

## Evaluating the **AD5339** 12-Bit, Dual-Channel, Voltage Output Digital-to-Analog Converter (DAC)

### FEATURES

- Full featured evaluation board (**EVAL-AD5339DBZ**) in conjunction with *nano*DAC motherboard (**EVAL-MBnanoDAC-SDZ**)
- On-board references
- Various link options
- PC control in conjunction with Analog Devices, Inc., system demonstration platform (SDP)

### EVALUATION KIT CONTENTS

- EVAL-AD5339DBZ** daughter board
- EVAL-MBnanoDAC-SDZ** motherboard
- USB cable

### SOFTWARE REQUIRED

- EVAL-AD5339DBZ** evaluation software

### HARDWARE REQUIRED

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

### GENERAL DESCRIPTION

This user guide details the operation of the **EVAL-AD5339DBZ** evaluation board for the **AD5339**, a 12-bit, dual-channel, voltage output DAC. The **AD5339** operates from a single 2.5 V to 5.5 V supply.

The **EVAL-AD5339DBZ** is designed to quickly prototype **AD5339** circuits and reduce design time. The **EVAL-AD5339DBZ** evaluation board interfaces with the USB port of a PC via the **SDP-B** controller board. Software can be downloaded via the **EVAL-AD5339DBZ** product page, allowing users to program the **AD5339**.

This evaluation board requires the **SDP-B** controller board, which is available to order on the Analog Devices website.

Full specifications for the **AD5339** are listed in the **AD5339** data sheet available from Analog Devices, Inc., and should be consulted in conjunction with this user guide when using the evaluation board.

### PHOTOGRAPH OF THE **EVAL-AD5339DBZ**, **EVAL-MBnanoDAC-SDZ**, AND **EVAL-SDP-CB1Z**

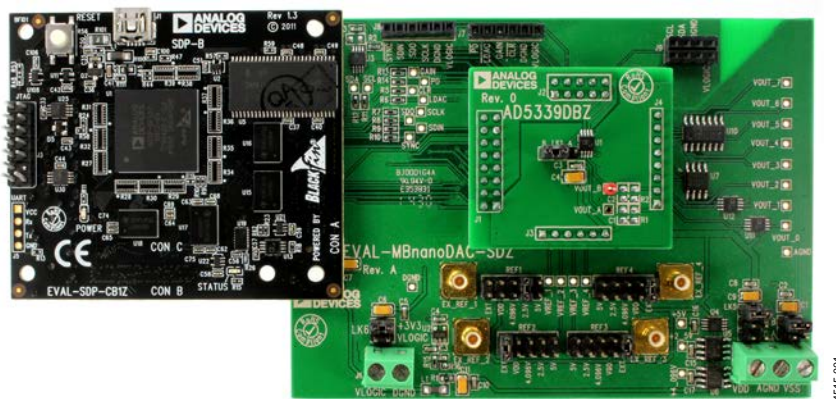


Figure 1.

**TABLE OF CONTENTS**

Features .....	1	Daughter Board Link Options.....	3
Evaluation Kit Contents.....	1	Evaluation Board Software.....	4
Software Required .....	1	Installing THE EVAL-AD5339DBZ Evaluation Software.....	4
Hardware Required .....	1	Running the Software .....	4
General Description .....	1	Software Operation .....	5
Photograph of the EVAL-AD5339DBZ, EVAL-MBnanoDAC-SDZ, and EVAL-SDP-CB1Z.....	1	Evaluation Board Schematics and Artwork.....	6
Revision History .....	2	EVAL-MBnanoDAC-SDZ Motherboard .....	6
Evaluation Board Hardware.....	3	EVAL-AD5339DBZ Daughter Board .....	9
Power Supplies .....	3	Ordering Information.....	12
Link Options .....	3	Bill of Materials.....	12

**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.

Power the EVAL-AD5339DBZ evaluation board from either 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 EVAL-AD5339DBZ evaluation board. The AGND and DGND planes connect at one location on the EVAL-MBnanoDAC-SDZ. It is recommended that AGND and DGND do not connect elsewhere in the system to avoid ground loop problems.

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

**Table 1. Power Supply Connectors**

Connector	Label	Voltage
J5, Pin 1 (J5-1)	VDD	Analog positive power supply, $V_{DD}$ ; 5.5 V single and dual supply
J5, Pin 2 (J5-2)	AGND	Analog ground
J5, Pin 3 (J5-3)	VSS	Analog negative power supply, $V_{SS}$ ; -5.5 V dual supply
J6, Pin 1 (J6-1)	VLOGIC	Digital supply from 1.8 V to $V_{DD}$ .
J6, Pin 2 (J6-2)	DGND	Digital ground

### 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 EVAL-AD5339DBZ. Table 2 describes the positions of the links that control the evaluation board via the SDP-B controller 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 to Table 4 match the evaluation board imprints (see Figure 9).

**Table 2. Link Options for SDP Control (Default)**

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

### DAUGHTER BOARD LINK OPTIONS

The EVAL-AD5339DBZ daughter board has one link option. LK1 sets the LSB of the I<sup>2</sup>C address for the DAC (see Table 3). For proper device operation, set LK1 to B. Table 4 describes the function of LK1.

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

Link Number	Label	Position
LK1	A0	B (low, default) A (high)

**Table 4. Link Functions**

Link Number	Function
REF1 to 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 SDP-B controller board. Position B selects the internal voltage source 3.3 V from the ADP121. Position C selects an external supply voltage, $V_{DD}$ .
LK6	This link selects the $V_{LOGIC}$ voltage source. Position +3V3 selects the digital voltage source from the SDP-B controller board (+3V3). 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

### INSTALLING THE EVAL-AD5339DBZ EVALUATION SOFTWARE

The [EVAL-AD5339DBZ](#) 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](#) controller board to the USB port of the PC to ensure the [SDP-B](#) controller board is recognized when it connects to the PC.

To install the [EVAL-AD5339DBZ](#) evaluation software, take the following steps:

1. Start the Windows operating system.
2. Download the installation software from the [EVAL-AD5339DBZ](#) 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 the evaluation board as described in the Power Supplies section.
5. Connect the [EVAL-AD5339DBZ](#) to the [SDP-B](#) controller board and the [SDP-B](#) controller board to the PC using the USB cable included in the evaluation kit.
6. When the software detects the [EVAL-AD5339DBZ](#), proceed through any dialog boxes that appear to finalize the installation.

### RUNNING THE SOFTWARE

To run the [EVAL-AD5339DBZ](#) evaluation software, proceed with the following steps:

1. Connect the [EVAL-AD5339DBZ](#) to the [SDP-B](#) controller board and connect the USB cable between the [SDP-B](#) controller board and the PC.
2. Power the [EVAL-AD5339DBZ](#) as described in the Power Supplies section.
3. Click **Start > All Programs > Analog Devices > AD5339 Evaluation Software** to locate the evaluation board.

If the [SDP-B](#) controller board is not connected to the USB port when the software launches, a connectivity error displays (see Figure 2).

Connect the [SDP-B](#) controller board to the USB port of the PC and wait a few seconds. When the [SDP-B](#) controller board and the [EVAL-AD5339DBZ](#) daughter board are detected, the display updates (see Figure 3).

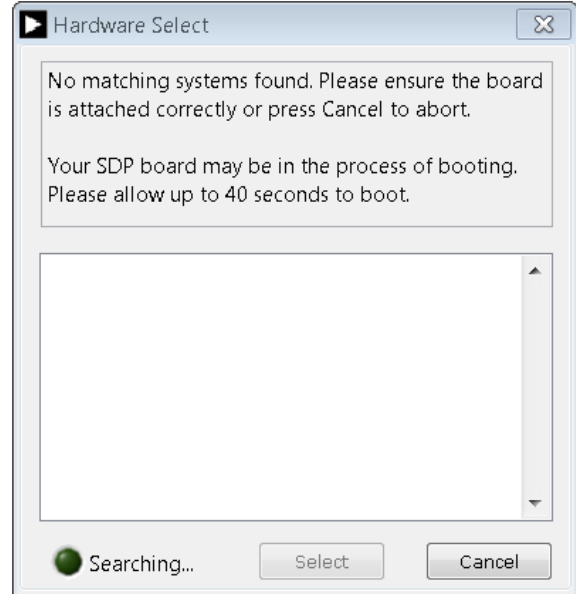


Figure 2. Connectivity Error

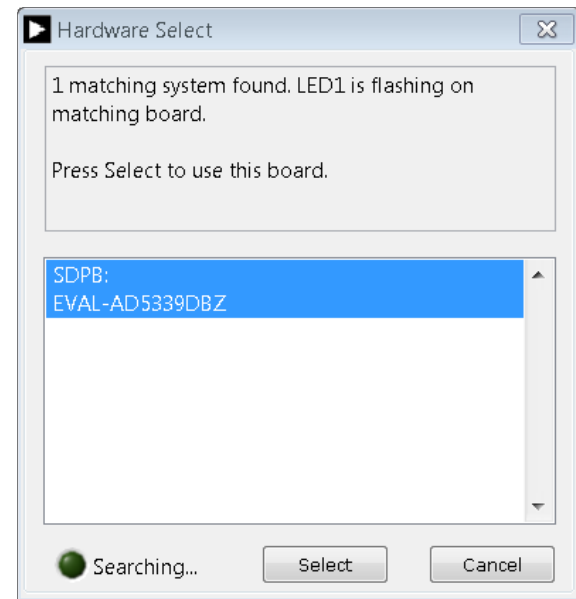


Figure 3. Hardware Select Window

Alternatively, the [EVAL-AD5339DBZ](#) evaluation software can be used without an evaluation board. The [EVAL-AD5339DBZ](#) evaluation software runs in simulation mode displaying the expected outputs based on the input data. The main window of the [EVAL-AD5339DBZ](#) evaluation software then opens, shown in Figure 4.

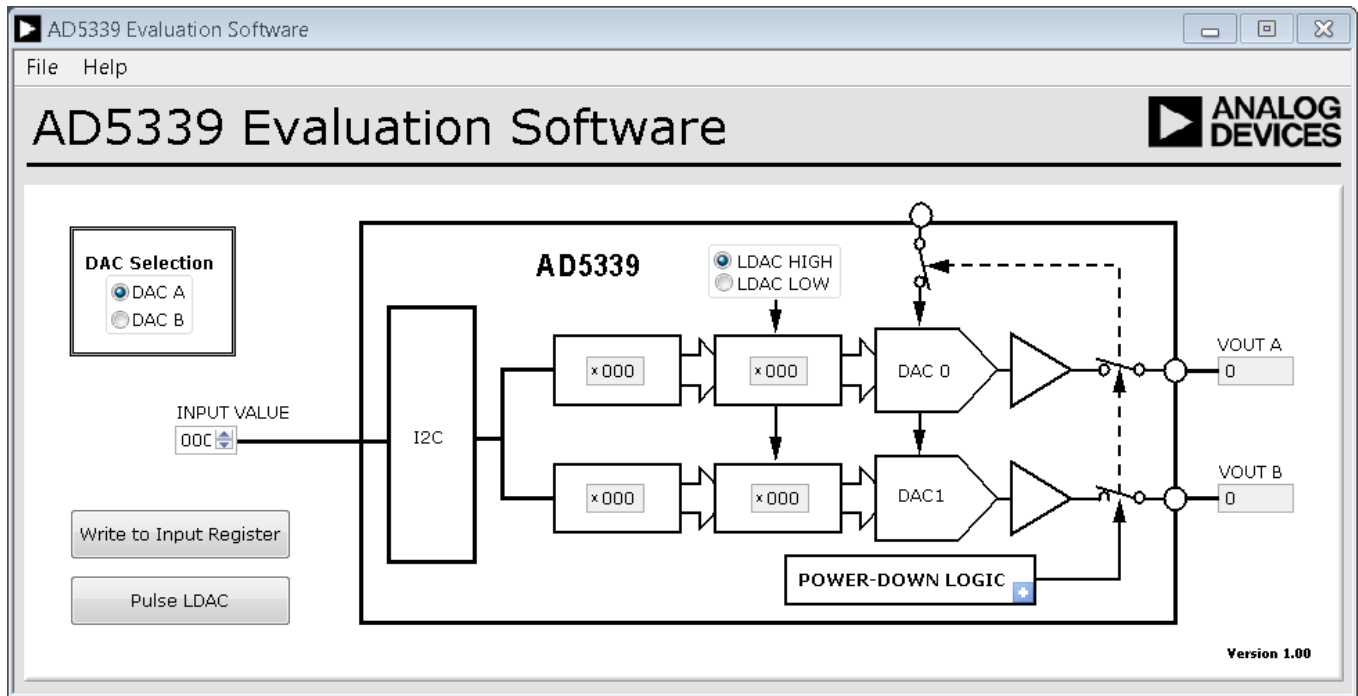


Figure 4. AD5339 Evaluation Board Software Main Window

**SOFTWARE OPERATION**

The EVAL-AD5339DBZ evaluation software allows the user to program values to the input and DAC registers of each DAC individually or collectively (see Figure 4).

**Write to Input Register**

Select the **Write to Input Register** button to load the code of the input data control to the input register of selected DAC in the DAC Selection panel.

**LDAC Control**

Select the **Pulse LDAC** button to bring the  $\overline{\text{LDAC}}$  pin low and then back high, copying the data from the input registers to the DAC registers, and updating the outputs accordingly.

The  $\overline{\text{LDAC}}$  pin can also be set to high or low by clicking **LDAC HIGH** or **LDAC LOW**, respectively.

**Power-Down Control**

All of the DACs can be powered down simultaneously. Click on the blue progressive disclosure buttons on the **POWER-DOWN LOGIC** block to access the **POWER-DOWN LOGIC** block to access the Powerdown window (see Figure 5). The selected **DAC Selection** pane allows the DAC to operate in normal mode or three different power-down modes. When the power-down setting for the DAC is selected, click **OK** to write the appropriate values to the AD5339.

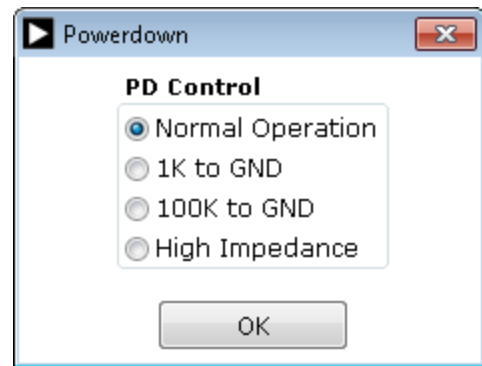


Figure 5. Powerdown Window

# EVALUATION BOARD SCHEMATICS AND ARTWORK

## EVAL-MBnanoDAC-SDZ MOTHERBOARD

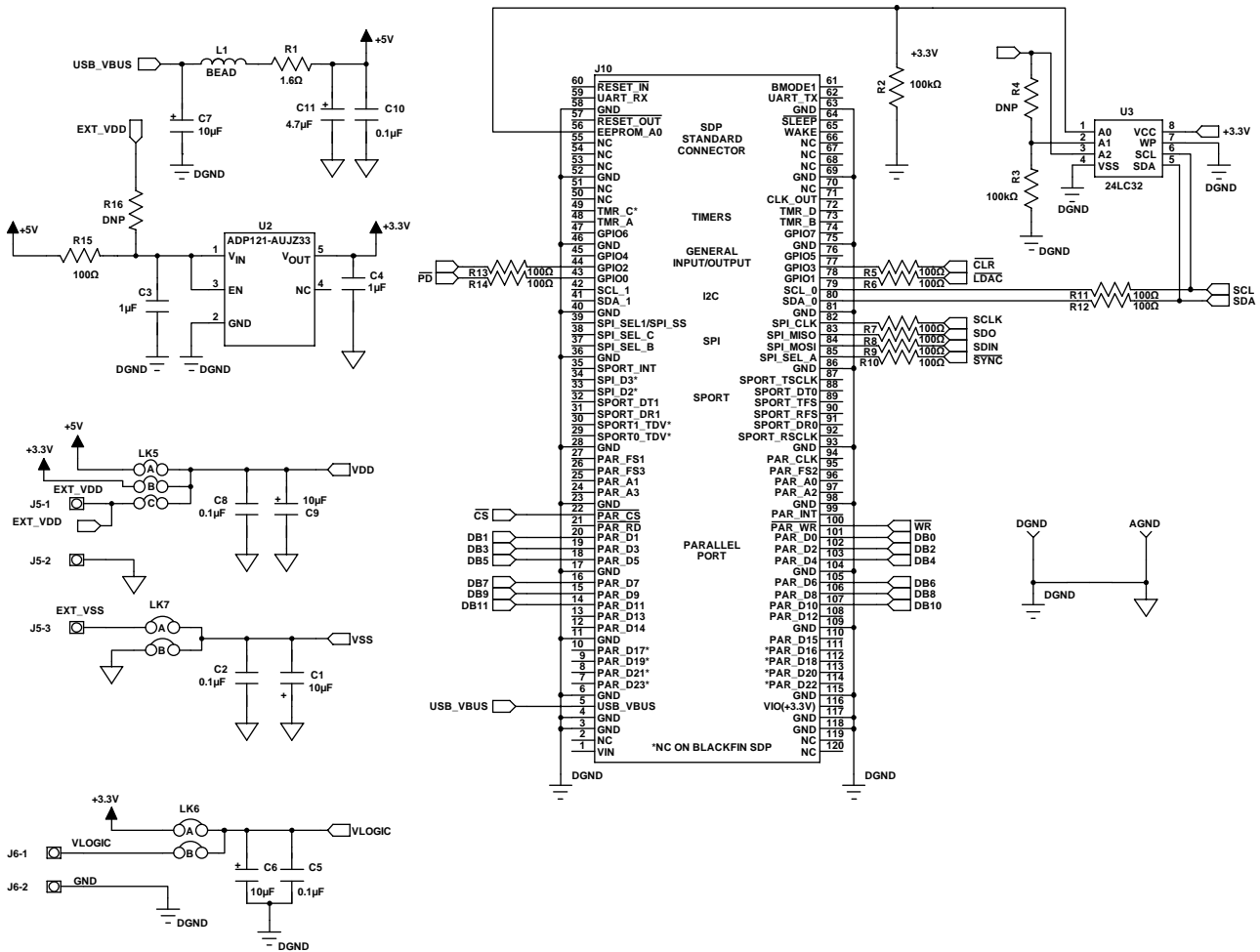


Figure 6. EVAL-MBnanoDAC-SDZ Motherboard, SDP-B Controller Board Connector, and Power Supply

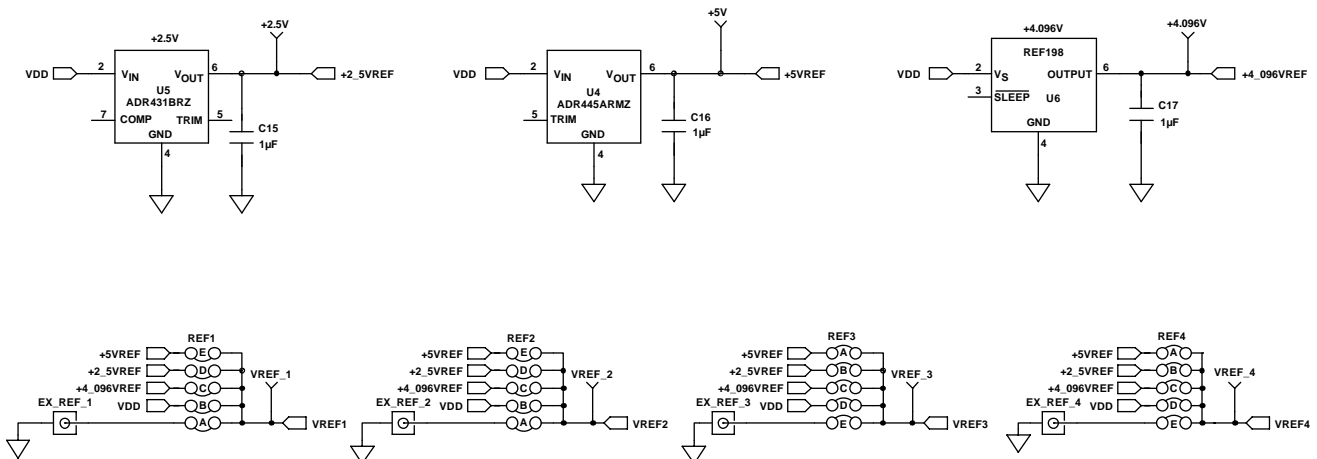


Figure 7. EVAL-MBnanoDAC-SDZ Motherboard Reference Voltage Selector Circuit

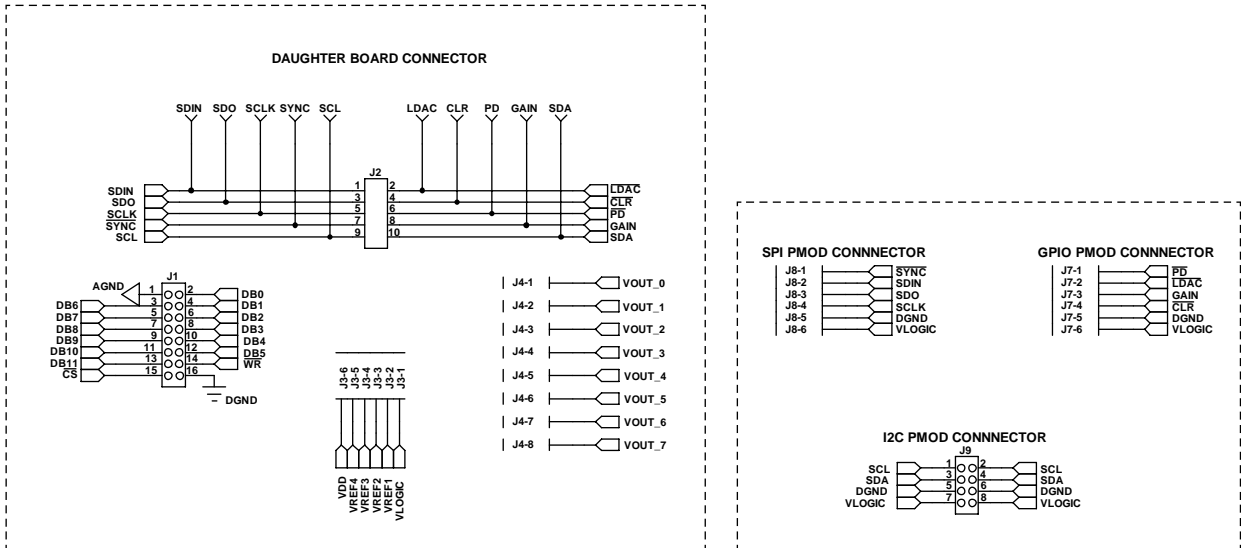


Figure 8. EVAL-MBnanoDAC-SDZ Motherboard Connectors to Daughter Board and Serial Interface

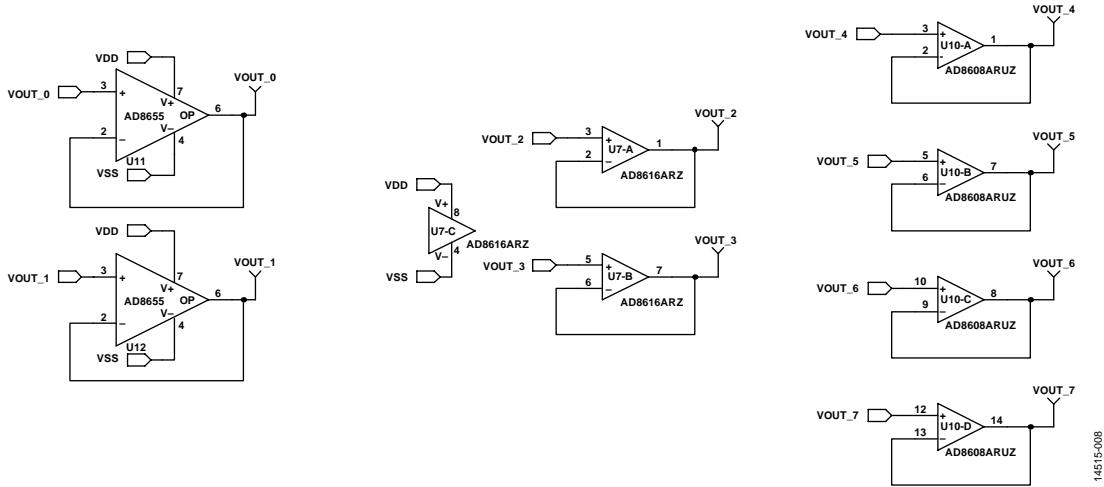
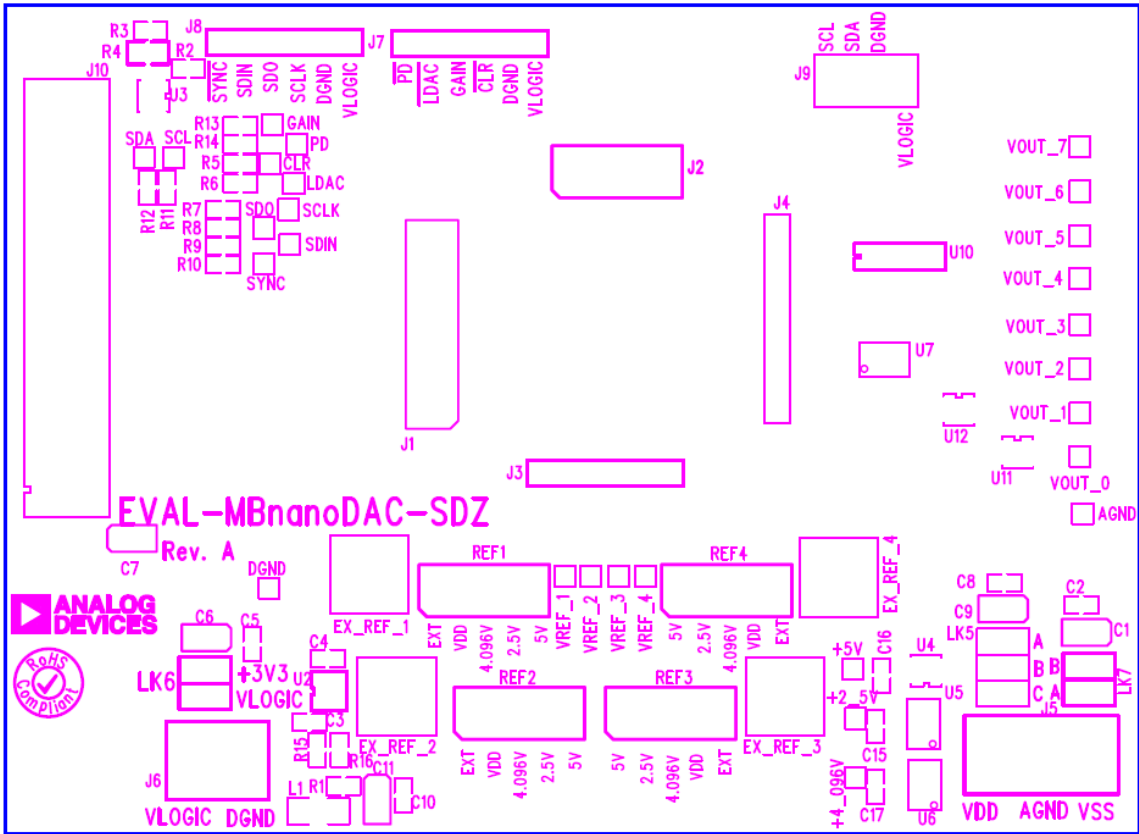
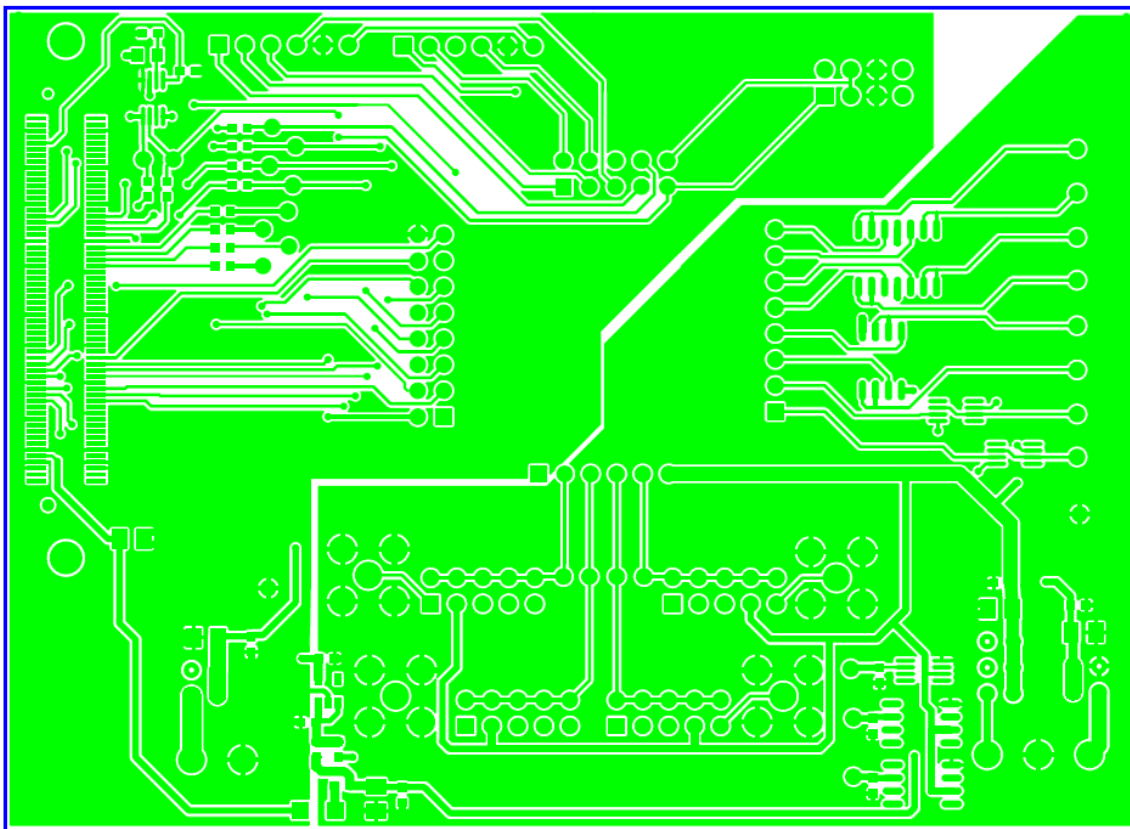


Figure 9. EVAL-MBnanoDAC-SDZ Motherboard Output Amplifier Circuit



14515-009

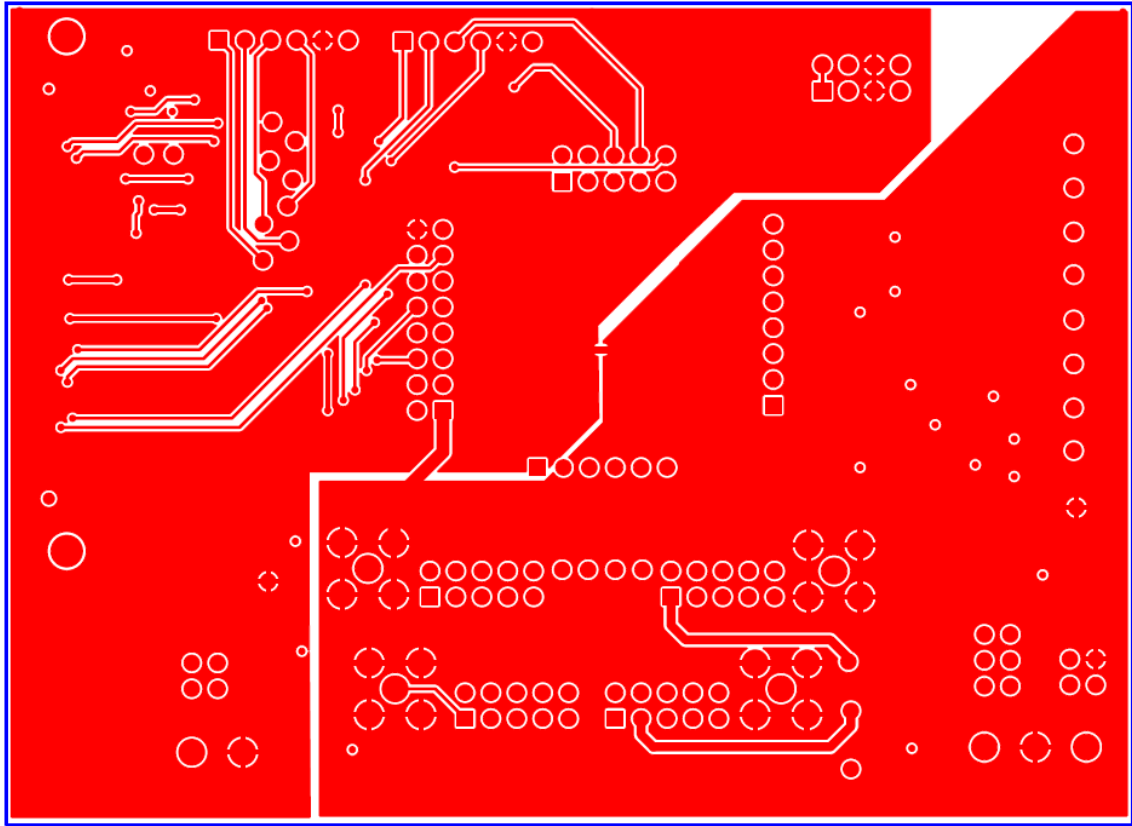
Figure 10. EVAL-MBnanoDAC-SDZ Motherboard Component Placement



14515-010

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

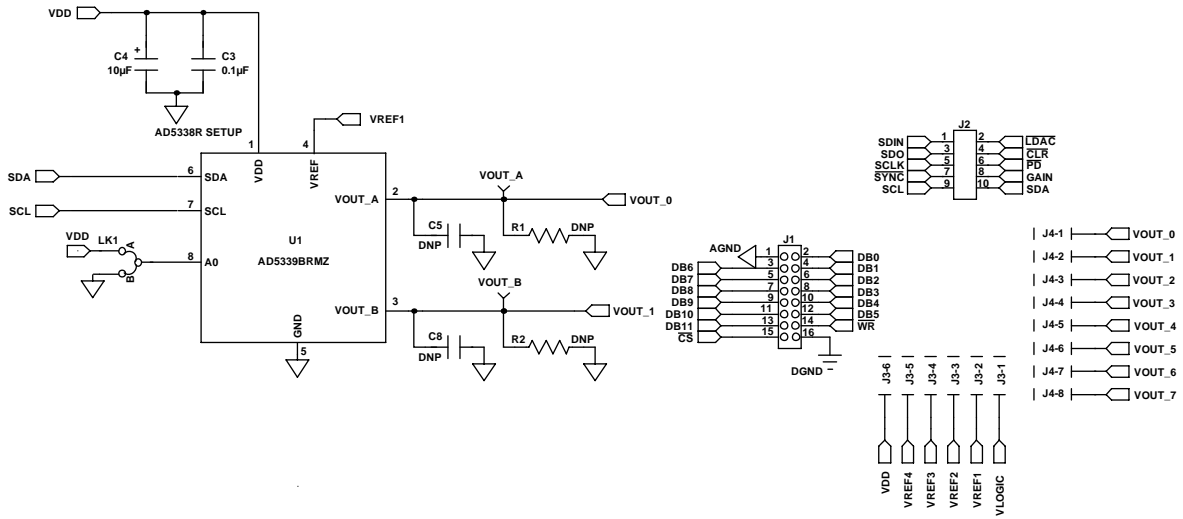




14515-011

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

**EVAL-AD5339DBZ DAUGHTER BOARD**



14514-012

Figure 13. EVAL-AD5339DBZ Daughter Board Schematics

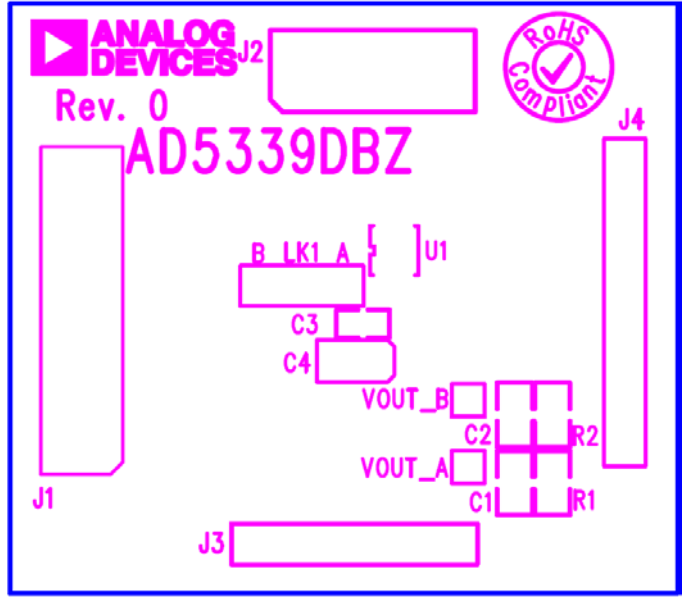


Figure 14. EVAL-AD5339DBZ Daughter Board Component Placement

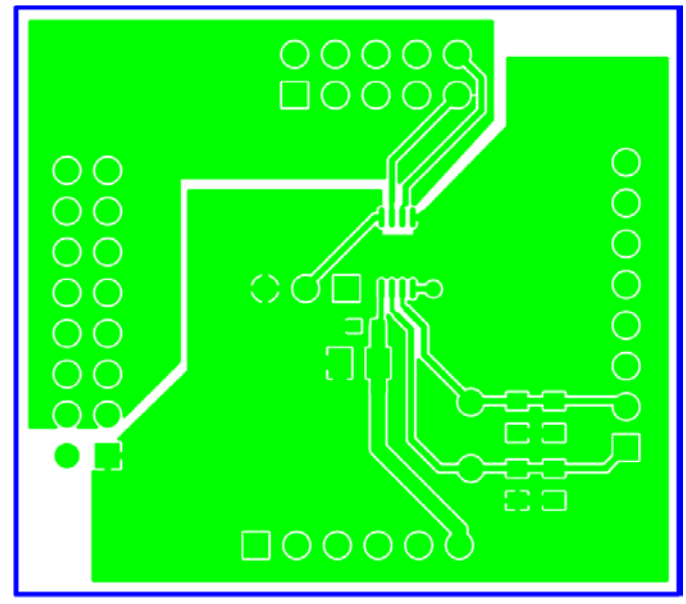
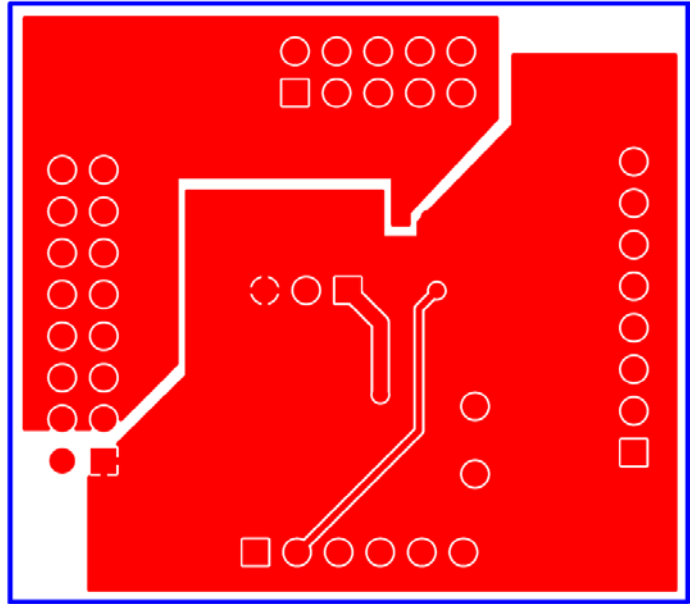


Figure 15. EVAL-AD5339DBZ Daughter Board Top Side Routing



1481E-015

Figure 16. EVAL-AD5339DBZ Daughter Board Bottom Side Routing

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 5. EVAL-MBnanoDAC-SDZ Motherboard

Reference Designator	Description	Supplier <sup>1</sup> /Part Number
C1, C6, C7, C9	6.3 V tantalum capacitors (Case A), 10 $\mu$ F, $\pm$ 20%	FEC 1190107
C2, C5, C8, C10, C15 to C17	50 V, X7R ceramic capacitors, 0.1 $\mu$ F, $\pm$ 10%	FEC 1759122
C3, C4	10 V, X5R ceramic capacitors, 1 $\mu$ F, $\pm$ 10%	GRM188R61A105KA61D <sup>2</sup>
C11	6.3 V tantalum capacitor (Case A), 4.7 $\mu$ F, $\pm$ 20%	FEC 1432350
EXT_REF_1 to EXT_REF_4	Straight PCB mount SMB jacks, 50 $\Omega$	FEC 1206013
J1	Header, 2.54 mm, 2 $\times$ 8-way	FEC 2308428
J2	Header, 2.54 mm, 2 $\times$ 5-way	FEC 9689583
J3, J7, J8	Headers, 2.54 mm, 1 $\times$ 6-way	FEC 9689508
J4	Header, 2.54 mm, 1 $\times$ 8-way	FEC 1766172
J5	3-pin terminal block	FEC 1667472
J6	2-pin terminal block	FEC 151789
J9	Header, 2.54 mm, 2 $\times$ 4-way	FEC 1667509
J10	120-way connector	FEC 1324660
L1	Inductor, SMD, 600 $\Omega$	FEC 9526862
LK5	6-pin (3 $\times$ 2) 0.1" header and shorting block	FEC 148-535 and FEC 150-411 (36-pin strip)
LK6, LK7	4-pin (2 $\times$ 2) 0.1" header and shorting blocks	FEC 148-535 and FEC 150-411 (36-pin strip)
REF1 to REF4	10-pin (5 $\times$ 2) 0.1" header and shorting blocks	FEC 1022227 and FEC 150-411
R1	Resistor, surge, 1.6 $\Omega$ , 1%, 0603	FEC 1627674
R2, R3	SMD resistors, 100 k $\Omega$ , 1%, 0603	FEC 9330402
R5 to R15	SMD resistors, 100 $\Omega$ , 1%, 0603	FEC 9330364
U2	3.3 V linear regulator	<a href="#">ADP121-AUJZ33R7</a>
U3	32 k $\Omega$ I <sup>2</sup> C serial EEPROM	FEC 1331330
U4	5 V reference MSOP	<a href="#">ADR445ARMZ</a>
U5	Ultralow noise XFET <sup>®</sup> voltage reference	<a href="#">ADR431BRZ</a>
U6	4.096 V reference	<a href="#">REF198ESZ</a>
U7	Dual-op amp	<a href="#">AD8616ARZ</a>
U10	Quad-op amp	<a href="#">AD8608ARMZ-R7</a>
U11, U12	Op amp	<a href="#">AD8655ARMZ</a>

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

<sup>2</sup> GRM refers to Murata Manufacturing Company.

Table 6. EVAL-AD5339DBZ Daughter Board

Reference Designator	Description	Supplier <sup>1</sup> /Part Number
C1, C2	Not applicable	Do not insert
C3	50 V X7R ceramic capacitor	FEC 1759122
C4	6.3 V tantalum capacitor (Case A)	FEC 1190107
J1	16-pin (2 $\times$ 8 -way) header	FEC 2308428, inserted from solder side
J2	10-pin (2 $\times$ 5-way) straight header, 2.54 mm pitch	FEC 9689583, inserted from solder side
J3	6-pin (1 $\times$ 6 -way) straight header, 2.54 mm pitch	FEC 9689508, inserted from solder side
J4	Header, 2.54 mm, PCB, 1 $\times$ 8-way	FEC 1766172, inserted from solder side
LK1	Jumper block using 3-pin SIP header	FEC 1022248 and FEC 150410
R1	Not applicable	Not inserted
R2	Not applicable	Not inserted
U1	Dual 12-bit DAC	<a href="#">AD5339BRMZ</a>
VOUT_A	Red test point	Do not insert
VOUT_B	Red test point	FEC 8731144

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

## NOTES

I<sup>2</sup>C refers to a communications protocol originally developed by Phillips 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 NON-INFRINGEMENT 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.

©2017 Analog Devices, Inc. All rights reserved. Trademarks and registered trademarks are the property of their respective owners.  
UG14515-0-3/17(0)



www.analog.com