

## Evaluation Board for CS4391

### Features

- Demonstrates recommended layout and grounding arrangements
- CS8414 receives AES/EBU, S/PDIF, & EIAJ-340 compatible digital audio
- Digital and analog patch areas
- Requires only a digital signal source and power supplies for a complete Digital-to-Analog-Converter system

### Description

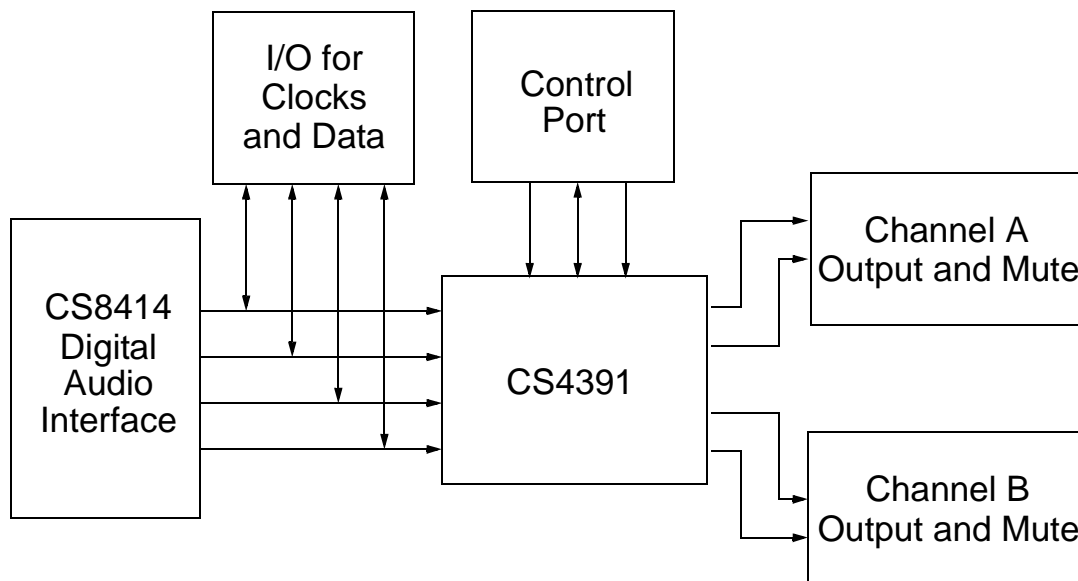
The CDB4391 evaluation board is an excellent means for quickly evaluating the CS4391 24-bit, stereo D/A converter. Evaluation requires an analog signal analyzer, a digital signal source, a PC for controlling the CS4391 (for control port mode only) and a power supply. Analog line level outputs are provided via RCA phono jacks.

The CS8414 digital audio receiver I.C. provides the system timing necessary to operate the Digital-to-Analog converter and will accept AES/EBU, S/PDIF, and EIAJ-340 compatible audio data. The evaluation board may also be configured to accept external timing and data signals for operation in a user application during system development.

### ORDERING INFORMATION

CDB4391

Evaluation Board



### Preliminary Product Information

This document contains information for a new product. Cirrus Logic reserves the right to modify this product without notice.

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## 1. CDB4391 SYSTEM OVERVIEW

The CDB4391 evaluation board is an excellent means of quickly evaluating the CS4391. The CS8414 digital audio interface receiver provides an easy interface to digital audio signal sources including the majority of digital audio test equipment. The evaluation board also allows the user to supply clocks and data through a 10-pin header for system development.

The CDB4391 schematic has been partitioned into 9 schematics shown in Figures 2 through 10. Each partitioned schematic is represented in the system diagram shown in Figure 1. Notice that the system diagram also includes the interconnections between the partitioned schematics.

## 2. CS4391 DIGITAL TO ANALOG CONVERTER

A description of the CS4391 is included in the CS4391 datasheet.

## 3. CS8414 DIGITAL AUDIO RECEIVER

The system receives and decodes the standard S/PDIF data format using a CS8414 Digital Audio Receiver, Figure 5. The outputs of the CS8414 include a serial bit clock, serial data, left-right clock (FSYNC), de-emphasis control and a 256 Fs master clock. The operation of the CS8414 and a discussion of the digital audio interface are included in the CS8414 datasheet.

During normal operation, the CS8414 operates in the Channel Status mode where the LED's display channel status information for the channel selected by the CSLR/FCK jumper. This allows the CS8414 to decode the de-emphasis bit from the digital audio interface for control of the CS4391 de-emphasis filter, when the CS4391 is in stand-alone mode.

When the Error Information Switch is activated, the CS8414 operates in the Error and Frequency information mode. The information displayed by the LED's can be decoded by consulting the CS8414

datasheet. It is likely that the de-emphasis control for the CS4391 will be erroneous and produce an incorrect audio output if the Error Information Switch is activated and the CS4391 is in the stand-alone mode with internal serial clock mode selected.

Encoded sample frequency information can be displayed provided a proper clock is being applied to the FCK pin of the CS8414. When an LED is lit, this indicates a "1" on the corresponding pin located on the CS8414. When an LED is off, this indicates a "0" on the corresponding pin. Neither the L nor R option of CSLR/FCK should be selected if the FCK pin is being driven by a clock signal.

The evaluation board has been designed such that the input can be either optical or coax, see Figure 6. However, both inputs cannot be driven simultaneously.

## 4. CS8414 DATA FORMAT

The CS8414 data format can be set with switches M0, M1, M2, and M3, as described in the CS8414 datasheet. The format selected must be compatible with the data format of the CS4391, as shown in the CS4391 datasheet. Please note that the CS8414 does not support all the possible modes of the CS4391 and the Left-Justified Format for the CS8414 and the CS4391 have incompatible serial clocks, see Table 1. The default settings for M0-M3 on the evaluation board are given in Tables 3-4.

CS4391 CP Mode Format	CS4391 SA Mode Format	CS8414 Format
0	0	Unsupported
1	1	2
2	2	5
3	3	Unsupported
4	-	Unsupported
5	-	6

**Table 1. CS8414 Supported Formats**

## 5. INPUT/OUTPUT FOR CLOCKS AND DATA

The evaluation board has been designed to allow interfacing to external systems via the 10-pin header, J9. This header allows the evaluation board to accept externally generated clocks and data. The schematic for the clock/data I/O is shown in Figure 9. The 74HC243 transceiver functions as an I/O buffer where HRD1 through HRD6 determine if the transceiver operates as a transmitter or receiver. A transmit function is implemented with all jumpers, HRD1 through HDR6 in the 8414 position. LRCK, SDATA, and SCLK from the CS8414 will be outputs on J9. The transceiver operates as a receiver with HRD1 through HDR6 in the EXT\_CLK position. MCLK, LRCK, SDATA and SCLK on J9 become inputs.

## 6. POWER SUPPLY CIRCUITRY

Power is supplied to the evaluation board by six binding posts (GND, +5V, +3/+5V, VL, VCC and VEE), see Figure 10. The +5V input supplies power to the +5 volt digital circuitry (VA+5, VD+5, VDPC+5), while the VL input supplies power to the Voltage Level Converters and the CS4391 VL pin. +3/+5V supplies power to the CS4391. VCC and VEE supply power to the op-amp and can be +/-5 to +/-12 volts.

**WARNING:** Refer to the CS4391 datasheet for maximum allowable voltages levels. Operation outside of this range can cause permanent damage to the device.

## 7. GROUNDING AND POWER SUPPLY DECOUPLING

The CS4391 requires careful attention to power supply and grounding arrangements to optimize performance. Figure 10 details the power distribution used on this board. The decoupling capacitors are located as close to the CS4391 as possible. Extensive use of ground plane fill in the evaluation board yields large reductions in radiated noise.

## 8. CONTROL PORT SOFTWARE

The CDB4391 is shipped with Windows based software for interfacing with the CS4391 control port via the DB25 connector, P1. The software can be used to communicate with the CS4391 in either SPI<sup>®</sup> or I<sup>2</sup>C<sup>®</sup> mode; however, in SPI mode the CS4391 registers are write-only. Note: The CDB4391 must be configured for control port mode as shown in Table 4.

Further documentation for the software is available on the distribution diskette. The documentation is available in the plain text format file, README.TXT.

## 9. DSD OPERATION

The CDB4391 supports Direct Stream Digital (DSD) operation through the header for external clocks and data, J9. The CS4391 must be placed into the DSD mode and the jumpers HDR1 through HDR6 must be placed into the external clock positions.

CONNECTOR	INPUT/OUTPUT	SIGNAL PRESENT
+5V	Input	+ 5 Volt power
+3/+5V	Input	+ 2.7 to + 5.5 Volt power for the CS4391
V <sub>L</sub>	Input	+ 1.8 to +5.5 digital interface voltage (Note that V <sub>L</sub> should not exceed the voltage applied to the +3/+5V terminal)
V <sub>EE</sub>	Input	-12 to -5V negative supply for the op-amp
V <sub>CC</sub>	Input	+5 to +12V positive supply for the op-amp
GND	Input	Ground connection from power supply
Coax Input	Input	Digital audio interface input via coax
Optical Input	Input	Digital audio interface input via optical
J9	Input/Output	I/O for master, serial, left/right clocks and serial data
Parallel Port	Input/Output	Parallel connection to PC for SPI / I <sup>2</sup> C control port signals
HDR9	Input/Output	I/O for SPI / I <sup>2</sup> C control port signals
AOUTA	Output	Channel A line level analog output
AOUTB	Output	Channel B line level analog output

**Table 2. System Connections**

<b>JUMPER / SWITCH</b>	<b>PURPOSE</b>	<b>POSITION</b>	<b>FUNCTION SELECTED</b>
SW1 - M0	CS8414 mode selection	*LO	See CS8414 datasheet for details
SW1 - M1	CS8414 mode selection	*HI	See CS8414 datasheet for details
SW1 - M2	CS8414 mode selection	*LO	See CS8414 datasheet for details
SW1 - M3	CS8414 mode selection	*LO	See CS8414 datasheet for details
SW1 - CSLR/FCK	Selects channel for CS8414 channel status information	*LO	See CS8414 datasheet for details
HDR8	External mute for AOUTA	*ON OFF	Mute Enabled Mute Disabled
HDR7	External mute for AOUTB	*ON OFF	Mute Enabled Mute Disabled
ENCTRL	Enables / Disables parallel port	ENABLE *DISABLE	Invalid for Stand-Alone Mode Disables parallel port
<b>M0/AD0/CS</b>	CS4391 Mode Selection	*HI LO	See CS4391 datasheet for details
<b>M1/SDA/CDIN</b>	CS4391 Mode Selection	HI *LO	See CS4391 datasheet for details
<b>M2/SCL/CCLK</b>	CS4391 Mode Selection	GND HI *DEM	See CS4391 datasheet for details Allows the CS8414 to control de-emphasis
<b>M3</b>	CS4391 Mode Selection	HI *LO	See CS4391 datasheet for details
HDR1 to HDR6	Selects source of clocks and audio data	*8414 EXT	Selects CS8414 as source Digital I/O header becomes source

**Table 3. CDB4391 Jumper and Switch settings - STAND-ALONE MODE**

\*Settings for Stand-Alone mode

Notes: The CDB4391 evaluation board is shipped from the factory configured for Control Port mode.

<b>JUMPER</b>	<b>PURPOSE</b>	<b>POSITION</b>	<b>FUNCTION SELECTED</b>
SW1 - M0	CS8414 mode selection	*LO	See CS8414 datasheet for details
SW1 - M1	CS8414 mode selection	*HI	See CS8414 datasheet for details
SW1 - M2	CS8414 mode selection	*LO	See CS8414 datasheet for details
SW1 - M3	CS8414 mode selection	*LO	See CS8414 datasheet for details
SW1 - CSLR/FCK	Selects channel for CS8414 channel status information	*LO	See CS8414 datasheet for details
HDR8	External mute for AOUTA	*ON OFF	Mute Enabled Mute Disabled
HDR7	External mute for AOUTB	*ON OFF	Mute Enabled Mute Disabled
ENCTRL	Enables / Disables parallel port	*ENABLE DISABLE	Enables parallel port Invalid for Control Port mode
M0/AD0/CS	AD0/CS	*HI LO	“Don’t Care” for Control Port mode
M1/SDA/CDIN	SDA/CDIN Pull-Up	*HI LO	SDA/CDIN pulled high Invalid for Control Port mode
M2/SCL/CCLK	SCL/CCLK Pull-Up	GND *HI DEM	Invalid for Control Port mode SCL/CCLK pulled high Invalid for Control Port mode
M3	Not Functional	HI *LO	Must be low for Control Port mode
HDR1 to HDR6	Selects source of clocks and audio data	*8414 EXT	Selects CS8414 as source Digital I/O header becomes source

**Table 4. CDB4391 Jumper and Switch settings - CONTROL PORT MODE**

\*Settings for Control Port mode

Notes: The CDB4391 evaluation board is shipped from the factory configured for Control Port mode.

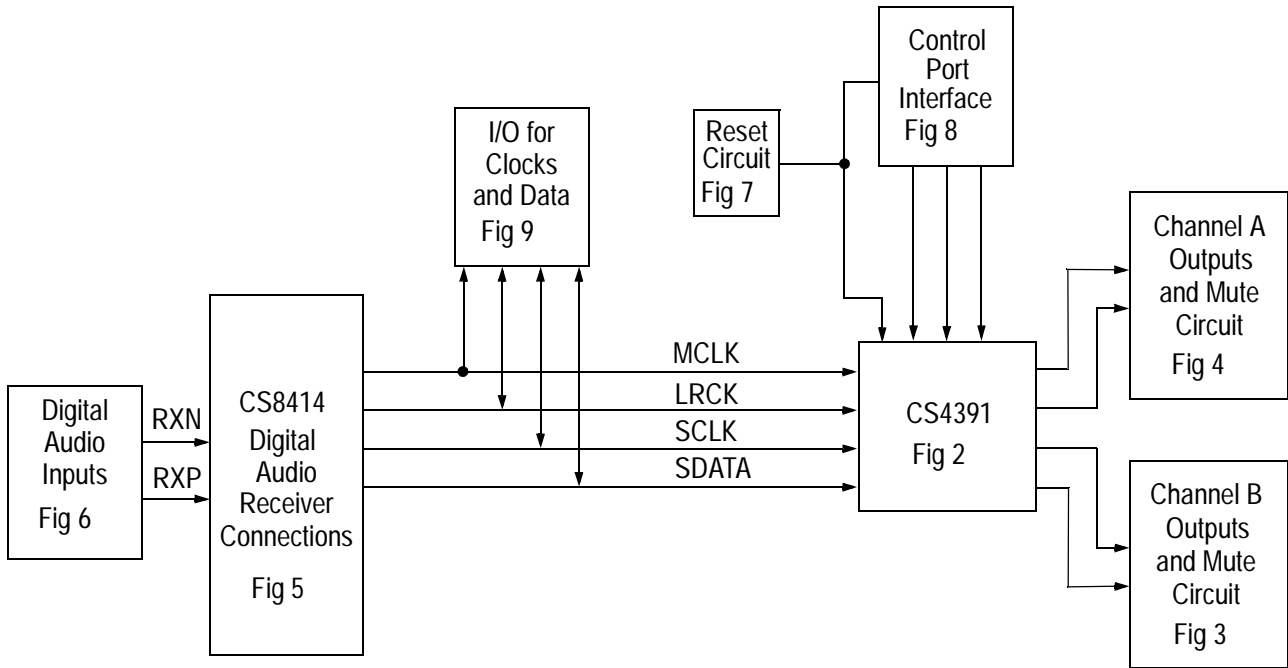


Figure 1. System Block Diagram and Signal Flow



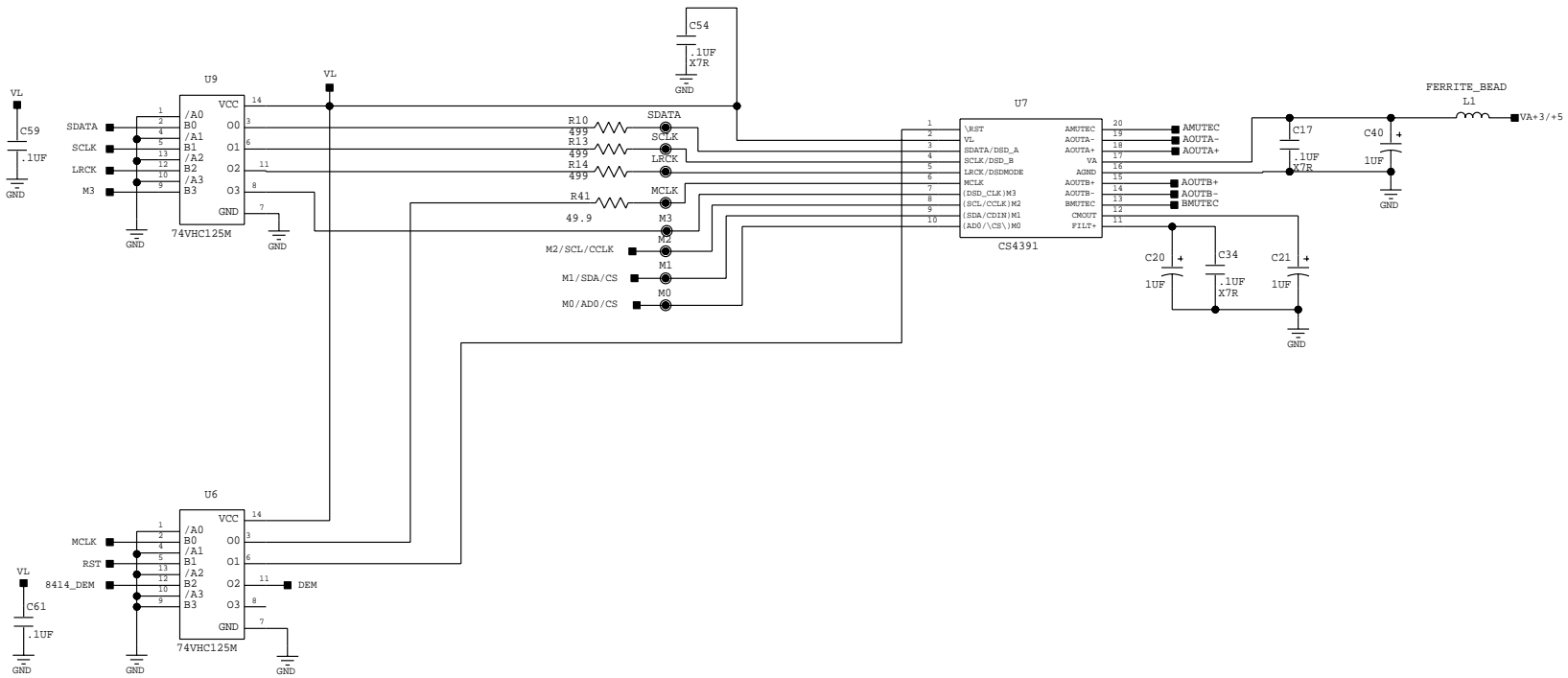


Figure 2. CS4391 and Level Shift

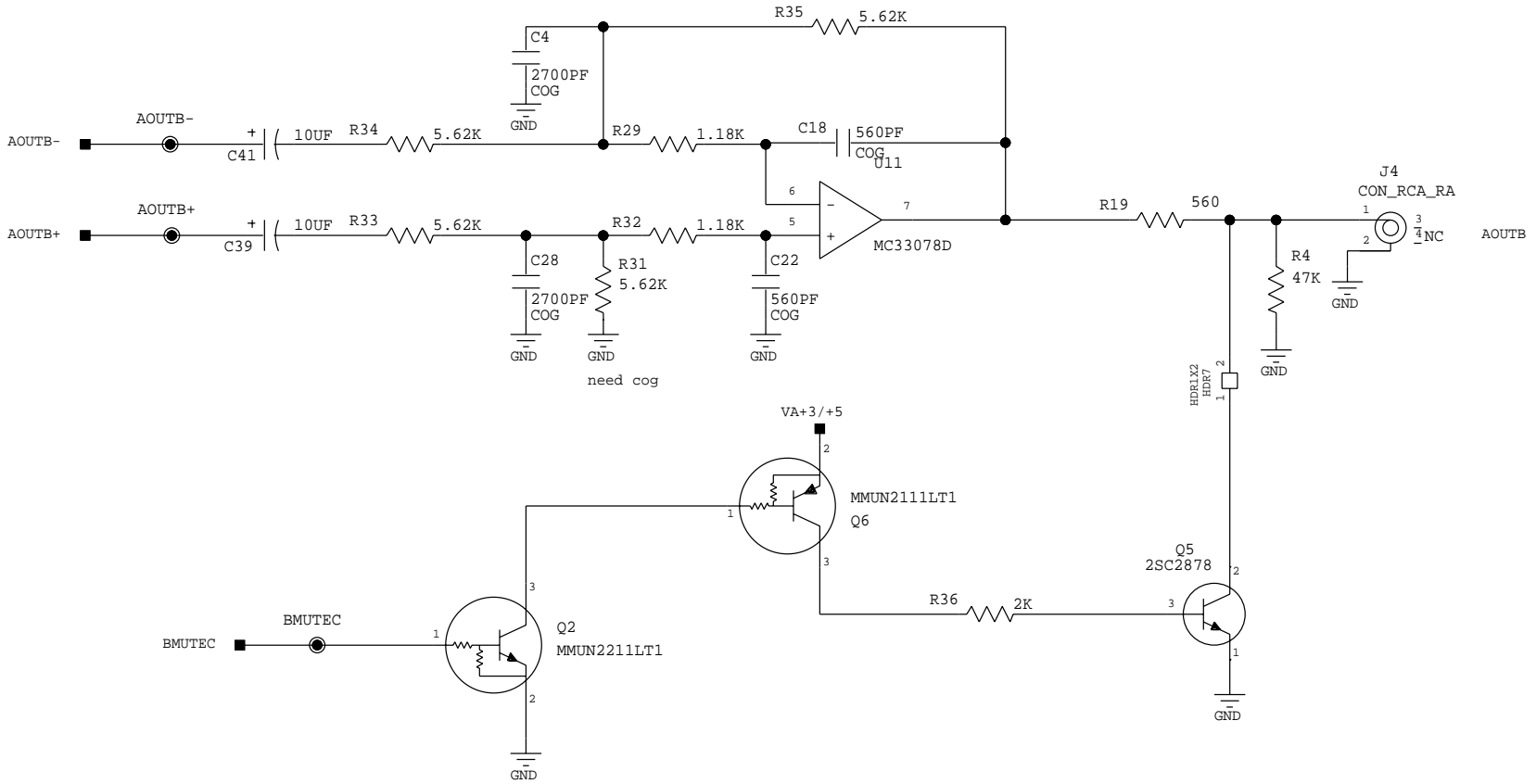


Figure 3. Channel B Audio Output and Mute Circuit

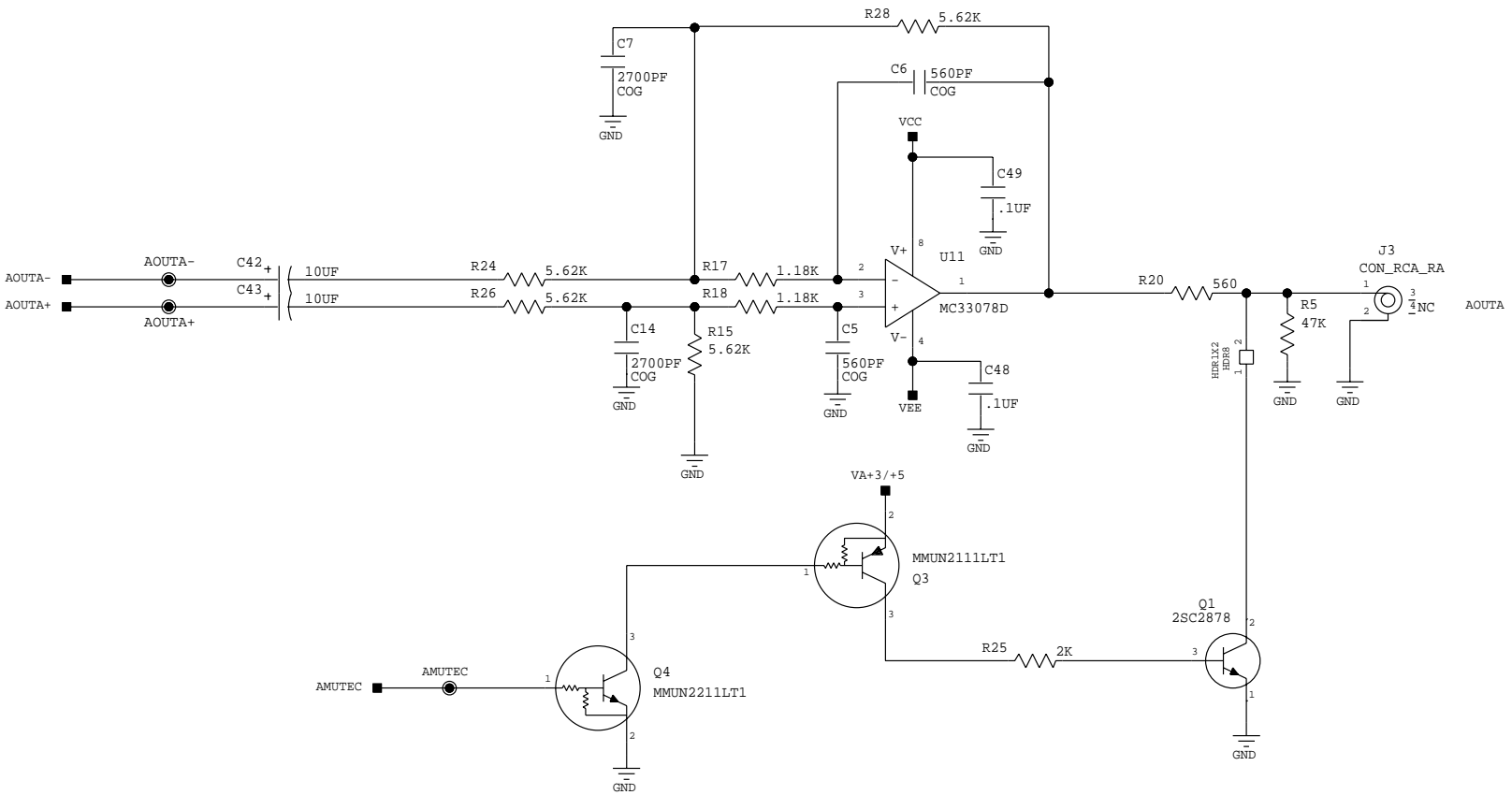


Figure 4. Channel A Audio Output and Mute Circuit

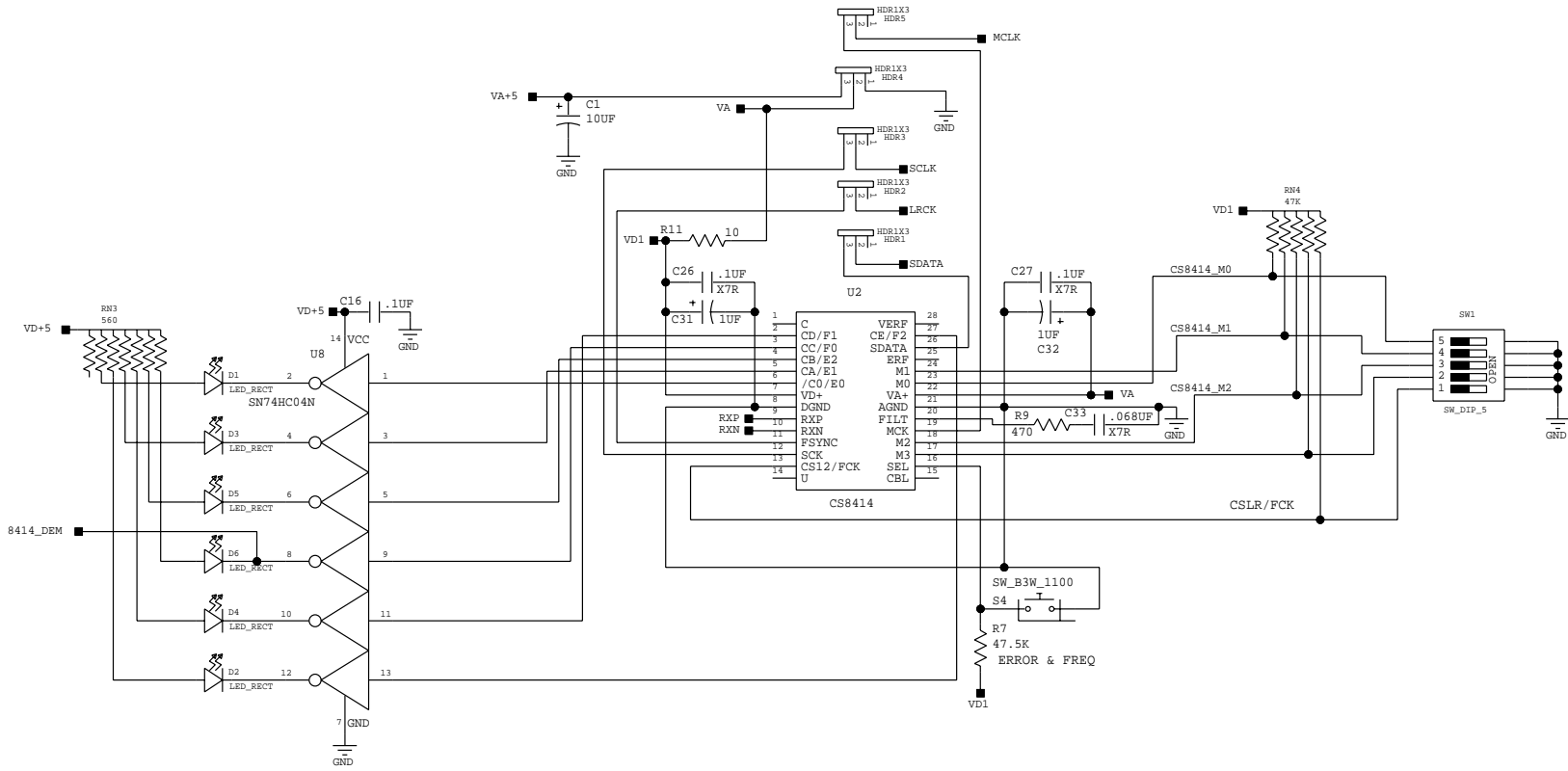


Figure 5. CS8414 Digital Audio Receiver

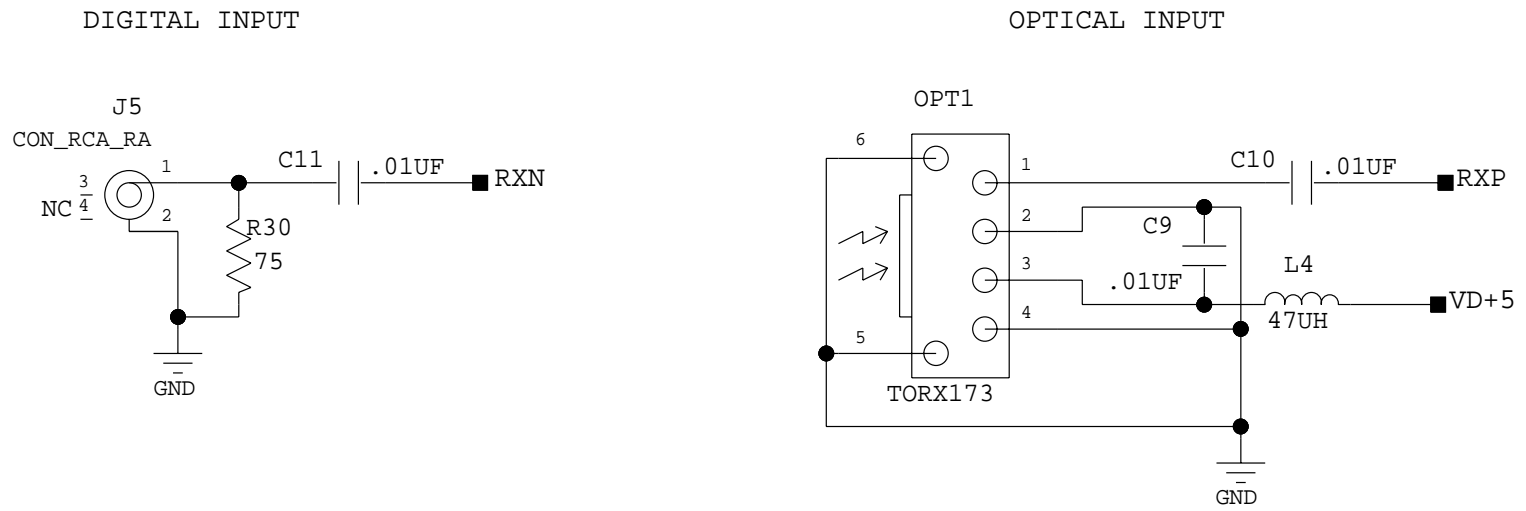


Figure 6. Digital Audio Inputs

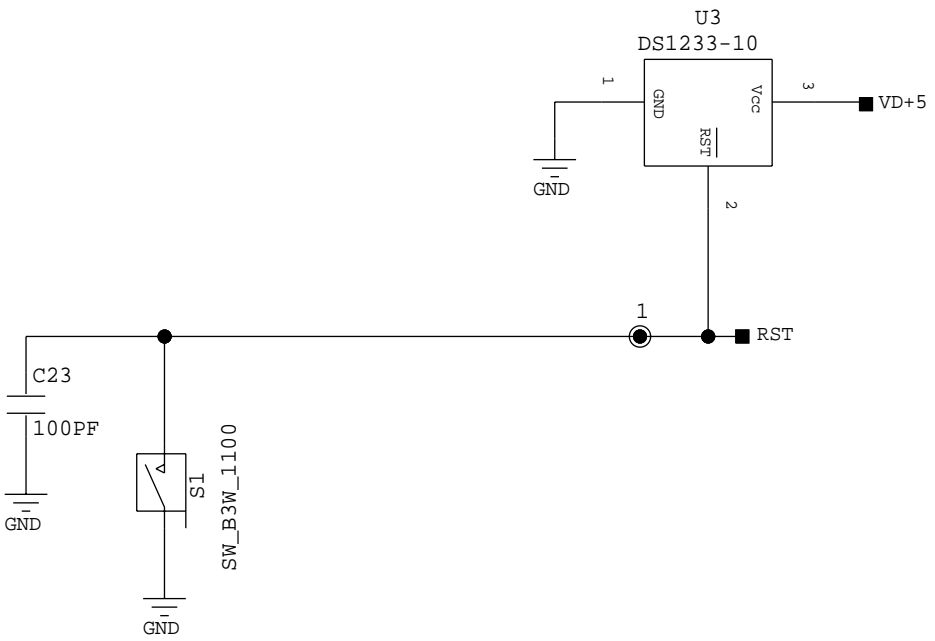


Figure 7. Reset Circuit

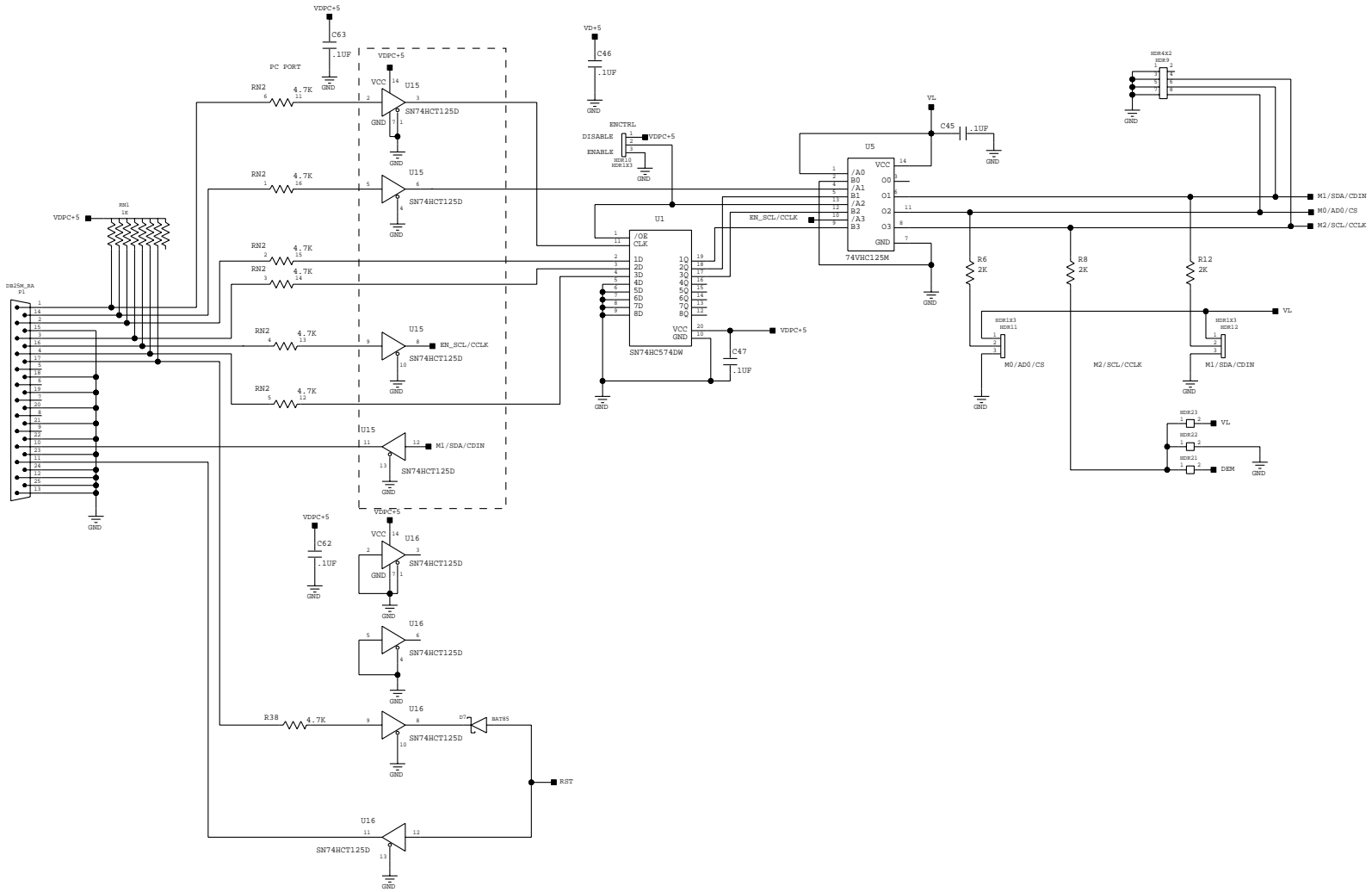


Figure 8. Control Port Interface

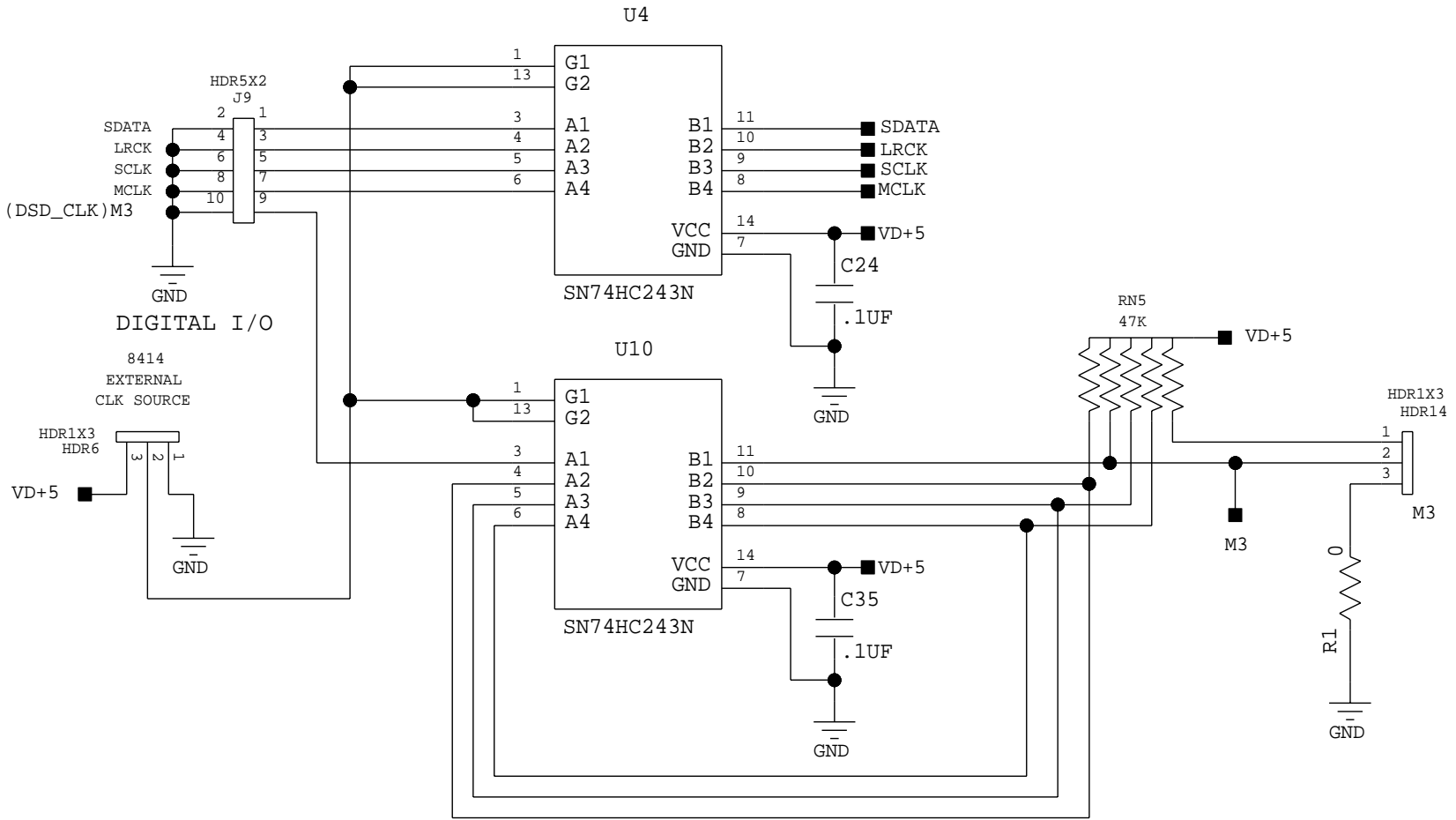


Figure 9. I/O for Clocks and Data



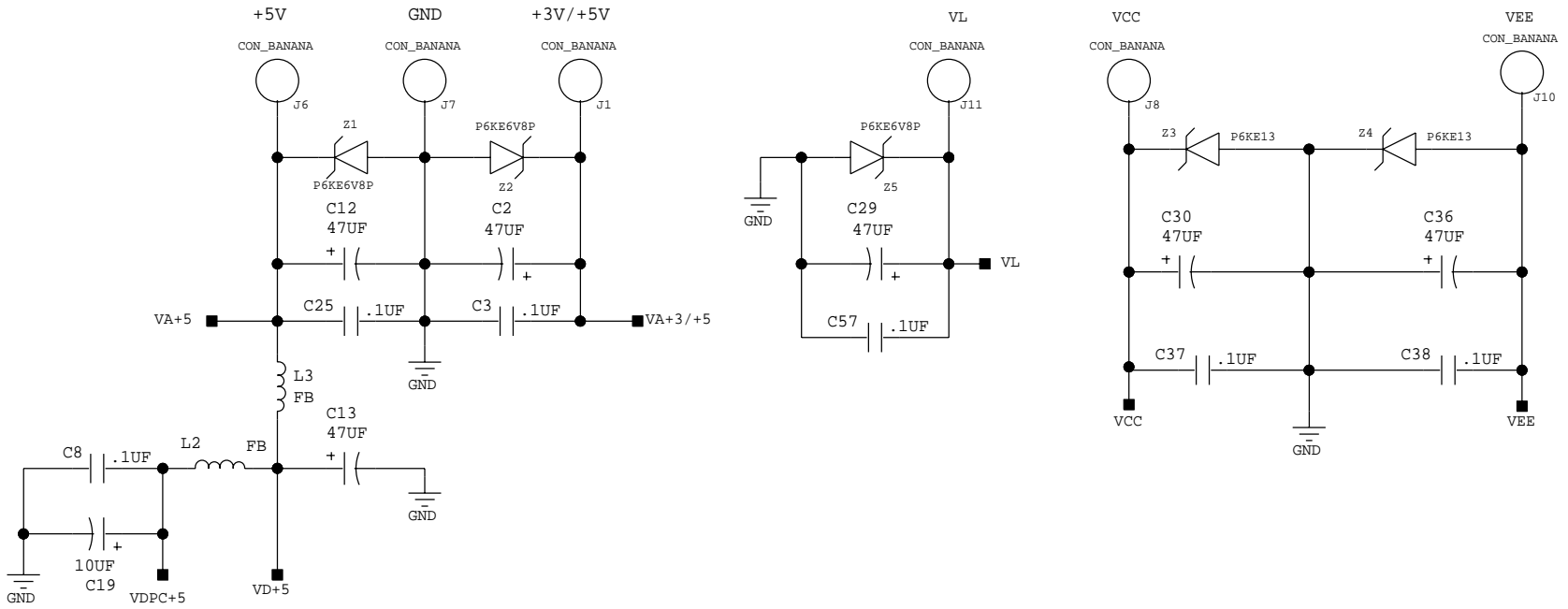


Figure 10. Power Supply

CRYSTAL SEMICONDUCTOR  
CS4391 Engineering Eval Bd  
CDB4391 RevB.0

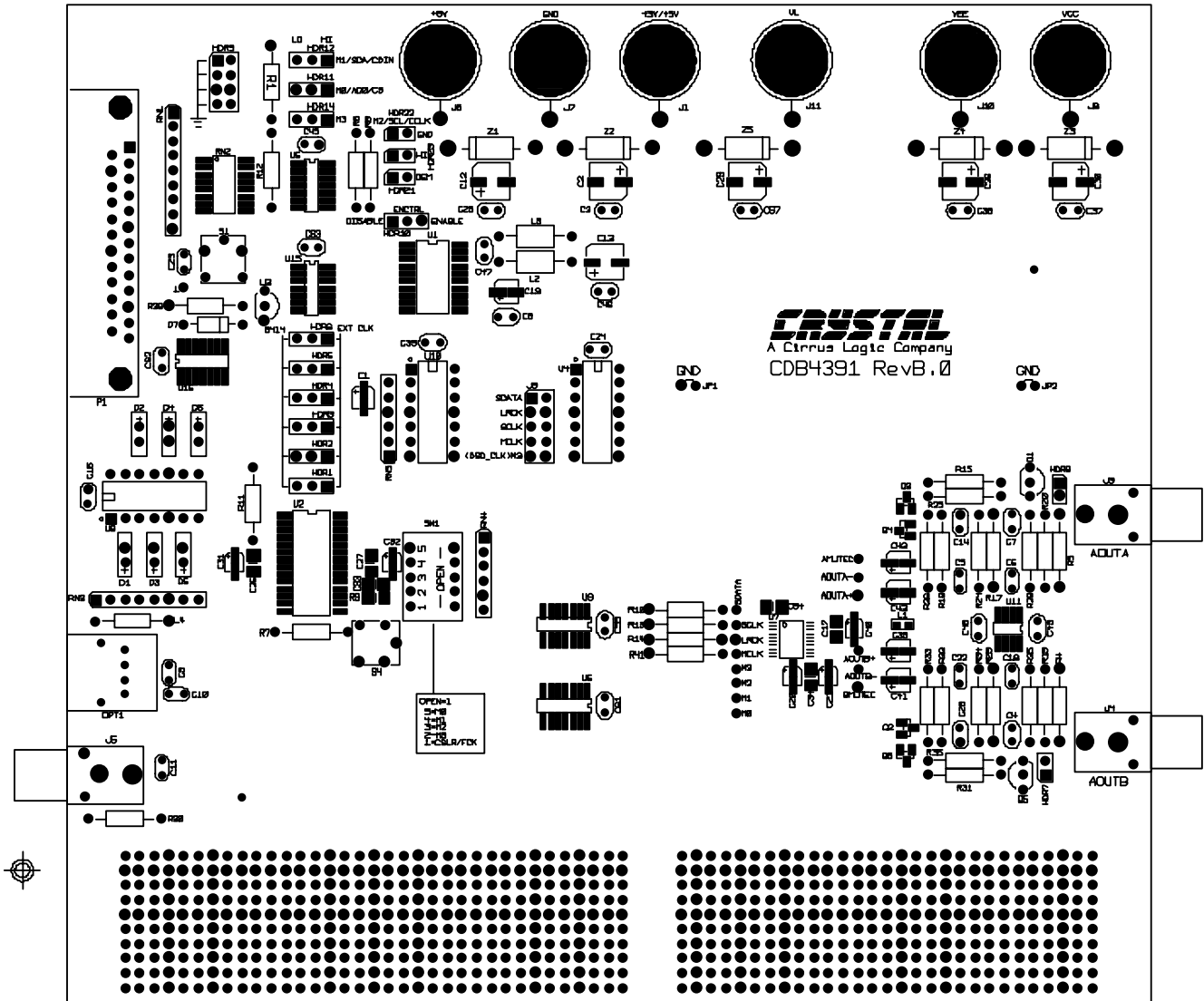
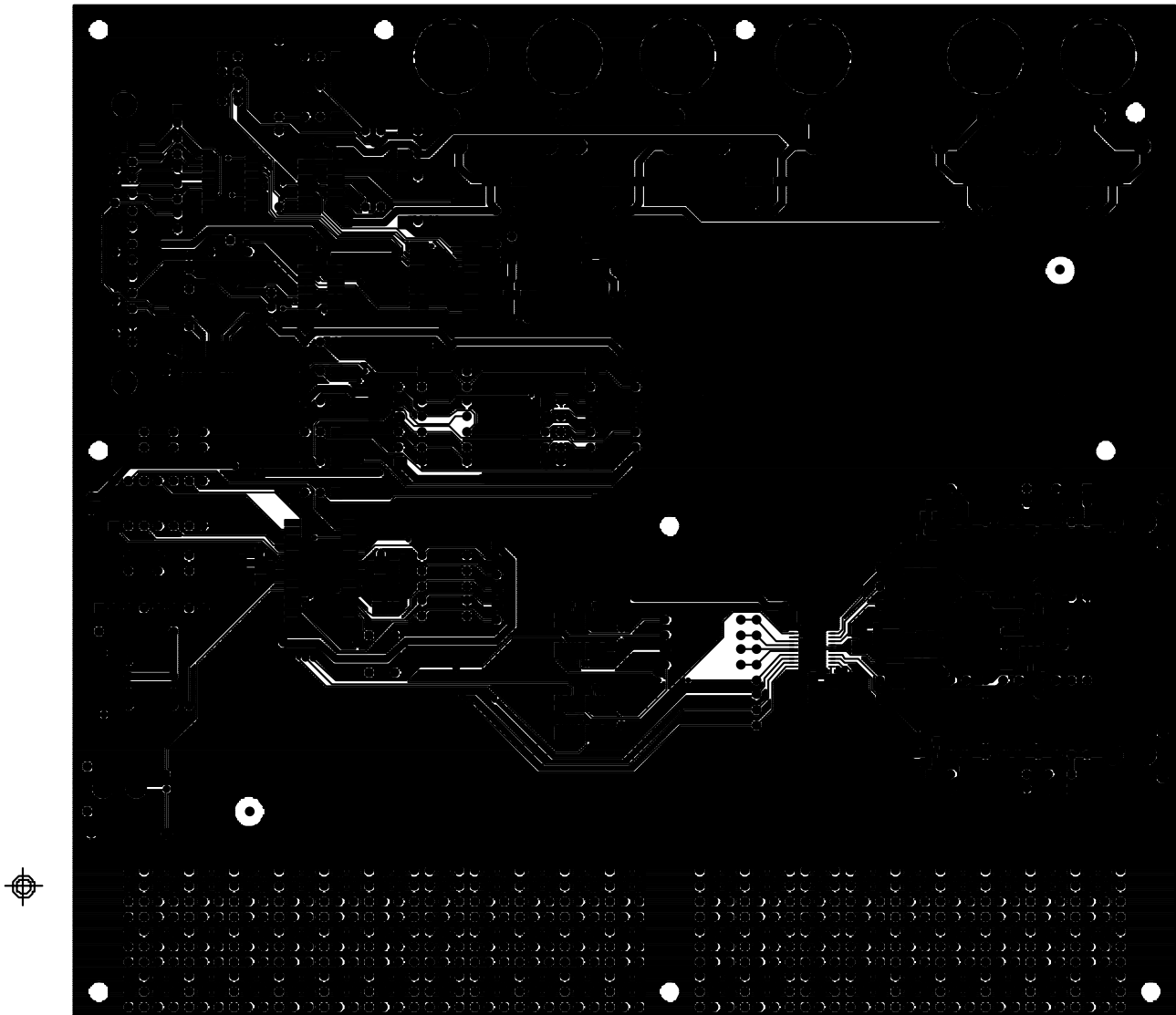


Figure 11. Silkscreen Top

CRYSTAL SEMICONDUCTOR  
CS4391 Engineering Eval Bd  
CDB4391 RevB.0



TOP SIDE

Figure 12. Top Side

CRYSTAL SEMICONDUCTOR  
CS4391 Engineering Eval Bd  
CDB4391 RevB.0

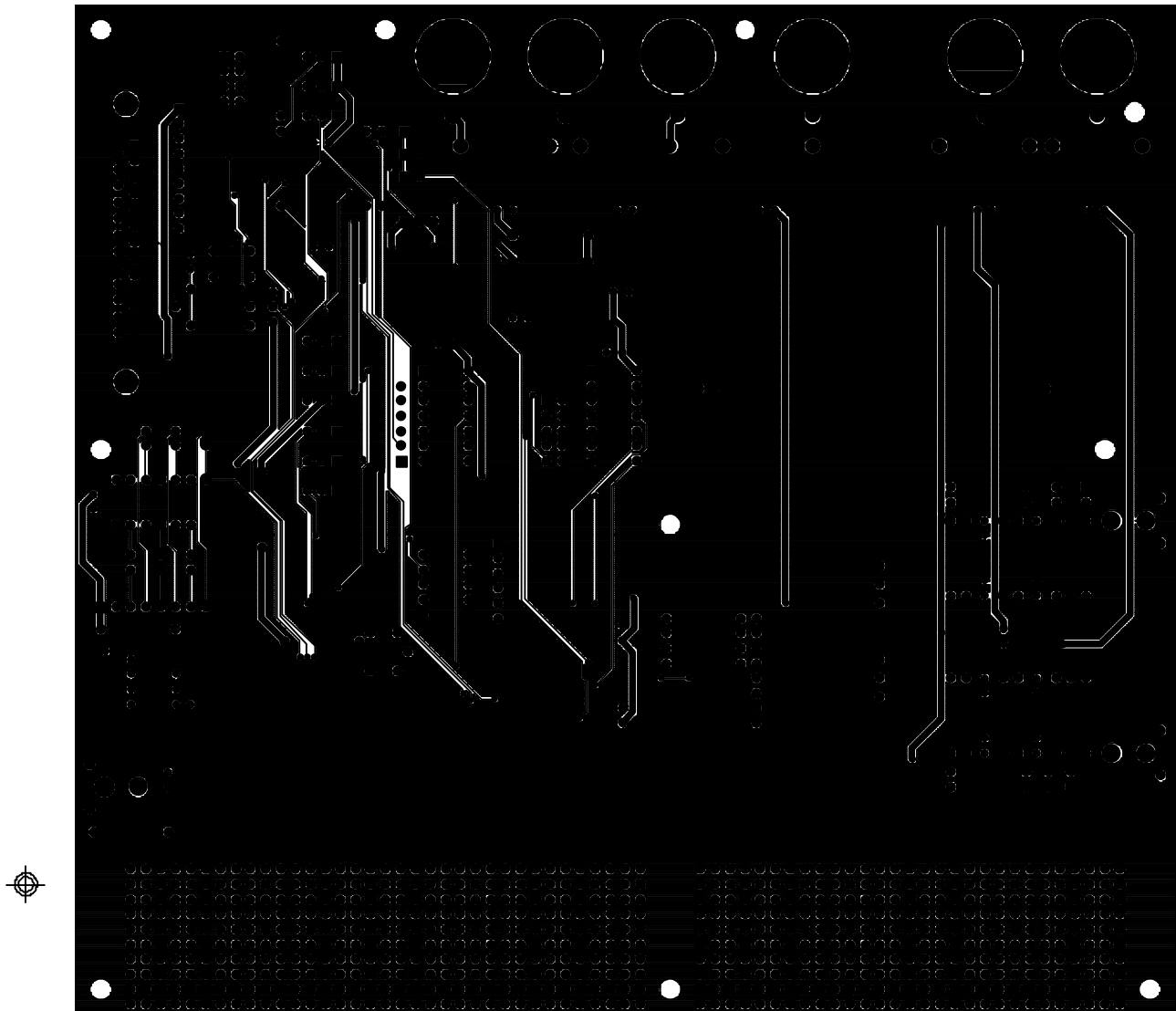


Figure 13. Bottom Side

**10. PACKING LIST FOR CDB4391**

Inspect the Contents of the package and confirm that the following contents are included:

- 1) CDB4391
- 2) CDB4391 datasheet
- 3) CS4391 datasheet
- 4) 3.5 inch floppy disk with the Windows based CDB4391 Graphical User Interface
- 5) 25-pin RS-232 cable

<b>Item</b>	<b>Revision</b>
CDB4391	B
CS4391-KZ	A
CDB4391 data sheet	DS335DB2
CS4391 Data sheet	DS335PP2
3.5 inch floppy disk with windows based graphical user interface	1.0
25-pin RS-232 cable	

If any of the items are missing please contact Cirrus for Crystal<sup>®</sup> Audio support at (800) 888-5016.

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