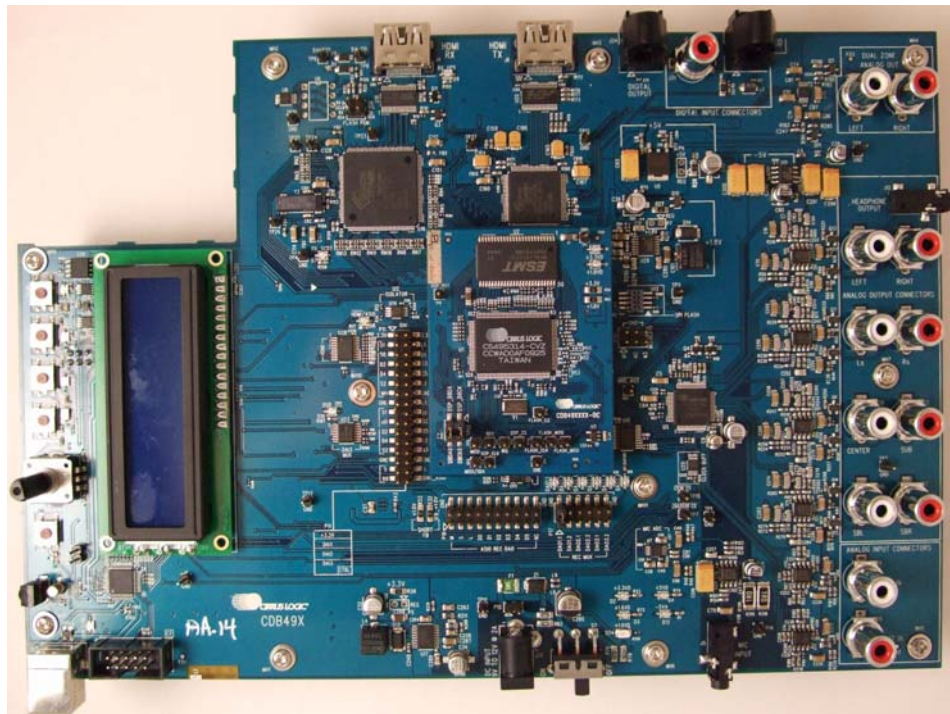


**CK49x**  
*Customer Kit*

# **CK49x–4953xx/ 4970x4**

## ***User's Manual***



*Preliminary Product Information*

This document contains information for a new product.  
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## Chapter 1

# Customer Kit Contents and Requirements

## 1.1 CK49x Customer Kit Contents

Table 1-1. CK49x Customer Kit Contents

Customer Kit	Item	Quantity
CK49x-49530 <sup>1</sup> CK49x-49531 CK49x-495303 <sup>1</sup> CK49x-495313 <sup>1</sup> CK49x-497024 CK49x-497014 <sup>4</sup>	CDB49x Evaluation Board <sup>2</sup>	1
CK49x-49530 <sup>1</sup>	DC49530 Daughter Card (128-pin package) with CS495304 DSP	1
CK49x-49531	DC49531 <sup>3</sup> Daughter Card (128-pin package) with CS495314 DSP	1
CK49x-495303 <sup>1</sup>	DC49503 Daughter Card (128-pin package) with CS495303 DSP	1
CK49x-495313 <sup>1</sup>	DC49513 Daughter Card (128-pin package) with CS495313 DSP	1
CK49x-497024	DC497024 Daughter Card (128-pin package) with CS497024 DSP	1
CK49x-497014 <sup>4</sup>	DC497014 Daughter Card (128-pin package) with CS497014 DSP	1
CK49x-49530 CK49x-49531 CK49x-495303 <sup>1</sup> CK49x-495313 <sup>1</sup> CK49x-497024 CK49x-497014 <sup>4</sup>	Power Supply: +9V, 2A, 100V - 240V with AC Power Cord	1
CK49x-49530 CK49x-49531 CK49x-495303 <sup>1</sup> CK49x-495313 <sup>1</sup> CK49x-497024 CK49x-497014 <sup>4</sup>	USB Cable (USB 2.0)	1
CK49x-49530 CK49x-49531 <sup>1</sup> CK49x-495303 CK49x-495313 <sup>1</sup> CK49x-497024 CK49x-497014 <sup>4</sup>	Document Card explaining how to get the latest board software	1

1. Not available for ordering.
2. In this manual, the main (large) board is called the "CDB49x Evaluation Board as shown in [Figure 1-1](#)." When a daughter card is installed on the CDB49x Evaluation Board as shown in [Figure 1-2](#), the board is then called the "CK49x Evaluation System"
3. DC49531 is being renamed to DC495314.
4. Use the DC497014 daughter card when implementing firmware other than firmware from DTS.



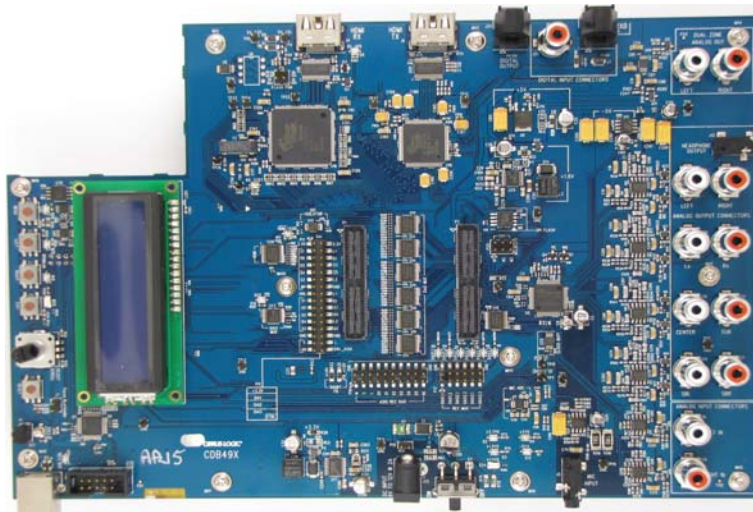


Figure 1-1. CDB49x Evaluation Base Board (without DC4953x Installed)

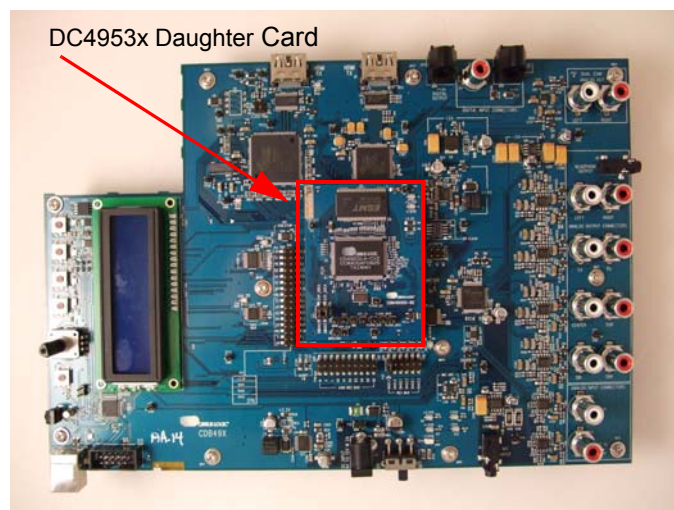


Figure 1-2. CK49x Evaluation System (CDB49x Evaluation Base Board (with DC4953x Installed))

## 1.2 Requirements

### 1.2.1 PC Requirements

- Microsoft® Windows XP® Operating System
- USB 2.0 Support

### 1.2.2 Software Requirements

- Cirrus Board Software Package (available from your local Cirrus Logic representative)

### 1.2.3 Support Hardware Requirements

- Digital or Analog Audio Source (for example, DVD player, PC with a digital audio card/device)
- Amplified Speakers for audio playback (for example, powered PC speakers, AVR/amp + speakers)

---

## 1.2.4 Cabling Requirements

- Digital Audio Inputs – HDMI cables, S/PDIF optical cables, RCA audio cables (Connect to digital audio card, audio analyzer, or DVD player), 20-pin ribbon cable (Play I<sup>2</sup>S audio from digital audio card)
- Digital Audio Output – HDMI cables, S/PDIF Optical cable, RCA audio cable (Connect to digital audio card, audio analyzer, or AV), 20-pin ribbon cable (Record I<sup>2</sup>S audio from digital audio card)
- Analog Audio Inputs – RCA audio cables (Connect CK49x line-level inputs to analog audio source)
- Analog Audio Outputs – RCA audio cables (Connect CK49x line-level outputs to powered speakers or AVR), 1/8" stereo headphone cable (Connect CK49x line-level output to headphones)

## 1.3 CK49x System Description

A block diagram of the CDB49x main board is shown in [Figure 1-3](#) and a block diagram of the DC4953x daughter card in [Figure 1-4](#). The sections that follow provide a detailed description of each block.

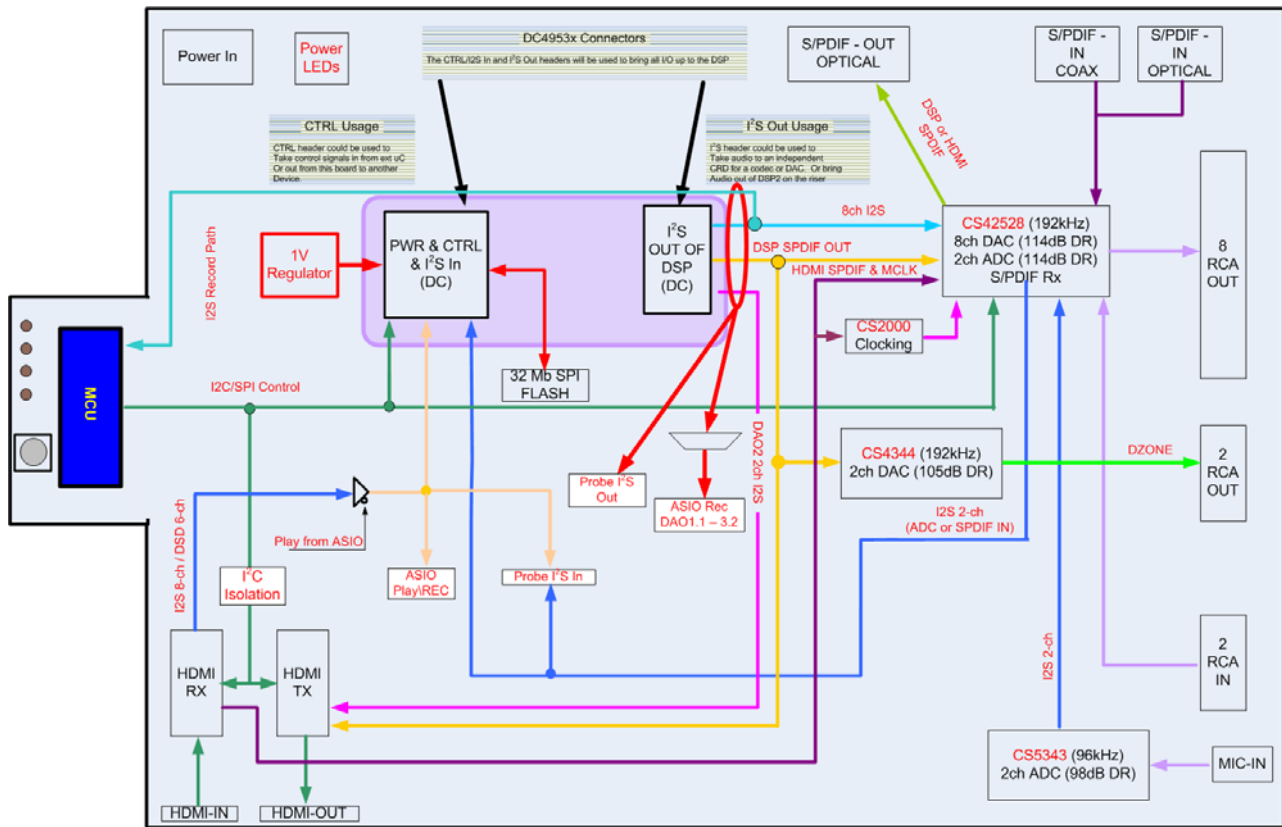


Figure 1-3. CDB49x Main Board Block Diagram

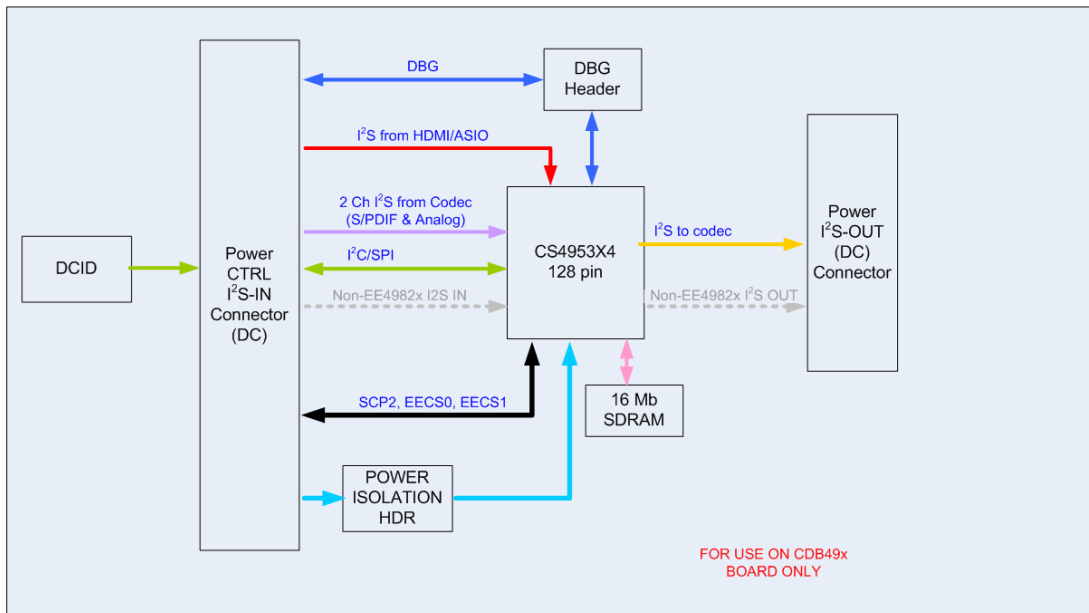


Figure 1-4. DC4953x Daughter Card Block Diagram

---

## 1.3.1 Audio Inputs

### 1.3.1.1 Analog Line-level Inputs

Analog line-level inputs have the following characteristics:

- Connector Type: RCA Female
- Absolute Maximum Signal Level: +12Vp-p
- Full Scale Amplitude: 2VRMS
- Reference Designators: J26,J28, or LEFT-IN, RIGHT-IN

### 1.3.1.2 HDMI Digital Input

HDMI digital inputs have the following characteristics:

- Connector Type: HDMI Type A Female
- Reference Designators: J4, or HDMI RX

### 1.3.1.3 Optical Digital Inputs

Optical digital inputs have the following characteristics:

- Connector Type: Fiber Optic RX for Digital Audio, JIS F05 (TOSLINK)
- Reference Designators: J8, or RX0

### 1.3.1.4 Coaxial Digital Inputs

Coaxial digital inputs have the following characteristics:

- Connector Type: RCA Female
- Maximum Signal Level: 5Vp-p
- Reference Designators: J31, or RX1

### 1.3.1.5 I<sup>2</sup>S Digital Input

Coaxial digital inputs have the following characteristics:

- Connector Type: 0.100" Male Header
- Maximum Signal Level: +3.3V
- Reference Designator: P3

### 1.3.1.6 Microphone Input

The microphone input has the following characteristics:

- Connector Type: 3.5mm (1/8") Stereo Female
- Absolute Maximum Signal Level: 14.3mVp-p
- Full Scale Amplitude: 6.5mVp-p
- Reference Designator: J5

---

## 1.3.2 Audio Outputs

### 1.3.2.1 Main Analog Line-level Outputs

Analog line-level outputs have the following characteristics:

- Connector Type: RCA Female
- Full Scale Amplitude: 2VRMS
- Reference Designators: J33-J40, or LEFT, RIGHT, Ls, Rs, CENTER, SUB, SBL, SBR

### 1.3.2.2 Headphone Output

Analog line-level outputs have the following characteristics:

- Connector Type: 3.5mm (1/8") Stereo Female
- Full Scale Amplitude: 2VRMS
- Reference Designators: J12, or HEADPHONE OUT

The headphone output shares the same Op Amp that drives Main LEFT/RIGHT outputs, which means that headphone content will always be the same as Main LEFT/RIGHT. Only one pair of outputs should be connected to a load - either HEADPHONE OUT or J34/J36.

### 1.3.2.3 Dual Zone Analog Line-level Outputs

Analog line-level outputs have the following characteristics:

- Connector Type: RCA Female
- Max Full Scale Amplitude: 1.23VRMS
- Reference Designators: J1, J10, or LEFT, RIGHT

### 1.3.2.4 HDMI Digital Output<sup>1</sup>

HDMI digital outputs have the following characteristics:

- Connector Type: HDMI Type A Female
- Reference Designators: J6, or HDMI TX

### 1.3.2.5 Optical Digital Output

The optical digital output has the following characteristics:

- Connector Type: Fiber Optic TX for Digital Audio, JIS F05 (TOSLINK)
- Reference Designator: J24, or DIGITAL OUTPUT

### 1.3.2.6 I<sup>2</sup>S Digital Output

I<sup>2</sup>S digital output has the following characteristics:

- Connector Type: 0.100" Male Header
- Maximum Signal Level: +3.3V
- Reference Designator: P12

---

1. HDMI Digital Output is not currently supported.

---

### 1.3.2.7 I<sup>2</sup>S Digital Output (DAO Mux Output)

I<sup>2</sup>S digital output has the following characteristics:

- Connector Type: 0.100" Male Header
- Maximum Signal Level: +3.3V
- Reference Designator: P16

### 1.3.3 DC Power Input

The DC power input has the following characteristics and is switched by S7:

- Voltage Range: +9V<sub>DC</sub> TO +12V<sub>DC</sub>
- Minimum Power: 18W supply (2A @ 9V)
- Connector Type: 2mm Female, positive center pin
- Reference Designator: J25

### 1.3.4 USB Connector

The control header has the following characteristics:

- Connector Type: USB Standard B Connector
- Reference Designator: J2

This connector is the interface between the CK49x and the PC.

### 1.3.5 MCU Programming Header

This header is used to program the MCU from a Silicon Labs programming dongle. This is not for customer use, and should be used only by Cirrus FAEs for upgrading the board.

- Connector Type: 0.100" Shrouded Male Header
- Reference Designator: J9

### 1.3.6 Reset button

The button S6 (located near the USB connector J2) is used to reset the MCU. In stand-alone mode this will re-initialize the entire board and start the stand-alone program over from the beginning.

In USB-control mode, this button will re-initialize the board and force the device to re-enumerate itself on the PC USB interface.

### 1.3.7 Buttons and Knobs

The buttons S1 - S4 (located near the LCD) are used for controlling the MCU when in stand-alone mode.

The knob S5 is also used for controlling the MCU when in stand-alone mode.

### 1.3.8 DAO MUX Select Header

The DAO outputs of the DSP are sent to a mux that drives I<sup>2</sup>S Digital Output header P16. The signals driven to P16 are selected by the Header P17. Only 1 shunt may be installed on header P17 at any time. Using more than 1 shunt will cause multiple buffers to drive their outputs simultaneously and cause contention.

The output buffer currently enabled is indicated by the LEDs D18 - D23.

### 1.3.9 DAI1 Audio Input Source Multiplexer

The audio input source multiplexer has the following characteristics:

- Source 0 [shunt removed]: HDMI RX I2S Audio
- Source 1 [shunt installed]: I<sup>2</sup>S Audio (ASIO I<sup>2</sup>S Board)
- Reference Designators: U15, U28

This multiplexer is controlled by pins 1-2 of header P4, and is used to select which audio source feeds the CS495xxx/CS497xxx DAI1 pins when the ASIO I<sup>2</sup>S Board is installed. When the on-board sources (HDMI RX) are being used, the ASIO audio data cannot be processed. Likewise, when the ASIO audio data source (ASIO I<sup>2</sup>S Board) is selected, the on-board audio inputs are disabled.

### 1.3.10 DAI2 Audio Input Source Multiplexer

The audio input source multiplexer has the following characteristics:

- Source 0: CS42528 Audio (ADC or S/PDIF)
- Source 1: Bi-Phase Encoded S/PDIF Signal
- Reference Designator: U23

This multiplexer is controlled by GPO1 of the CS42528 (U5), and is used to select which audio sources feed the CS495xxx/CS497xxx DAI2 pins. When the DSD audio from HDMI RX is being used, the CS42528 data cannot be processed. Likewise, when the CS42528 audio is selected, the HDMI RX DSD audio is disabled.

### 1.3.11 CS495xxx/CS497xxx Audio DSP

The audio DSP (U1 on DSP Daughtercard) is a dual-core processor designed specifically for audio applications. The CK49x allows a designer to evaluate the CS495xxx/CS497xxx DSPs in many different modes of multi-channel input and output. The 128-pin footprint on this board is compatible with any CS495xxx/CS497xxx chip that uses the LQFP128 package.

Audio input data to the DSP can come from any of the following sources:

- CS42528 Line-Level Analog In
- CS42528 Microphone Analog In
- CS42528 Digital S/PDIF In
- HDMI RX
- I<sup>2</sup>S Through ASIO I<sup>2</sup>S Board (feature not currently supported)

Audio output data from the DSP can be sent to the following destinations:

- CS42528 Line-Level Analog Output
- CS42528 Headphone Analog Output
- CS42528 Digital S/PDIF Out
- HDMI TX
- I<sup>2</sup>S Through Header P16

The CS4953xx/CS4970x4 has many applications stored in internal ROM, but a host is still required to configure the application for a particular system. The CK49x allows the PC to act as a host to boot and configure the DSP through the GUI software.

The DSP is booted primarily from external serial Flash (U13 on CDB49x) using the DSP Condenser system for simplified MCU control.

### 1.3.12 Debug Header

The DC49xxx daughtercard (DSP daughtercard) has a debug port (TP13) intended for factory testing of the DSP. By default, shunts are installed across the header to allow debug from the attached MCU. If the jumpers are removed, it is possible to debug the DSP using an external controller.

### 1.3.13 CS2000 Clock Synthesizer

The CS2000 (U25) is a high performance clocking device that is used to reduce jitter on recovered clocks through the use of a low-jitter PLL and clean reference clock. The CS2000 is used on this board to reduce the jitter on the MCLK recovered from an HDMI link.

The CS2000 can also be programmed to pass the reference clock (XTAL\_OUT from the DSP) directly to the CS42528 audio CODEC and S/PDIF RX.

### 1.3.14 CS42528 S/PDIF RX

The CS42528 (U5) has an integrated 192 kHz S/PDIF receiver with an input multiplexer. All of the S/PDIF sources on the board (RX0, RX1, DSP, U16) are connected to the CS42528 input multiplexer. The active S/PDIF signal is selected by changing the internal mux through the serial host port of the CS42528. This selection is controlled through the Audio In configuration within DSP Composer (see [Chapter 4, "Programming the DSP on the CK49x Evaluation Board"](#) for details).

When S/PDIF audio is being processed, the CS42528 must master MCLK for the system (see [Figure 1-6](#) for details).

### 1.3.15 CS42528 Audio CODEC

The CS42528 (U5) is a high-performance, multi-channel audio CODEC capable of supporting sample rates up to 192 kHz on its 2 ADCs and 8 DACs. This device is used for main-channel analog-to-digital and digital-to-analog conversions on the CK49x.

All analog inputs (J5, J26, J28) and 8 of the analog outputs (J33 - J40) are connected to the CS42528. The microphone input (J5) uses an external ADC (U7) to feed the dedicated ADC input of the CS42528. When the microphone is in use, a special TDM format is used to deliver the digitized microphone audio to the DSP via the SAI data output of the CS42528.

When analog audio is being processed, the 24.576 MHz crystal for the CS495xxx/CS497xxx must master MCLK for the system (see ["Audio Clocking on page 1-10"](#) for details).

### 1.3.16 CS4344 DAC

The CS4344 (U3) is a high-performance, 2-channel DAC capable of converting audio data with sample rates up to 192 kHz. This device is used for the dual-zone digital-to-analog conversions on the CK49x.

Analog outputs (J1, J10) are connected to the CS4344. The dual-zone DAC is connected to the DAO2 port of the CS495xxx/CS497xxx to allow up to 10 channels of simultaneous analog output.



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### 1.3.17 HDMI Receiver (RX)

The Silicon Image™ Si9135 HDMI Rx (U16) is used for the HDMI input on the CK49x. It can provide up to 4 lines of I<sup>2</sup>S data which can support PCM, legacy compressed audio (DD, DTS), and new HD audio streams.

Because the Si9135 responds to all I<sup>2</sup>C addresses, a bus isolator (U14) has been used to prevent the HDMI Rx from responding to serial communication intended for other devices on the CK49x.

### 1.3.18 HDMI Transmitter (TX)

The Silicon Image Si9134 HDMI Tx (U19) is used for the HDMI output on the CK49x.

**Note:** The HDMI Tx function is currently not supported on the CK49x.

Because the Si9134 responds to all I<sup>2</sup>C addresses, a bus isolator (U14) has been used to prevent the HDMI Tx from responding to serial communication intended for other devices on the CK49x.

### 1.3.19 Memory

The CDB49x is assembled with a 32-Mbit serial Flash (U13).

The CS495xxx/CS497xxx can use external SDRAM (U15 on DC4953x) to implement features such as large multi-channel audio delays. A 16 Mbit SDRAM (200 MHz) is connected to the 150 MHz memory bus of the CS495xxx/CS497xxx.

### 1.3.20 Audio Clocking

Clocking architecture is one of the most important aspects of an audio system. The input and output clock domains of the DSP must be synchronous when delivering audio data in an isochronous fashion (constant bit-rate delivery), even if the input/output domains operate at different frequencies (e.g. 48 kHz input/96 kHz output). Systems utilizing I<sup>2</sup>S delivery of S/PDIF input, ADC input, or other digital audio input use isochronous delivery.

The requirements are slightly more complicated for systems using “bursty” delivery on the input side of the DSP, but the CK49x is designed to emulate isochronous systems.

The CK49x can operate in three different clocking modes. Each of these modes is explained in the following sections.

### 1.3.20.1 Clock and Data Flow for ADC Input

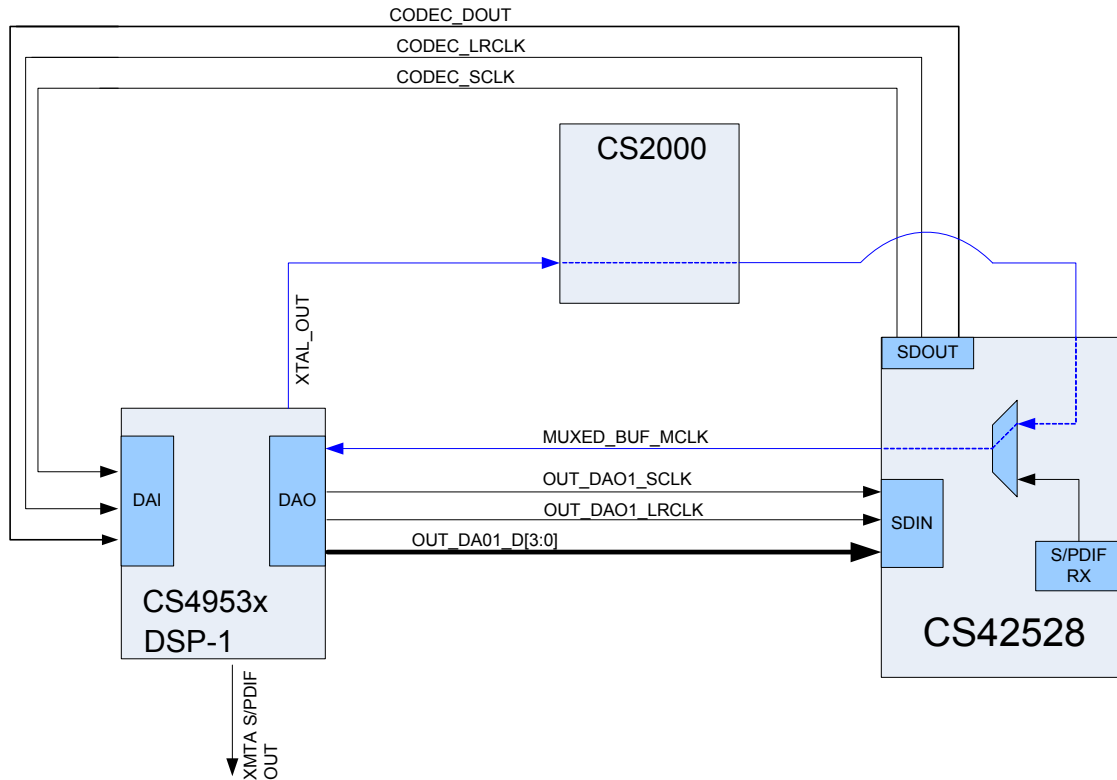


Figure 1-5. CS495xxx/CS497xxx ADC Clocking

The ADC clocking architecture is used when the ADCs are used as the only audio input (i.e. S/PDIF is disabled, and the audio input source multiplexer (U23) is used to select CODEC audio sources. [Figure 1-5](#) illustrates this clocking configuration.

XTAL\_OUT from the CS495xxx/CS497xxx is MCLK for the system via the CS2000 and CS42528 clocking mux, and the codec masters the input clocks (MUXED\_SCLK/MUXED\_LRCLK) of the CS495xxx/CS497xxx. The system routing of the clocks was simplified by using the CS42528 to drive MCLK to the system, but the internal clock multiplexer of the CS42528 is forced to the OMCK setting to pass XTAL\_OUT.

The CS495xxx/CS497xxx always masters its output clocks (OUT\_DAO1\_SCLK/OUT\_DAO1\_LRCLK).

Table 1-2. ADC Clocking

Clock Name	Clock Master Source	Clock Driver	Clock Frequency
MUXED_BUF_MCLK	CS495xxx/CS497xxx	CS42528	24.576 MHz
CODEC_SCLK	MUXED_BUF_MCLK	CS42528	64*Input Fs (default)
CODEC_LRCLK	MUXED_BUF_MCLK	CS42528	Input Fs
OUT_DAO1_SCLK	MUXED_BUF_MCLK	CS495xxx/CS497xxx	64*Output Fs (default)
OUT_DAO1_LRCLK	MUXED_BUF_MCLK	CS495xxx/CS497xxx	1*Input Fs (default)

**Note:** MUXED\_MCLK is the clock signal that is driven by the CS42528's RMCK pin. The CS42528 provides the recovered clock from the S/PDIF input unless it loses signal lock, in which case the CS42528 passes the DSP clock (XTAL\_OUT) that it receives on the OMCK pin via the CS2000.

### 1.3.20.2 Clock and Data Flow for S/PDIF Input

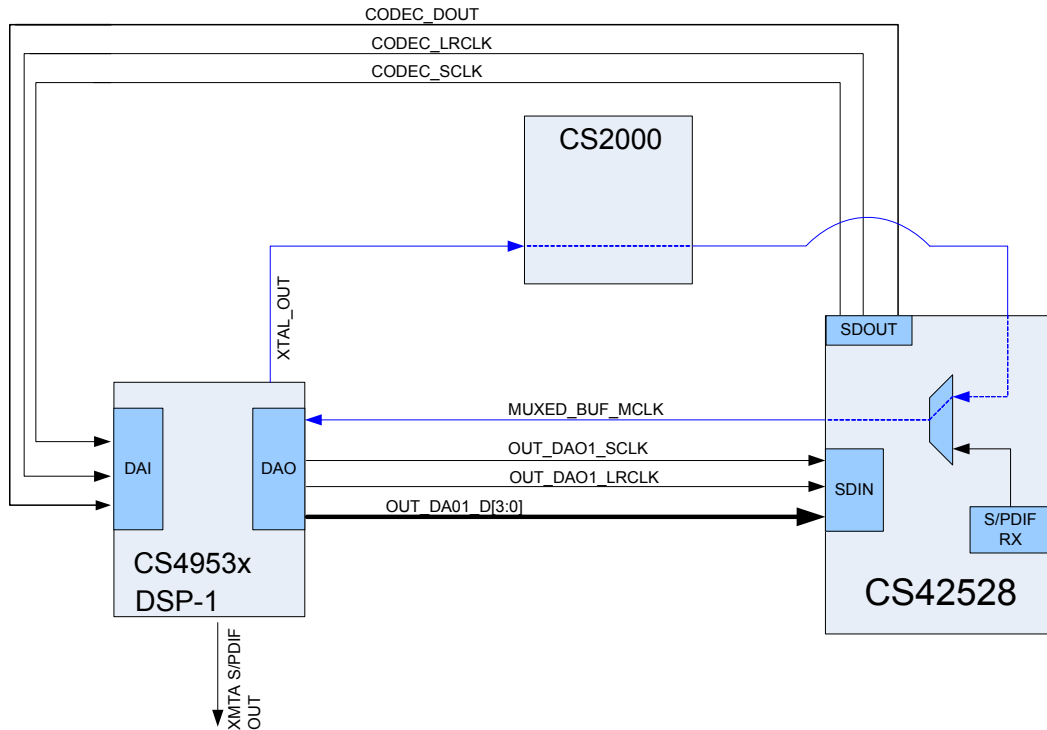


Figure 1-6. CS495xxx/CS497xxx S/PDIF Clocking

The S/PDIF clocking architecture is used when any S/PDIF RX is used as an audio source. That is, any S/PDIF RX is selected, and the audio input source multiplexer (U23) is used to select CODEC audio sources. Figure 1-6 illustrates this clocking configuration.

MCLK recovered from the incoming S/PDIF stream must be MCLK for the system, and the codec masters the input clocks (CODEC\_SCLK/CODEC\_LRCLK) of the CS495xxx/CS497xxx. In this configuration the internal multiplexer of the CS42528 routes the recovered MCLK to MUXED\_MCLK.

The CS495xxx/CS497xxx always masters its output clocks (OUT\_DAO1\_SCLK/OUT\_DAO1\_LRCLK).

Table 1-3. S/PDIF Clocking

Clock Name	Clock Master Source	Clock Driver	Clock Frequency
MUXED_MCLK	CS42528	CS42528	512*S/PDIF Fs (e.g. 24.576 MHz for 48 kHz),
CODEC_SCLK	MUXED_MCLK	CS42528	64*Input Fs (default)
CODEC_LRCLK	MUXED_MCLK	CS42528	Input Fs
OUT_DAO1_SCLK	MUXED_MCLK	CS495xxx/CS497xxx	64*Output Fs (default)
OUT_DAO1_LRCLK	MUXED_MCLK	CS495xxx/CS497xxx	1*Input Fs (default)

**Note:** MUXED\_MCLK is the clock signal that is driven by the CS42528's RMCK pin. The CS42528

provides the recovered clock from the S/PDIF input unless it loses signal lock, in which case the CS42528 passes the DSP clock (XTAL\_OUT) that it receives on the OMCK pin.

### 1.3.20.3 Clock and Data Flow for HDMI or ASIO Input Data Delivery

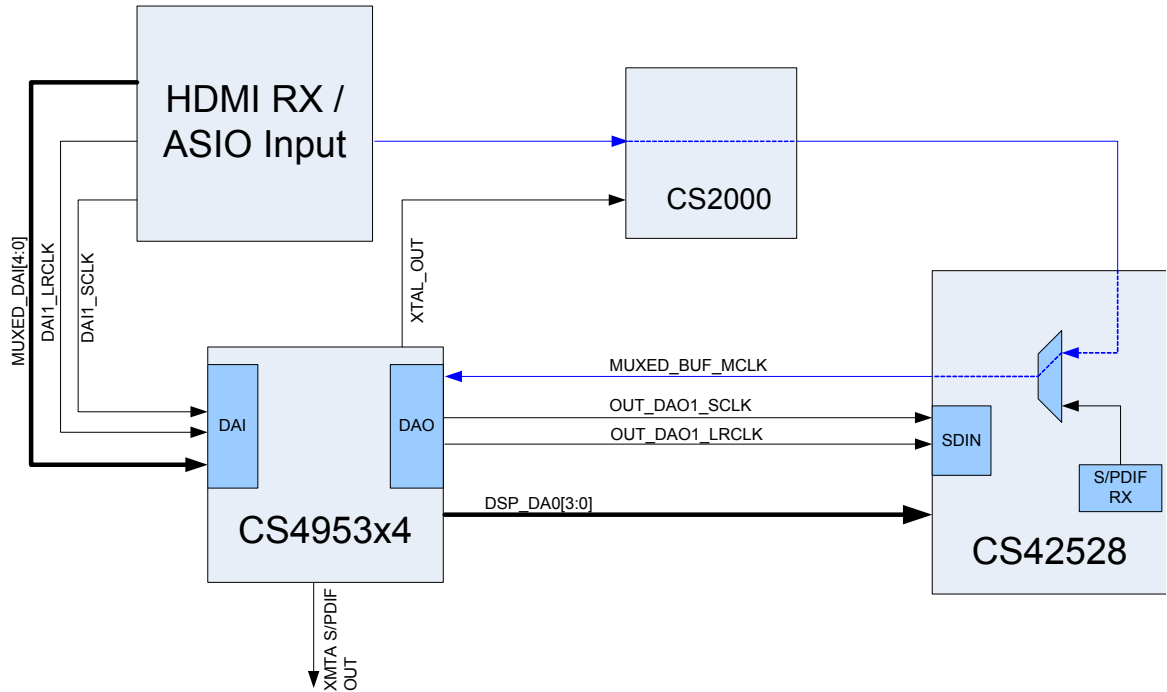


Figure 1-7. HDMI Clocking

When the HDMI or ASIO source is selected, that device masters the system MCLK, and the input clocks (MUXED\_SCLK/MUXED\_LRCLK) of the CS495xxx/CS497xxx.

The CS495xxx/CS497xxx always masters its output clocks (OUT\_DAO1\_SCLK/OUT\_DAO1\_LRCLK).

Table 1-4. HDMI Clocking

Clock Name	Clock Master Source	Clock Driver	Clock Frequency
MUXED_MCLK	HDMI/ASIO Source	HDMI/ASIO Source	256*S/PDIF Fs (e.g. 12.288 MHz for 48 kHz)
DAI1_SCLK	MUXED_MCLK	HDMI/ASIO Source	64*Input Fs (default)
DAI1_LRCLK	MUXED_MCLK	HDMI/ASIO Source	Input Fs
OUT_DAO1_SCLK	MUXED_MCLK	CS495xxx/CS497xxx	64*Output Fs (default)
OUT_DAO1_LRCLK	MUXED_MCLK	CS495xxx/CS497xxx	1*Input Fs (default)

**Note:** MUXED\_MCLK is the clock signal that is driven by the HDMI source.

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## 1.4 DS898CK4Other Useful Information

### 1.4.1 Web Sites

- Cirrus Logic main web site: [www.cirrus.com](http://www.cirrus.com)

### 1.4.2 DSP Information

The following information can be obtained from your Cirrus Logic representative.

- *CS495xxx/CS497xxx Data Sheet*
- *CS495xxx/CS497xxx System Designer's Guide*
- AN288, *CS495xxx/CS497xxx Firmware User's Manual*

### 1.4.3 Board Information

- The following information can be obtained from your local Cirrus Logic representative.
- Schematics
- BOM
- Artwork and PCB stack up

### 1.4.4 Audio CODEC Information

The following information can be obtained from your local Cirrus Logic representative.

- *CS42528 Data Sheet*
- *CS42528 Errata*

### 1.4.5 DSP Software Utility Information

The following information can be obtained from your local Cirrus representative.

- *DSP Composer™ User's Manual*
- *DSP Composer™ Primitive Elements Reference*

The documents listed above are updated periodically and may be more up-to-date than the information in this document. Check the Cirrus Logic web site for the latest updates.

## Introduction to CK49x Evaluation System

### 2.1 Introducing the CK49x Evaluation System

The CK49x Evaluation System is composed of the CDB49x base board and the DC4953x daughter card where the C24953x4 DSP is installed. The CK49x Evaluation System provides a practical platform for emulating a typical multi-channel audio system application. The on-board MCU provides a USB control port used to interface the host PC to the CK49x Evaluation System, and convert GUI commands into the serial control protocol required for configuring the CS4953x4 DSP, CS42528 and CS2000 audio ICs, and the HDMI interface chips. [Figure 2-1](#) shows the CK49x Evaluation System when controlled by the user's PC. [Figure 2-2](#) shows the CK49x Evaluation System operating in Standalone mode. Standalone mode is described in detail in [Chapter 5](#).

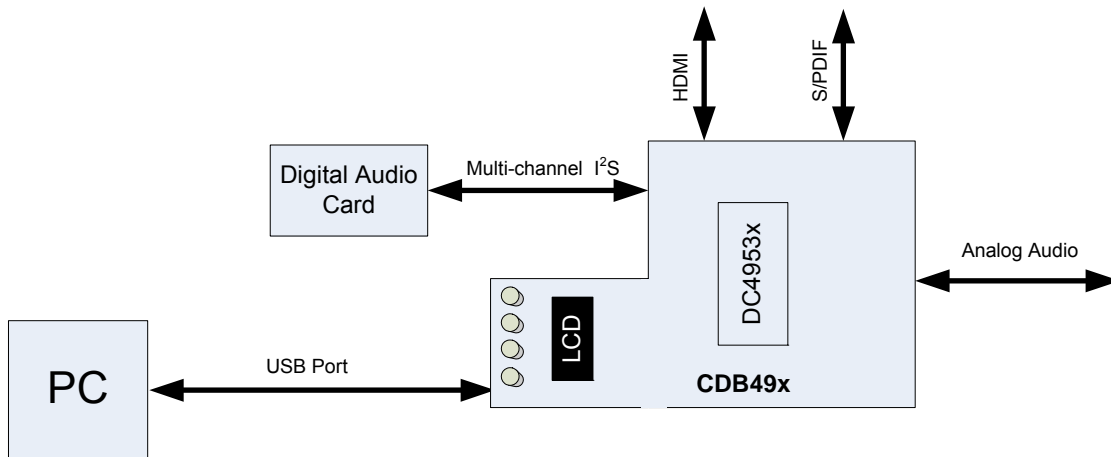


Figure 2-1. CK49x Evaluation System Block Diagram Using PC Control

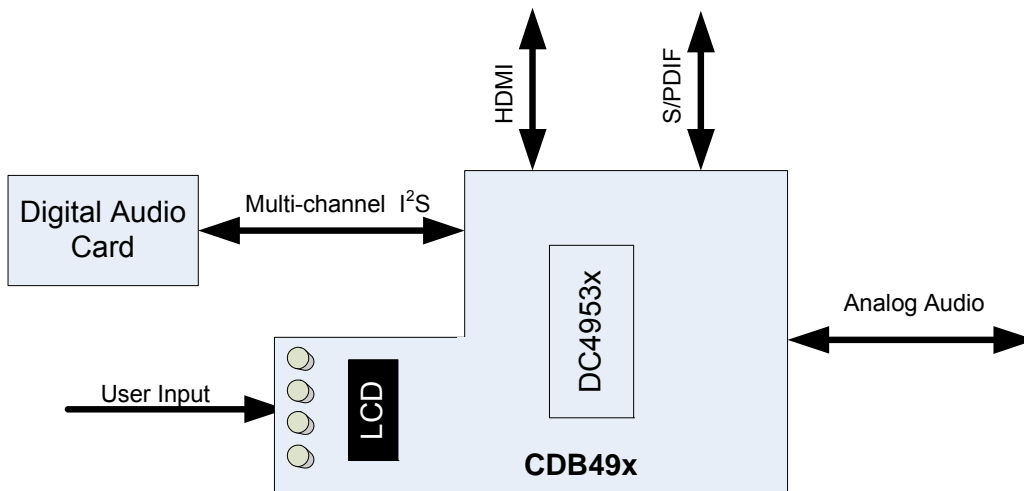


Figure 2-2. CK49x System Block Diagram in Standalone Mode

This document will concentrate on the features and basic operation of the CK49x board. Detailed information regarding the operation and programming of the CS4953x4 DSP is covered by the CS4953xx *Data Sheet*, the CS4970x4/CS4953x4 *System Designer's Guide* and the application note AN288. See [Section 1.4 "DS898CK4 Other Useful Information" on page 1-14](#) for more details.

The CK49x is a convenient and easy-to-operate evaluation platform. It has been designed to demonstrate the majority of the DSP functions on a 9" x 6.5" base board. These features include:

- PC control of the DSP using the DSP Composer™ graphical user interface
- Serial control of audio devices on CK49x Evaluation System via I<sup>2</sup>C™ or SPI™ protocols
- Digital audio input of PCM or compressed data via optical or coaxial S/PDIF
- Digital audio input of PCM or compressed data via HDMI
- 2-channel analog audio input via the CS42528 audio codec
- 8-channel analog output through the CS42528 audio codec
- Digital audio output of PCM data via optical S/PDIF
- Digital audio output of PCM or compressed data via HDMI (feature not currently supported)
- Multi-channel digital audio input via P11 header (feature not currently supported)
- Separate input and output clocking domains to allow 1FS-to-2FS audio processing on the DSP
- DSP Memory expansion through external 16-Mbit SDRAM
- Fast boot –master boot of custom applications from 32 Mbit serial SPI Flash device.
- Microphone input with integrated amplifier for Intelligent Room Calibration (IRC) evaluation
- Supports all members of the CS495xxx/CS4970x4 family in the 128-pin LQFP package.

**Note:** Not all features of the DSP are exercised on the CK49x. Evaluation System

## 2.2 Identifying Components on the CK49x Evaluation System

### 2.2.1 CDB49x Main Board Components

[Figure 2-3](#) shows the top side of the CDB49x Main Board. The accompanying legend identifies the main components of the board. [Section 2.2.1.1](#) contains the legend for the reference points called out in red in [Figure 2-3](#).

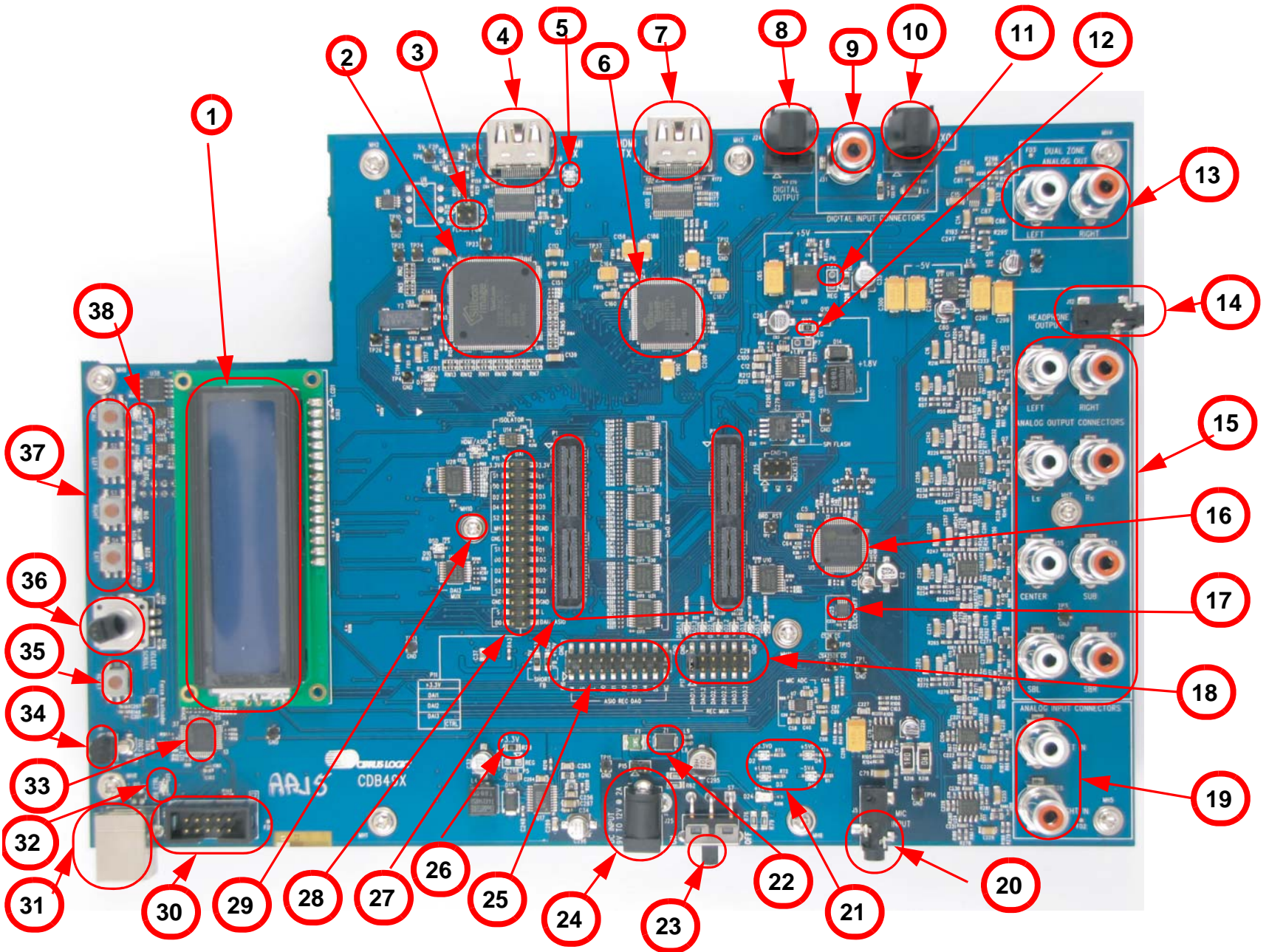


Figure 2-3. CDB49x Main Board Top View



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### 2.2.1.1 CDB49x Main Board Components

The circled numbers found in [Figure 2-3](#) refer to the CDB49x Main Board components in the following list:

1. LCD
2. HDMI Receiver (Rx)
3. Extended Display Identification Data (EDID) Programming Header
4. HDMI Input Connector
5. Hot Plug Indicator
6. HDMI Transmitter (Tx)
7. HDMI Output Connector
8. S/PDIF Optical Tx
9. S/PDIF Coax Rx
10. S/PDIF Optical Rx
11. +5V Header
12. +1.8V Header
13. Dual Zone Analog Outputs
14. Headphone Output
15. Main Analog Line-Level Outputs (Left/Right; Left Surround/Right Surround; Center/Subwoofer; Surround Back Left/Surround Back Right)
16. Cirrus Logic CS42528 CODEC
17. Cirrus Logic CS2000 Clock Generator and Clock Multiplier/Jitter-Reduced Clock Frequency Synthesizer
18. DAO Selection
19. Analog Line-Level Input
20. Mic Input
21. Power Indicator LEDs (4)
22. Slave Boot Control
23. Power Switch
24. +9V Power Connector
25. DAO Mux Header
26. +3.3V Header
27. Daughter Card Connectors (2)
28. DAI 1, 2, and 3 Header
29. DSD/I<sup>2</sup>S Mux LED
30. MCU Programming Header (C2 Header)
31. USB Connector
32. USB Active LED
33. 8051 MCU

- 34. IR Receiver
- 35. System Reset
- 36. Rotary Encoder Knob
- 37. MCU Buttons (4) (Menu, Left, Right, Exit)
- 38. MCU LEDs (4)

## 2.2.2 DC4953x Daughter Card

Figure 2-4 shows the top side of the DC4953x Daughter Card. The accompanying legend identifies the main components of the board. Section 2.2.2.1 contains the legend for the reference points called out in red in Figure 2-4.

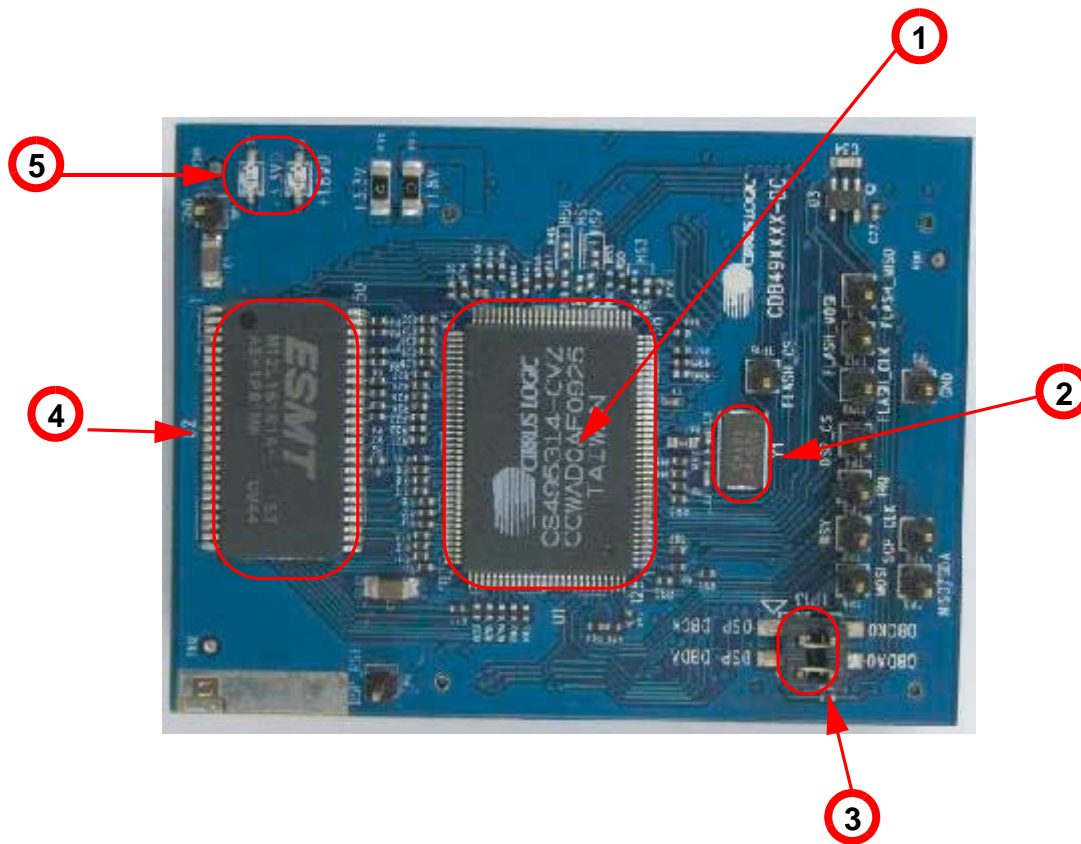


Figure 2-4. Top View DC4953x/DC4953x3/DC4970x4 Daughter Card

### 2.2.2.1 DC4953x Daughter Card Components

The circled numbers found in [Figure 2-4](#) refer to the DC4953x Daughter Card components in the following list:

1. Cirrus Logic CS4953x DSP (U1)
2. 24.576 MHz Crystal (Y1)
3. Debug Header (P5)
4. ESMT 16-Mbit SDRAM (U2)
5. Power LEDs (2)

### 2.2.2.2 DC4970x4 Daughter Card Components

The circled numbers found in [Figure 2-4](#) refer to the DC4970x4 Daughter Card components in the following list:

1. Cirrus Logic CS4970x4 DSP (U1)
2. 24.576 MHz Crystal (Y1)DS898CK4
3. Debug Header (P5)
4. ESMT 16-Mbit SDRAM (U2)
5. Power LEDs (2)

### 2.2.2.3 DC4953x3 Daughter Card Components

The circled numbers found in [Figure 2-4](#) refer to the DC4953x3 Daughter Card components in the following list:

1. Cirrus Logic CS4953x3 DSP (U1)
2. 24.576 MHz Crystal (Y1)
3. Debug Header (P5)
4. ESMT 16-Mbit SDRAM (U2)
5. Power LEDs (2)

Table 2-1. HDMI Clocking

Daughter Card Variants	Populate	Do Not Populate
DC495303	R89,R87,R81	R90,R85,R86
DC495313	R90,R85,R86	R89,R87,R81
DC495304	R89,R85,R81	R90,R87,R86
DC495314	R89,R87,R86	R90,R85,R81
DC497024	R85,R89,R86	R90,R87,R81

## Installation, Setup, and Running Application

### 3.1 Installation, Setup, and Running First Application



It is important to install the Board Software BEFORE connecting the USB cable. Failure to install the board software before the initial connection can result in an inability to communicate with the CDB49x.

#### 3.1.1 Board Software Installation

The DSP board software installation will first install the Cirrus Logic DSP board software followed by the installation of the required USB drivers.

1. Run the latest DSP board software installation executable (*CS4953x\_eval\_kit\_rc\*\*.exe* or later). This executable is supplied by your Cirrus Logic representative.
2. At the *Welcome* screen, click *Next*.
3. At the *Licensing Agreement* window, select the “*I accept the agreement*” radio button to agree to the terms and then select *Next*.
4. Select the *Destination Location* window, Select the default location “*C:\CirrusDSP*” and click *Next*.
5. Select *Start Menu Folder* window, Select the default location “*C:\CirrusDSP*” and click *Next*.
6. The *Ready to Install* window indicates the selected destination location and the *Start* menu folder for confirmation, select *Install* to begin the install process which should take less than one minute. When the software is being installed, release notes of the various components are opened. Release notes are stored in *C:\CirrusDSP\cs49xxx\doc\release\_notes* for future reference.
7. The Cirrus DSP board software will then prompt the user to click *Finish* to exit the setup wizard.

#### 3.1.2 Setting up the CK49x Evaluation Board

Follow these steps to set up the CK49x Evaluation Board

1. Place the CDB49x on a static-free surface
2. Plug in the DSP daughter Card to the CDB49x base board. This board is now called the CK49x Evaluation System.
3. Connect the power supply jack to the CK49x Evaluation System as shown in [Figure 3-1](#) and the adapter to a wall power socket or power strip.
4. Verify that 4 MCU LEDs on the CDB49x base board and the 2 LEDs on the daughter card are illuminated.
5. The LCD Display on the Screen is Blank.
6. Connect a SPDIF source the CK49x Evaluation System
  - Connect one end of the digital audio S/SPDIF optical RX cable on the CK49x Evaluation System

- 
- Connect the other end of the optical cable to the optical output on the back of a DVD player or other digital audio source.
7. Connect powered speaker to the CK49x Evaluation System:
- Use the RCA audio cables to connect the line-level analog outputs to powered speakers as shown in [Figure 3-1](#).

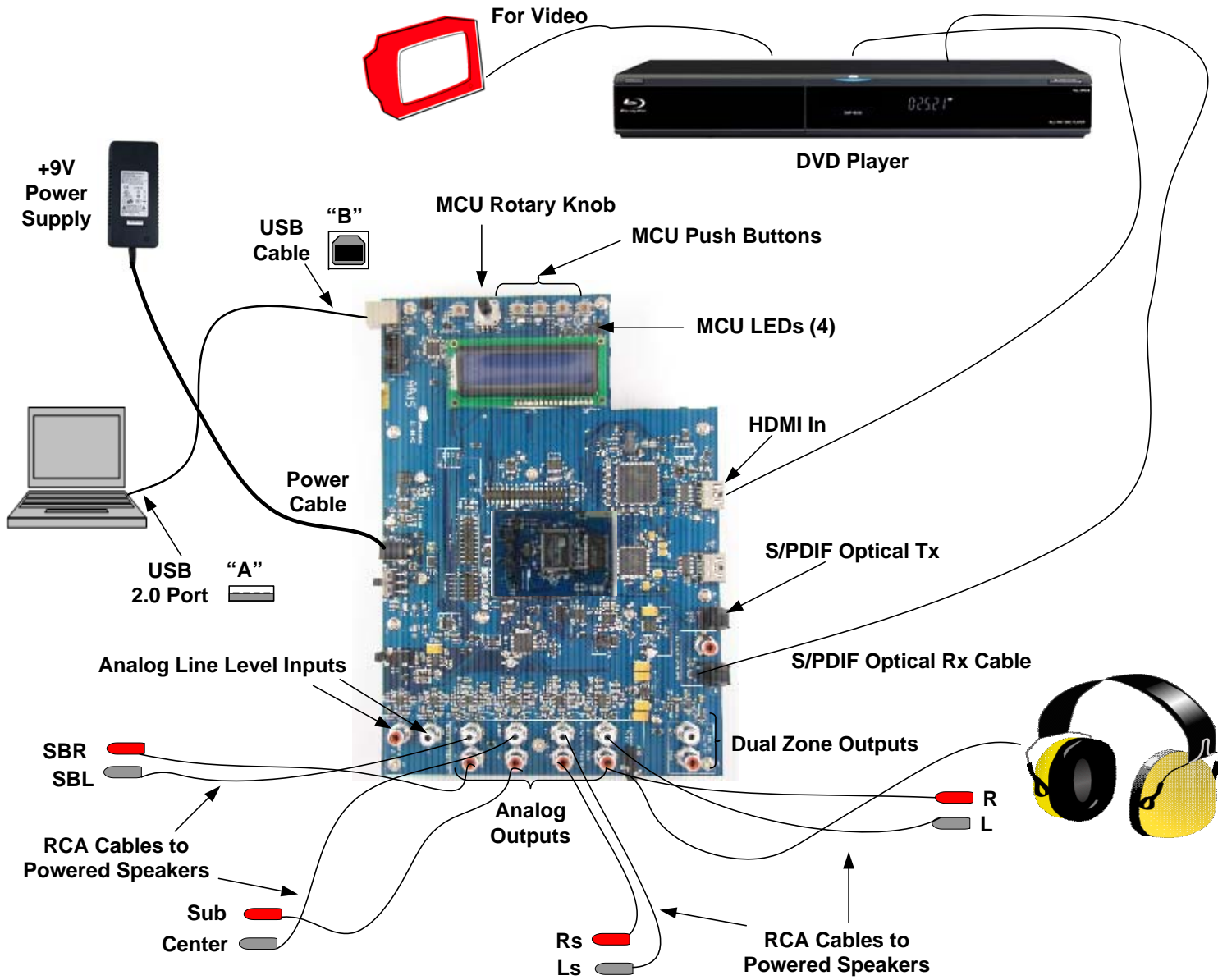


Figure 3-1. Board Setup and Connection Diagram

### 3.1.3 Connecting to a PC

**Note:** There is a possibility that the CK49x Evaluation Board may disconnect from the PC during operation. It is recommended to short across pads of R97 and C203 by the USB connector on the board to avoid any USB connectivity issues.

Follow these steps, to connect the PC

1. Connect the “B” end of the USB cable to P1 on the CK49x Evaluation System.
2. Connect the “A” end of the USB Cable to a USB 2.0 port on a notebook or PC running Windows XP®.
3. The LCD displays “Wait for USB enumeration...” message first and then shows the board name, “CK49x”, “USB” which signifies that a USB connection is active, and the MCU firmware revision number that is currently active.
4. On the PC the “Found new Hardware” message will be displayed and the necessary USB device drivers will be installed automatically
5. In the system tray an icon called CDM (Cirrus Device Manager) will be running as shown in [Figure 3-2](#).

**Caution:** The Cirrus Device Manager must be running in order for the board to operate correctly.

6. The CDM icon stays gray in color until the board is detected. Once the board is detected the icon turns dark blue as shown in [Figure 3-2](#).



Figure 3-2. Cirrus Device Manager Icon

7. Double click on the icon to open up CDM and verify that the board listed is correct. An example with DC49531 is shown in [Figure 3-3](#).

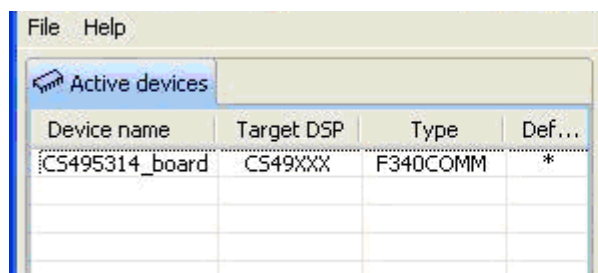


Figure 3-3. Cirrus Device Manager as Displayed after Double-clicking the CDM Icon

### 3.1.4 Opening a Console Window from the Cirrus Device Manager

1. Double click on the system tray icon to open up CDM
2. Right click on the board that is listed/detected (e.g.: CS495314\_board), and click on “Start Console” menu option, as shown in [Figure 3-4](#).

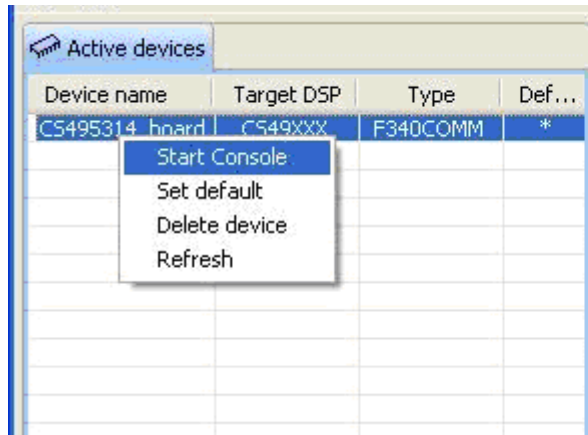


Figure 3-4. Opening a Console Window from Cirrus Device Manager

3. [Figure 3-5](#) shows the CDM Console window, which is now available for the user to enter commands.

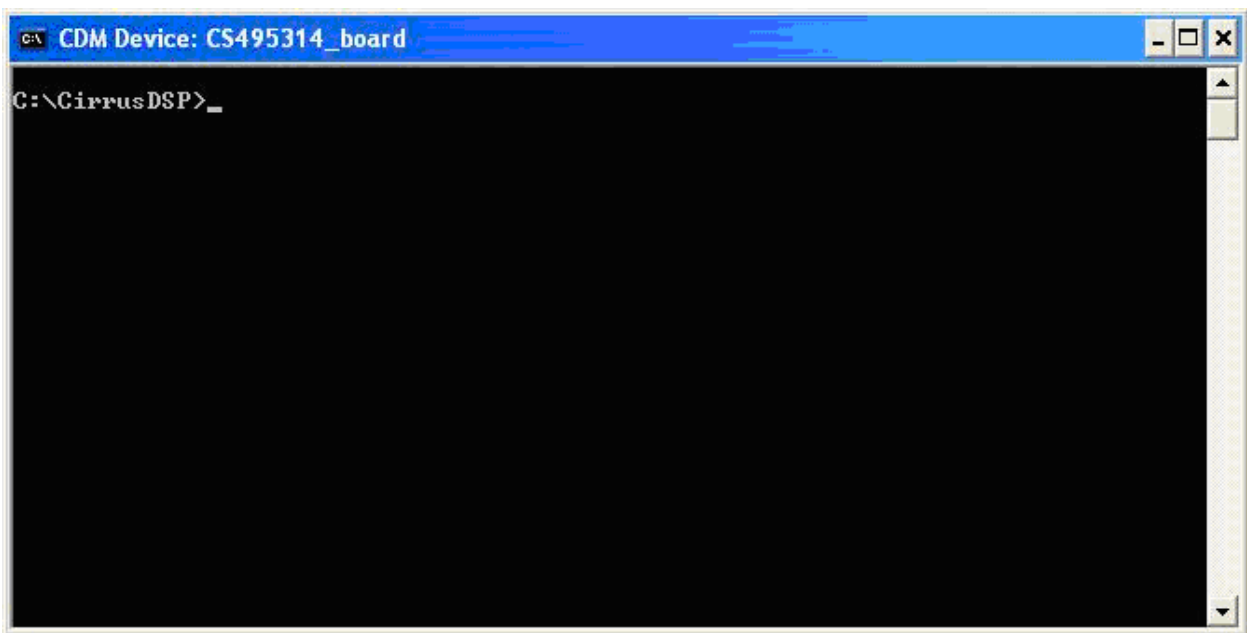


Figure 3-5. CDM Device Console Window



### 3.1.5 Running a Stereo PCM Application on CK49x

Figure 3-6 shows the DSP Composer™ main window for a PCM pass-through application on the CK49x. The blocks shown in the main window of DSP Composer™ can be selected from the folders in the left-hand window pane, and then connected together by “wires” to indicate the processing path as shown

The “Audio In” and “Audio Out” blocks represent the hardware ports that need to be configured. The “Audio In” block is used to select the S/PDIF Input or Analog or HDMI input that is to be processed, and configure the digital audio format for the CS42526’s ADC, Sil9135 HDMI Rx, and the CS4953x4 DAI port.

The “Audio Out” block is used to configure the digital audio format for the CS495xxx/CS497xxx DAO port, the CS4252’s 8 DACs, and enable or disable the S/PDIF TX output of the CK49x.

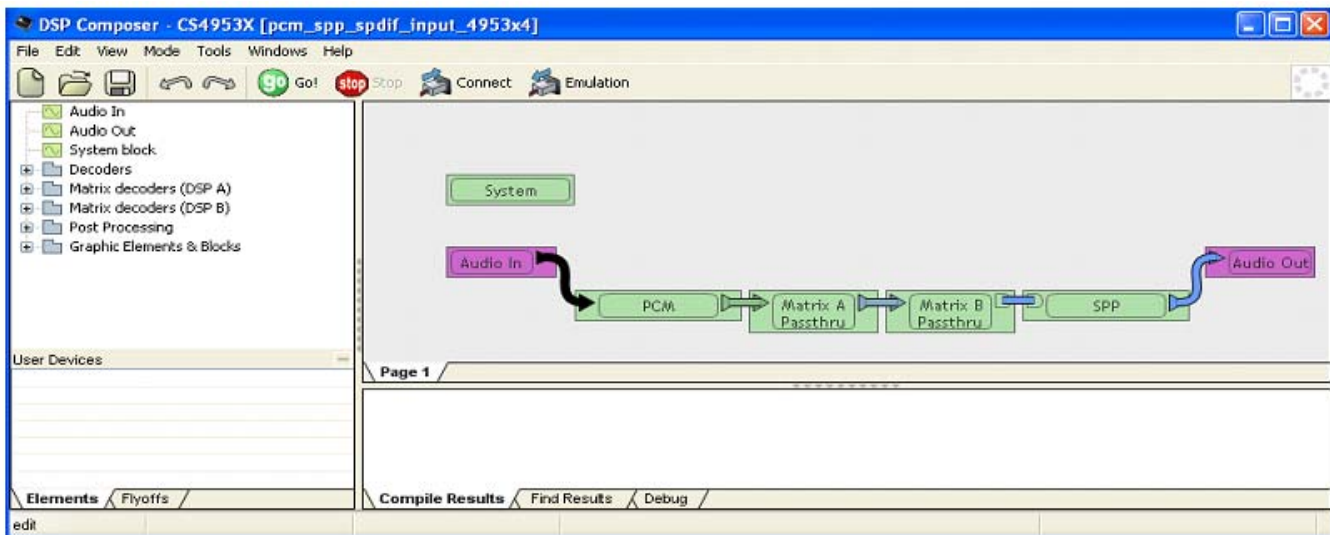


Figure 3-6. PCM Pass-through Example Application

To run a stereo PCM application on the CK49x Evaluation System, follow these steps:

1. Launch DSP Composer
  - If DC4953xxx is used, Start ⇒ Program ⇒ Cirrus DSP ⇒ CS495xxx/CS497xxx
  - If DC4970x4 is used, Start ⇒ Program ⇒ Cirrus DSP ⇒ CS497x
2. In DSP Composer, go to File ⇒ Open and open C:\CirrusDSP\CS4953X\projects\- 3. Press the GO button
- 4. Insert PCM material into the DVD player (e.g. music CD). If a DVD is being used as the audio source, make sure that the DVD Player (or other digital audio source) is configured to output PCM data and S/PDIF out of the player connected to RX0 on the board.
- 5. Press Play on the DVD player (or other digital audio source). You should now hear audio from the speakers.

**Note:** Click on File->Properties in DSPComposer and make sure the board connected field is set to CDB49x

### 3.1.6 Downloading Other Applications

Separate project files (.cpa) are provided for other applications such as Dolby Digital. In order to evaluate these, please contact your local FAE to ensure that the necessary licensing agreements have been completed.

### 3.1.7 Running a Multichannel PCM Application via HDMI

The CK49x Evaluation System includes an HDMI 1.3–compliant receiver (Sil9135; To receive support for the Sil9134 and Sil9135 chips, contact Silicon Image, Inc.) and an HDMI 1.32–compliant transmitter (Sil9134), both of which are manufactured by Silicon Image, Inc.

To play multi-channel PCM via HDMI, follow the configuration and connections shown in [Figure 3-1](#).

1. Open the appropriate .cpa file
  - For the DC4953x3, use the CS4953x->DSPComposer menu option and open:  
C:\CirrusDSP\CS4953x\projects\pcm\_mch\_spp\_hdmi\_input\_4953x3.cpa.
  - For the DC4970x4, use the CS497xx->DSPComposer menu option and open:  
C:\CirrusDSP\CS4953x\projects\pcm\_mch\_spp\_hdmi\_input\_4970x4.cpa.
2. Ensure that the cable is connected between HDMI Rx of the board and HDMI output of the player.
3. Play a 1 fs (44.1 kHz or 48 kHz) PCM track on the player. The user can choose to set the player to always send PCM out through HDMI if you have a track/disc with compressed material.
4. Press “Go” in DSP Composer
5. The user will now hear audio through the powered speakers.

**Note:** Click on File->Properties in DSPComposer and make sure the board connected field is set to CDB49x

### 3.1.8 Running a Stereo Analog Input Application

The 4953x Evaluation System supports applications using Stereo Analog Input sources.

To play audio via Stereo Analog input, follow the configuration shown in [Figure 3-1](#).

1. Open the appropriate .cpa file
  - For the DC4953x, use the CS4953x->DSPComposer menu option and open  
C:\CirrusDSP\CS4953x\projects\pcm\_app\_analog\_input\_4953x4.cpa.
  - For the DC4953x3, use the CS4953x->DSPComposer menu option and open  
C:\CirrusDSP\CS4953x\projects\pcm\_app\_analog\_input\_4953x3.cpa.
  - For the DC4970x4, use the CS497xx->DSPComposer menu option and open  
C:\CirrusDSP\CS4953x\projects\pcm\_app\_analog\_input\_4970x4.cpa.
2. Connect a Stereo Analog Source to Analog Input Connectors on the board.
3. For the DC4953x only, play a 1 fs (44.1 kHz or 48 kHz) PCM track on the player. The user can choose to set the player to always send PCM out through HDMI if you have a track/disc with compressed material.
4. Press “Go” in DSP Composer
5. The user will now hear audio through the powered speakers.

**Note:** Click on File->Properties in DSPComposer and make sure the board connected field is set to CDB49x

## Programming the DSP on the CK49x Evaluation Board

### 4.1 Introduction

With the exception of the power selection jumpers, the CK49x is configured exclusively through software. The DSP Composer™ software is a graphical user interface (GUI) that is used to program the CK49x DSP, and to configure the CK49x. This chapter provides basic instruction for using the GUI to control the CK49x. Detailed information on using the DSP Composer can be found in the *DSP Composer™ User's Manual*. Your local Cirrus Logic representative can assist you in obtaining both the DSP Composer software and the User's Manual for the software.

### 4.2 Basic Application Download and System Configuration - PCM Pass-through

Follow the instructions in [Section 3.1.5 "Running a Stereo PCM Application on CK49x"](#) on page 3-6.

#### 4.2.1 System Block

In DSP Composer, when you drag the System block onto the work space, a pop-up menu is displayed, as illustrated in [Figure 4-1](#) and [Figure 4-2](#). This menu offers the option of selecting the *Chip ID* that you need to evaluate, the *Firmware version* and the *PCM input mode* from the pull-down menu.

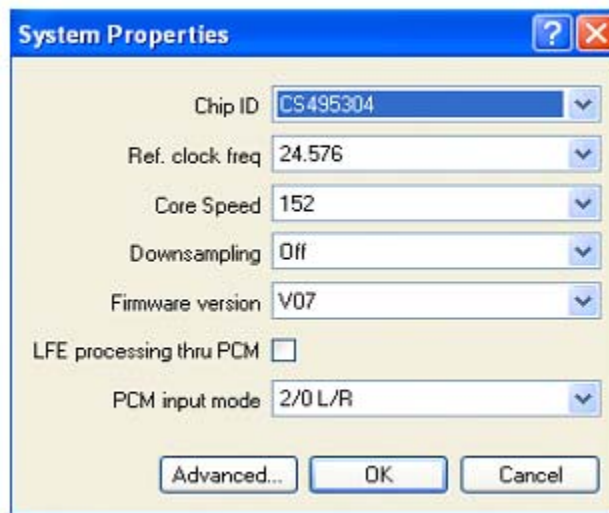


Figure 4-1. System Properties Showing CS495304 as the Chip ID

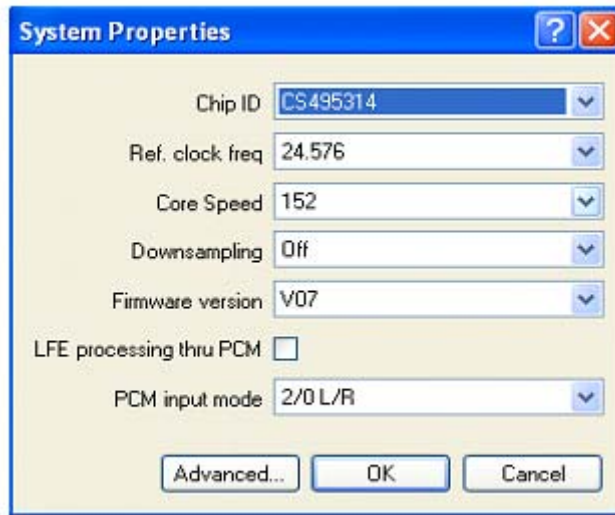


Figure 4-2. System Properties Showing CS495314 as the Chip ID

## 4.2.2 Channel Remap of the DSP

The audio output channels of the DSP can be mapped by double-clicking on the System block in DSP Composer

In DSP Composer, select the DAO remap tab as illustrated in [Figure 4-3](#) and click on the DAO1 Combo Box to select the internal channel to route to DA01 channel.

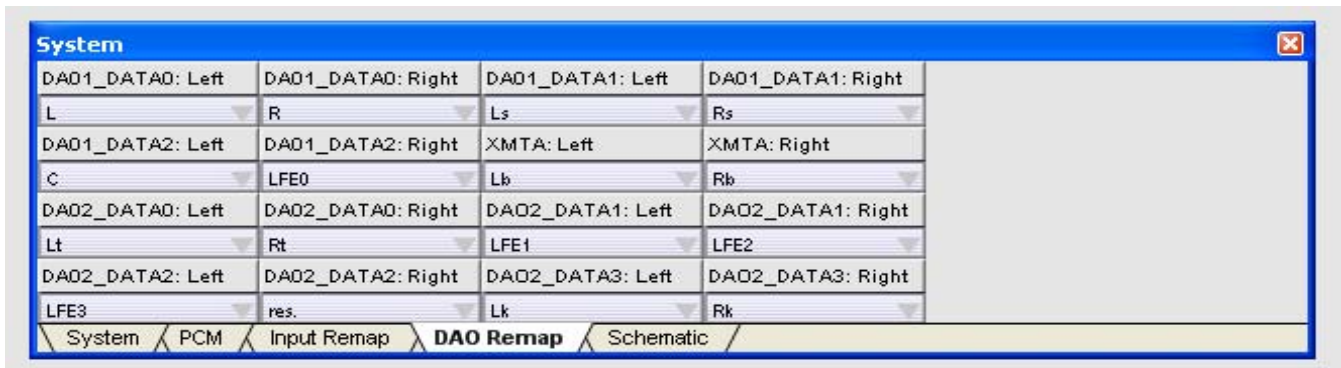


Figure 4-3. CK49x DAO Channel Remap

## 4.3 Changing Audio Input Source

The active audio input to the CK49x is selected through the “Audio In” block in DSP Composer, this is done by right-clicking on the “Audio In” block and selecting *Device Properties*, as illustrated in [Figure 4-4](#).

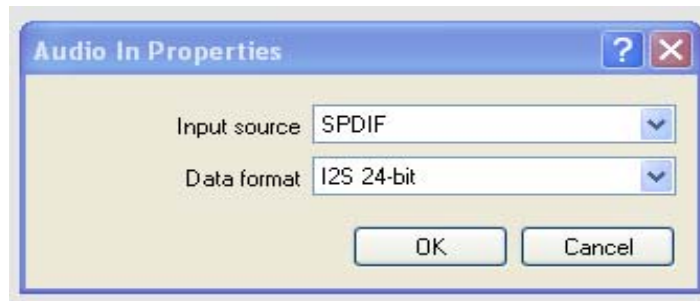


Figure 4-4. CK49x Audio In Properties

This dialog allows the user to set the following parameters for the CK49x:

- Input Source - S/PDIF, Analog, or USB
- Audio Data Format - I<sup>2</sup>S, LJ, etc.

### 4.3.1 S/PDIF Audio Input

The CK49x has four different S/PDIF input jacks. Select the SPDIF input by right-clicking the “Audio In” block and selecting “SPDIF” as the Input Source. Double click the Audio In block to see the signal flow. Selecting the “SPDIF” block followed by right-clicking and selecting *Device Properties* will display the *SPDIF Rx Properties* dialog as illustrated in [Figure 4-5](#). The Master/Slave property must always be set to Master to indicate that the SPDIF transmitter masters MCLK, SCLK, and LRCLK as described in [Section 1.3.20 “Audio Clocking” on page 1-10](#).

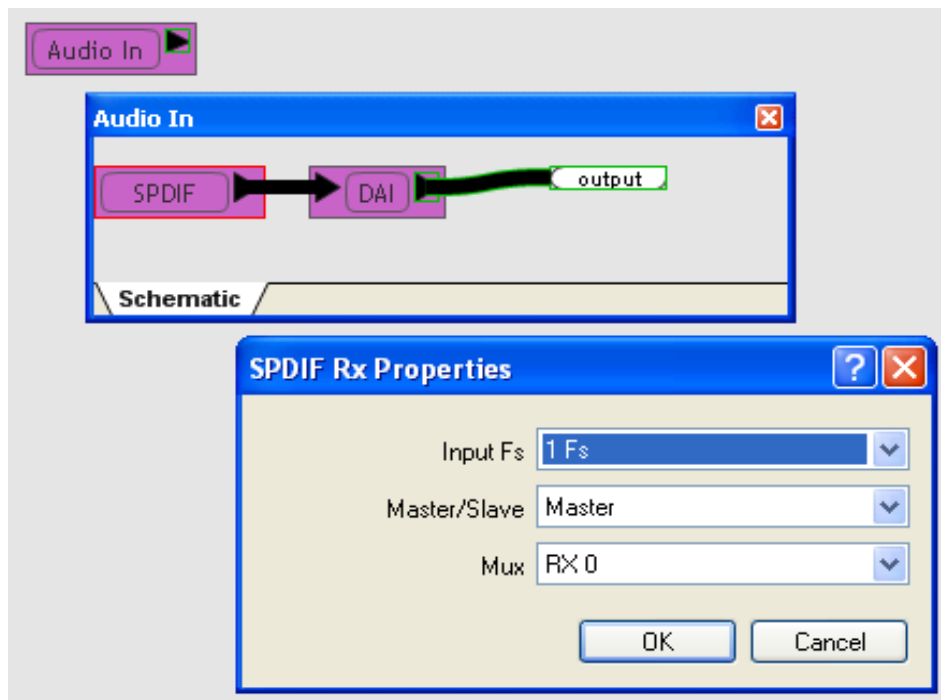


Figure 4-5. CK49x S/PDIF Rx Properties

## 4.3.2 Analog Audio Input

To deliver data to the DSP via 6ch ADC, select “Analog” as the Input Source following the same steps used in selecting SPDIF as described in the previous section. Double click the “Audio In” block to see the signal flow. Right-clicking the “ADC” block and selecting *Device Properties* will display the *CODEC Properties* dialog as illustrated in Figure 4-6. The Master/Slave property must always be set to Master to indicate that the ADC will master SCLK and LRCLK as described in Section 1.3.20 “Audio Clocking” on page 1-10.

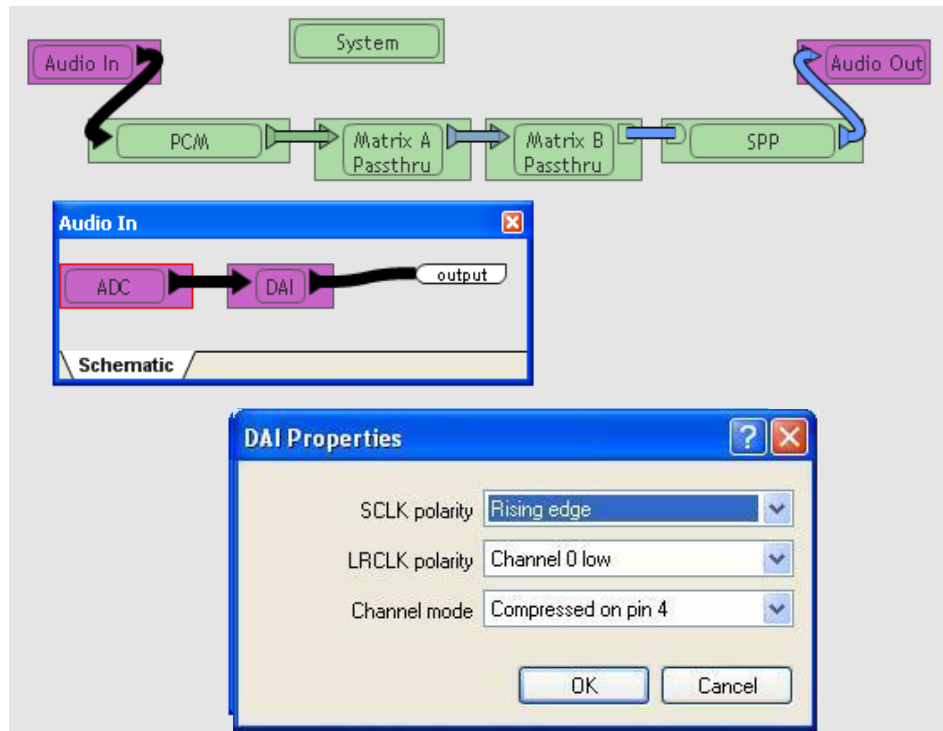


Figure 4-6. CK49x Analog Properties

The dialog windows of both SPDIF RX Properties and CODEC Properties allow the user to set the following parameters:

- Input Sampling Frequency Range - Select the  $F_s$  range of the ADC on the CS42448 CODEC in accordance to the input stream where
  - $1F_s = 32 \text{ kHz}, 44.1 \text{ kHz}, \text{ or } 48 \text{ kHz}$
  - $2F_s = 64 \text{ kHz}, 88.2 \text{ kHz}, \text{ or } 96 \text{ kHz}$
  - $4F_s = 128 \text{ kHz}, 176.4 \text{ kHz}, \text{ or } 192 \text{ kHz}$
- Master/Slave settings for the SCLK & LRCLK pins on the CS8416.
- *SPDIF input only* Mux: RX0 - RX3, and 'NONE'. Choosing 'NONE' forces the CS8416 to pass the DSP clock that comes in on the OMCK pin to MUXED\_MCLK (RMCK). Use this setting when using the ADC.
- *Analog input only* - Enable microphone input.

### 4.3.3 HDMI Audio Input

Right-click on the HDMI element to access the HDMI properties dialog and to select from the following HDMI configuration options:

- InputFS field has the following options:
  - 1 fs
  - 2 fs
  - 4 fs. (default)

**Note:** The sampling rate selected in the InputFS field is the sample rate of the data as it's streamed from the HDMI port to the DSP. This rate is not the audio sampling rate for it's possible to receive a 4fs (192 kHz) stream of HDMI data that contains audio encoded at 48 kHz..

- Port RX Config: field has the following options:
  - HD Low Bitrate
  - HD High Bitrate (default)
  - PCM 96 kHz
- PRX Port Select field has the following option:
  - Port HDMI0

See [Section 3.1.7 "Running a Multichannel PCM Application via HDMI" on page 3-7](#) for details on running a sample .cpa file using an HDMI source.

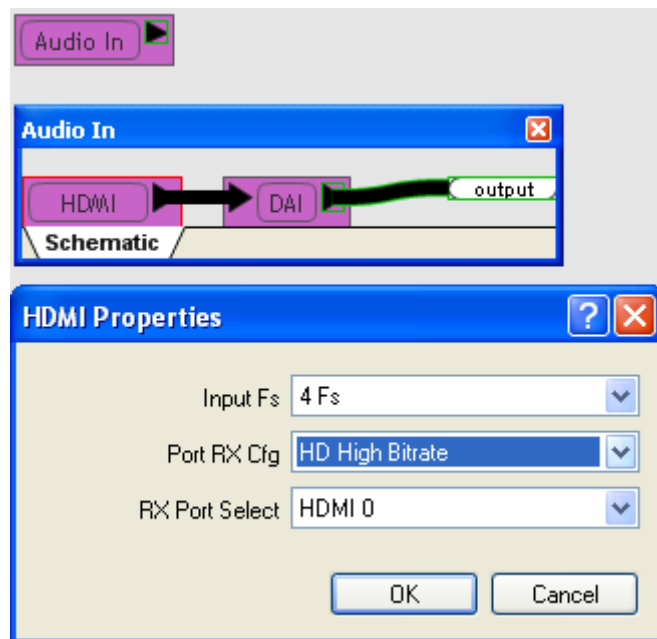


Figure 4-7. DSP Composer Support for HDMI Audio Input via I<sup>2</sup>S

### 4.3.4 DAI Input

Each available audio source for the board is shown as a block connected to the DAI port of the CK49x as illustrated in Figure 4-8. Right-clicking any of the sources and selecting *Device Properties*, produces the *DAI Properties* dialog.

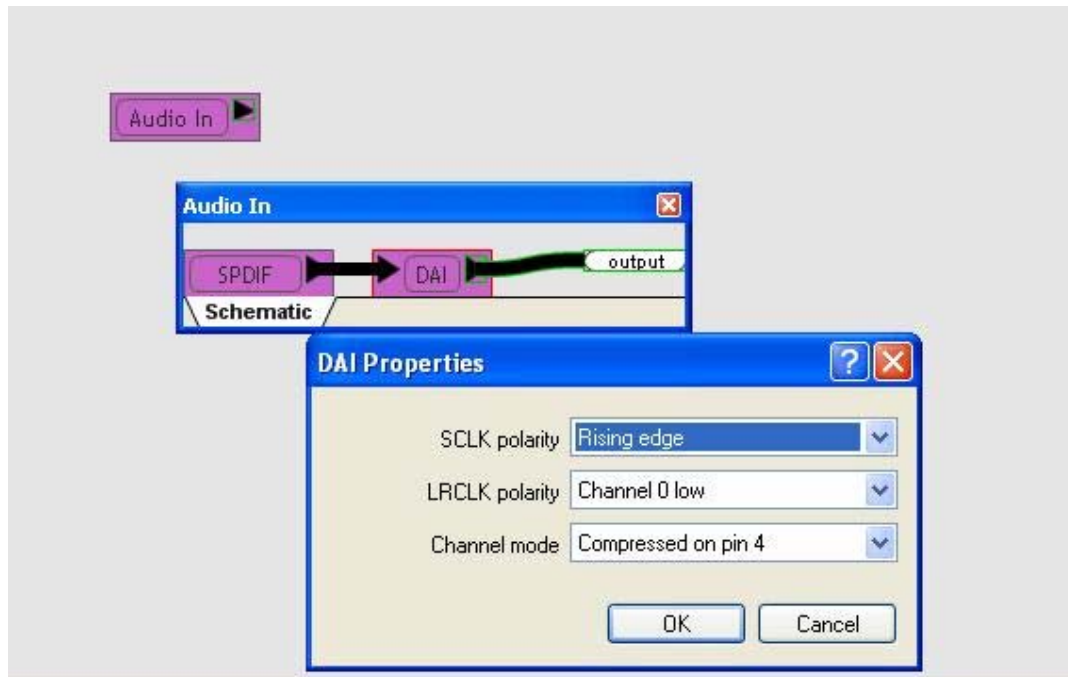


Figure 4-8. CK49x DAI Input Properties

This dialog allows the user to set the following parameters for the CK49x:

- SCLK polarity - Rising edge / Falling edge
- LRCLK polarity - Channel 0 low / Channel 0 high
- Channel Mode - SPDIF on pin 4 / SPDIF on pin 0
- Temperature Grade - CK49xs are populated with commercial-grade chips by default
- Ref Clock - Set to the frequency of the crystal driving the CS49353xx (Y1). This is the reference clock is used to determine the clock dividers needed to derive  $F_s$  in ADC-only applications. If this number changes, then all dividers for LRCLK/SCLK will change by the same ratio (e.g. @24.576 MHz  $MCLK/512 = 1F_s = LRCLK$ , @12.288 MHz  $MCLK/256 = 1F_s = LRCLK$ )



## 4.4 Changing Audio Output Source

The audio output section of the CK49x is configured through the “Audio Out” block in DSP Composer, this is done by right-clicking on the “Audio Out” block and selecting *Device Properties*, as illustrated in [Figure 4-9](#).

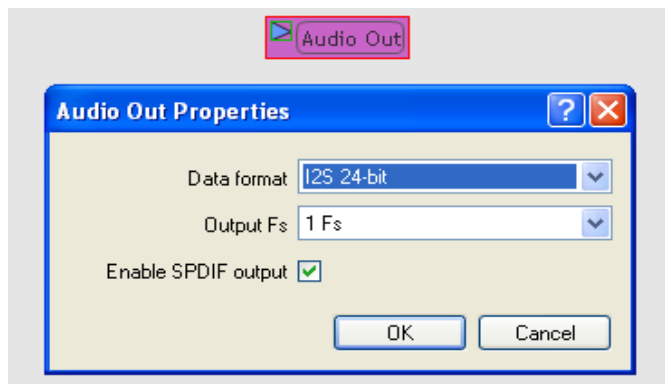


Figure 4-9. CK49x Audio Out Properties

This resulting dialog allows the user to set the following parameters for the CS42448 DACs:

- Audio Data Format - I<sup>2</sup>S, LJ, etc.
- Output Sampling Frequency Range - Select the Fs range where 1Fs = 32 kHz, 44.1 kHz, or 48 kHz, 2Fs = 64 kHz, 88.2 kHz, 96 kHz, 4Fs= 128 kHz, 176.4 kHz, 192 kHz, etc.
- SPDIF Enable - Checking this box configures DAO for S/PDIF output rather than I<sup>2</sup>S.

### 4.4.1 DAO Output of the DSP

The digital audio output (DAO) of the DSP is very flexible, making it compatible with a wide variety of audio devices. This port can be configured using the dialog box shown in [Figure 4-10](#). Double-click on the “Audio Out” block, then select the DAO block. Right-clicking the DAO block and selecting *Device Properties* produces the *DAO Properties* dialog.

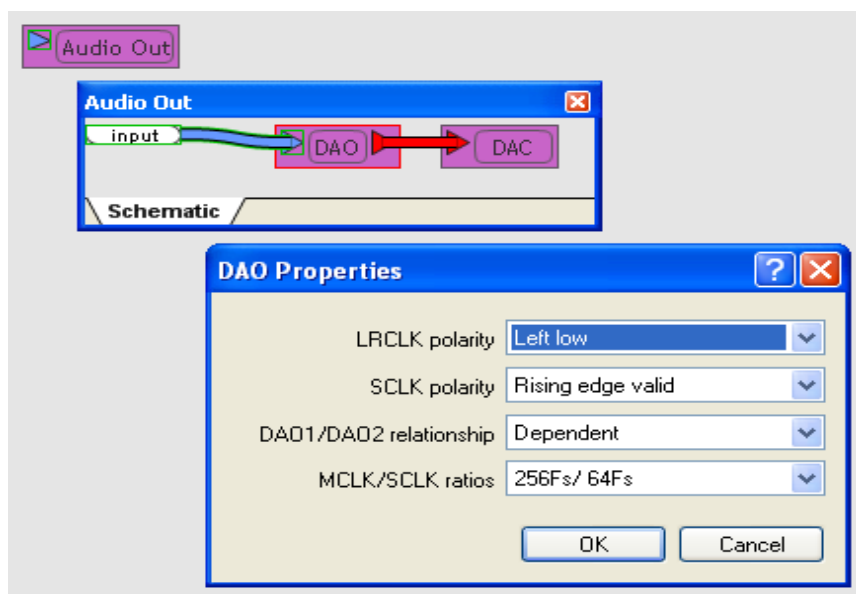


Figure 4-10. CK49x Digital Audio Output Properties

This dialog allows the user to set the following parameters for the CK49x Audio Output:

- LRCLK polarity - Select the phase of LRCLK when the left-sample will be shifted out.
- SCLK polarity - Select which edge of SCLK for which the output data will be valid.
- DAO1/DAO2 - Select independent or unified clock domains for the DAO1 and DAO2 audio output ports.
- MCLK/SCLK Ratios - Select the ratio of LRCLK to MCLK, and LRCLK to SCLK.

#### 4.4.2 Changing Serial Control Protocol (I<sup>2</sup>C™ or SPI™) / Memory Usage

The CK49x is designed to communicate using either I<sup>2</sup>C or SPI protocols. In order to change the communication mode in DSP Composer, go to the menu bar and select *File* ⇒ *Properties*, which brings up the *Project Properties* dialog. To configure Memory usage click on the *Advanced* button, as illustrated in [Figure 4-11](#). Max memory allocation and external memory can be enabled from this panel.

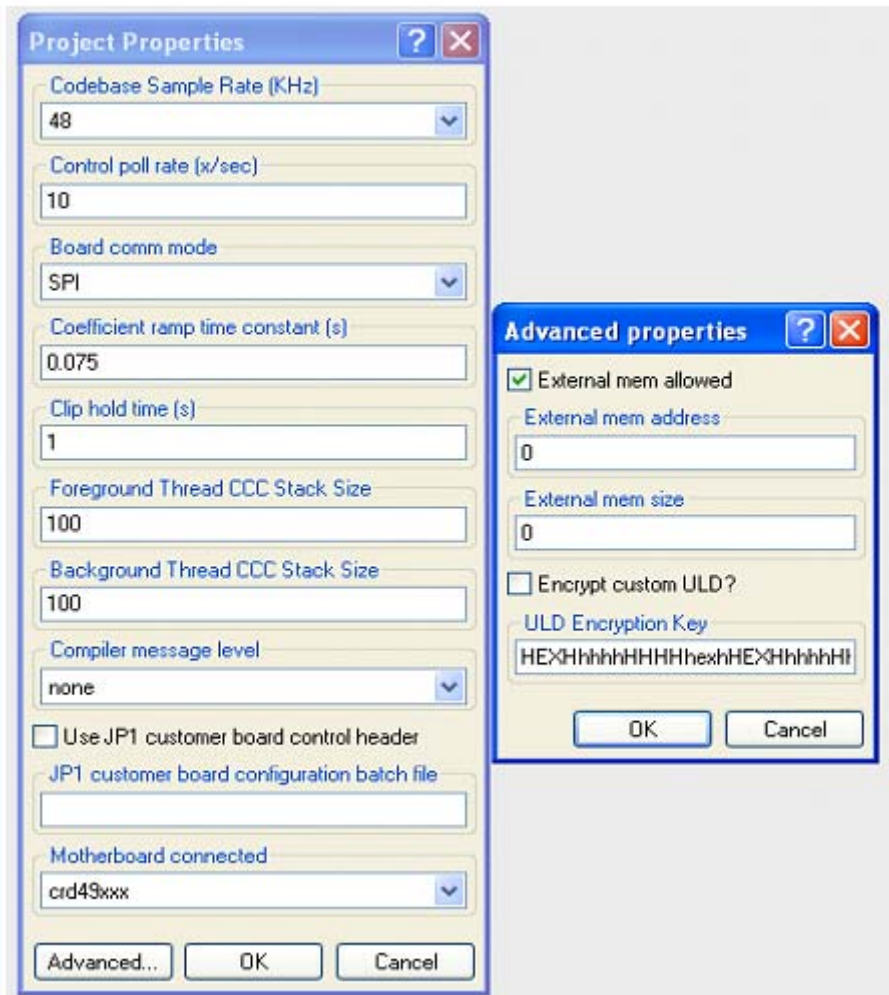


Figure 4-11. CK49x Comm Mode / Memory Usage

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## 4.5 Programming the On-board Serial Flash

The CK49x is populated with 4 Mbits of serial Flash that can be used to store custom DSP firmware or run-time firmware configuration options. In order to emulate a system that boots the DSP from Flash, the serial Flash can be programmed in system with the desired DSP firmware. The host (the PC in this case) can be used to perform a master boot to boot the CK49x.

A special *.uld* file is loaded into the CK49x which provides the programming interface to the system host. Programming then becomes a sequence of messages to the CK49x. See Chapter 7 of the *CS4953x4/CS4970x4 System Designer's Guide* for instructions on to use the DSP Condenser application to program the serial Flash device located on the DC4953x daughter card.

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## Chapter 5

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# Running the CK49x Board in Standalone Mode

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## 5.1 Introduction

The CK49x Evaluation System supports two methods of communicating with the CS4953x4 DSP on the daughter card attached to the main board.

- *Connect a PC to CK49x Evaluation System via USB cable* – The USB connection supports communication between DSP Composer on the user's PC and the CK49x Evaluation System. See [Chapter 3, "Installation, Setup, and Running Application"](#) for how to use DSP Controller on the CK49x
- *Disconnect the USB cable* – This action puts the CK49x Evaluation System in Standalone mode. Standalone mode can be used to run a quick demo of the audio on the system without PC control and to conduct a quick verification of the operation of the CK49x hardware.

The MCU on the CK49x board automatically switches between USB and Standalone operation based on whether a USB connection is detected.

The CK49x MCU in Standalone mode is an independent host that controls the DSP. While in Standalone mode, the MCU is responsible for system boot -up, run-time monitoring of DSP operations, and controlling the user interface. The MCU has three operational modes:

- Status Display mode
- Volume Adjustment mode
- Set-up mode to select /control the features described in [Table 5-1](#) for activation on the CK49x Evaluation System.

**Note:** Standalone code is currently supported only for DC49530,DC49531, DC497024

### 5.1.1 Standalone Mode Setup

Follow these steps to set up the CK49x Evaluation System in Standalone mode.

1. *Connect the DSP daughter card* to the CK49x main board.
2. *Load the DSP with the Cirrus Licensed Technology Serial Flash Image.* The CK49x Evaluation System comes with the Cirrus Unlicensed Technology Serial Flash image that the Cirrus DSP uses to operate. The unlicensed technology Flash image does **not** contain any third-party algorithms such as PLLx or Neo6.

To access the functionalities such as Surround, Virtualizer, and Bass Management, described in this chapter, the user **must** load the Cirrus Licensed Technology Serial Flash Image. Refer to Section 7.3.2.1 of the CS4953x4/CS4970x4 System *Designer's Guide*, "Using the DSP Condenser Wizard to Create a Serial Flash Image." to program the DSP with the Cirrus licensed technology Serial Flash Image.

3. *Connect audio inputs* (SPDIF, HDMI, and Analog Input) to the CK49x Evaluation System.
4. *Connect powered speakers* to the CK49x Evaluation System.

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## 5.2 System Boot-up

If the USB cable **is** connected to the CK49x Evaluation System, the system will boot up in USB mode upon power up or system reset. The LCD displays “Wait for USB enumeration...” message first and then shows the board name, “CK49x”, “USB” which signifies that a USB connection is active, and the MCU firmware revision number that is currently active.

If the USB cable is **not** connected to the CK49x Evaluation System, the system will boot in Standalone mode on power up or system reset. The LCD displays “Booting 49x” and firmware revision number if DSP startup failed. Otherwise, the LCD displays “Booted 49x Successfully!” message and then goes to the Status Display mode.

If the MCU application does not recognize the installed daughter card, the user should check the connection between the DS4953x daughter card and the CDB49x main board, and, if necessary, reconnect the two boards. This action should correct any connectivity problems between the two boards.

## 5.3 Top-Level Description of the CK49x Evaluation System Buttons and Rotary Knob Functions

In Standalone mode, the functionality of the on-board buttons and Rotary Knob are defined as follows.

### MENU Button

By pressing the MENU button, the system enters Set-up mode, which allows the user to manually turn the S5 Button/Rotary Knob to cycle through the Level 1 menu options show in [Table 5-1](#). In this mode, the user can configure the audio source, surround sound mode, virtualization mode, and bass management mode. Pressing this button again exits the Set-up mode.

### LEFT Button

In the Set-up mode, pressing this button causes the menu selection that is visible on the LCD screen to move one menu level up in the menu hierarchy.

### RIGHT Button

In the Set-up mode, pressing this button causes the menu selection that is visible on the LCD screen to move one menu level down in the menu hierarchy, making a submenu option visible with a blinking cursor next to it. By pressing the Right Button again, the user can activate this submenu option. Once the option is chosen, an asterisk (\*) will appear next to the option indicating that the option is now the new default.

### EXIT Button

In Set-up mode or Volume Adjustment mode, pressing this button exits to Status Display mode.

[Figure 5-1](#) shows the location of the CK49x Evaluation System push buttons

## Button/Rotary Knob (S5)

In Setup mode, turning the Rotary Knob clockwise/counterclockwise displays next/previous option(s) on the menu respectively. Pressing this knob selects or activates the current option.

In Status Display mode, turning the Rotary Knob causes the system to enter Volume Adjustment mode. In this mode, turning the Rotary Knob clockwise/counterclockwise adjusts audio gain up/down. Pressing this knob again returns to the Status Display mode.

## Reset Button

Pressing this button causes the system hardware to reset.

Figure 5-1 shows the location of the CK49x Evaluation System push buttons, Rotary Knob, and Reset button.

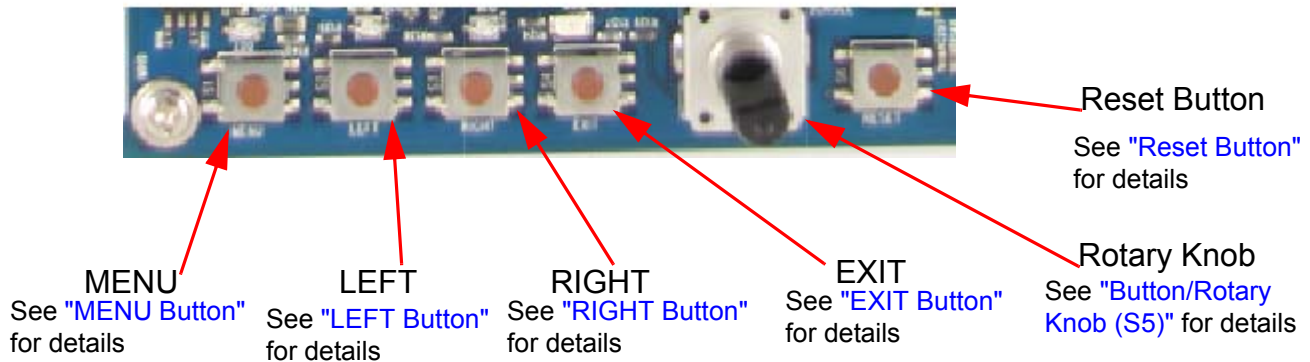


Figure 5-1. Close-up View of the CK49x Evaluation System Push Buttons and Rotary Knob

Table 5-1. Options for when S5 Button/Rotary Knob is Turned

Level 1 Menu Option	Level 2 Submenu Options	Level 3 Submenu Options
Audio Source>	<ul style="list-style-type: none"> <li>• SPDIF Input (Default)</li> <li>• HDMI Input</li> <li>• Analog Input</li> </ul>	

Table 5-1. Options for when S5 Button/Rotary Knob is Turned (Continued)

Level 1 Menu Option	Level 2 Submenu Options	Level 3 Submenu Options
Surround Sound>	None (Default)	
	Crossbar Mode>	<ul style="list-style-type: none"> <li>• Main</li> <li>• Main DZ</li> <li>• L R 7CH</li> <li>• L C R 7 CH</li> <li>• L R LS RS 7 CH</li> <li>• L C R LS RS 7</li> <li>• L R 5CH</li> <li>• L C R 5 CH</li> <li>• L C R LS RS 5</li> </ul>
	COMS2 Mode>	<ul style="list-style-type: none"> <li>• CLASSICA</li> <li>• HALL1</li> <li>• PANORAMA</li> <li>• ROM1</li> <li>• STADIUM</li> <li>• THEATER 1</li> <li>• 7STEREO</li> </ul>
	PL2X Mode>	<ul style="list-style-type: none"> <li>• Movie</li> <li>• Music</li> <li>• MC Movie</li> <li>• MC Music</li> <li>• DD EX</li> </ul>
	NEO6>	<ul style="list-style-type: none"> <li>• Cinema</li> <li>• Music</li> <li>• Matrix</li> </ul>
	RETURN	
	Virtualizer>	None (Default)
Virtualizer>	DVS2 Mode>	<ul style="list-style-type: none"> <li>• Reference</li> <li>• Reserved</li> <li>• Wide</li> </ul>
	HP2 Mode	<ul style="list-style-type: none"> <li>• Bypass</li> <li>• Reserved</li> <li>• DHMD</li> </ul>
	RETURN	
	Bass Management> (Continued on Next Page)	BM Mode: Bypass BM (Default)
	BM Mode: LLLLLL <sub>1</sub> <sup>1</sup>	
	BM Mode: SSSSSS <sub>1</sub> <sup>2</sup>	

Table 5-1. Options for when S5 Button/Rotary Knob is Turned (Continued)

Level 1 Menu Option	Level 2 Submenu Options	Level 3 Submenu Options
Bass Management> (Continued from Previous Page)	BM Mode:LSSSSS1 <sup>3</sup>	
EXIT		

- $X_0X_1X_2X_3X_4X_5Y_0$   
 $X_0 = L / R$   
 $X_1 = C$   
 $X_2 = LS$   
 $X_3 = RS$   
 $X_4 = LB$   
 $X_5 = RB$   
 - where L = Large and S = Small  
 $Y_0 = LFE$   
 - where 0 = no subwoofer and 1 = subwoofer present  
 so LLLLLL1 means all large speakers with a sub, also known as Dolby Bass Manager Configuration 0. See Section 3.1 of AN246PPB, "Standard Bass Manager Module".
- Dolby Bass Manager Configuration 1. See Section 3.2 of AN246PPB, "Standard Bass Manager Module".
- Dolby Bass Manager Configuration 2. See Section 3.3 of AN246PPB, "Standard Bass Manager Module".

## 5.4 Configuration Modes Details

### 5.4.1 Status Display Mode

The Status Display mode is the default display mode of the Standalone mode. It shows the current operation status on the LCD screen. The status message display shown in [Figure 5-2](#) rotates between the following settings every 4 seconds:

- Current audio source
- Current audio stream type (Displayed when audio stream is present.)
- Current audio stream channels (Displayed when audio stream is present.)
- Current audio stream sample rate (Displayed when audio stream is present.)
- Current surround sound mode
- Current virtualization mode



Figure 5-2. LED Status Display: Current Audio Stream Sample Rate



## 5.4.2 Adjusting Audio Volume

Follow these steps to adjust audio volume. See [Figure 5-3](#) to view the Volume Adjustment (Master Gain) mode on display on the system LCD.:

1. In the Status Display mode, turn the Rotary Knob either clockwise or counterclockwise to activate the Volume Adjustment (Master Gain) mode
2. Turn the Rotary Knob clockwise to increment the volume, while turning the knob counterclockwise decrements the volume.
3. To mute the audio, turn the Rotary Knob counterclockwise until it reaches the minimum level.
4. The Volume Adjustment mode automatically switches back to the Status Display mode after user activity has ceased for 20 seconds or when the Rotary Knob is pressed.



Figure 5-3. Using the Rotary Knob to Increments/Decrements the Volume

## 5.4.3 Selecting the Audio Source

Follow these steps to set the audio source. See [Figure 5-4](#) to view the Audio Source Selection display on the system LCD.:

1. Press the MENU button to enter Set-up mode.
2. Turn the Rotary Knob to select “Audio Source>” entry and press the knob or RIGHT button to select one of the Audio Source Selection options. Now the audio playback is from the selected source.
3. Press the MENU button or Exit button to exit the Set-up mode.



Figure 5-4. Setting the Audio Source

## 5.4.4 Selecting the Surround Sound Mode

Follow these steps to select one of the available Surround Sound modes. See [Figure 5-5](#) to view the Surround Mode display on the system LCD.

1. Press the MENU button to enter the Set-up mode.
2. Turn the Rotary Knob until “Surround Sound>” appears on the LCD screen. Press the Rotary Knob to access the set of available Surround Sound submenu options. Turn the Rotary Knob clockwise/ counterclockwise to browse through the submenu options. In the Surround Sound submenu, “None” disables surround sound and “RETURN” goes back to the top of the Set-up menu.

3. Press the RIGHT button or the Rotary Knob to activate the Surround Sound submenu option of your choice. Once the option is chosen, an asterisk (\*) will appear next to the option indicating that the option is now the new default.
4. Press the MENU or EXIT button to exit the Set-up mode.



Figure 5-5. Setting Surround Mode

### 5.4.5 Selecting the Virtualizer Mode

Follow these steps to select the Virtualizer Mode. See [Figure 5-6](#) to view the Virtualizer Mode display on the system LCD.:

1. Press the MENU button to enter Set-up mode.
2. Turn the Rotary Knob until "Virtualizer>" appears on the LCD screen. Press the Rotary Knob to access the set of available Virtualizer submenu options. Turn the Rotary Knob clockwise/ counterclockwise to browse through the submenu options. In the Virtualizer submenu, "None" disables the Virtualizer> mode and pressing "RETURN" goes back to top of the Set-up menu.
3. Press the RIGHT button or the Rotary Knob to activate the Virtualizer submenu option of your choice. Once the option is chosen, an asterisk (\*) will appear next to the option indicating that the option is now the new default.
4. Press the MENU or EXIT button to exit the Set-up mode.



Figure 5-6. Setting the Virtualizer Mode

### 5.4.6 Selecting the Bass Management Mode

Follow these steps to select the Bass Management Mode. See [Figure 5-7](#) to view the Bass Management Mode display on the system LCD.:

1. Press the MENU button to enter Set-up mode.
2. Turn the Rotary Knob until "Bass Management>" appears on the LCD screen. Press the Rotary Knob to access the set of available Bass Management submenu options. Turn the Rotary Knob clockwise/ counterclockwise to browse through the submenu options.
3. Press the RIGHT button or the Rotary Knob to activate the Bass Management submenu option of your choice. Once the option is chosen, an asterisk (\*) will appear next to the option indicating that the option is now the new default.
4. Press the MENU or EXIT button to exit the Set-up mode.



Figure 5-7. Setting the Bass Management Mode

## 6.1 Obtaining Schematic Updates

Updates to the schematics for the CK49x Development Board can be found in the Schematics menu accessed via Start > All Programs > Cirrus Logic DSP > Schematics after installing the Cirrus DSP eval kit or the Cirrus DSP SDK. The schematics are provided in Adobe's PDF and PADS™ format.

The latest schematics are included in Cirrus DSP full eval kit and Cirrus DSP SDK. After installing the eval kit or the SDK, the schematic and the PADS format .pcb file for the latest revision of the CDB49x base board can be found in C:\CirrusDSP\schematics\CDB49x\_<rev> folder, assuming the SDK or eval kit is installed into C:\CirrusDSP\ folder.

### 6.1.1 CK49x Daughter Card Schematics

The daughter card schematics in PDF and PADS formats are available with the evaluation kit installer. When the Cirrus DSP SDK or the Cirrus DSP full eval kit is installed, the schematics are saved in C:\CirrusDSP\schematics\CDB49XXXX-DC\_<rev>, assuming the SDK or eval kit is installed into the C:\CirrusDSP\ folder.

#### 6.1.1.1 DC4953xx Daughter Card Modification

Refer to [Appendix A](#) for the serial flash related modification on DC4953x3 daughter cards.

## 7.1 Troubleshooting Guide

This section provides solutions to problems that users might experience when using the CK49x.

### 7.1.1 Power LEDs

Problem: Power LEDs are not illuminated.

- Possible cause: **DC power supply is not connected to CK49x.**

**Solution:** Ensure the DC wall supply is connected to the DC power input jack (J25), and the supply is plugged into a wall outlet and the power switch is set to the On position.

### 7.1.2 Board not Recognized by PC

Problem: CK49x is not Recognized by PC

- Possible cause: **DC power supply is not connected to CK49x.**

**Solution:** The CK49x is not a USB-powered device. Make sure the DC wall supply is connected to the DC power input jack (J25), and the supply is plugged into a wall outlet and the power switch is On.

- Possible cause: **CK49x USB Drivers not installed before connecting to PC.**

**Solution:** Follow these steps:

1. Pull the DC power plug on the CK49x.
2. Open the device manager on the PC and search for the "Opal Kelly" device under "USB Devices".
3. If there is a question mark next to the device, right click on it and open "Properties." Press the "Update Driver" button and let Windows automatically find the driver.
4. Wait 3 seconds, and plug the DC power supply back in.

### 7.1.3 Audio is not Heard

Problem: Audio cannot be heard.

Possible cause: **S/PDIF Source is not connected to RX0.**

**Solution:** Follow the instructions in ['Running a Stereo PCM Application on CK49x on page 3-6](#) and ensure that an audio source is connected to RX0 using an optical cable.

---

### 7.1.4 Only Stereo Audio is Heard

Problem: Only Stereo Audio is heard even when delivering a multi-channel compressed audio stream (e.g. Dolby Digital, DTS).

Possible cause: **DVD Player is not configured properly.**

**Solution:** DSP is auto detecting a PCM stream and playing the 2-channel PCM. Navigate to the audio setup for the DVD player and set to "Bitstream Out" instead of "PCM Out."

## Appendix A

# Modification for the Serial Flash Chip Select Signal on DC4953x3

This modification should be present on daughter cards populated with CS495303 and CS495313 to enable Host Controlled Master Boot from the serial flash connected to SCP2 port of the DSP.

1. Refer to [Figure A-1](#).
2. Remove R93
3. Connect wire from pin 38 of U1 (DSP) to pad 1 of R93.

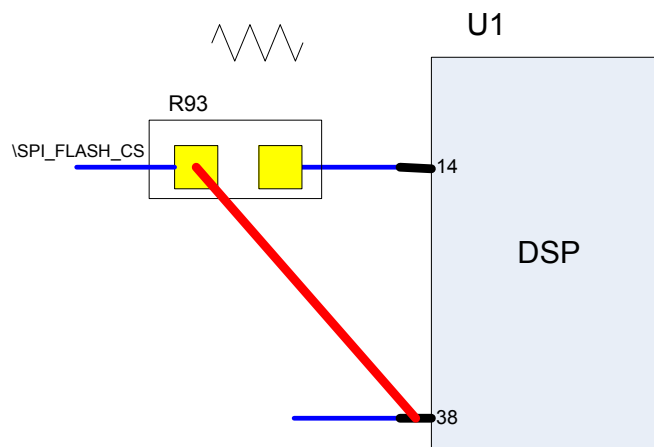


Figure A-1. Flash Chip Select for DC4953x3

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## Appendix B

### DAI I2S Play Back Header

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#### B.1 DAI I2S Play Back Header

See [Figure B-1](#) for DC1: DAI Record and Asio Play Block Diagram. See [Figure B-2](#) for DC1: DAI Record and Asio Play.



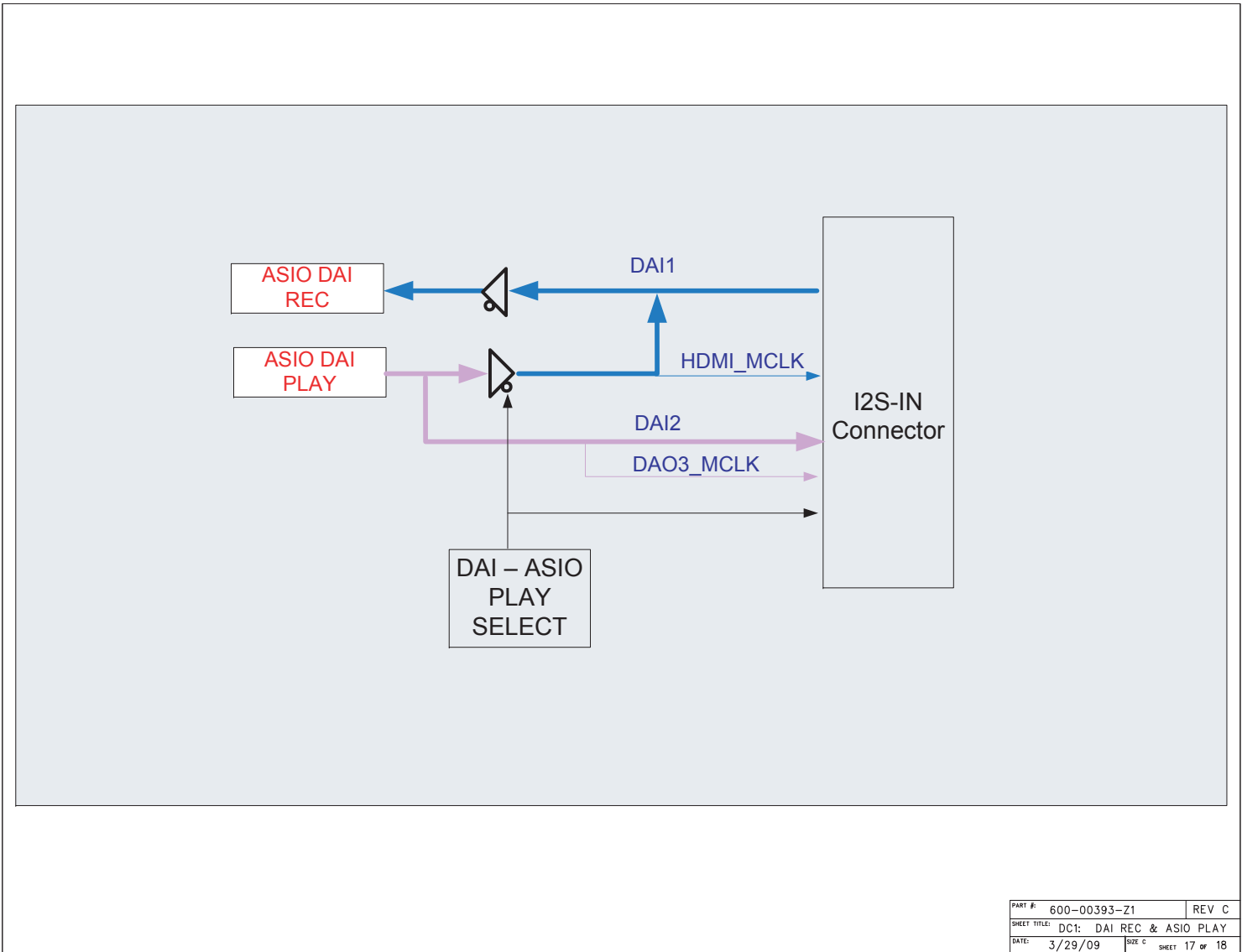


Figure B-1. DC1: DAI Record and Asio Play Block Diagram

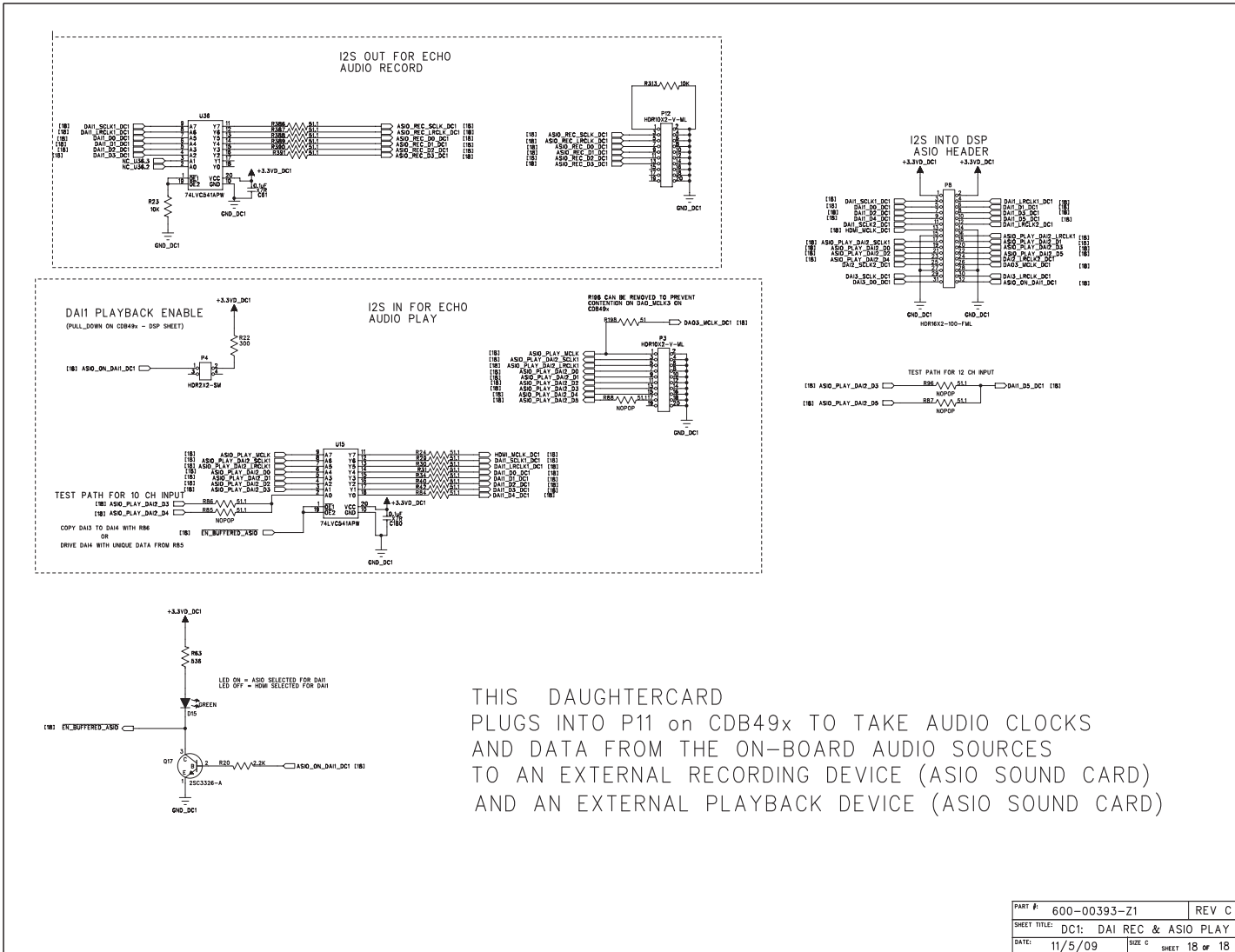


Figure B-2. Figure A-2. DC1: DAI Record and Asio Play

## CDB49x Rev. A Rework for I<sup>2</sup>C Buffer on SCP\_CLK

### C.1 Modifications to Improve the Signal Integrity of I<sup>2</sup>C Communications

The rework instructions in this appendix apply only to Rev. A of the CDB49x, and it is only necessary if the user wants to communicate with the DSP using I<sup>2</sup>C rather than SPI. The board is configured to use SPI by default, as SPI is a much faster protocol than I<sup>2</sup>C.

In order to improve the signal integrity of I<sup>2</sup>C communications, a modification has been created to buffer the SCP\_CLK signal driven from the PCA9517 buffer and make its falling edge cleaner at the DSP.

1. Cut the SCP\_CLK trace on the bottom of board as shown in yellow.
2. Connect Pin 5 of NC7SZ125 buffer to 3.3V on J4.2
3. Connect the 3.3k resistor between pins 1 and 5 of NC7SZ125 buffer
4. Scrape the solder mask off the plane on the bottom of the board and connect to Pins 2 and 3 of NC7SZ125 buffer
5. Connect 15  $\Omega$  resistor to Pin 4 of the NC7SZ125 buffer and the other end of resistor to exposed end of cut trace closest to J4.2 in [Figure C-1](#)

[Figure C-1](#) shows the modifications made in Steps 1 to 5 on the actual board layout.

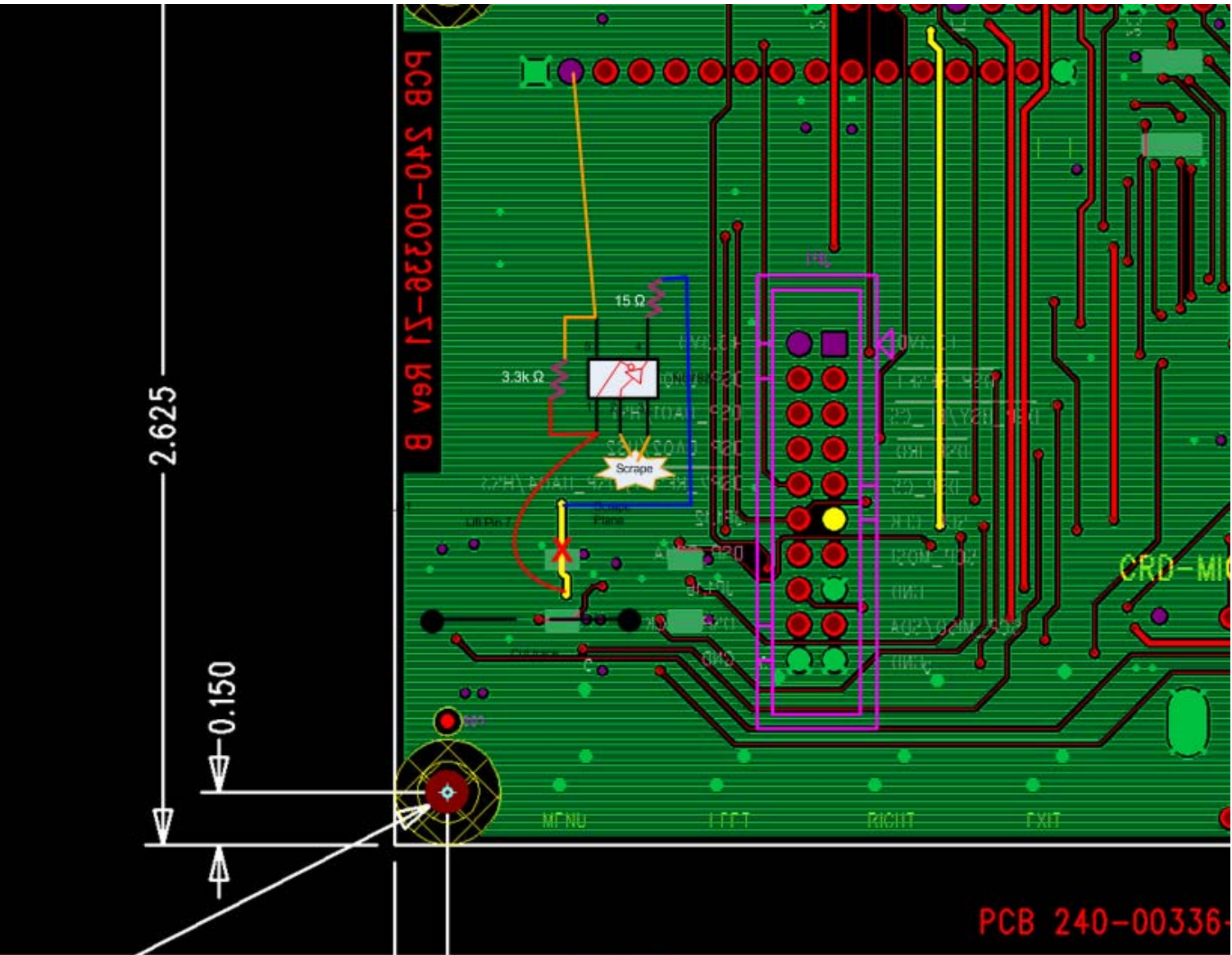


Figure C-1. Appendix D Modifications Shown on the Actual Board Layout

Figure C-2 shows the logical representation of the Appendix D Modifications

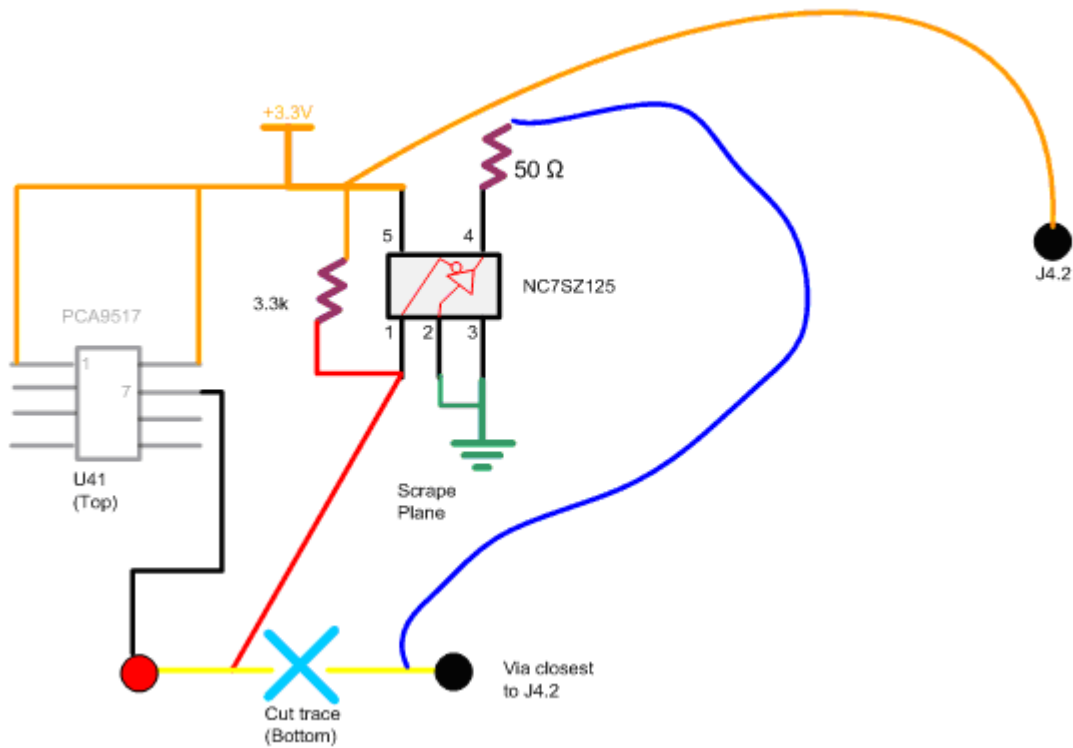


Figure C-2. Logical Representation of the Modifications Described in this Appendix

## CDB49x Rev. A Rework for I<sup>2</sup>C Buffer on DBCK Signal

### D.1 Modifications to Improve the Signal Integrity of Debugger Communications

The rework instructions in this appendix apply only to Rev. A of the CDB49x, and it is only necessary for use of the proprietary debug port connected to the DSP. Normal demonstration features are not affected by this modification.

In order to improve the signal integrity of I<sup>2</sup>C communications, a modification has been created to buffer the DBCK signal driven from the PCA9517 buffer and make its falling edge cleaner at the DSP.

1. Lift Pin 47 of U41.
2. Connect Pin 5 of the NC7SZ125 buffer to 3.3V.
3. Connect Pin 7 of U41 to Pin 1 of the NC7SZ125 buffer.
4. Connect a 3.3k resistor between Pins 1 and 5 of the NC7SZ125 buffer.
5. Connect Pins 2 and 3 of the NC7SZ125 buffer to GND on JP1.19 or JP1.20
6. Wire Pin 4 of the NC7SZ125 buffer to a 50  $\Omega$  resistor, and connect the other end of the resistor to JP1.18

Figure D-1 shows the logical representation of the modifications

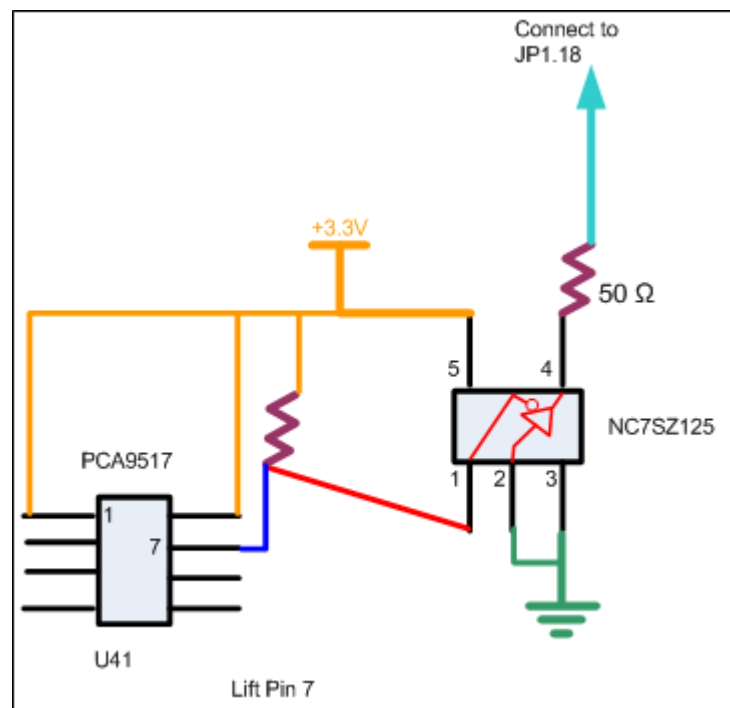


Figure D-1. Logical Representation of Appendix D Modifications.

## Revision History

Revision	Date	Changes
CK1	February, 2010	Initial release.
CK2	March, 2010	Updates related to DC4953x3 and DC4970x4
CK3	June, 2010	Updated Chapter 4 with updated screen captures
CK4	February, 2011	<p>Added the following note at the end of <a href="#">Section 3.1.5</a>, <a href="#">Section 3.1.7</a>, and <a href="#">Section 3.1.8</a></p> <p>“Note: Click on File-&gt;Properties in DSPComposer and make sure the board connected field is set to CDB49x.”</p> <p>In <a href="#">Section 6.1.1.1</a>, the text "Use the DC49530 card daughter when implementing firmware other than firmware from DTS" was changed to "Use the DC497014 card daughter when implementing firmware other than firmware from DTS."</p> <p>In <a href="#">Section 6.1.1</a>, the text "...the schematics are saved in C:\CirrusDSP\schematics\DC4953x folder" was changed to "...the schematics are saved in the C:\CirrusDSP\schematics\DC4953xx_DC497xx folder, assuming the SDK or eval kit is installed into C:\CirrusDSP folder"</p> <p>The following sentence was added to <a href="#">Section 6.1</a>: "The latest schematics are also included in Cirrus DSP full eval kit and Cirrus DSP SDK. After installing the eval kit or the SDK, the schematic and the PADS format .pcb file for the latest revision of the hardware can be found in C:\CirrusDSP\schematics\CDB49x_&lt;rev&gt; folder, assuming the SDK or eval kit is installed into C:\CirrusDSP folder."</p>
CK5	December, 2011	Updated language referring user to schematics menu in <a href="#">Section 6.1</a> . Added assumption statement to <a href="#">Section 6.1.1</a> . Added <a href="#">Appendix A - DAI I<sup>2</sup>S Play Back Header</a> .
CK6	August, 2012	Added note to <a href="#">Section 3.1.3</a> regarding USB connectivity issues.
CK7	December, 2012	Added board image to cover page.