HDMI Audio EI3 EZ-Extender® Manual

Revision 1.0, December 2015

Part Number
82-000707-01

Analog Devices, Inc.
One Technology Way
Norwood, MA 02062-9106

ANALOG DEVICES

Copyright Information

Printed in the USA.

Disclaimer

Analog Devices, Inc. reserves the right to change this product without prior notice. Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use; nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under the patent rights of Analog Devices, Inc.

Trademark and Service Mark Notice

The Analog Devices logo, Blackfin, CrossCore, EngineerZone, EZ-Board, EZ-KIT, EZ-KIT Lite, EZ-Extender, SHARC, and VisualDSP++ are registered trademarks of Analog Devices, Inc.

Blackfin+, SHARC+, and EZ-KIT Mini are trademarks of Analog Devices, Inc.

All other brand and product names are trademarks or service marks of their respective owners.

Regulatory Compliance

The HDMI Audio EI3 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 HDMI Audio EI3 EZ-Extender is in the process of being certified to comply with the essential requirements of the European EMC directive 2004/108/EC and therefore carries the ***"CE"*** mark.

This board 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.	

Contents

Preface

Product Overview 1–1

Purpose of This Manual 1–2

Intended Audience 1–2

Manual Contents 1–2

What's New in This Manual 1–3

Technical Support 1–3

Supported Products 1–4

Product Information 1–4

Analog Devices Website 1–4

EngineerZone 1–4

Notation Conventions 1–4

Using the HDMI Audio EI3 EZ-Extender

Package Contents 2–1

HDMI Audio EI3 EZ-Extender Default Configuration 2–2

HDMI Audio EI3 EZ-Extender Setup 2–2

Analog Interface 2–3

Video Interface 2–4

Example Programs 2–4

HDMI Audio EI3 EZ-Extender Hardware Reference

System Architecture 3–1

Software-Controlled Switches (SoftConfig) 3–3

Overview of SoftConfig 3–4
SoftConfig on the EZ-Extender 3–7
Programming SoftConfig Switches 3–7
Switches 3–9
Audio Loopback Switches (SW1-4, 6, 7) 3–10
Jumpers 3–10
I/O Voltage (JP8) 3–11
Board Power (JP9) 3–11
LEDs 3–11
HDMI Input Hot Plug Detect (LED1-4) 3–12
Power (LED5) 3–12
HDMI Output Hot Plug Detect (LED7-8) 3–12
Connectors 3–12
Expansion Interface III (1A, 1B, 1C, 2A and 3A) 3–13
RCA Audio (J2-7) 3–13
HDMI (P2-7) 3–14

HDMI Audio EI3 EZ-Extender Bill Of Materials

1 Preface

Thank you for purchasing the HDMI Audio EI3 EZ-Extender®, Analog Devices, Inc. daughter board to an EZ-KIT® evaluation system.

The EZ-KIT and HDMI Audio EI3 EZ-Extender are designed to be used in conjunction with the CrossCore® Embedded Studio (CCES) 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 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.

Product Overview

The HDMI Audio EI3 EZ-Extender is a separately sold daughter board that plugs onto the expansion interface III of the EZ-KIT evaluation platform. The daughter board aids the design and prototyping phases of HDMI® HD audio decode/encode applications.

The board extends the capabilities of the evaluation system by providing a connection to three analog audio codecs, along with an HDMI transmitter/receiver.

The HDMI Audio EI3 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^2S modes at 48 kHz, 96 kHz, and 192 kHz sample rates

- HDMI Interface
  - ADV7625 HDMI transmitter/receiver
  - 8 channels of HD audio from HDMI (7.1 surround sound)
  - 4 HDMI inputs and 2 HDMI outputs
- Single-ended input/output
  - Twelve RCA phono jack inputs
  - Twenty four RCA phono jack outputs
- IR interface
  - HDMI CEC/remote control support

All of the power necessary to operate the extender can be provided from an external power supply (default) or from the mating EZ-KIT. Before using any of the interfaces, follow the setup procedure in HDMI Audio EI3 EZ-Extender Setup.

Purpose of This Manual

The *HDMI Audio EI3 EZ-Extender* describes operation and configuration of the extender board components. A schematic and a bill of materials are provided as a reference guide.

Intended Audience

This manual is a user's guide and reference to the HDMI Audio EI3 EZ-Extender. Programmers who are familiar with the Analog Devices 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, such as the *Hardware Reference* manual.

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

Manual Contents

The manual consists of:

- Chapter 1, Using the HDMI Audio EI3 EZ-Extender

  Provides basic board information.
- Chapter 2, HDMI Audio EI3 EZ-Extender Hardware Reference

  Provides information about the hardware aspects of the board.
- Appendix A, HDMI Audio EI3 EZ-Extender Bill Of Materials

Provides a list of components used to manufacture the board.

- HDMI Audio EI3 EZ-Extender Schematic

  A companion file in PDF format lists the resources for board-level debugging.

What's New in This Manual

This is the first revision of the *HDMI Audio EI3 EZ-Extender Manual*.

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***

  Choose ***Help*** > ***Email Support***. This creates an e-mail to processor.tools.support@analog.com and automatically attaches your CrossCore Embedded Studio version information and `license.dat` file.

- E-mail your questions about processors and processor applications to:

  processor.tools.support@analog.com

  processor.china@analog.com

- Contact your Analog Devices sales office or authorized distributor. Locate one at:

  http://www.analog.com/adi-sales

- Send questions by mail to:

```
Analog Devices, Inc.

One Technology Way

P.O. Box 9106

Norwood, MA 02062-9106
```

USA

Supported Products

The HDMI Audio EI3 EZ-Extender is designed as an extender board to any Analog Devices evaluation platform featuring the expansion interface III (EI3) .

Product Information

Product information can be obtained from the Analog Devices website and CCES online help.

Analog Devices Website

The Analog Devices website, http://www.analog.com, provides information about a broad range of products—analog integrated circuits, amplifiers, converters, and digital signal processors.

To access a complete technical library for each processor family, go to http://www.analog.com/processors/technical_library. 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.com is a free feature of the Analog Devices website that allows customization of a web page to display only the latest information about products you are interested in. You can choose to receive weekly e-mail notifications containing updates to the web pages that meet your interests, including documentation errata against all manuals. MyAnalog.com provides access to books, application notes, data sheets, code examples, and more.

Visit MyAnalog.com to sign up. If you are a registered user, just log on. Your user name is your e-mail address.

EngineerZone

EngineerZone is a technical support forum from Analog Devices, Inc. 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.

Notation Conventions

Text conventions used in this manual are identified and described as follows. Additional conventions, which apply only to specific chapters, may appear throughout this document.

Example	*Description*
File > Close	Titles in bold style indicate the location of an item within the CrossCore Embedded Studio IDE's menu system (for example, the ***Close*** command appears on the ***File*** menu).
`{this | that}`	Alternative required items in syntax descriptions appear within curly brackets and separated by vertical bars; read the example as `this` or `that`. One or the other is required.
`[this | that]`	Optional items in syntax descriptions appear within brackets and separated by vertical bars; read the example as an optional `this` or `that`.
`[this, …]`	Optional item lists in syntax descriptions appear within brackets delimited by commas and terminated with an ellipsis; read the example as an optional comma-separated list of `this`.
`.SECTION`	Commands, directives, keywords, and feature names are in text with `letter gothic` font.
`filename`	Non-keyword placeholders appear in text with `letter gothic` font and italic style format.
NOTE:	***NOTE:*** For correct operation, .. A note provides supplementary information on a related topic. In the online version of this book, the word ***NOTE:*** appears instead of this symbol.
CAUTION:	***CAUTION:*** Incorrect device operation may result if .. ***CAUTION:*** Device damage may result if .. A caution identifies conditions or inappropriate usage of the product that could lead to undesirable results or product damage. In the online version of this book, the word ***CAUTION:*** appears instead of this symbol.
ATTENTION:	***ATTENTION:*** Injury to device users may result if .. A warning identifies conditions or inappropriate usage of the product that could lead to conditions that are potentially hazardous for devices users. In the online version of this book, the word ***ATTENTION:*** appears instead of this symbol.

2 Using the HDMI Audio EI3 EZ-Extender

This chapter describes the HDMI Audio EI3 EZ-Extender contents, configuration, installation procedure, and analog audio interface.

The information is presented in the following order.

- Package Contents

  Describes the product's package contents.
- HDMI Audio EI3 EZ-Extender Default Configuration

  Describes the board's default configuration.
- HDMI Audio EI3 EZ-Extender Setup

  Provides the board's setup procedure.
- Analog Interface

  Describes the board's analog audio interface
- Video Interface

  Describes the board's video audio interface.
- Example Programs

  Describes the example programs installed with the board's software.

For more information about the mating processor on the EZ-KIT, see the processor's *Hardware Reference* manual.

Package Contents

Your HDMI Audio EI3 EZ-Extender package contains the following items.

- HDMI Audio EI3 EZ-Extender board
- 5V 3.6A power supply

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

HDMI Audio EI3 EZ-Extender Default Configuration

The HDMI Audio EI3 EZ-Extender board is designed to be used in conjunction with an EZ-KIT containing the EI3 (Expansion Interface III) connectors.

The following image shows the default settings, connector locations, and LEDs. Confirm that your board is in the default configuration before using the board.

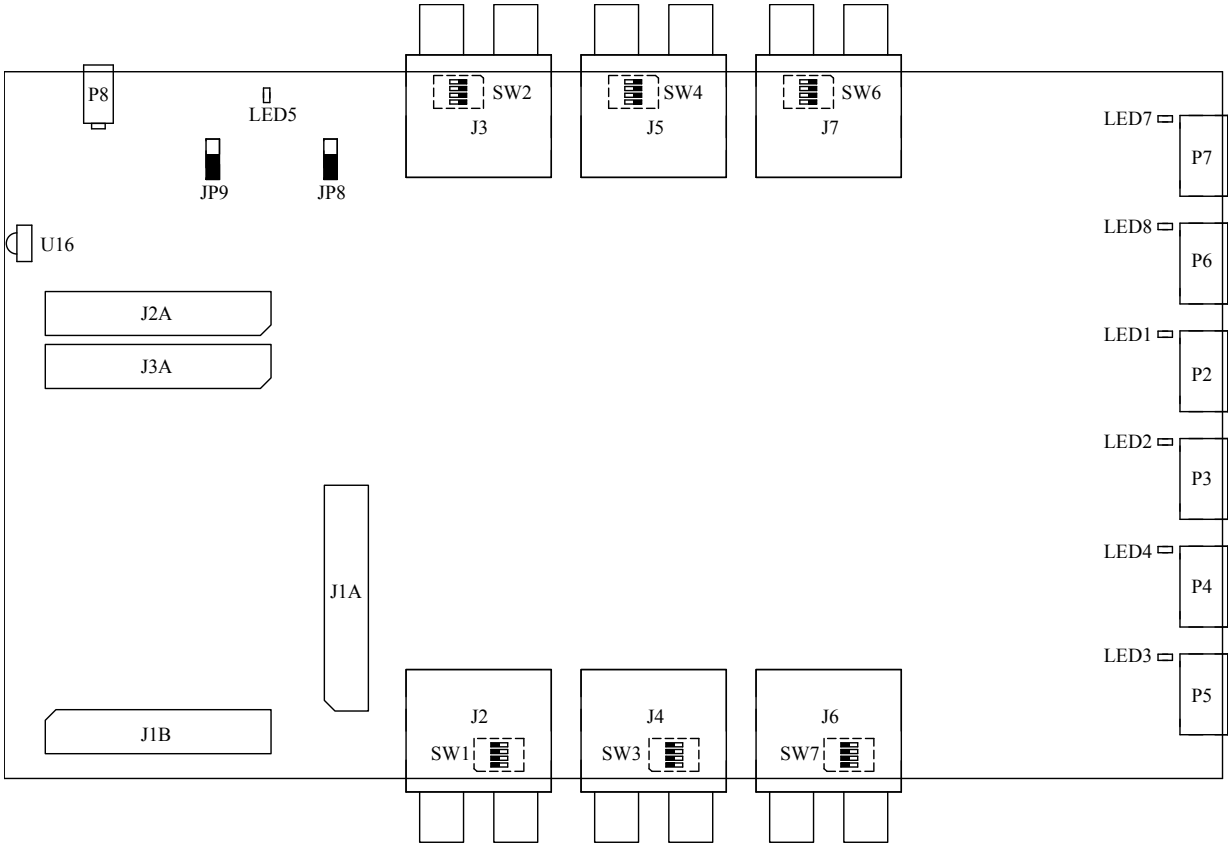

Figure 2-1: Default Configuration

HDMI Audio EI3 EZ-Extender Setup

It is important to set up all components of a system containing the HDMI Audio EI3 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 analog and video interface section in this chapter - the text provides an overview of the interface capabilities.
2. Read System Architecture to understand physical connections of the daughter board. For detailed information, refer to the *HDMI Audio EI3 EZ-Extender Schematic*.

3. Refer to the readme files in the `Examples` folder of the product installation directory. For custom setups, use System Architecture in conjunction with other information in the *HDMI Audio EI3 EZ-Extender Hardware Reference* chapter.

Analog Interface

The HDMI Audio EI3 EZ-Extender's analog audio interface is comprised of three Analog Devices AD1939 multi-channel 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 HDMI Audio EI3 EZ-Extender Default Configuration more details can be found in the ***HDMI Audio EI3 EZ-Extender Schematic***. The three codec chips (referred to as "AD1939A", "AD1939B", and "AD1939C") connect in parallel to the serial peripheral interface (SPI) port of the processor. The SPI port of the processor is used to adjust volume and other audio parameters of each codec.

The serial ports (SPORTs) are used to transmit and receive audio data to and from the processor. The analog audio channels are available via the single-ended RCA Audio (J2-7) connectors.

The SPORT 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^2S) 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^2S modes with all ADCs inputs and DACs outputs. Codecs B and C are wired on the extender and allow TDM mode operations only.

- At a 48 kHz sample rate, TDM mode provides 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.
- 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, refer to the AD1939 product documentation.

Video Interface

The HDMI Audio EI3 EZ-Extender's video interface is comprised of an ADV7625 transceiver.

The ADV7625 is a high-performance, five-input, dual-output, High-Definition Multimedia Interface (HDMI) transceiver with crosspoint and splitter capabilities. The ADV7625 supports 3 GHz video and features two independent HDMI receivers, two independent HDMI transmitters, two audio output ports, two audio input ports, and a pixel port input. The ADV7625 supports all HDCP repeater functions through fully-tested repeater software libraries and drivers from Analog Devices, Inc.

The HDMI receivers and transmitters in the ADV7625 support the reception and transmission of 3 GHz video formats up to 4k × 2k at 24 Hz/25 Hz/30 Hz, in addition to all mandatory HDMI 3D TV formats. The receivers and transmitters also provide support for THX® Media Director™.

Each HDMI receiver features an integrated equalizer that ensures robust operation of the interface with cable lengths up to 30 meters. The HDMI receivers share a 768-byte volatile extended display identification data (EDID) memory, which can facilitate one or two EDIDs, one for each receiver. Each HDMI port features dedicated 5 V detect and Hot Plug™ assert pins.

Each HDMI transmitter supports audio return channel (ARC) and features an integrated HDMI CEC controller that supports capability discovery and control (CDC).

The ADV7625 offers two audio output ports and two audio input ports. Each audio port supports the extraction and insertion of up to eight channels of audio data out of or into the HDMI streams. HDMI audio formats, including I2S, S/PDIF, direct stream digital (DSD), and high bit rate (HBR) audio are supported.

For more information about the ADV7625 transceiver, refer to the ADV7625 product documentation.

Example Programs

Example programs are provided with the HDMI Audio EI3 EZ-Extender 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 extender's Board Support Package (BSP).

3 HDMI Audio EI3 EZ-Extender Hardware Reference

This chapter describes the hardware design of the HDMI Audio EI3 EZ-Extender.

The following topics are covered.

- System Architecture

  Describes the board's configuration and explains how the board components interface with the processor and EZ-KIT.

- Switches

  Shows the locations and describes the on-board configuration switches.

- LEDs

  Shows the location and describes the on-board LEDs.

- Connectors

  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

The ***Block Diagram*** figure shows a block diagram of the product.

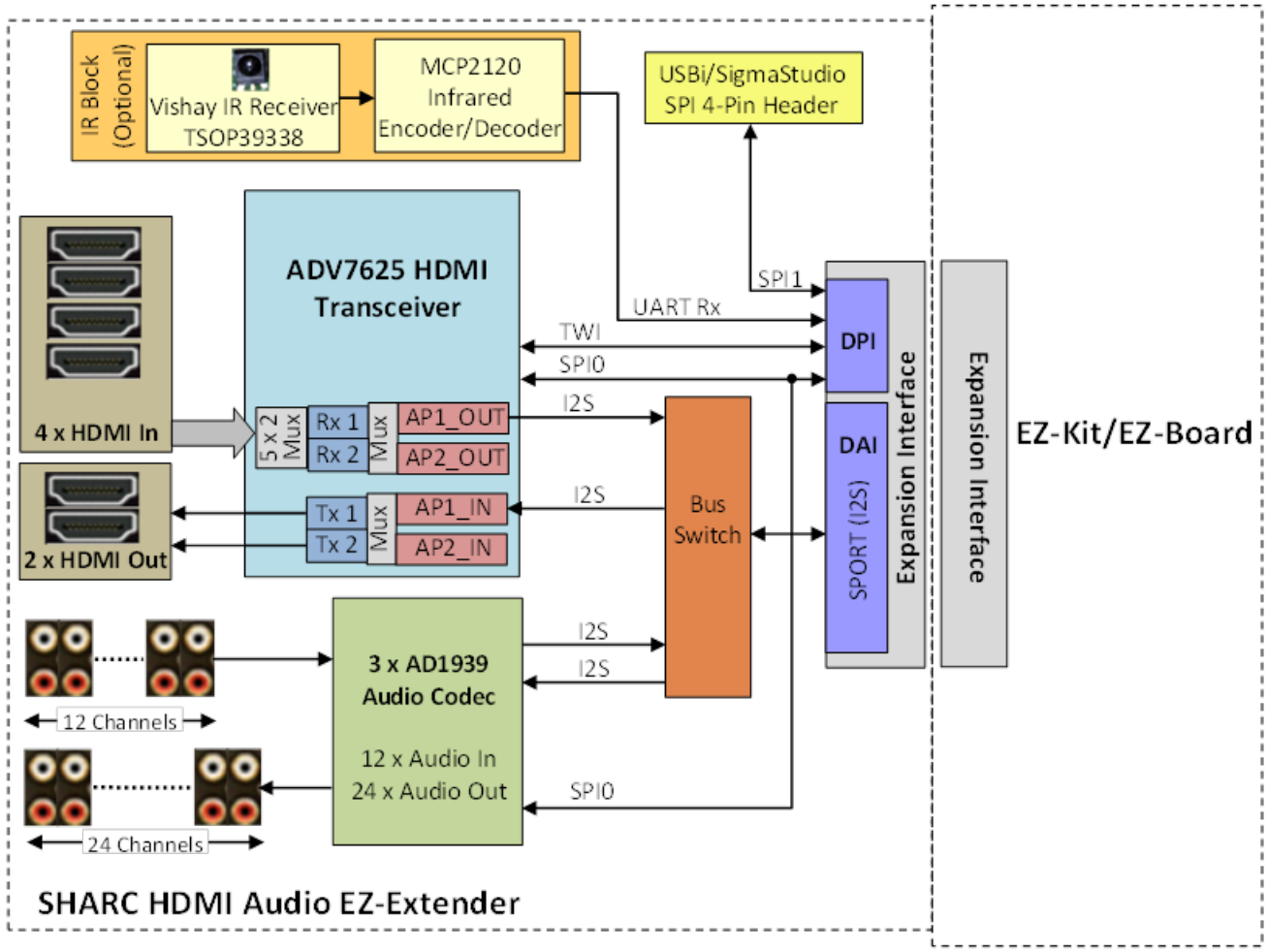

Figure 3-1: Block Diagram

The figure shows a block diagram of the audio and video interfaces; the diagram illustrates how the serial ports are interfaced to the processor, AD1939 codecs and ADV7625 on a mating EZ-KIT. 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 the *HDMI Audio EI3 EZ-Extender Schematic*.

The analog audio interface consists of three AD1939 audio codec ICs (referred to as “AD1939A”, “AD1939B”, and “AD1939C”), which use up to six serial ports (SPORTs) of the processor. All of the clock and frame sync signals of the processor are driven by the master AD1939 codec (AD1939A).

The master codec can run in either time-division multiplexed (TDM) mode or integrated interchip sound (I^2S) mode at a 48 KHz, 96 KHz, or 192 KHz sample rate in both modes using only two serial ports. Codecs B and C are connected to be slaves only and are hard-wired on the extender to run in dual-line TDM. Codecs B and C can run in conjunction with codec A, using six of the processor’s eight serial ports for dual-line TDM operation at a 192 KHz sample rate. In all cases, the processor is wired to be a slave, and the serial port clock and frame syncs are generated by the master codec (AD1939A).

The three AD1939s are configured using the SPI port of the processor. Each codec includes its own chip select pin. The ADV7625 registers are configured usign TWI and the OSD block is configured usign SPI.

The following table lists the four different modes the board can operate in. The mode of the board is configured via software, using SoftConfig. Refer to the example programs for more information on available modes.

Mode	Audio In			Audio Out		
	Device	Requires	Half SPORT	Device	Requires	Half SPORT
0 Digital In Analog Out	ADV7625 HDMI HDMI x 1 instance Digital Input	1 SCLK 1 LRCLK 4 I^2S data lines	2	AD1939 Audio CODEC x 3 instances Analog Output Up to 24 PCM Out channels	1 SCLK 1 LRCLK 12 I^2S data lines	6
1 Digital In Digital Out	ADV7625 HDMI HDMI x 1 instance Digital Input	1 SCLK 1 LRCLK 4 I^2S data lines	2	ADV7625 HDMI HDMI x 1 instance Digital Output	1 SCLK 1 LRCLK 4 I^2S data lines	2
2 Analog In Digital Out	AD1939 Audio CODEC x 3 instances Analog Input Up to 12 PCM In channels	1 SCLK 1 LRCLK 6 I^2S data lines	3	ADV7625 HDMI HDMI x 1 instance Digital Output	1 SCLK 1 LRCLK 4 I^2S data lines	2
3 Analog In Analog Out	AD1939 Audio CODEC x 3 instances Analog Input Up to 12 PCM In channels	1 SCLK 1 LRCLK 6 I^2S data lines	3	AD1939 Audio CODEC x 3 instances Analog Output Up to 24 PCM Out channels	1 SCLK 1 LRCLK 12 I^2S data lines	6

Software-Controlled Switches (SoftConfig)

On the EZ-KIT, most of the traditional mechanical switches have been replaced by I^2C software-controlled switches. The remaining mechanical switches are provided for boot modes and push buttons. Reference any `SoftConfig*.c` file found in the installation directory for an example of how to set up the SoftConfig feature of the EZ-KIT through software.

The SoftConfig section of this manual serves as a reference to any user that intends to modify an existing software example. If Analog Devices provided software is used, there should be little need to reference this section.

NOTE: Care should be taken when changing SoftConfig settings not to create a conflict with interfaces. This is especially true when connecting extender cards.

Overview of SoftConfig

In order to further clarify the use of electronic single FET switches and multi-channel bus switches, an example of each is illustrated and compared to a traditional mechanical switching solution. This is a generic example that uses the same FET and bus switch components that are on the EZ-KIT.

After this generic discussion, there is a detailed -explanation of the SoftConfig interface specific to the EZ-KIT.

The circuit in the following figure shows two individual FET switches (Pericom PI3A125CEX) with reference designators UA and UB. Net names ENABLE_A and ENABLE_B control UA and UB. The default FET switch-enable settings in this example are controlled by resistors RA and RB, which pull the enable pin 1 of UA and UB to ground (low). In a real example, these enable signals are controlled by the Microchip IO expander. The default pull-down resistors connect the signals EXAMPLE_SIGNAL_A and EXAMPLE_SIGNAL_B and also connect signals EXAMPLE_SIGNAL_C and EXAMPLE_SIGNAL_D. To disconnect EXAMPLE_SIGNAL_A from EXAMPLE_SIGNAL_B, the Microchip IO expander is used to change ENABLE_A to a logic 1 through software that interfaces with the Microchip. The same procedure for ENABLE_B disconnects EXAMPLE_SIGNAL_C from EXAMPLE_SIGNAL_D.

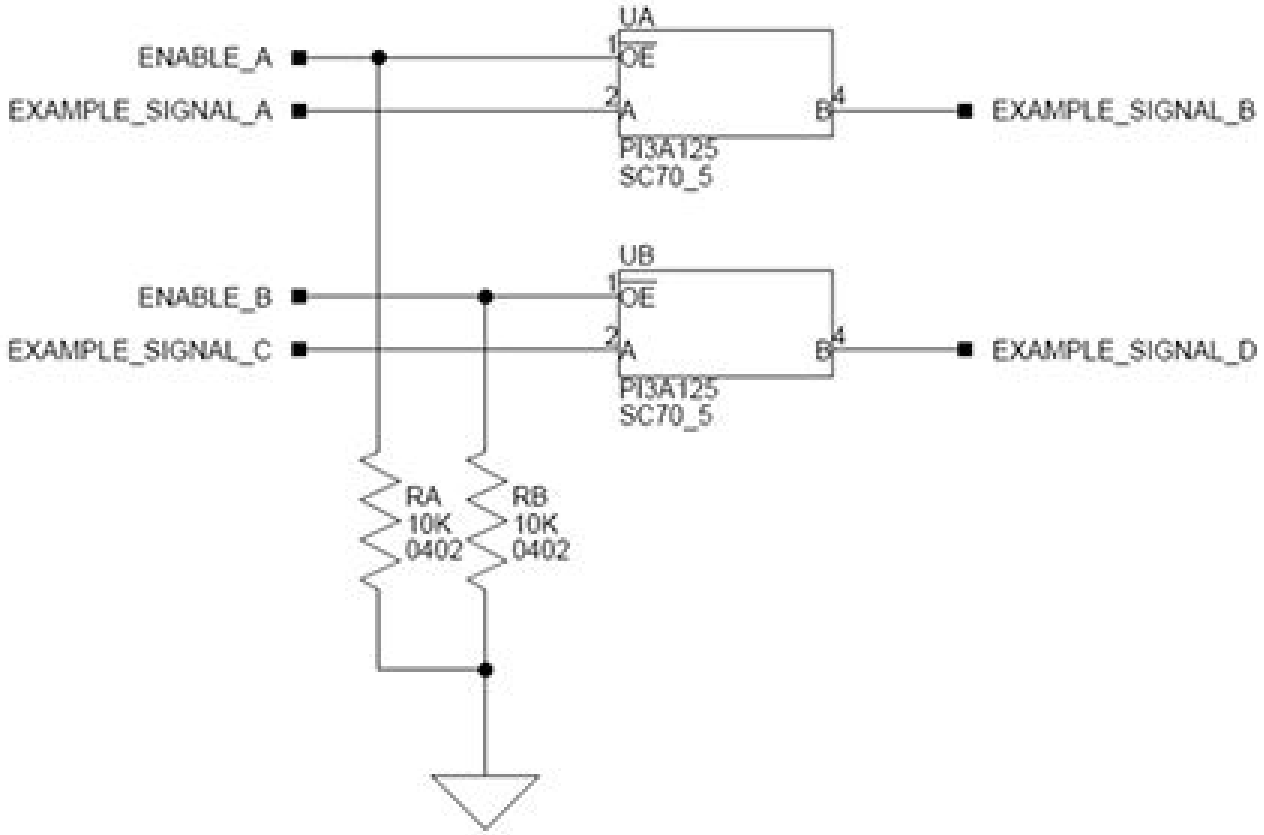

Figure 3-2: Example of Individual FET Switches

The following figure shows the equivalent circuit as above but utilizes mechanical switches that are in the same package. Notice the default is shown by black boxes located closer to the ON label of the switches. In order to disconnect these switches, physically move the switch to the OFF position.

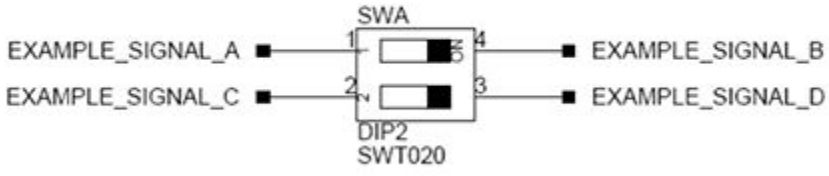

Figure 3-3: Example of Mechanical Switch (equivalent to the previous figure)

The circuit in the following figure shows a bus switch example, reference designator UC (Pericom PI3LVD512ZHE), selecting between lettered functionality and numbered functionality. The signals on the left side are multiplexed signals with naming convention letter_number. The right side of the circuit shows the signals separated into letter and number, with the number on the lower group (0B1) and the letter on the upper group (0B2). The default setting is controlled by the signal CONTROL_LETTER_NUMBER, which is pulled low. This selects the number signals on the right to be connected to the multiplexed signals on the left by default. In this example, the Microchip IO expander is not shown but controls the signal CONTROL_LETTER_NUMBER and allows the user to change the selection through software.

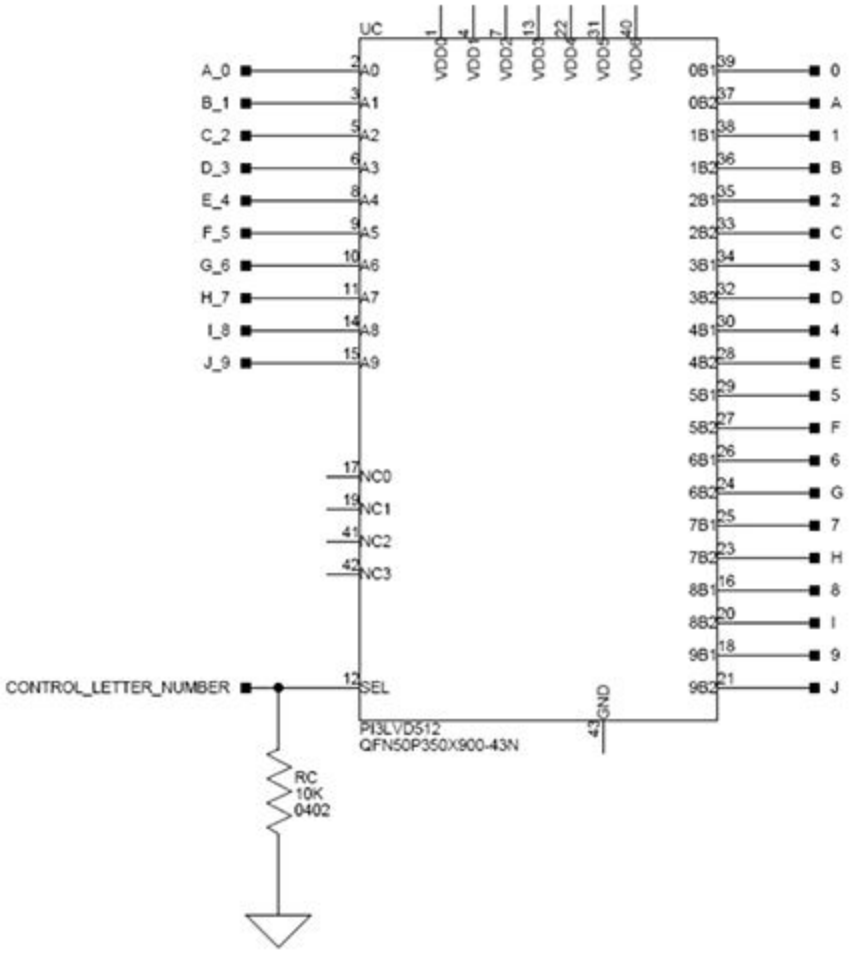

Figure 3-4: Example of Bus Switch

The following figure shows the equivalent circuit (as in the previous figure) but utilizes mechanical switches. Notice the default for reference designators SWC and SWD is illustrated by black boxes located closer to the ON label of the switches to enable the number signals by default. Also notice the default setting for reference designators SWE and SWF is OFF. In order to connect the letters instead of the numbers, the user physically changes all switches on SWC and SWD to the OFF position, and all switches on SWE and SEF to the ON position.

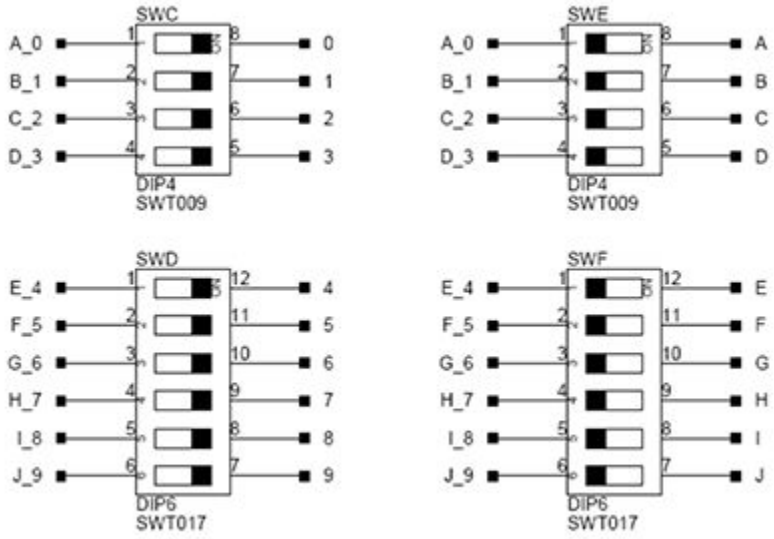

Figure 3-5: Example of Mechanical Switch (equivalent to the previous figure)

SoftConfig on the EZ-Extender

One Microchip MCP23017 GPIO expander provides control for the individual electronic switches. The TWI0 interface of the processor communicates with the Microchip devices.

Note that only interfaces affected by software switches are listed.

Programming SoftConfig Switches

On the extender, one Microchip MCP23017 device exists. The device has the following programming characteristics.

Each switch has two programmable GPIO registers.

GPIO Register	Register Address
GPIOA	0x12
GPIOB	0x13

Each GPIO register controls eight signals (software switches).

- By default, the Microchip MCP23017 GPIO signals function as input signals.
- The signals must be programmed as output signals to override their default values. The following table shows the Microchip register addresses and the values that must be written to them to program the signals as output signals.

IODIR Register	IODIR Register Address	Value to be Written to Program Signals as Outputs
IODIRA	0x00	0
IODIRB	0x01	0

Each of the examples in the ADSP-SC58x Board Support Package includes source files that program the soft switches, even if the default settings are being used. The README for each example identifies only the signals that are being changed from their default values. The code that programs the soft switches is located in the SoftConfig_SC589.c file in each example.

The following table outlines the default values for the Microchip MCP23017 device.

GPIO	MCP23017 Register Address	Default Value
GPIOA	0x12	0xBE
GPIOB	0x13	0xFC

The extender schematic shows how the Microchip GPIO expander is connected to the board's ICs.

The following tables show the output signals of the Microchip GPIO expander (U47), with a TWI address of 0100 001X, where X represents the read or write bit. The signals that control an individual FET have an entry under the FET column. The Component Connected column shows the board IC that is connected if the FET is enabled. The Microchip (U47) is controlling the enable signal of a FET switch. Also note that if a particular functionality of the processor signal is being used, it will be in bold font under the Processor Signal column.

Table 3-1: Output Signals of Microchip GPIO Expander (U47 Port A)

Bit	Signal Name	Description	FET	Processor Signal	Component Connected	Default
0	HDMI_AUDIO_MODE0	Digital In Analog Out	U3	NA	U17-19, U21	Low
1	HDMI_AUDIO_MODE1	Digital In Digital Out	U2	NA	U17-19, U21	High
2	HDMI_AUDIO_MODE2	Analog In Digital Out	U4	NA	U17-19, U21	High
3	HDMI_AUDIO_MODE3	Analog In Analog Out	U1	NA	U17-19, U21	High
4	SPORT_CLK_FS_EN	Frame Sync Enable	U15,U74-76	SPORT FS	U78	Low
5	AD1939_OSC_AD1939_CLKIN	AD1939 CLKIN	U80	NA	U6	High

Table 3-1: Output Signals of Microchip GPIO Expander (U47 Port A) (Continued)

Bit	Signal Name	Description	FET	Processor Signal	Component Connected	Default
6	HDMI_TXMCLK_AD1939_CLKIN	AD1939 CLKIN	U81	NA	U6	Low
7	$\overline{\text{POWERUP\_RESET\_EN}}$	AD1939 RESET	U82	NA	U73	Low

Table 3-2: Output Signals of Microchip GPIO Expander (U47 Port B)

Bit	Signal Name	Description	FET	Processor Signal	Component Connected	Default
0	AD1939A_ABCLK_DBCLK_LPBK	Clock Loopback	U83	NA	U17	Low
1	AD1939A_ALRCLK_DLRCLK_LPBK	Clock Loopback	U84	NA	U17	High
2	HDMI_RXSCLK_TXSCLK_LPBK	Clock Loopback	U85	NA	U21	High
3	HDMI_RXLRCLK_TXLRCLK_LPBK	Clock Loopback	U86	NA	U21	High

Switches

This section describes operation of the configuration switches. Before using the HDMI Audio EI3 EZ-Extender, follow the steps documented in the readme text files in the `Examples` folder of the installation directory.

The switch locations are shown in the following figure. Switches on the bottom side of the extender board are shown with a dashed line.

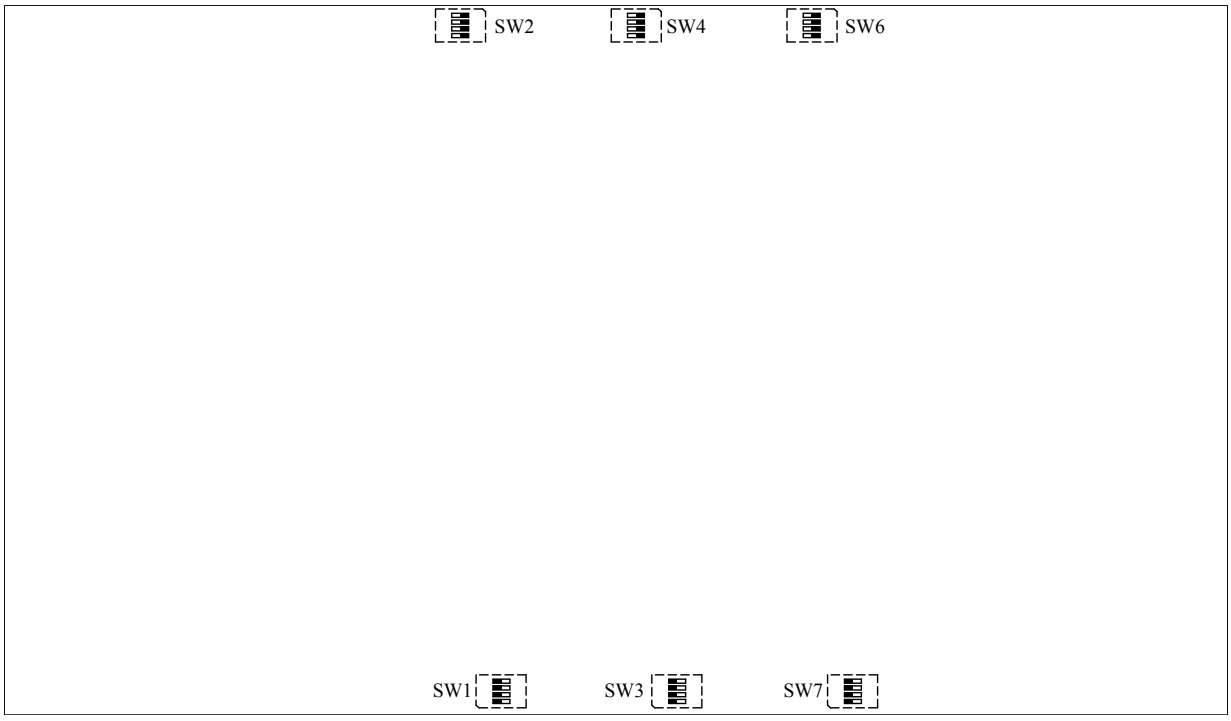

Figure 3-6: Switch Locations

Audio Loopback Switches (SW1-4, 6, 7)

The audio loopback switches (`SW1-4, 6, 7`) are intended for test purposes only. The switches loop-back any analog output signal, generated from an AD1939 codec's digital-to-analog converter (DAC) circuit to analog-to-digital converter (ADC) circuit:

- `SW1-2` are designed for the master codec (AD1939A)
- `SW3-4` are designed for the secondary codec (AD1939B)
- `SW6-7` are designed for the third codec (AD1939C)

By default, all of the switches are set to `OFF`.

Jumpers

This section describes operation of the configuration jumpers. Before using the HDMI Audio EI3 EZ-Extender, follow the steps documented in the readme text files in the `Examples` folder of the installation directory.

The jumper locations are shown in the following figure.

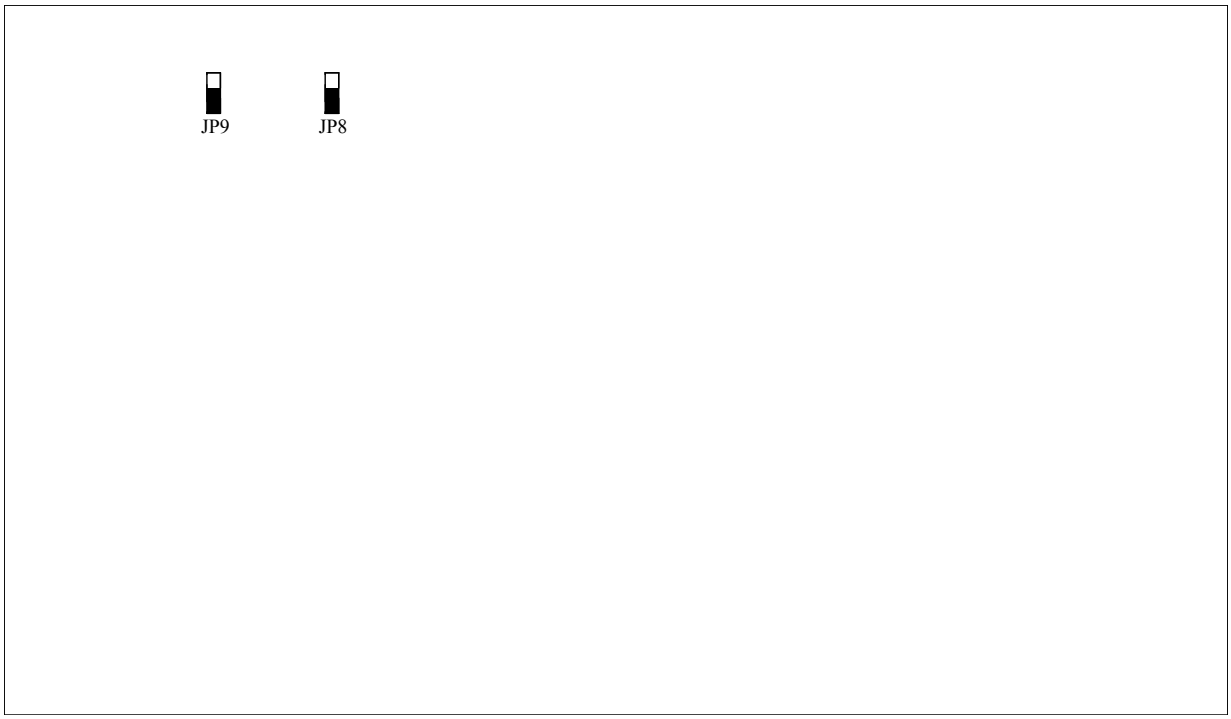

Figure 3-7: Jumper Locations

I/O Voltage (JP8)

The jumper is used to select the IO voltage for the signal buffers, which are on the EI3 connectors. The following table shows the different configurations.

Installed Jumper	Power Source
1 and 2	3.3V (default)
2 and 3	EZ-KIT `VDDIO`

Board Power (JP9)

The jumper is used to select the main power source for the HDMI Audio EI3 EZ-Extender. The following table shows the different configurations.

Installed Jumper	Power Source
1 and 2	External power(default)
2 and 3	Powered from EZ-KIT

LEDs

This section describes operation of the LEDs. Before using the HDMI Audio EI3 EZ-Extender, follow the steps documented in the readme text files in the `Examples` folder of the installation directory.

The LED locations are shown in the following figure.

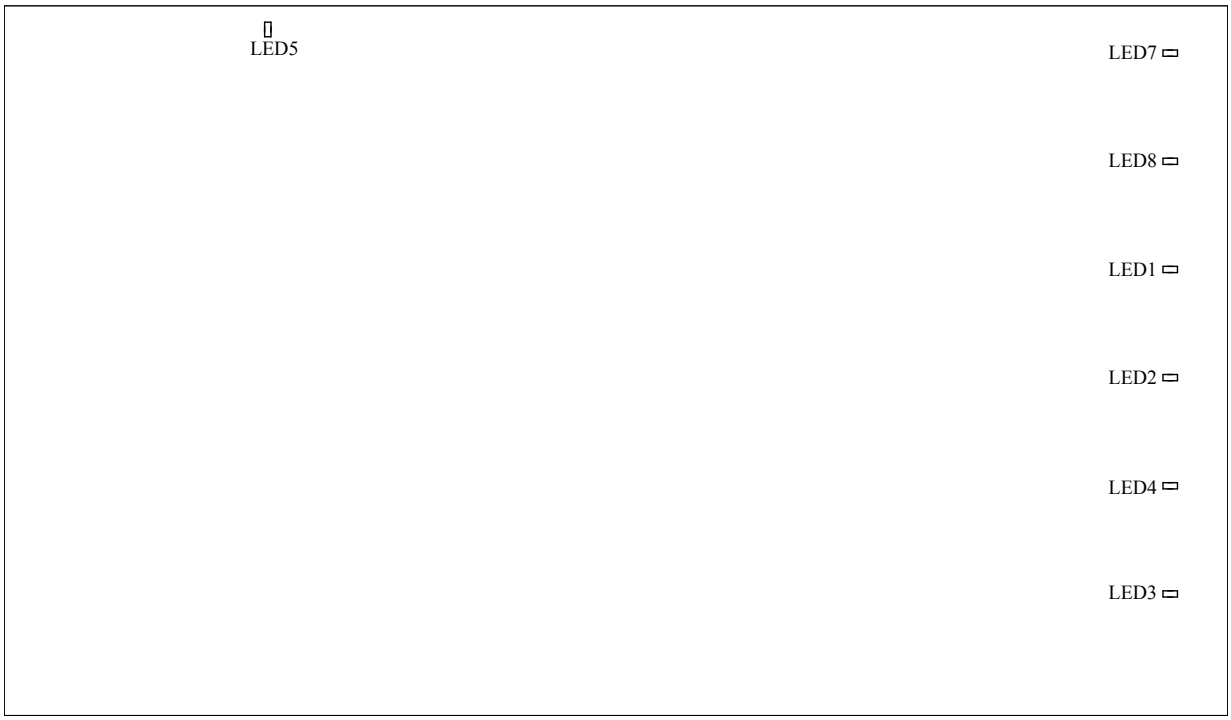

Figure 3-8: LED Locations

HDMI Input Hot Plug Detect (LED1-4)

The LEDs (LED1-4) are used to detect when an HDMI cable is connected to an HDMI input connector (P2-5).

Power (LED5)

The LED (LED5) is ON (green) when power is properly supplied to the board.

HDMI Output Hot Plug Detect (LED7-8)

The LEDs (LED7-8) are used to detect when an HDMI cable is connected to an HDMI output connector (P6-7)

Connectors

This section describes operation of the connectors. Before using the HDMI Audio EI3 EZ-Extender, follow the steps documented in the readme text files in the `Examples` folder of the installation directory.

The connector locations are shown in the following table.

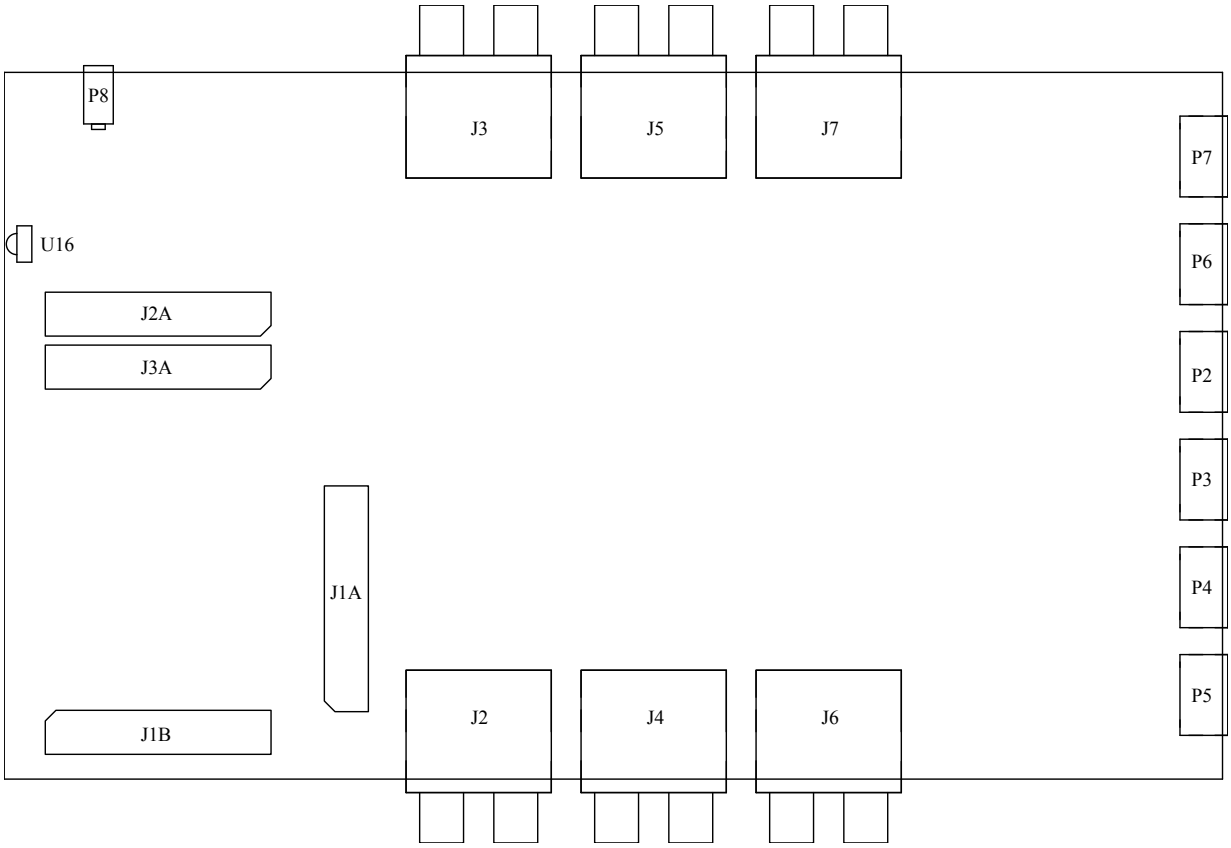

Figure 3-9: Connector Locations

Expansion Interface III (1A, 1B, 1C, 2A and 3A)

The expansion interface connectors (`1A`, `1B`, `1C`, `2A`, and `3A`) are for mating with the EZ-KIT.

Part Description	*Manufacturer*	*Part Number*
120-position 0.6mm	Hirose	FX8-120S-SV(21)
Mating Connector		
120-position 0.6mm	Hirose	FX8-120P-SV1(91)

RCA Audio (J2-7)

The RCA audio connectors (`J2-7`) provide the interface to the analog audio channels.

Part Description	*Manufacturer*	*Part Number*
RCA 2 x 3	KYOYAKU ENT	WSP-256V1-09
Mating Cable		
6' RCA audio cable	CABLESTOGO	03171

HDMI (P2-7)

The HDMI connectors (P2–7) provide the interface to and are intended for an evaluation of the AD1939 codecs via XLR connectors. A standard, off-the-shelf DB25 connector to XLR cables is required.

Part Description	*Manufacturer*	*Part Number*
HDMI Receptacle	FCI	10029449-002TLF
Mating Connector		
1m HDMI Cable	CABLESTOGO	12087

4 HDMI Audio EI3 EZ-Extender Bill Of Materials

The bill of materials corresponds to the *HDMI Audio EI3 EZ-Extender Schematic*.

Qty	Description	Reference Designator	Manufacturer	Part Number
4	BSS123 SOT23D	Q1-Q4	FAIRCHILD	BSS123
1	12.288MHZ OSC003	U5	EPSON (R)	SG-8002CA MP
2	SN74LVC1G125 SOT23-5	U71,U72	TI (R)	74LVC1G125DBVRE4
1	SN74LVC1G08 SOT23-5	U73	TI (R)	SN74LVC1G08DBVE
6	SN74AVC8T245 TSSOP24	U11-U14,U77,U78	TI (R)	SN74AVC8T245PW
9	IDT5T30553 SOIC8	U6-U10,U15,U74-U76	IDT (R)	5T30553DCG
1	28.6363MHZ OSCJ850P1140X470-4	Y1	DIGI KEY	300-8572-1-ND
7	74CBTLV1G125 SC70_5	U80-U86	TI (R)	SN74CBTLV1G125DCKR
1	MCP23017 QFN65P600X600-29N	U79	DIGI-KEY (R)	MCP23017-E/ML-ND
1	TSOP39338 TSOP39338	U16	DIGIKEY	751-1390-5-ND
1	DB3X314K0L SOT95P280-3N	D27	PANASONIC	DB3X314K0L
4	PI5C16210AE TSSOP48	U1-U4	PERICOM (R)	PI5C16210AE
1	MCP2120 SOIC14	U20	MICROCHIP (R)	MCP2120-I/SL
1	7.3728MHZ OSC012	U70	DIGI-KEY	535-9273-2-ND
1	ADP1706-1.8V LFCSP8	VR1	ADI (R)	ADP1706ACPZ-1.8-R7
1	ADP1706-3.3V LFCSP8	VR2	ADI (R)	ADP1706ACPZ-3.3-R7
3	AD1939YSTZ LQFP64	U17-U19	ADI (R)	AD1939YSTZ
48	AD8652ARZ SOIC_N8	U22-U69	ADI (R)	AD8652ARZ
2	ADP1715 MSOP8	VR3,VR4	ADI (R)	ADP1715ARMZ-3.3-R7
1	ADV7625KBCZ-8-U2 BGA260C80P18X18_1500X1500	U21	ANALOG	ADV7625KBCZ-8

Qty	Description	Reference Designator	Manufacturer	Part Number
6	DIP4 SWT018	SW1-SW4,SW6,SW7	ITT	TDA04HOSB1
1	3A RESETABLE FUS004	F1	TYCO ELECT (R)	SMD300F-2
1	PWR .65MM CON045	P8	DIGI-KEY (R)	CP1-023-ND
2	IDC 3X1 IDC3X1_SMT	JP8,JP9	SAMTEC (R)	TSM-103-01-T-SV
6	RCA 2x3 CON_RCA_6B	J2-J7	KYOYAKU ENT.	WSP-256V1-09H
6	HDMI 19P FCI_10029449-002TLF	P2-P7	FCI	10029449-002LF
4	0.6MM 120PIN HIROSE_FX8-120S-SV(21)	J1A-J3A,J1B	HIROSE (R)	FX8-120S-SV(21)
2	0 1/4W 5% 1206	R590,R596	KOA (R)	0.0ECTRk7372BTTED
2	600 500MA 1206	FER2,FER3	LAIRD TECH	HZ1206B601R-10
1	10K 31MW 5% RNET8	RN1	CTS	746X101103JP
1	190 5A FER002	FER4	MURATA (R)	DLW5BSN191SQ2
15	10UF 6.3V 10% 0805 X5R	C21,C111,C297,C318,C353,C356,C359,C360,C363,C364,C395,C402,C460,C461,C466	AVX CORPOR (R)	08056D106KAT2A
114	0.1UF 10V 10% 0402 X5R	C27,C34,C36,C37,C41,C43,C46,C47,C51,C63-C66,C72-C74,C77,C86-C88,C91,C100-C102,C106,C129,C131,C132,C136,C138,C141,C142,C146,C158-C161,C167-C169,C172,C181-C183,C186,C195-C197,C201,C211,C215,C216,C219,C224,C228,C229,C232,C235-C238,C271,C273-C275,C288,C289,C2	AVX CORPOR (R)	0402ZD104KAT2A
71	0.01UF 16V 10% 0402 X7R	C4-C18,C26,C114,C119-C124,C206-C209,C249-C262,C264,C272,C276-C287,C290,C292,C294,C304,C339,C350,C362,C386,C394,C396-C401,C404	AVX CORPOR (R)	0402YC103KAT2A

Qty	Description	Reference Designator	Manufacturer	Part Number
35	10K 1/16W 5% 0402	R1,R2,R101,R111,R131, R162,R257,R284,R287, R288,R293,R296,R297, R311-R314,R316,R317,R324, R333,R508,R510,R511, R513,R518-R520,R524,R525,R571, R591,R593,R713,R714	VISHAY (R)	CRCW040210K0FKED
6	10K 1/16W 5% 0402	R42,R47,R261,R282,R283,R594	VISHAY (R)	CRCW040210K0FKED
4	4.7K 1/16W 5% 0402	R564,R585-R587	DIGI-KEY (R)	541-4.7KJTR-ND
1	0 1/10W 5% 0402	R583	PANASONIC (R)	ERJ-2GE0R00X
25	0 1/10W 5% 0402	R17,R96,R509,R530,R531,R553,R556-R563,R565-R568,R570,R582,R584, R588,R589,R592,R722	PANASONIC (R)	ERJ-2GE0R00X
78	33 1/16W 5% 0402	R3-R5,R7-R15,R19,R30-R36,R58,R71,R75,R97,R98,R102,R107,R110,R125-R128,R130,R138,R147, R161,R163,R164,R166, R167,R174,R183,R197-R200,R202,R203,R210, R221,R222,R227,R233, R244,R499,R512,R514, R521-R523,R526,R528,R529, R532-R535,R543-R548,R551,R552,R578, R597,R599	VISHAY (R)	CRCW040233R0JNED
3	4.7K 31MW 5% RNET8	RN2-RN4	CTS	746X101472JP
3	100UF 10V 10% C TANT-LOW-ESR	CT2,CT39,CT81	AVX CORPOR (R)	TPSC107K010R0075
4	2.2UF 10V 10% 0805 X5R	C28,C29,C372,C373	AVX CORPOR (R)	0805ZD225KAT2A
1	1A SK12 DO-214AA	D25	DIODES INC (R)	B120B-13-F
6	0.1UF 16V 10% 0603 X7R	C22,C23,C115,C116,C391,C392	AVX CORPOR (R)	0603YC104KAT2A
4	1UF 16V 10% 0603 X5R	C266-C269	DIGI-KEY (R)	399-5090-2-ND
4	10K 1/10W 5% 0603	R487,R488,R491,R493	VISHAY (R)	CRCW060310K0JNEA

Qty	Description	Reference Designator	Manufacturer	Part Number
2	10K 1/10W 5% 0603	R715,R721	VISHAY (R)	CRCW060310K0JNEA
7	330 1/10W 5% 0603	R219,R484,R485,R494, R496,R712,R718	DIGI-KEY (R)	541-330GTR-ND
1	0.0 1/10W 1% 0603	R6	PHYCOMP (R)	232270296001L
24	237.0 1/10W 1% 0603	R40,R43,R51,R53,R62,R 64,R65,R67,R226,R229, R237,R239,R248,R250, R251,R253,R409,R413, R419,R420,R429,R433, R439,R440	DIGI-KEY (R)	311-237HRTR-ND
12	49.9K 1/10W 1% 0603	R37,R56,R73,R74,R223, R242,R259,R260,R412, R426,R432,R446	DIGI-KEY (R)	311-49.9KHRTR-ND
1	0.1 1/10W 1% 0603	R16	PANASONIC (R)	ERJ-3RSFR10V
3	562.0 1/10W 1% 0603	R29,R220,R598	VISHAY (R)	CRCW0603562RFKEA
3	390PF 25V 5% 0603 NPO	C24,C117,C390	AVX CORPOR (R)	06033A391FAT2A
3	5600PF 16V 5% 0805 NPO	C25,C118,C389	AVX CORPOR (R)	0805YA562JAT2A
132	4.99K 1/16W 1% 0603	R38,R41,R44,R48-R50,R59-R61,R68-R70,R76,R78,R79,R89,R91-R93,R109,R116,R117,R119-R121,R124,R133,R140, R152,R153,R155-R157,R160,R169,R176, R188,R189,R191-R193,R196,R205,R212, R224,R228,R230,R234-R236,R245-R247,R254-R256,R262,R264,R265, R275,R277-R279,R295,R302,	VISHAY (R)	CRCW06034K99FKEA
8	10UF 10V 10% 0805 X5R	C42,C137,C222,C263,C 291,C301,C387,C403	MURATA (R)	GRM21BR61A106KE19L
12	5.76K 1/10W 1% 0603	R39,R52,R63,R66,R225, R238,R249,R252,R410, R411,R430,R431	PANASONIC (R)	ERJ-3EKF5761V
1	10UF 16V 10% 1210 X5R	C2	AVX CORPOR (R)	1210YD106KAT2A
2	1000PF 50V 5% 1206	C1,C3	AVX CORPOR (R)	12065A102JAT2A
1	5A MBRS540T3G SMC	D26	ON SEMICON (R)	MBRS540T3G

Qty	Description	Reference Designator	Manufacturer	Part Number
6	47.0K 1/16W 1% 0402	R489,R490,R492,R498, R573,R574	ROHM	MCR01MZPF4702
3	1.0K 1/16W 1% 0402	R55,R241,R428	PANASONIC (R)	ERJ-2RKF1001X
7	10.0K 1/16W 1% 0402	R18,R20-R24,R26	DIGI-KEY (R)	541-10.0KLCT-ND
3	10.0K 1/16W 1% 0402	R25,R27,R28	DIGI-KEY (R)	541-10.0KLCT-ND
24	100K 1/16W 5% 0402	R104,R105,R134,R135, R170,R171,R206,R208, R290,R291,R320,R321, R356,R357,R392,R394, R451,R482,R623,R624, R670,R675,R706,R711	DIGI-KEY (R)	541-100KJTR-ND
4	22UF 6.3V 20% 1206 X7R	C470-C473	TDK (R)	C3216X5R0J226M
4	51.1 1/16W 1% 0402	R576,R577,R580,R581	DIGI-KEY	541-51.1LCT-ND
3	4.3 1/4W 5% 1206	R601-R603	PANASONIC (R)	ERJ-8GEYJ4R3V
48	2.67K 1/16W 1% 0402	R81,R83,R87,R103,R13 6,R137,R142,R146,R172 ,R173,R178,R182,R207, R209,R214,R218,R267, R269,R273,R289,R322, R323,R328,R332,R358, R359,R364,R368,R393, R395,R400,R404,R469, R473,R476,R477,R609, R613,R617,R618,R656, R660,R664,R665,R692, R696,R700,R701	PANASONIC (R)	ERJ-2RKF2671X
1	27K 1/16W 5% 0402	R569	PANASONIC (R)	ERJ-2GEJ273X
36	100.0 1/16W 1% 0402	R45,R46,R57,R72,R99,R 100,R118,R129,R154,R1 65,R190,R201,R231,R23 2,R243,R258,R285,R286 ,R304,R315,R340,R351, R376,R387,R414,R425, R434,R445,R479,R480, R620,R621,R667,R668, R703,R704	DIGI-KEY (R)	541-100LCT-ND
24	1000PF 50V 5% 0402 NPO	C30,C31,C35,C40,C45, C48,C53,C54,C125,C12 6,C130,C135,C140,C14 3,C148,C149,C214,C21 7,C220,C221,C227,C23 0,C233,C234	DIGI-KEY (R)	490-3244-1-ND

Qty	Description	Reference Designator	Manufacturer	Part Number
12	100PF 50V 5% 0402 COG	C33,C38,C44,C50,C128 ,C133,C139,C145,C212, C218,C225,C231	MURATA	GCM1555C1H101JA16D
12	300PF 100V 5% 0603 COG	C32,C39,C49,C52,C127 ,C134,C144,C147,C210, C213,C223,C226	DIGI-KEY	490-1362-2-ND
48	2.43K 1/16W 1% 0402	R80,R84,R88,R90,R113, R114,R143,R144,R149, R150,R179,R180,R185, R186,R215,R216,R266, R270,R274,R276,R299, R300,R329,R330,R335, R336,R365,R366,R371, R372,R401,R402,R466, R467,R471,R472,R606, R607,R611,R612,R653, R654,R658,R659,R689, R690,R694,R695	DIGI-KEY	541-2.43KLCT-ND
48	750.0 1/16W 1% 0402	R82,R85,R86,R108,R11 2,R115,R141,R145,R148 ,R151,R177,R181,R184, R187,R213,R217,R268, R271,R272,R294,R298, R301,R327,R331,R334, R337,R363,R367,R370, R373,R399,R403,R465, R468,R470,R474,R605, R608,R610,R614,R652, R655,R657,R661,R688, R691,R693,R697	DIGI-KEY	541-750LCT-ND
48	620PF 50V 5% 0402 COG	C56,C61,C62,C67,C69, C70,C75,C79,C83,C84, C89,C93,C97,C98,C103 ,C107,C151,C156,C157, C162,C164,C165,C170, C174,C178,C179,C184, C188,C192,C193,C198, C202,C240,C241,C245, C248,C406,C407,C410, C414,C419,C420,C423, C426,C433,C434,C437, C440	DIGI-KEY	490-3239-2-ND
48	680PF 50V 5% 0402 COG	C57,C58,C60,C68,C76, C78,C81,C82,C90,C92, C95,C96,C104,C105,C1	DIGI-KEY	490-3240-1-ND

Qty	Description	Reference Designator	Manufacturer	Part Number
		09,C110,C152,C153,C155,C163,C171,C173,C176,C177,C185,C187,C190,C191,C199,C200,C204,C205,C242,C243,C246,C247,C408,C411,C413,C416,C421,C422,C424,C425,C435,C436,C438,C439		
60	22UF 6.3V 20% ELEC_4MM ELEC	CT1,CT3-CT13,CT16,CT17,CT20,CT21,CT26,CT27,CT32,CT33,CT38,CT40-CT50,CT53,CT54,CT57,CT58,CT63,CT64,CT69,CT70,CT75-CT80,CT82-CT88,CT93,CT98,CT99,CT104,CT105,CT110,CT111	PANASONIC (R)	EEE-FC0J220R
24	22UF 6.3V 20% ELEC_5MM BIPOLAR	C55,C59,C71,C80,C85,C94,C99,C108,C150,C154,C166,C175,C180,C189,C194,C203,C239,C244,C409,C418,C431,C432,C445,C446	MOUSER	647-UWP0J220MCL
48	6.81K 1/10W 1% 0603	R77,R94,R95,R106,R122,R123,R132,R139,R158,R159,R168,R175,R194,R195,R204,R211,R263,R280,R281,R292,R308,R309,R318,R325,R344,R345,R354,R361,R380,R381,R390,R397,R447-R450,R625-R628,R671-R674,R707-R710	DIGI-KEY	311-6.81KHRTR-ND
3	806.0 1/10W 1% 0402	R54,R240,R427	VISHAY (R)	CRCW0402806RFKED
1	30A GSOT05 SOT23-3	D24	VISHAY (R)	GSOT05-E3-08
1	30A GSOT03 SOT23-3	D23	VISHAY (R)	GSOT03-GS08
1	GREEN LED_0603	LED5	DIGI-KEY (R)	475-1409-2-ND
7	4700PF 2A FIL_NFE61PT	FER5-FER9,FER12,FER13	DIGI-KEY (R)	490-2554-2-ND
2	887.0 1/10W 1% 0603	R575,R579	DIGIKEY	311-887HRTR-ND

Qty	Description	Reference Designator	Manufacturer	Part Number
18	5A RCLAMP0524 DIO_RCLAMP0524	D5-D22	SEMTECH	RCLAMP0524P.TCT
4	6A RCLAMP0504 DIO_RCLAMP0504	D1-D4	SEMTECH	RCLAMP0504P.TCT
4	2.0K 1/10W 1% 0402	R716,R717,R719,R720	PANASONIC (R)	ERJ-2RKF2001X
2	47PF 50V 5% 0603 COG	C265,C270	Yageo (R)	CC0603JRNP09BN470
3	100UF 6.3V 20% 1210 X5R	C19,C112,C388	DIGI-KEY	490-3390-2-ND
12	22PF 50V 5% 0402 NPO	C448-C459	DIGIKEY	311-1018-2-ND
6	YELLOW LED_0603	LED1-LED4,LED7,LED8	DIGI-KEY (R)	475-2558-1-ND
3	47UF 6.3V 20% 0805 X5R	C20,C113,C393	DIGIKEY	587-1779-2-ND
2	100 1/2W 1% 1210	R572,R595	PANASONIC (R)	ERJ14NF1000U