

## Evaluating the **ADA4961** Low Distortion, 3.2 GHz, Differential DGA

### INTRODUCTION

The **ADA4961** is a differential in, differential out, digital variable gain amplifier (DVGA), intended for driving 50  $\Omega$  loads, with bandwidths greater than 2 GHz. This document describes, in detail, the standard test procedure for verifying the operation of the **ADA4961**.

Complete specifications for the **ADA4961** are available in the **ADA4961** data sheet available from Analog Devices, Inc., and should be consulted in conjunction with this user guide when using the evaluation board.

### TEST EQUIPMENT

The test equipment required consists of the following:

- +5 V power supply, capable of 200 mA output
- Two CW generators, capable of 0 dBm output at >100 MHz
- One spectrum analyzer
- One Mini-Circuits ZFSC-2-2500-S+ RF splitter
- One Windows® 7 PC with **ADA4961** software loaded, USB 2.0 or later interface required

For reference, a photo of the complete setup is shown in Figure 1.

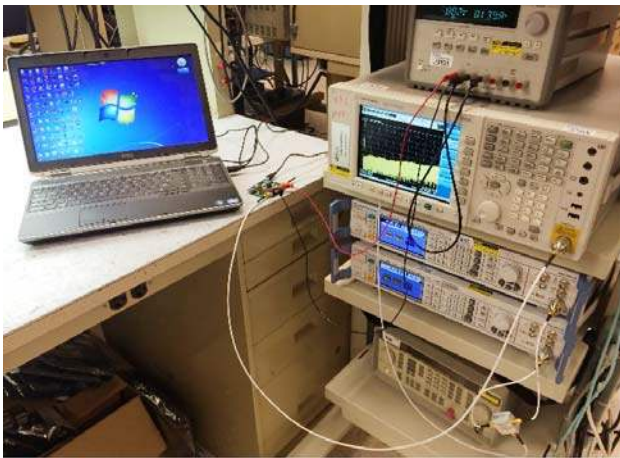


Figure 1. **ADA4961** Test Procedure Setup

### INITIAL EQUIPMENT SETUP

1. Set the power supply to +5 V, power supply turned off for now.
2. Set CW Generator 1 to 99 MHz at -20 dBm, RF output off for now.
3. Set CW Generator 2 to 101 MHz at -20 dBm, RF output off for now.
4. Set the spectrum analyzer to a center frequency of 100 MHz, with a 10 MHz span, an RBW of 30 kHz, and an input attenuation of 10 dB. Use the peak detector mode on the spectrum analyzer for this test.

5. Connect the two generator outputs to the input terminals of the Mini-Circuits combiner. Connect the output of the combiner to the input SMA connector, J1, on the **ADA4961** evaluation board. The output SMA connector, J2, on the **ADA4961** evaluation board connects to the spectrum analyzer. The details of the SMA connections, as well as the **SDP-S** daughter card connection and the USB cable connection to the PC, are shown in Figure 2.
6. If the spectrum analyzer allows, place markers at 97 MHz, 99 MHz, 101 MHz, and 103 MHz.

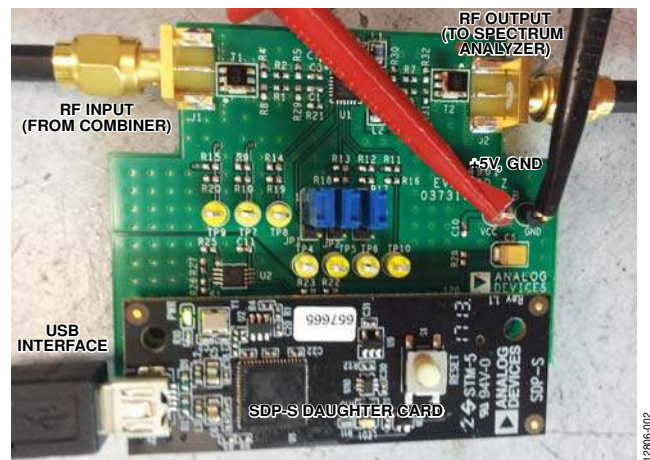


Figure 2. Detail of Connections from Test Equipment and PC to the **ADA4961** Evaluation Board

### SOFTWARE INSTALLATION

The user software for the **ADA4961** evaluation board is built around the Analog Devices **SDP-S** USB hardware and software. All software described in the following steps is available in the **ADA4961** software archive. To install the software for this environment, perform the following steps:

1. To install the **SDP-S** drivers, run the executable, **SDPDriversNET\_2013.exe**.
2. The SDP EEPROM Programmer must be installed on the PC. In the **SDPEEPROMProgrammer\_2013** folder in the **ADA4961** software archive, there is a **setup.exe** file. Run this setup file. At the conclusion, the SDP EEPROM Programmer is visible from the Windows 7 **Start** menu.
3. Extract the file, **ADA4961\_0p0p0.zip**.
4. From the **ADA4961** unzipped archive, run the **ADA4961\_0p0p0\_installer.exe** executable.
5. An **ADA4961** icon appears on the PC desktop, but is not ready to use until the DUT EEPROM is initialized in the next step.

**DUT EEPROM INITIALIZATION**

To perform this initialization, users must have the executable, **EEPROMProgrammer.exe**, and the file, **ADA4961\_eval\_board.sdpeeprom**, stored on their PC.

The **ADA4961** interfaces with the PC through the **SDP-S** daughter card interface, as shown in Figure 2.

There is an EEPROM installed on the **ADA4961** evaluation board. This EEPROM must be programmed initially for the USB interface to recognize the board. To program the EEPROM, take the following steps:

1. Without applying power to the **ADA4961** evaluation board, connect the evaluation board and the **SDP-S** daughter card, as shown in Figure 2. Connect the **SDP-S** USB cable to the PC.
2. Run the SDP EEPROM Programmer. The SDP EEPROM Programmer GUI opens, as shown in Figure 3.

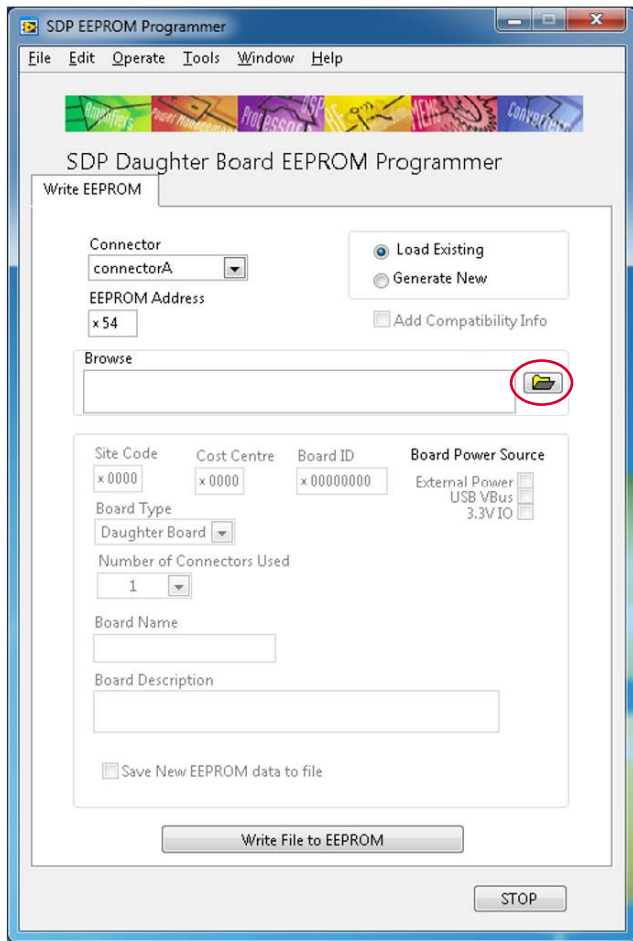


Figure 3. SDP EEPROM Programmer GUI

3. Enter 0x54 for the EEPROM address, click **Load Existing**, click the **Select Folder** button (circled in red in Figure 3), and then a selection window opens, as shown in Figure 4. You may need to navigate to the directory where the EEPROM configuration file is stored. Open the **ADA4961\_eval\_board.sdpeeprom** file, and then click **OK**.

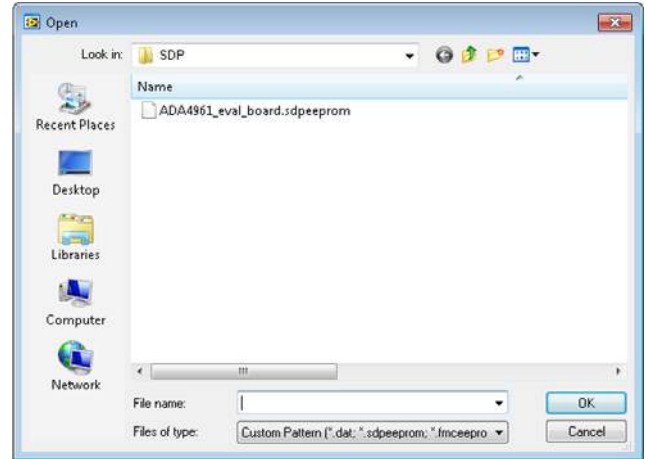


Figure 4. Selection Window for EEPROM Configuration File

4. After Step 3 is completed, the SDP EEPROM Programmer GUI window opens again, as shown in Figure 3. Click **Write File to EEPROM**, and a window opens indicating that the EEPROM has been programmed, as shown in Figure 5.

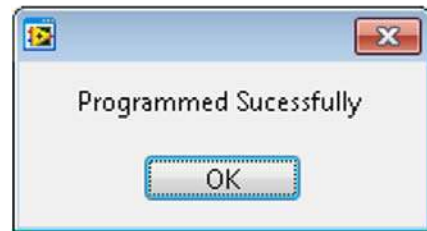


Figure 5. EEPROM Programmed

**RUNNING THE SOFTWARE GUI**

After the DUT EEPROM is initialized, the ADI ADA4961 Customer Software rev 0.0.0 is able to detect the evaluation board. To run the software, double click the ADA4961 icon that is present on the desktop. The ADI ADA4961 Customer Software rev 0.0.0 GUI opens, as shown in Figure 6. When the ADI ADA4961 Customer Software rev 0.0.0 GUI is started, move the gain control slider to the bottom of its range (the slider all the way to the bottom on the ADI ADA4961 Customer Software rev 0.0.0 GUI).

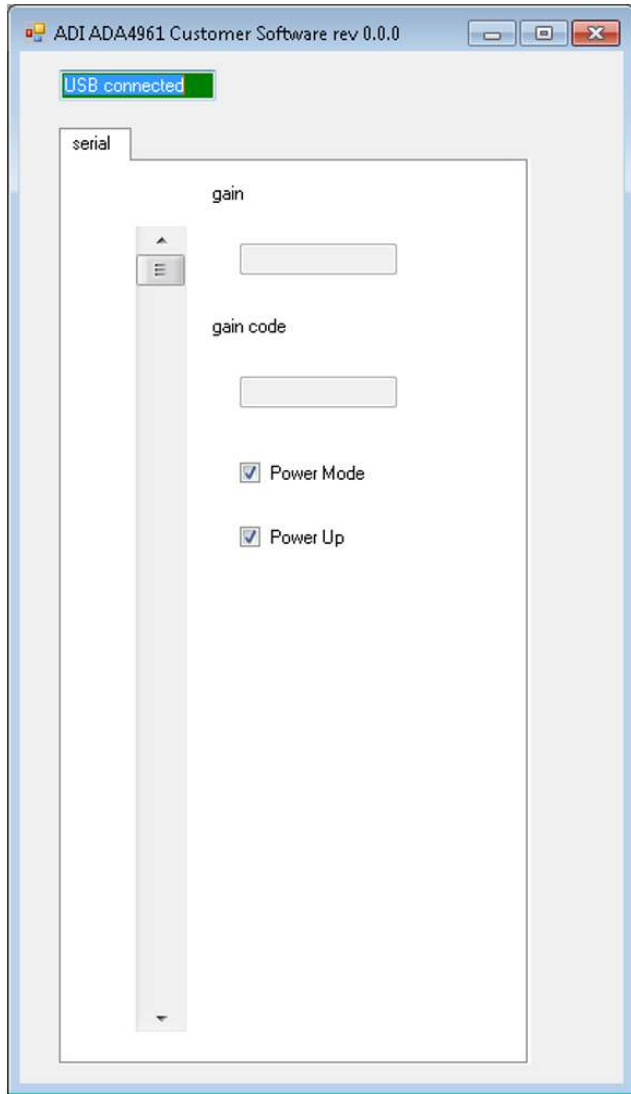


Figure 6. ADI ADA4961 Customer Software rev 0.0.0 GUI

**APPLYING POWER AND MEASUREMENT INITIALIZATION**

Turn on the +5 V power supply. The measured current is between 130 mA and 145 mA. Turn on the RF outputs on both CW signal generators. Markers were enabled in a previous step in the procedure, so the spectrum analyzer appears similar to Figure 7.



Figure 7. Initial View of Spectrum Analyzer

Adjust the level of each CW generator so that Marker 1 and Marker 2 are at -40 dBm, as shown in Figure 8. Note that this step only needs to be done on the first ADA4961 DUT tested. For remaining tests on this DUT, leave the CW output power levels as they are currently set. The power/tone during this measurement is between -39 dBm and -41 dBm.



Figure 8. Spectrum Analyzer Screen, CW Generators Set for -40 dBm/Tone on ADA4961 Output

Move the gain control slider in the ADI ADA4961 Customer Software rev 0.0.0 GUI to the top of its range. The power/tone increases to between -20 dBm and -18 dBm, as shown in Figure 9. Note that during this step, the current increases to between 155 mA and 170 mA. The current stays at this level for the remainder of the test. This increase is a result of the software enabling the ADA4961 high performance mode.

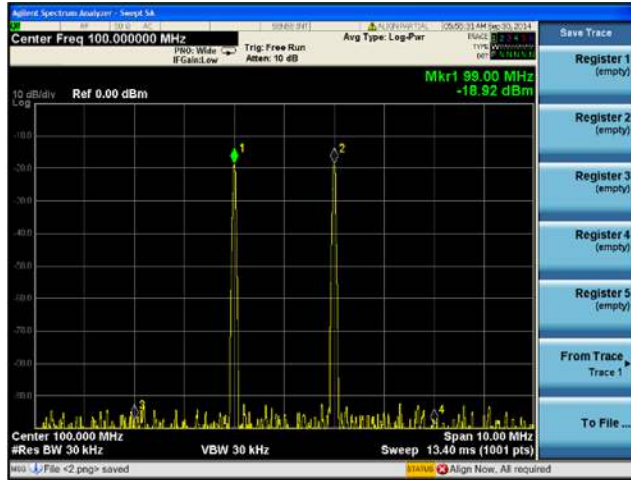


Figure 9. Spectrum Analyzer Display with ADA4961 Set to Maximum Gain

**SPUR MEASUREMENT, COMPLETION OF TEST**

Marker 3 and Marker 4 indicate the third-order harmonic performance of the ADA4961 amplifier and measurements system. On top end spectrum analyzers such as the Agilent PXA or Rohde and Schwarz, these markers may be in the noise floor. If lesser performing spectrum analyzers are used, spur height for Marker 3 and Marker 4 may be as high as -90 dBm. If this requirement is met, the DUT has passed test and this procedure is complete.

**REVISION HISTORY**

11/14—Rev. 0 to Rev. A	
Change to Title.....	1
10/14—Revision 0: Initial Version	



**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.

