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# Evaluation Board for the AD7091 Analog-to-Digital Converter

## FEATURES

**Full-featured evaluation board for the AD7091**
**On-board power supplies**
**Standalone capability**
**PC control in conjunction with system demonstration platform (EVAL-SDP-CB1Z)**
**PC software for control and data analysis**

## ONLINE RESOURCES

**Evaluation kit contents**
**EVAL-AD7091SDZ evaluation board**
**Evaluation software CD for the AD7091**
**Documents needed**
**AD7091 data sheet**
**EVAL-AD7091SDZ user guide**
**Required software**
**EVAL-AD7091SDZ evaluation software**
**Design and integration files**
**Schematics, layout files, bill of materials**

## EQUIPMENT NEEDED

**EVAL-AD7091SDZ evaluation board**
**EVAL-SDP-CB1Z system demonstration platform**
**External 7 V to 9 V power supply**
**AC or dc signal source**
**USB cable**
**PC running Windows with USB 2.0**
**SMB cable**

## GENERAL DESCRIPTION

The EVAL-AD7091SDZ is a full-featured evaluation board designed to allow the user to easily evaluate all features of the AD7091 analog-to-digital converter. A 7 V to 9 V external bench top supply is regulated to ±5 V and 3.3 V to supply the AD7091 and support all necessary components. The EVAL-AD7091SDZ board connects to the USB port of the PC by connecting to the EVAL-SDP-CB1Z motherboard.

The EVAL-AD7091SDZ software provides dynamic performance analysis in the form of waveform graphs, histograms, and FFT analysis for ADC performance evaluation.

On-board components include the AD8031 high speed precision rail-to-rail op amp, the AD8032 high speed precision rail-to-rail dual op amp, the ADP3303 high accuracy 200 mA, low dropout, linear regulator, and the ADP7104 adjustable low noise 500 mA low dropout linear regulator. Other on-board components include the ADG3308 bidirectional logic level translator, the REF196 3.3 V precision voltage reference, the ADM1185 quad voltage monitor and sequencer, and the ADP1613 step-up dc-to-dc switching converter.

## FUNCTIONAL BLOCK DIAGRAM

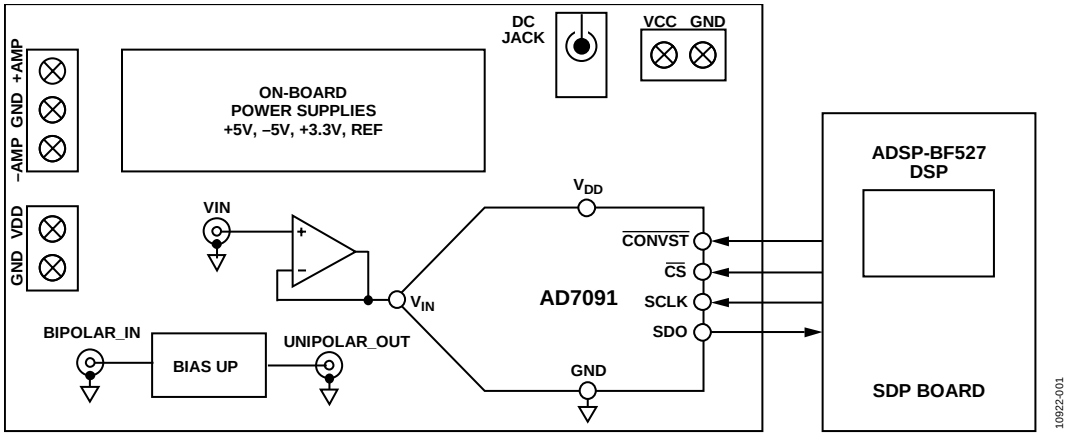


*Figure 1. EVAL-AD7091SDZ Block Diagram*

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## REVISION HISTORY

**2/13—Revision 0: Initial Version**

# EVAL-AD7091SDZ QUICK START GUIDE

Follow these steps to quickly evaluate the AD7091:

1. Install the EVAL-AD7091SDZ software from the enclosed CD. 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 default link options are configured as outlined in Table 2.
3. Connect the EVAL-SDP-CB1Z board to the EVAL-AD7091SDZ shown in Figure 2.
4. Screw the two boards together with the enclosed nylon screw/nut set to ensure that the boards connect firmly together.
5. Connect the power supply adapter included in the kit to Connecter J700 on the EVAL-AD7091SDZ board.
6. 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.
7. Launch the **AD7091(R)** software from the **Analog Devices** subfolder in the **Programs** menu.
8. If the input signal is unipolar, proceed to Step 9. Otherwise, connect a bipolar input signal via the BIPOLAR IN connector, J3. A unipolar signal is then available at the BIPOLAR OUT connector, J4.
9. Connect a unipolar input signal via the VIN connector, J2.
10. Press the SAMPLE button to initiate a measurement.

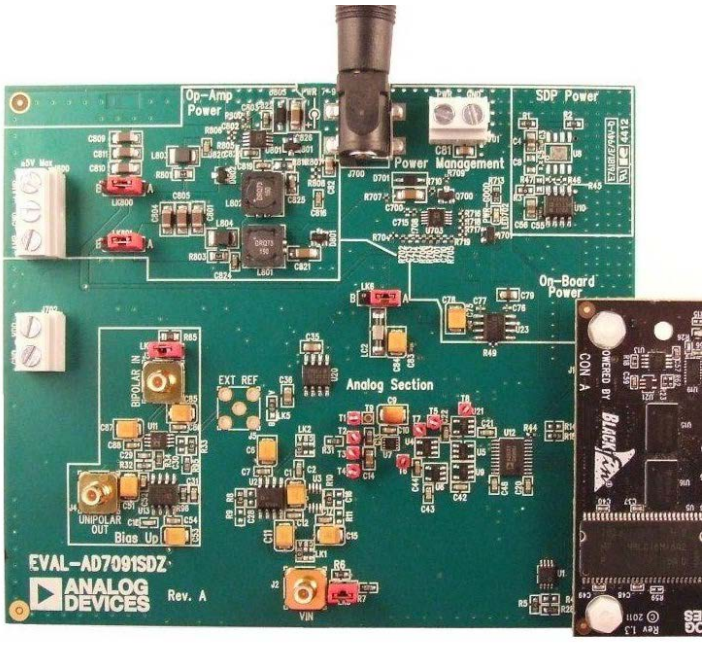



*Figure 2. Hardware Configuration—Setting Up the EVAL-AD7091SDZ*

# EVALUATION BOARD HARDWARE

## DEVICE DESCRIPTION

This user guide describes the evaluation board for the AD7091 analog-to-digital converter.

The AD7091 is a 12-bit, ultralow power, successive approximation ADC. The AD7091 operates from a single 2.09 V to 5.25 V power supply and is capable of achieving a throughput rate of 1 MSPS. The AD7091 also features an on-chip conversion clock and a high speed serial interface.

The conversion process and data acquisition are controlled using a $\overline{\text{CONVST}}$ signal and an internal oscillator. The AD7091 has a serial interface allowing data to be read after the conversion, while achieving a 1 MSPS throughput rate. The AD7091 uses advanced design and process techniques to achieve ultralow power dissipation at high throughput rates. The reference is taken internally from $V_{DD}$.

Complete specifications for the AD7091 are provided in the AD7091 data sheet, available from Analog Devices, which should be consulted in conjunction with this user guide when using the evaluation board.

Full details on the EVAL-SDP-CB1Z are available at online.

## 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

Care should be taken 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.

This evaluation board is supplied with a wall-mountable switching power supply that provides a 9 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 J700. The 9 V supply is connected to the on-board 3.3 V linear regulator that supplies the correct supply voltage to the board and the EVAL-SDP-CB1Z board.

If the evaluation board is used without the 9 V adapter, an external power supply in the range of 7 V to 9 V must be connected to the J701 connector. When using this evaluation board with the EVAL-SDP-CB1Z board, it is necessary to power the board through the J700 or J701 connector.

If supplies other than the on-board 3.3 V are required, an external power supply in the range of 2.09 V to 5.25 V must be connected to the VDD input via J702 to supply the AD7091 $V_{DD}$ pin. Additionally, +5 V and −5 V should be supplied to connector J800 to supply the on-board amplifier circuits.

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

**Table 1. External Power Supplies Ranges**

| Power Supply | Voltage Range | Purpose |
|---|---|---|
| DC Jack | 9 V ± 5% | Supplies power to on-board power management devices |
| VCC | 7 V to 9 V | Supplies power to on-board power management devices |
| +AMP | 5 V ± 10% | Amplifier positive supply rail |
| −AMP | −5 V ± 10% | Amplifier negative supply rail |
| VDD | 2.09 V to 5.25 V | Digital supply rail without EVAL-SDP-CB1Z connected |
| | 3.3 V to 5.25 V | Digital supply rail with EVAL-SDP-CB1Z connected |

**Table 2. Link Options**

| Category | Link | Default Position | Function |
|---|---|---|---|
| Buffer Settings | LK1 | A | This link is used to select the analog signal path.<br>In Position A, the analog signal is buffered via U2, a unity gain buffer.<br>In Position B, the analog signal is buffered via U3, a unity gain buffer.<br>In Position C, the analog signal bypasses U2 and U3. |
| | LK2 | A | This link is used to select the source of the analog input signal to the AD7091.<br>In Position A, the analog signal is sourced via the U2 op amp.<br>In Position B, the analog signal is sourced via the U3 op amp.<br>In Position C, the analog signal bypasses U2 and U3. |
| Termination | LK3 | Inserted | Adds a 51 Ω termination resistor to GND at VIN.<br>Inserted—51 Ω termination on the VIN input.<br>Not inserted—no 51 Ω termination on the VIN input. |
| | LK4 | Inserted | Adds a 51 Ω termination resistor to GND at BIPOLAR_IN.<br>Inserted—51 Ω termination on the BIPOLAR_IN input.<br>Not inserted—no 51 Ω termination on the BIPOLAR_IN input. |
| Power Supplies | LK5 | A | This link is used to select the reference source for the bias up circuitry.<br>In Position A, the REF signal is sourced via the on-board reference chip.<br>In Position B, the REF signal is sourced via VDD. |
| | LK6 | A | This link is used to select the source of the VDD supply line for the evaluation board<br>In Position A, the VDD supply is sourced from the on-board 3.3 V supply.<br>In Position B, the VDD supply is sourced from the external J702 connector. |
| | LK800 | A | This link is used to select the source of the +OP_AMP supply line for the on-board amplifiers.<br>In Position A, the +OP_AMP supply is sourced from the on-board supply.<br>In Position B, the +OP_AMP supply is sourced from the external J800 connector. |
| | LK801 | A | This link is used to select the source of the −OP_AMP supply line for the on-board amplifiers.<br>In Position A, the −OP_AMP supply is sourced from the on-board supply.<br>In Position B, the −OP_AMP supply is sourced from the external J800 connector. |

## SOCKETS/CONNECTORS

The connectors and sockets on the EVAL-AD7091SDZ are outlined in Table 3.

The default interface to this evaluation board is via the 120-way connector, which connects the EVAL-AD7091SDZ to the EVAL-SDP-CB1Z board.

## TEST POINTS

There are numerous test points on the EVAL-AD7091SDZ board. These test points enable the user to have easy access to the signals from the evaluation board for probing, evaluation, and debugging.

It is also possible to access the AD7091 via the test points to operate the EVAL-AD7091SDZ in standalone mode without the need for the EVAL-SDP-CB1Z board.

**Table 3. On-Board Connectors**

| Connector | Function |
|---|---|
| J1 | 120-way connector for EVAL-SDP-CB1Z interface |
| J2 | VIN analog input signal |
| J3 | BIPOLAR_IN analog input signal to bias up circuit |
| J4 | UNIPOLAR_OUT output of bias up circuit |
| J5 | External reference voltage connector |
| J700 | 9 V, 2.0 mm dc jack connector |
| J701 | External VCC and GND power connector |
| J702 | External VDD and GND power connector |
| J800 | Amplifier power connector |

## EVAL-AD7091SDZ BASIC HARDWARE SETUP

The EVAL-AD7091SDZ board connects to the EVAL-SDP-CB1Z system demonstration platform board. The EVAL-AD7091SDZ board is the controller board, which is the communication link between the PC and the main evaluation board. Figure 2 shows a photograph of the connections between the EVAL-AD7091SDZ daughter board and the EVAL-SDP-CB1Z board.

The analog input range to the AD7091 is 0 V to $V_{DD}$ and should not be exceeded. When using the on-board supplies, $V_{DD}$ is 3.3 V. An input signal in the range of 3.3 V p-p should be connected to the EVAL-AD7091SDZ board via VIN. An on-board unity gain amplifier buffers the signal to the AD7091. This is the default configuration on the EVAL-AD7091SDZ.

If the input signal is bipolar, it should be connected to the BIPOLAR_IN, the J3 connector. This signal is biased to 1.65 V via the bias up circuitry on the EVAL-AD7091SDZ and is available at the UNIPOLAR_OUT connector, J4. The UNIPOLAR_OUT signal can then be connected to VIN connector.

Before connecting power, connect the EVAL-AD7091SDZ board to Connector A on the EVAL-SDP-CB1Z board. A nylon screw/nut set is included in the EVAL-AD7091SDZ kit and can be used to ensure that the EVAL-AD7091SDZ and EVAL-SDP-CB1Z boards are connected firmly together.

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

After the EVAL-AD7091SDZ board and the EVAL-SDP-CB1Z board are connected securely, connect the power to the EVAL-AD7091SDZ board. The EVAL-AD7091SDZ board requires an external power supply adapter, which is included in the evaluation board kit. Connect this power supply to Connector J700 on the EVAL-AD7091SDZ 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 EVAL-AD7091SDZ software has been installed from the enclosed CD. 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-AD7091SDZ 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-AD7091SDZ kit includes software on a CD. Double-click the **setup.exe** file from the CD to run the install. The default location for the software is

**C:\Program Files\Analog Devices\AD7091(R)**

Install the evaluation software before connecting 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.

There are two parts to the installation are as follows:

- EVAL-AD7091SDZ board software installation
- EVAL-SDP-CB1Z system demonstration platform board drivers installation

Follow Step 1 to Step 4 (see Figure 3 to Figure 7) to install the EVAL-AD7091SDZ software. Follow Step 5 to Step 8 (see Figure 8 to Figure 11) 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.

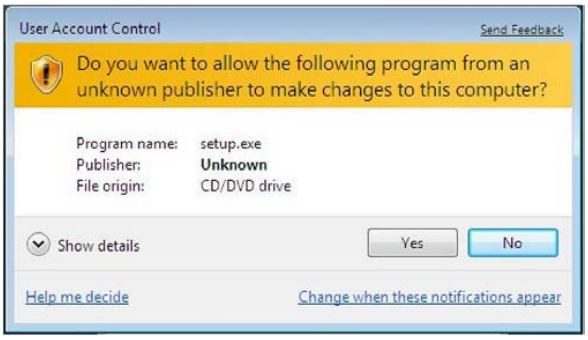



*Figure 3. EVAL-AD7091SDZ Installation—User Account Control*

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

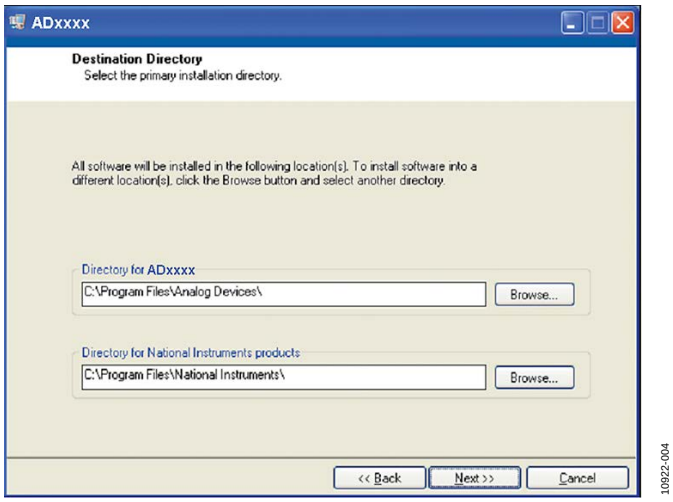



*Figure 4. EVAL-AD7091SDZ Installation—Destination Directory*

2. A license agreement appears. Read the agreement and then select **I accept the License Agreement** and click **Next**.

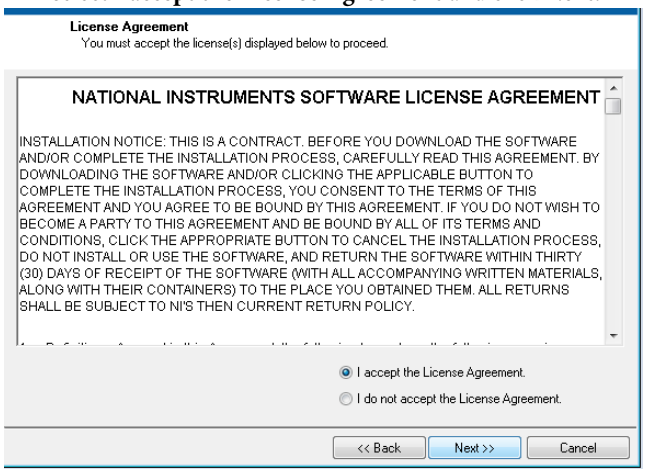



*Figure 5. EVAL-AD7091SDZ Evaluation Software Installation:*

3. Select the installation directory. Click **Next**.

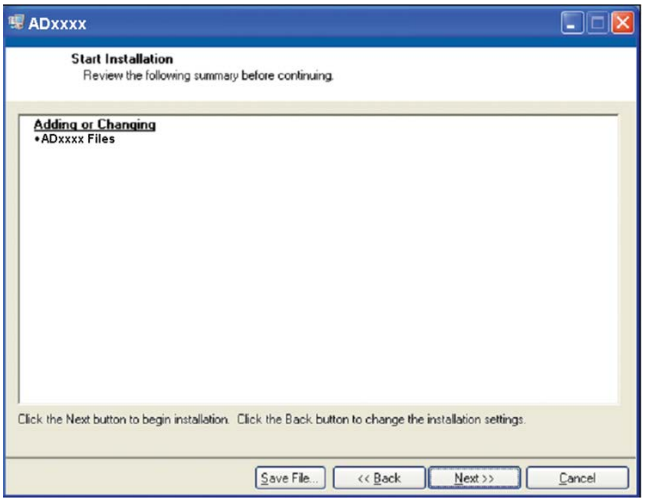



*Figure 6. EVAL-AD7091SDZ Installation—Start Installation*

4. Click **Next** to install the software.

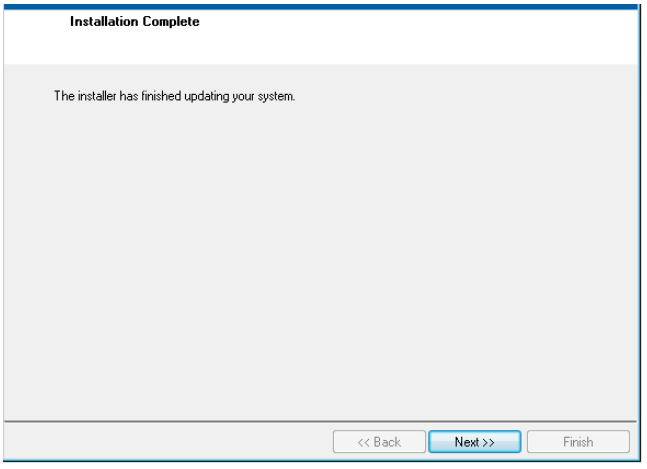



*Figure 7. EVAL-AD7091SDZ Installation—Installation Complete*

5. When the evaluation software installation is complete, click **Next** to proceed with the installation of the drivers.


*Figure 8. EVAL-SDP-CB1Z Drivers Installation—Setup Wizard*

6. The setup wizard opens. Click **Next** to begin the driver installation process.

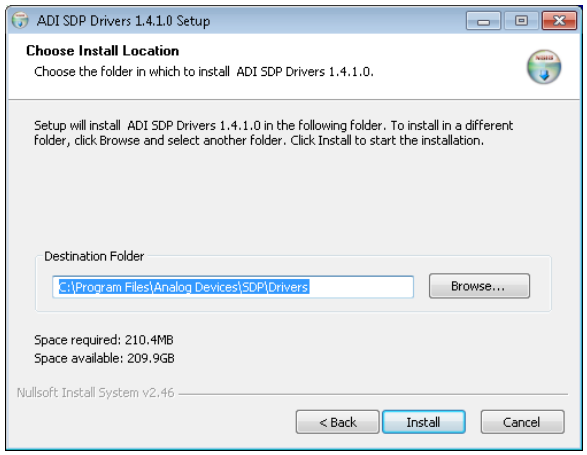



*Figure 9. EVAL-SDP-CB1Z Drivers Installation—Choose Install Location*

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

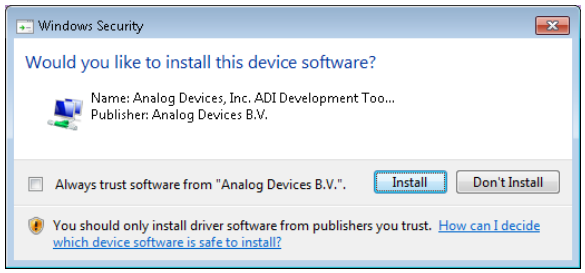



*Figure 10. EVAL-SDP-CB1Z Drivers Installation—Windows Security*

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

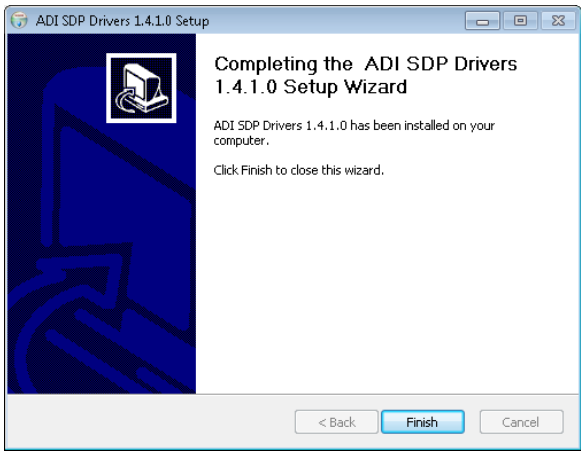



*Figure 11. EVAL-SDP-CB1Z Drivers Installation—Complete*

9. Click **Finish**.

After installation from the CD is complete, connect the EVAL-AD7091SDZ 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, you can 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**, as shown in Figure 12. The EVAL-SDP-CB1Z SDP-B board should appear under **ADI Development Tools**. This completes the installation.

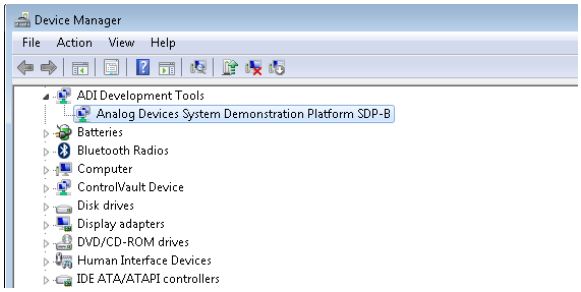


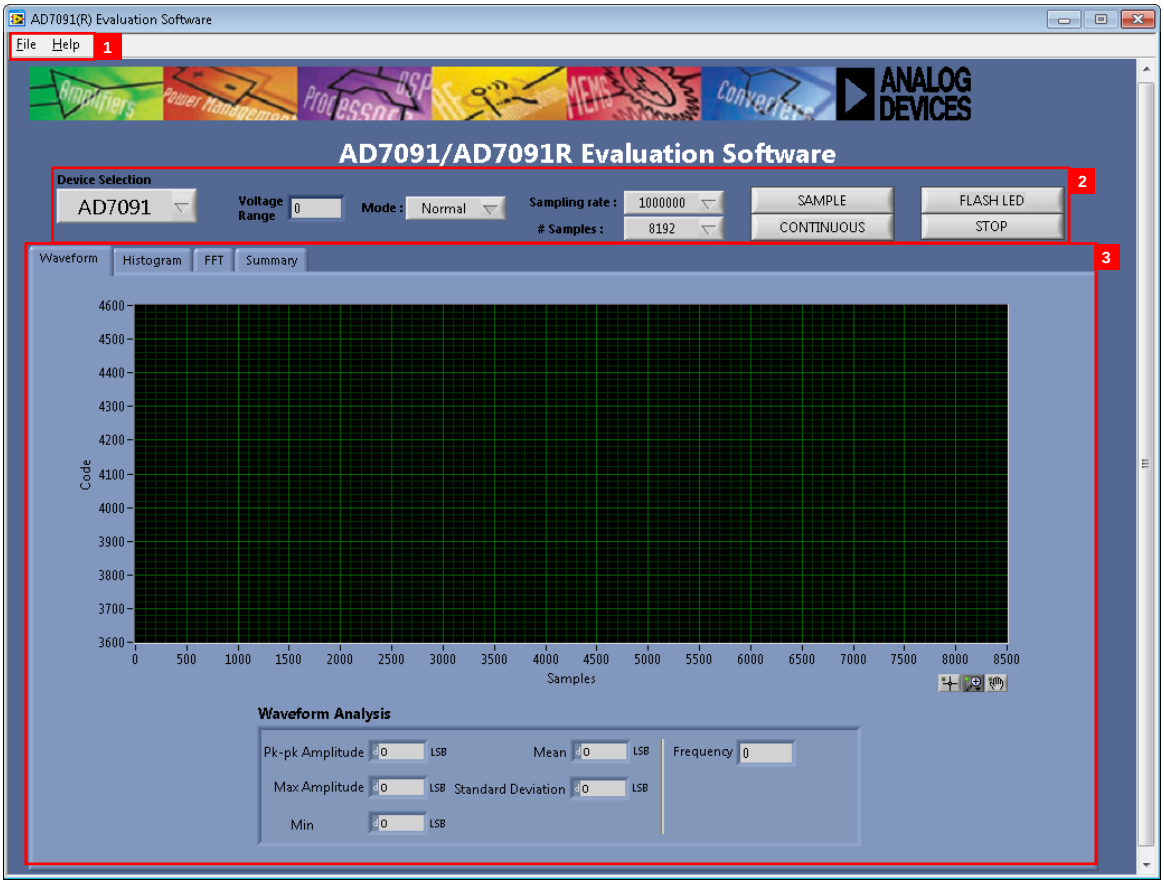

*Figure 12. Device Manager*

## LAUNCHING THE SOFTWARE

After the EVAL-AD7091SDZ and EVAL-SDP-CB1Z boards are correctly connected to your PC, the EVAL-AD7091SDZ software can be launched.

To launch the software, perform the following steps:

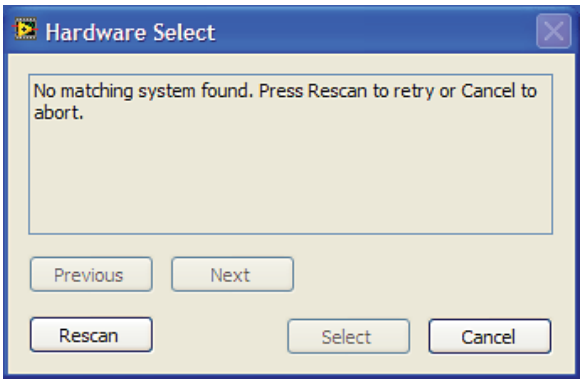
1. From the **Start** menu, select **Programs** >**Analog Devices** > **AD7091(R)** > **AD7091(R).** The main window of the software then opens (see Figure 13).
2. If the EVAL-AD7091SDZ board is not connected to the USB port via the EVAL-SDP-CB1Z when the software is launched, a connectivity error displays (see Figure 14). Connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the instructions.




1. MENU BAR.
2. CONTROL BUTTONS.
3. DATA CAPTURE DISPLAY.

10922-014

*Figure 13. Evaluation Software Main Window*




10922-013

*Figure 14. Connectivity Error Alert*

## DESCRIPTION OF MAIN SOFTWARE WINDOW

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

The user software panel as shown in Figure 13 has the following features:

- Menu bar
- Control buttons
- Data capture display

### *Menu Bar*

The menu bar consists of the **File** and **Help** menus.

**File Menu**

**Open (Sample Data).** Loads previously captured data in tab separated values (TSV) format for analysis.

**Save (Sample Data)**. Saves captured data in TSV format for future analysis.

**Print Front Panel Picture**. Prints the software window displayed.

**Save As Picture**. Saves the front panel as a JPEG file.

**Exit.** Exits the program.

**Help Menu**

**Open analog.com**. Opens www.analog.com.

### *Control Buttons*

The EVAL-AD7091SDZ software includes control buttons, drop-down boxes, and indicators.

**Device Selection.** Selects the AD7091 or AD7091R device.

**Voltage Range.** Indicates the onboard reference voltage. This is dependent on the **Device Selection**.

**Mode**. Selects the operating mode of the AD7091. In **Normal** mode, the ADC is ready to acquire samples. In **Sleep** mode, the device enters power-down mode when the **SAMPLE** button is clicked.

**Sampling rate**. Selects the sampling rate of the data acquisition.

**# Samples**. Selects the number of samples to be completed in a single acquisition.

**SAMPLE**. Initiates the sampling and readback of the defined number of measurements.

**CONTINUOUS**. Performs a continuous capture from the ADC. Click a second time to stop sampling.

**FLASH LED**. Causes the orange **LED1A** on the SDP board to flash, which can be a useful debugging tool.

**STOP**. Stops the program.

### *Data Capture Display*

There are four tabs that 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.


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

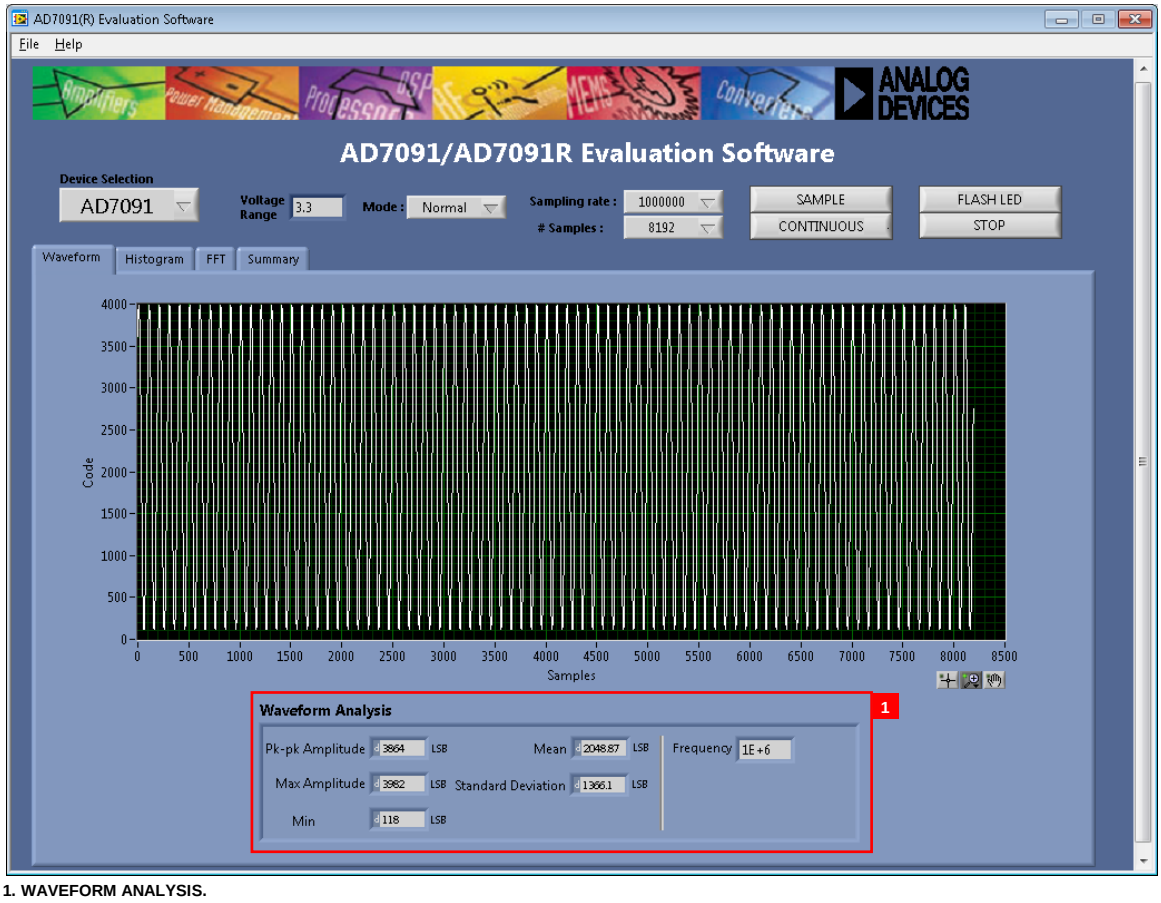
10922-015

*Figure 15. Chart Tools*

## WAVEFORM CAPTURE

Figure 16 illustrates the waveform capture tab.

The waveform analysis reports the amplitudes recorded from the captured signal in addition to the frequency of the signal tone.




1. WAVEFORM ANALYSIS.

*Figure 16. Waveform Capture Tab*

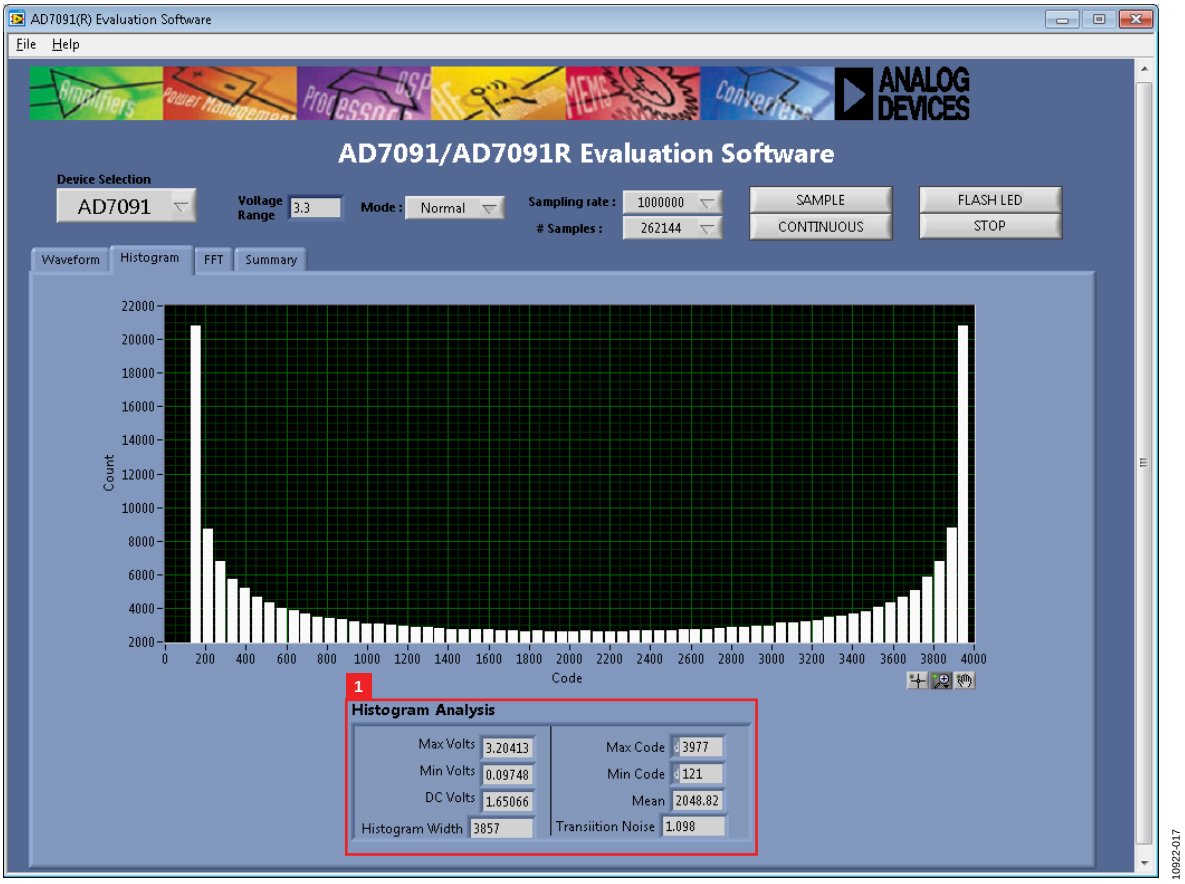



*Figure 17. Histogram Capture Tab*

## AC TESTING—HISTOGRAM

Figure 17 shows the histogram capture tab. This tests the ADC for the code distribution for the ac input and computes the mean and standard deviation, or transition noise of the converter, and displays the results.

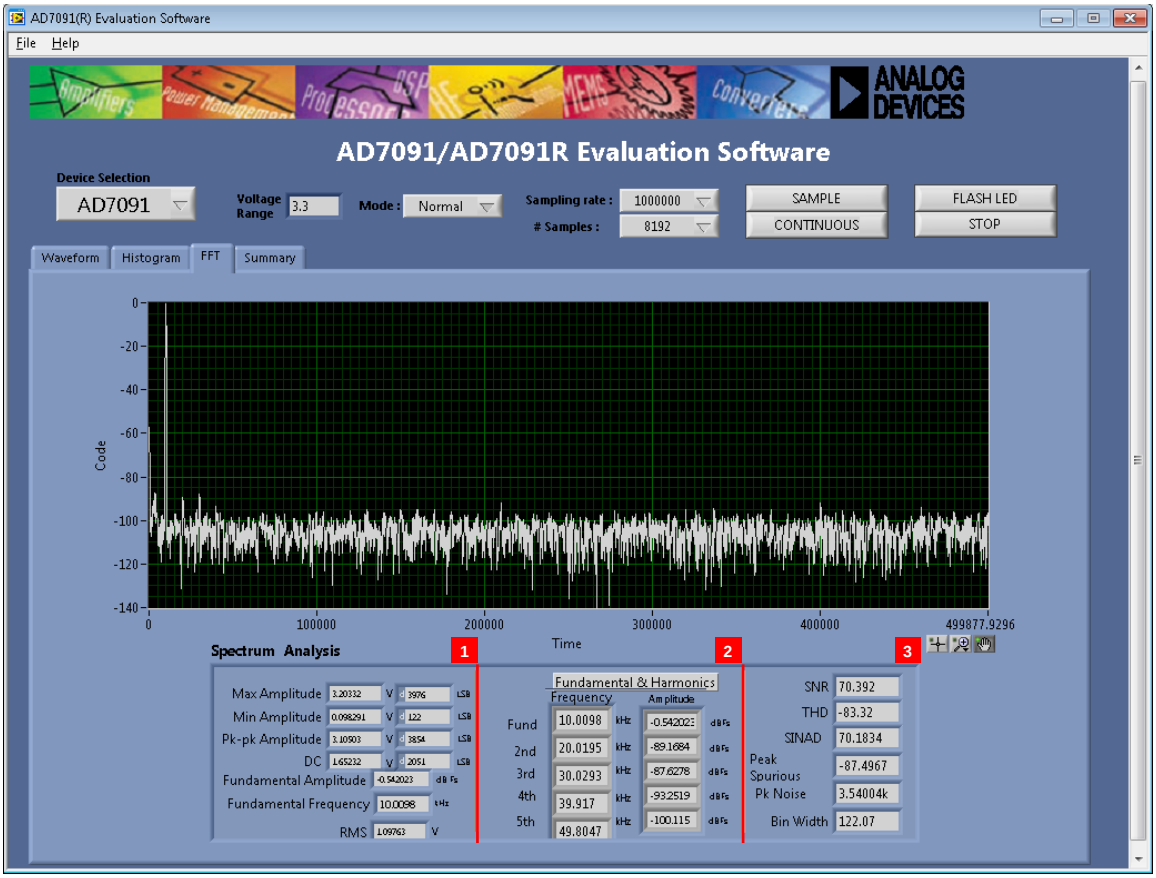
Raw data is captured and passed to the PC for statistical computations. To perform a histogram test, select the **Histogram** tab in the evaluation software main window and click the **SAMPLE** button.

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

## DC TESTING—HISTOGRAM

The histogram is more commonly used for dc testing. Similar to ac testing, this tests the ADC for the code distribution for the dc input and 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 evaluation software main window and click the **SAMPLE** button.




1. INPUT SIGNAL INFORMATION.
2. FUNDAMENTAL FREQUENCY AND AMPLITUDE.
3. PERFORMANCE DATA.

10922-018

*Figure 18. FFT Capture Tab*

## AC TESTING—FFT CAPTURE

Figure 18 shows the FFT capture tab. This 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 SNR, SINAD, THD, and SFDR. To perform an ac test, apply a sinusoidal signal to the evaluation board at the SMB input, J2. Low distortion, better than 115 dB, is required to allow true evaluation of the part. One possibility is to filter the input signal from the ac source. There is no suggested band-pass filter, but consideration should be taken in the choice. Furthermore, if using a low frequency band-pass filter when the full-scale input range is more than a few volts peak to peak, it is recommended to use the on-board amplifiers to amplify the signal, thus preventing the filter from distorting the input signal.

Figure 18 displays the results of the captured data.

- Section 1 shows the input signal information.
- Section 2 displays the fundamental frequency and amplitude in addition to the 2nd to 5th harmonics.
- Section 3 displays the performance data: SNR, dynamic range, THD, SINAD, and noise performance.

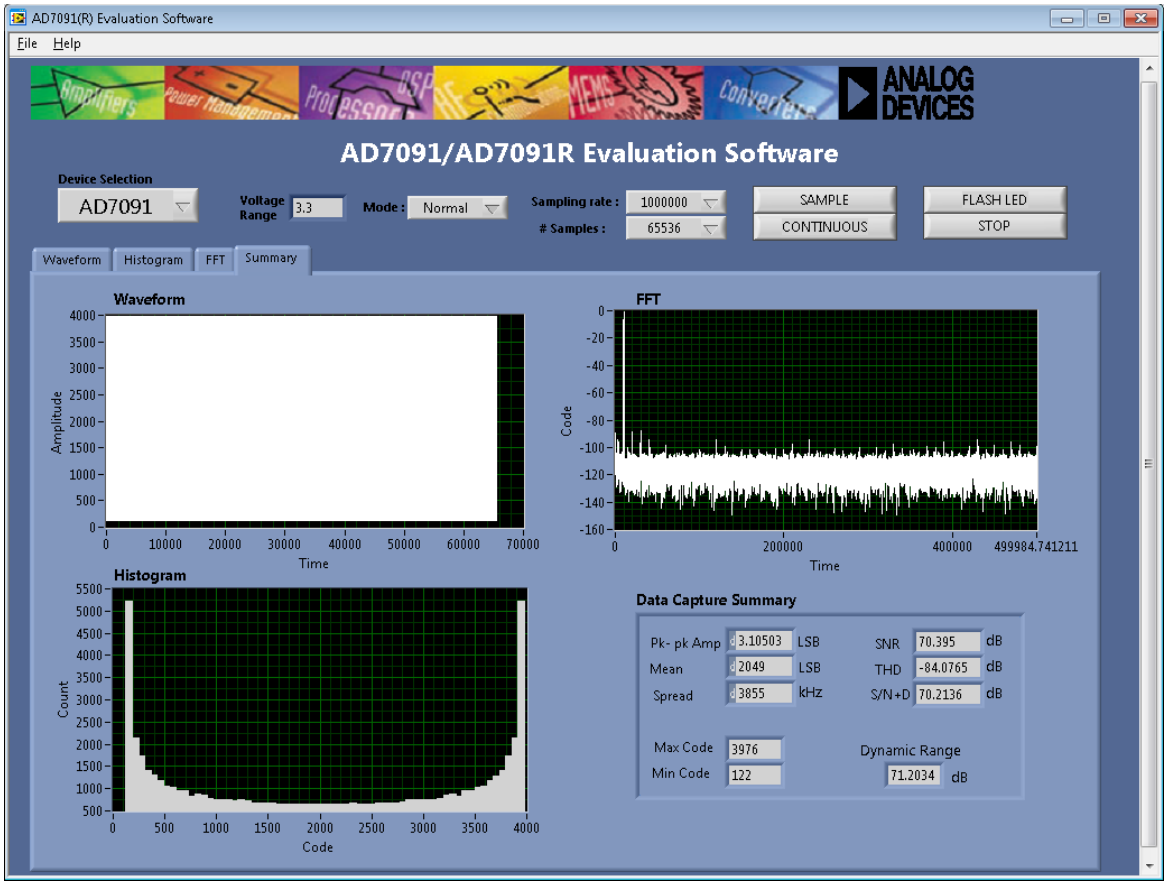



*Figure 19. Summary Tab*

## SUMMARY TAB

Figure 19 shows the summary tab. The summary tab captures all the display information, providing it on one panel with a synopsis of the information, including key performance parameters, such as SNR and THD.

## SAVE FILE

The software can save the current captured data for future analysis.

Go to the **File** menu, and click **Save (Sample Data)**. The save dialog box opens (see Figure 20). Save the file to an appropriate folder location.

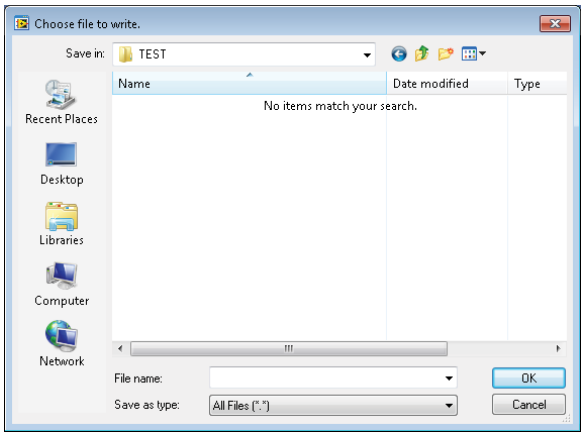



*Figure 20. Save File*

## OPEN FILE

The software can load captured data for analysis.

Go to the **File** menu, and click **Open (Sample Data)**. The open file dialog box opens. Load an appropriate file.

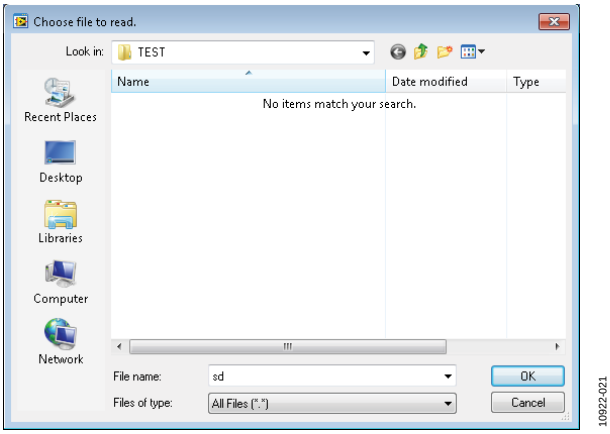



*Figure 21. Open File*

# EVALUATION BOARD SCHEMATICS AND ORDERING INFORMATION

The evaluation board schematics, artwork, and bill of materials is available for download from the Analog Devices website on the EVAL-AD7091SDZ page.

## ORDERING INFORMATION

See Table 4 for a list of the evaluation boards compatible with the hardware described in this user guide.

**Table 4. Compatible Boards**

| Model[1] | Description |
|---|---|
| EVAL-AD7091SDZ | AD7091 evaluation board |
| EVAL-SDP-CB1Z | Evaluation controller board |
| ADZS-BRKOUT-EX3 | Signal breakout board |

[1] Z = RoHS-compliant part.