Evaluating the AD1940 SigmaDSP Using the EVAL-AD1940MINIBZ

PACKAGE CONTENTS
AD1940 mini evaluation board
EVAL-ADUSB2EBZ (USBi) communications adapter
USB cable with mini-B plug
Evaluation board/software quick start guide

OTHER SUPPORTING DOCUMENTATION
AD1940/AD1941 data sheet
AD1938 data sheet
AN-1006 Application Note, Using the EVAL-ADUSB2EBZ

EVALUATION BOARD OVERVIEW
This document explains the design and setup of the AD1940 SigmaDSP® miniature evaluation board.

This evaluation board provides a simple analog input and output setup for the AD1940. The SigmaDSP is controlled by the Analog Devices, Inc., SigmaStudio™ software, which interfaces to the board via a USB connection. This evaluation board may be powered either over the USB or by a single 3.8 V to 6 V supply, which is regulated to the voltages required on the board. The PC board is a 3” × 3” 4-layer design, with a single ground plane and a single power plane on the inner layers. The AD1938 codec handles all signal conversion between the analog and digital domains.

Use the AD1940 evaluation board for AD1941 evaluation also. There is no dedicated AD1941 evaluation board.

EVALUATION BOARD PHOTOGRAPHES

Figure 1. Evaluation Board Top Side
Figure 2. Evaluation Board Bottom Side
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REVISION HISTORY

7/10—Revision 0: Initial Version
FUNCTIONAL BLOCK DIAGRAMS

[Diagram of block diagram showing analog inputs, analog outputs, power supply regulation, USBi interface, AD1938 codec, AD1940, etc.]

Figure 3. Functional Block Diagram

BOARD LAYOUT BLOCK DIAGRAMS

TOP SIDE

[Diagram of board layout showing SPI communication interface, AD1940 SigmaDSP audio processor, AD1938 digital audio codec, power indicator, reset switch, input sensitivity and clip detection, etc.]

Figure 4. Board Layout Block Diagram (Top Side)

BOTTOM SIDE

[Diagram of board layout showing DAC output filters, power supply regulation, reset generator, input sensitivity and clip detection, etc.]

Figure 5. Board Layout Block Diagram (Bottom Side)
SETTING UP THE EVALUATION BOARD

INSTALLING THE SigmaStudio SOFTWARE

Download the latest version of SigmaStudio online at: http://www.analog.com/sigmastudiodownload.

To install, use the following steps:

1. Open the downloaded installer file and extract the files to your PC.
2. Install the Microsoft®.net Framework, if not already installed.
3. Install SigmaStudio by double-clicking setup.exe, and following the prompts.

INSTALLING THE USBi DRIVERS

1. SigmaStudio must be installed to use the USBi. Once SigmaStudio has been properly installed, connect the USBi to an available USB port with the included USB cable. At this point, Windows® Vista recognizes the device and prompts the user to install drivers.

3. Click Search for the best driver in these locations, then select Include this location in the search. Click Browse to find the SigmaStudio 3.0/USB drivers directory (see Figure 8).

![Found New Hardware Wizard—Search and Installation Options](image)

Figure 8. Windows Found New Hardware Wizard—Search and Installation Options

4. When the warning about Windows Logo testing appears on the screen, click Continue Anyway (see Figure 9).

![Warning Logo Testing](image)

Figure 9. Windows Logo Testing Warning

The USBi drivers should now be successfully installed. Leave the USBi connected to the PC.
CONFIGURING THE DEFAULT SWITCH AND JUMPER SETTINGS

The board is hardwired in a stereo analog input, six channel analog output configuration that cannot be modified. No jumpers exist on this board, but there is one configuration switch, S2. The setting of S2 determines the input gain of the ADC preamp. The switch can be configured in 1 V p-p or 2 V p-p mode to match the input audio source.

POWERING UP THE BOARD

To power up the board, connect the USBi’s ribbon cable to the EVAL-AD1940MINIBZ’s communications header, J1.

CONNECTING THE AUDIO CABLES

1. Connect a stereo audio source to J6 (ADC input).
2. Connect headphones or powered speakers to J3 (DAC Output 1). The labels for J6 and J3 are only visible on the bottom of the board.

SETTING UP COMMUNICATIONS IN SigmaStudio

1. Start SigmaStudio by double-clicking the shortcut on the desktop.
2. Click File > New Project or press Ctrl+N to create a new project. The default view of the new project is called the Hardware Configuration tab.
3. To use the USBi in conjunction with SigmaStudio, first select it in the Communication Channels subsection of the toolbox on the left side of the Hardware Configuration tab (see Figure 10). Add it to the project space by clicking and dragging it to the right.

![Figure 10. Adding the USBi Communication Channel](image)

If SigmaStudio cannot detect the USBi on the USB port of the computer, then the background of the USB label displays red (see Figure 11). This may happen when the USBi is not connected or when the drivers are incorrectly installed.

![Figure 11. USBi Not Detected by SigmaStudio](image)

4. To add an AD1940 to the project, select it from the Processors (ICs / DSPs) list and drag it to the project space (see Figure 13).

![Figure 13. Adding an AD1940](image)

5. To use the USBi to communicate with the target IC, connect it by dragging a wire between the blue pin of the USB Interface cell and the green pin of the IC. The corresponding drop-down box of the USBi automatically fills with the default mode and channel for that IC.

![Figure 14. Connecting the USBi to an AD940 IC](image)
CREATING A BASIC SIGNAL FLOW

To create a basic signal flow, use the following steps:

1. To access the Schematic tab, where a signal processing flow can be created, click the Schematic tab at the top of the screen (see Figure 15).

![Figure 15. Schematic Tab](image)

2. The left side of the schematic view houses the Tree Toolbox, which contains all of the algorithms that can run in the SigmaDSP. Navigate to the IO > Input folder and select an Input cell.

![Figure 16. Input Cell Selection](image)

3. Click and drag the input cell into the blank schematic space to the right of the toolbox (see Figure 17).

![Figure 17. Input Cell](image)

4. In the Tree Toolbox, navigate to the IO > Output folder and select an Output cell (see Figure 18).

![Figure 18. Output Cell Selection](image)
5. Click and drag an output cell to the schematic. Repeat so there will be two outputs (see Figure 19).

![Figure 19. Output Cells](image)

6. In the Tree Toolbox, navigate to the Volume Controls > Adjustable Gain > Single/Multiple Controls > Clickless (RC Type) HW Slew folder and select a Single Volume Control cell (see Figure 20).

![Figure 20. Volume Control Cell Selection](image)

7. Click and drag the Single Volume Control cell to the schematic.

![Figure 21. Volume Control Cell](image)

8. By default, this cell only has one input channel and one output channel, as indicated by the green input and blue output dots. To add a channel, right click in the blank white part of the cell and select Add Algorithm > IC 1 > Gain (slew) from the menu (see Figure 22).

![Figure 22. Adding a Channel to the Volume Control](image)

The cell should now have two inputs and two outputs (see Figure 23).

![Figure 23. Stereo Volume Control Cell](image)

9. Navigate to the Filters > Second Order > Single Precision > 2 Ch folder and select a Medium Size Eq cell (see Figure 24).

![Figure 24. EQ Cell Selection](image)
10. Click and drag the cell to the schematic (see Figure 25).

![Figure 25. Single-Band Stereo EQ Cell](image)

11. By default, the EQ only has one band. To increase the number of bands, right click in the blank white part of the cell and select **Grow Algorithm > 1.2 Channel – Single Precision > 4** to increase the EQ to 5 bands (see Figure 26).

![Figure 26. Growing the EQ Cell](image)

The EQ should now have five bands (see Figure 27).

![Figure 27. Five-Band Stereo EQ Cell](image)

12. To change the properties of a filter, click once on its corresponding blue filter icon (see Figure 28).

![Figure 28. Filter Properties Button](image)

13. Configure each filter as required. As an example, Figure 29 shows a low shelf at 50 Hz, peaking filters at 200 Hz, 500 Hz, and 2000 Hz, and a high shelf at 10 kHz.

![Figure 29. Configured 5-Band EQ Cell](image)

14. Connect the cells together by left clicking a blue output dot and dragging to the green output dot of the next cell. Continue until the signal flow is completed from input to output for each channel.

![Figure 30. Completed Signal Flow](image)

The basic signal flow is now complete with stereo I/O, a five-band equalizer, and a clickless volume control (see Figure 30).

**DOWNLOADING THE PROGRAM TO THE DSP**

To compile and download the code to the DSP, click once on the **Link-Compile-Download** button in SigmaStudio's main toolbar (Figure 31). Alternatively, press the **F7** key.

![Figure 31. Link-Compile-Download Button](image)

The signal flow should now be running on the evaluation board, and audio should pass from input to output. The controls for filters and volume can be changed in real-time by clicking and dragging them with the mouse.
USING THE EVALUATION BOARD

POWER
Power can be supplied either via the USB bus by connecting the EVAL-ADUSB2EBZ (USBi) to Header J1 or by a tip-positive 3.8 V to 6 V dc power supply on Connector J2. The on-board regulator generates the 3.3 V dc supply for the on-board circuitry. LED D1 lights up when power is supplied to the board.

INPUTS AND OUTPUTS
The board is configured in an analog input-analog output mode. There are two ADC inputs and 6 DAC outputs, each accessible by standard stereo TRS 1/8” mini jacks.

The input and output filters are active, and the outputs can drive passive headphones or active speakers.

The input sensitivity switch sets the preamp gain, and it can be configured as required for various audio input levels. The two gain settings are 1 V rms and 2 V rms.

The input clip LED, D2, lights up when an input signal is close to the full-scale input level of the AD1938.

AD1938 AUDIO CODEC
The audio codec operates in standalone FS mode. Its serial ports are configured in master mode, so the serial ports of the AD1940 should be configured as slaves.

The audio codec generates a master clock with its on-board oscillator and the 12.288 MHz crystal resonator, Y1. It sends master clock, frame clock, and bit clock signals to the AD1940.

AD1940 SigmaDSP
The AD1940 receives one FS stream from the AD1938's ADCs and sends three FS streams to the AD1938's DACs. The registers of the AD1940 and its signal processing flow can be configured in SigmaStudio.

COMMUNICATIONS HEADER
The communications header, J1, connects to the EVAL-ADUSB2EBZ, also called the USBi. More information about the USBi can be found in the AN-1006 Application Note.

The AD1940 uses the SPI communication protocol. The communication port of the AD1938 is not accessible on this evaluation board.

RESET
The reset switch, S1, initiates a reset signal, which is generated by the ADM811. This in turn resets the AD1940 and AD1938. A reset event causes the AD1940 to lose its register settings and RAM contents.
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Figure 33. Board Schematics, Page 2—DAC Outputs
Figure 34. Board Schematics, Page 3—SigmaDSP and Audio Codec
Figure 35. Board Schematics, Page 4—Clip Detection, Power Supply, Reset, Communications
Figure 36. Board Layout, Page 1—Top Assembly

Figure 37. Board Layout, Page 2—Top Layout and Screen
Figure 40. Board Layout, Page 5—Power Plane
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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.

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. 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.

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 NONINFRINGEMENT 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 UNITED STATES 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.

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