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# **SHARC<sup>®</sup> Audio EZ-Extender<sup>®</sup> Manual**

Revision 1.1, August 2012

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## Regulatory Compliance

The SHARC Audio EZ-Extender is designed to be used solely in a laboratory environment. The board is not intended for use as a consumer end product or as a portion of a consumer end product. The board is an open system design which does not include a shielded enclosure and therefore may cause interference to other electrical devices in close proximity. This board should not be used in or near any medical equipment or RF devices.

The SHARC Audio EZ-Extender has been certified to comply with the essential requirements of the European EMC directive 2004/108/EC and therefore carries the “CE” mark.

The SHARC Audio EZ-Extender has been appended to Analog Devices, Inc. EMC Technical File (EMC TF) referenced **DSPTOOLS1**, issue 2 dated June 4, 2008 and was declared CE compliant by an appointed Notified Body (No.0673) as listed below.

Notified Body Statement of Compliance: Z600ANA2.037, dated May 21, 2010.



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The SHARC Audio EZ-Extender contains ESD (electrostatic discharge) sensitive devices. Electrostatic charges readily accumulate on the human body and equipment and can discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused extender boards in the protective shipping package.





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# Contents

# PREFACE

Thank you for purchasing the SHARC® Audio EZ-Extender®, Analog Devices, Inc. daughter board to the EZ-Board® evaluation system for the ADSP-21xxx processors.

SHARC processors are based on a 32-bit super Harvard architecture that includes a unique memory architecture comprised of two large on-chip, dual-ported SRAM blocks coupled with a sophisticated IO processor, which gives a SHARC processor the bandwidth for sustained high-speed computations. SHARC processors represents today's de facto standard for floating-point processing, targeted toward premium audio applications.

The EZ-Board and SHARC Audio EZ-Extender are designed to be used in conjunction with the CrossCore® Embedded Studio (CCES) and VisualDSP++® software development environments. The development environment facilitates advanced application code development and debug, such as:

- Create, compile, assemble, and link application programs written in C++, C, and SHARC Audio EZ-Extender assembly
- Load, run, step, halt, and set breakpoints in application programs
- Read and write data and program memory
- Read and write core and peripheral registers
- Plot memory

To learn more about Analog Devices development software, go to <http://www.analog.com/dsp/tools>.

# Product Overview

The SHARC Audio EZ-Extender is a separately sold daughter board that plugs onto the expansion interface II of the ADSP-21469 EZ-Board and all future SHARC evaluation boards. The daughter board aids the design and prototyping phases of analog audio applications.

The board extends the capabilities of the evaluation system by providing a connection to three analog audio codecs.

The SHARC Audio EZ-Extender features:

- Analog audio interface
  - AD1939 – three Analog Devices 192 kHz audio codecs
  - 24 channels of audio out (twelve stereo channels)
  - Twelve channels of audio in (six stereo channels)
  - TDM and I<sup>2</sup>S modes at 48 KHz, 96 KHz, and 192 KHz sample rates
- Single-ended input/output
  - Three RCA phono jack inputs (4 x 1)
  - Three RCA phono jack outputs (4 x 2)
- Differential input/output
  - Two DB25 connector inputs
  - Three DB25 connector outputs

All of the power necessary to operate the extender is derived from the mating EZ-Board. Before using any of the interfaces, follow the setup procedure in [“SHARC Audio EZ-Extender Setup” on page 1-4](#).

Example programs are available to demonstrate capabilities of the SHARC Audio EZ-Extender board.

## Purpose of This Manual

The *SHARC Audio EZ-Extender Manual* describes operation and configuration of the extender board components. A schematic and a bill of materials are provided as a reference guide for future SHARC processor board designs.

## Intended Audience

This manual is a user's guide and reference to the SHARC Audio EZ-Extender. Programmers who are familiar with the Analog Devices SHARC processor architecture, operation, and development tools are the primary audience for this manual.

Programmers who are unfamiliar with Analog Devices processors can use this manual but should supplement it with other texts that describe your target architecture. For the locations of these documents, see [“Related Documents”](#).

Programmers who are unfamiliar with CCES or VisualDSP++ should refer to the online help and user's manuals.

# Manual Contents

The manual consists of:

- Chapter 1, “[Using the SHARC Audio EZ-Extender](#)” on page 1-1  
Provides basic board information.
- Chapter 2, “[SHARC Audio EZ-Extender Hardware Reference](#)” on page 2-1  
Provides information about the hardware aspects of the board.
- Appendix A, “[SHARC Audio EZ-Extender Bill of Materials](#)” on page A-1  
Provides a list of components used to manufacture the board.
- Appendix B, “[SHARC Audio EZ-Extender Schematic](#)” on page B-1  
Provides the resources to allow board-level debugging or to use as a reference guide. Appendix B is part of the online help.

## What’s New in This Manual

This is revision 1.1 of the *SHARC Audio EZ-Extender Manual*. The manual has been updated to include CCES information. In addition, modifications and corrections based on errata reports against the previous manual revision have been made.

For the latest version of this manual, please refer to the Analog Devices Web site.

## Technical Support

You can reach Analog Devices processors and DSP technical support in the following ways:

- Post your questions in the processors and DSP support community at EngineerZone®:  
<http://ez.analog.com/community/dsp>
- Submit your questions to technical support directly at:  
<http://www.analog.com/support>
- E-mail your questions about processors, DSPs, and tools development software from **CrossCore Embedded Studio** or **VisualDSP++**:

Choose **Help > Email Support**. This creates an e-mail to [processor.tools.support@analog.com](mailto:processor.tools.support@analog.com) and automatically attaches your **CrossCore Embedded Studio** or **VisualDSP++** version information and `license.dat` file.

- E-mail your questions about processors and processor applications to:  
[processor.support@analog.com](mailto:processor.support@analog.com) or  
[processor.china@analog.com](mailto:processor.china@analog.com) (Greater China support)
- In the **USA only**, call **1-800-ANALOGD** (1-800-262-5643)
- Contact your Analog Devices sales office or authorized distributor. Locate one at:  
[www.analog.com/adi-sales](http://www.analog.com/adi-sales)

## Supported Products

- Send questions by mail to:  
Processors and DSP Technical Support  
Analog Devices, Inc.  
Three Technology Way  
P.O. Box 9106  
Norwood, MA 02062-9106  
USA

## Supported Products

The SHARC Audio EZ-Extender is designed as an extender board to the ADSP-214xx EZ-Board evaluation systems.

## Product Information

Product information can be obtained from the Analog Devices Web site and the online help.

## Analog Devices Web Site

The Analog Devices Web site, [www.analog.com](http://www.analog.com), provides information about a broad range of products—analogue integrated circuits, amplifiers, converters, and digital signal processors.

To access a complete technical library for each processor family, go to <http://www.analog.com/dsp/tools>. The manuals selection opens a list of current manuals related to the product as well as a link to the previous revisions of the manuals. When locating your manual title, note a possible errata check mark next to the title that leads to the current correction report against the manual.

Also note, [myAnalog](#) is a free feature of the Analog Devices Web site that allows customization of a Web page to display only the latest information

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## **EngineerZone**

EngineerZone is a technical support forum from Analog Devices. It allows you direct access to ADI technical support engineers. You can search FAQs and technical information to get quick answers to your embedded processing and DSP design questions.

Use EngineerZone to connect with other DSP developers who face similar design challenges. You can also use this open forum to share knowledge and collaborate with the ADI support team and your peers. Visit <http://ez.analog.com> to sign up.



## Related Documents

For additional information about the product, refer to the following publications.

Table 1. Related Processor Publications

| Title  | Description   |
|--|---|
| <i>ADSP-214xx SHARC Processor Data Sheet</i>         | General functional description, pinout, and timing                            |
| <i>ADSP-214xx SHARC Processor Hardware Reference</i> | Description of the internal processor architecture and all register functions |
| <i>SHARC Processor Programming Reference</i>         | Description of all allowed processor assembly instructions                    |

# 1 USING THE SHARC AUDIO EZ-EXTENDER

This chapter describes the SHARC Audio EZ-Extender package contents, configuration, installation procedure, and analog audio interface.

The information is presented in the following order.

- [“Package Contents” on page 1-2](#)  
Describes the product’s package contents.
- [“SHARC Audio EZ-Extender Default Configuration” on page 1-2](#)  
Describes the board’s default configuration.
- [“SHARC Audio EZ-Extender Setup” on page 1-4](#)  
Provides the board’s setup procedure.
- [“Audio Interface” on page 1-4](#)  
Describes the board’s analog audio interface.
- [“Example Programs” on page 1-6](#)  
Describes the example programs installed with the board’s software.

For more information about the mating ADSP-21469 processor, see documents referred to as [“Related Documents”](#).

# Package Contents

Your SHARC Audio EZ-Extender package contains the following items.

- SHARC Audio EZ-Extender board
- 3.5 mm stereo headphones
- 6-foot RCA audio cable
- 6-foot 3.5 mm/RCA x 2 Y-cable
- 3.5 mm stereo female to RCA male Y-cable

If any item is missing, contact the vendor where you purchased your EZ-Extender or contact Analog Devices, Inc.

## SHARC Audio EZ-Extender Default Configuration

The SHARC Audio EZ-Extender contains ESD (electrostatic discharge) sensitive devices. Electrostatic charges readily accumulate on the human body and equipment and can discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused extender boards in the protective shipping package.



The SHARC Audio EZ-Extender board is designed to run outside your personal computer as a standalone unit. You do not have to open your computer case.

When removing the extender board from the package, handle the board carefully to avoid the discharge of static electricity, which may damage some components. [Figure 1-1](#) shows the default jumper and switch settings, connector locations, and LED used in installation. Confirm that your board is in the default configuration before using the board.

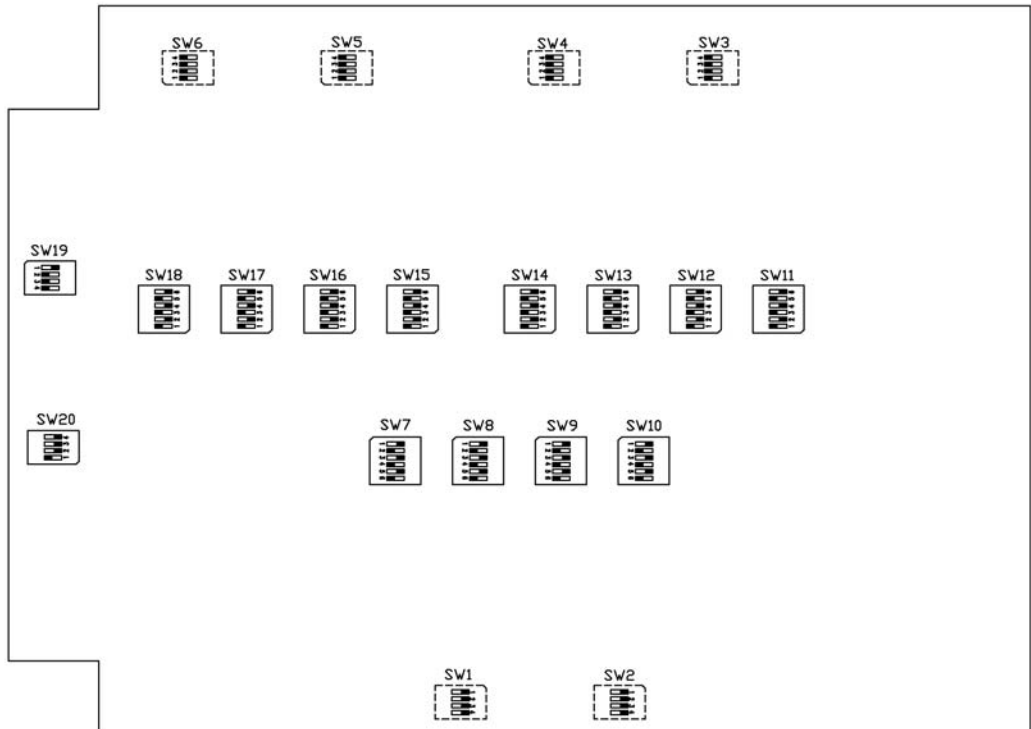


Figure 1-1. EZ-Extender Lite Hardware Setup

# SHARC Audio EZ-Extender Setup

It is important to set up all components of the system containing the SHARC Audio EZ-Extender, then apply power to the system. The following procedure is recommended for the correct setup.

Power your system after these steps are completed:

1. Read the audio interface section in this chapter—the text provides an overview of the interface capabilities.
2. Read [“System Architecture” on page 2-2](#) to understand physical connections of the daughter board. For detailed information, refer to [“SHARC Audio EZ-Extender Schematic” on page B-1](#).
3. Refer to the readme files in the `Examples` folder of the installation directory. For custom setups, use [“System Architecture” on page 2-2](#) in conjunction with [“SHARC Audio EZ-Extender Hardware Reference” on page 2-1](#).

## Audio Interface

The SHARC Audio EZ-Extender’s analog audio interface is comprised of three Analog Devices AD1939 multichannel audio codecs.

The AD1939 is a high performance, single-chip codec featuring four analog-to-digital converters (ADCs) for audio input and eight digital-to-analog converters (DACs) for audio output. This translates to twelve channels of audio in and twenty four channels of audio out. The codec/extender can input and output data at a sample rate of up to 192 kHz on all channels.

The audio interface connections are shown in [Figure 2-2](#); more details can be found in [“SHARC Audio EZ-Extender Schematic” on page B-1](#). The three codec chips (referred to as “AD1939A”, “AD1939B”, and

“AD1939C”) connect in parallel to the serial peripheral interface (SPI) port of the ADSP-21469 SHARC processor via the DPI pins. The SPI port of the processor is used to adjust volume and other audio parameters of each of the three codecs.

The serial ports (SPORTs) are used to transmit and receive audio data to and from the processor via the DAI pins. The analog audio channels are available via single-ended RCA connectors (J2–7) or differential DB25 connectors (P1–5). By default, the extender is shipped with the RCA connectors used by the AD1939 codecs for audio in and out. P1–5 are used to switch to differential mode. A standard, off the shelf DB25 connector to XLR cables is required to operate in differential mode. The P1–5 connectors require five XLR cables for full functionality. The XLR cables are not provided with the EZ-Extender. The mating cable’s manufacturer and part number information can be found in [“Differential In/Out Connectors \(P1–5\)” on page 2-19](#).

The DAI pins of the master codec can be configured to transfer serial data from the codec in Time-Division Multiplexing (TDM) mode or Integrated Interchip Sound (I<sup>2</sup>S) mode. The master input clock (MCLK) of the codec is generated by the on-board 12.288 MHz oscillator. The internal PLL of the codec is used to generate varying sample rates. The codec can be set up for 48 KHz, 96 KHz, or 192 KHz frequencies. The master codec (codec A) can run at these frequencies in both TDM and I<sup>2</sup>S modes with all ADCs inputs and DACs outputs. Codecs B and C are wired on the EZ-Extender and allow TDM mode operations only.

- At a 48 kHz sample rate, TDM mode allows up to 16 channels of data to be sent from each chip in each direction. Each chip uses four of the 16 input channels and eight of the 16 output channels. The number of channels can be set up in the control registers and is dependent on the sample rate. As the sample rate increases, the number of possible channels decreases.

## Example Programs

- At 96 kHz, the AD1939 operates with a maximum of eight channels in each direction. At 96 kHz, all of the TDM channels are used by all analog outputs, but there are still four extra input channels, two of which can be used by the digital inputs.
- At the 192 kHz sample rate, a maximum of four channels in each direction can be used, meaning that four of the output channels cannot be used. To run at 192 KHz with all ADCs and DACs in TDM mode, the codec must run in dual-line TDM mode.

For more information about the AD1939 codecs, go to [AD1939](#).

Example programs are included in the EZ-Extender installation directory to demonstrate how to configure and use the board's analog audio interface.

For more information, see [“System Architecture” on page 2-2](#), [“Configuration Switches” on page 2-5](#), [“Power LED” on page 2-16](#), and [“Connectors” on page 2-17](#).

## Example Programs

Example programs are provided with the SHARC Audio EZ-Extender EZ-KIT Lite to demonstrate various capabilities of the product. The programs are included in the product installation kit and can be found in the `Examples` folder of the installation. Refer to a readme file provided with each example for more information.

CCES users are encouraged to use the example browser to find examples included with the EZ-KIT Lite Board Support Package.

# 2 SHARC AUDIO EZ-EXTENDER HARDWARE REFERENCE

This chapter describes the hardware design of the SHARC Audio EZ-Extender.

The following topics are covered.

- [“System Architecture” on page 2-2](#)  
Describes the daughter board’s configuration and explains how the board components interface with the processor and EZ-Board.
- [“Configuration Switches” on page 2-5](#)  
Shows the locations and describes the on-board configuration switches.
- [“Power LED” on page 2-16](#)  
Shows the location and describes the on-board power LED.
- [“Connectors” on page 2-17](#)  
Shows the locations, describes, and provides part numbers for the on-board connectors. In addition, the manufacturer and part number information is provided for the mating parts.



# System Architecture

A block diagram of the SHARC Audio EZ-Extender is shown in Figure 2-1.

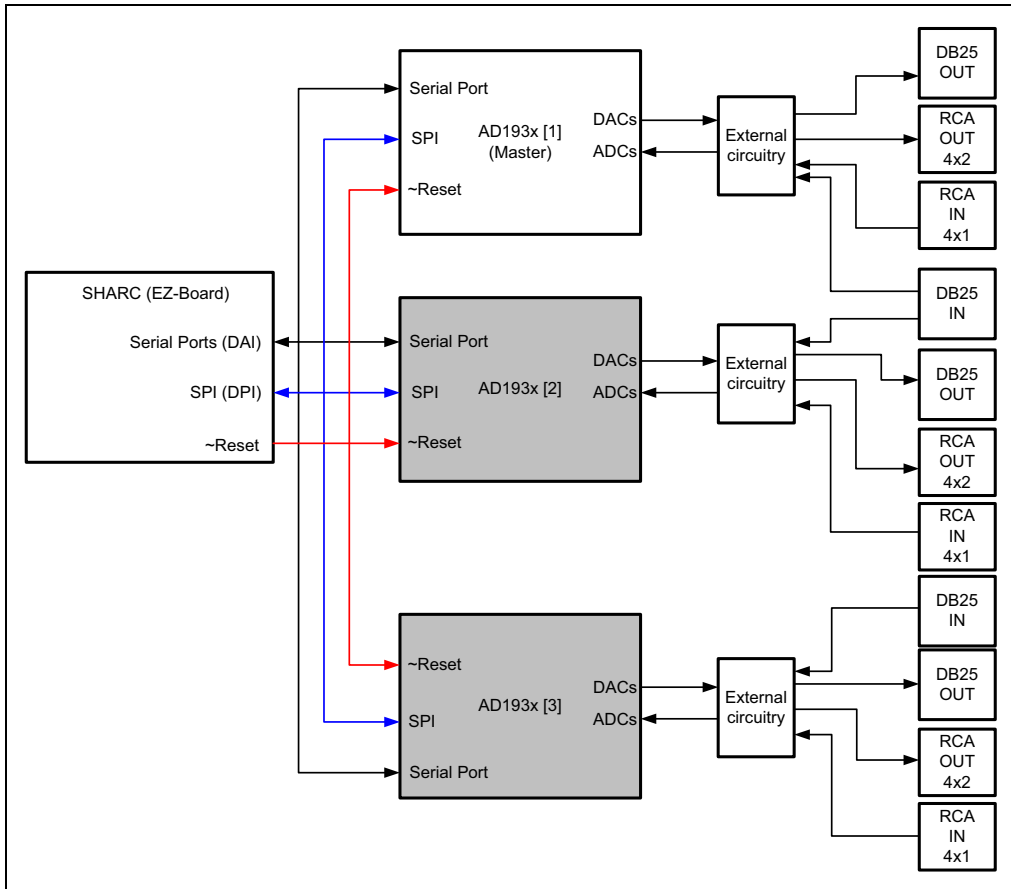


Figure 2-1. SHARC Audio EZ-Extender Block Diagram

Figure 2-2 is a block diagram of the audio interface; the diagram illustrates how the serial ports are interfaced to the processor and AD1939 codecs on a mating SHARC EZ-Board. The block diagram is a high-level diagram and does not show the voltage translation circuitry or clock buffers. The schematic pages are available in “SHARC Audio EZ-Extender Schematic” on page B-1.

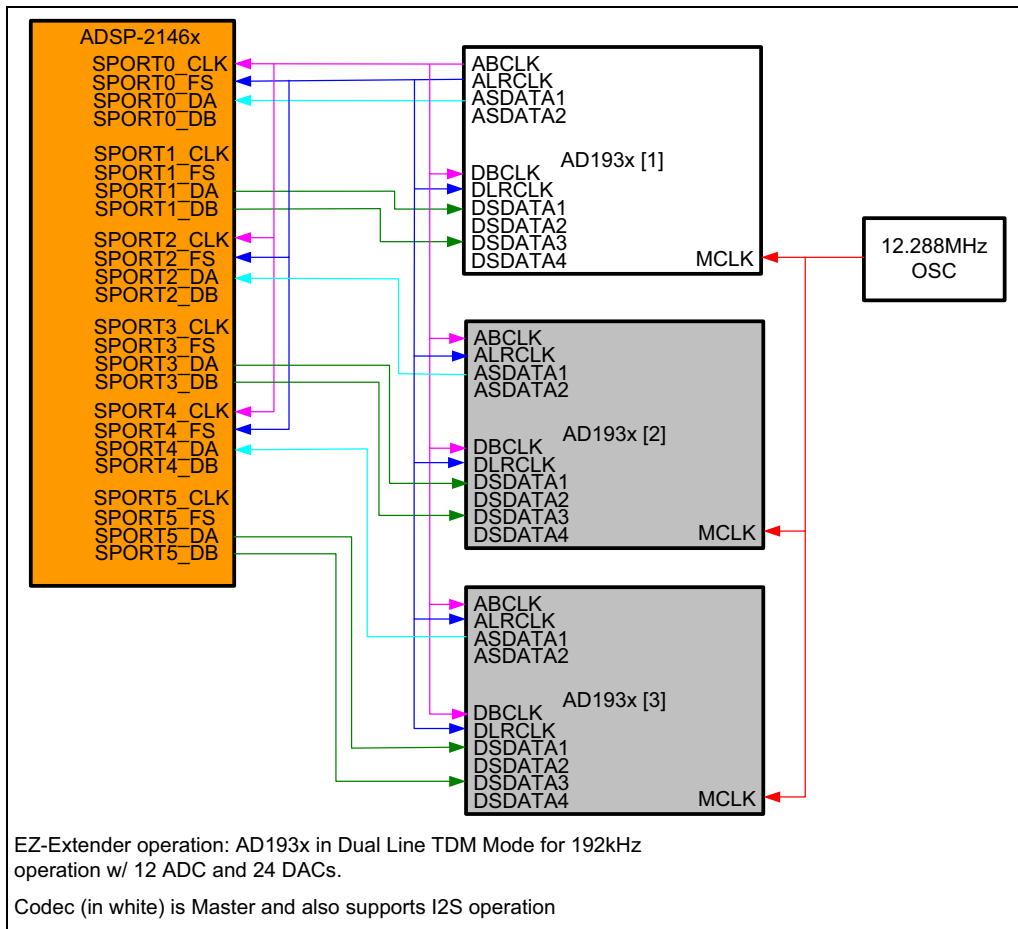


Figure 2-2. Serial Port Configuration Block Diagram