Evaluation Board for the AD7091R Analog-to-Digital Converter

FEATURES
Full-featured evaluation board for the AD7091R
On-board power supplies
Standalone capability
PC control in conjunction with system demonstration platform (EVAL-SDP-CB1Z)
PC software for control and data analysis

EVAL-AD7091RSDZ CONTENTS
Evaluation board hardware
Evaluation software CD for the AD7091R
Mains power supply adapter

ADDITIONAL EQUIPMENT NEEDED
System demonstration platform (EVAL-SDP-CB1Z) when using evaluation software
Signal source

EVALUATION BOARD DESCRIPTION
The EVAL-AD7091RSDZ is a full-featured evaluation board designed to allow the user to easily evaluate all features of the AD7091R analog-to-digital converter. The evaluation board can be controlled via the SDP connector (J4). The SDP board allows the evaluation board to be controlled through the USB port of a PC using the EVAL-AD7091RSDZ software.

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, and the ADP3303 high accuracy 200 mA low dropout linear regulator.

FUNCTIONAL BLOCK DIAGRAM

Figure 1. EVAL-AD7091RSDZ Block Diagram
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REVISION HISTORY

8/12—Revision 0: Initial Version
**EVAL-AD7091RSDZ QUICK START GUIDE**

Follow these steps to quickly evaluate the AD7091:

1. Install the EVAL-AD7091RSDZ 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-AD7091RSDZ board as 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 Connector J1 on the EVAL-AD7091RSDZ 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 software from the Analog Devices subfolder in the Programs menu.

8. Connect a bipolar input signal via the VINB connector, J6.


![Figure 2. Hardware Configuration—Setting Up the EVAL-AD7091RSDZ](image-url)
EVALUATION BOARD HARDWARE

DEVICE DESCRIPTION

This user guide describes the evaluation board for the AD7091R analog-to-digital converter.

The AD7091R is a 12-bit, ultralow power, successive approximation ADC. The AD7091R operates from a single 2.7 V to 5.25 V power supply and is capable of achieving a throughput rate of 1 MSPS. The AD7091R also features an on-chip conversion clock, an accurate reference, and a high speed serial interface.

The conversion process and data acquisition are controlled using a CONVST signal and an internal oscillator. The AD7091R has a serial interface allowing data to be read after the conversion, while achieving 1 MSPS throughput rate. The AD7091R uses advanced design and process techniques to achieve ultralow power dissipation at high throughput rates. An on-chip, accurate 2.5 V reference is available.

Complete specifications for the AD7091R are provided in the AD7091R 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 http://www.analog.com/EVAL-SDP-CB1Z.

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 mains 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 J1. The 9 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 board and the EVAL-SDP-CB1Z board.

When using this evaluation board with the EVAL-SDP-CB1Z board, it is necessary to power the board through the J1 connector.

If the evaluation board is used without the 9 V adapter, an external power supply in the range of 2.7 V to 5.25 V must be connected to the VDD input to supply the AD7091R VDD pin. In addition, an external supply in the range of 1.65 V to 5.25 V must be connected to the VDRIVE input to supply the AD7091R VDRIVE pin.

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

There are two main ground planes, AGND and DGND. These are connected at one location close to the AD7091R.

Caution

When the EVAL-AD7091RSDZ evaluation board is connected to the EVAL-SDP-CB1Z, care must be taken to ensure that, if an external voltage is supplied to the VDRIVE input connector, J3, the voltage does not exceed 3.3 V. Otherwise, permanent damage may occur to the EVAL-SDP-CB1Z board.

Table 1. External Power Supplies Required

<table>
<thead>
<tr>
<th>Power Supply</th>
<th>Voltage Range</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Jack</td>
<td>9 V ± 5%</td>
<td>Supplies power to on-board power management devices</td>
</tr>
<tr>
<td>VDD</td>
<td>2.7 V to 5.25 V</td>
<td>Analog supply rail</td>
</tr>
<tr>
<td>VDRIVE</td>
<td>1.65 V to 5.25 V</td>
<td>Digital supply rail without EVAL-SDP-CB1Z connected</td>
</tr>
<tr>
<td></td>
<td>3.3 V ± 5%</td>
<td>Digital supply rail with EVAL-SDP-CB1Z connected</td>
</tr>
</tbody>
</table>
Table 2. Link Options

<table>
<thead>
<tr>
<th>Category</th>
<th>Link</th>
<th>Default Position</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer Settings</td>
<td>LK1</td>
<td>A</td>
<td>This link is used to select the analog signal path.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Position A, the analog signal is buffered via U2, a unity gain buffer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Position B, the analog signal is buffered via U3, a unity gain buffer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Position C, the analog signal bypasses U2 and U3.</td>
</tr>
<tr>
<td></td>
<td>LK2</td>
<td>A</td>
<td>This link is used to select the source of the analog input signal to the AD7091R.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Position A, the analog signal is sourced via the U2 op amp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Position B, the analog signal is sourced via the U3 op amp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Position C, the analog signal bypasses U2 and U3.</td>
</tr>
<tr>
<td></td>
<td>LK3</td>
<td>Fitted</td>
<td>This resistor link option is used to select a biased signal as the analog input signal.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fitted—bias up circuit connected to the signal path.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Not fitted—bias up circuit disconnected from the signal path.</td>
</tr>
<tr>
<td>Termination</td>
<td>LK4</td>
<td>Inserted</td>
<td>Adds a 51 Ω termination resistor to AGND at VIN.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inserted—51 Ω termination on the VIN input.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Not inserted—no 51 Ω termination on the VIN input.</td>
</tr>
<tr>
<td>Power Supplies</td>
<td>LK5</td>
<td>A</td>
<td>This link is used to select the source of the VDRIVE supply for the AD7091R.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Position A, the VDRIVE supply is sourced externally via the J3 connector.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Position B, the VDRIVE supply is sourced from the EVAL-SDP-CB1Z via the J4 connector.</td>
</tr>
<tr>
<td></td>
<td>LK6</td>
<td>A</td>
<td>This link is used to select the source of the VDD supply for the AD7091R and on-board buffers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Position A, the VDD supply is sourced internally from the on-board power supplies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Position B, the VDD supply is sourced externally via the J2 connector.</td>
</tr>
</tbody>
</table>

SOCKETS/CONNECTORS

The connectors and sockets on the EVAL-AD7091RSDZ are as outlined in Table 3.

Table 3. On-Board Connectors

<table>
<thead>
<tr>
<th>Connector</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>9 V, 2.0 mm dc jack connector</td>
</tr>
<tr>
<td>J2</td>
<td>External VDD and AGND power connector</td>
</tr>
<tr>
<td>J3</td>
<td>External VDRIVE and DGND power connector</td>
</tr>
<tr>
<td>J4</td>
<td>120-way connector for EVAL-SDP-CB1Z interface</td>
</tr>
<tr>
<td>J5</td>
<td>VIN analog input signal</td>
</tr>
<tr>
<td>J6</td>
<td>VINB analog input signal to bias up circuit</td>
</tr>
<tr>
<td>J7</td>
<td>External reference voltage connector</td>
</tr>
</tbody>
</table>

The default interface to this evaluation board is via the 120-way connector, which connects the EVAL-AD7091RSDZ to the EVAL-SDP-CB1Z board.

TEST POINTS

There are numerous test points on the EVAL-AD7091RSDZ 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 AD7091R via the test points to operate the EVAL-AD7091RSDZ in standalone mode without the need for the EVAL-SDP-CB1Z board.
EVAL-AD7091RSDZ BASIC HARDWARE SETUP

The EVAL-AD7091RSDZ board 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. Figure 2 shows a photograph of the connections between the EVAL-AD7091RSDZ daughter board and the EVAL-SDP-CB1Z board.

The analog input range to the AD7091R is 0 V to VREF and should not be exceeded. When using the on-chip reference, VREF is 2.5 V. An input signal in the range of 2.5 V p-p should be connected to the EVAL-AD7091RSDZ board via VIN or VINB.

A bipolar input signal should be connected to VINB, the J6 connector. This signal is biased to 1.25 V via the bias up circuitry on the EVAL-AD7091RSDZ. The signal source should be a low impedance source. An on-board unity gain amplifier buffers the signal to the AD7091R. This is the default configuration on the EVAL-AD7091RSDZ.

A unipolar input signal should be connected to VIN, the J5 connector. An on-board unity gain amplifier buffers the signal to the AD7091R.

Before connecting power, connect the EVAL-AD7091RSDZ board to Connector A on the EVAL-SDP-CB1Z board. A nylon screw/nut set is included in the EVAL-AD7091RSDZ kit and can be used to ensure that the EVAL-AD7091RSDZ 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-AD7091RSDZ board and the EVAL-SDP-CB1Z board are connected securely, connect the power to the EVAL-AD7091RSDZ board. The EVAL-AD7091RSDZ board requires an external power supply adapter, which is included in the evaluation board kit. Connect this power supply to Connector J1 on the EVAL-AD7091RSDZ 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-AD7091RSDZ 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-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-AD7091RSDZ 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\AD7091R\ 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:

- EVAL-AD7091RSDZ board 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 EVAL-AD7091RSDZ 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.

1. Click Yes to begin the installation process.

2. Select the installation directory. Click Next.

3. Click Next to install the software.

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

5. The setup wizard opens. Click Next to begin the driver installation process.
6. Select a destination folder for the SDP drivers, and click Install.

7. Click Install to proceed with the installation.

8. Click Finish.

After installation from the CD is complete, connect the EVAL-AD7091RSDZ 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 11. The EVAL-SDP-CB1Z SDP-B board should appear under ADI Development Tools. This completes the installation.

**LAUNCHING THE SOFTWARE**

After the EVAL-AD7091RSDZ and EVAL-SDP-CB1Z boards are correctly connected to your PC, the EVAL-AD7091RSDZ software can be launched.

To launch the software, perform the following steps:

1. From the Start menu, select Programs > Analog Devices > AD7091R. The main window of the software then opens (see Figure 13).

2. If the EVAL-AD7091RSDZ 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 evaluation board to the USB port of the PC, wait a few seconds, click Rescan, and follow the instructions.
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 TSV (tab separated values) format for analysis.
- **Save (Sample Data)**. Saves captured data in TSV (tab separated values) format for future analysis.

**Control Buttons**

The EVAL-AD7091RSDZ software includes the following control buttons, drop-down boxes, and indicators.

- **Mode**. Selects the operating mode of the AD7091R. 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.
- **Save As Picture**. Saves the front panel as a JPEG file.
- **Exit**. Exits the program.

**Help Menu**


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

Figure 13. Evaluation Software Main Window
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 14 allow user control of the different chart displays.

WAVEmO FORM CAPTURE

Figure 15 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.

![Waveform Capture Tab](image)
AC TESTING—HISTOGRAM

Figure 16 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/VINB connectors.

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.
AC TESTING—FFT CAPTURE

Figure 17 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, J5 or J6. 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 17 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.
SUMMARY TAB

Figure 18 shows the summary tab. The summary tab captures all the display information and provides them in 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. Save to an appropriate folder location.

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.
EVALUATION BOARD SCHEMATICS AND ARTWORK

Figure 21. Schematic Page 1
Figure 22. Schematic Page 2
Board ID EEPROM (24LC32/64) must be on I2C bus 0

VIN: Use this pin to power the SDP requires 4-7V 200mA

EEPROM A0 pin wired to connect or pin 56 selects slave address based on which SDP connector is used

* NC on BLACKFIN SDP

Figure 23. Schematic Page 3
Figure 24. EVAL-AD7091RSDZ Top-Side Silkscreen

Figure 25. EVAL-AD7091RSDZ Top Layer

Figure 26. EVAL-AD7091RSDZ Bottom Layer
ORDERING INFORMATION

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVAL-AD7091RSDZ</td>
<td>AD7091R evaluation board</td>
</tr>
<tr>
<td>EVAL-SDP-CB1Z</td>
<td>Evaluation controller board</td>
</tr>
<tr>
<td>ADZS-BRKOUT-EX3</td>
<td>Signal breakout board</td>
</tr>
</tbody>
</table>

1 Z = RoHS-compliant part.
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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