ANALOG DEVICES

EVAL-AD7887SDZ User Guide
UG-674

One Technology Way • P.O. Box 9106 • Norwood, MA 02062-9106, U.S.A. • Tel: 781.329.4700 • Fax: 781.461.3113 • www.analog.com

Evaluating the AD7887 12-Bit, Analog-to-Digital Converter

FEATURES

Full featured evaluation board for the AD7887
On-board power supplies
Standalone capability
System demonstration platform (SDP) compatible (EVAL-SDP-CB1Z)
PC software for control and data analysis (download from product page)

ONLINE RESOURCES

Documents needed
AD7887 data sheet
EVAL-AD7887SDZ user guide
Required software
EVAL-AD7887SDZ evaluation software
Design and integration files
Schematics, layout files, bill of materials

EVALUATION KIT CONTENTS

EVAL-AD7887SDZ evaluation board
Evaluation software CD for the AD7887
Mains power supply adapter
Screw/nut kit

ADDITIONAL EQUIPMENT NEEDED

EVAL-SDP-CB1Z system demonstration platform
PC running Windows XP SP2, Windows Vista, or Windows 7 with USB 2.0 port
Signal source
USB cable
SMB cable

EVALUATION BOARD DESCRIPTION

The EVAL-AD7887SDZ is a full featured evaluation board designed to allow easy evaluation of all the features of the AD7887 analog-to-digital converter (ADC). The evaluation board can be controlled via the SDP connector (J20). The SDP board (EVAL-SDP-CB1Z) allows the evaluation board to be controlled through the USB port of a PC using the software available for download from the EVAL-AD7887SDZ product page.

The EVAL-AD7887SDZ software provides dynamic performance analysis in the form of waveform graphs, histograms, and FFT analysis for ADC performance evaluation.

On-board components include: the AD8033 and the AD8034 *FastFET* high speed precision rail-to-rail op amps, the ADP3303 high accuracy 200 mA low dropout linear regulator, and the AD780 2.5 V/3.0 V ultrahigh precision band gap voltage reference.

EVAL-AD7887SDZ FUNCTIONAL BLOCK DIAGRAM

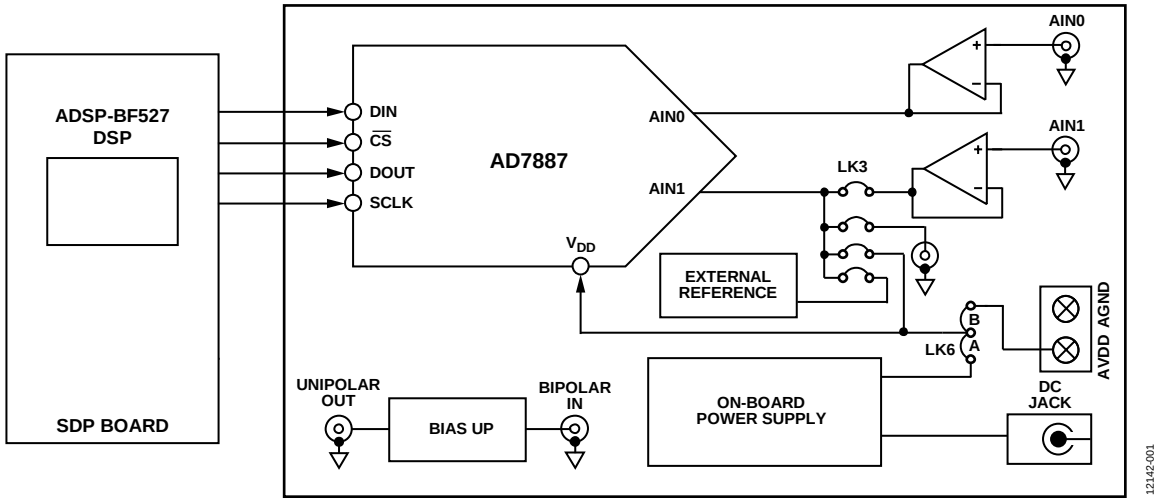

Figure 1.

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REVISION HISTORY

9/14—Revision 0: Initial Version

QUICK START GUIDE

Follow these steps to quickly evaluate the AD7887 ADC:

1. Install the evaluation software from the AD7887 product page. Ensure that the EVAL-SDP-CB1Z board is disconnected from the USB port of the PC while installing the software. The PC may need to be restarted after the installation.
2. Ensure that the various link options are configured as described in Table 2.
3. Connect the EVAL-SDP-CB1Z board to the EVAL-AD7887SDZ evaluation board as shown in Figure 2. Screw the two boards together using the enclosed nylon screw/nut set to ensure that the boards connect firmly together.
4. Connect the power supply adapter included in the evaluation kit to Connecter J1 on the evaluation board.
5. Connect the EVAL-SDP-CB1Z board to the PC via the USB cable. For Windows® XP, you may need to search for the EVAL-SDP-CB1Z drivers. Choose to automatically search for the drivers for the EVAL-SDP-CB1Z board if prompted by the operating system.
6. Launch the evaluation software from the **Analog Devices** subfolder in the **Programs** menu.
7. Connect an input signal via either the AIN0 or AIN1 single-ended input.

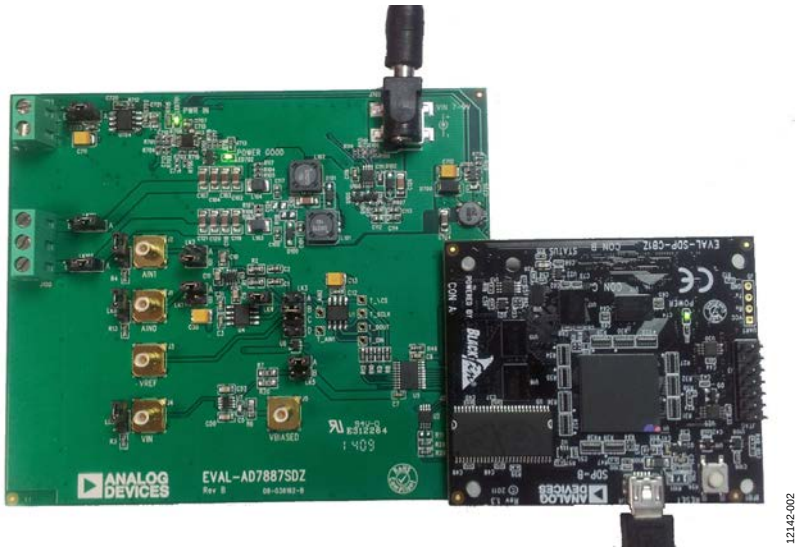

Figure 2. EVAL-AD7887SDZ Evaluation Board (Left) Connected to the EVAL-SDP-CB1Z SDP Board (Right)

EVALUATION BOARD HARDWARE

DEVICE DESCRIPTION

The AD7887 ADC is a 12-bit, low power, successive approximation ADC. It operates from a single 2.7 V to 5.25 V power supply and is capable of achieving a throughput rate of 125 kSPS. The input track-and-hold acquires a signal in 500 ns and features a single-ended sampling scheme. The output coding for the AD7887 is straight binary, and the device is capable of converting full power signals up to 2.5 MHz.

Full data on the AD7887 is available in the AD7887 data sheet, which must be consulted in conjunction with this user guide when using the evaluation board. Full details on the EVAL-SDP-CB1Z are available at the controller board product page.

HARDWARE LINK OPTIONS

The functions of the link options are described in Table 2. The default setup is configured to operate the board with the main power supply adapter and to interface to the EVAL-SDP-CB1Z board.

POWER SUPPLIES

Take care before applying power and signals to the evaluation board to ensure that all link positions are set according to the required operating mode. See Table 2 for the complete list of link options.

The EVAL-AD7887SDZ evaluation board is supplied with a wall mountable switching power supply that provides 7 V dc output. Connect the supply to a 100 V to 240 V ac wall outlet at 50 Hz to 60 Hz. The output from the supply is provided through a 2.0 mm inner diameter jack that connects to the evaluation board at J702. The 7 V supply is connected to the on-board, 5 V linear regulator that supplies the correct bias to each of the various sections on the evaluation board and on the EVAL-SDP-CB1Z board.

When using the EVAL-AD7887SDZ evaluation board with the EVAL-SDP-CB1Z board, power the EVAL-AD7887SDZ board through the J702 connector.

If the evaluation board is used without the 7 V adapter, an external power supply in the range of 2.7 V to 5.25 V must be connected to the AVDD input to supply the AD7887 V_{DD} pin. In addition, an external supply in the range of ±5 V to ±24 V must be connected to the VDD, VSS, and AGND of the J100 connector, and LK101 and LK102 must be set in accordance with Table 2, to drive the input buffer amplifiers and reference buffer amplifier.

Each supply is decoupled on this board using 10 µF tantalum and 100 nF multilayer ceramic capacitors.

Table 1. External Power Supplies Required

Power Supply	Voltage Range	Description
DC Jack	7 V to 9 V ± 5%	Supplies power to on-board power management devices
AVDD	2.7 V to 5.25 V	Analog supply rail
VDD/VSS	±5 V to ±24 V	Amplifier supply rail
SDP	3.3 V ± 5%	Digital supply rail with EVAL-SDP-CB1Z connected

Table 2. Link Options

Link	Default Position	Function
LK1	A	This link is used to select the input to AIN0. In Position A, the input is connected to the SMB connector J1. In Position B, the input is connected to AGND.
LK2	B	This link is used to select the input to AIN1. In Position A, the input is connected to the SMB connector J2. In Position B, the input is connected to AGND.
LK3	B	This link is used to select the input to the AIN1/V_{REF} pin for the AD7887. In Position A, the pin is connected to the buffered AIN1 input. In Position B, V_{REF} is supplied by the AD780 external reference. In Position C, V_{REF} is supplied by the J3 connector. In Position D, V_{REF} is tied to AVDD.
LK4	Not inserted	This link is used to select the output voltage of the AD780 external reference. Inserted: output select is connected to AGND, and V_{OUT} is 3 V. Not inserted: output select is floating, and V_{OUT} is 2.5 V.
LK5	A	This link is used to select the biasing level for VBIASED. In Position A, the VIN input to connector J4 is dc biased around V_{REF}/2. In Position B, the VIN input to connector J4 is dc biased around AVDD/2.
LK6	Not inserted	Adds a 51 Ω termination resistor to AGND at VIN. Inserted: 51 Ω termination on the VIN input. Not inserted: no 51 Ω termination on the VIN input.
LK7	Not inserted	Adds a 51 Ω termination resistor to AGND at AIN1. Inserted: 51 Ω termination on the AIN1 input. Not inserted: no 51 Ω termination on the AIN1 input.
LK8	Not inserted	Adds a 51 Ω termination resistor to AGND at AIN0. Inserted: 51 Ω termination on the AIN0 input. Not inserted: no 51 Ω termination on the AIN0 input.
LK101	A	This link is used to select either the on-board or external amplifier negative supply. In Position A, the on-board generated −12 V supply is used for VSS. In Position B, the externally supplied VSS to Connector J100 is used.
LK102	A	This link is used to select either the on-board or external amplifier positive supply. In Position A, the on-board generated +12 V supply is used for VDD. In Position B, the externally supplied VDD to Connector J100 is used.
LK701	A	This link is used to select either the on-board or external AVDD supply. In Position A, the on-board generated +5 V supply is used for AVDD. In Position B, the externally supplied AVDD to Connector J703 is used.

SOCKETS/CONNECTORS

The connectors and sockets on the EVAL-AD7887SDZ are outlined in Table 3.

Table 3. On-Board Connectors

Connector	Function
J1	AIN0 analog input signal
J2	AIN1 analog input signal
J3	External reference voltage connector
J4	VIN analog input signal to bias up circuit
J5	VBIASED analog output from bias up circuit
J20	120-way connector for EVAL-SDP-CB1Z interface
J100	External VDD, GND, and VSS power connector
J702	7 V, 2.0 mm dc jack connector
J703	External AVDD and AGND power connector

The default interface to this evaluation board is via the 120-way connector, which connects the EVAL-AD7887SDZ to the EVAL-SDP-CB1Z board.

TEST POINTS

There are numerous test points on the EVAL-AD7887SDZ board. These test points provide easy access to the signals from the evaluation board for probing, evaluation, and debugging.

It is also possible to communicate with the AD7887 device via the test points to operate the evaluation board in standalone mode without the need for the EVAL-SDP-CB1Z board.

BASIC HARDWARE SETUP

The EVAL-AD7887SDZ connects to the EVAL-SDP-CB1Z system demonstration platform board. The EVAL-SDP-CB1Z board is the controller board, which is the communication link between the PC and the main evaluation board using the bundled software. The latest software is available for download from the AD7887 product page.

Figure 2 shows a photograph of the connections between the EVAL-AD7887SDZ daughter board and the EVAL-SDP-CB1Z board.

The analog input range to the AD7887 device is 0 V to V_{REF}, and this range must not be exceeded. When using the on-chip reference, V_{REF} is 2.5 V. An input signal in the range of 2.5 V p-p must be connected to the evaluation board via either of the analog input connectors, AIN0 or AIN1. When using the AIN1 channel, the on-chip reference must be used.

If an input signal is a bipolar input, it must be connected to VIN, the J4 connector. This signal is biased to $V_{REF}/2$ via the bias up circuitry on the EVAL-AD7887SDZ. The signal source must be a low impedance source. The signal must then be connected to any unipolar analog input by connecting VBIASED, the J5 connector, to any connector (J1 or J2). The on-board unity-gain amplifiers buffer the signal to the ADC, which is the default configuration on the evaluation board.

Directly connect a unipolar signal to either analog input via Connector J1 and/or Connector J2. On-board unity-gain amplifiers buffer the signal to the AD7887.

Before connecting power, connect the EVAL-AD7887SDZ to Connector A on the EVAL-SDP-CB1Z board. A nylon screw/nut set is included in the evaluation kit to firmly connect the evaluation board and the EVAL-SDP-CB1Z boards together.

Ensure that the link options are in the default positions, as shown in Table 2.

After the evaluation board and the EVAL-SDP-CB1Z board are connected securely, connect the power to the evaluation board. The evaluation board requires an external power supply adapter, which is included in the evaluation board kit. Connect this power supply to Connector J1 on the evaluation board. For further details on the required power supply connections and options, see the Power Supplies section.

Before connecting the EVAL-SDP-CB1Z board to your PC, ensure that the evaluation software has been installed. The full software installation procedure is detailed in the Evaluation Board Software section.

Finally, connect the EVAL-SDP-CB1Z board to the PC via the USB cable enclosed in the EVAL-SDP-CB1Z kit. If using a Windows XP platform, you may need to search for the EVAL-SDP-CB1Z drivers. Choose to automatically search for the drivers for the EVAL-SDP-CB1Z board if prompted by the operating system.

EVALUATION BOARD SOFTWARE

SOFTWARE INSTALLATION

The EVAL-AD7887SDZ kit includes the evaluation software on a CD; the software is also available for download from the AD7887 product page.

Take the following steps to install the software:

1. Start the Windows operating system and download the evaluation software from the AD7887 product page.
2. Unzip the downloaded file.
3. Double-click the **setup.exe** file to run the install. The default location for the software is **C:\Program Files\Analog Devices\AD7887**.
4. Power up the evaluation board as described in the Power Supplies section.
5. Connect the evaluation board and the EVAL-SDP-CB1Z board to the USB port of the PC to ensure that the evaluation system is correctly recognized when connected to the PC.
6. When the software detects the evaluation board, proceed through the dialog boxes that appear to finalize the installation.

There are two parts to the installation:

- EVAL-AD7887SDZ evaluation software installation
- EVAL-SDP-CB1Z system demonstration platform board drivers installation

Follow Step 1 to Step 4 (see Figure 3 to Figure 6) to install the evaluation board software. Follow Step 5 to Step 8 (see Figure 7 to Figure 10) to install the EVAL-SDP-CB1Z drivers. Proceed through all of the installation steps, allowing the software and drivers to be placed in the appropriate locations. Connect the EVAL-SDP-CB1Z board to the PC only after the software and drivers have been installed.

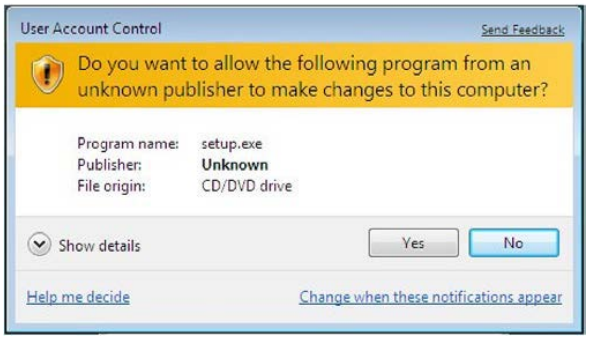

Figure 3. Evaluation Software Installation—User Account Control

1. Click **Yes** to begin the installation process.

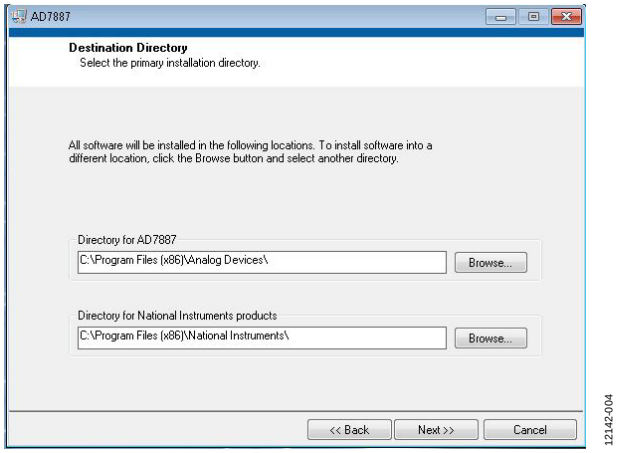

Figure 4. Evaluation Software Installation—Destination Directory

2. Select the installation directory. Click **Next** >>.

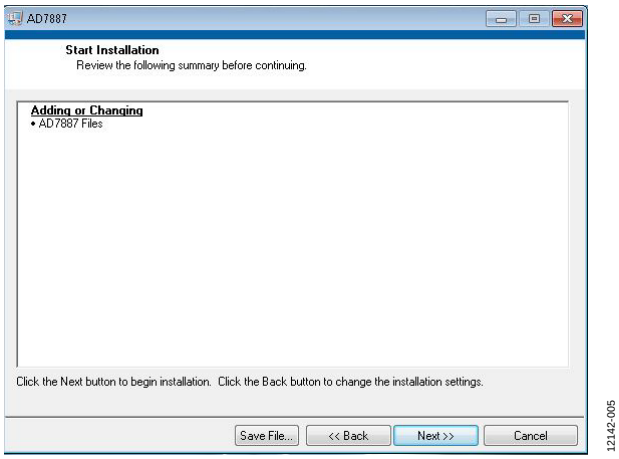

Figure 5. Evaluation Software Installation—Start Installation

3. Click **Next** >> to install the software.

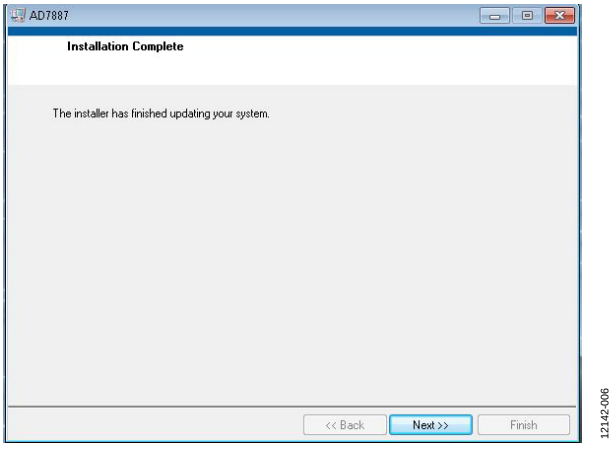

Figure 6. Evaluation Software Installation—Installation Complete

4. The installation of the evaluation software completes. Click **Next** to proceed with the installation of the SDP drivers.

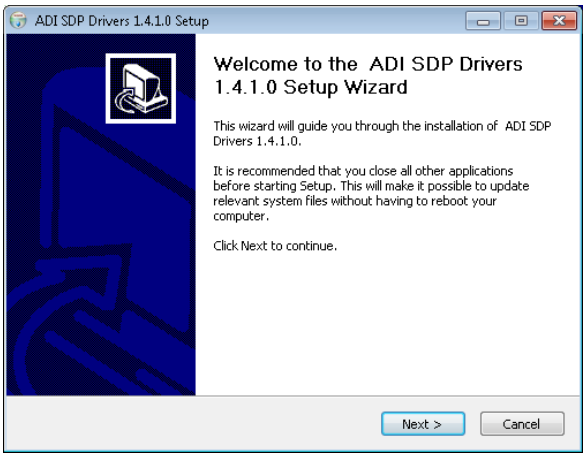

Figure 7. EVAL-SDP-CB1Z Drivers Installation—Setup Wizard

5. The **ADI SDP Drivers Setup Wizard** opens. Click **Next >** to begin the driver installation process.

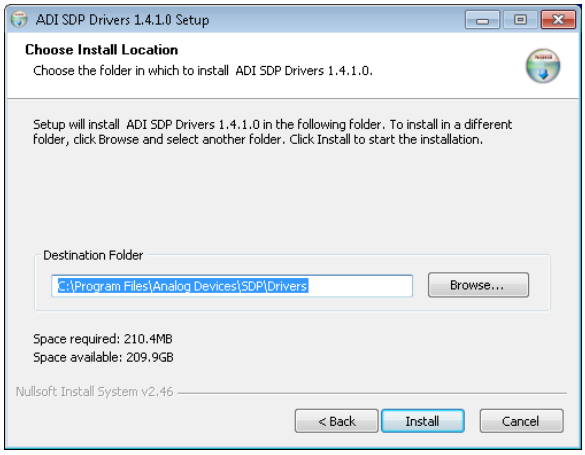

Figure 8. EVAL-SDP-CB1Z Drivers Installation—Choose Install Location

6. Select a destination folder for the SDP drivers, and click **Install**.

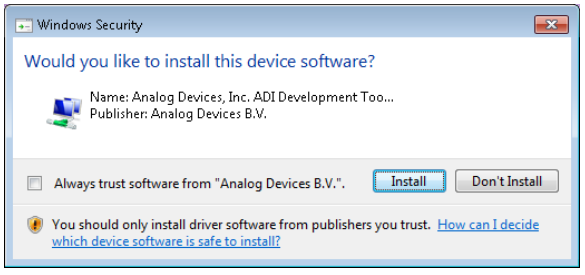

Figure 9. EVAL-SDP-CB1Z Drivers Installation—Windows Security

7. Click **Install** to proceed with the installation.

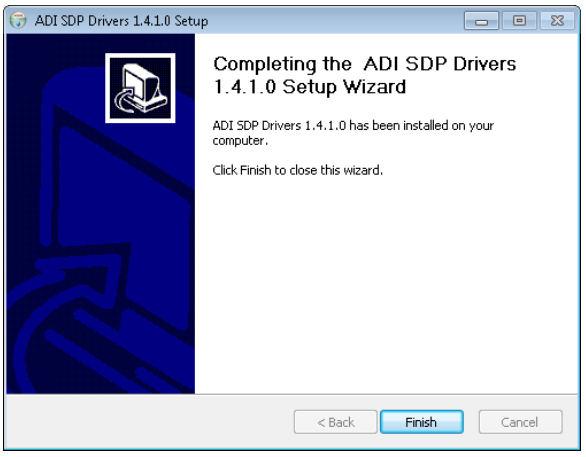

Figure 10. EVAL-SDP-CB1Z Drivers Installation—Complete

8. Click **Finish**.

After the evaluation software installation is complete, connect the EVAL-AD7887SDZ board to the EVAL-SDP-CB1Z board, as described in the Evaluation Board Hardware section.

When you first plug in the EVAL-SDP-CB1Z board via the USB cable provided, allow the **Found Hardware Wizard** to run. After the drivers are installed, check that the board is connected correctly by looking at the **Device Manager** of the PC. The **Device Manager** can be found by right-clicking **My Computer** > **Manage** > **Device Manager** from the list of **System Tools**.

The EVAL-SDP-CB1Z SDP-B board appears under **ADI Development Tools**, as shown in Figure 11.

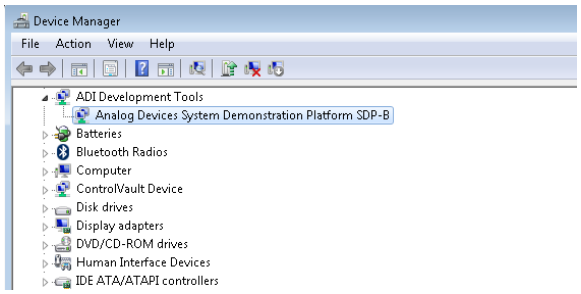

Figure 11. Device Manager

LAUNCHING THE SOFTWARE

After the evaluation board and EVAL-SDP-CB1Z board are correctly connected to your PC, the EVAL-AD7887SDZ software can be launched.

From the **Start** menu, click **Programs** > **Analog Devices** > **AD7887.** The main window of the software then opens (see Figure 13).

If the evaluation board is not connected to the USB port via the EVAL-SDP-CB1Z when the software is launched, a connectivity error displays (see Figure 12). Connect the EVAL-AD7887SDZ to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the instructions.

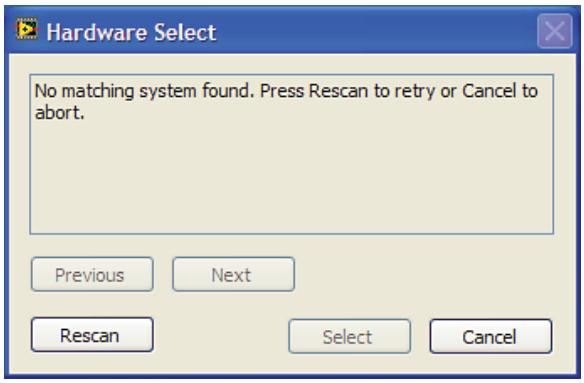

Figure 12. Connectivity Error Alert

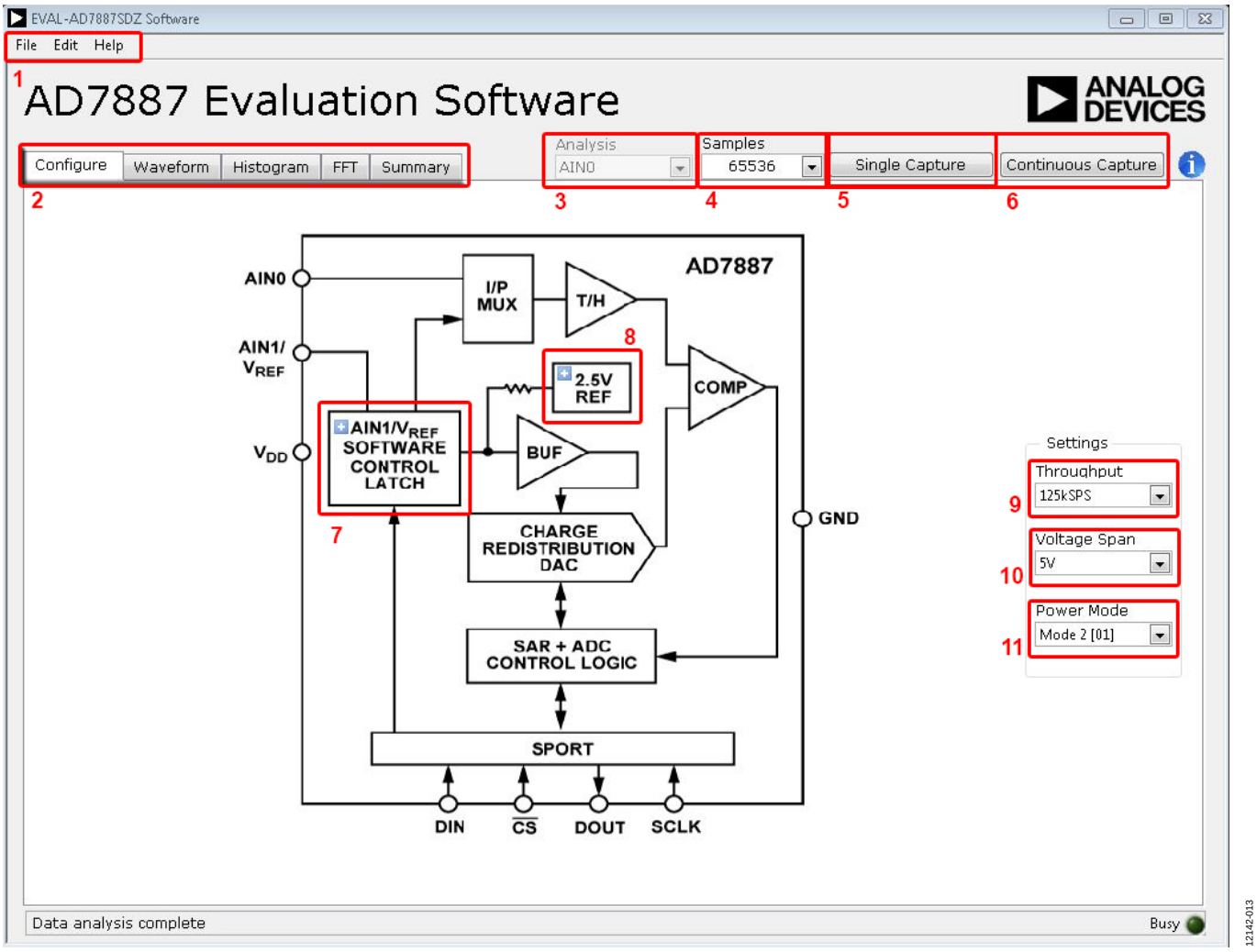

*Figure 13. **EVAL-AD7887SDZ Software** Main Window*

DESCRIPTION OF MAIN WINDOW

The following tools allow user control of the different chart displays. When the software is launched, the main EVAL-AD7887SDZ software window opens (see Figure 13).

The main evaluation software window, as shown in Figure 13, has the following features:

- Menu bar
- Control buttons
- Configuration display
- Data capture display

Menu Bar

The menu bar, Label 1 in Figure 13, consists of the **File**, **Edit**, and **Help** menus.

File Menu

- **Open.** Loads previously captured data in comma separated values (CSV) format for analysis.
- **Save Data.** Saves captured data in CSV format for future analysis.
- **Save Picture**. Saves captured data images as a JPEG file.
- **Exit.** Exits the program.

Edit Menu

- **Reinitialize to default**. Places the evaluation board in a known default state.

Help Menu

- **User Guide.** Opens the evaluation kit user guide.
- **Context Help.** Turns on context sensitive help.
- **Analog.com.** Links to the Analog Devices, Inc., website.

Control Buttons, Drop-Down Boxes, and Indicators

The **Configure**, **Waveform**, **Histogram**, **FFT**, and **Summary** tabs, Label 2 in Figure 13, control what tab is displayed. In each of these tabs, device configuration and data analysis results can be set and viewed, respectively.

The **Analysis** drop-down menu, Label 3 in Figure 13, controls whether analysis is carried out on data on Channel 0 or Channel 1 when operating in dual-channel mode.

The **Samples** drop-down menu, Label 4 in Figure 13, configures how many samples are taken on each capture. In dual channel mode, this is the total number of samples acquired; therefore, each channel acquires half the total number.

The capture buttons, Label 5 (**Single Capture**) and Label 6 (**Continuous Capture**) in Figure 13, select whether to acquire one set of samples or to acquire samples until told to stop.

Throughput, Label 9 in Figure 13, is used to select the rate of data capture by the ADC, up to a maximum of 125 kSPS.

Voltage Span, Label 10 in Figure 13, sets the maximum input signal peak-to-peak range, for data analysis. This value must always match the value of V_{REF}.

Power Mode, Label 11 in Figure 13, is used to select between Mode 1, Mode 2 (normal), and Mode 3. Refer to the Modes of Operation section of the AD7887 data sheet for further information. When operating in Mode 1 or Mode 3, the software switches the device to Mode 2 for conversions.

Configuration Buttons

There are two configuration buttons, for configuring the control register, contained within the block diagram under the **Configure** tab. Clicking the blue icon shown in Figure 14 produces dialog boxes that allow you to configure the respective section of the block diagram.

Figure 14. Configuration Button

The two buttons, Label 7 and Label 8 in Figure 13, control whether single- or dual-channel operation is desired, which channel must be read first, and whether the on-board reference is enabled or disabled. Refer to the AD7887 data sheet for details on available configuration options.

WAVEFORM CAPTURE

Figure 16 shows the **Waveform** tab, which is used for waveform capture.

The waveform analysis reports the amplitudes recorded from the captured signal as well as the frequency of the signal tone. The analysis report is generated for the channel selected via the **Analysis** drop-down menu (see Label 1 in Figure 16). All enabled channels are shown in the waveform plot.

Data Capture Display

Four tabs display the conversion data in different formats: **Waveform**, **Histogram**, **FFT**, and **Summary**.

The tools shown in Figure 15 allow user control of the different chart displays within the four tabs.

1. USED FOR CONTROLLING THE CURSOR IF PRESENT.
2. USED FOR ZOOMING IN AND OUT.
3. USED FOR PLANNING.

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Figure 15. Chart Tools

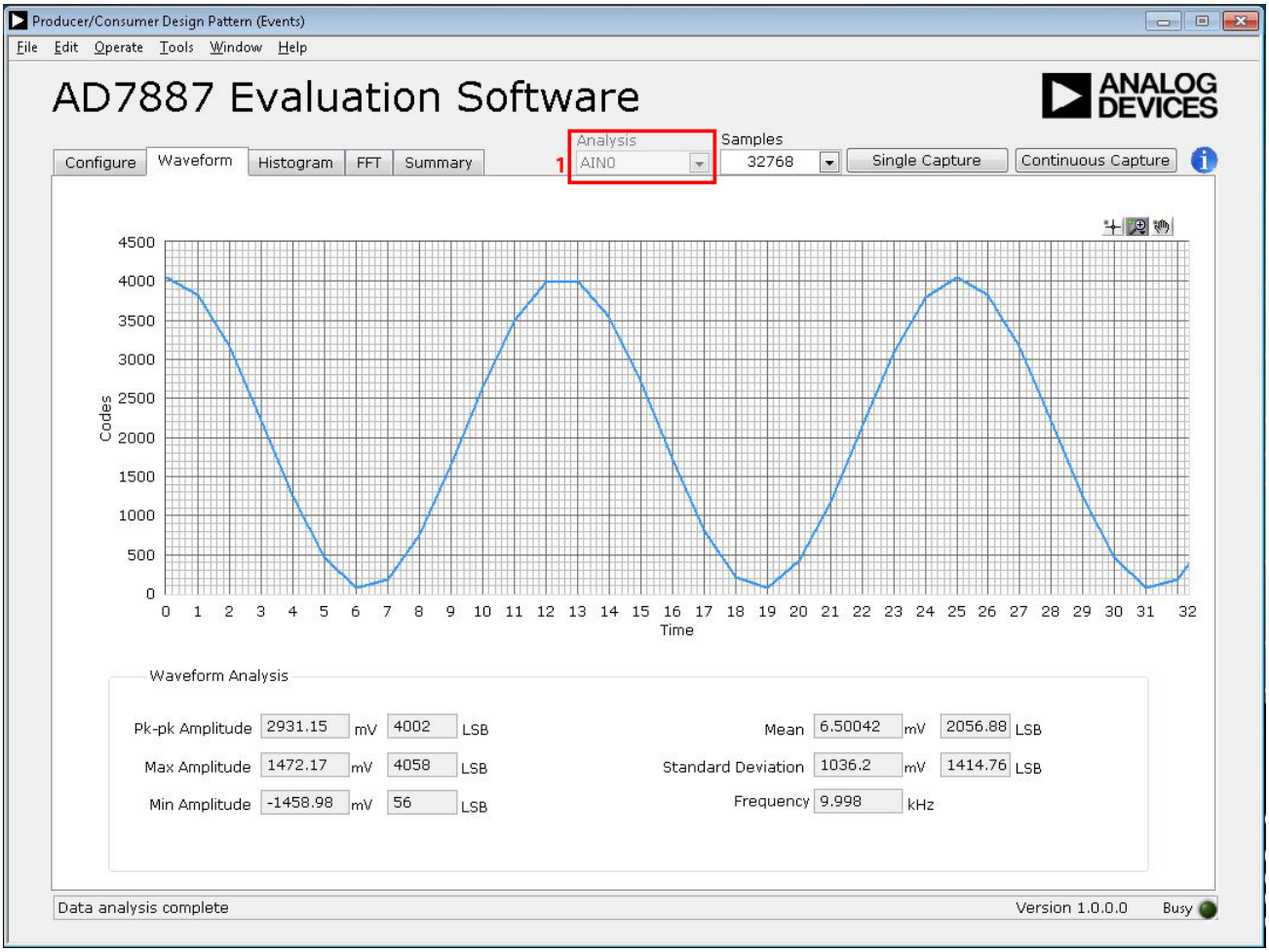

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*Figure 16. **Waveform** Capture Tab*

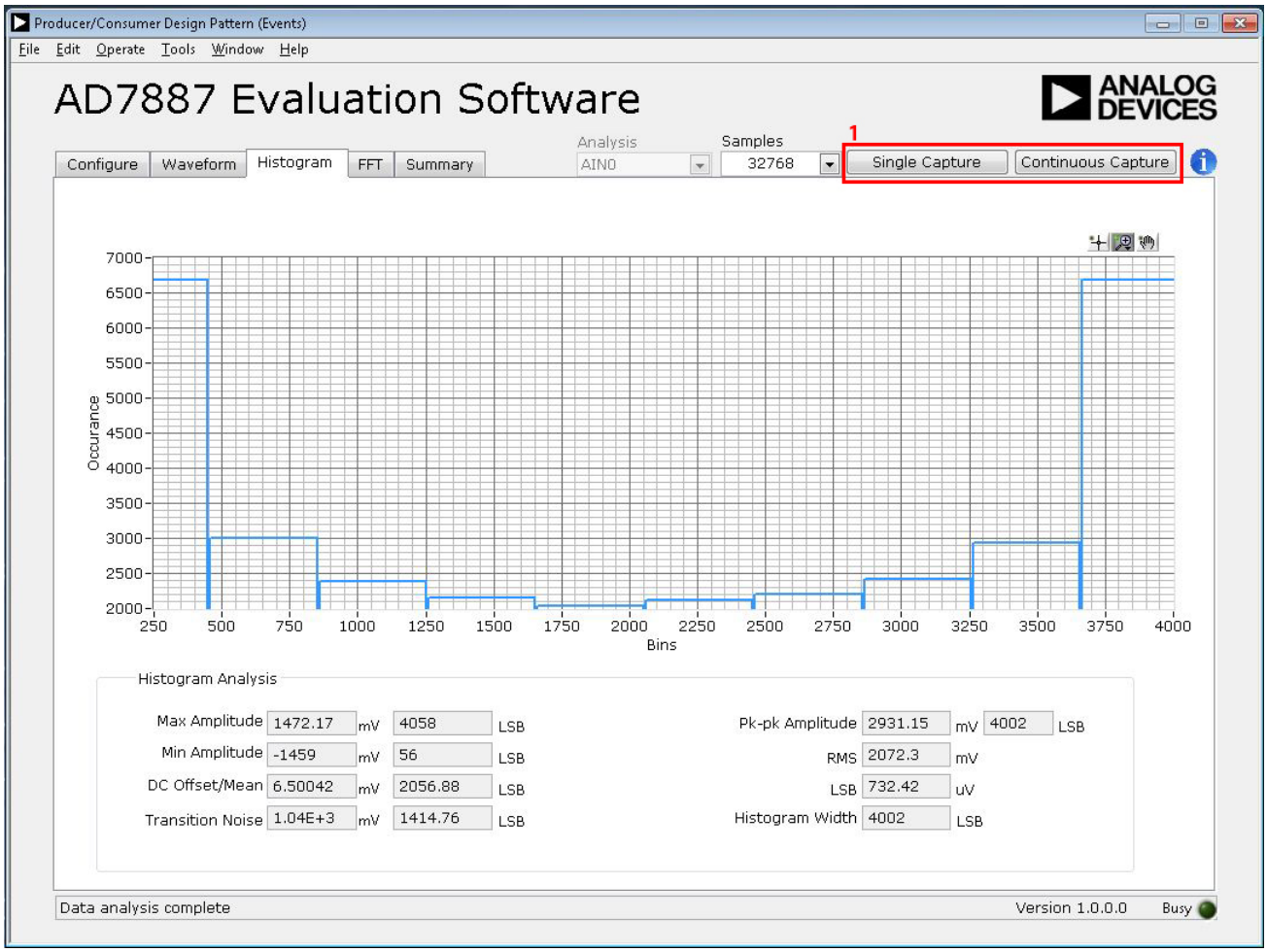

*Figure 17. **Histogram** Capture Tab*

AC TESTING—HISTOGRAM

Figure 17 shows the **Histogram** capture tab. The histogram shows the ADC code distribution for the ac input, computes the mean and standard deviation (or transition noise) of the converter, and displays the results.

Raw data is captured and passed to the PC for statistical computations. To perform a histogram test, select the **Histogram** tab in the EVAL-AD7887SDZ software main window and click **Single Capture** or **Continuous Capture** (Label 1 in Figure 17).

Note that an ac histogram requires a quality signal source applied to the input VIN connector or the AIN0 connector.

DC TESTING—HISTOGRAM

The histogram is more commonly used for dc testing. Similar to ac testing, the histogram shows the ADC code distribution for the dc input, computes the mean and standard deviation (or transition noise) of the converter, and displays the results.

Raw data is captured and passed to the PC for statistical computations. To perform a histogram test, select the **Histogram** tab in the EVAL-AD7887SDZ software main window and click **Single Capture** or **Continuous Capture** (Label 1 in Figure 17).

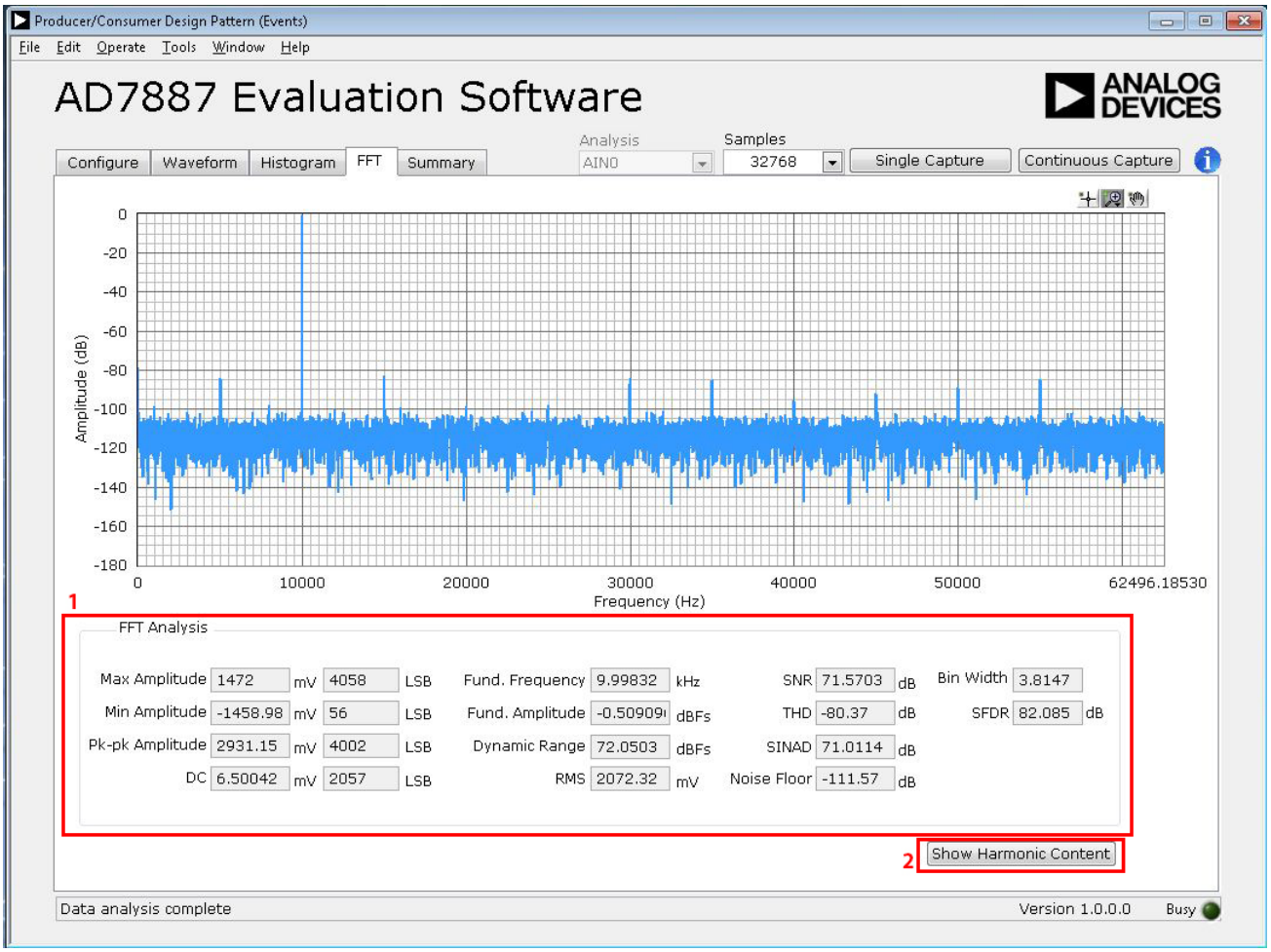

*Figure 18. **FFT** Capture Tab*

AC TESTING—FFT CAPTURE

Figure 18 shows the **FFT** capture tab. The FFT tests the traditional ac characteristics of the converter and displays a fast Fourier transform (FFT) of the results. As in the histogram test, raw data is captured and passed to the PC, where the FFT is performed, displaying the signal-to-noise ratio (SNR), signal-to-noise-and-distortion (SINAD), and total harmonic distortion (THD.)

To perform an ac test, apply either a bipolar sinusoidal signal to the evaluation board at the VIN input, J4, then connect the VBIASED connector, J5, to the AIN0 or AIN1 connector, J1 or J2, respectively; or apply a unipolar sinusoidal signal directly to either of these channel connectors. Low distortion, better than 115 dB, is required to allow true evaluation of the device. One possibility is to filter the input signal from the ac source. There is no suggested band-pass filter, but consideration must be taken in the choice of filter.

The optional, on-board, antialias filtering can be implemented by populating the RC filters connected to the noninverting inputs of channel buffers.

Figure 18 displays the spectral analysis results of the captured data.

- The plot is the FFT image of the analysis channel selected.
- The **FFT Analysis** panel displays the performance data: **SNR**, **THD**, **SINAD, Dynamic Range**, and noise performance along with the input signal characteristics. See Label 1 in Figure 18.
- Click **Show Harmonic Content** to switch the panel to display the frequency and amplitude of the fundamental in addition to the second harmonics to the fifth harmonics. See Label 2 in Figure 18.

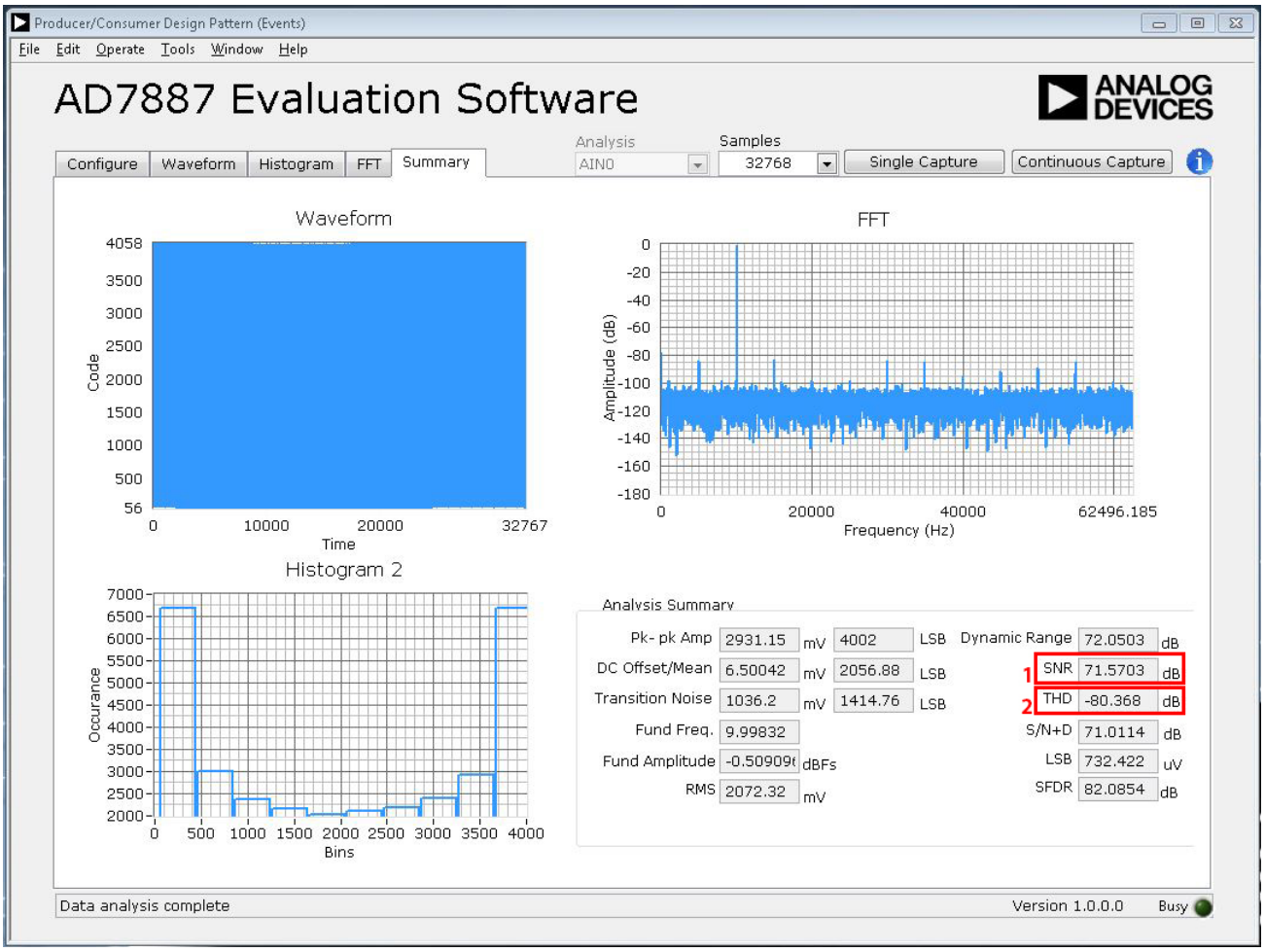

*Figure 19. **Summary** Tab*

SUMMARY TAB

Figure 19 shows the **Summary** tab. This tab captures and displays all of the information in one panel with a synopsis of the information, including key performance parameters, such as **SNR** and **THD**, Label 1 and Label 2, respectively. Waveform, histogram, and FFT plots are also displayed in summary format.

SAVING FILES

The software can save the current captured data for future analysis. The software can capture the current plot images and the current device configuration, as well as the raw waveform data, histogram data, and ac spectrum data.

Saving Data

To save data, go to the **File** menu and click **Save Data**. This action saves the raw data captured as seen in the **Waveform** tab.

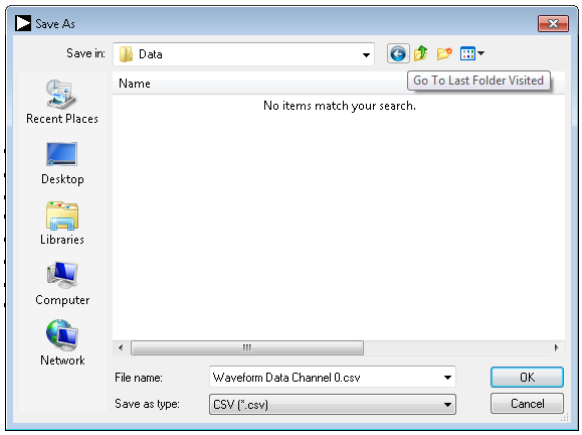

*Figure 20. **Save As** Data Dialog Box*

Saving Plot Images

To save plot images, go to the desired analysis tab, click the **File** menu, and then click **Save Picture**.

The images are saved in JPEG format and do not contain any raw data information. Saved plots cannot be loaded back into the evaluation environment.

Figure 21 shows the **Save As** image dialog box. Save the images to an appropriate location.

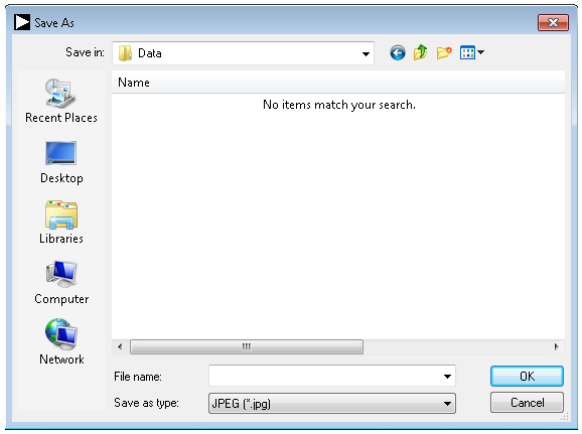

*Figure 21. **Save As** Image Dialog Box*

OPENING FILES

Loading Captured Data

The software can load previously captured data for analysis.

Go to the **File** menu, click **Open**, and select **Waveform Data**. The waveform data is a raw data capture that rebuilds the histogram and ac spectrum analyses upon being loaded into the evaluation platform.

When **Waveform Data** is selected, the **open** dialog box in Figure 22 opens for loading an appropriate file. The evaluation software expects that a previously generated waveform file is in CSV format.

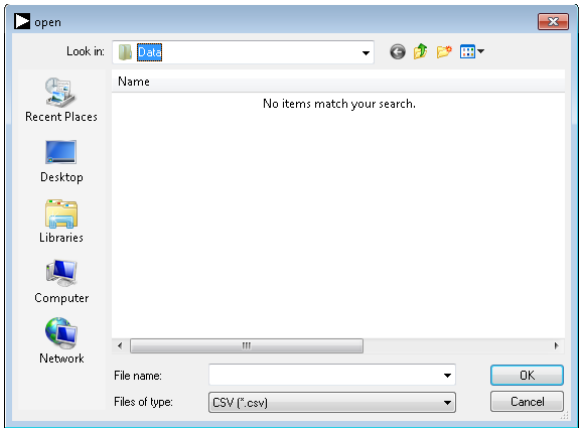

Figure 22. Open File Dialog Box

EVALUATION BOARD SCHEMATICS AND ARTWORK

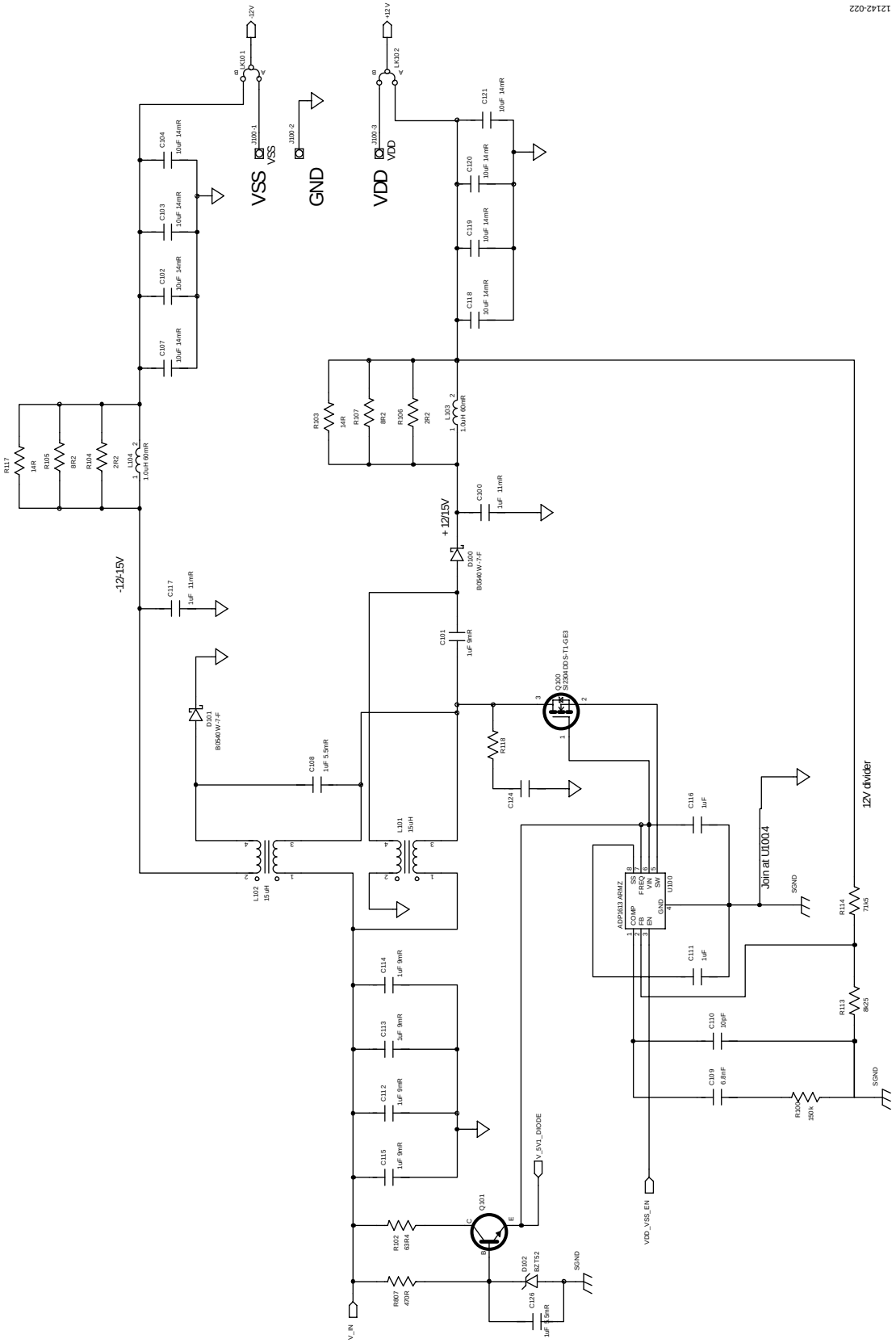

Figure 23. EVAL-AD7887SDZ Schematic Page 1

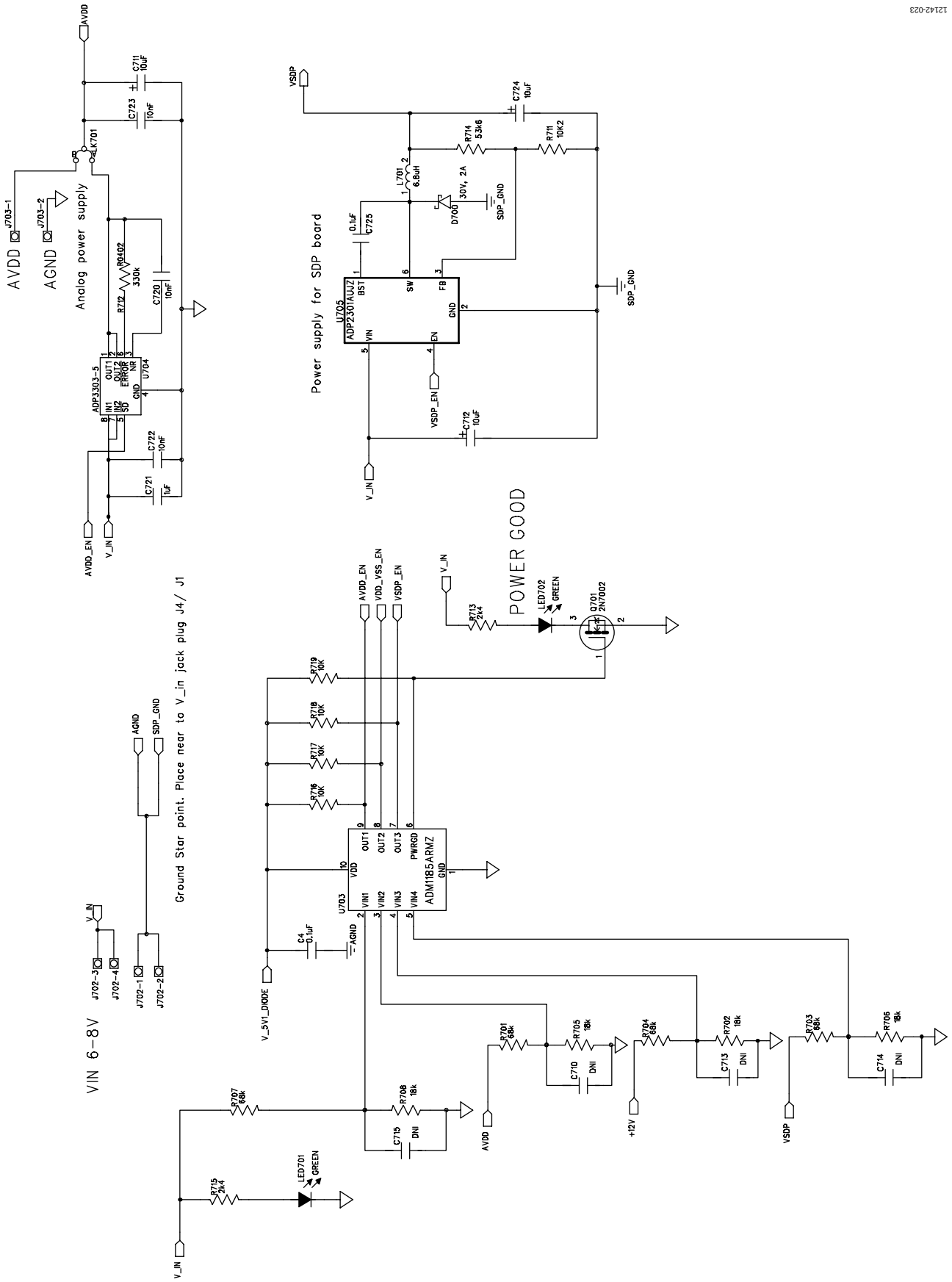

Figure 24. EVAL-AD7887SDZ Schematic Page 2

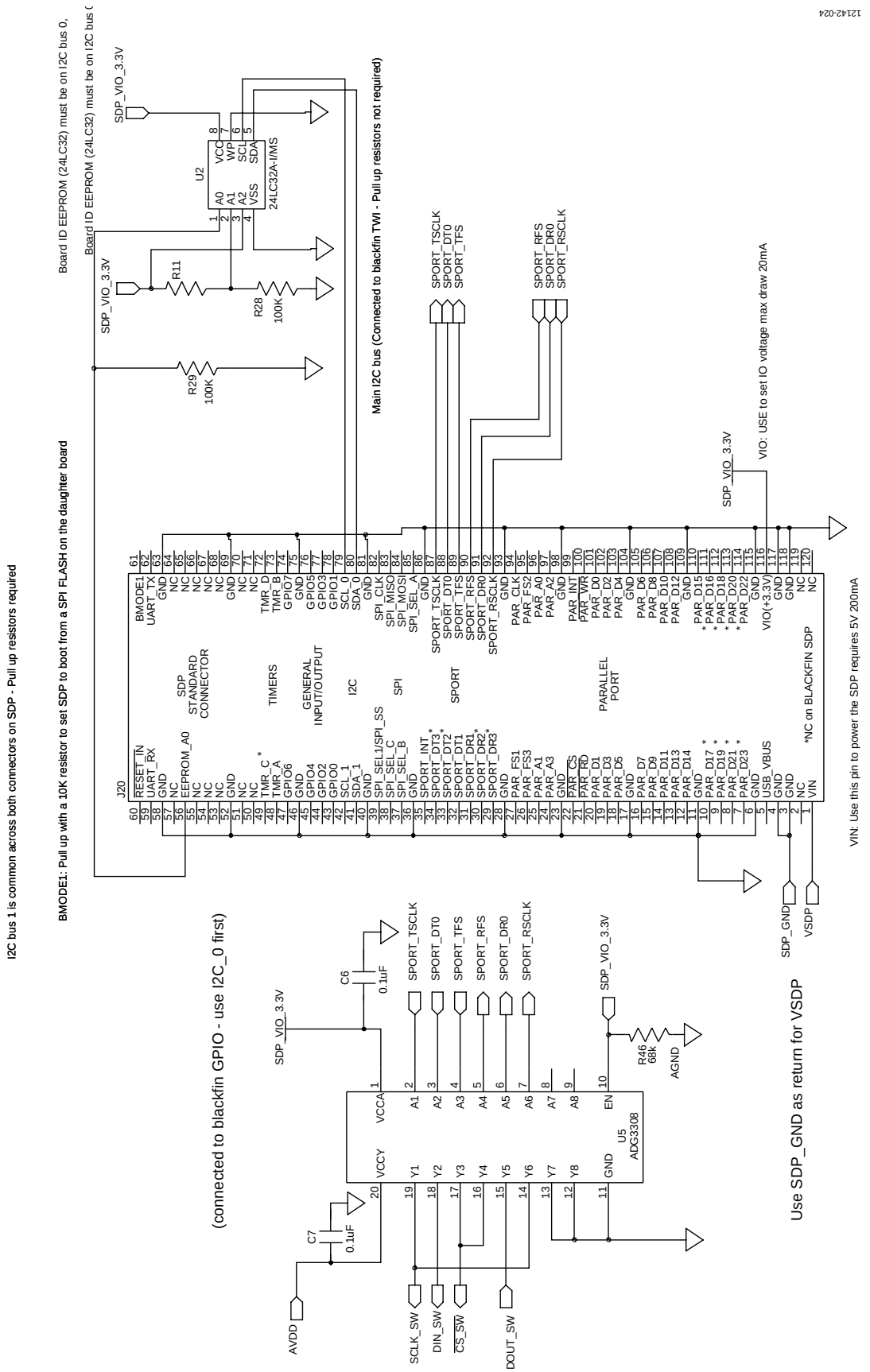

Figure 25. EVAL-AD7887SDZ Schematic Page 3

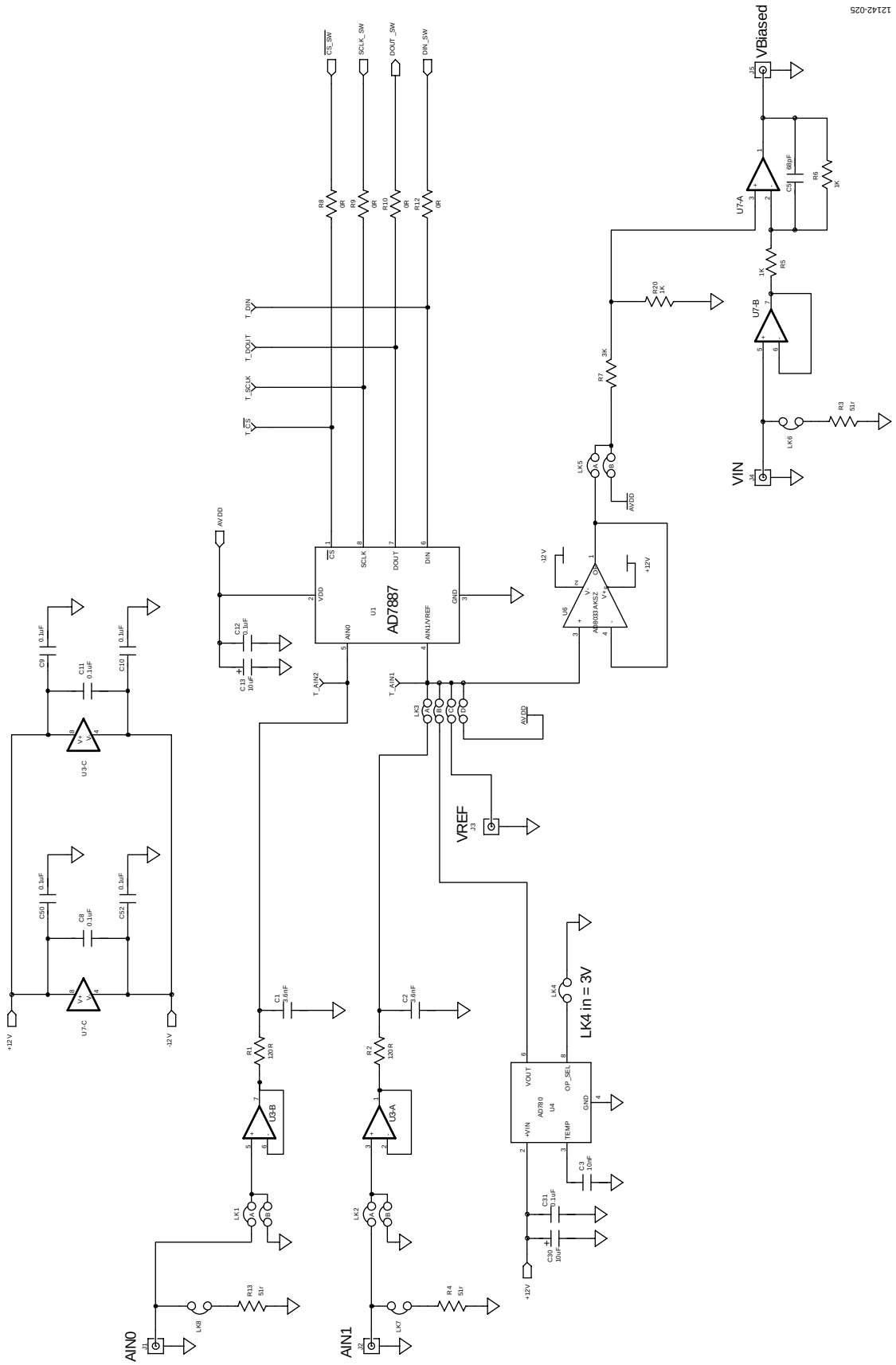

Figure 26. EVAL-AD7887SDZ Schematic Page 4

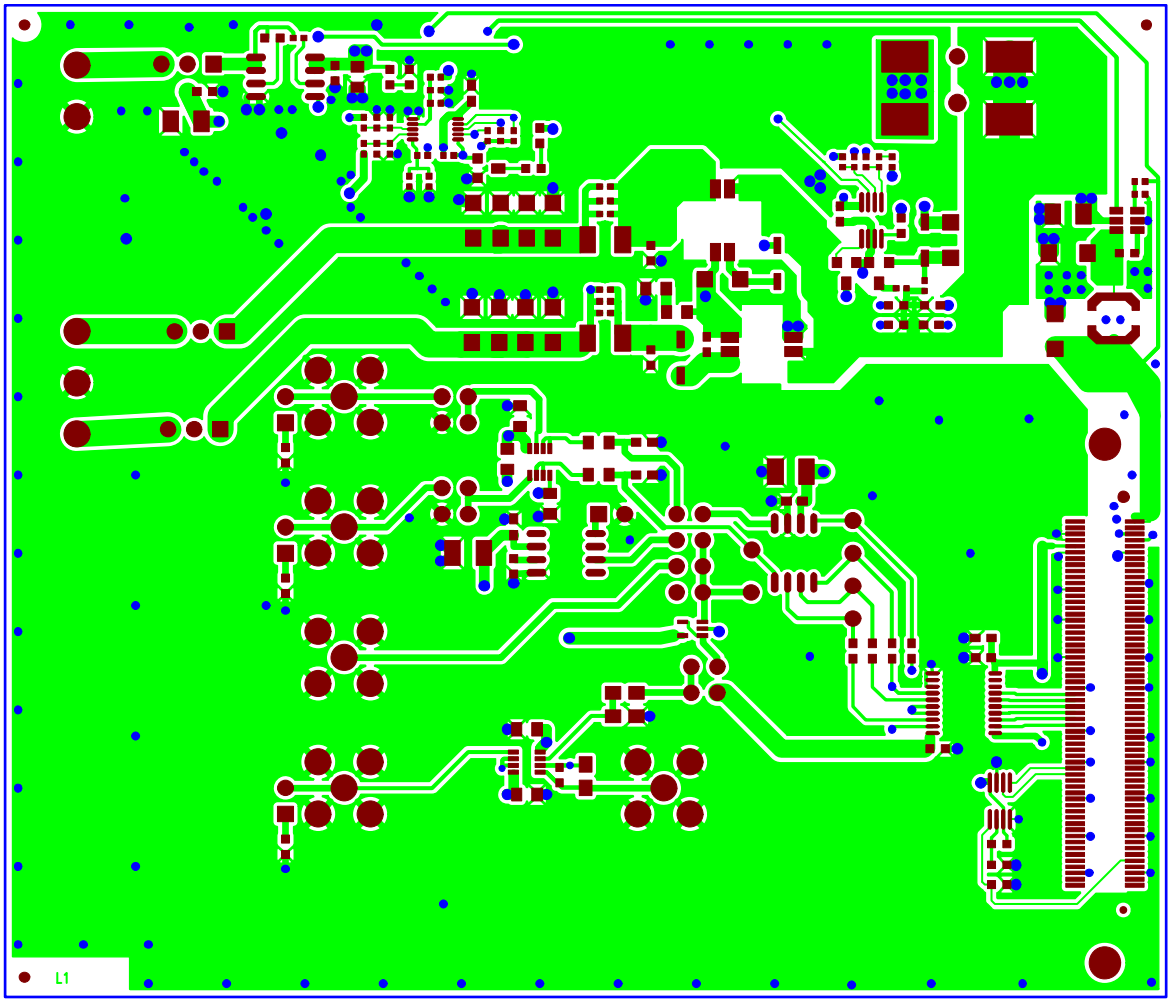

Figure 27. EVAL-AD7887SDZ Top Side Layer 1

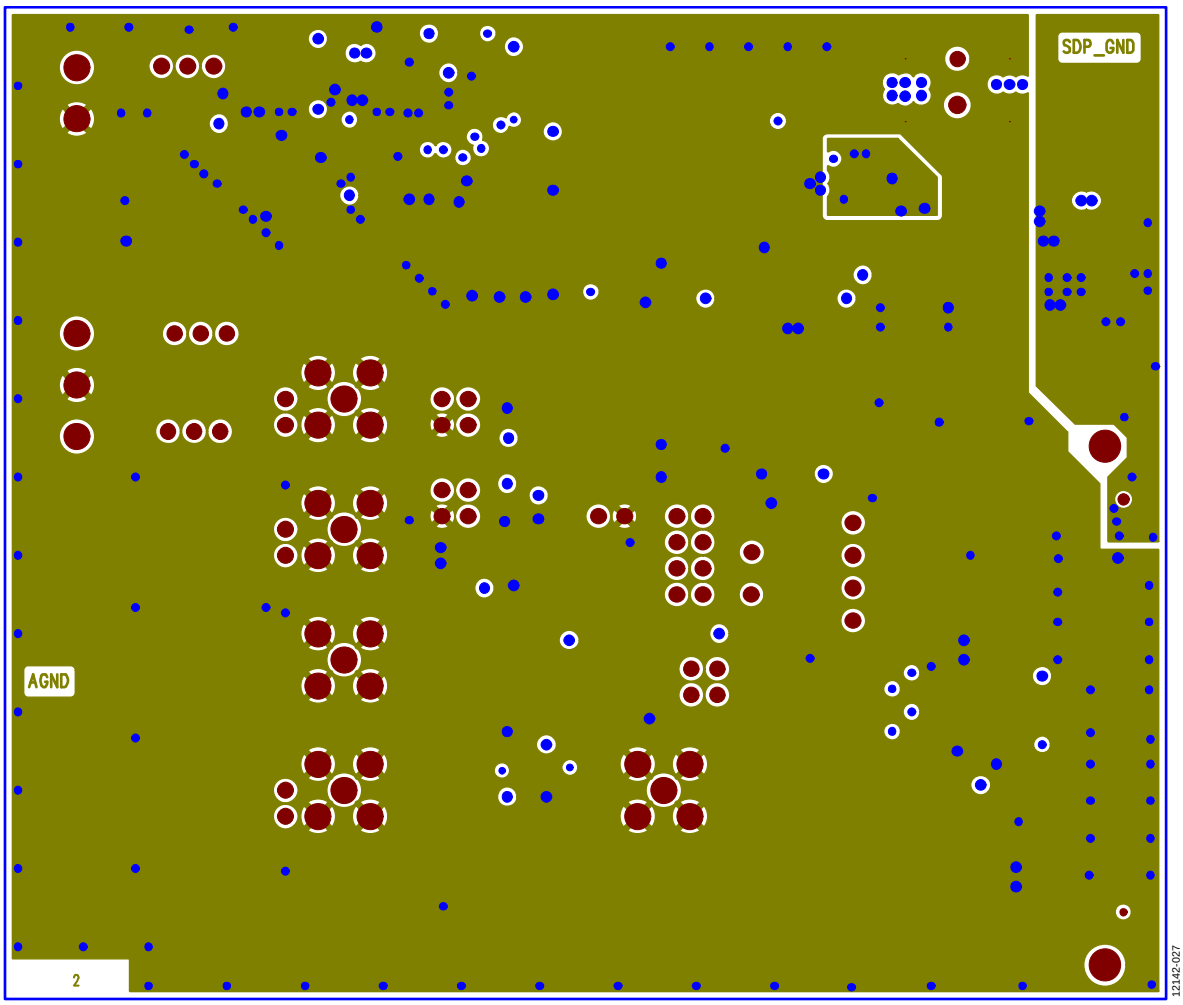

Figure 28. EVAL-AD7887SDZ Layer 2, Ground

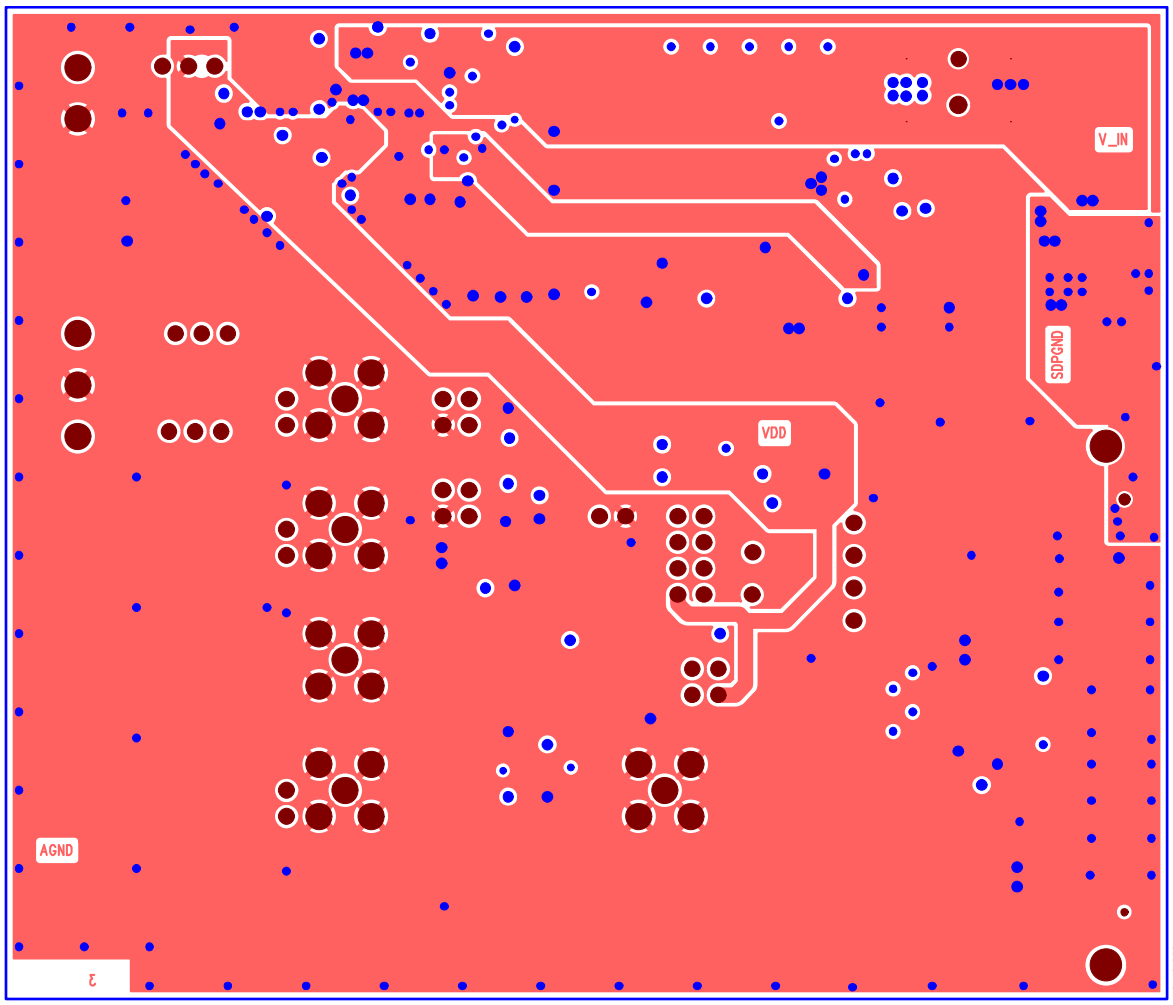

Figure 29. EVAL-AD7887SDZ Layer 3, Power

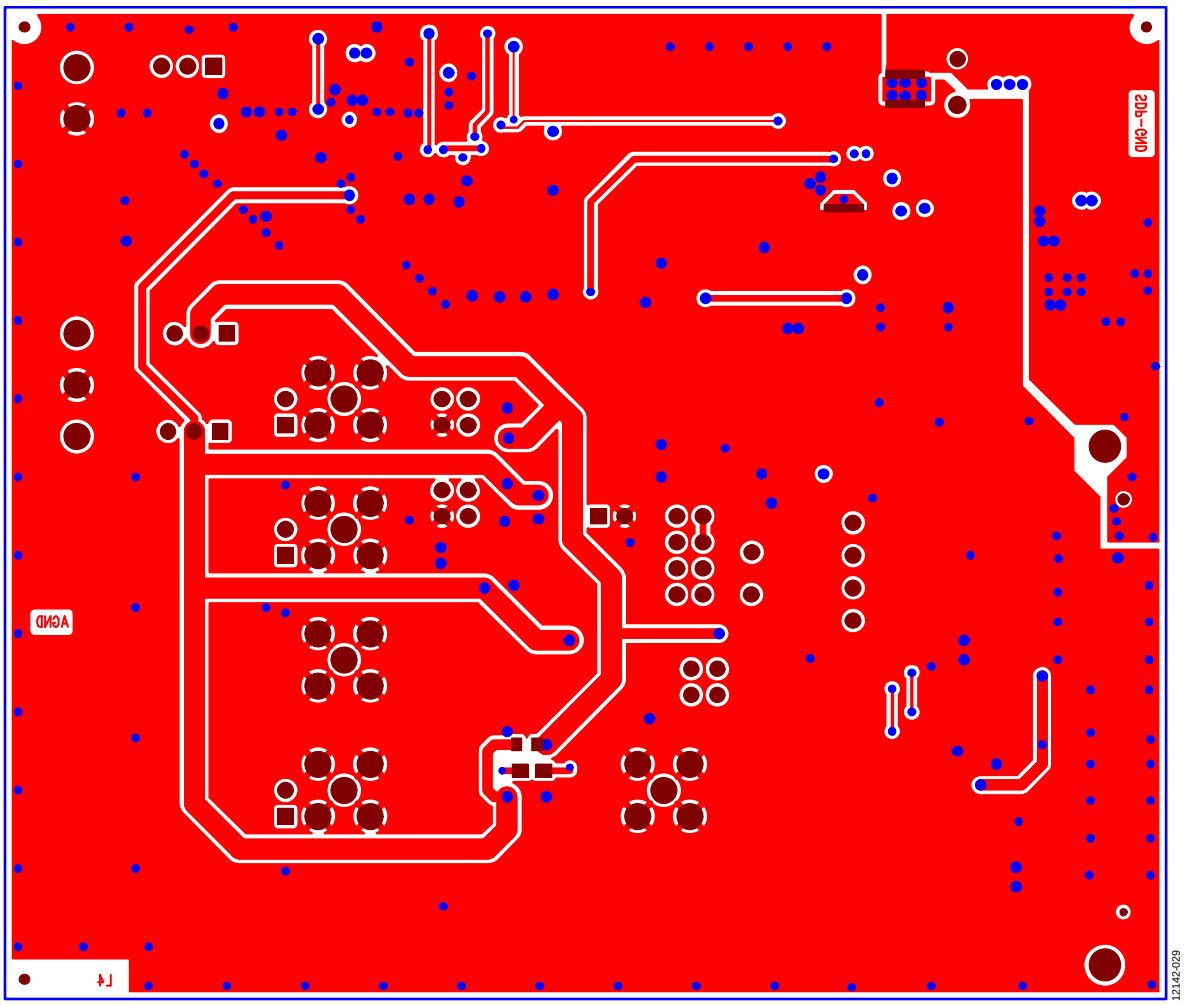

Figure 30. EVAL-AD7887SDZ Bottom Side Layer 4

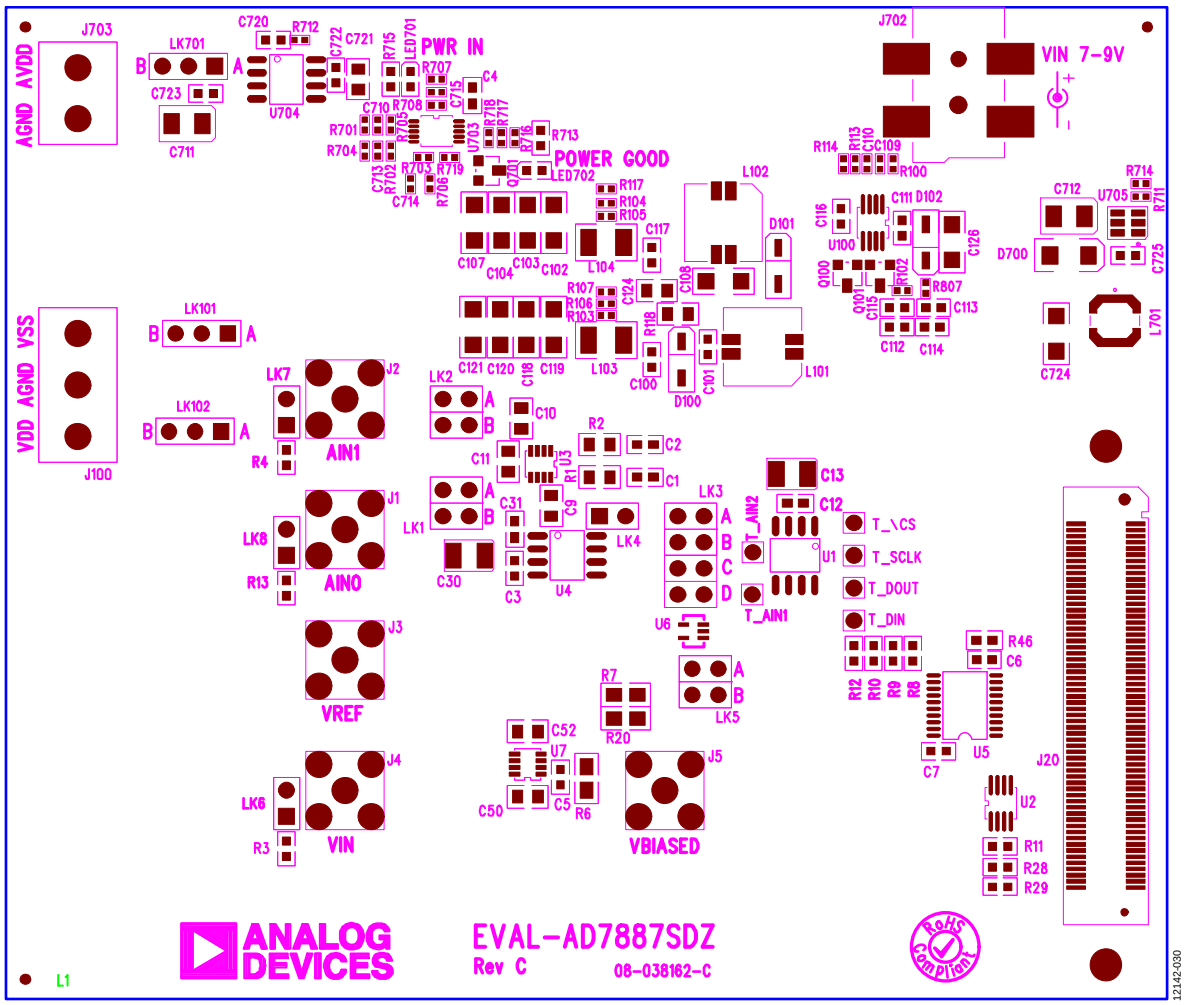

Figure 31. EVAL-AD7887SDZ Top Side Silkscreen

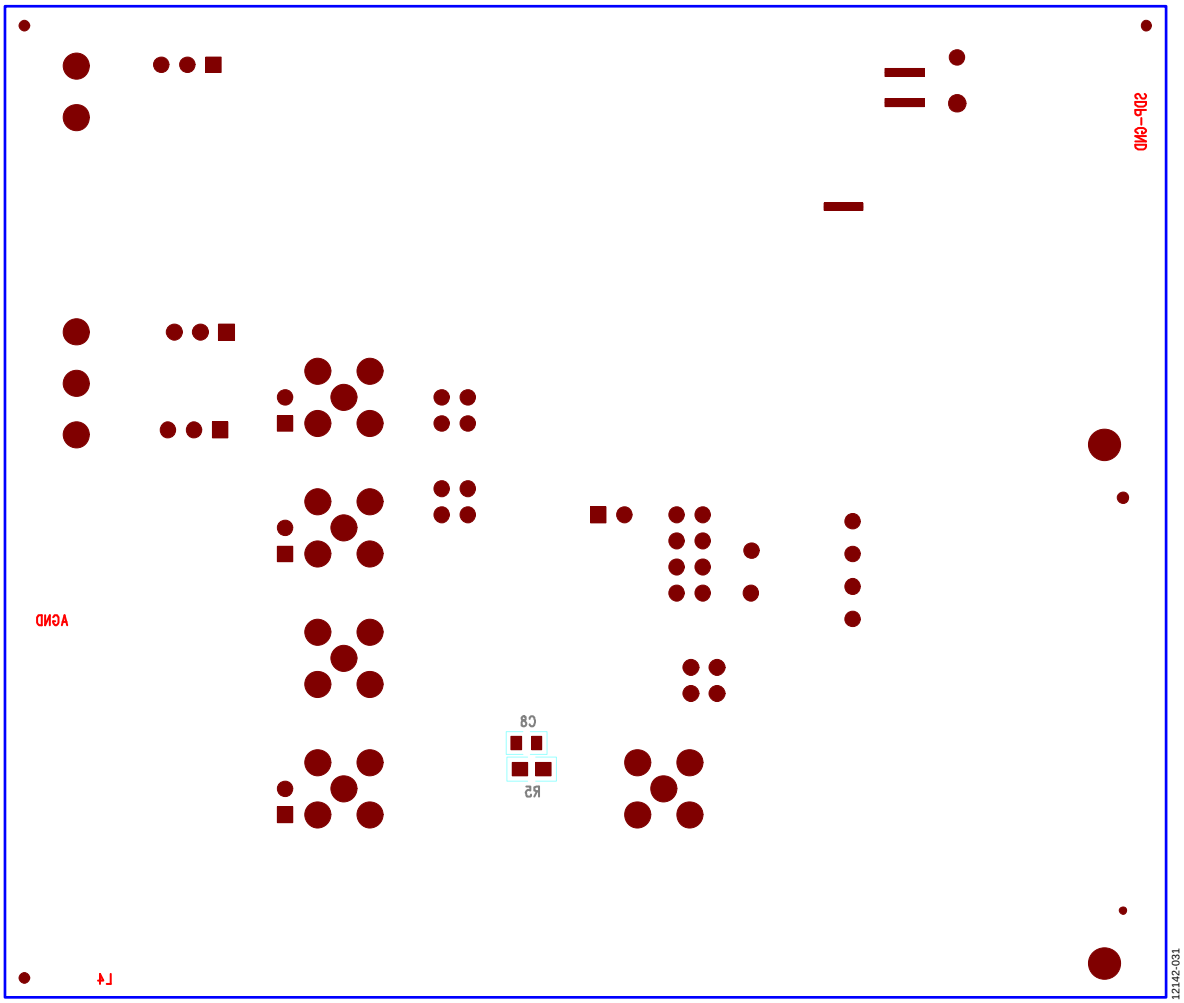

Figure 32. EVAL-AD7887SDZ Solder Side Silkscreen

NOTES

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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