Click the blue progressive disclosure button on the **REF** block to access the control options. A window opens that allows the user to click either an external or internal reference for the DAC, as shown in Figure 6. Click **Confirm** to write the appropriate values to the [AD5664R](#).

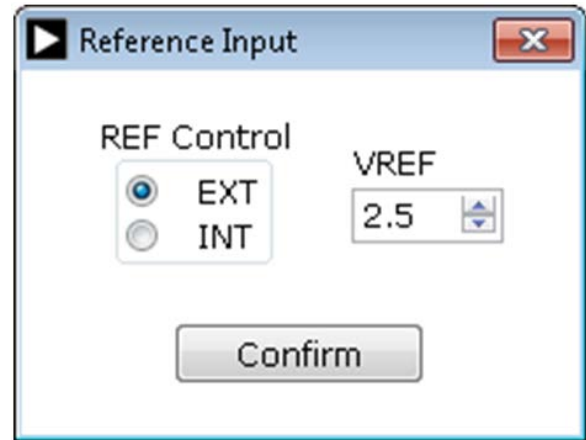


Figure 6. **Reference Input** Window

# EVALUATION BOARD SCHEMATICS AND ARTWORK

## EVAL-MBNANODAC-SDZ MOTHERBOARD

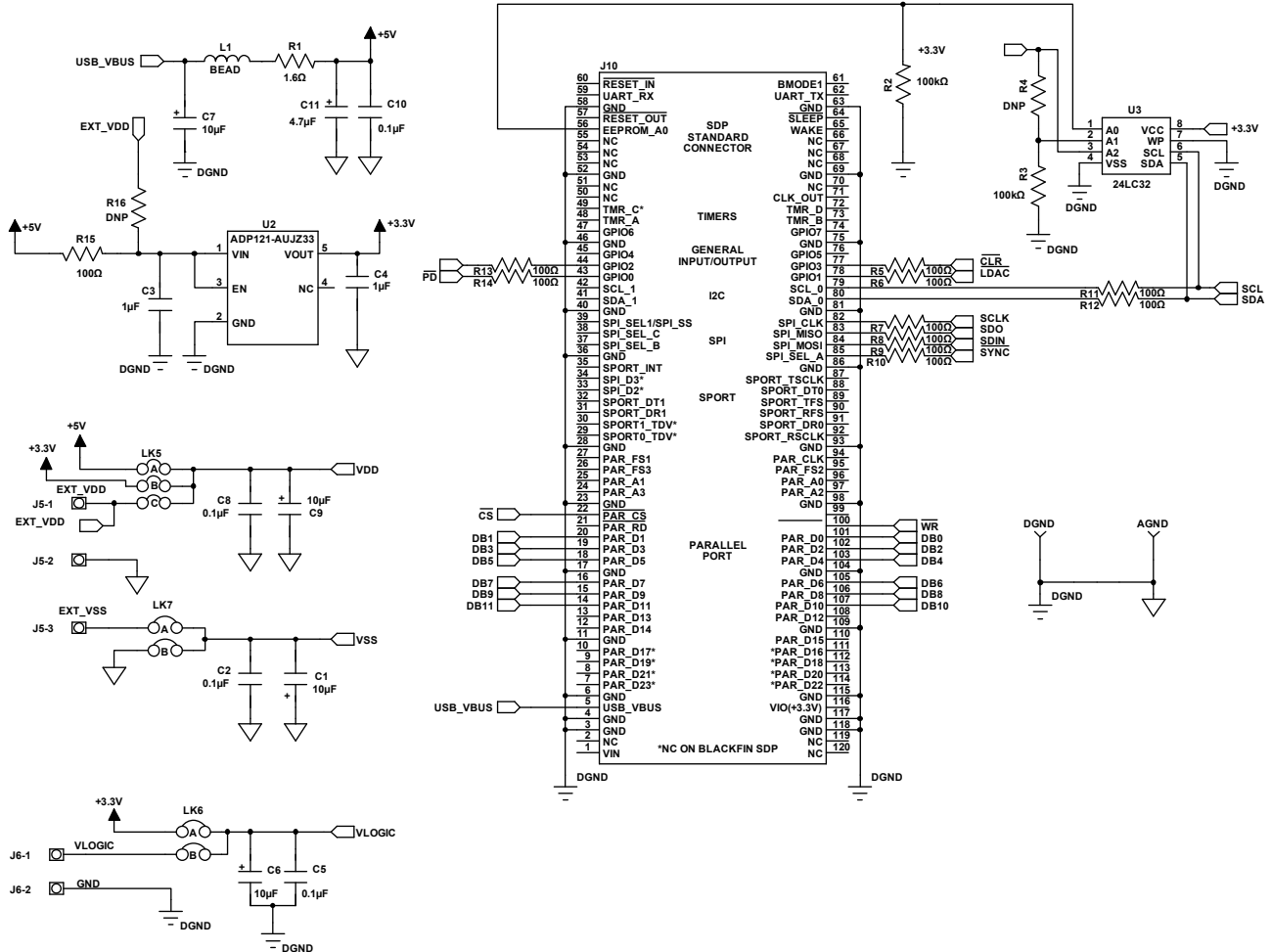


Figure 7. EVAL-MBnanoDAC-SDZ Motherboard SDP-B Connector and Power Supply

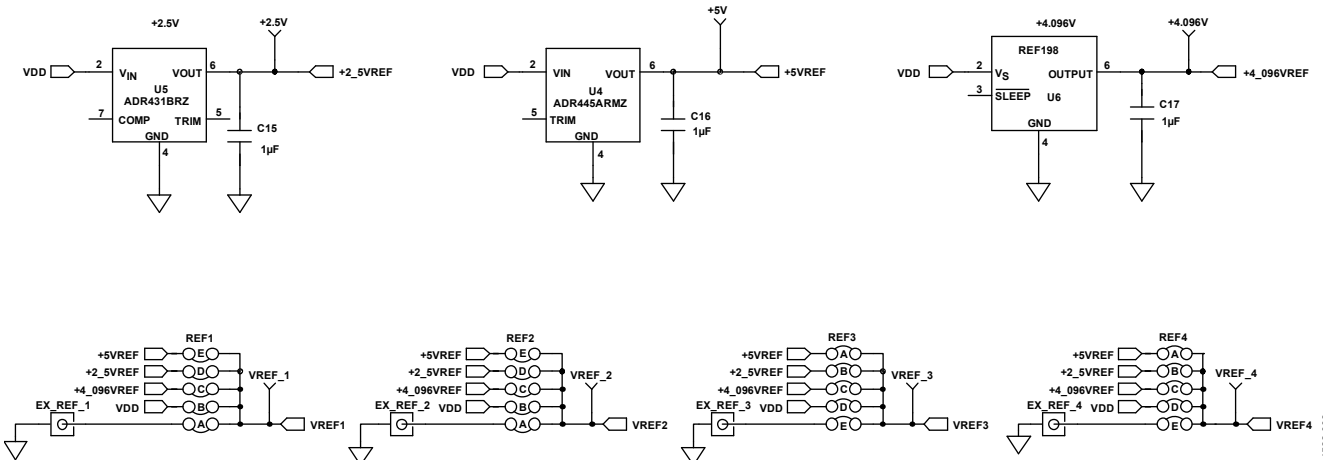


Figure 8. EVAL-MBnanoDAC-SDZ Motherboard Reference Voltage Selector Circuit



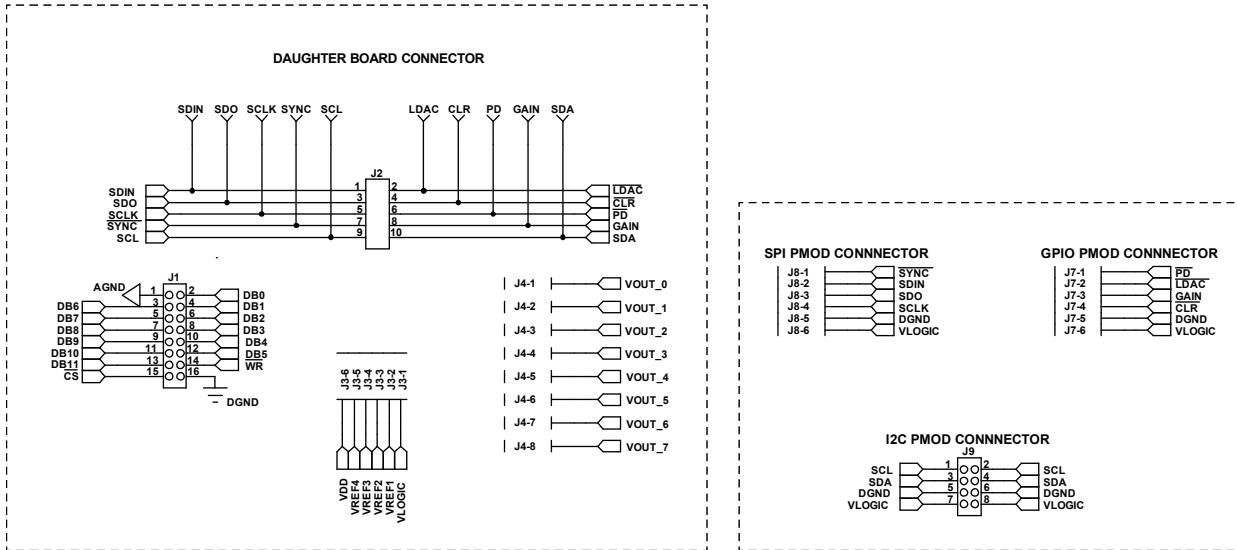


Figure 9. EVAL-MBnanoDAC-SDZ Motherboard Connectors to EVAL-AD5664RDBZ Daughter Board and Serial Interface

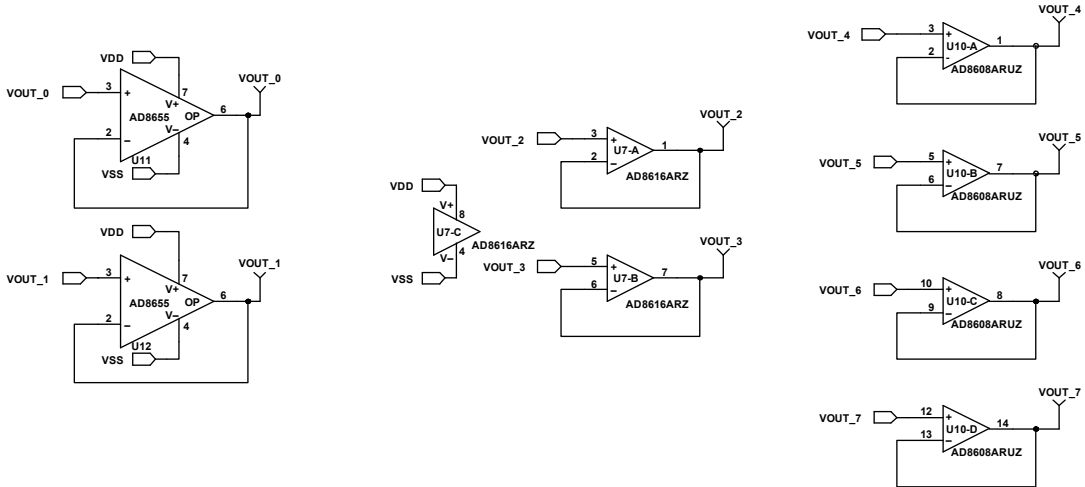


Figure 10. EVAL-MBnanoDAC-SDZ Motherboard Output Amplifier Circuit

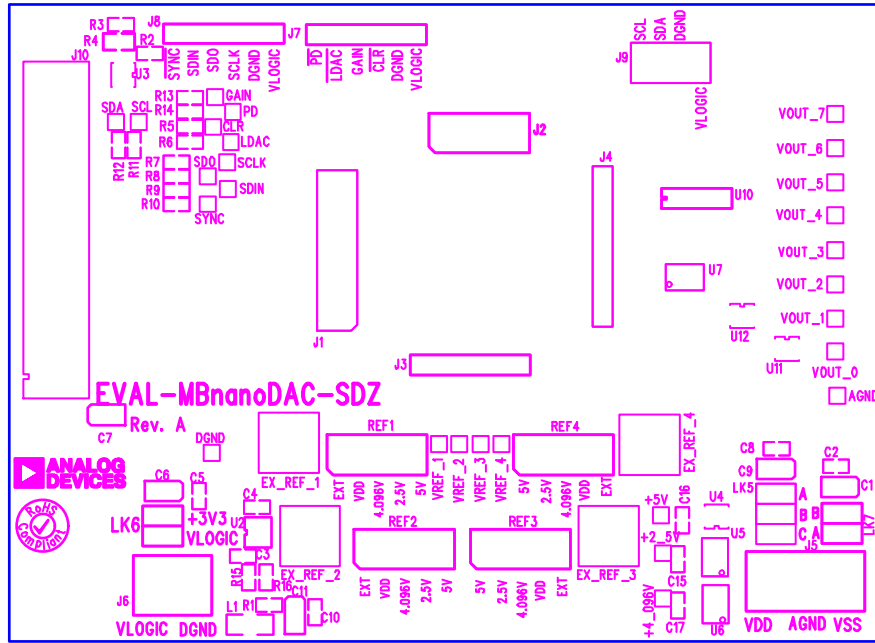


Figure 11. EVAL-MBnanoDAC-SDZ Motherboard Component Placement

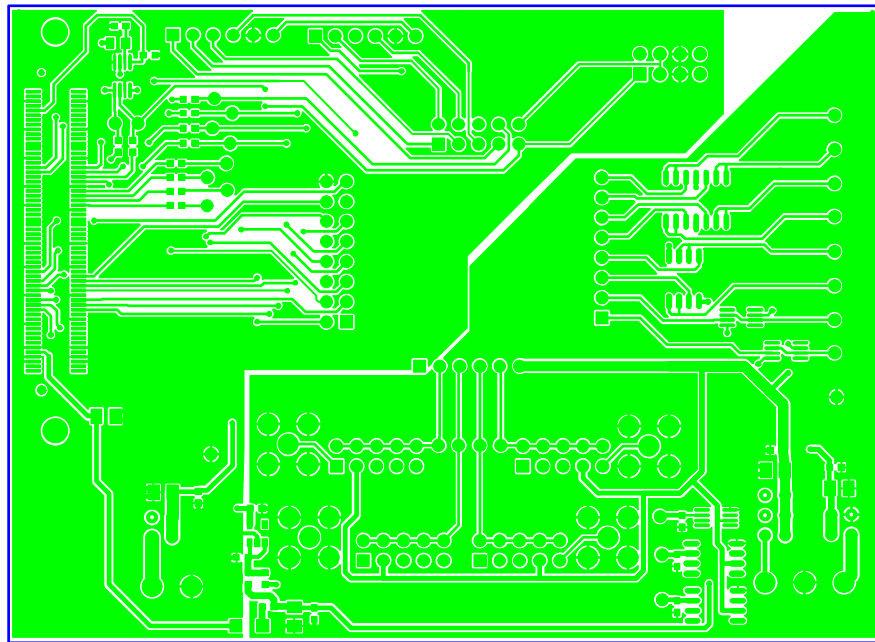
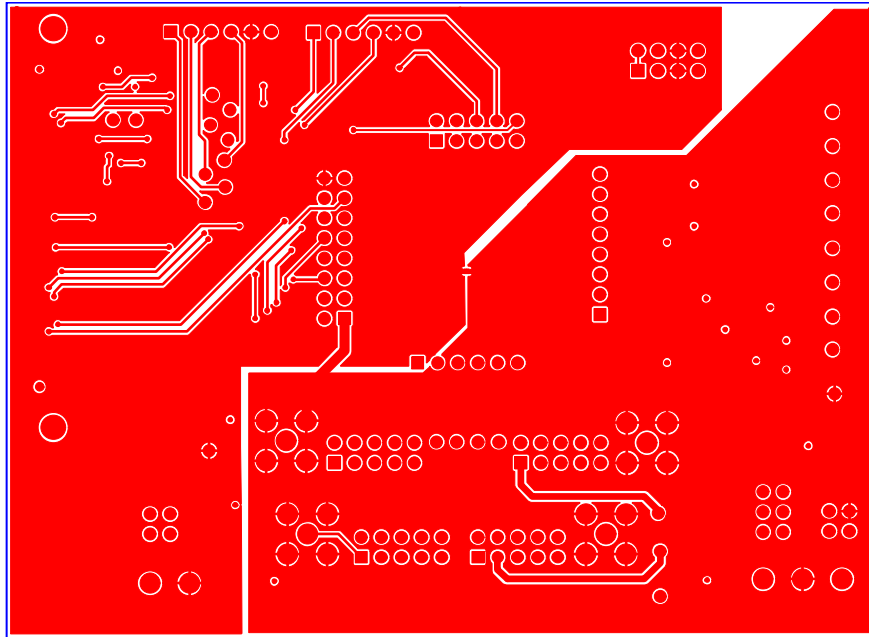


Figure 12. EVAL-MBnanoDAC-SDZ Motherboard Top Side Routing



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

**EVAL-AD5664RDBZ DAUGHTER BOARD**

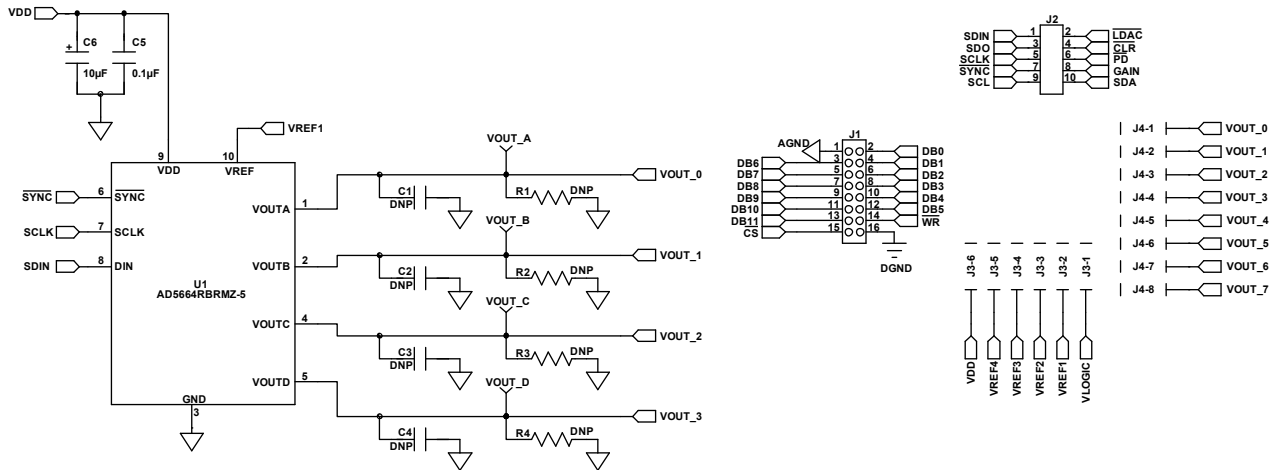


Figure 14. EVAL-AD5664RDBZ Daughter Board Schematics

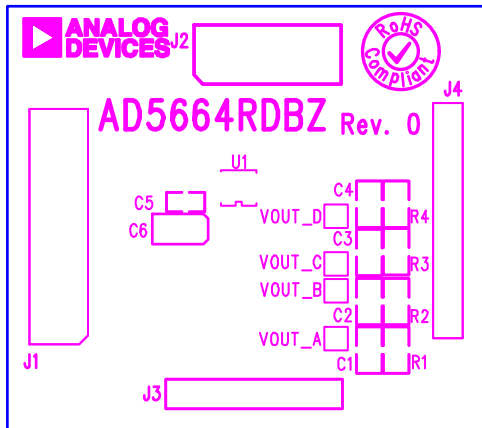


Figure 15. EVAL-AD5664RDBZ Daughter Board Component Placement

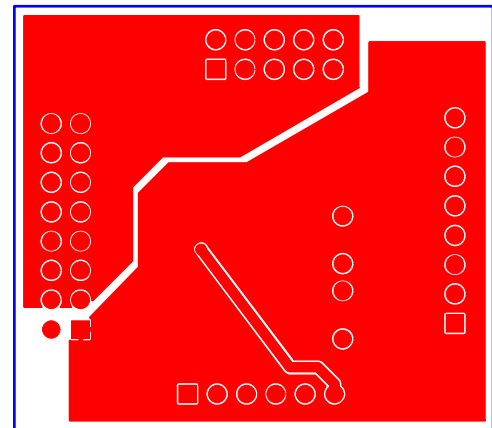


Figure 17. EVAL-AD5664RDBZ Daughter Board Bottom Side Routing

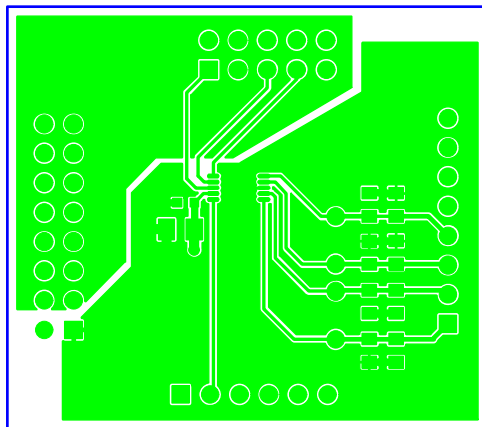


Figure 16. EVAL-AD5664RDBZ Daughter Board Top Side Routing

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 4. Components List for [EVAL-MBnanoDAC-SDZ](#) Motherboard

Qty	Reference Designator	Description	Stock Code/Part Number <sup>1</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 <sup>2</sup>
1	C11	6.3 V tantalum capacitor (Case A), 4.7 $\mu$ F, $\pm$ 20%	FEC 1432350
4	EXT_REF_1, EXT_REF_2, EXT_REF_3, 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, R6, R7, R8, R9, R10, R11, R12, R13, R14, 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 manufacturing company.

Table 5. Components List for EVAL-AD5664RDBZ 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 μF, ±10%	FEC 1759122
1	C6	6.3 V tantalum capacitor (Case A), 10 μF, ±20%	FEC 1190107
1	J1	16-pin (2 × 8) header	FEC 2308428 inserted from solder side
1	J2	10-pin (2 × 5) straight header, 2.54 mm pitch	FEC 9689583 inserted from solder side
1	J3	6-pin (1 × 6) straight header, 2.54 mm pitch	FEC 9689508 inserted from solder side
1	J4	Header, 2.54 mm, PCB, 1 × 8-way	FEC 1766172 inserted from solder side
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	Quad 16-bit DAC	Analog Devices AD5664RBRMZ-5
1	V <sub>outA</sub>	Red test point	Do not insert
1	V <sub>outB</sub>	Red test point	Do not insert
1	V <sub>outC</sub>	Red test point	Do not insert
1	V <sub>outD</sub>	Red test point	Do not insert

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

<sup>1</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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