

## Evaluation Board for the **AD5320** 12-Bit, Single-Channel, Voltage Output 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-AD5320DBZ** evaluation board  
**EVAL-MBnanoDAC-SDZ** motherboard

### SOFTWARE NEEDED

**EVAL-AD5320DBZ** evaluation software

### HARDWARE NEEDED

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

### DOCUMENTS NEEDED

Electronic version of the **AD5320** data sheet  
 Electronic version of **EVAL-AD5320DBZ** user guide

### GENERAL DESCRIPTION

This user guide details the operation of the evaluation board for the **AD5320** single-channel, voltage output, digital-to-analog converter (DAC).

The evaluation board is designed to help users quickly prototype new **AD5320** circuits and reduce design time. The **AD5320** operates from a single 2.7 V to 5.5 V supply.

For full data, see the **AD5320** 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-B** board. Software is available for download from the **EVAL-AD5320DBZ** evaluation board page to allow the user to program the **AD5320**.

### **EVAL-AD5320DBZ, EVAL-MBnanoDAC-SDZ, AND SDP-B BOARDS**

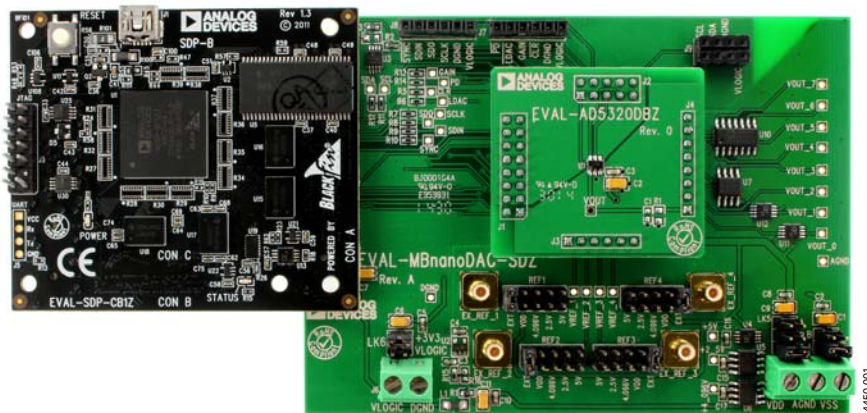


Figure 1.

TABLE OF CONTENTS

|                                               |   |                                                       |    |
|-----------------------------------------------|---|-------------------------------------------------------|----|
| Features .....                                | 1 | Link Options .....                                    | 3  |
| Package Contents.....                         | 1 | Evaluation Board Software Quick Start Procedures..... | 4  |
| Software Needed .....                         | 1 | Installing the Software .....                         | 4  |
| Hardware Needed .....                         | 1 | Running the Software .....                            | 4  |
| Documents Needed.....                         | 1 | Software Operation .....                              | 5  |
| General Description .....                     | 1 | Evaluation Board Schematics and Artwork.....          | 6  |
| EVAL-AD5320DBZ, EVAL-MBnanoDAC-SDZ, and SDP-B |   | EVAL-MBnanoDAC-SDZ Motherboard .....                  | 6  |
| Boards.....                                   | 1 | EVAL-AD5320DBZ Daughter Board .....                   | 9  |
| Revision History .....                        | 2 | Ordering Information.....                             | 11 |
| Evaluation Board Hardware.....                | 3 | Bill of Materials.....                                | 11 |
| Motherboard Power Supplies.....               | 3 |                                                       |    |

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-AD5320DBZ](#) 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, $V_{DD}$ . Single supply 5 V, dual supply 5 V. |
| J5, Pin 2 (J5-2) | AGND   | Analog ground.                                                               |
| J5, Pin 3 (J5-3) | VSS    | Analog negative power supply, $V_{SS}$ , dual supply $-5$ V.                 |
| J6, Pin 1 (J6-1) | VLOGIC | Digital supply from 1.8 V to $V_{DD}$ of the daughter board DAC.             |
| J6, Pin 2 (J6-2) | DGND   | Digital ground.                                                              |

**Table 3. Link Functions**

| Link Number  | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| REF1 to REF4 | These links select the reference source.<br>Position EXT selects an off-board voltage reference via the appropriate EXT_REF_x 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, $V_{DD} = 5.5$ V. |
| 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 an external supply voltage, $V_{DD}$ .                                                                                                                                        |
| LK6          | This link selects the VLOGIC 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.                                                                                                                                                                                                                                                                                                                                            |

### LINK OPTIONS

A number of 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 3. The positions listed in Table 2 and Table 3 match the evaluation board imprints (see Figure 10).

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

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

## EVALUATION BOARD SOFTWARE QUICK START PROCEDURES

### INSTALLING THE SOFTWARE

The [EVAL-AD5320DBZ](#) 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.

To install the software, take the following steps:

1. Start the Windows operating system. Download the installation software from the [EVAL-AD5320DBZ](#) evaluation board page.
2. Run the setup.exe file from the installer folder if it does not open automatically.
3. After installation is complete, power up the evaluation board as described in the Motherboard Power Supplies section.
4. Connect the evaluation board to the [SDP-B](#) board and the [SDP-B](#) board to the PC using the USB cable included in the evaluation kit.
5. When the software detects the evaluation board, click through any dialog boxes that appear to finalize the installation.

### RUNNING THE SOFTWARE

To run the program, take the following steps:

1. Connect the evaluation board to the [SDP-B](#) board and connect one end of the USB cable to the [SDP-B](#) board, and connect the other end of the cable to 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, AD5320 Evaluation Software**.
4. If the [SDP-B](#) 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](#) 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 [AD5320](#) evaluation software then opens, as shown in Figure 4.

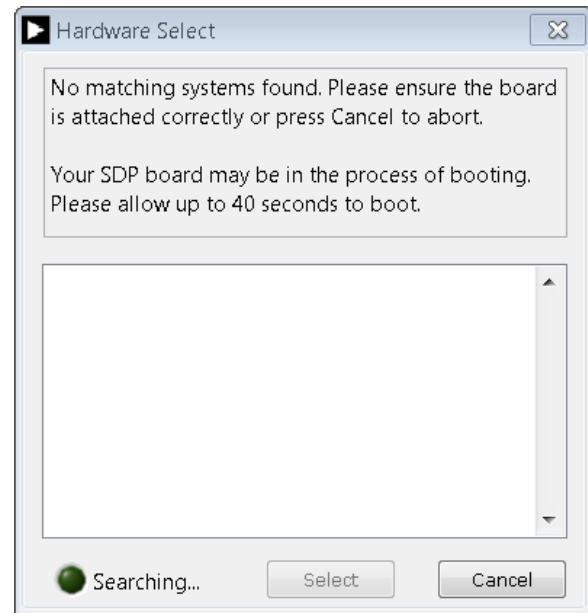


Figure 2. Connectivity Error

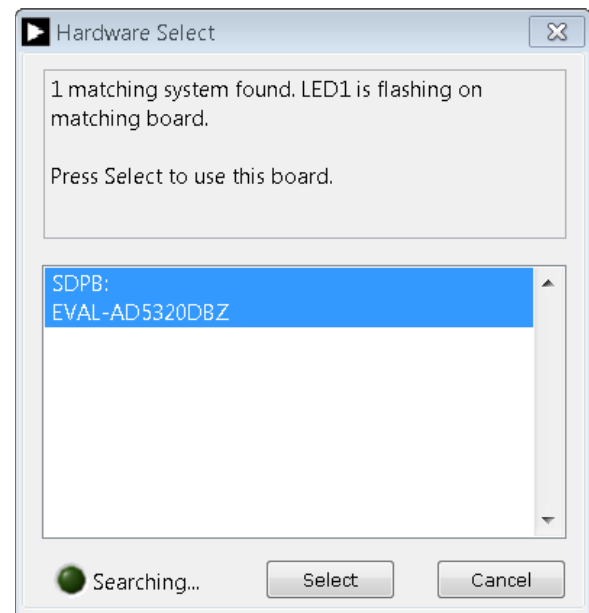


Figure 3. Hardware Select

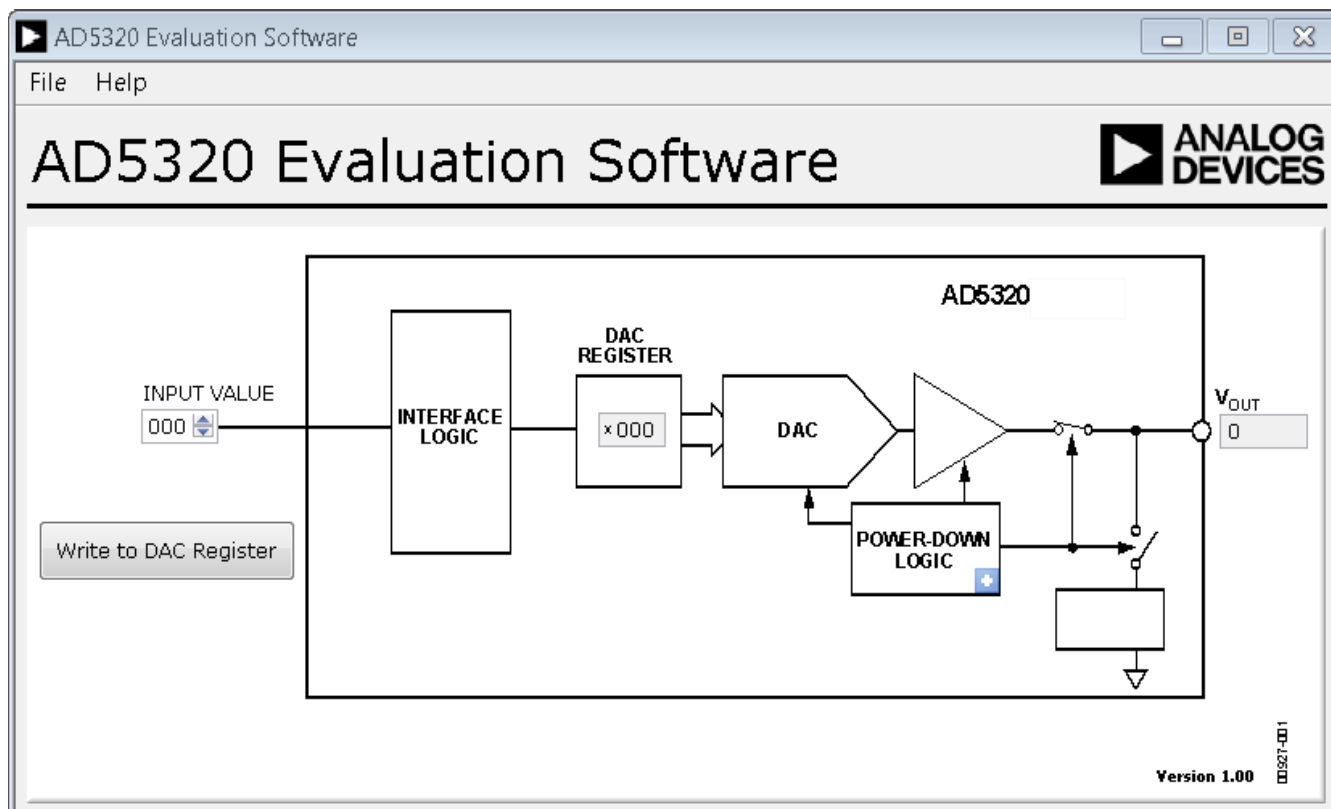


Figure 4. AD5320 Evaluation Software Main Window

## SOFTWARE OPERATION

The software for the [AD5320](#) allows the user to program values to the DAC register of the DAC.

### Write to DAC Register

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

### Power-Down Control

On the **POWER-DOWN LOGIC** block, click the blue progressive disclosure option to select the power-down setting for the DAC. The associated selection box allows the device to operate in normal mode or three different power-down modes. Click the relevant radio option as shown in Figure 5. When the power-down setting for the DAC is selected, click **OK** to write the appropriate values to the [AD5320](#).

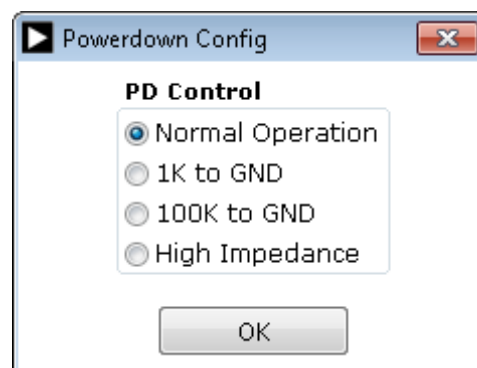


Figure 5. PD Control in the Powerdown Config Window

## EVALUATION BOARD SCHEMATICS AND ARTWORK

## EVAL-MBnanoDAC-SDZ MOTHERBOARD

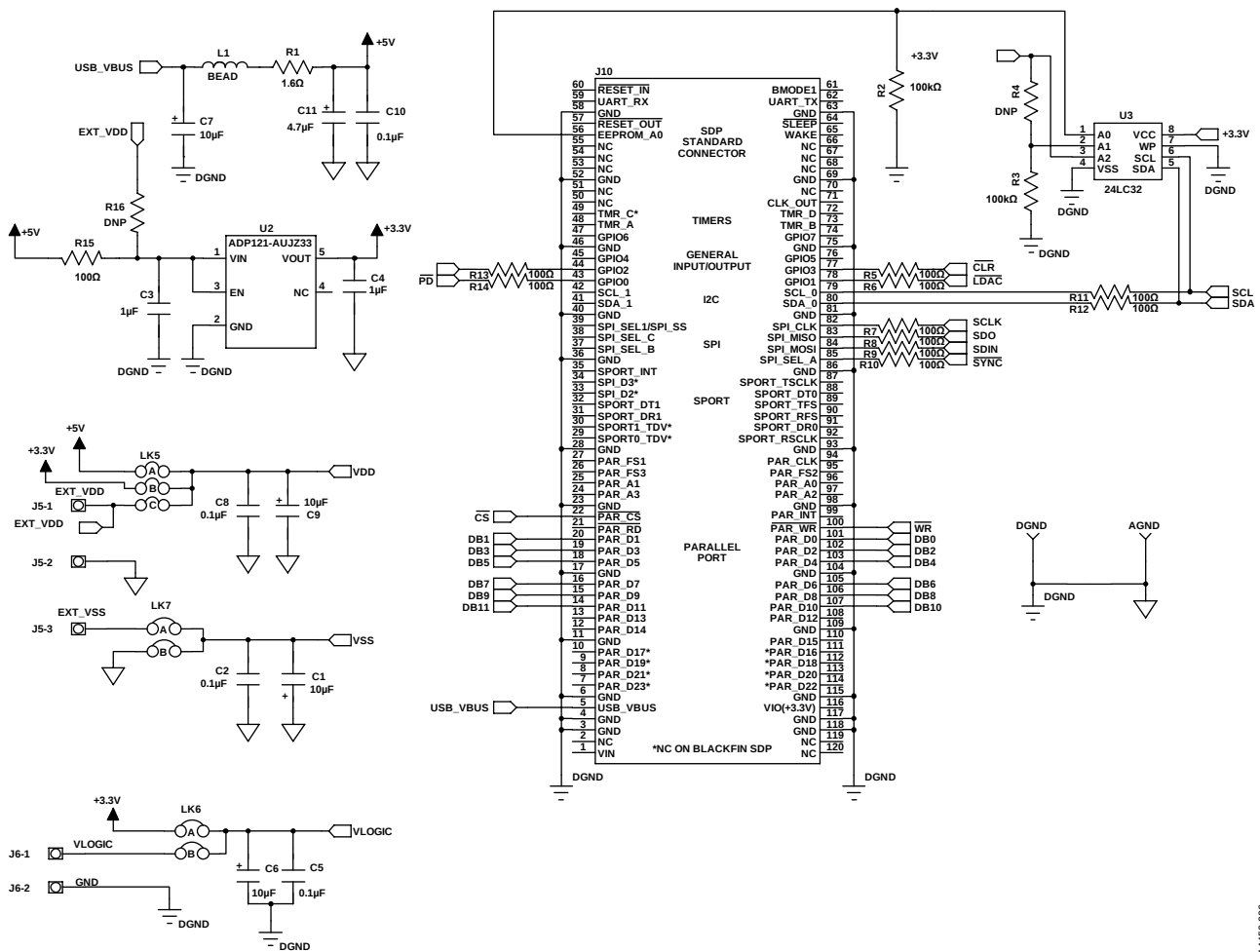


Figure 6. EVAL-MBnanoDAC-SDZ Motherboard SDP-B Connector and Power Supply

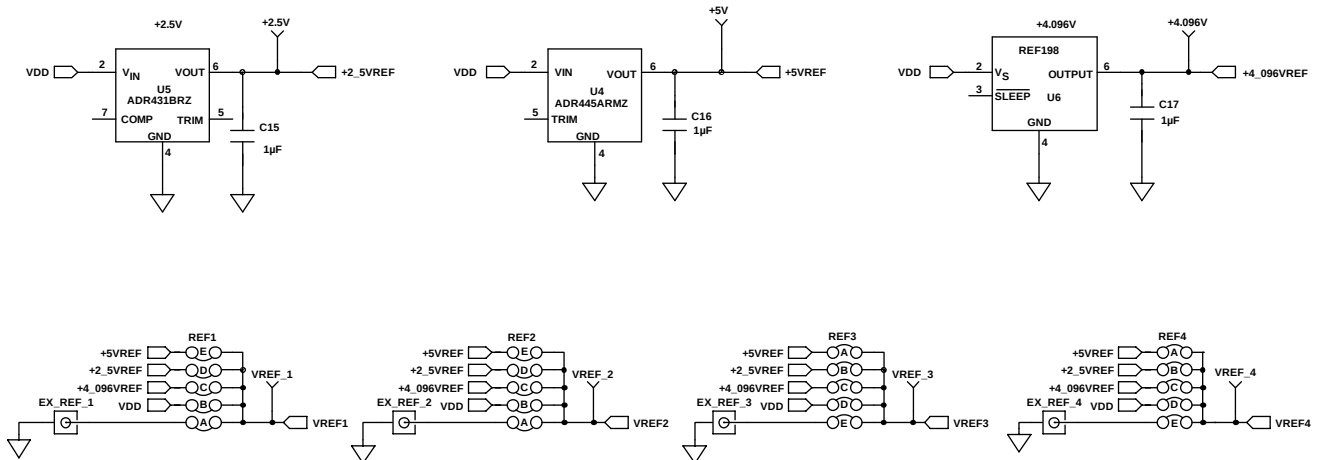


Figure 7. EVAL-MBnanoDAC-SDZ Motherboard Reference Voltage Selector Circuit

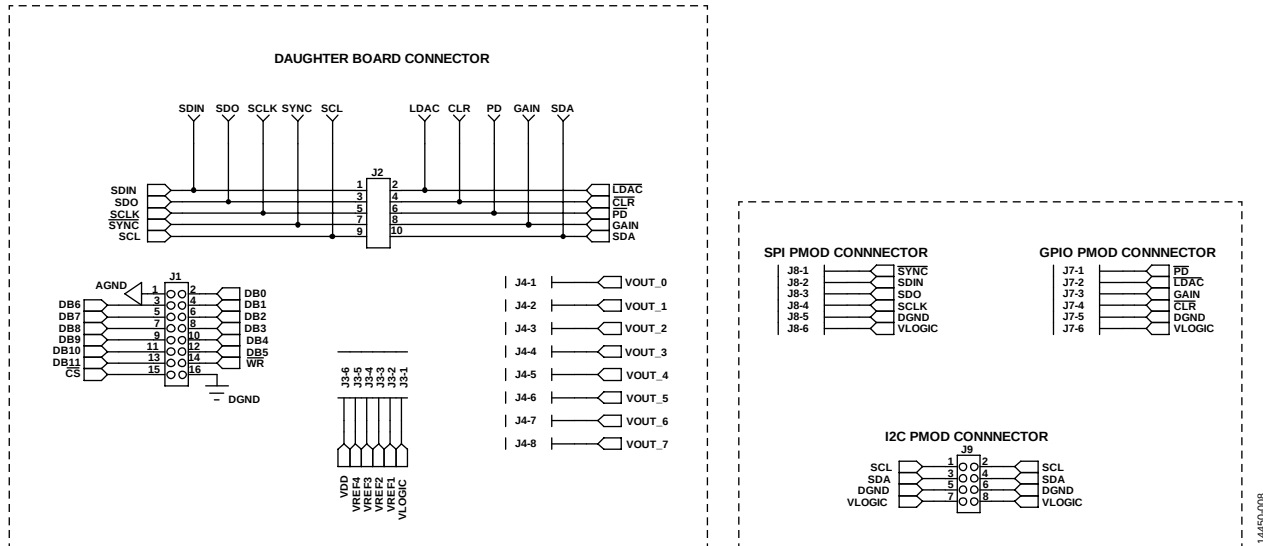


Figure 8. EVAL-MBnanoDAC-SDZ Motherboard Connectors to Daughter Board and Serial Interface

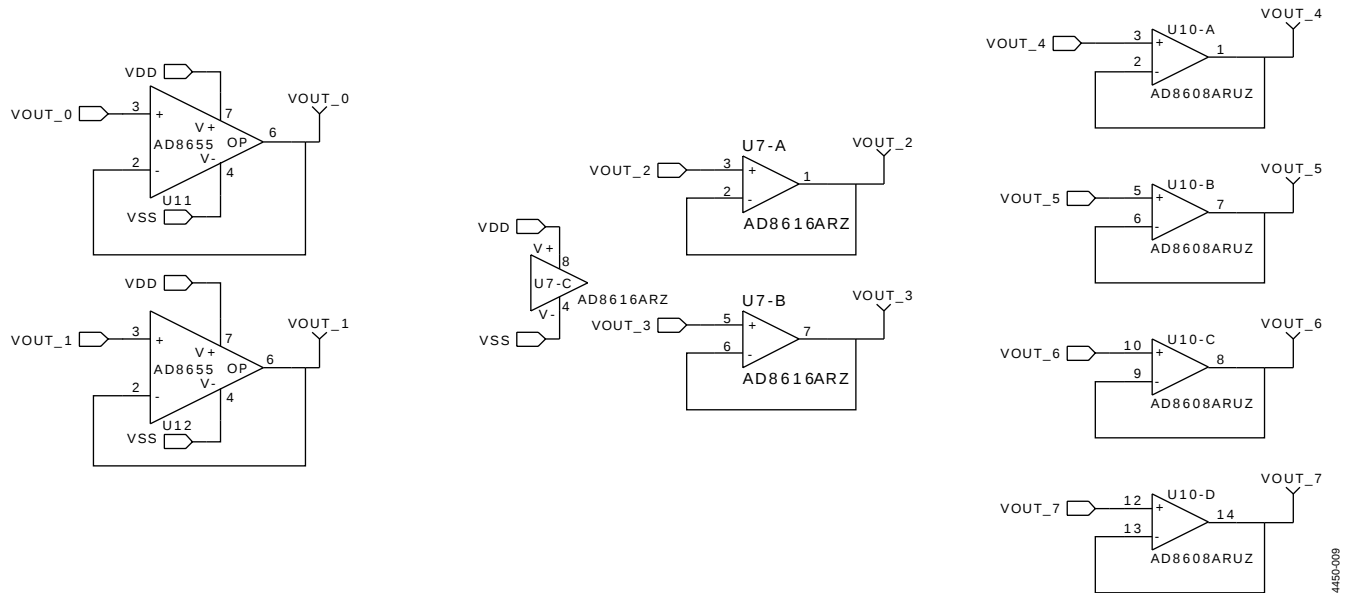


Figure 9. EVAL-MBnanoDAC-SDZ Motherboard Output Amplifier Circuit

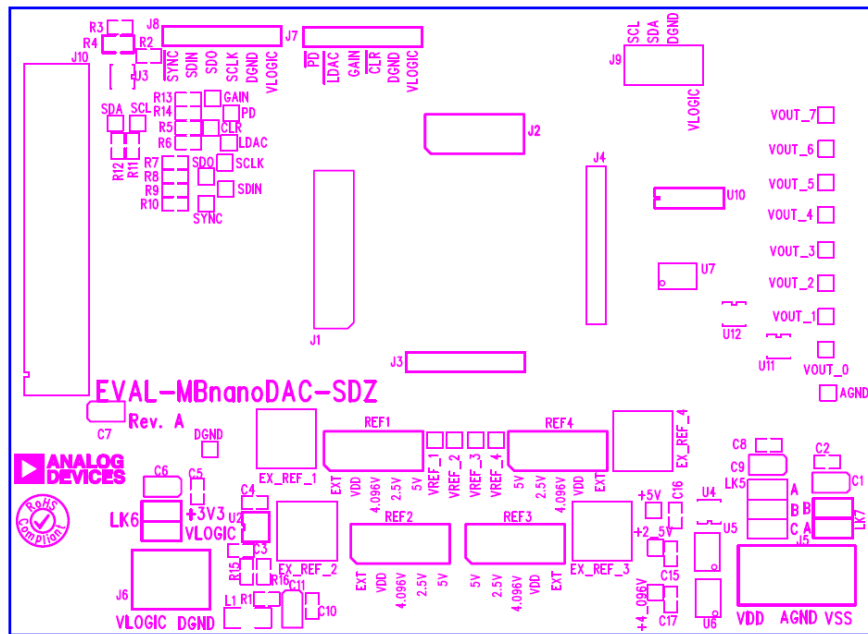


Figure 10. EVAL-MBnanoDAC-SDZ Motherboard Component Placement

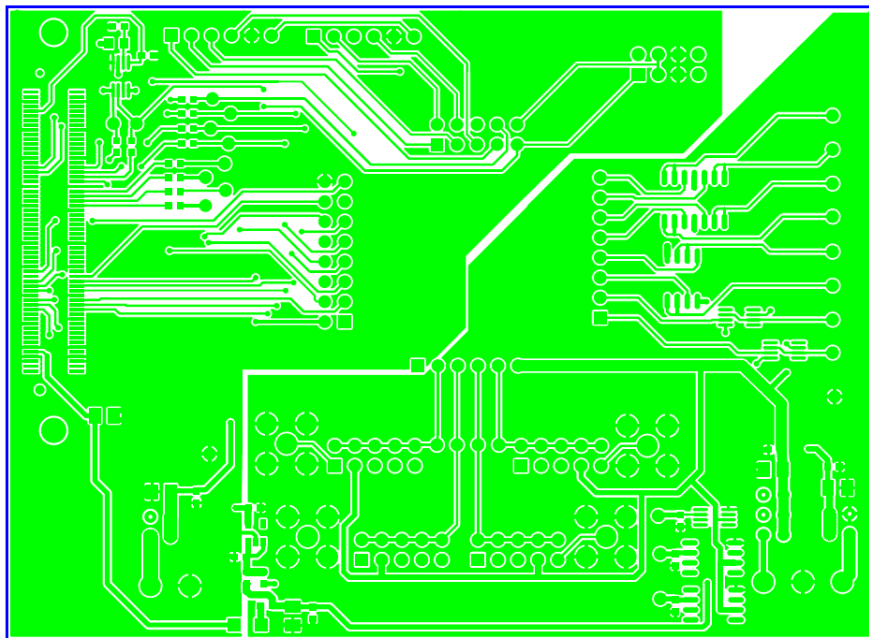


Figure 11. EVAL-MBnanoDAC-SDZ Motherboard Top Side Routing

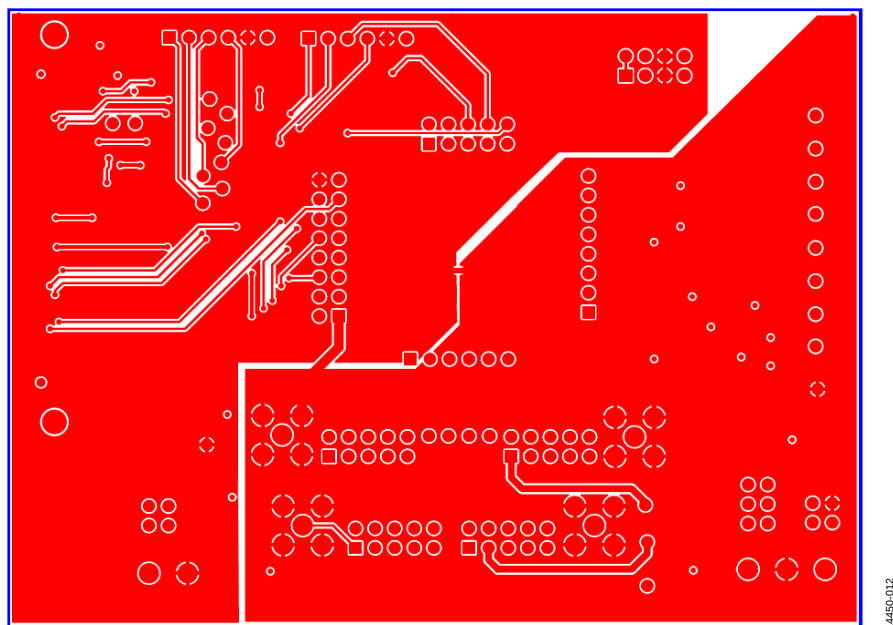


Figure 12. EVAL-MBnanoDAC-SDZ Motherboard Bottom Side Routing

## EVAL-AD5320DBZ DAUGHTER BOARD

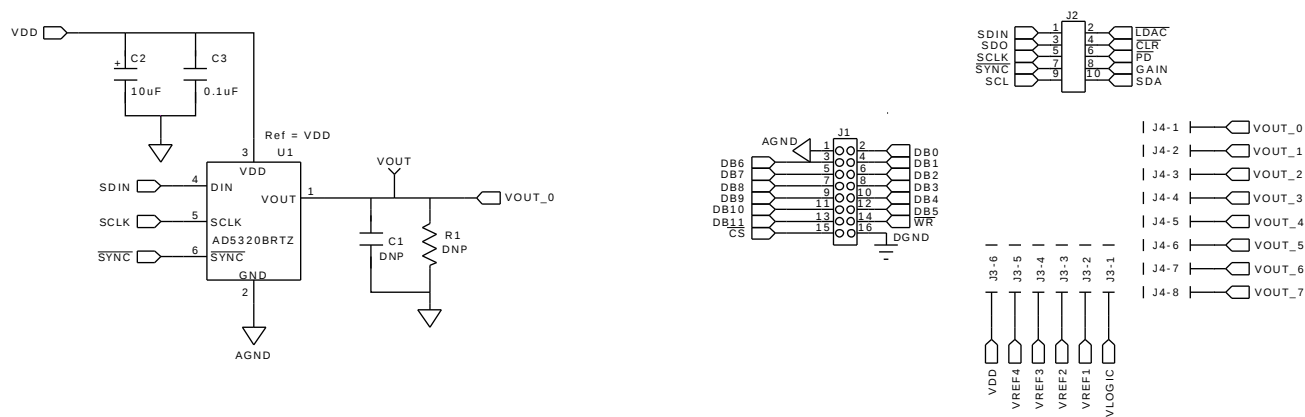


Figure 13. EVAL-AD5320DBZ Daughter Board Schematics

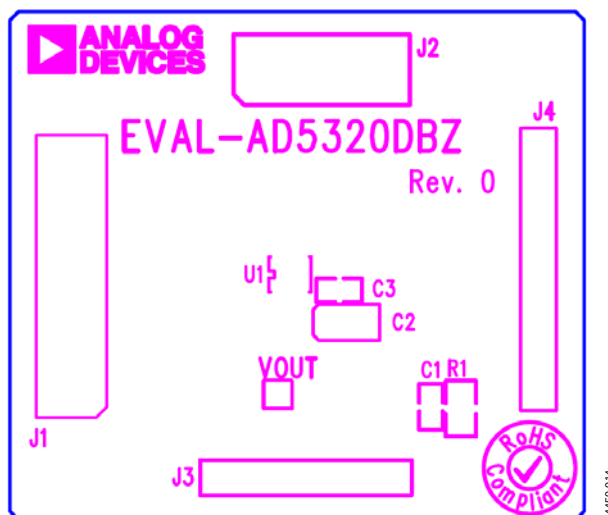
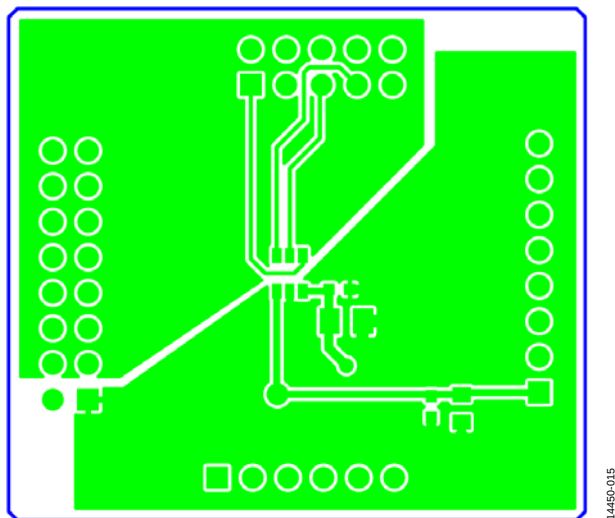
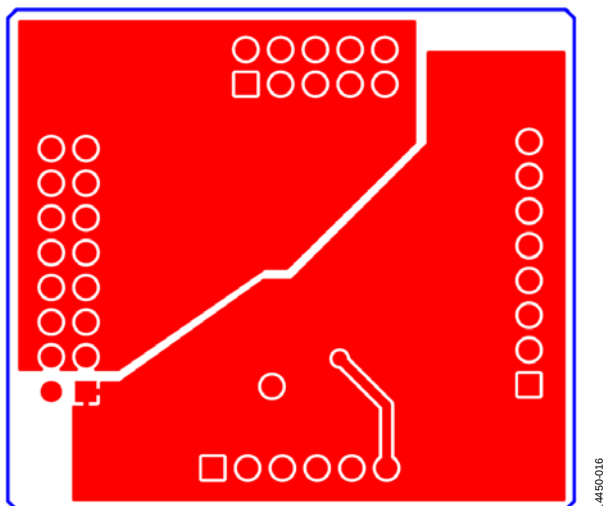


Figure 14. EVAL-AD5320DBZ Daughter Board Component Placement



14450-015

Figure 15. EVAL-AD5320DBZ Daughter Board Top Side Routing



14450-016

Figure 16. EVAL-AD5320DBZ 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 printed circuit board (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-AD5320DBZ Daughter Board

| Qty | Reference Designator | Description                                          | Supplier/Part Number <sup>1</sup>          |
|-----|----------------------|------------------------------------------------------|--------------------------------------------|
| 1   | C1                   | 50 V, X7R, ceramic capacitor                         | Do not populate                            |
| 1   | C2                   | 6.3 V, tantalum capacitor (Case A)                   | FEC/1190107                                |
| 1   | C3                   | 50 V, X7R, ceramic capacitor                         | FEC/1759122                                |
| 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      |
| 1   | R1                   | 0805 resistor location                               | Do not populate                            |
| 1   | U1                   | 12-bit DAC                                           | Analog Devices/ <a href="#">AD5320BRTZ</a> |
| 1   | VOUT                 | Red test point                                       | Do not insert                              |

<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.

**Legal Terms and Conditions**

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. **CONFIDENTIALITY.** This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. **ADDITIONAL RESTRICTIONS.** Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. **TERMINATION.** ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. **LIMITATION OF LIABILITY.** THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). **EXPORT.** Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. **GOVERNING LAW.** This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.