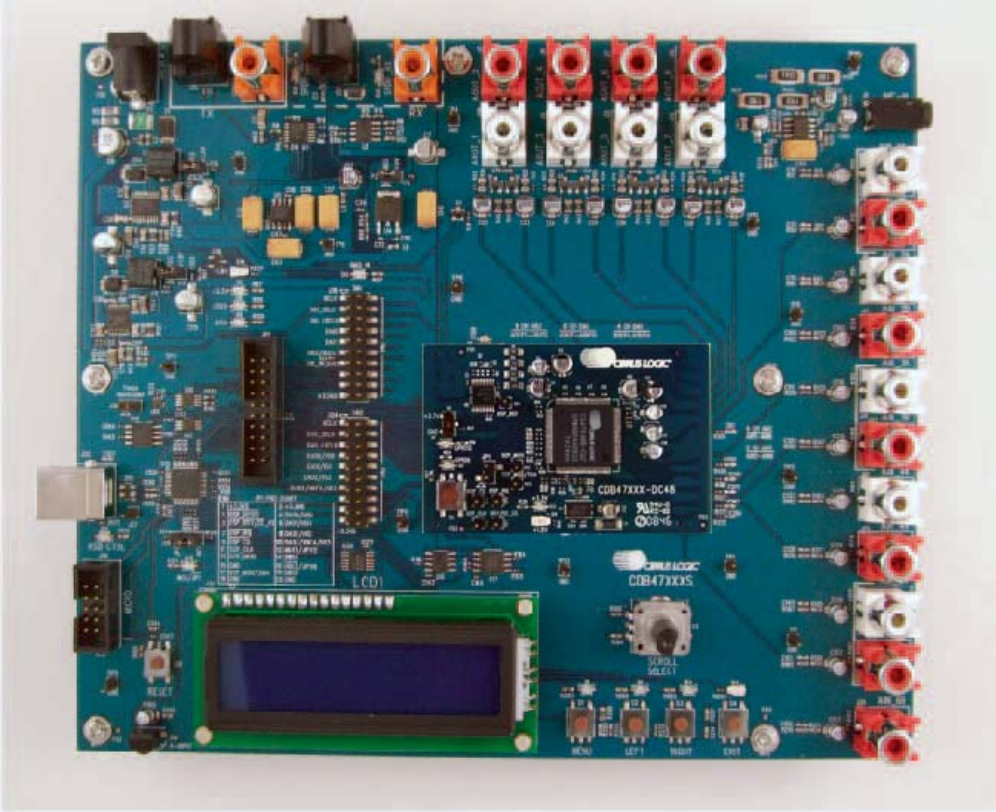
CDB47xxx
Evaluation Kit

CDB47xxx

User's Manual



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Chapter 1

Kit Contents and Requirements

1.1 CDB47xxx Kit Contents

Each CDB47xxx kit comes with the items listed in Table 1-1.

Table 1-1. CDB47xxx Kit Contents

CRD Kit	Item	Quantity
CDB47xxxS-DC48 CDB47xxxS-DC28 CDB47xxxS-DC24	CDB47xxxS Single-Ended Development Board with integrated MCU & USB interface with daughtercard populated with either the CS47048, CS4028, or CS47024 DSP.	1
CDB47xxxD-DC48 CDB47xxxD-DC28 CDB47xxxD-DC24	CDB47xxxD Differential Development Board with integrated MCU & USB interface with daughtercard populated with either the CS47048, CS4028, or CS47024 DSP.	1
CDB47xxxS-DCxx CDB47xxxD-DCxx	Power Supply: +9V, 2A, 100V - 240V with AC Power Cord	1
CDB47xxxS-DCxx CDB47xxxD-DCxx	USB Cable	1
CDB47xxxS-DCxx CDB47xxxD-DCxx	Document Card explaining how to get the latest board software	1

Figure 1-1 and Figure 1-2 show the kit contents for the CDB47xxxS-DCxx (Single-ended) and CDB47xxxD-DCxx (Differential) development boards respectively.

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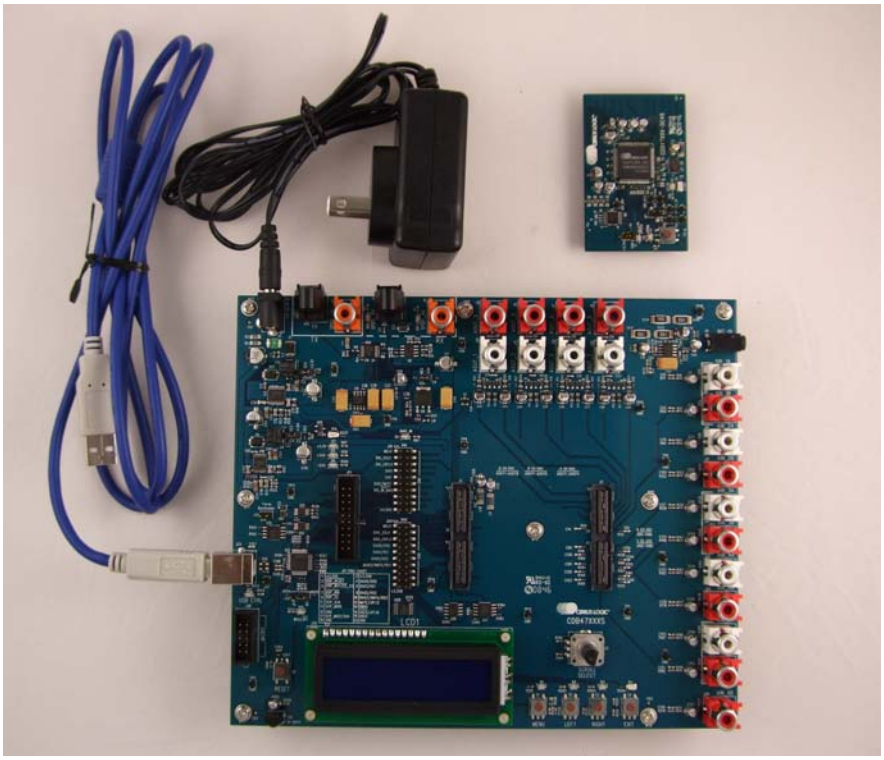

Figure 1-1. CDB47xxxS-DCxx Kit Contents

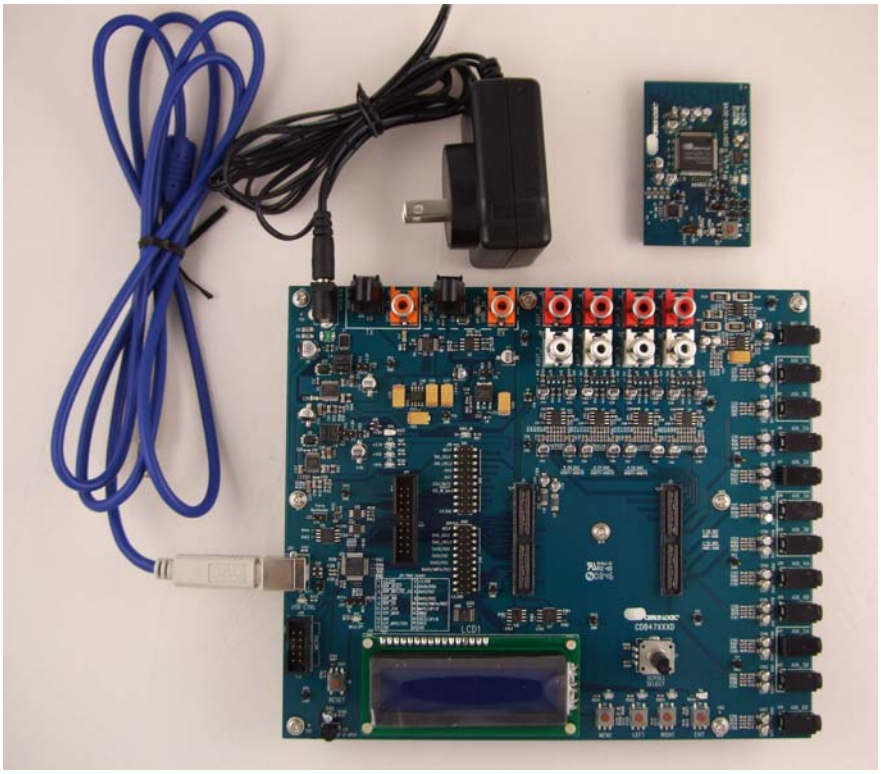

Figure 1-2. CDB47xxxD-DCxx Kit Contents

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1.2 Requirements

1.2.1 PC Requirements

- Microsoft® Windows® XP with Service Pack 2 or higher or Windows 7 (32– or 64–bit) Operating System
- USB 2.0 Support

1.2.2 Software Requirements

- Cirrus® Evaluation 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 – S/PDIF optical cables, RCA audio cables (Connect to digital audio card, audio analyzer, or DVD player.)
- Digital Audio Output – S/PDIF Optical cable, RCA audio cable (Connect to digital audio card, audio analyzer, or AVR.)
- Analog Audio Inputs – 1/8" stereo plug microphone cable (Connect microphone to ADC), RCA audio cables (**CDB47xxxS only**), 1/8" stereo plug differential cable (**CDB47xxxD only**)
- Analog Audio Outputs – RCA audio cables (Connect CDB47xxx line-level outputs to powered speakers.)

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1.3 CDB47xxx Main Board System Description

A detailed block diagram of the CDB47xxxS Development Board is shown in Figure 1-3. The block diagram of the CDB47xxxD Development Board is shown in Figure 1-4 The sections that follow provide a detailed description of each block.

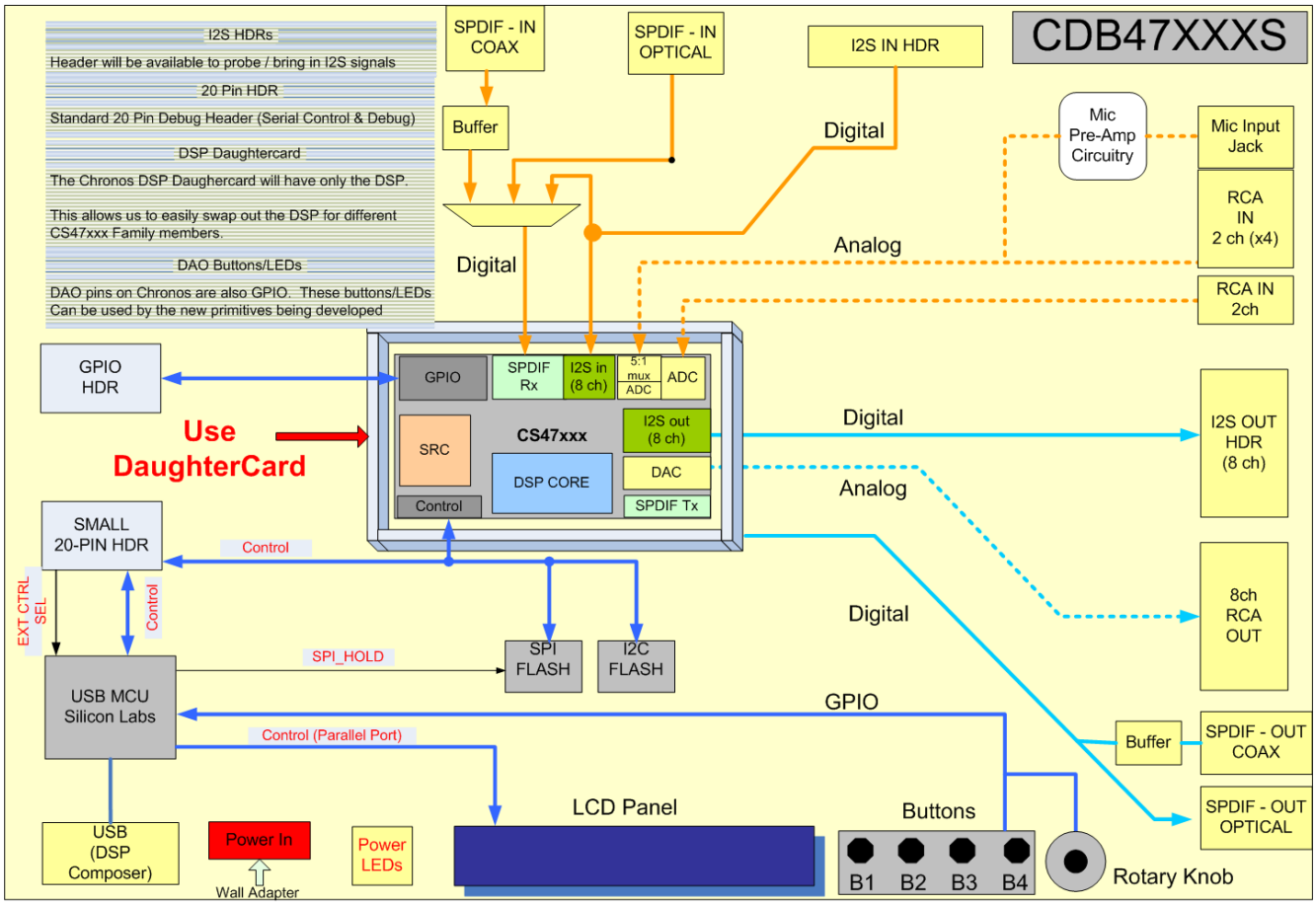

Figure 1-3. CDB47xxxS Main Board Block Diagram

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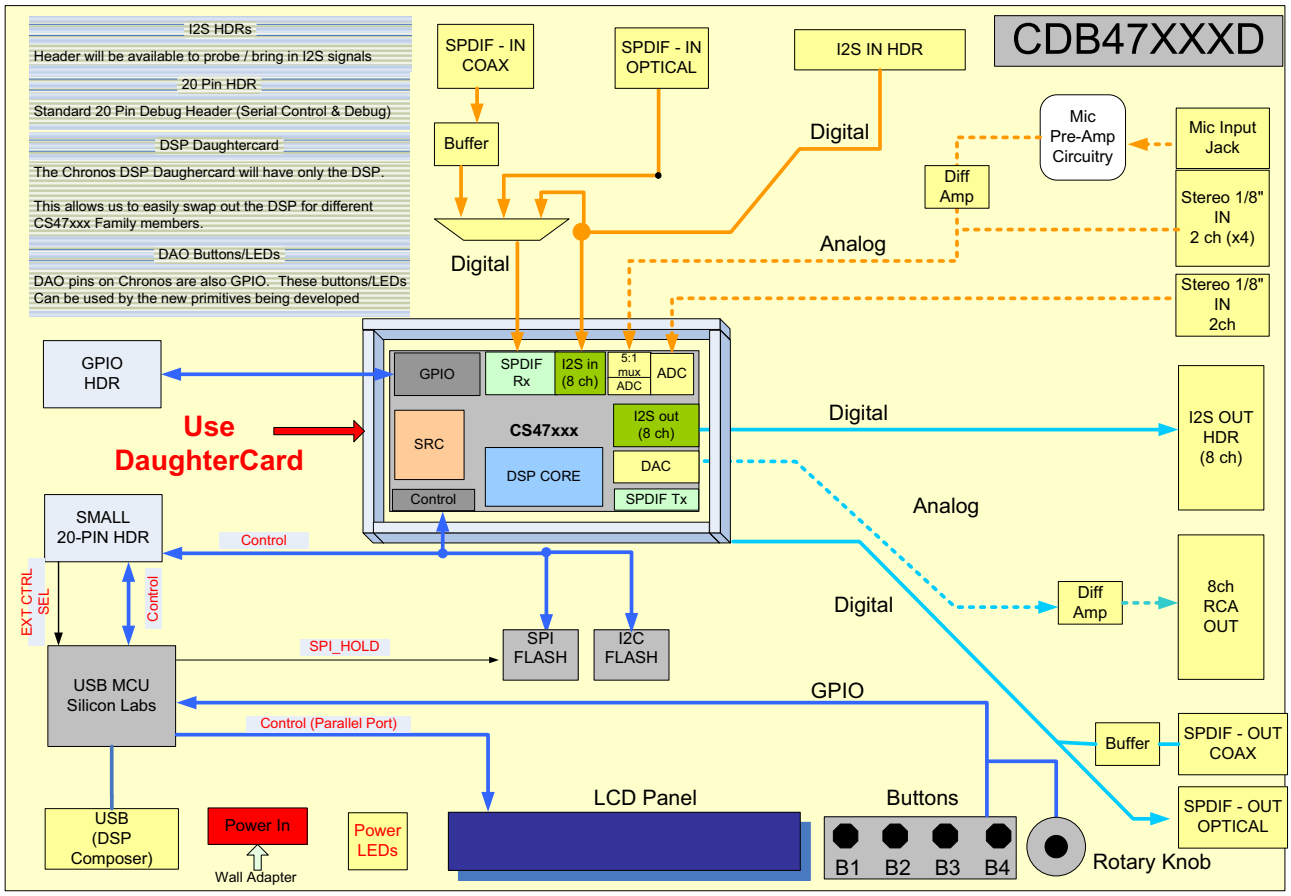

Figure 1-4. CDB47xxxD Main Board Block Diagram

1.3.1 Audio Inputs

1.3.1.1 Analog Line-level Inputs -- Single-Ended (CDB47xxxS only) (AIN1A - AIN5B, AIN6B)[1]

Analog line-level inputs have the following characteristics:

- Connector Type: RCA Female
- Absolute Maximum Signal Level: 8Vp-p
- Full Scale Amplitude: 2VRMS

1.3.1.2 Analog Line-level Inputs -- Differential (CDB47xxxD only) (AIN1A - AIN5B, AIN6B)

Analog line-level inputs have the following characteristics:

- Connector Type: 3.5mm (1/8") Stereo Female
- Absolute Maximum Differential Signal Level: 16Vp-p
- Full Scale Differential Amplitude: 4VRMS

1. Reference designators are listed at the end of the heading for each board component listed in this chapter.

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1.3.1.3 Optical Digital Input (J21)

Optical digital inputs have the following characteristics:

- Connector Type: Fiber Optic RX for Digital Audio, JIS F05 (TOSLINK)

1.3.1.4 Coaxial Digital Input (J4)

Coaxial digital inputs have the following characteristics:

- Connector Type: RCA Female
- Input Impedance: 75Ω
- Maximum Signal Level: 1.5Vp-p
- The CDB47xx-S, CDB47xx-D Rev B can accept 500mV Vpp signal to be amplified so that the S/PDIF Rx pin on the DSP gets a digital signal with 2V swing compatible with Vih and Vil input voltage thresholds of the DSP.

1.3.1.5 Microphone Input (J9)

The microphone input has a stereo connector, but only the LEFT channel is used for the microphone input. This input has the following characteristics:

- Connector Type: 3.5mm (1/8") Stereo Female
- Absolute Maximum Signal Level: 8Vp-p
- Full Scale Amplitude: 20mVp-p

1.3.1.6 DSP Digital Audio Input (DAI) (J18 or DAI)

The DAI connector has the following characteristics:

- Connector Type: 2x10, 0.100 inch Male Header
- Absolute Maximum Signal Level: +3.6V
- Absolute Minimum Signal Level: -0.3V

1.3.2 Audio Outputs

1.3.2.1 Main Analog Line-level Outputs (CDB47xxxS and CDB47xxxD) (J5-J8, J10-J13, or AOUT_1 - AOUT_8)

Analog line-level outputs are RCA connectors on both the single-ended and differential boards. The CDB47xxxD board has a differential to single-ended amplifier that feeds the RCA connectors. The outputs have the following characteristics:

- Connector Type: RCA Female
- Full Scale Amplitude: $2V_{RMS}$

1.3.2.2 Optical Digital Output (J1)

The optical digital output has the following characteristics:

- Connector Type: Fiber Optic TX for Digital Audio, JIS F05 (TOSLINK)

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1.3.2.3 Coaxial Digital Output (J35)

The coaxial digital output has the following characteristics:

- Connector Type: RCA Female
- Maximum Signal Output Level: 1Vp-p into 75Ω load

1.3.2.4 DSP Digital Audio Output (DAO) (J24 or DAO)

The DAO connector has the following characteristics:

- Connector Type: 2x10, 0.100 inch Male Header
- Absolute Maximum Signal Level: +3.6V
- Absolute Minimum Signal Level: -0.3V

1.3.3 DC Power Input (J2)

The DC power input has the following characteristics:

- Voltage Range: +9VDC TO +12VDC
- Minimum Power: 18W supply (2A @ 9V)
- Connector Type: 2mm female barrel connector with a positive center pin

1.3.4 External Control Header (JP1)

The control header has the following characteristics:

- Connector Type: 2x10, 0.100 inch Shrouded Male
- Absolute Maximum Signal Level: +3.6V
- Absolute Minimum Signal Level: -0.3V

This connector is the interface between the CS470xx DSP and an external host. This connector is used to control the DSP when the on-board MCU is bypassed.

1.3.5 USB Connector (J25)

The control header has the following characteristics:

- Connector Type: USB Connector
- Absolute Maximum Signal Level: +5V
- Absolute Minimum Signal Level: -0.3V

1.3.6 On-Board Voltage Selection Headers (P1-P3)

The on-board voltage selection headers have the following characteristics:

- Connector Type: 1x2, 0.100 inch, Stake Header

The CDB47xxx is designed to operate from a single DC power input. The 9V power supply provided with the kit is connected to the DC power input jack (J22) and is regulated down to the system voltages (5V, 3.3V, 1.8V). The power selection headers should be installed when using the DC wall supply. This is the default mode of operation and should not need to be changed for most applications.

It is possible to bypass the regulated power supplies for any of the voltages by removing the jumper from the appropriate power selection header, and connecting an external voltage supply to pin 2 of that

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selection header. Pin 1 of each header is marked with a triangle and the word "REG". Pin 2 of each header is labeled with the voltage required for that pin (+5V, +3.3V, or +1.8V).

1.3.7 Digital Audio Input Source Multiplexer (U1)

The audio input source multiplexer has the following characteristics:

- Source 1: Optical S/PDIF Input
- Source 2: Coaxial S/PDIF Input
- Source 3: Digital Audio Input (DAI) Header

This multiplexer is used to select which audio source feeds the CS470xx DAI3 pin. When the CS470xx has DAI3 configured as a S/PDIF receiver, either Source 1 or Source 2 can be selected by the MCU. When DAI3 is configured as a standard I2S input, Source 3 can be selected as the data source.

The CDB47xxx has been designed to indicate which input is currently selected by illuminating a specific LED for each Source, as described below:

- Source 1 selected: D12 will be on
- Source 2 selected: D51 will be on
- Source 3 selected: D5 will be on

1.3.8 CS470xx Audio System-On-a-Chip (ASOC)

The CS470xx ASOCs are a family of ICs designed specifically for audio applications. The CDB47xxx allows a designer to evaluate the CS470xx ASOCs in many different modes of multi-channel input and output. The 100-pin footprint on the daughtercard is compatible with any CS470xx chip that uses the LQFP100 package.

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

- Line-Level Analog Audio Input Connectors
- Optical S/PDIF Input Connector
- Coaxial S/PDIF Input Connector
- DAI Header

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

- Line-Level Analog Audio Output Connectors
- Optical S/PDIF Output Connector
- Coaxial S/PDIF Input Connector
- DAO Header

The CS470xx can be booted from external serial Flash for custom applications in which a host MCU is not desired.

The CDB47xxx also allows the PC to act as a host to boot and configure the DSP through the GUI software for real-time configuration of the audio processing.

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1.3.9 C8051 MCU

The C8051 (U15) is a USB slave controller and general purpose MCU used to control the CDB47xxx Board in stand-alone applications, and also used to interface to the PC through the USB port (DSP Composer). Standalone applications can be as simple as using the MCU to configure the inputs on the board to feed the DSP and provide a power-on-reset (POR) to the DSP. But standalone applications can also take advantage of the LCD display, buttons, and rotary encoder to provide a user interface that is managed by the C8051.

When DSP Composer is needed to perform real-time application development on the CS470xx, the USB port should be used to connect the CDB47xxx Board to a PC that has DSP Composer™ installed.

1.3.10 MCU Input: Push Buttons(S1-S4) and Rotary Encoder (S5)

The C8051 can accept user input through the buttons on the CDB47xxx when USB is not connected.

There are 4 momentary contact push-buttons provided.

There is also a rotary encoder knob that can be used to scroll up and down through options provided through the MCU interface. The rotary encoder has an integrated momentary contact push-button that is activated by pushing down on the knob.

1.3.11 MCU Output (LCD) (LCD1)

The C8051 can provide feedback to the user through the on-board LCD when USB is not connected.

1.3.12 Memory (U17, U16 and U14))

The CDB47xxx is assembled with a 32-Mbit SPI Flash (U17) and a 512-kbit I^2C Flash (U16) which are dedicated for DSP firmware and configuration data. The serial control lines are routed down from the DSP through the daughter-card connectors.

There is an additional 32-Mbit SPI Flash component on the board (U14) that is used only to store MCU firmware, and it is not required by the DSP.

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1.4 CDB47xxx Daughtercard System Description

The CS470xx Audio SOC Daughtercard is exactly the same for both the CDB47xxxS and CDB47xxxD evaluation kits. All of the analog and digital audio signals are fed to the CS470xx (U1) through the daughtercard connectors (J2 - J3). All of the analog pins of the CS470xx are connected to the analog daughtercard connector (J3). The distinction between a differential system and single-ended system is made on the main board where either the full differential pair is used, or only the positive (+) half of the pair.

A detailed block diagram of the CDB47xxxD(or S)-DC48 daughtercard for single-ended or differential platforms is shown in Figure 1-5. The CDB47xxxD (or S)-DC28 and CDB47xxxD (or S)-DC24 daughtercards for single-ended or differential platforms are shown in Figure 1-6 and Figure 1-7 respectively. The sections that follow provide a detailed description of each block.

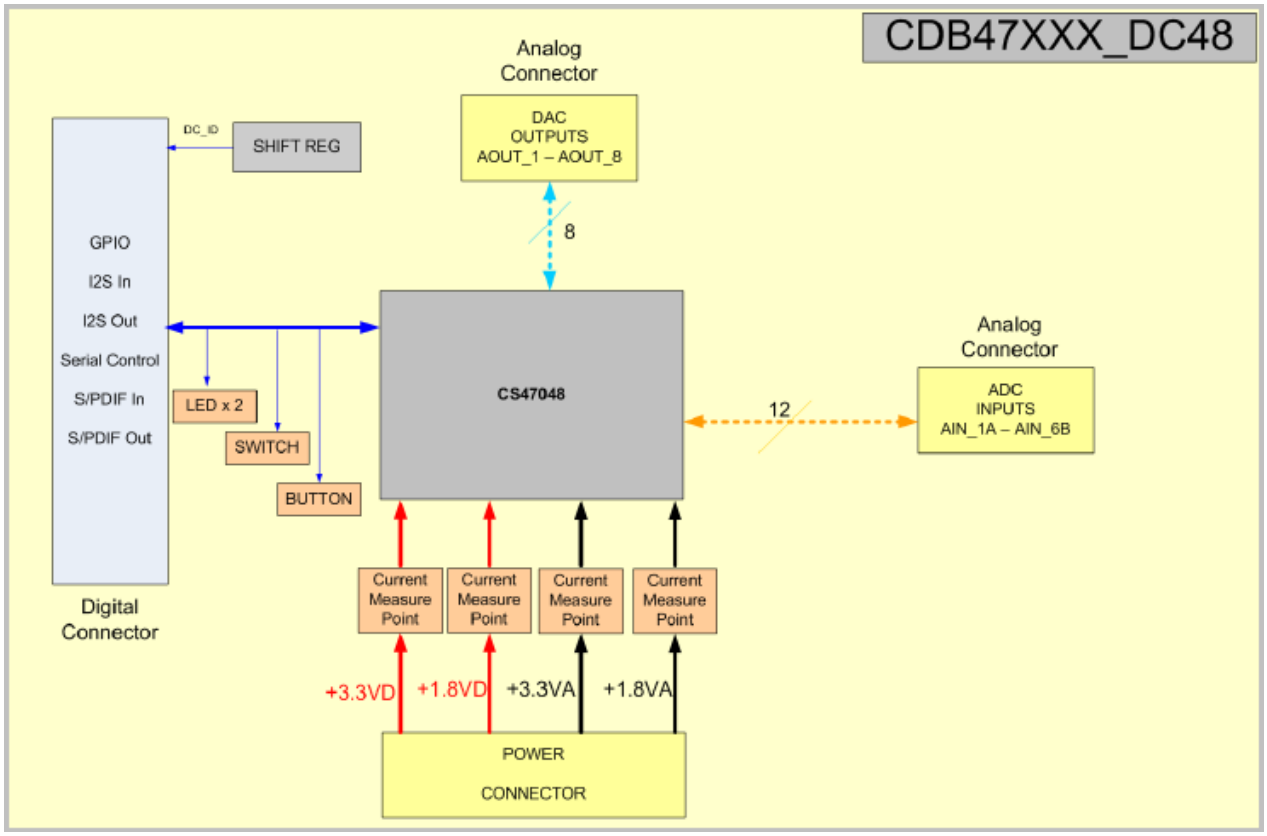

Figure 1-5. CDB47xxx-DC48 Daughtercard Block Diagram

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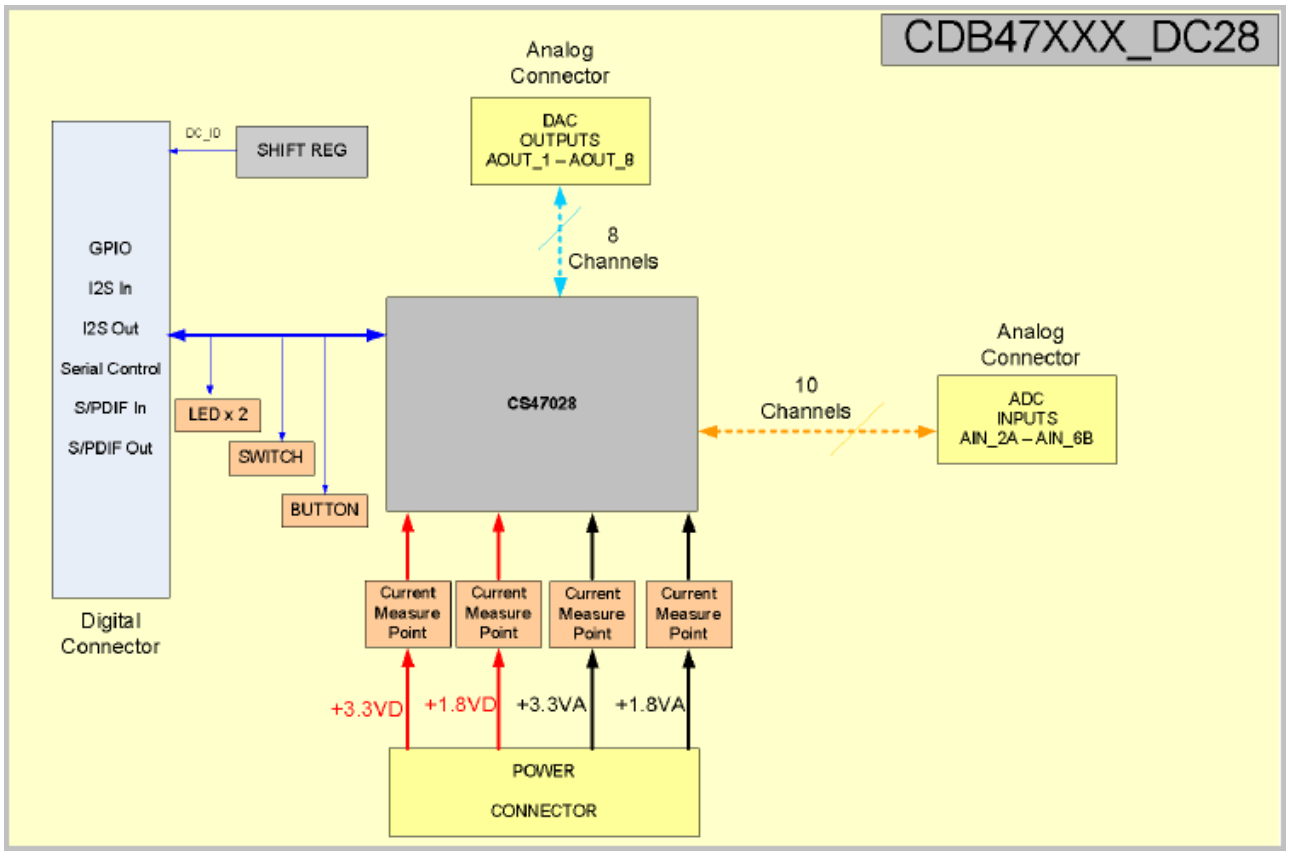

Figure 1-6. CDB47xxx-DC28 Daughtercard Block Diagram

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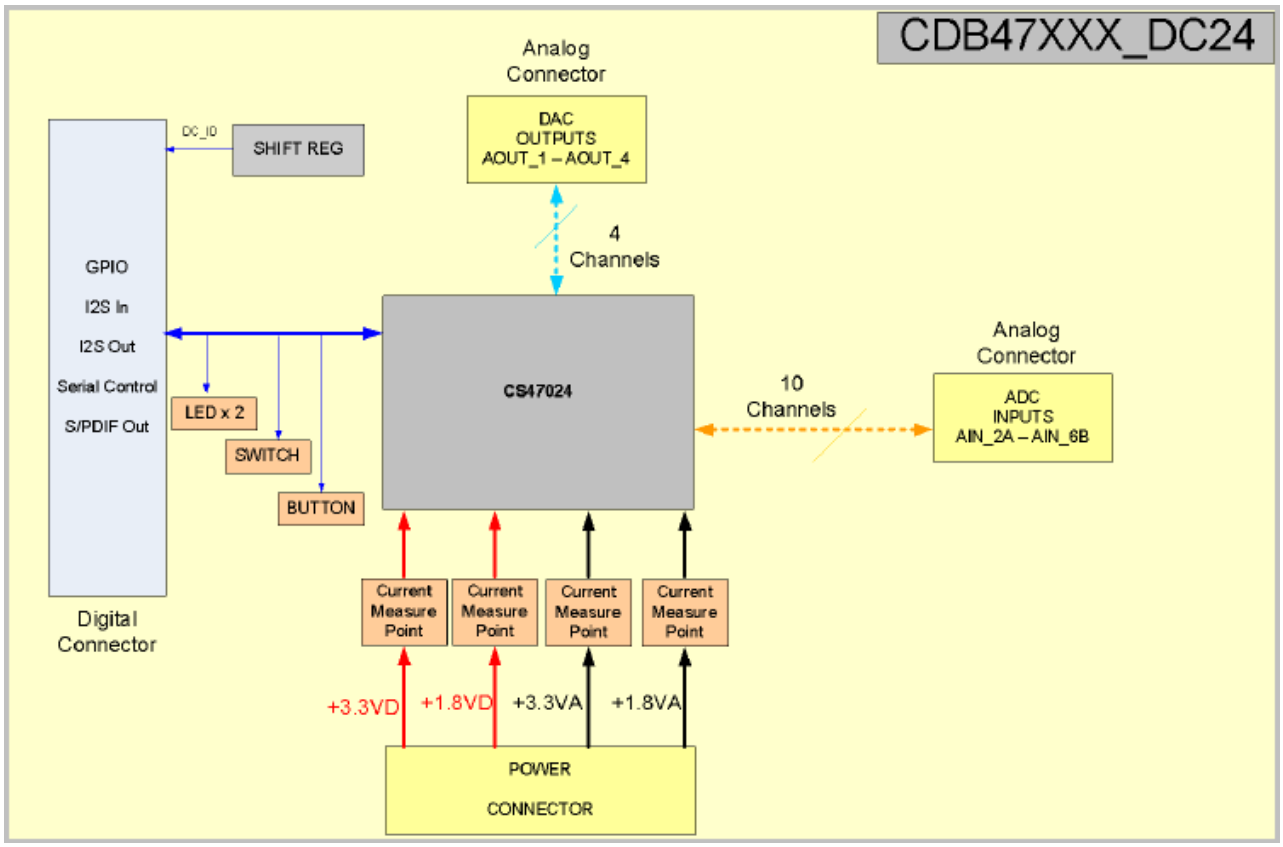

Figure 1-7. CDB47xxx-DC24 Daughtercard Block Diagram

1.4.1 Audio Inputs

1.4.1.1 Analog Line-level Inputs (J3)

Analog line-level inputs have the following characteristics:

- Connector Type: High-Density High-Speed Shrouded Female Connector
- Absolute Maximum Signal Level: These signals should only be driven from the connectors on the main board. Voltages should comply with the Max Signal Level specification for the main board circuitry.

1.4.1.2 Digital Audio Inputs (DAI) (J2)

The DAI connector has the following characteristics:

- Connector Type: High-Density High-Speed Shrouded Female Connector
- Absolute Maximum Signal Level: +3.6V
- Absolute Minimum Signal Level: -0.3V

This connector passes all serial audio data and clock signals up from the main CDB47xxx board.

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1.4.2 Audio Outputs from the CS470xx DSP

1.4.2.1 Analog Line-level Outputs (J3)

Analog line-level outputs have the following characteristics:

- Connector Type: High-Density High-Speed Shrouded Female Connector
- Maximum Signal Output Level: These signals should only be driven from the connectors on the main board. Voltages will comply with the Max Signal Level specification for the main board circuitry.

1.4.2.2 Digital Audio Outputs (DAO) (J2)

The DAO connector has the following characteristics:

- Connector Type: High-Density High-Speed Shrouded Female Connector
- Absolute Maximum Signal Level: +3.6V
- Absolute Minimum Signal Level: -0.3V

This connector passes all serial audio data and clock signals up from the main CS47xxx board.

1.4.3 Control Header (J2)

The control header has the following characteristics:

- Connector Type: High-Density High-Speed Shrouded Female Connector
- Absolute Maximum Signal Level: +3.6V
- Absolute Minimum Signal Level: -0.3V

This connector passes all serial control signals up from the main CS47xxx board.

1.4.4 User Input (S1 and S2)

The CS470xx can be configured to accept user input through the slide switch and button on the daughtercard. The button and switch are connected to GPIO pins on the ASOC which are monitored by the DSP. This feature is firmware dependent and may not be available in all applications.

There is a slide switch (S1) provided. It can connect Pin 7 (GPIO0) of the DSP to either 3.3V or ground through a 10K resistor on the DSP.

There is a momentary contact push-button (S2) provided. When pressed it connects Pin 19 (GPIO3) to 3.3V through a pull-up resistor.

1.4.5 User LED Output (D1and D2)

The CS470xx can be configured to provide user feedback through LEDs on the daughtercard. This feature is firmware dependent and will not be available in all applications.

There are 2 LEDs provided for user feedback. These LEDs light up when their associated GPIO pin is driven low by the DSP. The LEDs map to their pins as follows:

- LED D1 is connected to pin 7 (GPIO16) of the DSP.
- LED D2 is connected to pin 18 (GPIO6) of the DSP.

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1.5 Audio Clocking

Clocking architecture is one of the most important aspects of an audio system. This can also be one of the most complicated parts of a system design to insure that clocking is valid and stable for all scenarios. This is one of the major advantages of the CS470xx Audio System On-a-Chip (ASOC). Because of the integrated ADC and DAC along with the integrated SRCs, the CS470xx makes audio clocking very simple. For analog-only systems, the clocking architecture is as simple as a crystal feeding the CS470xx.

Traditionally the input and output clock domains of the DSP needed to be synchronous when delivering audio data in an isochronous fashion (constant bitrate delivery), even if the input/output domains operate at different frequencies (e.g. 48 kHz input/96 kHz output). Systems utilizing serial audio data (I^2S) delivery would thus use isochronous delivery.

The CS470xx's integrated SRCs remove this requirement because the CS470xx can rate match the input (DAI) Fs to any Fs on the output side (DAO). The examples below show configurations that support an Fs that is synchronized between DAI and DAO, as well as an output Fs that is independent of the input Fs.

1.5.1 Clock and Data Flow for ADC Input

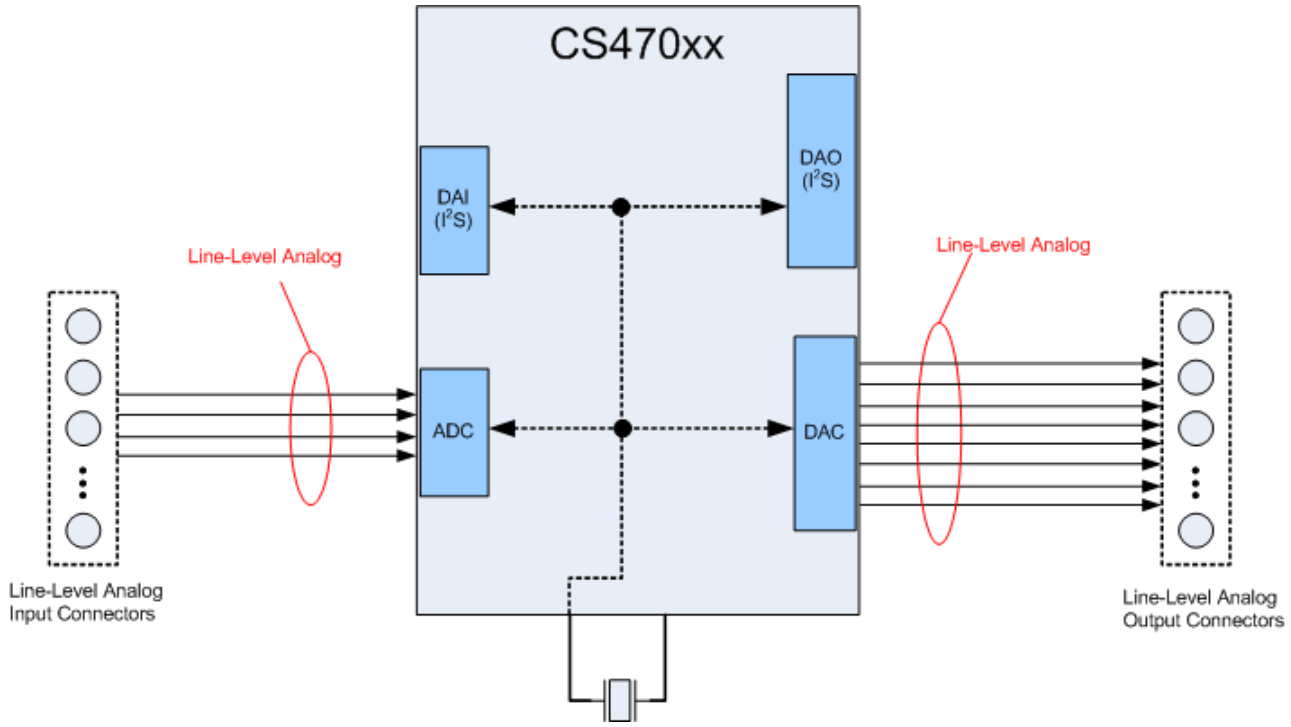

Figure 1-8. ADC Clocking

The ADC clocking architecture is used when the internal ADCs are used as the only audio input (that is, SPDIF is disabled and there are no serial audio signals connected to DAI or DAO). In this scenario, the CS470xx has all audio clocking self contained. Figure 1-8 illustrates this clocking configuration.

The clock fed to XTI of the CS470xx is MCLK for the system, and the ASOC masters clocks to DAC and ADC. The user need only route in analog signals and route out the processed analog signals.

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1.5.2 Clock and Data Flow for S/PDIF Input

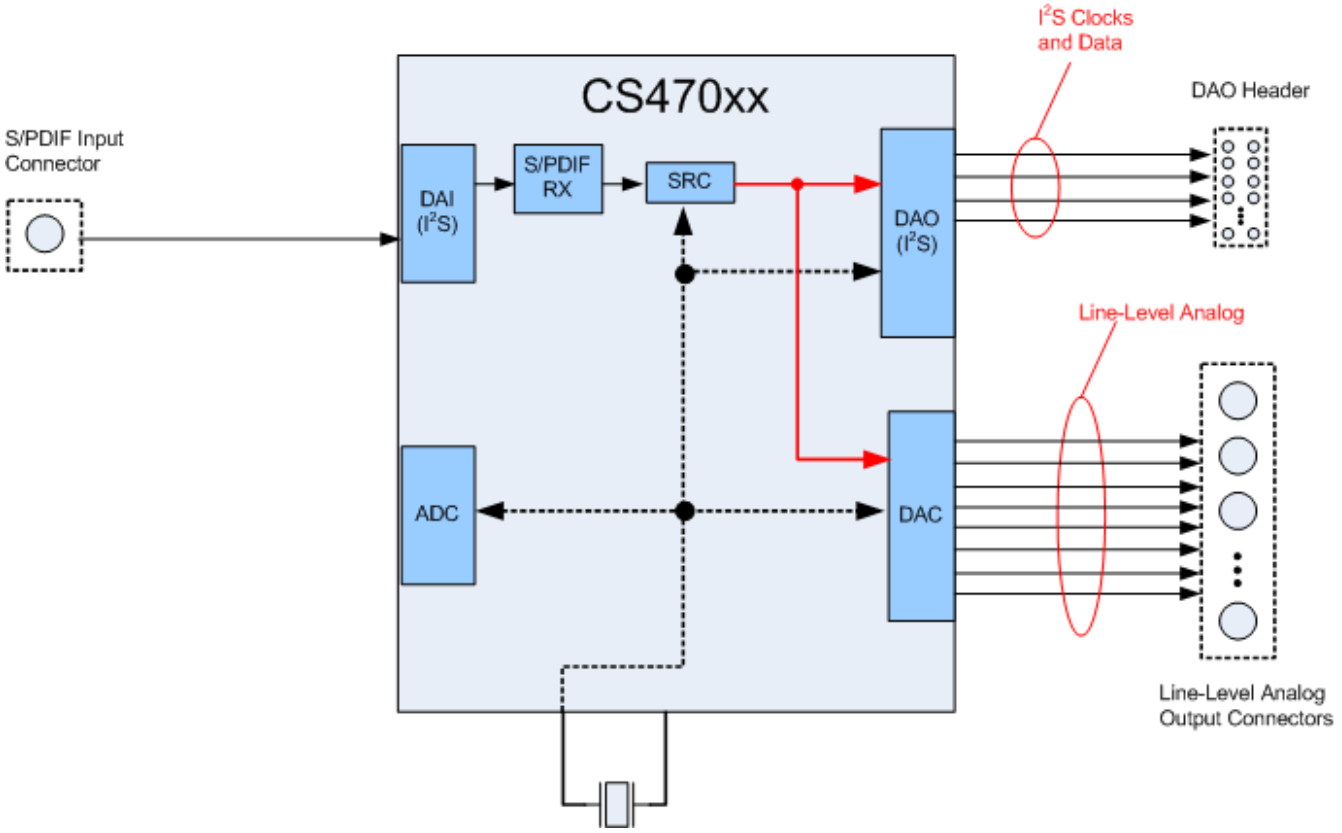

Figure 1-9. S/PDIF Clocking

The S/PDIF clocking architecture is used when any S/PDIF RX is used as an audio source, whether from the optical RX, coaxial RX, or brought in on the DAI header. Figure 1-9 illustrates this clocking configuration.

The incoming S/PDIF stream is always rate matched to another MCLK in the system through an SRC. This means that the DAO can be run at a constant Fs that is independent of the incoming S/PDIF Fs. This is useful in systems with digital amplifiers and wireless audio transmitter modules that requires a fixed Fs.

The CS470xx can master its output clocks, or slave to clocks from another source.

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1.5.3 Clock and Data Flow for DAI Input with Fixed Output Fs

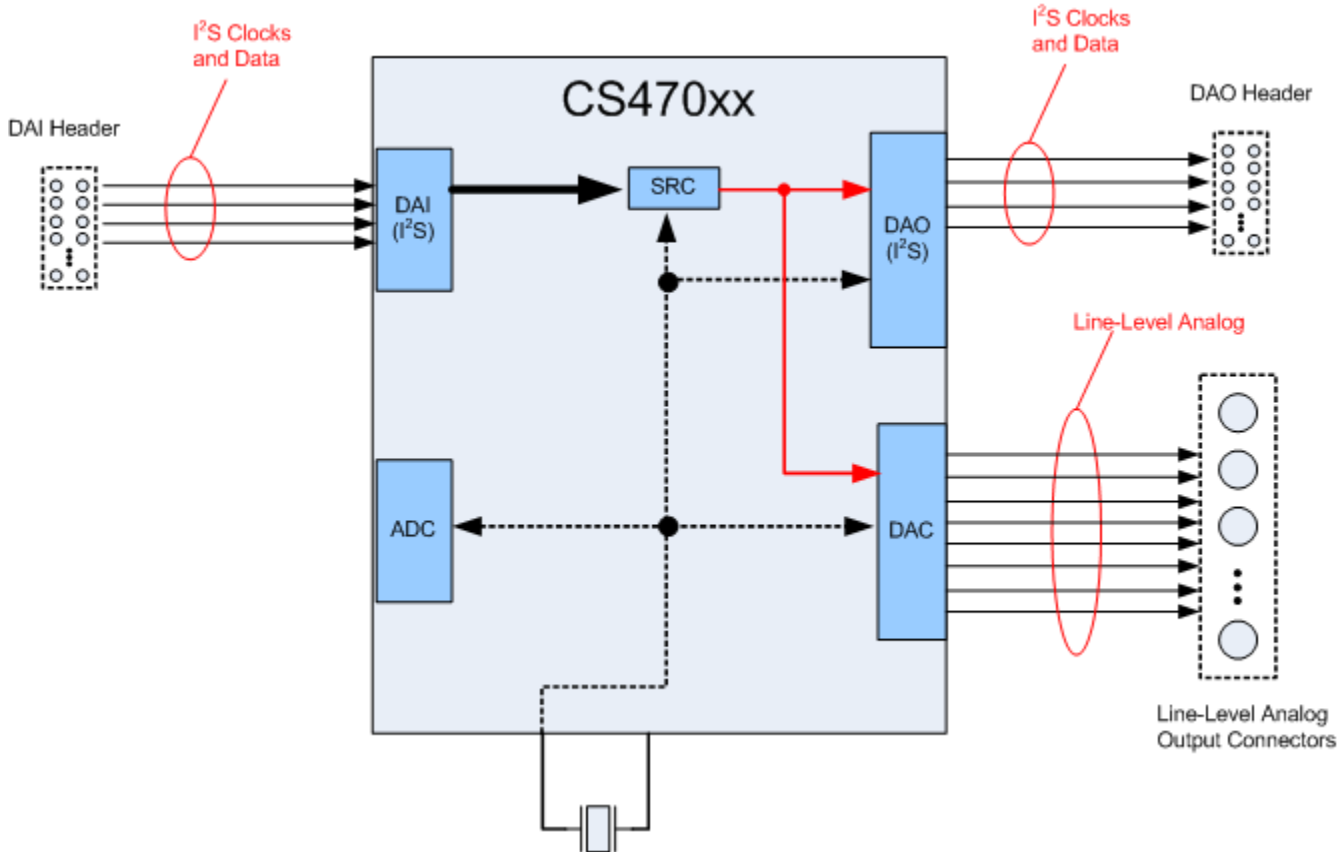

Figure 1-10. DAI Clocking with Variable Input Fs and Fixed Output Fs

The DAI clocking architecture is used when any serial audio data source is connected to the DAI header. Figure 1-10 illustrates this clocking configuration. Note that the incoming DAI data is passed out of the CS470xx at the Fs of the crystal connected to the ASOC.

Like the S/PDIF clocking configuration, this allows the DAI to be rate matched to another MCLK in the system through an SRC. This means that the DAO can be run at a constant Fs that is independent of the incoming DAI Fs. This is useful in systems with a digital amplifier that requires a fixed Fs.

The CS470xx can masters its output clocks, or slave to clocks from another source.

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1.5.4 Clock and Data Flow for DAI Input with Matched DAO Fs

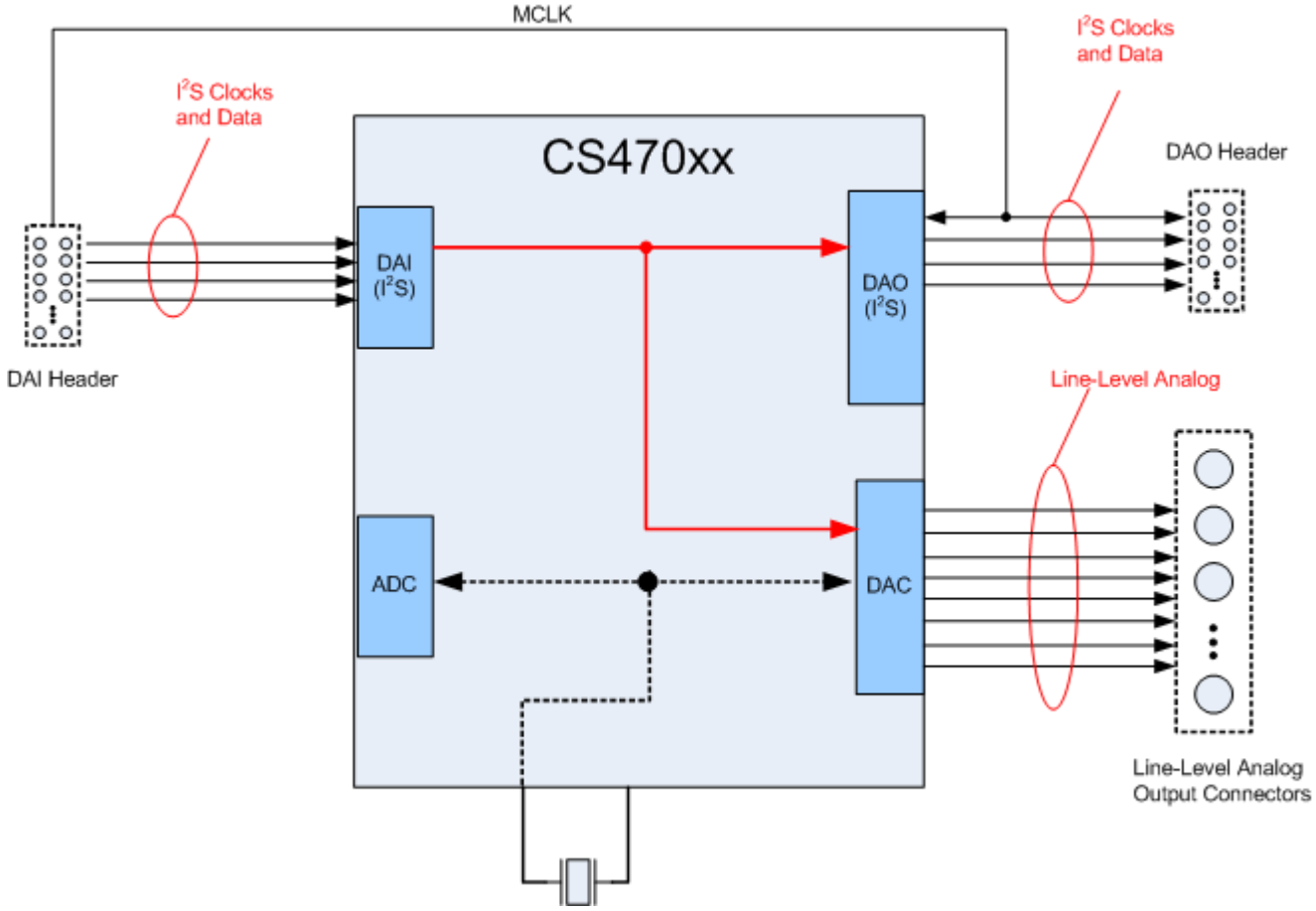

Figure 1-11. DAI Clocking with Fixed Output Fs

The DAI clocking architecture is used when any serial audio data source is connected to the DAI header. Figure 1-11 illustrates this clocking configuration. Note that the incoming DAI data is synchronized to the DAO using a common MCLK.

This is a more traditional clocking architecture for serial audio data, where the DAI Fs and the DAO Fs are synchronous. In this configuration, the SRC is bypassed for the DAO.

1.6 Other Useful Information

1.6.1 Web Sites

- Cirrus Logic main web site: www.cirrus.com

1.6.2 DSP Information

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

- *CS470xx Data Sheet*
- *CS470xx Hardware User's Manual*
- AN333, *CS470xx Firmware User's Manual*

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1.6.3 Board Information

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

1.6.4 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. Contact your Cirrus Logic sales representative for the latest updates.

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Chapter 2

Introduction to CDB47xxx Kit

2.1 Introducing the CDB47xxx Customer Development Kit

The CDB47xxx kit is composed of the CDB47xxxS or CDB47xxxD main board and a daughtercard that can support any member of the CS470xx Audio SOC (ASOC) family. The CDB47xxx provides a practical platform for emulating a typical multi-channel audio system application. The system can be an independent evaluation platform controlled by the on-board MCU, or using the USB connector, the CDB can be connected to a host PC which can configure and control the board using DSP Composer, the Cirrus Proprietary GUI. Figure 2-1 shows the relationship between the CDB47xxx and the optional PC.

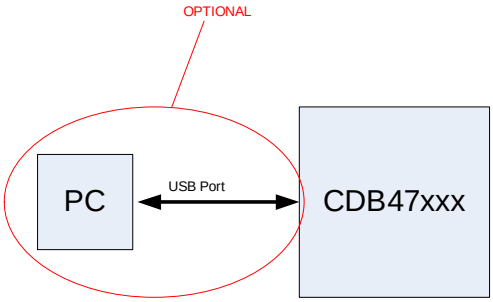

Figure 2-1. CDB47xxx System Block Diagram

This document will concentrate on the features and basic operation of the CDB47xxx kit. Detailed information regarding the operation and programming of the CS470xx Audio SOC is covered by the CS470xx *Data Sheet*, *CS470xx Hardware User's Manual* and application note AN333. See Section 1.6 for more details.

The CDB47xxx is a convenient and easy-to-operate evaluation platform. It has been designed to demonstrate the majority of the CS470xx functions on a small base board. These features include:

- PC control of the CS470xx using the DSP Composer™ graphical user interface.
- Serial control of audio devices on CDB47xxx via I^2C™ or SPI™ protocols.
- Digital audio input of PCM or compressed data via optical or coaxial S/PDIF.
- Up to 4 channels of simultaneous analog audio input via the integrated ADCs of the CS470xx.
- The 5:1 analog multiplexer integrated into one of the CS470xx ADCs.
- Up to 8-channel analog output via the integrated DACs of the CS470xx.
- Digital audio output of PCM data via optical or coaxial S/PDIF.
- Multi-channel digital audio input via the DAI serial audio (I^2S) header.
- Capability to support fixed output Fs that is independent of input Fs.

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- Fast boot – master boot of custom applications from 32 Mbit serial SPI Flash device or 512 kbit I^2C device.
- Microphone input with integrated amplifier.
- Supports all members of the CS470xx family in the 100-pin LQFP package.

Note: Not all features of the CS470xx are exercised on the CDB47xxx.

2.2 Identifying CDB47xxx Components

2.2.1 CDB47xxxS Board

Figure 2-2 shows the top side of the CDB47xxxS Board. Section 2.2.1.1 contains the legend for the reference points called out in red in Figure 2-2 CDB47xxxS (Single-Ended) Top View.

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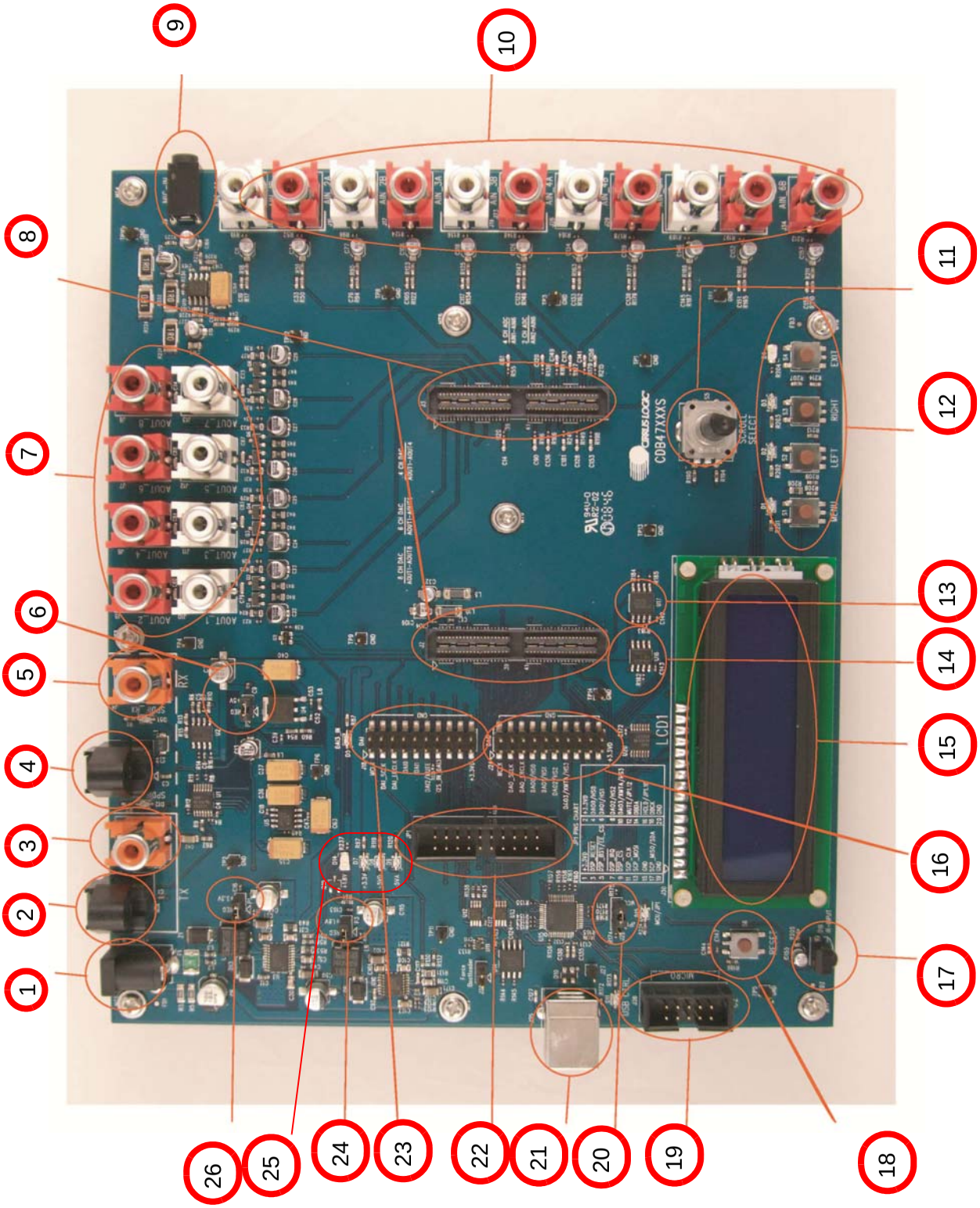

Figure 2-2. CDB47xxxS (Single-ended) Top View

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2.2.1.1 CDB47xxxS Board (Single-Ended) Components

The circled numbers found in Figure 2-2 refer to the CDB47xxxS board (single-ended) components in the following list.

1. +9V Power In
2. Optical S/PDIF Out
3. Coax S/PDIF Out
4. Optical S/PDIF In
5. Coax S/PDIF In
6. +5V Header
7. Line-Level Analog Outputs
8. CDB47xxS-DC48 Daughtercard Connectors
9. Mic Input
10. Single-Ended Line-Level Inputs
11. MCU Rotary Encoder
12. MCU Buttons
13. SPI Flash
14. I^2C EEPROM
15. LCD
16. DSP DAO Header
17. IR Receiver
18. Board Reset
19. MCU Programming Header
20. MCU Control Bypass Header
21. USB Connector
22. DSP External Control Header
23. DSP DAI Header
24. +1.8V Header
25. Power LEDs (4)
26. + 3.3V Header

2.2.2 CDB47xxxD Board

Figure 2-3 shows the top side of the CDB47xxxD Board. Section 2.2.2.1 contains the legend for the reference points called out in red in Figure 2-3.

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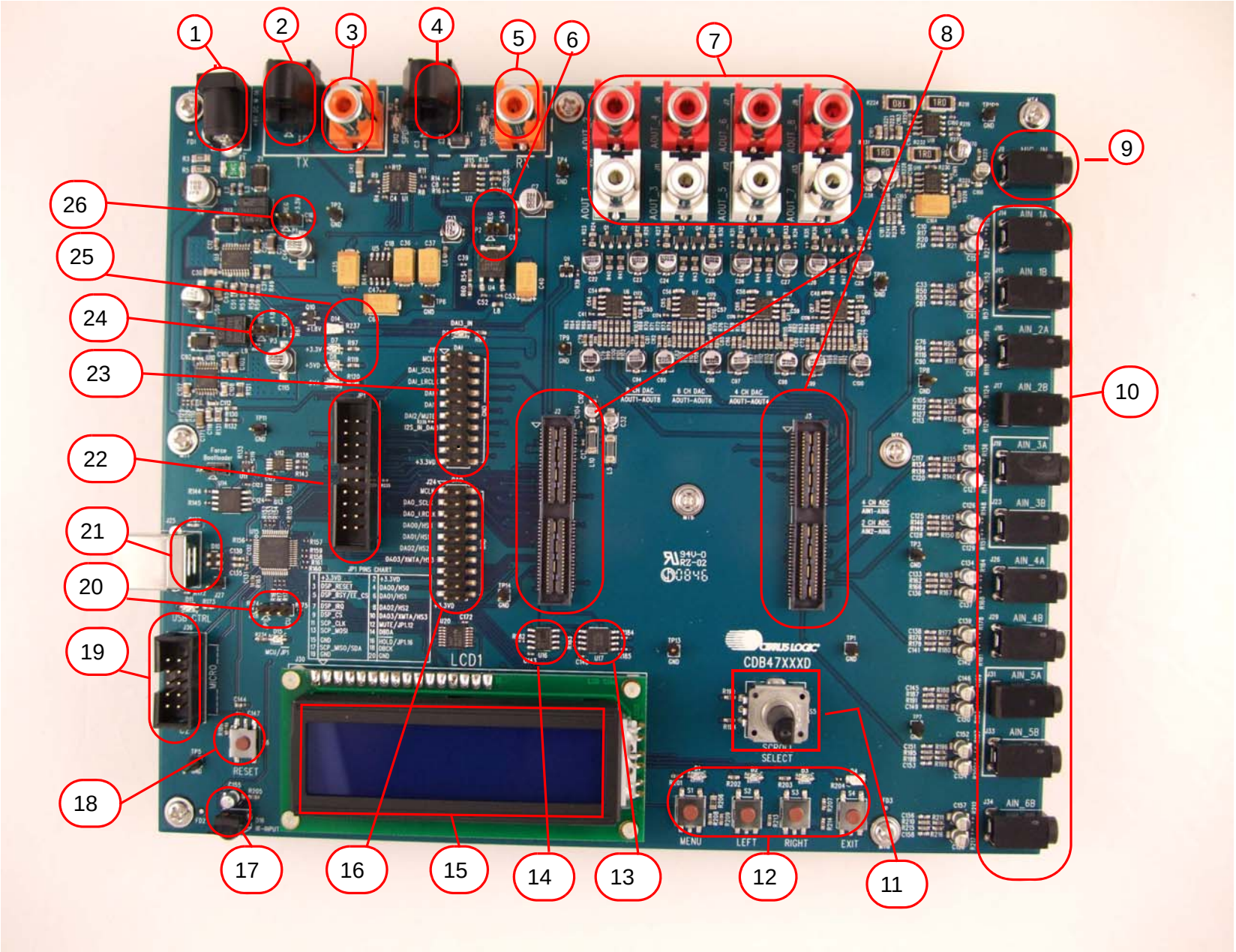

Figure 2-3. CDB47xxxD (Differential) Top View

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2.2.2.1 CDB47xxxD Board (Differential) Components

The circled numbers found in Figure 2-3 refer to the CDB47xxxD board (differential) components in the following list.

1. +9V Power In
2. Optical S/PDIF Out
3. Coax S/PDIF Out
4. Optical S/PDIF In
5. Coax S/PDIF In
6. +5V Header
7. Line-Level Analog Outputs
8. CDB47xxD-DC48 Daughtercard Connectors
9. Mic Input
10. Differential Line-Level Inputs
11. MCU Rotary Encoder
12. MCU Buttons
13. SPI Flash
14. I^2C EEPROM
15. LCD
16. DSP DAO Header
17. IR Receiver
18. Board Reset
19. MCU Programming Header
20. MCU Control Bypass Header
21. USB Connector
22. DSP External Control Header
23. DSP DAI Header
24. +1.8V Header
25. Power LEDs (4)
26. + 3.3V Header

2.2.3 CDB47xxx-DCxx Daughtercard

The layout for the daughtercard shipped with the CDB47xxx is the same, regardless of which type of main board (differential or single-ended) the customer orders. The daughtercard can be ordered populated with either the CS47048, Cs47028, or CS47024 DSP. The daughtercard with CS47024 DSP is labelled and referred to as CDB47xxx-DC24.

Figure 2-4 shows the top side of the CDB47xxx-DC48 daughtercard. The accompanying legend identifies the main components of the board.

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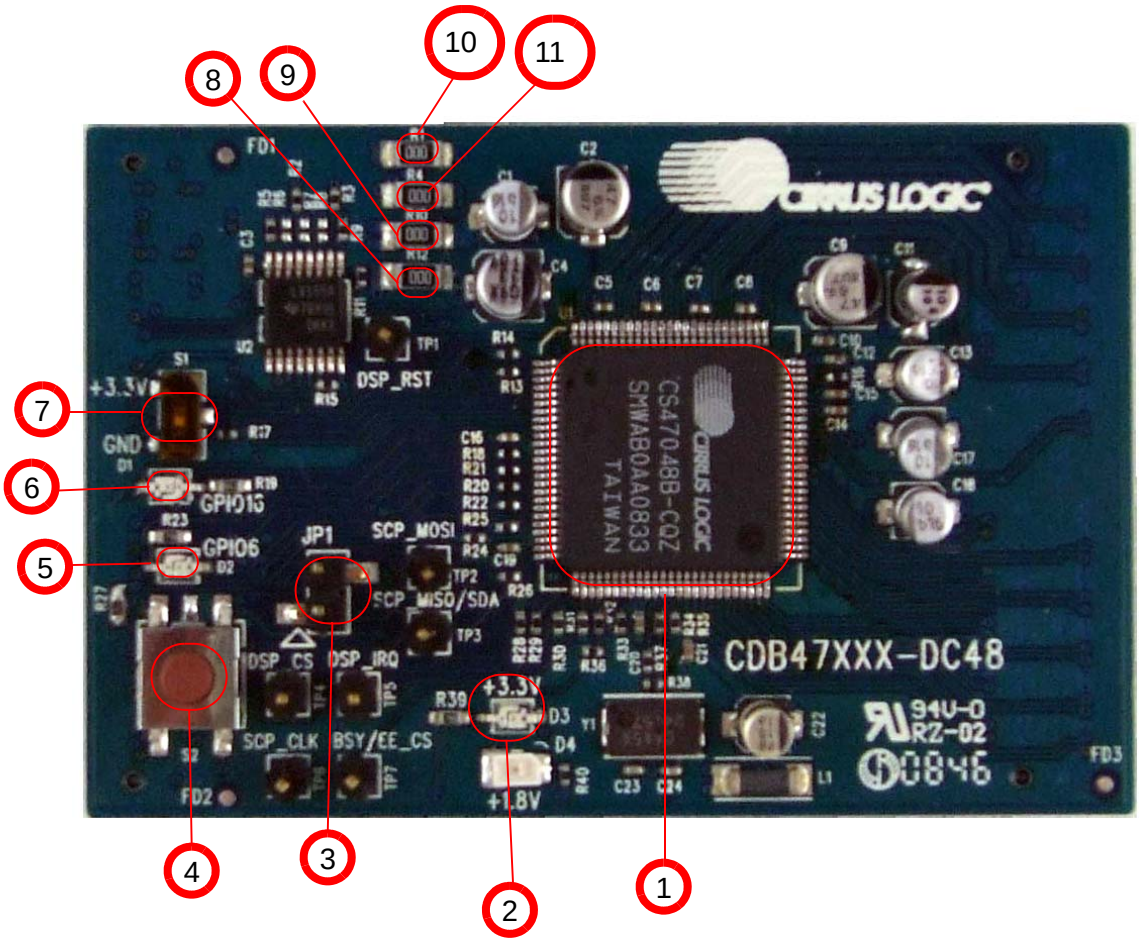

Figure 2-4. CDB47xxx-DC48 Daughtercard

2.2.3.1 CDB47xxx-DC48 Daughtercard Components

The circled numbers found in Figure 2-4 refer to the CDB47xxx-DC48 daughtercard components in the following list.

1. Cirrus Logic CS47048 DSP
2. Power LEDs (2)
3. MCLK-XTAL_OUT Header
4. DSP GPIO Button
5. DSP GPIO LED
6. DSP GPIO LED
7. DSP GPIO Switch
8. +1.8VD Probe Point
9. +3.3VD Probe Point
10. +1.8VA Probe Point
11. +3.3VA Probe Point

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Chapter 3

Installation and Setup of Development Board Software

3.1 Installation, Setup, and Running First Application

It is important to install the CDB47xxx Board software **before** connecting the USB cable from the PC to the USB port of the CDB47xxx Board. Failure to install the evaluation software before the initial connection can result in an inability to communicate with the CDB47xxx.

3.1.1 Evaluation Software Installation

The DSP evaluation software installation will first install the Cirrus Logic® DSP evaluation software followed by the USB drivers required to communicate with the CDB47xxx board.

1. Run the latest DSP evaluation software installation executable (cirrus_dsp_eval_<ver>.exe or cirrus_dsp_sdk_<ver>.exe). This executable is supplied by your Cirrus Logic representative.
2. At the *Welcome* screen, click *Next.*
3. At the Cirrus Logic *Licensing Agreement* window, select the *"I accept the agreement"* radio button to agree to the terms and then select *Next.*
4. Select the default destination directory suggested by the installer for downloading the evaluation kit files.
5. Select the default directory suggested by the Installer for storing the shortcuts to the programs and files you are downloading.
6. Press the *Install* button to begin the installation process.
7. Press the *Finish* button to complete the installation process.

3.1.2 Setting up the CDB47xxx Board with a DVD Player

Follow these steps to set up the CDB47xxx Board

1. Place the CDB47xxx and the CDB47XXX-DCxx daughtercard on a static-free surface.
2. If the boards are not connected, connect them together as shown in Figure 3-1.
3. Connect the power supply jack to the CDB47xxx Board at J2 and the adapter to a wall power socket or to a power strip.

Note: Never connect the power supply without the daughtercard being connected to the main board. The switching regulators on the main board rely on voltage sensing paths provided by the daughtercard. Opening these paths will cause the regulator ouput to reach potentially damaging voltages.

4. Ensure that the D14 (blue), D7 (green), D8 (yellow), and D9 (red) power indicator LEDs on the CDB47xxx illuminate when power is applied to the board.

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5. Make Audio Input connections to the CDB47xxx Board.
   - Connect one end of the digital audio S/PDIF optical cable to (J1) on the CDB47xxx Board.
   - Connect the other end of the optical cable to the optical output on the back of a DVD player or other digital audio source.
6. Make Audio Output connections from the CDB47xxx Board:
   - From the main Analog Line-level Outputs on the CDB47xxx, connect powered speakers to J5 and J10 using RCA audio cables.

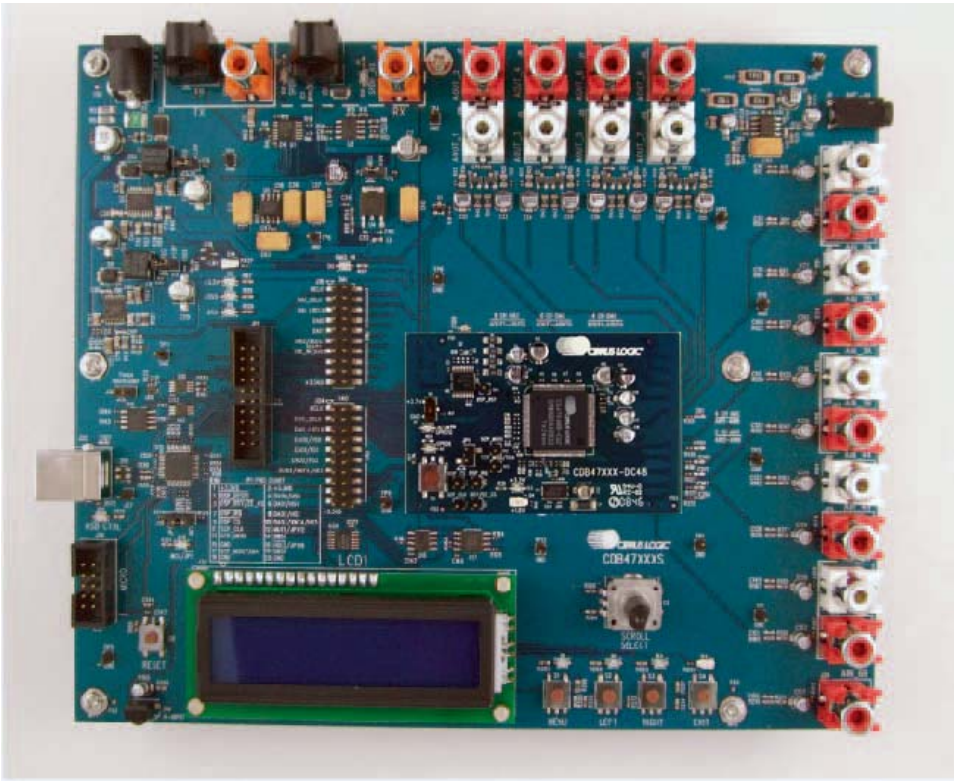

Figure 3-1. CDB47xxx Board with CDB47xxxD (or S)-DC-xx Daughtercard Attached

3.1.3 Connecting to a PC

Note: There is a possibility that the CDB47xxx Evaluation Board may disconnect from the PC during operation. It is recommended to short across pads of R172 by the USB connector on the board to avoid any USB connectivity issues.

Follow these steps, to connect the

1. Connect the "B" end of the USB cable to P1 on the USB-Master daughtercard.
2. Connect the "A" end of the USB Cable to a USB 2.0 port on a notebook or PC running Windows XP operating system.
3. The Windows operating system should recognize that a new device has been attached and display a notice saying *"Found New Hardware"*.

Note: In the Windows Device Manager, the CDB47xxx appears as a Universal Serial Bus Controller called "USBXpressDevice". The Device ID is "CDB47". The Cirrus Device Manager (CDM),

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which is launched after the CDB47xxx Evaluation Kit is installed and thereafter when the user's system is rebooted, displays the Device name as "CS47xxx_board". Look for the CDM icon in the Windows System Icon Tray (located, by default, in the lower-right side of the task bar).

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

3.1.4 Running a Stereo PCM SPDIF In, DAC Out Application on CDB47xxx

Launch DSP Composer (***Start →Program→Cirrus DSP→CS47XXX→DSPComposer***).

1. In DSP Composer, go to ***File→Open*** and open *C:\CirrusDSP\CS47xxx\projects\spdif_in_dacout.cpa.*

Note: If the pop up window "Project Out of Date" apprears, click on "Update Devices".

2. Press the *Go* button.
3. 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.

Note: Press *Play* on the DVD player (or other digital audio source). You should now hear audio from the speakers.

3.1.5 Running a Stereo ADC In, DAC Out Application on CDB47xxx

Launch DSP Composer (***Start→Program→Cirrus DSP→CS47XXX→DSPComposer***)

1. In DSP Composer, go to ***File→Open*** and open *C:\CirrusDSP\CS47xxx\projects\adc_in_dacout.cpa.*

Note: If the pop up window "Project Out of Date" appears, click on "Update Devices".

2. Press the *Go* button.
3. Provide analog audio input signals to inputs AIN_1A (J14) and AIN_1B (J15) of the CDB47xxx. (Full scale is approximately 4.3Vrms for a differential signal, and approximately 2.15Vrms for single ended.)
4. You should now hear audio from the speakers.

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Chapter 4

Programming the CDB47xxx Board

4.1 Introduction

With the exception of the power selection jumpers, the CDB47xxx is configured exclusively through software. The DSP Composer™ software is a graphical user interface (GUI) that is used to program the CS470xx DSP, and to configure the CDB47xxx. This chapter provides basic instructions for using the GUI to control the CDB47xxx. Detailed information on using the DSP Composer™ firmware 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 Running the ADC In / DAC Out Example Application

Follow the instructions in Chapter 3 in order to install the USB drivers on your PC and launch the DSP Composer software (the GUI used to control the CDB47xxx).

After following the instructions in "Running a Stereo ADC In, DAC Out Application on CDB47xxx"on page 3-3", the DSP Composer main window will appear as shown in Figure 4-1.

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

In this example, the Audio In and Audio Out blocks represent the analog input (ADC) and output (DAC) ports. These blocks can also be configured to represent various combinations of analog and digital I/O such as I^2S and S/PDIF. This is explained later beginning with Section 4.2.2. The terminals on the Audio In and the Audio Out blocks represent the I/O ports.

The MPM (Matrix Processing Module), VPM (Virtualizer Processing Module, and PPM (Post-Processing Module) blocks are intended to implement signal processing. In this example, the MPM and VPM blocks are pass through blocks containing no internal processing.

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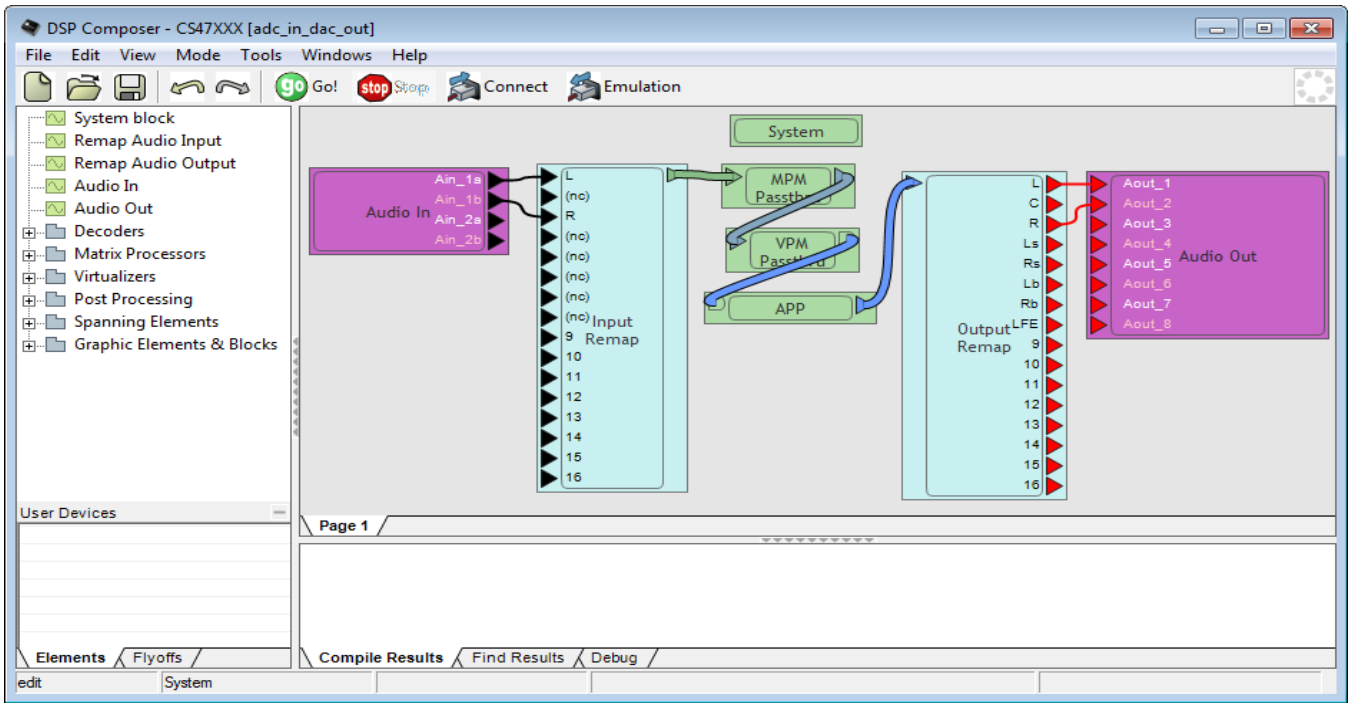

Figure 4-1. ADC In / DAC Out Example

4.2.1 System Block

All designs must contain the System block. In DSP Composer, when you drag the System block onto the workspace, the dialog box shown in Figure 4-2 is displayed. This dialog box provides options for selecting the Target chip associated with the development board, the Firmware version (memory map), Core Speed, Reference Clock Frequency (Ref. clock freq.), and the Autodetect Fs.

Note: Leave the Autodetect Fs default value as "None" unless the application note for a specific firmware module used in a Composer project provides a setting that differs from the default value.

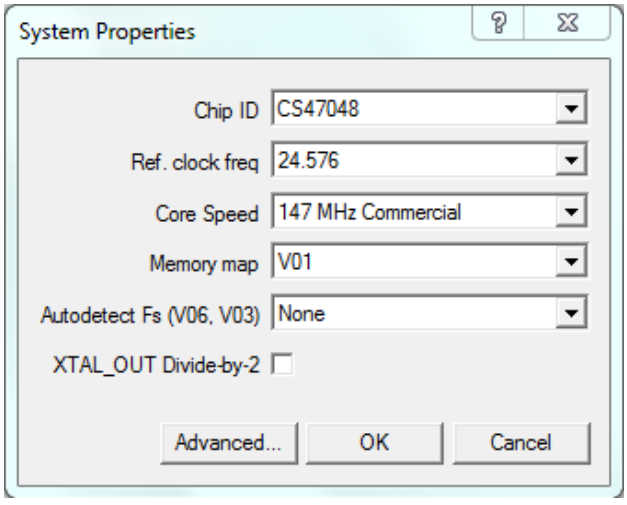

Figure 4-2. CDB47xxx System Properties

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Chip ID specifies the minimum Cirrus DSP chip that must be connected to the PC. The choices are CS47024, CS47028, and CS47048 Software designed for a lower numbered chip runs on a higher numbered chip.

Table 4-1. Chip ID and Audio Terminals

Chip ID	Audio Input Terminals	Audio Output Terminals
CS47024	2 (AIN_1a, b not supported)	4 (AOUT_5–AOUT_8 not supported)
CS47028	2 (AIN_1a, b not supported)	8
CS47048	4	8

4.2.2 Selecting / Changing Audio Input Sources

Configure the audio inputs to the DSP by dragging and dropping the Audio In block onto the workspace. The dialog box shown in Figure 4-3 then appears. Choose from one of the supported input combinations as described in the following sections. ADC is selected by default. The input configuration may be changed later by right-clicking on the Audio In block and selecting Device Properties.

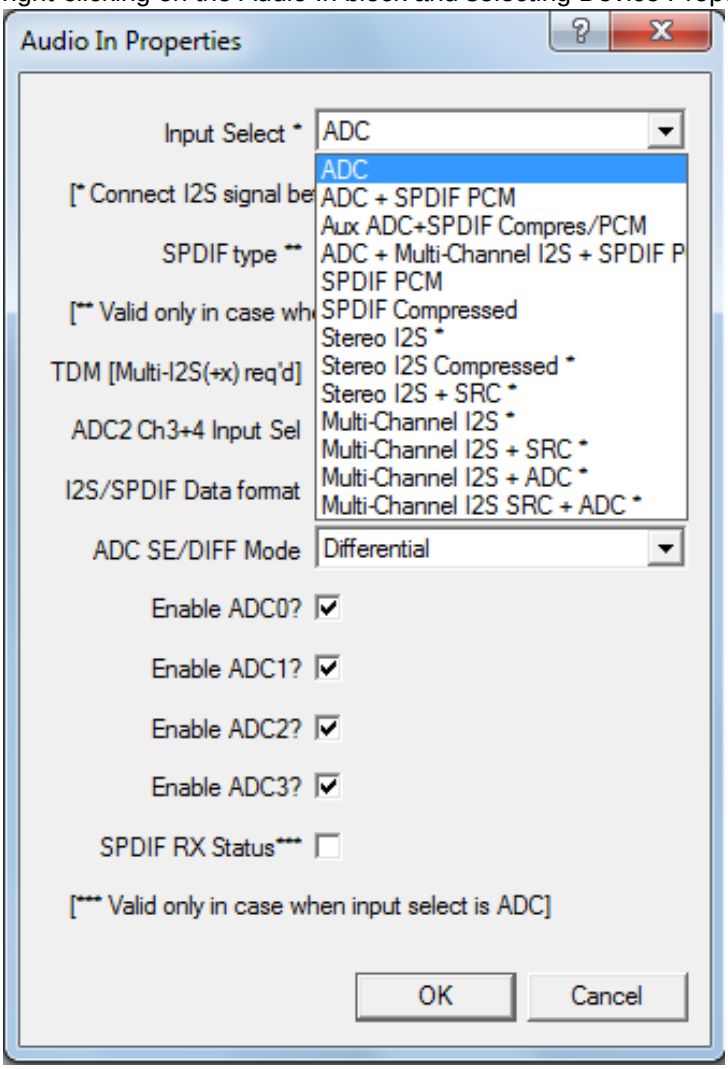

Figure 4-3. Selecting Audio In Source using Device Properties Dialog

Note: All designs must include the Input Remap block. For details, see Section 4.2.3 "Input Channel Remap" on page 4-6.

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4.2.2.1 Audio In via ADC

To deliver analog audio data to the DSP via the CS470xx ADCs, drag the Audio In block to the workspace and select an input configuration that includes ADC. The ADC2 input includes a 5:1 input multiplexer that is controlled by the pull-down list, ADC2 Ch 3+4 Input Sel, shown in Figure 4-4.

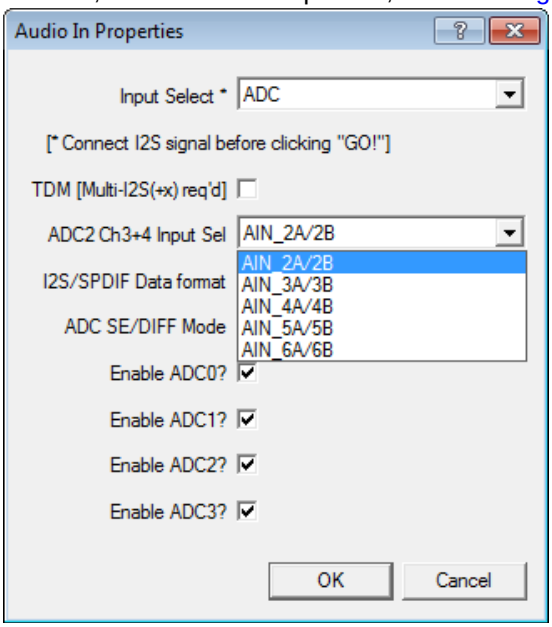

Figure 4-4. ADC2 Device Properties.

The ADC2 block's terminal names will change to match the physical input terminals that are now active. For the configuration shown in Figure 4-4, “Ain_2a” and “Ain_2b” are active. If the selection was “Ain_3A/3B” instead, the terminals would say “Ain_3a” and “Ain_3b.” On the CDB47xxx board, the microphone input is connected to terminal 6A.

4.2.2.2 Audio In via S/PDIF

To deliver digital audio data to the DSP via the S/PDIF receiver built into the CS47048 and CS47028 devices, drag the Audio In block to the workspace and select an input option that includes S/PDIF as

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shown in Figure 4-5.

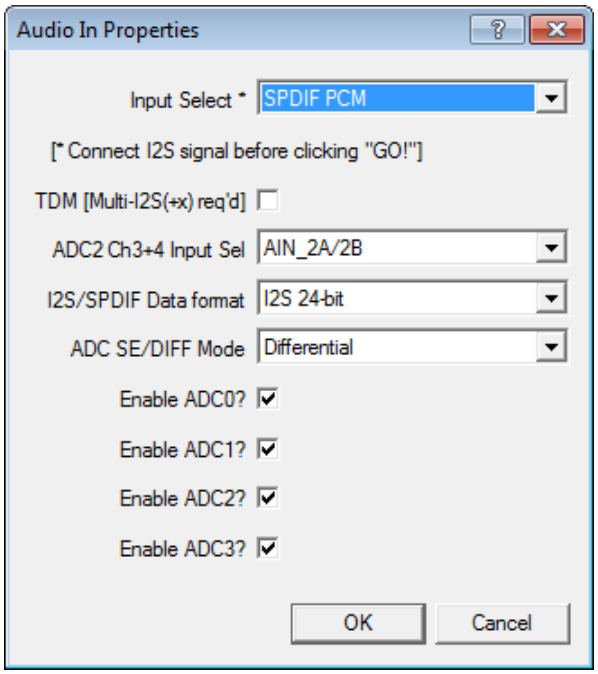

Figure 4-5. Selecting ADC2 input Terminals using Device Properties Dialog

4.2.2.3 I²S Audio Input

To deliver data to the DSP via I²S, drag the Audio In block to the canvas and choose an input combination that includes I²S as shown in Figure 4-6. As stated in the dialog box, **you must connect an I²S Signal before pressing "GO!"**

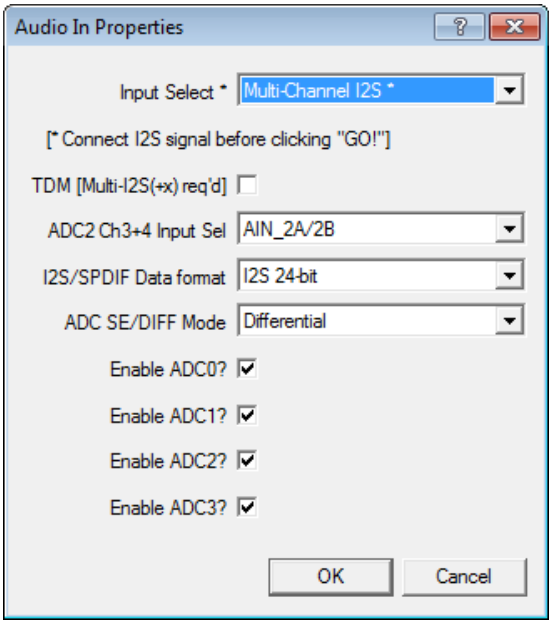

Figure 4-6. Selecting Multi-Channel I²S Input

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4.2.3 Input Channel Remap

All designs, regardless of the input sources chosen, must include the Input Remap block which maps the input sources to the internal channels of the DSP. Drag the Input Remap block to the workspace, right-click on the Remap Audio Input block, and choose Device Properties. Figure 4-7 shows the channel map/remap options that are available.

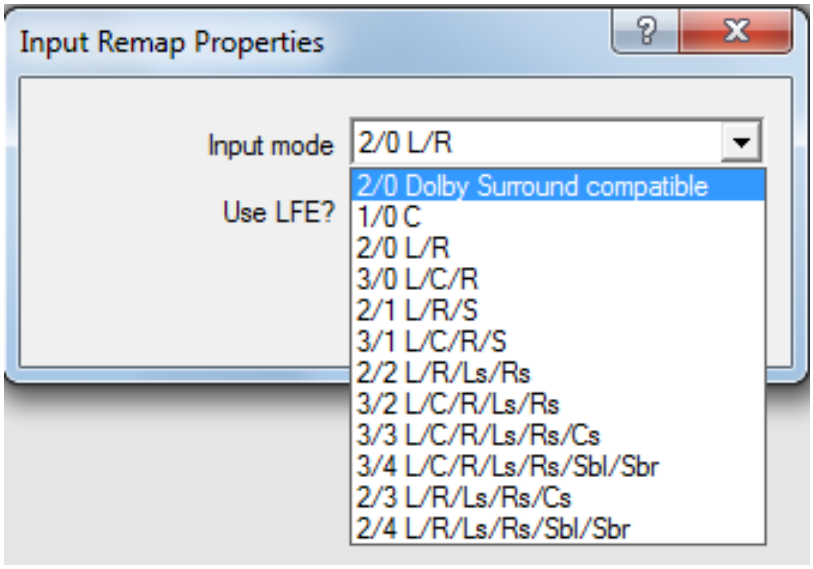

Figure 4-7. Input Remap Device Properties

After selecting the combination of channels to map or remap, the channel wiring options appear in the Remap Audio Input block. Channels that are not available, now appear as No Connects (NC). By changing from an option with a smaller number of channels to map, such as "2/0 L/R," to another option that maps more channels, such as "3/4 L, C, R, Ls, Rs, Lb, Rb," all the NO Connects go away and become available for wiring.

Enter the Wire Mode (Ctrl + w) of DSP Composer to make the following wiring connections:

- From the outputs of the Audio In block to the inputs of the Input Remap block.
- From the output of the Input Remap block to the input of the MPM processing block
- From the output of MPM to the input of VPM
- From the output of VPM to the input of PPM
- From the output of PPM to the input of the Output Remap block
- From the output of the Output Remap block to the input of the Audio Out block

4.2.4 Output Channel Remap

All designs, regardless of the output configuration chosen, must include the Output Remap block which maps the internal channels of the DSP to the output channels. Drag the Output Remap block to the workspace.(The Output Remap block has no Device Properties to edit.) Use the Composer Wire mode (Ctrl + w) and draw wires from the output terminals of the Output Remap block to the desired terminals of the Audio Output block discussed in the next section, "Selecting the Audio Output Configuration"

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4.2.5 Selecting the Audio Output Configuration

Configure the audio outputs to the DSP by dragging and dropping the Audio Out block onto the workspace. The dialog box shown in Figure 4-8 appears. Choose from one of the supported output combinations as described in the subsections, Section 4.2.5.1 to Section 4.2.5.3. DAC is selected by default. The input configuration may be changed later by right clicking on the Audio Out block and selecting Device Properties.

The Device Properties dialog box allows the user to configure one or more of the following:

- DAC
- I^2S
- S/PDIF Out

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Note that the Device Properties dialog box allows the user to select analog (DAC) outputs only, digital outputs only, or a mixture of the two. If digital outputs are enabled, then the two drop down lists at the bottom of the dialog box allow for DAO2 and DAO3 to be configured to output data in either I^2S or S/PDIF format.

4.2.5.1 Audio Out via DAC

To deliver data from the DSP via the Analog Out DAC outputs, drag the Audio Out block to the workspace. and check Enable Analog output. See Figure 4-8. Notice that the terminal labels "Aout_1" match those of the RCA output jacks on the board. Draw wires from the Remap Audio Output block to the DAC block for the desired mappings.

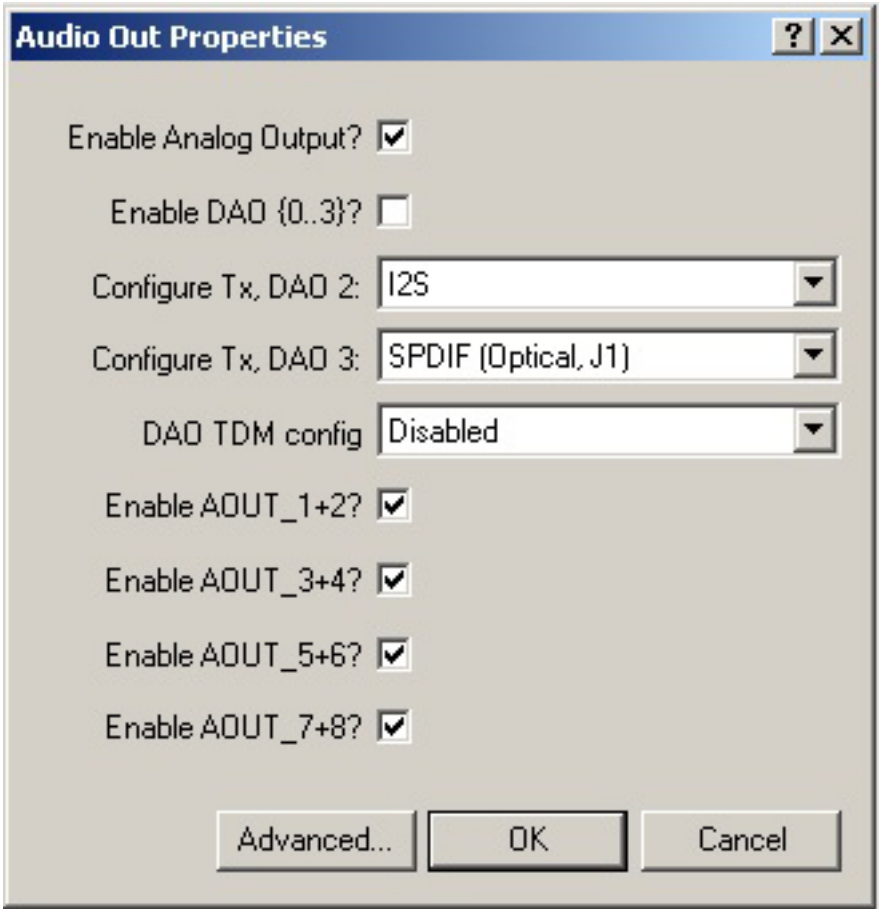

Figure 4-8. Selecting DAC Outputs Only using Device Properties Dialog

4.2.5.2 Audio Out via S/PDIF Out

To output audio data from the DSP via a S/PDIF output, drag the Audio Out block to the workspace, check the "Enable DAO {0...3} checkbox, and choose "SPDIF (Optical, J1)" from the DAO3 combo box.See Figure 4-9. Note that the terminals for DAO3 are replaced by the spdif.L and spdif.R terminals. Draw wires from the Remap Audio Out put block to the Audio Out block for the desired mappings. DAO2 can also be configured to be a S/PDIF output.

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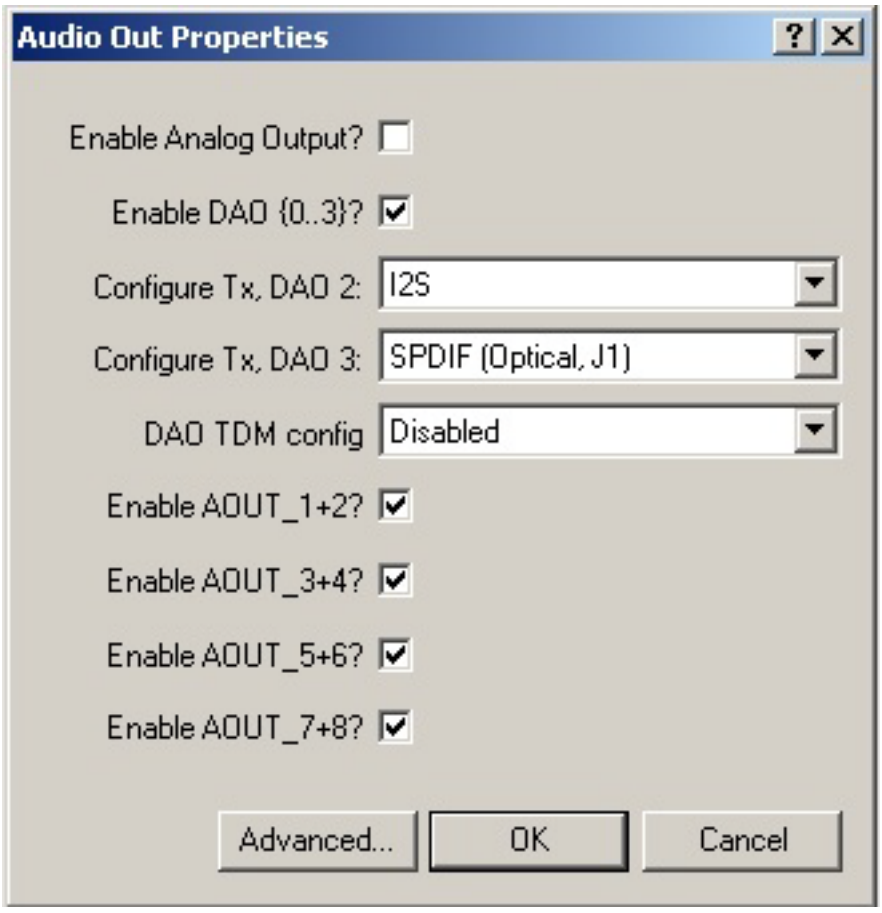

Figure 4-9. Selecting S/PDIF Outputs and I2S Outputs using Device Properties Dialog

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4.2.5.3 I²S Audio Input Output

To output audio data from the DSP via I²S, drag the Audio In block to the canvas and choose an input combination that includes I²S as shown in Figure 4-10. Draw wires from the Output Remap block to the Audio Out block for the desired mappings.

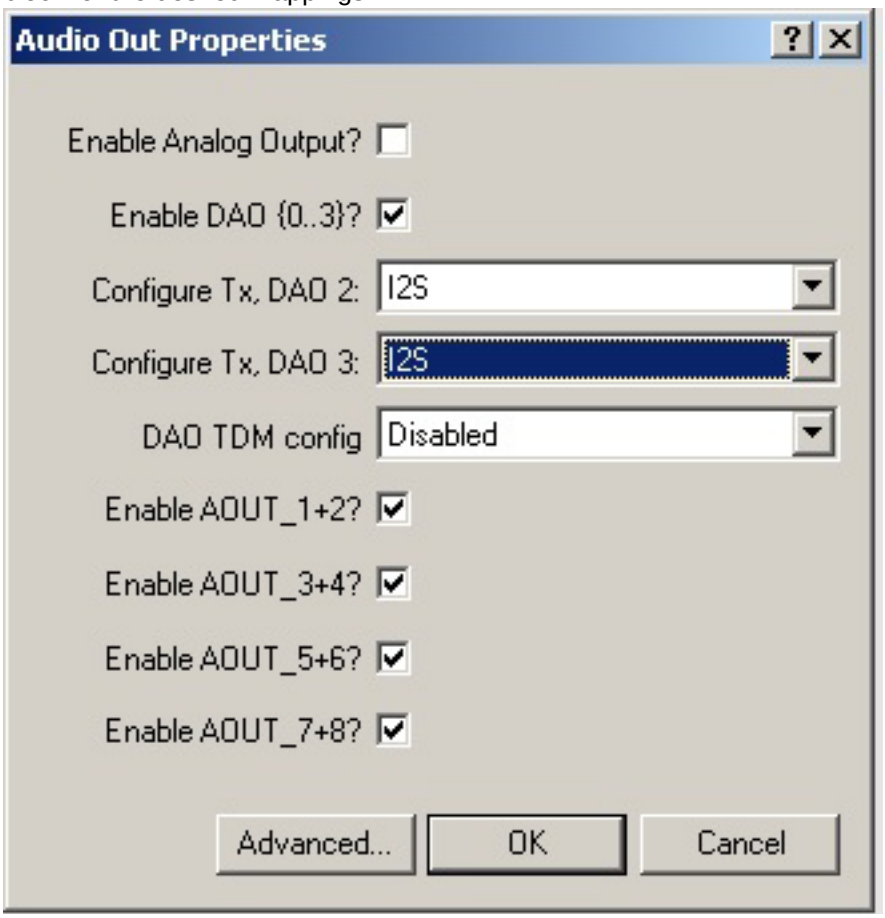

Figure 4-10. Selecting I2S Outputs using Device Properties Dialog

4.2.6 Changing Serial Control Protocol (I²C™ or SPI™) / Flash Type

The CDB47xxx is designed to communicate using either I²C™ or SPI™ protocols. In order to change the communication mode in the DSP Composer application, go to the menu bar and select File Properties, which brings up the Project Properties dialog. Click on the *Advanced* button, as illustrated in Figure 4-11, in order to set the Master Boot Flash type or put a specified I/O pin into a High-Z state. The Flash Type pull-down menu is used to select which Flash will be used for a Master Boot. The checkbox, when checked, puts the corresponding pin into the high-impedance state. See Section 5.1.1 for more details.

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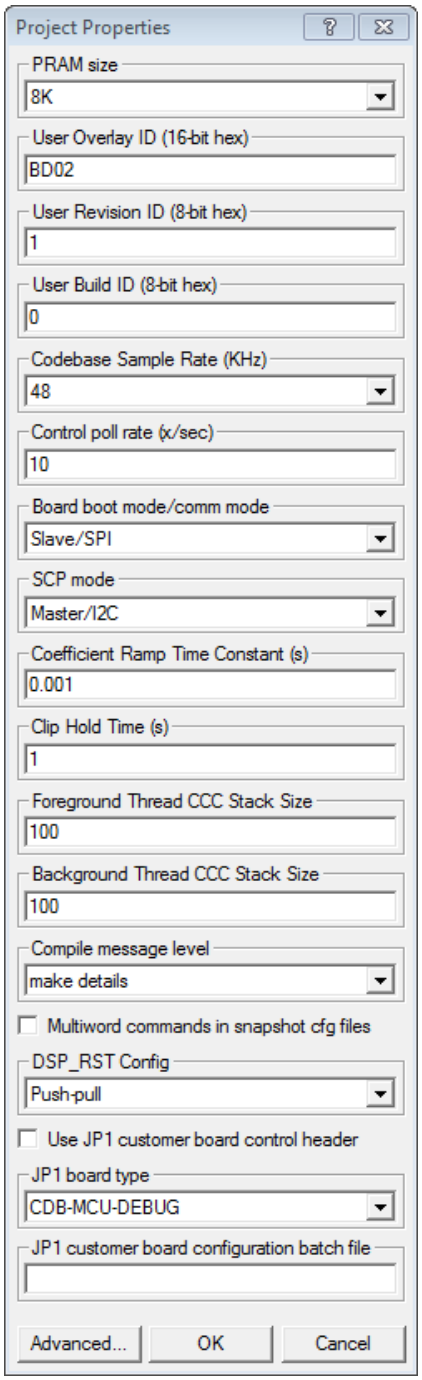

Figure 4-11. CDB47xxx Communication Modes / Flash Type

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Chapter 5

Using DSP Composer or Micro-Condenser Application to Create and Load a Flash Image

5.1 Programming a Serial Flash Device for Master or Slave Boot Operations

The CDB47xxx is populated with a 32-Mbit SPI (U17), a 512-kbit I^2C (U16), and a 32-Mbit SPI (U14) Flash devices. The SPI Flash (U17), and I^2C Flash (U16), devices can be used to store custom DSP firmware or run-time firmware configuration files. The SPI Flash U14) device is used to store microcontroller code and DSP firmware.

The CDB47xxx Board can be used to control the CS470xx DSP in Slave mode via the CDB47xxx on-board microcontroller. Or, a Flash Image can be downloaded to a Flash device on either the CDB47xxx or a customer board from which the CS470xx DSP can boot itself and operate in Master mode. This chapter describes the following topics:

- Using DSP Composer to download an image to either the SPI Flash (U17) or the I^2C Flash (U16) device and initiate Master Boot Operations
- Using Cirrus Logic's Micro-Condenser application to download an image containing multiple DSP Composer projects and snapshots to the SPI Flash (U14) device and to control the DSP in Slave mode.

5.1.1 Using DSP Composer to Create and Load a Flash Image for Master Mode Operations

The DSP Composer application allows the user to create a project, compile it into a binary image, deploy the binary image to the Flash device, and to initiate a Master Boot of the CS470xx DSP.

To create and load a Flash image to the DSP on the CDB47xxx Board or a customer board, follow these steps:

1. Create a conventional Slave Boot DSP Composer project. Click the *Go* button and check to see if the project performs in an acceptable manner when compiled.
2. Open the Project Properties dialog by following the **File→Properties** menu…path. Select one of the Master Boot options from the Board boot mode/ comm mode pull-down menu. In the example shown in Figure 5-1, the user has selected the Master I^2C protocol option to load the Flash image to the DSP.

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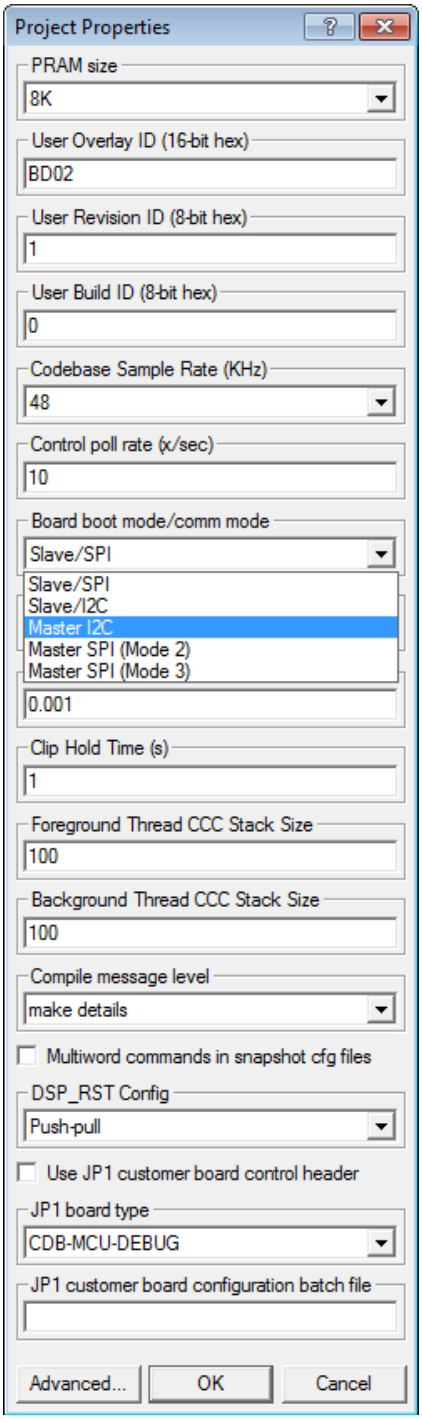

Figure 5-1. Project Properties Dialog Showing the Selection of the I^2C Protocol for Loading the Flash Image

3. Click the *Advanced* button and choose one the supported Flash types that will be receiving the Flash image download. When downloading a Flash image to a customer board, customers should consult their schematics to determine the Flash type to select. If downloading a Flash image to the CDB47xxx Board, choose the appropriate I^2C or SPI Flash device noted in the Flash Type pull-down menu.

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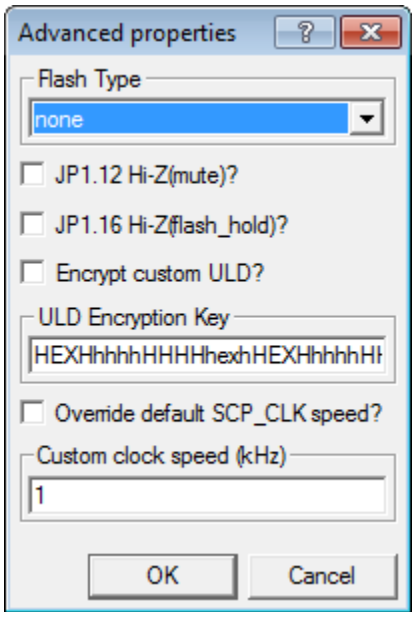

Figure 5-2. Selecting Flash Type via the Advanced Properties Dialog Box

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The two JP1 checkboxes allow the user to do one of the following:

- JP1 Pin 12--Check this box to three-state JP1 Pin 12 signal (mute) which leaves the audio outputs unmuted on the CDB47xxx. This actions allows the user to install an external mute control such as a DSP GPO.
- JP1 Pin 16-- Check this box to three state JP1 Pin 16 signal (flash_hold) which releases the DSP SPI Flash (U17).
- Check both boxes
- Leave both boxes unchecked (Default)-Allows the microcontroller to control both JP1 Pin 12 and JP1 Pin 16 as necessary.

4. Finally, Click the *Go* button and DSP Composer will compile the project into a binary image, deploy the image to the Flash device, and initiate a Master Boot of the CS470xx DSP on the CDB47xxx Board.

5.1.2 Using Micro-Condenser to Create and Load a Flash Image for Slave Mode Operations

Cirrus Logic's Micro-Condenser application allows the user to program the MCU SPI Flash (U14) through the USB port. Once the Flash device is programmed, the user is able to control the CS470xx DSP in Slave mode while disconnected from the PC. The user can then load and compile up to 20 DSP Composer projects with up to 20 snapshots for each project into the microcontroller Flash. The user can then run any of the loaded projects/snapshots onto the DSP running in Slave mode and control the operation of the firmware using the CDB47xxx on-board navigation buttons and dials.

5.1.2.1 Micro-Condenser Components

- flasher_micro.exe

  This PC tool builds the Flash image containing the DSP Composer deliverables. This tool uses an XML file as input.

- flash_image.xml

  This is the input file to flasher_micro.exe. This file specifies the following:

  - The desired output format (for example, .txt, .c)
  - Path and folder name of the DSP Composer deliverable
  - Input/output Fs and display_name of the project
  - The snapshots that are to be built into the Flash image, as well as the display name (display_name) of the image can be displayed on the CDB47xxx Board LCD
  - The start address of the Flash image
  - Whether little or big endian format is used
  - Optional addition of project or snapshot names to the Flash image

5.1.2.2 Micro-Condenser Restrictions/ Conventions

The Micro-Condenser application has the following restrictions/conventions:

- DSP Composer projects and snapshots currently are not identified by the name of the project or snapshot on the CDB47xxx LCD. They are identified by a number that is derived from the order in which the project/snapshot appears in the XML file used by Micro-Condenser when it generates the Flash image. A useful practice is to compile a list of the projects/snapshots created and the number associated with them in the XML file.
- Snapshot 0 is the initial configuration that is generated by DSP Composer when the *Go* button is pressed and is stored in the file, initial.cfg

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5.1.3 Using Micro-Condenser to Create and Load a Flash Image into the DSP

5.1.3.1 Creating a Flash Image

To use the Micro-Condenser application to create and load a Flash image to the CS470xx DSP on the CDB47xxx Board, follow these steps:

Follow these steps to create the Flash image:

1. Complete examples are included with the evaluation kits:

   `C:\CirrusDSP\micro_condenser\CS47XXX\example`

2. Use DSP Composer to create the desired Composer Project Archive (.cpa) files. If more than one setting of the DSP code is desired, you must save the desired settings as snapshots using the snapshot manager (**Tools →Snapshots**). This has been done in the .cpa example files.
3. When you have created all the desired snapshots, create the initial setting. Note that the initial setting is only generated when you press "Go". This means you must change the configuration in DSP Composer and then press "Go", after that save your .cpa file.
4. Generate Deliverables using the drop-down menu option **Tools →Generate Deliverables**.
5. Repeat steps 1 through 3 for each .cpa file.
6. Specify the projects and snapshots that are to be included in the Flash image, which is accomplished within an XML file, for the included example refer to:

   `C:\CirrusDSP\micro_condenser\projects\sample\flash_image.xml`

7. Build the Flash image. Open the Console window, navigate to the example folder containing the file, flash_image.xml
8. Run the file `create_flash_image.bat`, which contains the statement `flasher_micro.exe flash_image.xml` which builds the Flash image.
9. Open flash_image.txt to see the new Flash image data.

5.1.3.2 Programming the Flash Image into the Flash Device

Cirrus provides the usb_flash.exe utility with the CDB47xxx Evaluation Kit and is used to program memory storage devices. Run program_mcu_spi_flash.bat to program flash_image.txt into the microcontroller's external SPI Flash. The program_mcu_spi_flash.bat file calls the usb_flash.exe utility to program the flash_image.txt into the SPI Flash Device.

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Chapter 6

CDB47xxx Schematics

6.1 Introduction

The schematics included in this document are the original Revision A schematics of the CDB47xxx and reflects the board as it was manufactured. Newer schematics may be available that incorporate feature additions or corrections, and may not match Rev. A hardware.

6.2 CDB47xxS Single-Ended Schematic Descriptions

6.2.1 CDB47xxxS Block Diagram

Figure 6-1 shows the CDB47xxxS block diagram.

6.2.2 Daughtercard Connectors

Figure 6-3 shows the schematic for the daughtercard connectors on the CDB47xxxS board.

The digital connector (J2) carries the following signals:

- Serial Control signals for host control of the CS470xx
- Serial Control signals from CS470xx to the SPI Flash and I²C EEPROM
- Serial Audio Data and Clocks going to the DAI of the CS470xx
- Serial Audio Data and Clocks coming from the DAO of the CS470xx

The analog connector (J3) carries the following signals:

- 8 channels of line-level analog from the CS470xx DACs - can support differential or single-ended signaling
- 12 channels of line-level analog to the CS470xx ADCs - can support differential or single-ended signaling

The microphone input is routed to AIN_6A. The AIN_6B channel can be used for mono line-level input.

6.2.3 Digital Audio and Control Connectors

Figure 6-4 shows the schematics for the digital audio and control connectors on the CDB47xxxS board.

The audio input connectors consist of the following:

- 1 RCA jack for coaxial S/PDIF input
- 1 optical jack for optical S/PDIF input
- 1 2x10 header for serial audio data (I^2S)

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The audio output connectors consist of the following:

- 1 RCA jack for coaxial S/PDIF output
- 1 optical jack for S/PDIF output
- 1 2x10 header for serial audio data (I^2S)

There is one control connector - JP1. This 20-pin connector provides pins for the following functions:

- Serial control interface for configuring the DSP
- Reset line for the DSP
- Proprietary serial debug interface

Jumper (J28) can be used to bypass the on-board MCU and enable use of JP1. While this header is configured for MCU control (pins 2-3), the MCU will continue to drive all control lines to the CS470xx.

6.2.4 Memory

Figure 6-5 shows the schematic for the SPI Flash and I^2C EEPROM devices. The CDB47xxxS is designed with 32Mbits of SPI Flash and 512 kbit on-board. The serial control port for each device is routed to the daughtercard connector J2.

6.2.5 Microphone Preamplifier

Figure 6-6 shows the microphone preamplifier for the CDB47xxxS, which has a 1/8" microphone input jack to allow direct connection to an encapsulated condenser microphone (ECM). Because the output of the ECM is so small, a pre-amplifier is needed to boost the signal to a line-level voltage.

These specifications for the amplifier are noted on the schematic page. These parameters should be considered when choosing the microphone to be connected to the CDB47xxxS. Too large of a signal on the ADC input will result in distortion of the sampled signal.

It is important to note that although the amplifier circuit shown is non-inverting (the input to U19-B is the same polarity as the output from U19-C), the output of an ECM is inherently inverted since it acts as an open-collector device. Therefore the microphone signal driven to the CS470xx should be considered an inverted signal for processing purposes.

6.2.6 Power

Figure 6-7 shows the schematics for power on the CDB47xxxS board.

The DC input connector (J22) for the CDB47xxxS can accept +9 to +12 V_{DC}, and the power supply should be capable of supplying at least 2 amps of current.

The 4 voltage regulators on the CDB47xxxS generate the +1.8V, +3.3V, +5V and -5V necessary for powering all of the ICs on the board. Note that the +5V, +3.3V and +1.8V regulators run directly off the DC input supply connected to the CDB47xxxS. Also notice that the +1.8 V regulator is dependent upon +3.3V power to enable it (not necessarily the 3.3 V regulator).

The 3 power jumpers (P1-P3) are used to choose between the on-board regulators, and an external source for +5V, +3.3V, and +1.8V. This is a feature intended only for special applications, so these jumpers should be left populated for normal operation.

6.2.7 Input Filters

Figure 6-8 shows the input CDB47xxxS. Each input of the CS470xx has its own input filter that consists of a current limiter, an AC-coupling capacitor (10 μF), and an anti-aliasing capacitor (2200 pF) which is not

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populated. The current limiter is scaled to make the CDB47xxxS capable of accepting analog signals of up to 2 VRMS. The CS470xx analog inputs register full-scale for an input amplitude of 2VRMS with this input filter.

6.2.8 Output Filters

Figure 6-9 shows the output filters for the CDB47xxxS.

Each output of the CS470xx has an output filter that consists of an AC-coupling cap (22 μF), a pull-down resistor to prevent the output from floating when not connected to a load, a series resistor (560 Ω) to provide a voltage drop when the muting transistor is enabled, a filter cap (2200 pF) and a mute transistor that will pull the output low when the mute control signal is enabled. The series resistor is small enough that it does not affect the signal in normal operation, assuming a load of at least 5 kΩ is connected to the analog output of the board.

6.2.9 MCU Block Diagram

Figure 6-10 shows the MCU block diagram for the CDB47xxxS.

6.2.10 MCU

Figure 6-10 shows the MCU for the CDB47xxxS.

The USB connector (J25) is connected directly to the MCU (U15). All PC control must pass through the MCU, since it has an integrated USB interface.

Due to the way the MCU multiplexes its serial control pins, and the multiplexing of the pin functions on the CS470xx, there are two I^2C bus isolators (U12 and U13) to prevent slave Comm ports from receiving commands not intended for them.

The MCU has its own 32 Mbit SPI Flash (U14) for storing MCU firmware.

The LCD control port is multiplexed with other functions on the board, so a buffer (U20) is used to isolate those logic lines from the LCD data when the MCU is refreshing the LCD display.

The button S6 is the board reset. When the MCU is reset, it reboots and re-initializes the entire board according to the firmware stored in its internal Flash.

J36 is used only for updating the firmware in the MCU, and has no function in relation to the CS470xx.

6.2.11 User Interface Devices

Figure 6-12 shows the buttons, LEDs, and InfraRed receiver which comprise the standalone user interface for the CDB47xxxS.

The four momentary contact push-button switches (S1-S4) are routed to the ADC in the MCU (U15).

The rotary encoder with integrated push-button switch (S6) is also routed to the ADC in the MCU (U15).

The LCD (LCD1) is the primary feedback device for the MCU user interface.

The LEDs D1-D4 are also part of the MCU feedback interface showing the MCU status.

LED D11 is used to indicate that the USB interface is active.

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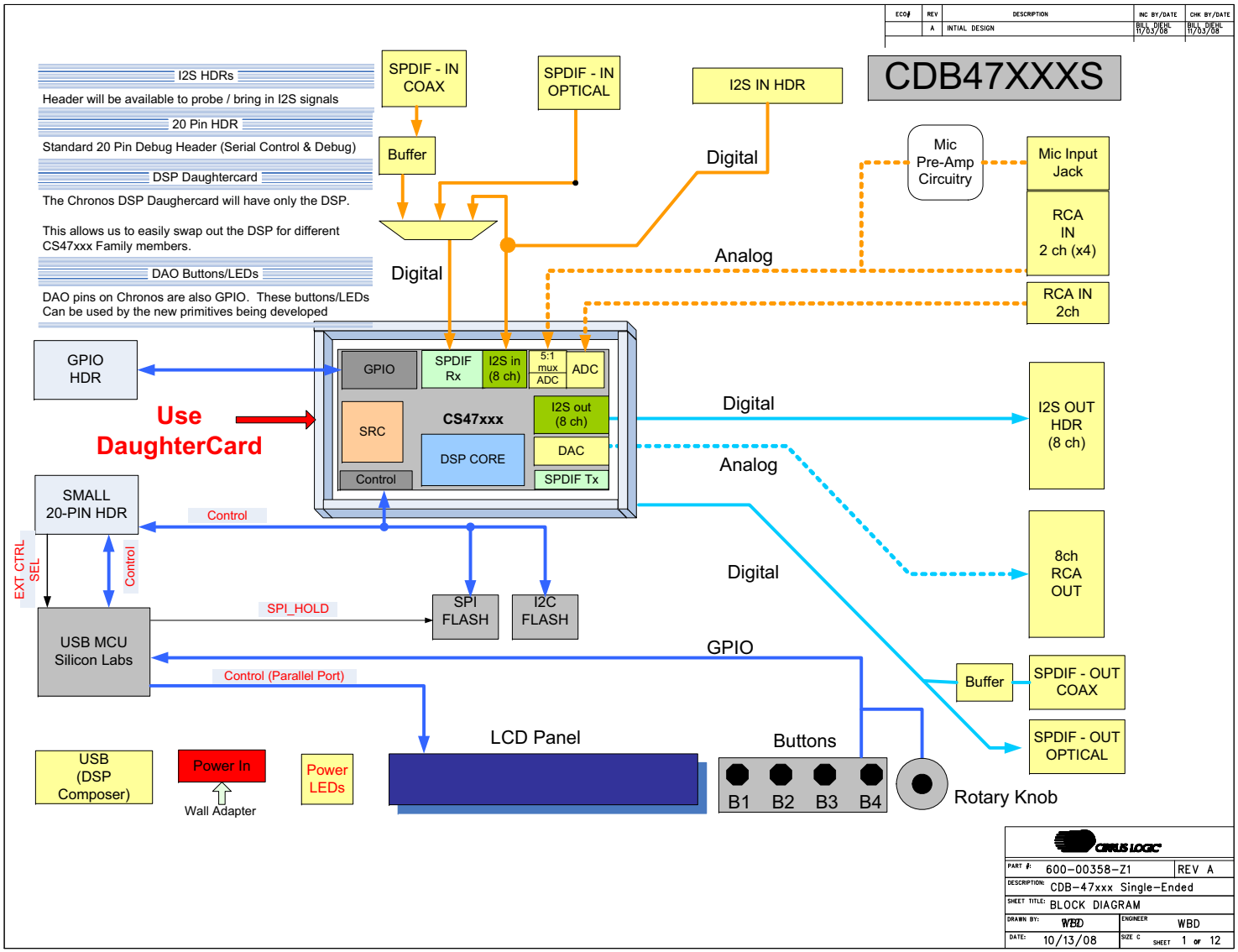

Figure 6-1. CDB47xxxS (Sngle-ended) Board Block Diagram

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1	Block Diagram
2	Schematic INDEX
3	DSP CONNECTORS
4	DIGITAL AUDIO/CTRL CONNECTORS
5	FLASH
6	MICROPHONE PREAMP
7	POWER
8	ADC FILTERS
9	DAC FILTERS
10	MCU BLOCK DIAGRAM
11	MCU – 8051F340
12	USER INTERFACE

Figure 6-2. CDB47xxS (Sngle-ended) Board Schematic Index

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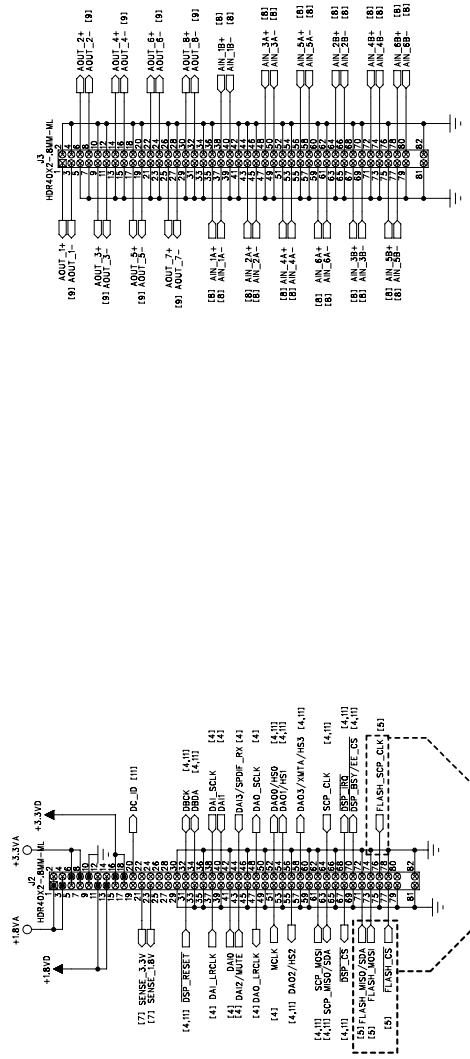

Figure 6-3. CDB47xxxS (Sngle-ended) Daughtercard Connectors

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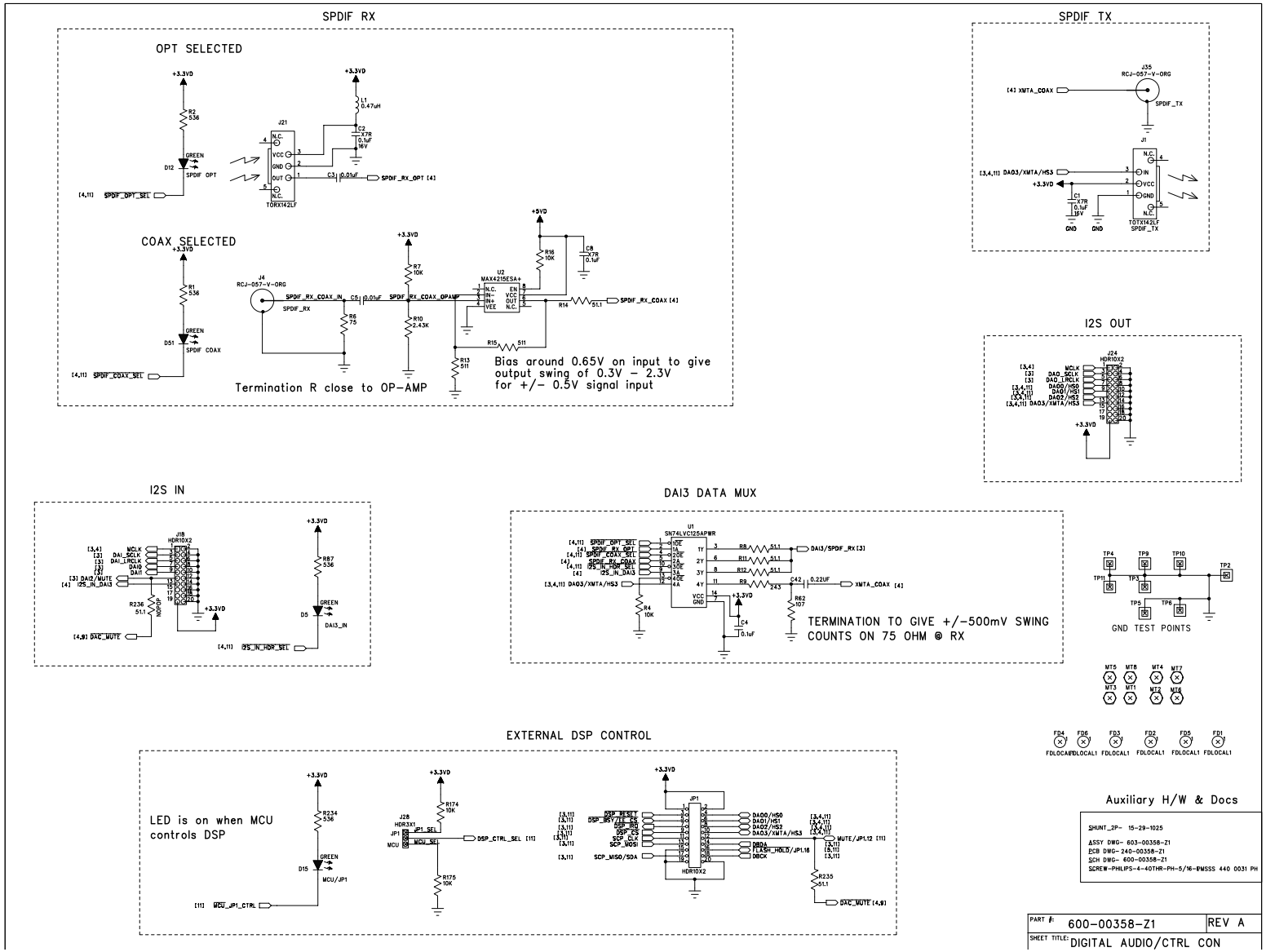

Figure 6-4. CDB47xxxS (Sngle-ended) Digital Audio Control Connectors

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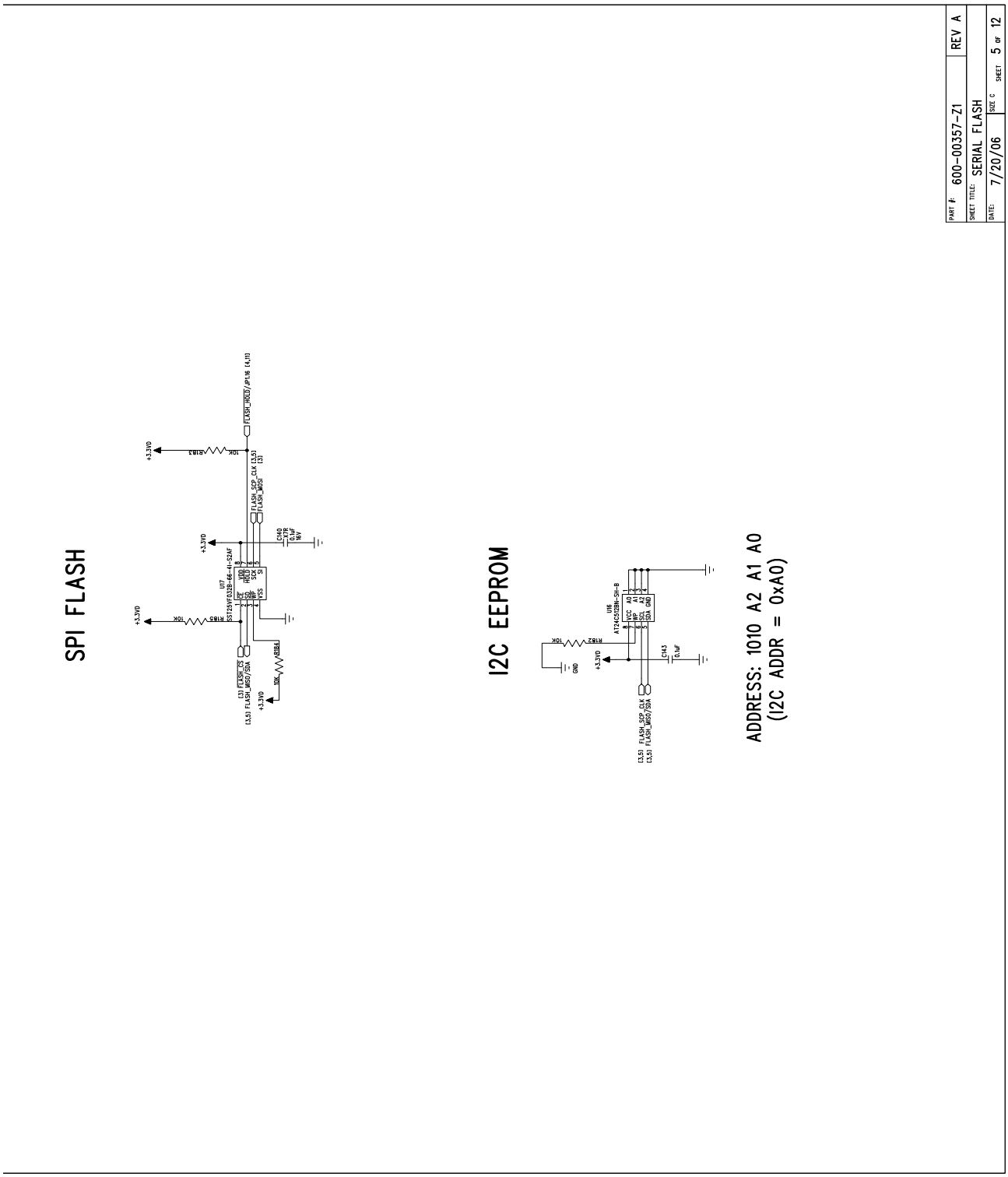

Figure 6-5. CDB47xxxS (Sngle-ended) Serial Memory

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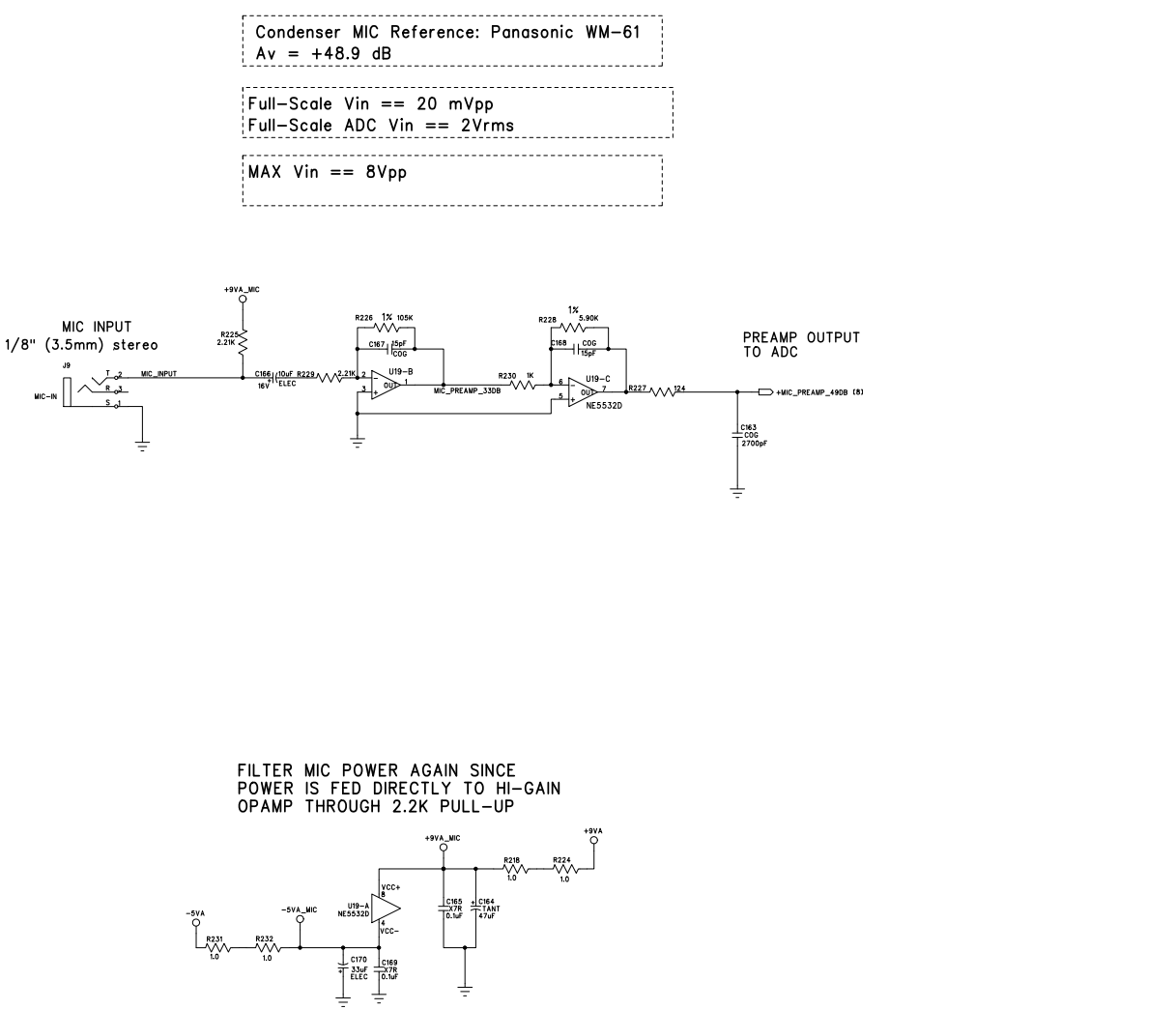

Figure 6-6. CDB47xxxS (Sngle-ended) Mic Pre-Amp

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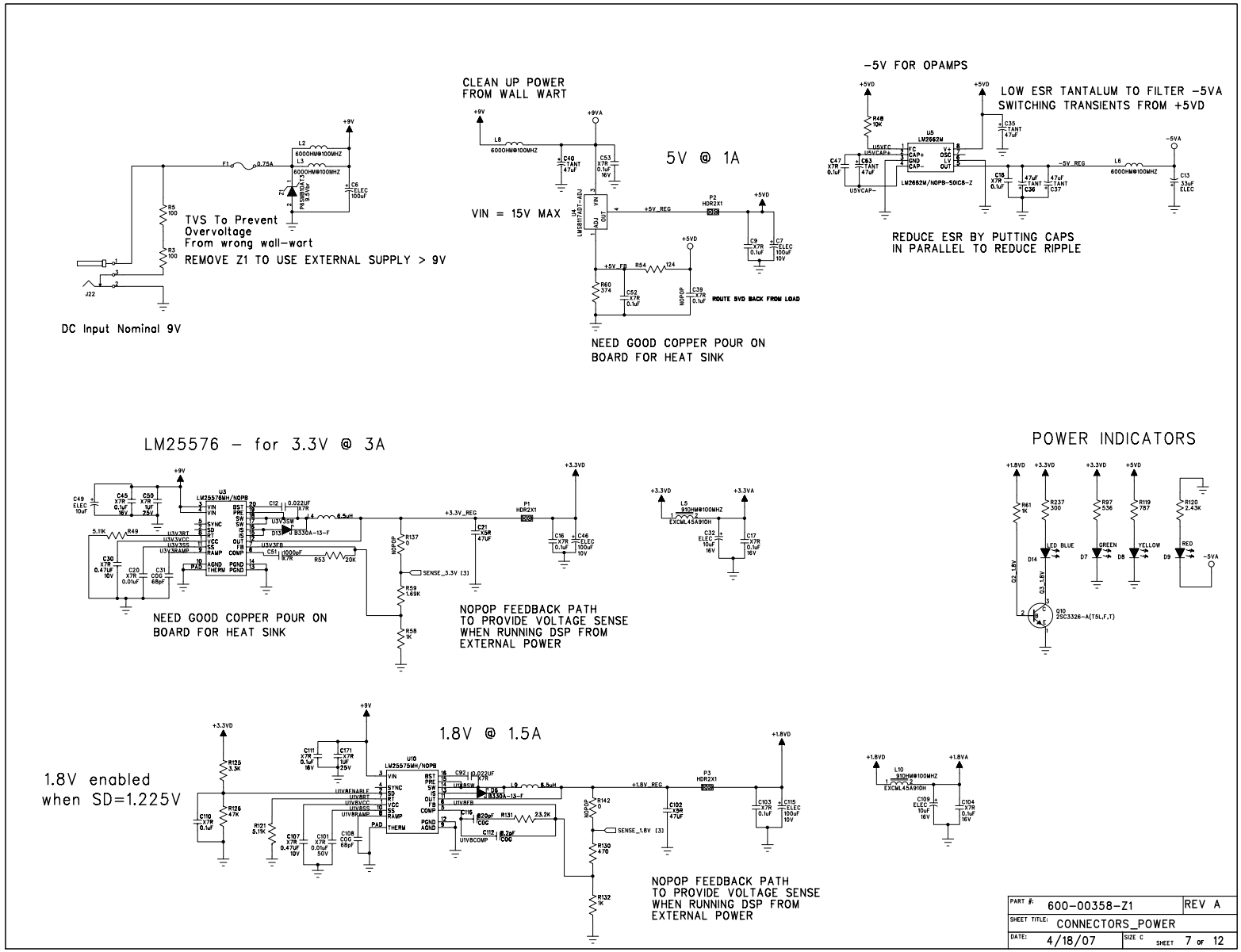

Figure 6-7. CDB47xxxS (Single-ended) Power Connectors

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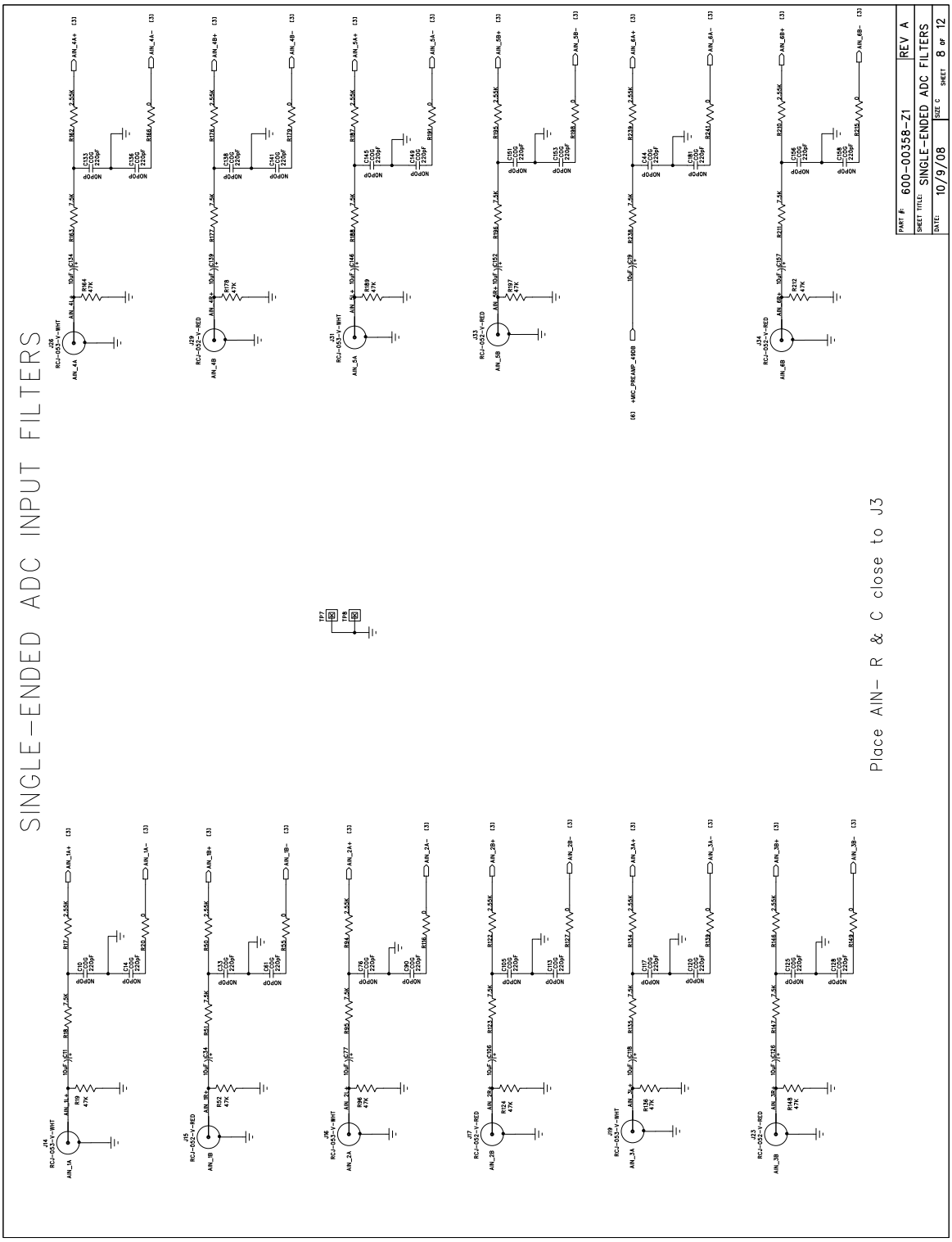

Figure 6-8. CDB47xxxS (Sngle-ended) ADC Filters

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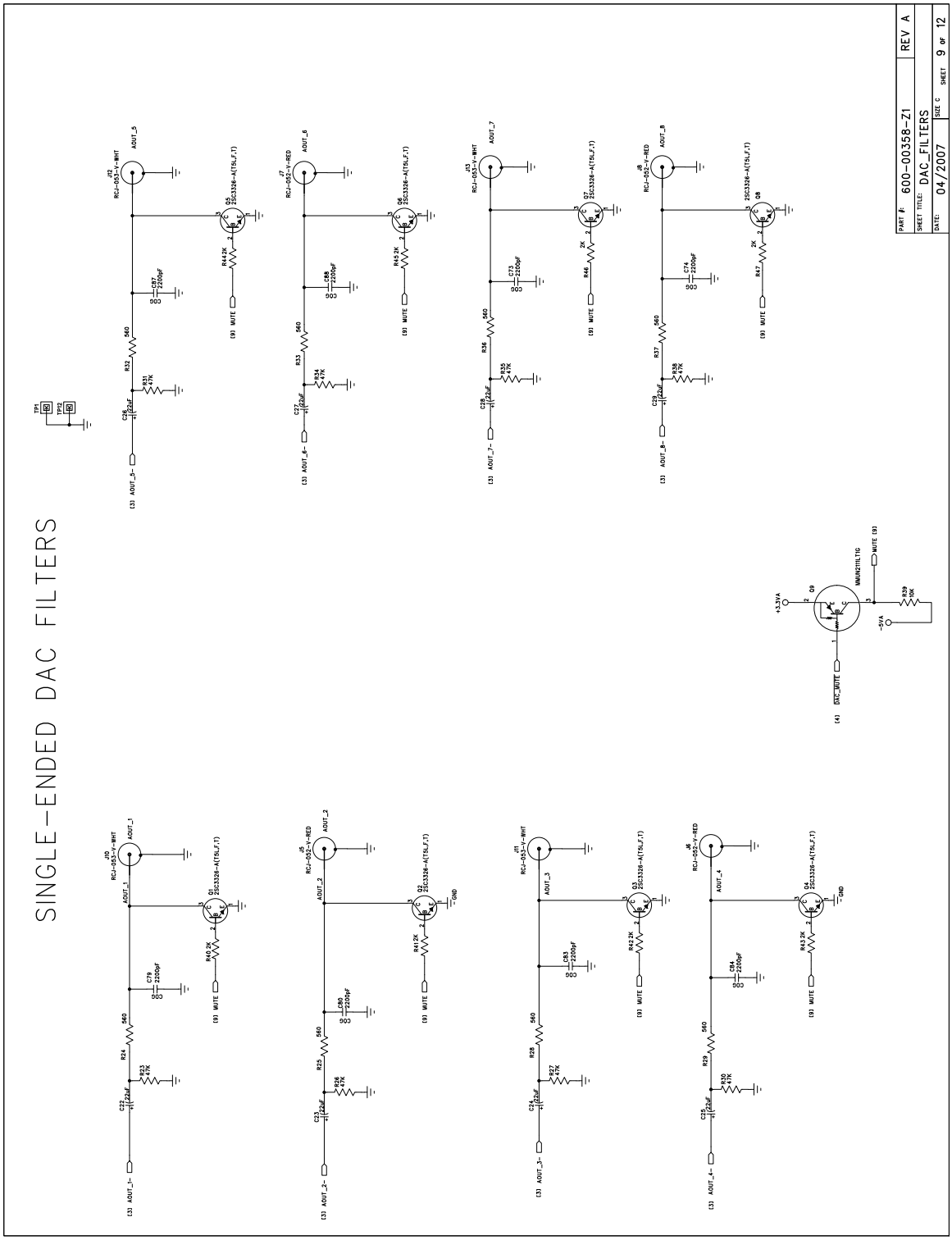

Figure 6-9. CDB47xxxS (Sngle-ended) DAC Filters

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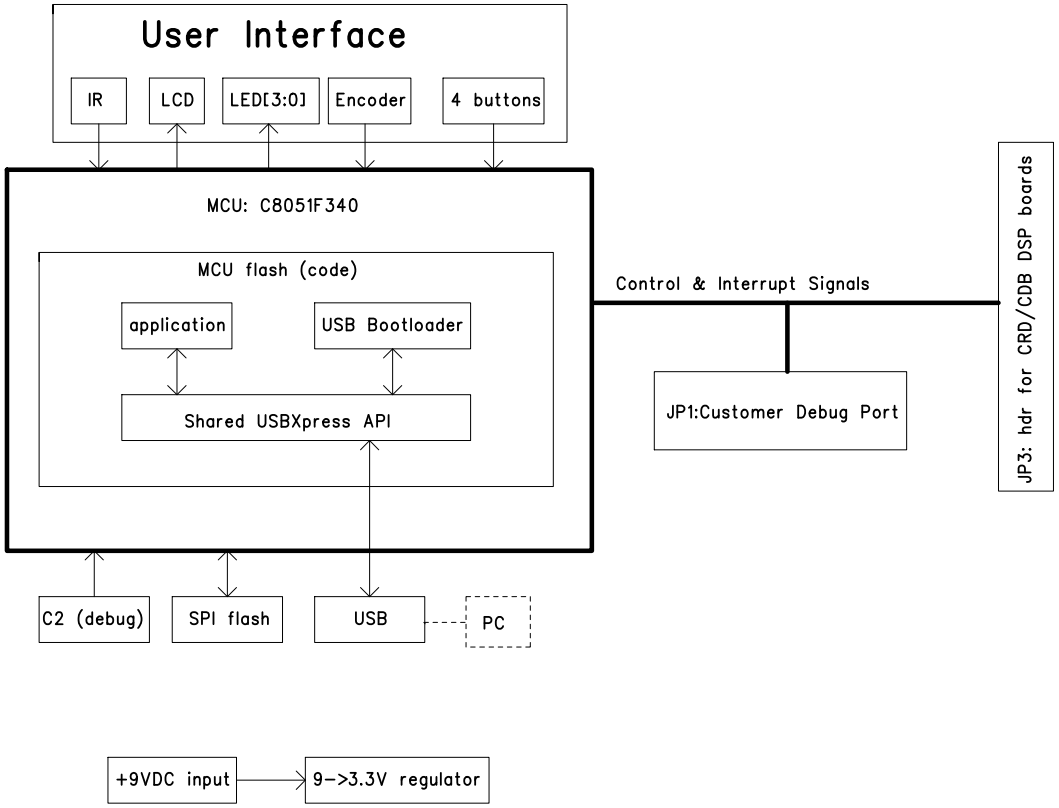

PART #: 600-00358-Z1		REV A
SHEET TITLE: MCU BLOCK DIAGRAM		
DATE: 4/18/07	SIZE C SHEET 10 OF 12	

Figure 6-10. CDB47xxxS (Sngle-ended) Microcontroller Card Interface

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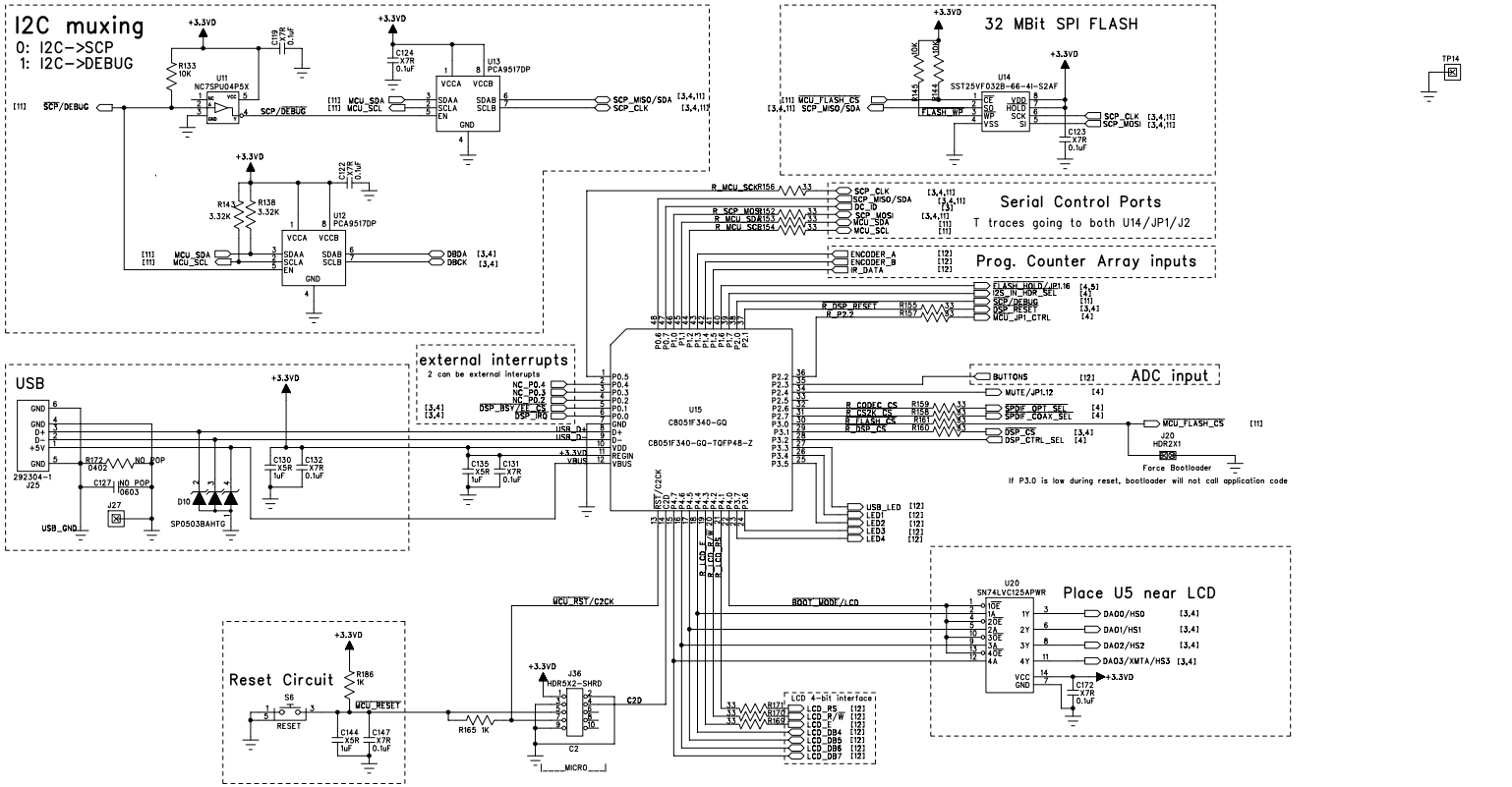

Figure 6-11. CDB47xxxS (Sngle-ended) Microcontroller Card User Interface

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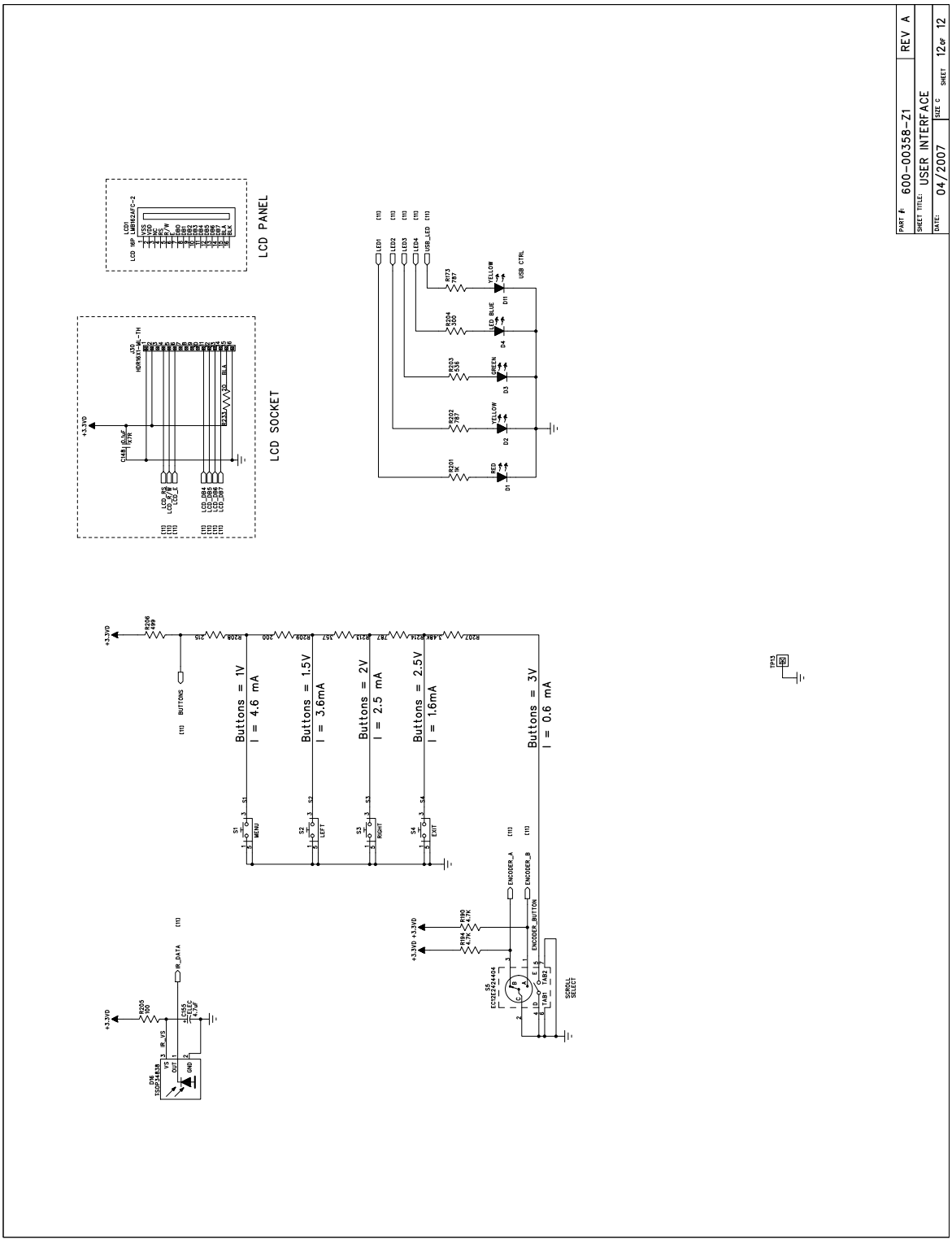

Figure 6-12. CDB47xxxS (Sngle-ended) Microcontroller Card User Interface

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6.3 CDB47xxD Differential Schematic Descriptions

6.3.1 CDB47xxxD Block Diagram

Figure 6-13 shows the CDB47xxxD block diagram

6.3.2 Daughtercard Connectors

Figure 6-15 shows the schematic for the daughtercard connectors on the CDB47xxxD board.

See section Section 6.2.2 for description of circuitry.

6.3.3 Digital Audio and Control Connectors

Figure 6-16 shows the schematics for the digital audio and control connectors on the CDB47xxxD board.

See section Section 6.2.3 for description of circuitry.

6.3.4 Memory

Figure 6-17 shows the schematic for the Flash memory devices.

See section Section 6.2.4 for description of circuitry.

6.3.5 Microphone Preamplifier

Figure 6-18 shows the microphone preamplifier for the CDB47xxxD.

See section Section 6.2.5 for description of circuitry.

6.3.6 Power

Figure 6-19 shows the schematics for power on the CDB47xxxD board.

See section Section 6.2.6 for description of circuitry.

6.3.7 Input Filters

Figure 6-20 shows the input CDB47xxxD. Each channel of the CS470xx is differential and input has its own input filter that consists of a current limiter, an AC-coupling capacitor (10 μF), and an anti-aliasing capacitor (2200 pF) which is not populated. The current limiter is scaled to make the CDB47xxxD capable of accepting analog signals of up to 4VRMS differentially.

6.3.8 Output Filters

Figure 6-21 shows the output filters for the CDB47xxxD.

Each channel of the CS470xx is differential and is fed to an op-amp that converts the differential signal into a single-ended output with a maximum swing of 2 V_{RMS}.

Each output has a series resistor (560 Ω) to provide a voltage drop when the muting transistor is enabled, and a mute transistor that will pull the output low when the mute control signal is enabled. The series resistor is small enough that it does not affect the signal in normal operation, assuming a load of at least 5 kΩ is connected to the analog output of the board.

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6.3.9 MCU Block Diagram

Figure 6-22 shows the MCU block diagram for the CDB47xxxD.

6.3.10 MCU

Figure 6-23 shows the MCU for the CDB47xxxD.

See section Section 6.2.10 for description of circuitry.

6.3.11 User Interface Devices

Figure 6-12 shows the buttons, LEDs, and InfraRed receiver which comprise the standalone user interface for the CDB47xxxD.

See section Section 6.2.11 for description of circuitry.

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CDB47XXXD_REV_A.sch-1 - Thu Jan 29 18:21:59 2009

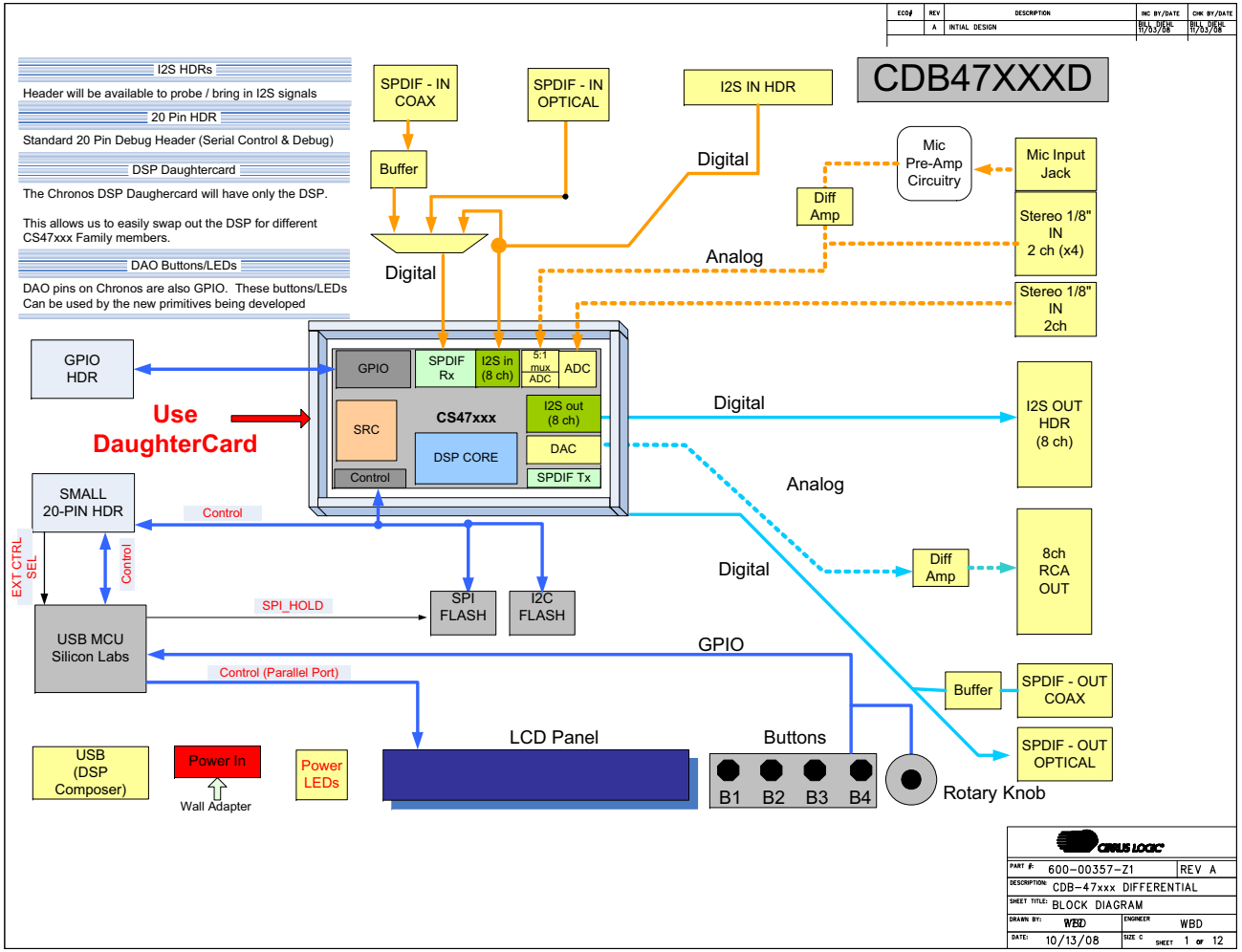

Figure 6-13. CDB47xxD (Differential) Board Block Diagram

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1	Block Diagram
2	Schematic INDEX
3	DSP CONNECTORS
4	DIGITAL AUDIO/CTRL CONNECTORS
5	FLASH
6	MICROPHONE PREAMP
7	POWER
8	ADC FILTERS
9	DAC FILTERS
10	MCU BLOCK DIAGRAM
11	MCU – 8051F340
12	USER INTERFACE

Figure 6-14. CDB47xxD (Differential) Board Schematic Index

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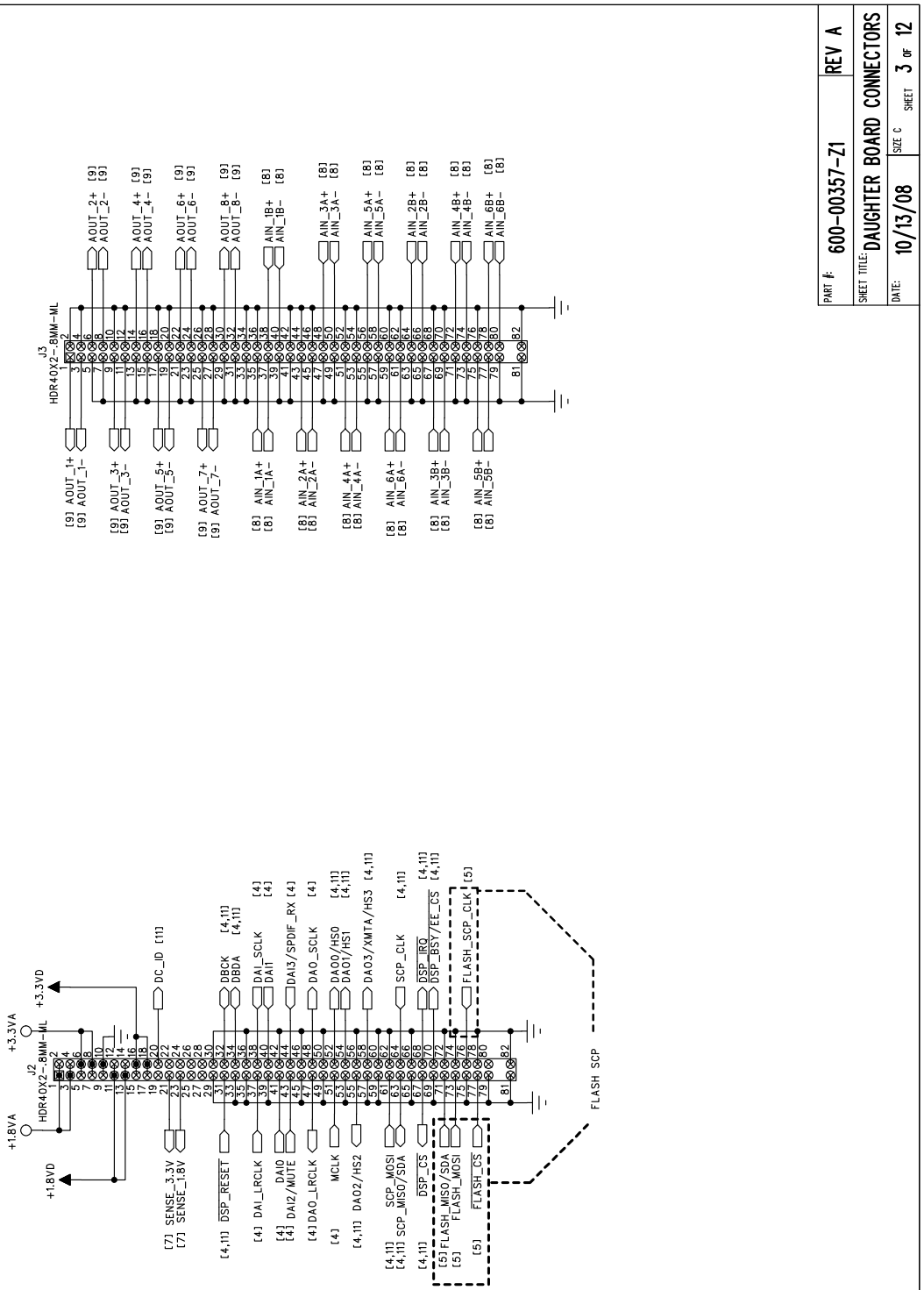

Figure 6-15. CDB47xxD (Differential) Daughtercard Connectors

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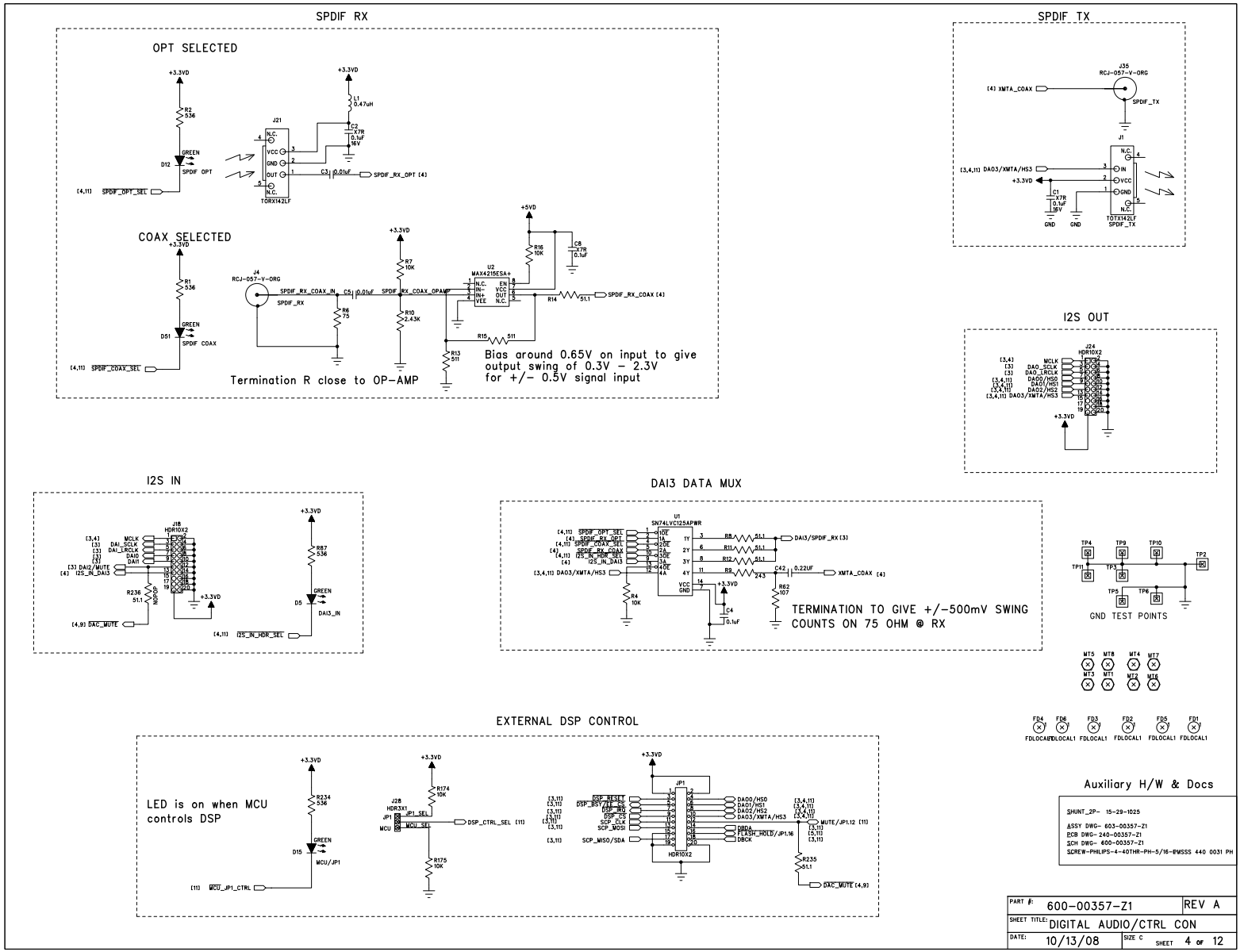

Figure 6-16. CDB47xxD (Differential) Digital Audio Control Connectors

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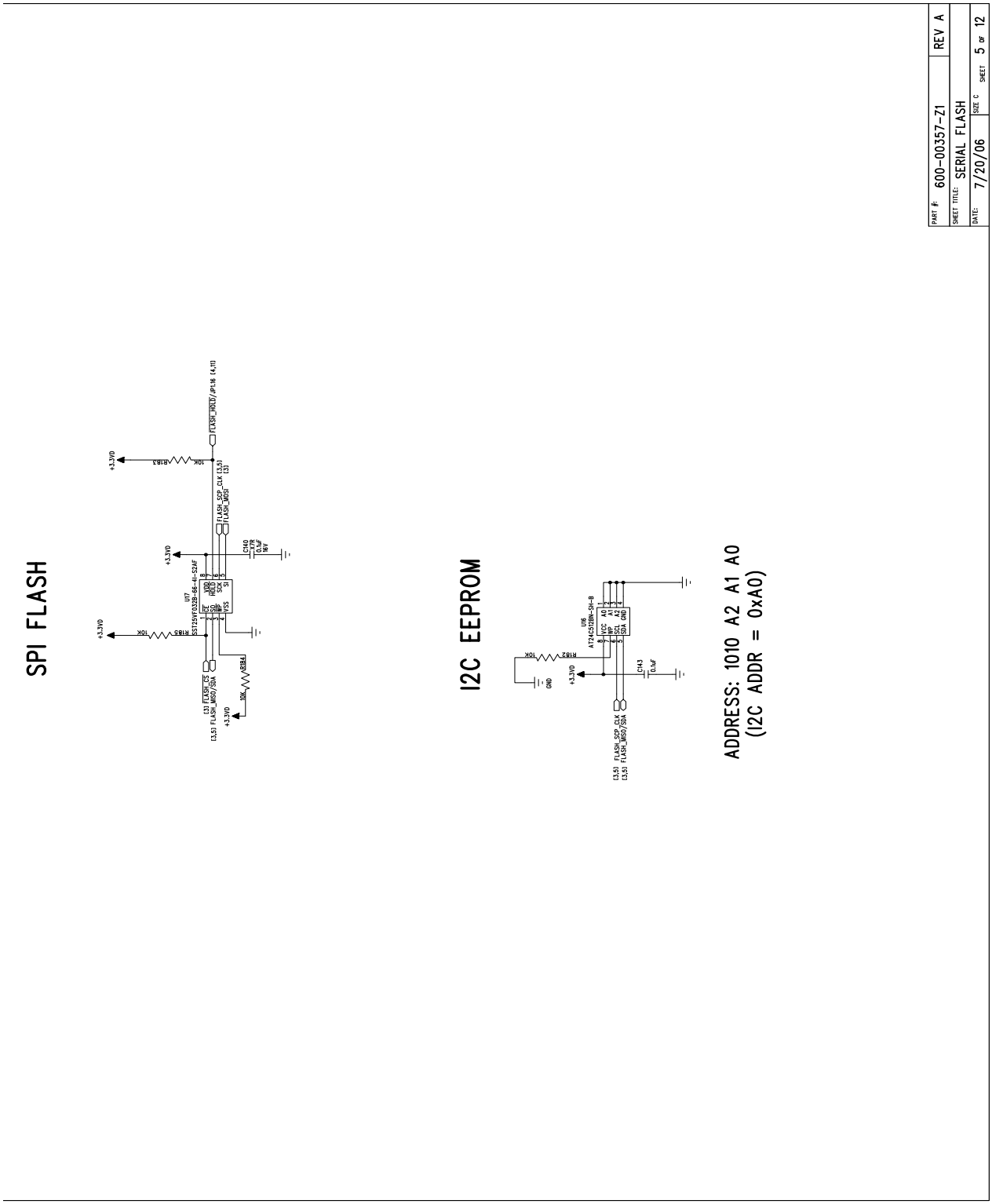

Figure 6-17. CDB47xxD (Differential) Digital Serial Flash

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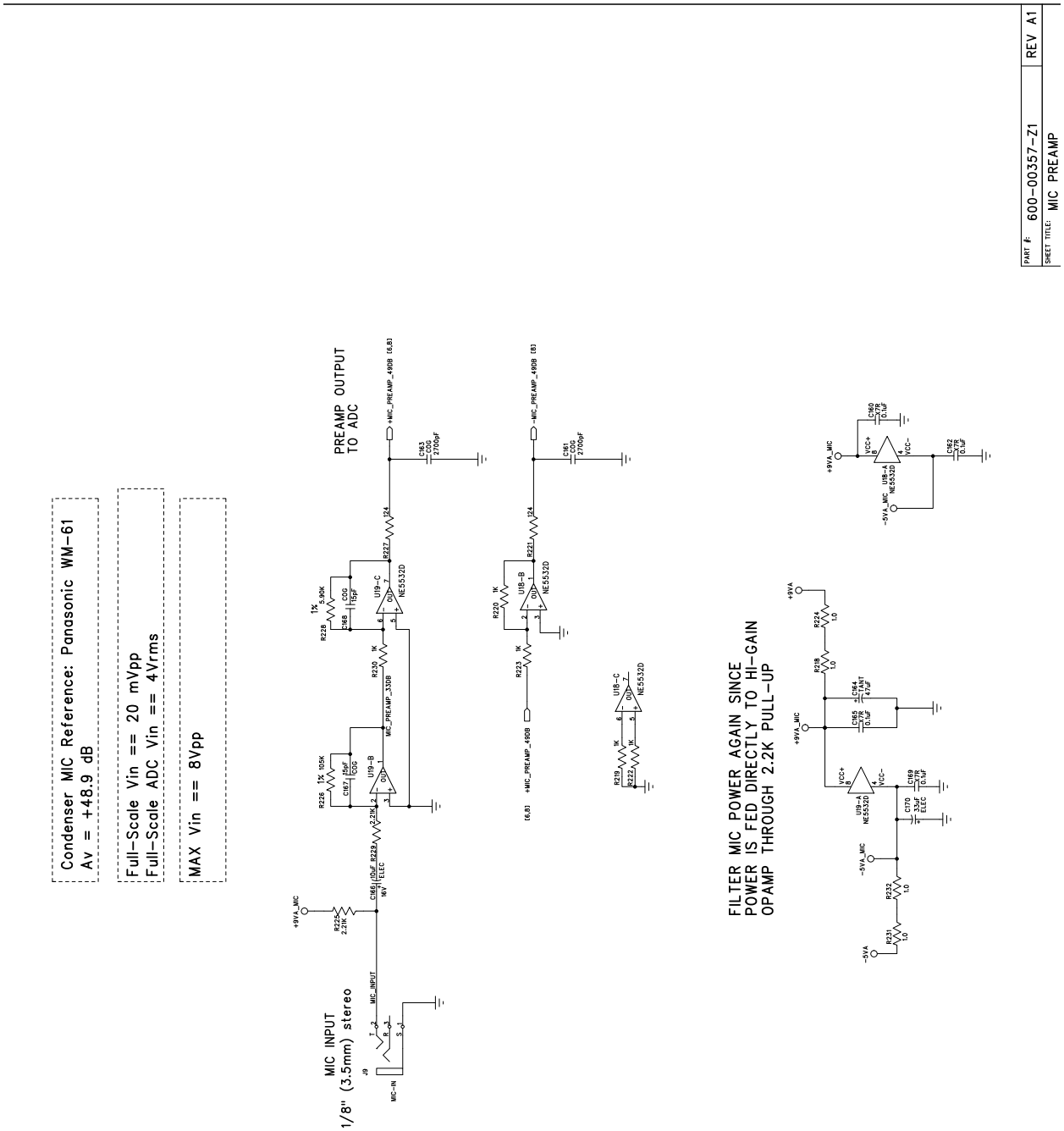

Figure 6-18. CDB47xxD (Differential) Mic Pre-Amp

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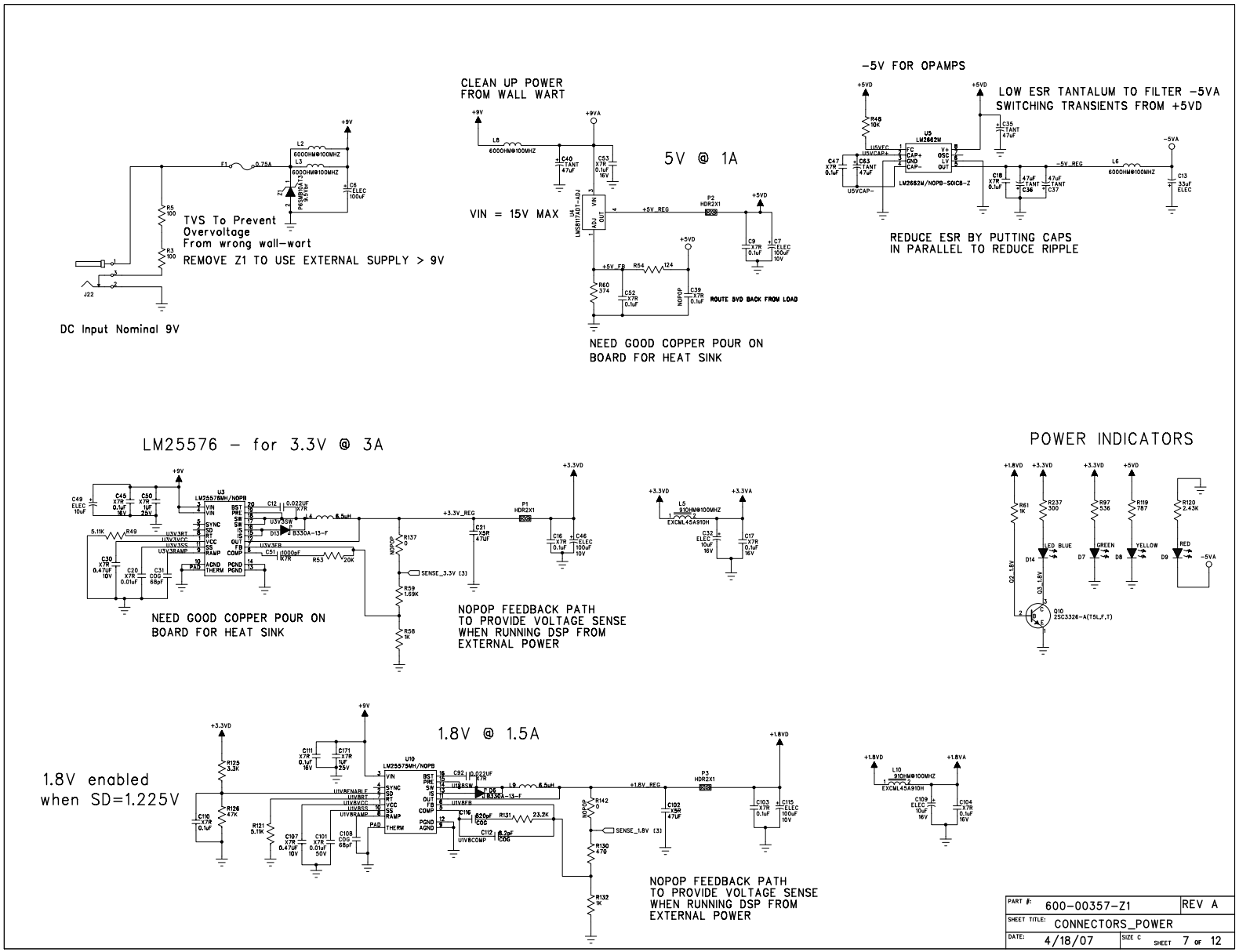

Figure 6-19. CDB47xxxD (Differential) Power Connectors

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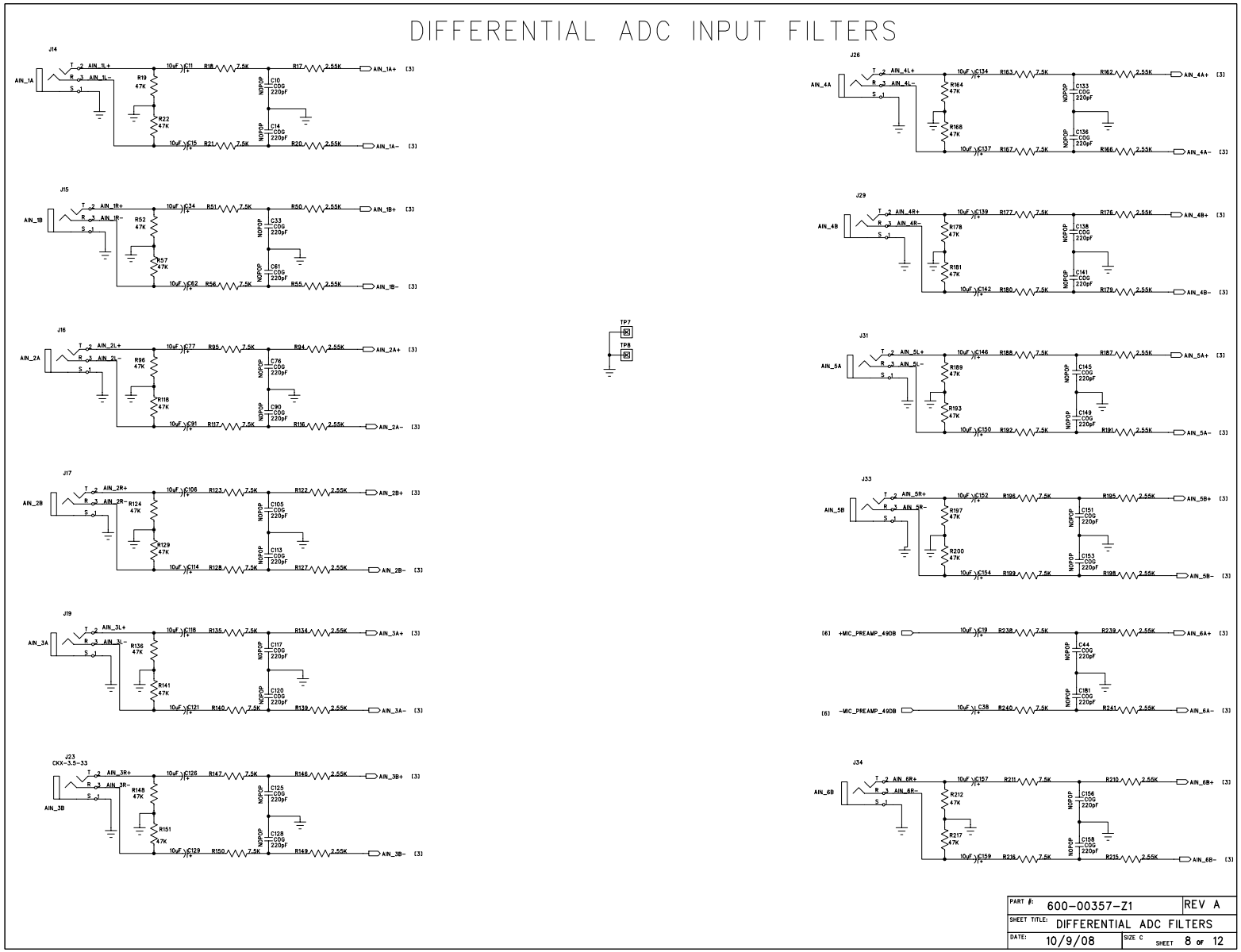

Figure 6-20. CDB47xxD (Differential) ADC Filters

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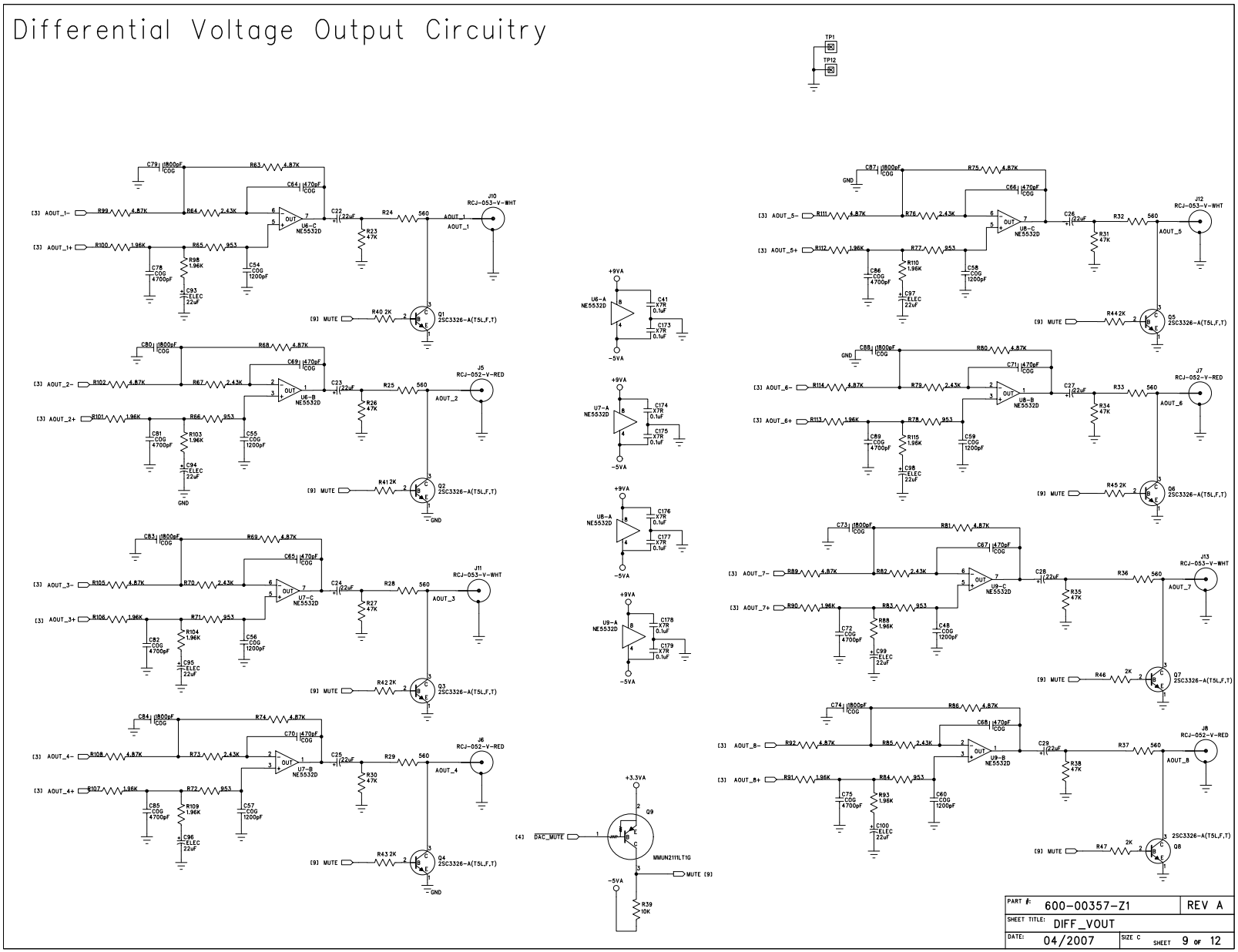

Figure 6-21. CDB47xxD (Differential) Voltage Output Circuitry

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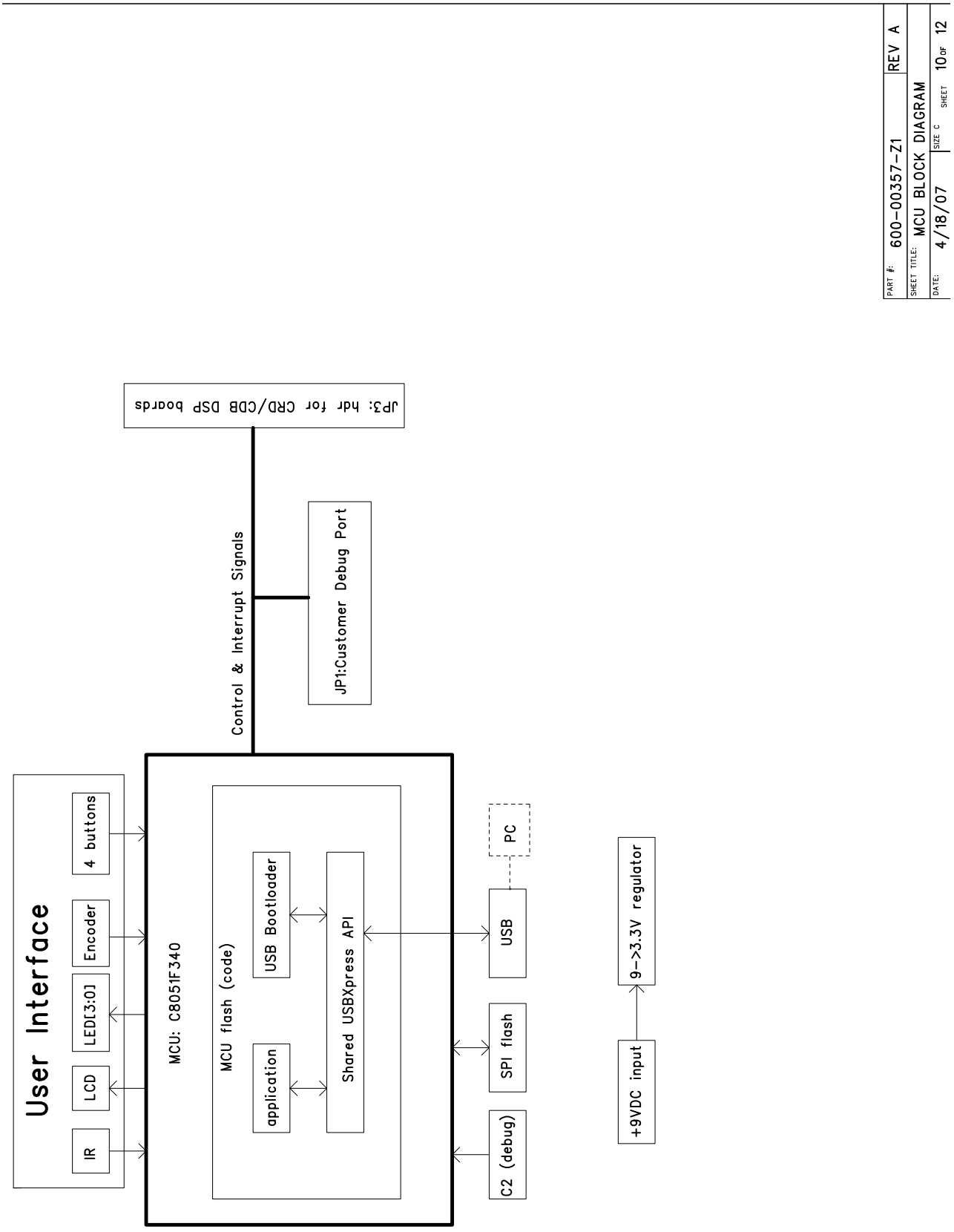

Figure 6-22. CDB47xxD (Differential) Microcontroller Card Interface

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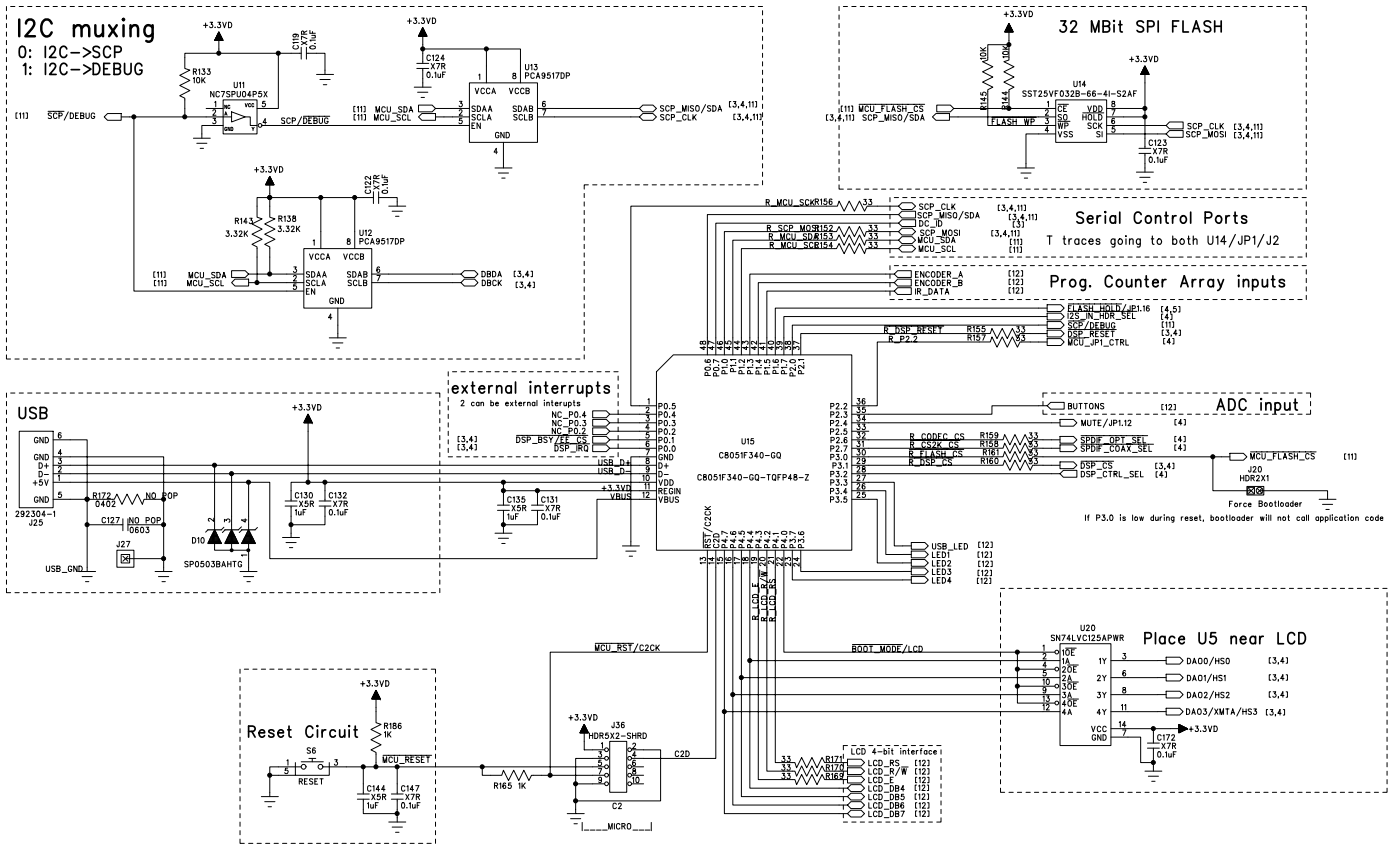

Figure 6-23. CDB47xxD (Differential) Microcontroller Card Schematic

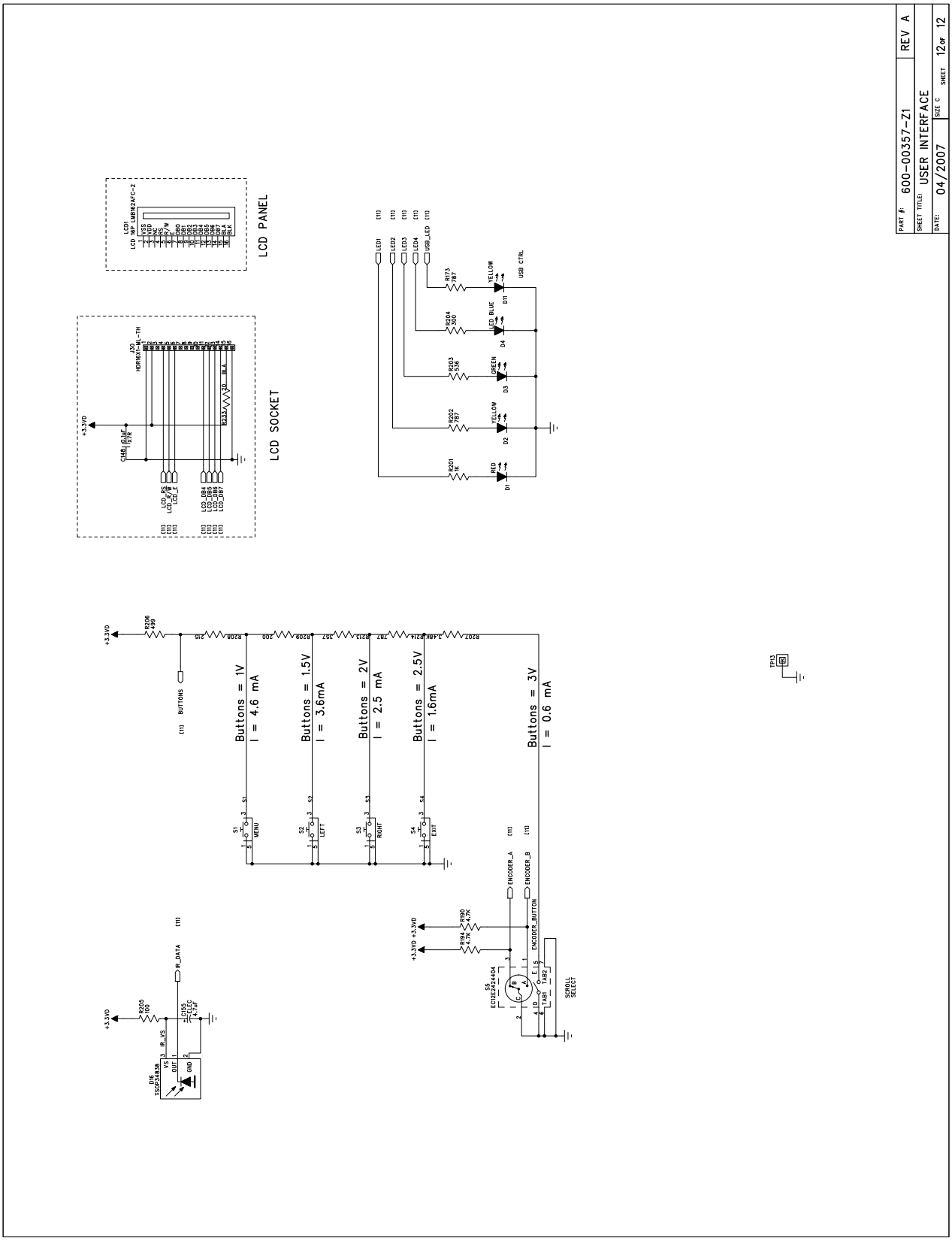

Figure 6-24. CDB47xxD (Differential) Microcontroller Card User Interface

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6.4 CDB47xxx-DC48 Daughtercard Schematic

6.4.1 CDB47xxx-DC48 Block Diagram

Figure 6-25 shows the CDB47xxx-DC48 block diagram

6.4.2 CDB47xxx-DC48 Schematic

The schematic for the CDB47xxx-DC48 daughtercard is shown in Figure 6-26. The CDB47xxx-DC48 employs the CS47048 DSP. The DSP is driven by an external crystal circuit. This fixed 24.576 MHz clock is used to drive the PLL inside the CS470xx for the core DSP clocks, and for all internal audio clocks.

The DSP has a dedicated reset line ($\overline{\text{DSP_RESET}}$) that must be driven by the host to initialize the CS470xx's communication mode and initiate the first boot sequence. This signal is independent of any other reset on the board and can be used to sequence device power up.

The host communication protocol of the DSP is determined by the state of the HS[3:0] pins at the rising edge of reset.

The serial host control port (SCP_CLK, SCP_MOSI, SCP_MISO/SDA, $\overline{\text{SCP_CS}}$, $\overline{\text{SCP_IRQ}}$, $\overline{\text{SCP1_BSY}}$) is used by the host controller to boot and control the DSP. Note that the pull-up resistors on the SCP_IRQ and SCP_BSY pins are required for both SPI and I^2C control, since these are open-drain pins. The pull-ups on the SCP_CLK and SC1_SDA pins are required only for I^2C operation.

The DSP has a debug port (DBDA, DBCK) that allows a developer to debug the DSP during normal operation. This is a slave port that can be connected to an I^2C master, or it can be simply terminated with pull-up resistors.

The DAI3 digital audio input pin of the CS470xx is driven by a multiplexer on the CDB47xxx main board that chooses between optical S/PDIF RX, coaxial S/PDIF RX, and DAI3 from the DAI header on the main board. The remaining DAI pins are driven directly by the DAI header on the main board.

The DAO port of the CS470xx is driven directly to the DAO header on the main CDB47xxx Board.

The DAC outputs are routed directly to the DAC filter circuitry on the CDB47xxx main board.

The ADC inputs are routed directly to the ADC filter circuitry on the CDB47xxx main board.

The Daughtercard ID register (U2) is used to identify which CS470xx chip is populated on the board. This register is read by the MCU or the PC in order to determine which DSP firmware is appropriate for the SOC.

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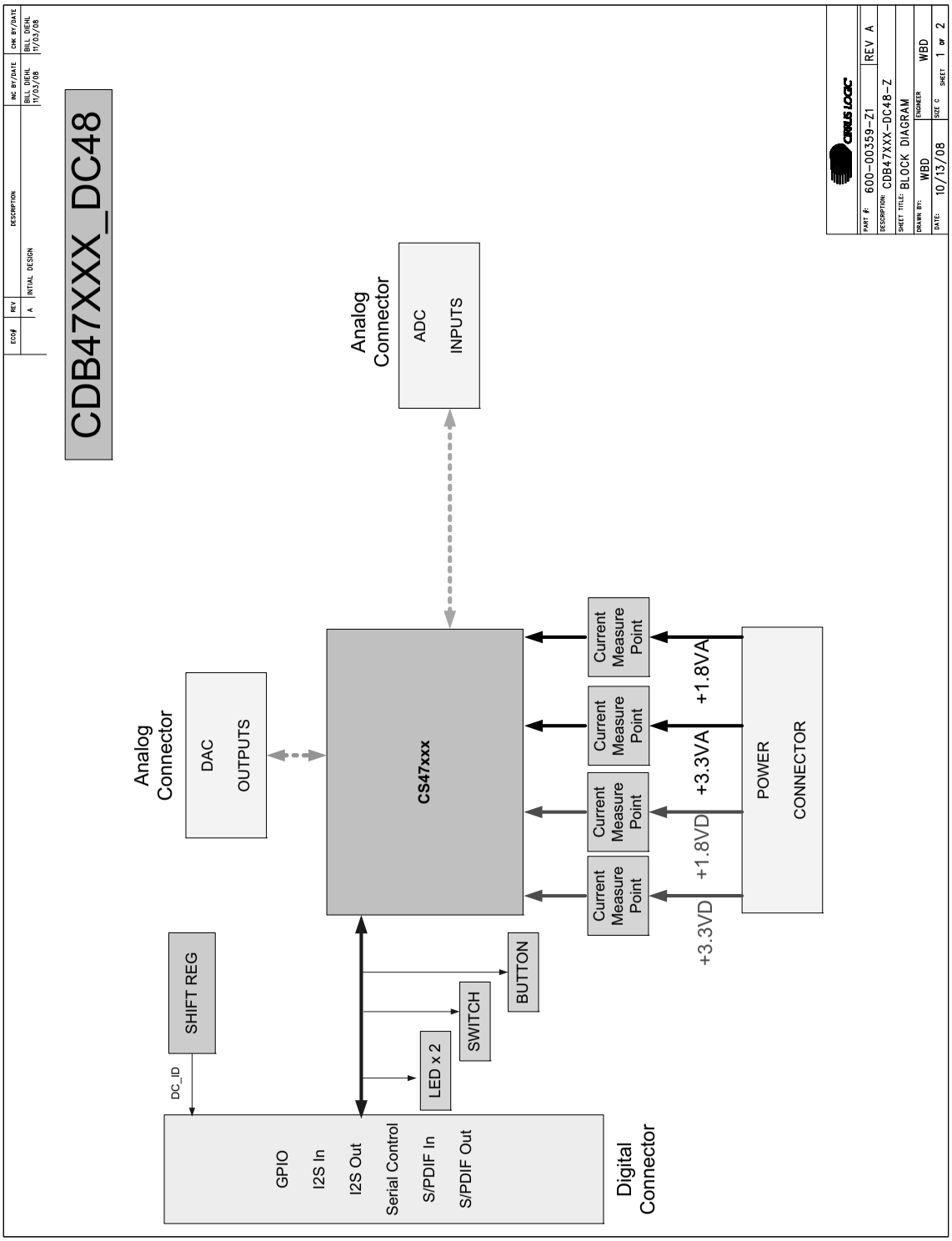

Figure 6-25. CDB47xxx-DC48 Daughtercard Block Diagram

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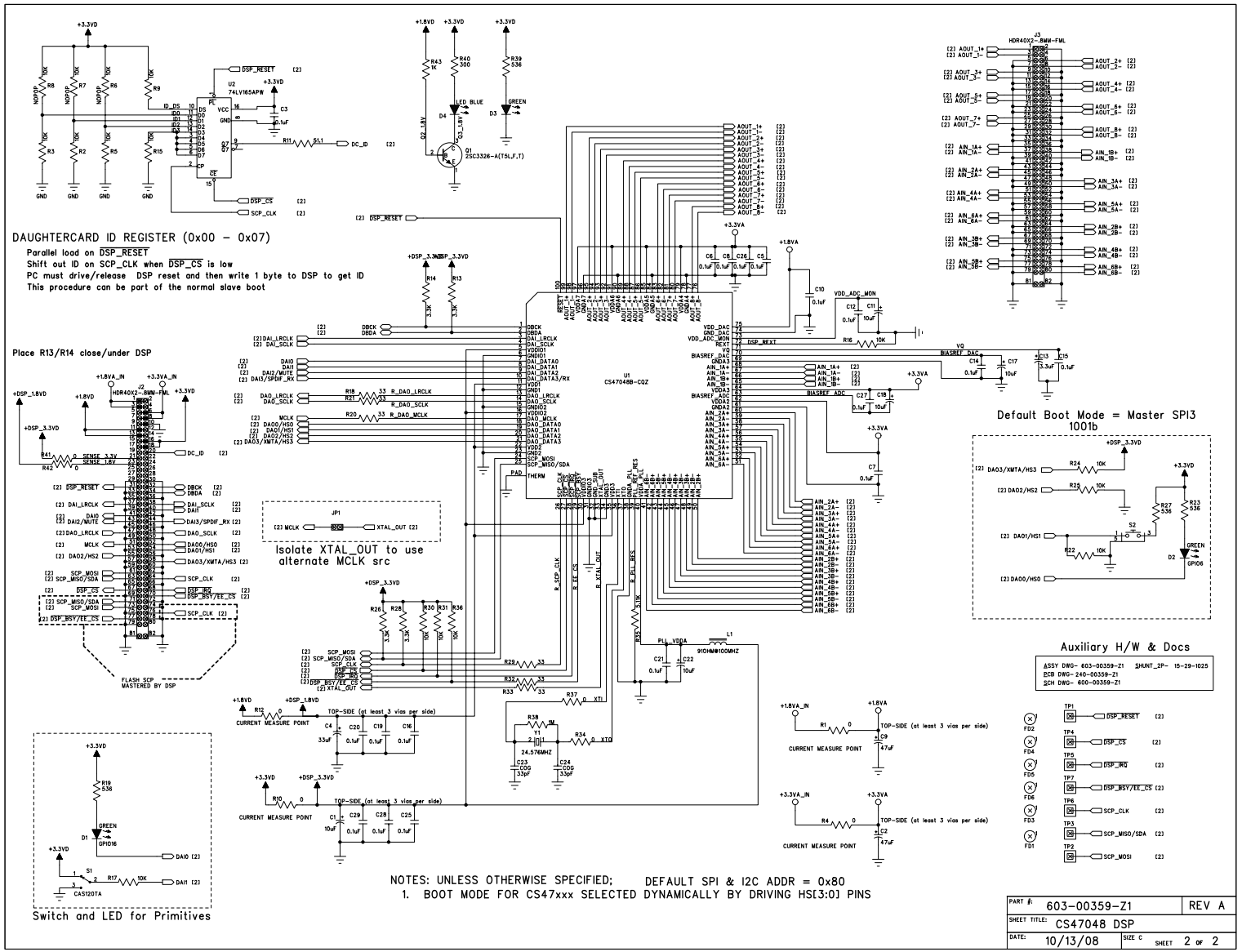

Figure 6-26. CDB47xxx-DC48 Daughtercard Schematic

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6.5 Obtaining Schematic Updates

Updates to the schematics for the CDB47xxx Development Board can be can be obtained from your local Cirrus Logic representative as part of a design package including the associated BOM, and layout artwork. The schematics are provided in Adobe's portable document format (PDF) and PADS™ format.

The schematics included in this document are the original Revision A schematics of the CDB47xxS and D boards and reflect the boards as they were manufactured. Newer schematics may be available that incorporate feature additions or corrections, and may not match Rev. A hardware.

The latest version of the CDB47xx and CDB47xx_DC schematics is installed with the Cirrus DSP SDK. If the SDK is installed to C:\CirrusDSP folder, then the schematics are installed as follows:

- CDB47xxx-S are saved in the C:\CirrusDSP\schematics\CDB47xxx-S-Z_<rev> folder.
- CDB47xxx-D are saved in the C:\CirrusDSP\schematics\CDB47xxx-D-Z_<rev> folder.
- CDB47xxx-DC48 are saved in the C:\CirrusDSP\schematics\CDB47xxx-DC48-Z_<rev> folder.

There is no difference in the schematics between CDB47xxx-DC24 and CDB47xxx-DC48 except for the DSP part populated.

A shortcut to the schematics folder is available from the start menu after installing the SDK:
Start > CirrusDSP > Schematics.

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Chapter 7

Troubleshooting

7.1 Troubleshooting Guide

This section provides solutions to problems that users might experience when using the CDB47xxx.

7.1.1 Power LEDs

Problem: Power LEDs are not illuminated.

- Possible cause: **DC power supply is not connected to CDB47xxx.**

  Solution: Ensure the DC wall supply is connected to the DC power input jack (J22), and the supply is plugged into a wall outlet.

- Possible cause: **Power selection headers (P1-P3) are not populated.**

  Solution: If you are using the DC wall supply provided with the CDB47xxx, all jumpers should installed.

- Possible cause: **Jumper settings when using an external power supply are set incorrectly.**

  Solution: If you are using an external power supply for any of the system voltages (5V, 3.3V, 1.8V), ensure that the jumper for that voltage has been removed and power is applied to pin 2 of the appropriate header.

7.1.2 Board not Recognized by PC

Problem: CDB47xxx is not Recognized by PC

- Possible cause: **DC power supply is not connected to CDB47xxx.**

  Solution: The CDB47xxx is not a USB-powered device. Make sure the DC wall supply is connected to the DC power input jack (J22), and the supply is plugged into a wall outlet.

- Possible cause: **CDB47xxx USB Drivers not installed before connecting to PC**.

  Solution: Follow these steps:

  1. Pull the DC power plug on the CDB47xxx.
  2. Open the Windows® Device Manager on the PC and search for the "USBXpress Device" under "USB Controllers".
  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® operating system automatically find the driver.
  4. Wait 3 seconds, and plug the DC power supply back into the power input jack.

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7.1.3 Audio is not Heard

Problem: Audio cannot be heard.

Possible cause: **Wrong S/PDIF Source is selected.**

Solution: Check to make sure that the LED next to the desired S/PDIF source is ON. If not, use MCU to select the appropriate S/PDIF input.

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Revision History

Revision	Date	Changes
DB7	March, 2012	Added Windows 7 to PC requirements of Section 1.2.1. Updated schematics screenshots in Chapter 6.
DB8	August, 2012	Added note to Section 3.1.3 regarding USB connectivity issues.
DB9	November, 2012	Added board image to cover page.
DB10	October, 2013	Updated Figure 4-8, Figure 4-9, and Figure 4-10.
DB11	February, 2014	Updated Figure 4-2, Figure 4-3, and Figure 4-7.

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