CRD4360-9

CrystalClear™ AC '97 Four Channel PCI Audio Reference Design

Features

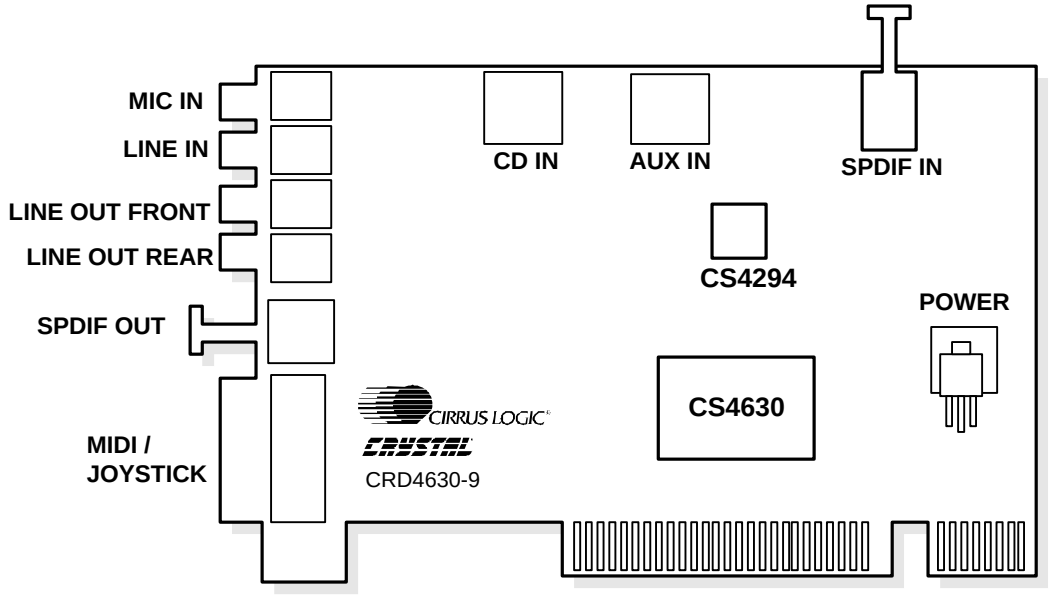
- CS4630 PCI audio controller and CS4294 four channel AC'97 audio codec
- 20-bit D to A conversion (DAC)
- 18-bit A to D conversion (ADC)
- S/PDIF (IEC-958) optical digital input and output
- Complete suite of Analog I/O connections:
  - Line, Mic, CD and Aux Inputs
  - Line Front, and Line Rear Outputs
- Joystick/MIDI Interface
- 2-layer low cost PC board
- PCI Audio Accelerator add-in card designed to meet AC '97 version 2.1 specification
- Exceeds Microsoft's® PC 99 audio performance requirements.

Description

The CRD4630-9 PCI add-in board reference design showcases Cirrus Logic's CS4630 audio controller and the CS4294 audio codec. This card features four channel 20-bit analog audio outputs and S/PDIF digital audio inputs and outputs.

The CRD4630-9 reference design is available by ordering the CMK4630-9 manufacturing kit. This kit includes a full set of schematic design files (OrCAD® 7.2 format), PCB job files (PADS® ASCII), PCB artwork files, and bill of materials. The design is production ready or can be easily modified to meet your specific design goals.

ORDERING INFO
CMK4630-9 (Manufacturing Kit)



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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http://www.cirrus.com/corporate/contacts/

LIST OF FIGURES

1. GENERAL INFORMATION

The CRD4630-9 is a production grade reference design that demonstrates the four channel capability of the CS4630 PCI audio controller and the CS4294 audio codec. The CRD4630-9 has a rich feature set and industry leading audio performance. In order to maintain high audio quality, careful consideration has been given to component selection and PC layout.

The CS4294 codec has four 20-bit DACs, a stereo 18-bit ADC and a very flexible analog audio mixer. It also features three stereo line level analog inputs, a microphone input, and a stereo pseudo-differential CD input. The input signals can be routed to the ADC for recording or mixed together for recording and direct playback. The CS4294 has 64 registers that are used to control its various features such as volume levels, mutes and signal routing. The CS4294 maintains high audio quality throughout its signal chain and exceeds the Microsoft® PC-99 audio performance specification.

The CS4630 is a high performance PCI Audio Accelerator. The CS4630 streams digital audio data and MIDI over the PCI bus and performs sophisticated digital audio processing.

The CS4630's audio 420 MIPs DSP core is optimized for handling complex signal processing tasks such as Sensaura 3D sound, wavetable synthesis and graphic equalization. The CrystalClear® Stream Processing DSP core is supported by a bus mastering PCI interface and a built-in dedicated DMA engine with hardware scatter-gather support. These functions ensure extremely efficient transfer of audio data streams with minimum loading of the host CPU.

The CS4294 codec and the CS4630 controller communicate through a 5-wire serial digital link known as the AC-Link. The AC-Link is used to transfers digital audio between the two devices. It is also used to send commands from the CS4630 to the CS4294's registers. For more information on the AC-Link, see the Intel® AC'97 version 2.1 specification.

2. SCHEMATIC DESCRIPTION

The block diagram in Figure 1 illustrates the interconnections between the schematic pages. The following are descriptions of the other pages contained in the schematics.

2.1 Analog Inputs (1)

The Line Input in Figure 2 is connected from the input jack to the CS4294 through a 6 dB voltage divider and AC coupling capacitors. The voltage divider allows Line In signal levels of up to 2 Vrms. The 10 µF AC coupling capacitor values are used to minimize the low frequency roll-off.

The microphone circuit buffers, amplifies and filters the incoming signal from an external microphone. It also provides low voltage phantom power for electret microphones. This circuit uses a Motorola MC33078D low noise dual op-amp. One of the op-amps provides 18 dB gain stage for the microphone. The other op-amp buffers the phantom power supply for the mic. The phantom power is derived from the +5 V analog supply and buffered to provide a maximum of 4.2 V with no load and a minimum of 2.0 V under a 0.8 mA load, as required by PC 99. The microphone circuit was designed for 3 dB rolloffs at 60 Hz and 15 kHz as specified in PC-99.

2.2 Analog Inputs (2)

The Aux Input in Figure 3 is connected from the input jack to the CS4294 through a 6 dB voltage divider and AC coupling capacitors. The voltage divider allows input signal levels of up to 2 Vrms. The 10 µF AC coupling capacitor values are used to minimize the low frequency roll-off.

The CS4294 has a pseudo-differential CD input that minimizes common mode noise and interference. The CD signals act as one side of the differential inputs and CD_COM as the other. CD_COM

is used as the common return path for both the left and right channels. For good common mode rejection performance, the voltage divider resistors for CD_COM have been set to half the value of those for CD L and R inputs.

There are provisions for two types of analog audio CD connectors. J4 is for the standard ATAPI connector and J2 for the legacy 2 mm Mitsumi connector. You can install only one of the two connectors, because the footprints of J2 and J4 are on top of each other.

2.3 Analog Outputs

The analog output circuit in Figure 4 drives the front and rear audio signals in a four channel audio system, or line out and headphone out in a two channel audio system.

The Line Out Front L/R stereo outputs are driven from the Line_Out left and right output pins of the CS4294 through a pair of Motorola MC33078 op-amps. The MC33078 is a high performance low noise op-amp well suited for audio applications. This output is designed to drive high impedance loads (10 KΩ).

The Line Out Rear L/R stereo outputs are driven from the Alt_Line_Out left and right output pins of the CS4294 through a pair of Motorola TDA1308 op-amps. The TDA1308 is a high performance op-amp capable of driving 32 Ω loads. This makes it ideal for driving low impedance headphones.

2.4 Anti-Pop Circuitry

Figure 5 shows the anti-pop circuity. During power up, transistors Q1, Q2, Q4, and Q5 momentarily mute the Front and Rear outputs to help suppress transients.

2.5 CS4294 Audio Codec

The audio codec is shown in figure 6. The input signals to the codec come from the analog inputs in Figures 2 and 3. The output of the codec go to the analog output circuitry in Figure 4. Each of the outputs has a 680 pF capacitor to analog ground. These capacitors are part of a signal pole lowpass output filter.

The AFLT1 and AFLT2 pins have 1000 pF capacitors to analog ground. These capacitors in combination with some internal resistors provide a single pole lowpass filter at the inputs of the ADCs. No other input filtering is required.

The FLT3D, FLTI, and FLTO pins are a part of the internal analog 3D enhancement filter.

The AC-Link requires series termination resistors to prevent reflections. These are normally placed as close as possible to the transmitting end of a particular AC-Link signal. Both SDATA_IN and BIT_CLK are outputs of the CS4294 and each have a 47 Ω series termination resistors.

The CS4294 is powered by separate analog and digital power supplies, each with their own ground return, AGND for analog ground, and DGND for digital ground. Each power pin needs separate decoupling capacitors. The CRD4630-9 uses a 0.1 uF ceramic capacitor for each 3.3 V digital supply pin along with a common 10 uF bulk capacitor. Each of the 5 V analog pins uses a 0.1 uF decoupling capacitor. These are placed as close to their respective pins as possible.

2.6 CS4630 PCI Controller

The CS4630-9 controller in Figure 7 acts as a bridge between the computers PCI bus and the codec. ASYNC and ASDOUT are AC-Link signals originating at the CS4630 and both require 47 Ω series termination resistors close to the controller.

An external EEPROM, U7, is used to provide Vendor ID and Subsystem ID to the CS4630 at power up. The EEPROM connects to the CS4630 through a data and clock line, EEDAT and EECLK. The EEPROM interface is enabled by connection the EEPDIS pin to digital ground.

The CS4630 requires three power supplies voltages: +3.3 V, +5 V and +2.5 V. PCIVDD supplies

+3.3 V to the CS4630 PCI bus drivers. CRYVDD supplies +3.3 V to the internal phase lock loop and crystal oscillator. VDD5REF is a +5 V pseudo supply for the PCI bus drivers. This supply enables the PCI interface to support and be tolerant of +5 V signals. CVDD supplies +2.5 V to the core stream processor inside the CS4630. All power supply pins have their own 0.1 uF bypass capacitors to digital ground.

Unused inputs such as the ZV port (ZLRCLK, ZSCLK, ZSDATA), external volume control (VOLDN, VOLUP) and AC-Link signals from a second codec (ASDIN2, ABITCLK2) are tied though a weak pulldown to digital ground.

2.7 MIDI and Joystick Connection

The MIDIOUT buffer driver circuit in Figure 8 provides the +5 V TTL compatible output on the DB-15 connector. This circuit can be removed, and R65 populated to bypass the buffer circuit if a +3.3 V compatible output is sufficient. C71, C78, C81, C84, C86, and C89 are provided for EMI suppression and can be removed if EMC testing shows they are not required. C72, C75, C79, C82, C87, C90, C91, C95 are functional to the joystick circuitry as well as provide for EMI suppression and therefore must not be removed.

2.8 S/PDIF Output

The S/PDIF (IEC-958) digital input and output, shown in Figure 9, are compatible with digital inputs and outputs on consumer devices such as consumer stereo receivers.

The S/PDIF output operates at a fixed sampling frequency of 48 KHz. The input is capable of accepting S/PDIF signals with a sample frequency from 22 KHz up to 48 KHz.

The S/PDIF input and output use industry standard TOSLINK a digital optical transmitter and receiver. The input uses a Toshiba TORX-173 digital optical receiver. The output uses a Toshiba TOTX-173 transmitter.

2.9 PCI Bus Connection

The PCI 2.1 specification requires that each unused +3.3 V power pin should be connected with an average of 0.01 µF capacitor. In Figure 10, three 0.047 µF capacitors in parallel provide the required capacitance. The 0 Ω resistors R84, R85, and R86 can be used to omit the +3.3 V regulator if this voltage is known to be provided on the PCI bus.

2.10 Power Supply

The CRD4630-9 has linear voltage regulators in figure 11 supply three power supply voltages: +5 V, +3.3 V and +2.5 V. The +5 V supply is used exclusively for the analog audio circuitry and the CS4294 codec. The +2.5 V and +3.3 V supplies are used by the CS4281 controller. An LM1117CST-3.3 supplies +3.3 V. A MC78M05ACDT, U6, supplies the +5 V analog voltage. A LM2937IMP-2.5, U12, supplies the +2.5 V. The +2.5 V and +5 V supplies both have provisions for using through hole instead of surface mount regulators.

2.11 Component Selection

Great attention was given to the particular components used on the CRD4630-9 board with cost, performance, and package selection as the most important factors. Listed are some of the guidelines used in the selection of components:

- No components smaller than 0805 package.
- Only single package components. No resistor packs.
- 8-pin devices are in surface mount packages.
- Dual footprint for 24.576 MHz crystal. Standard H49S, and small circular CA-301 pin in hole package.
- Dual footprint for +5 V and +2.5 V regulators. Surface mount and through hole packages are supported (SOT-223 surface mount and TO-220 for +5 V and TO-263 for +2.5 V through hole).

2.12 EMI Components

A number of capacitors and inductors are included to help the board meet EMI compliance tests, such as FCC Part 15. Modifying this selection of components without EMC testing could result in EMC compliance failure.

3. GROUNDING AND LAYOUT

The component layout and signal routing of the CRD4630-9 provides a good model for laying out your own PCI add-in card. PCI-bus based add-in cards have explicit requirements on trace lengths that are not imposed on motherboard designs. These trace length limits for add-in cards are as follows:

- Maximum trace length for 32-bit signals on 32-bit and 64-bit cards is 1.5 inches.
- Maximum trace lengths for signals on the 64-bit extension are 2 inches.
- Trace length for the PCI CLK signal is 2.5 inches ± 0.1 inch.
- The PCI CLK signal must drive only one load.

Please refer to the PCI 2.2 Specification for information on routing PCI bus signals on a motherboard.

3.1 Partitioned Voltage and Ground Planes

The CRD4630-9 is partitioned into separate digital and analog sections to prevent digital noise from affecting the performance of the analog circuits. The analog section is completely isolated from the digital section. The analog and digital sections each have their own separate ground plane. All analog components, power traces, and signal traces are routed over the analog ground plane. Digital components, power traces and signal traces are not allowed to crossover into the analog section.

The CS4294 is placed at the transition point between the analog and digital ground planes. The pins are arranged on the CS4294 so that the analog and digital signals are separated from each other. The analog and digital ground planes must be tied together for the codec to maintain proper voltage references. For best results, the two ground planes are tied together with a single wide trace under the codec near its digital ground pins.

Data converters are generally susceptible to noise on the crystal pins. In order reduce noise from coupling onto these pins, the area around the crystal and its signal traces is filled with copper on the top and bottom of the PCB and attached to digital ground.

A separate chassis ground provides a reference plane for all of the EMI suppression components. The chassis ground plane is connected to the analog ground plane at the external jacks.

3.2 CS4294 Layout Notes

Refer to the *CS4294 Data Sheet* for partitioning and bypass capacitors placement. Pay close attention to bypass capacitors on REFFLT, AFLT1, AFLT2 and the power supply capacitors.

4. REFERENCES

1) Intel, Audio Codec '97 Component Specification, Revision 2.1, May 22, 1998.
http://developer.intel.com/

2) PCI Special Interest Group, PCI Local Bus Specification, Revision 2.1, June 1, 1995.
http://www.pcisig.com/

3) Cirrus Logic, CS4630 PCI Audio Interface Data Sheet
http://www.cirrus.com/products

4) Cirrus Logic, CS4294 SoundFusion Audio Codec '97 Data Sheet
http://www.cirrus.com/products

5) Steve Harris, Clif Sanchez, Personal Computer Audio Quality Measurements, Ver 1.0
http://www.cirrus.com/pubs/meas100.pdf

6) Microsoft, PC Design Guidelines,
http://www.microsoft.com/hwdev/desguid/

7) M. Montrose. Printed Circuit Board Design Techniques for EMC Compliance, IEEE Press, New York: 1996.

4.1 ADDENDUM

- Schematic drawings
- Layout drawings
- Bill of materials

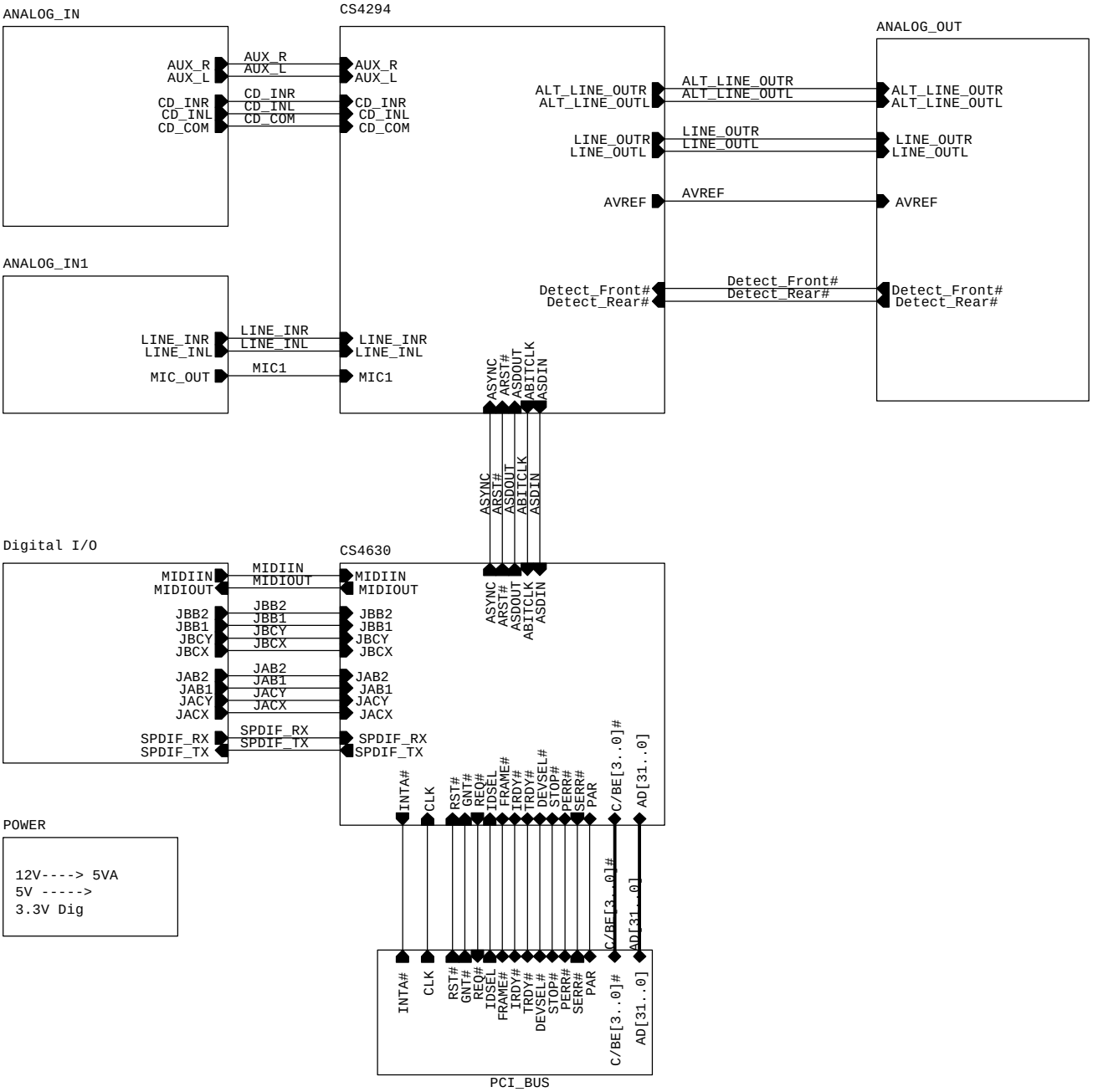

Figure 1. Block Diagram

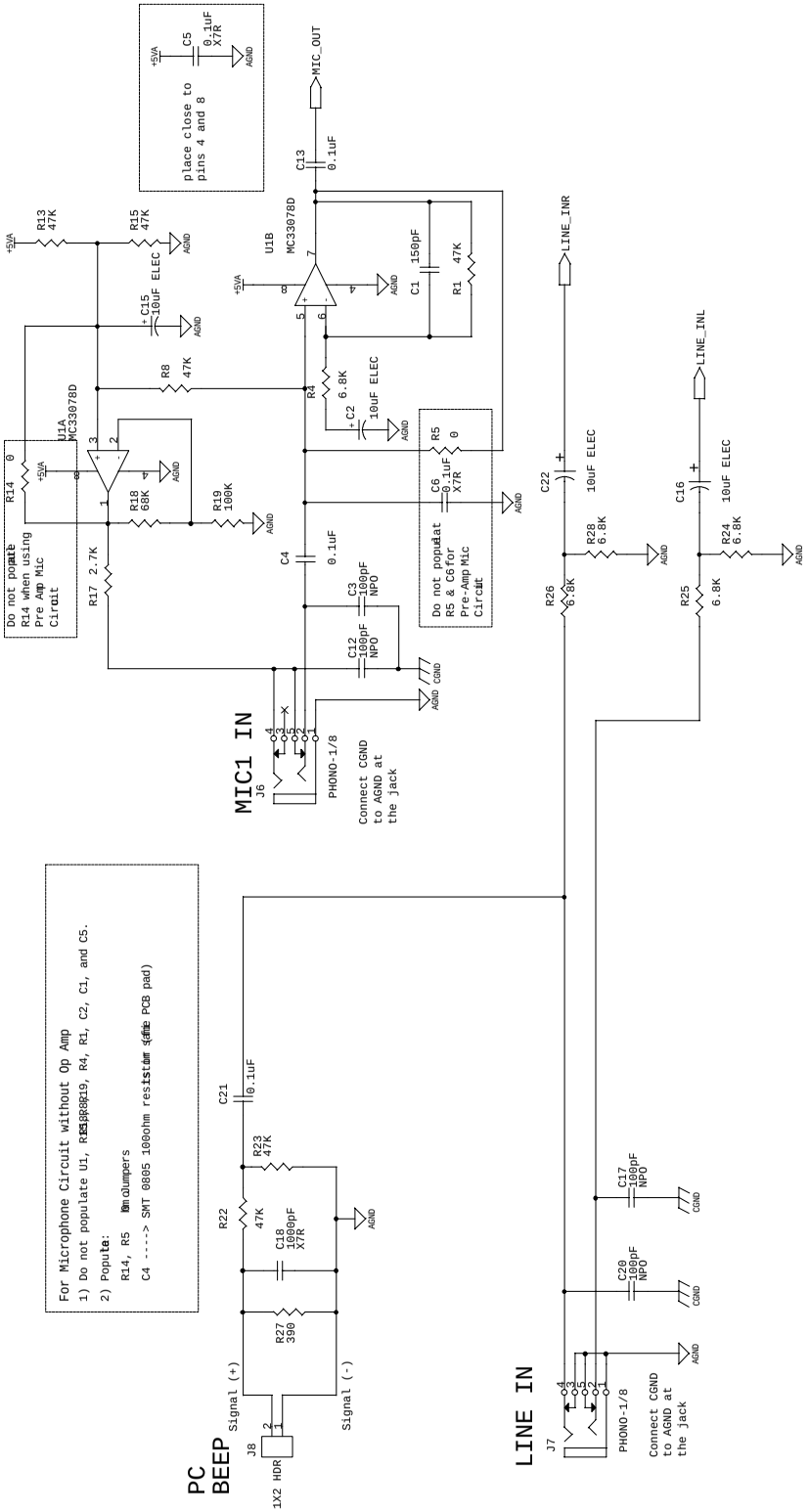

Figure 2. Analog Inputs (1)

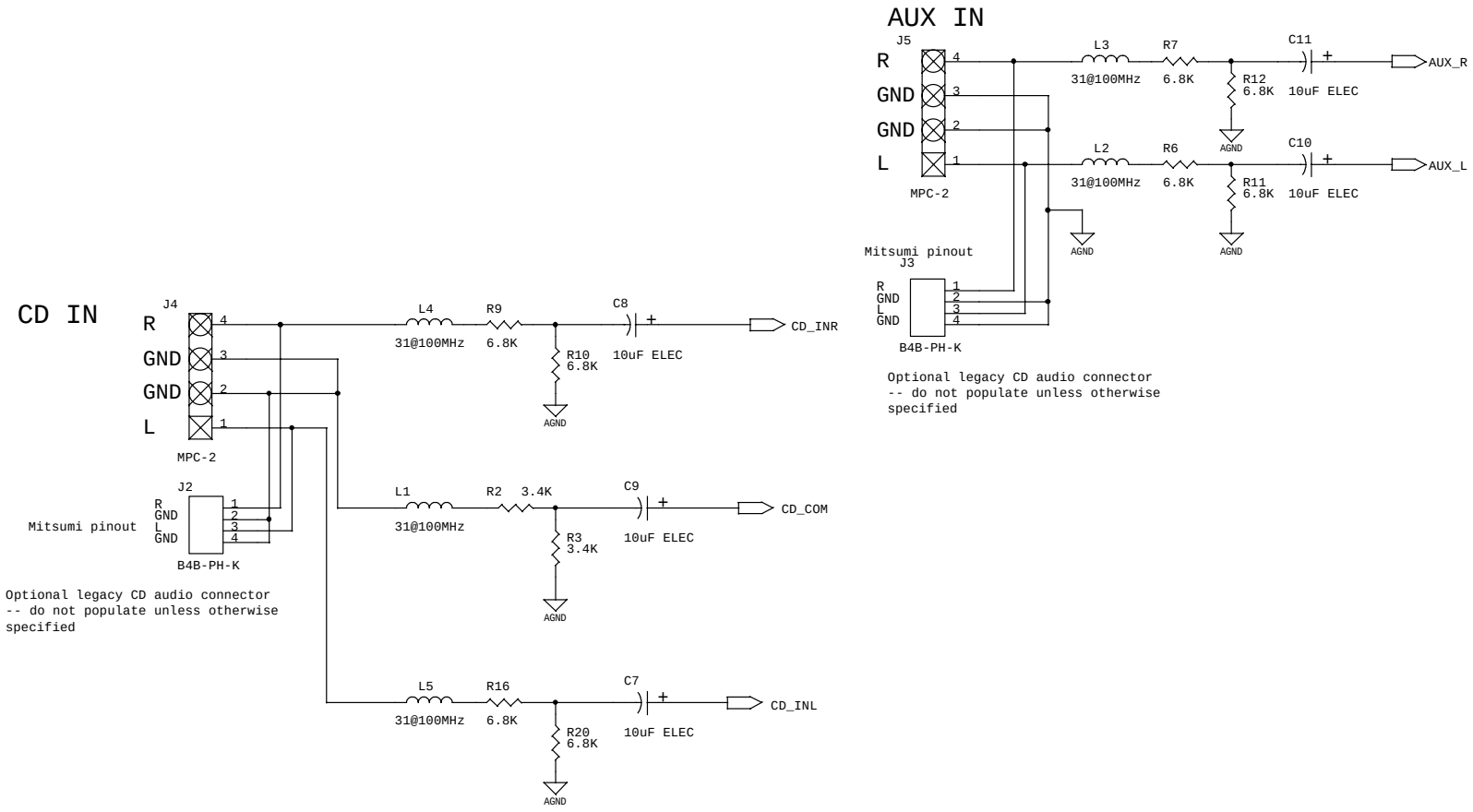

Figure 3. Analog Inputs (2)

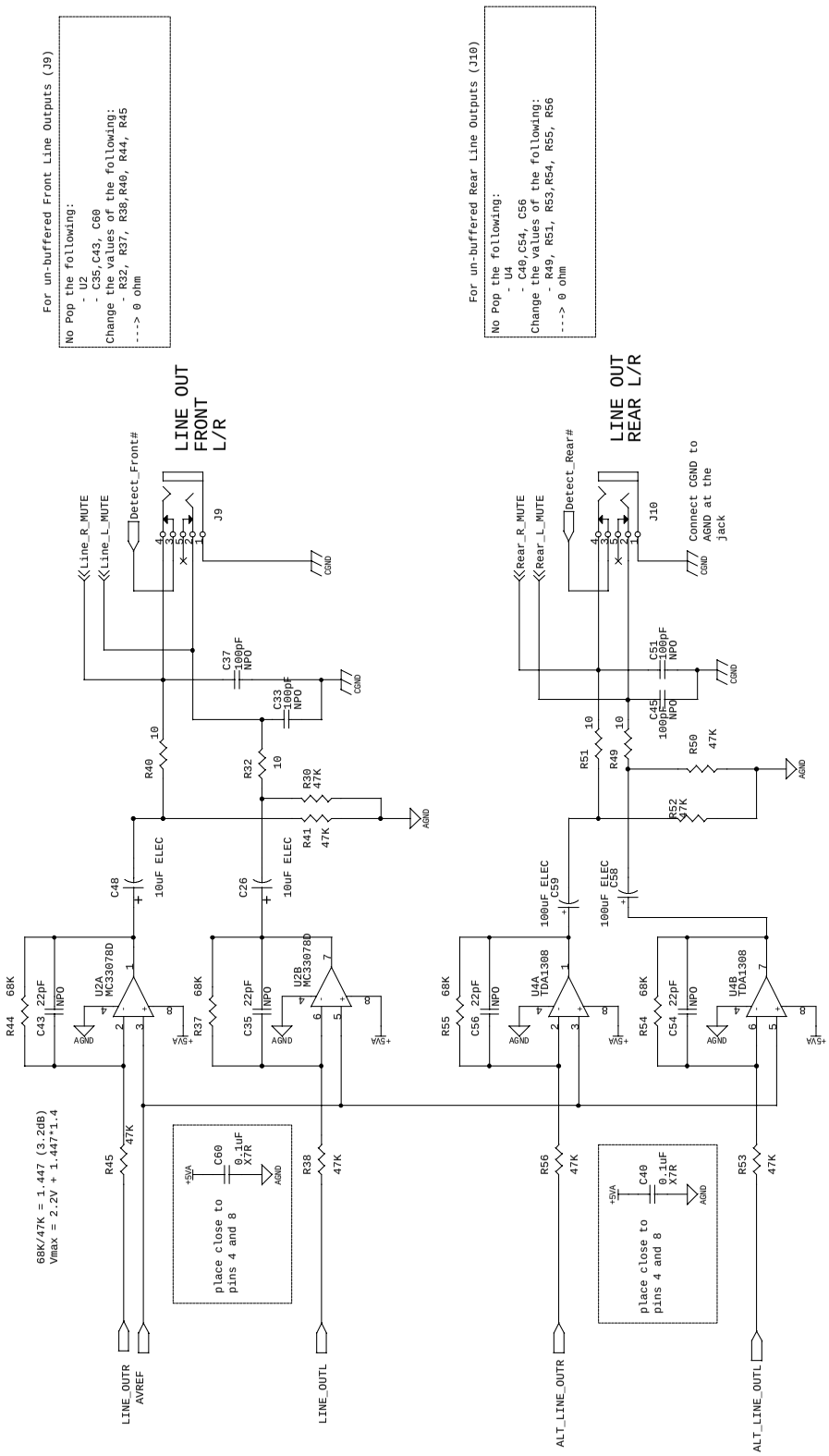

Figure 4. Analog Outputs

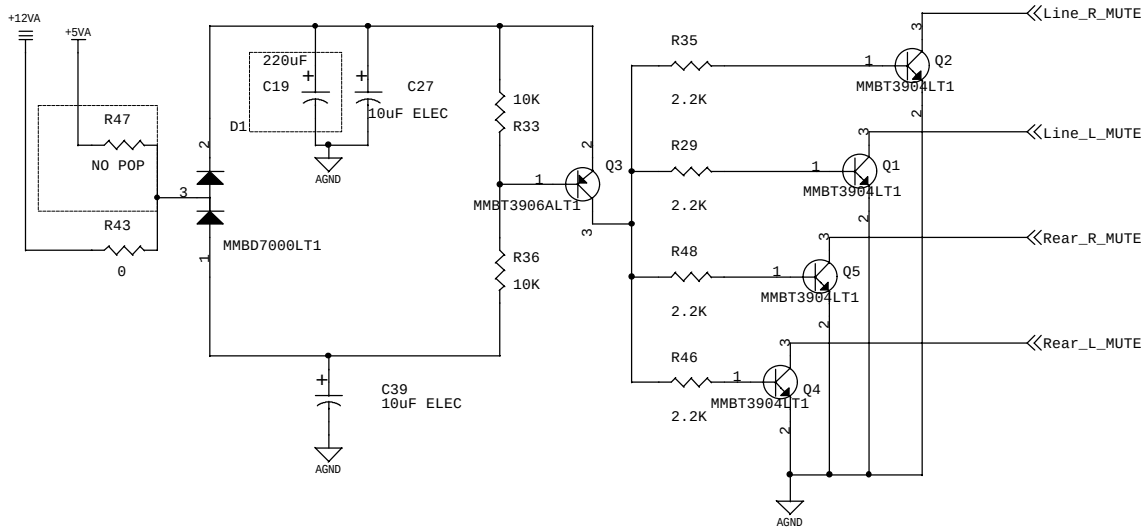

Figure 5. Anti-Pop Circuitry

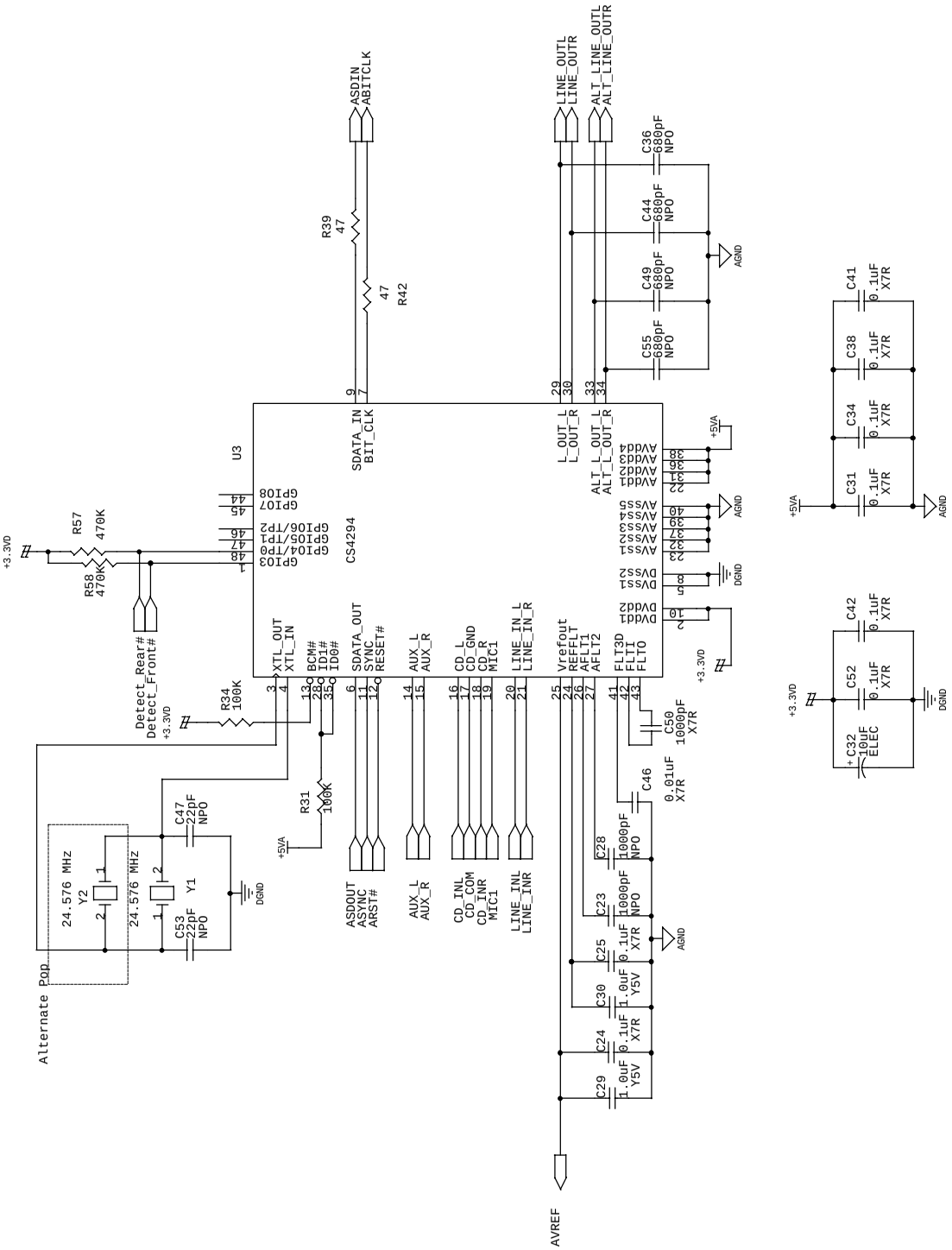

Figure 6. CS4294 AC'97 Audio Codec

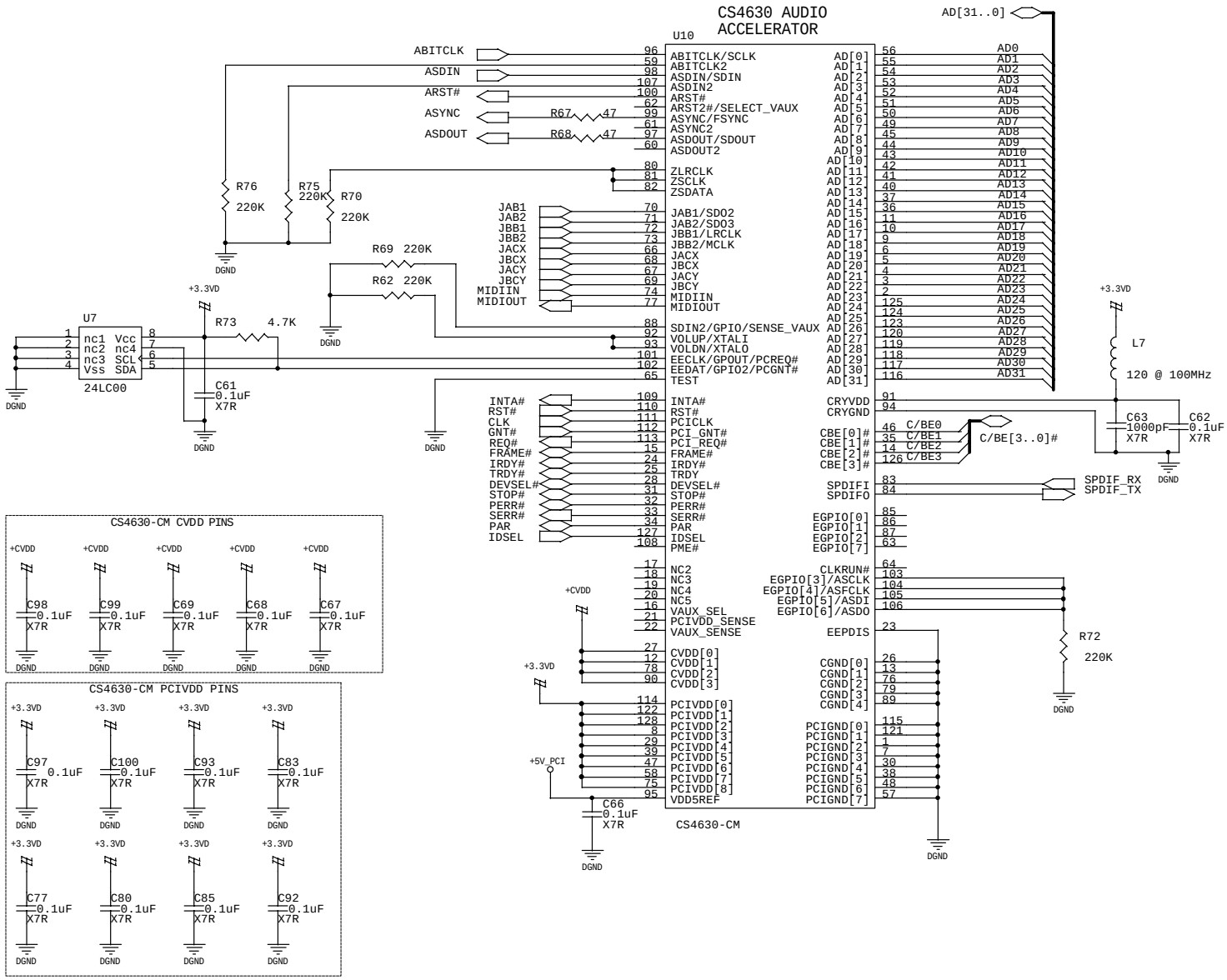

Figure 7. CS4630 Controller

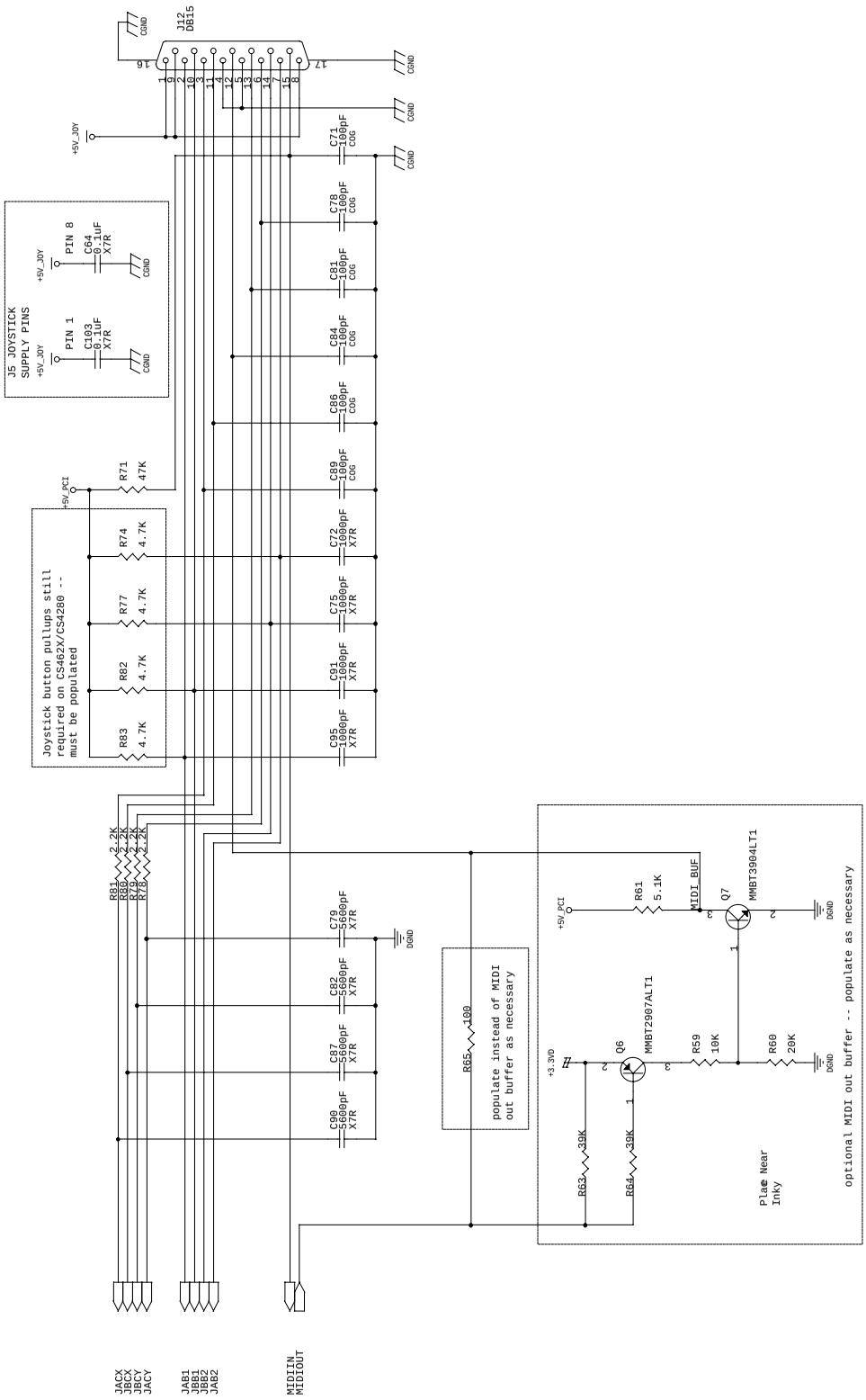

Figure 8. MIDI and Joystick Control

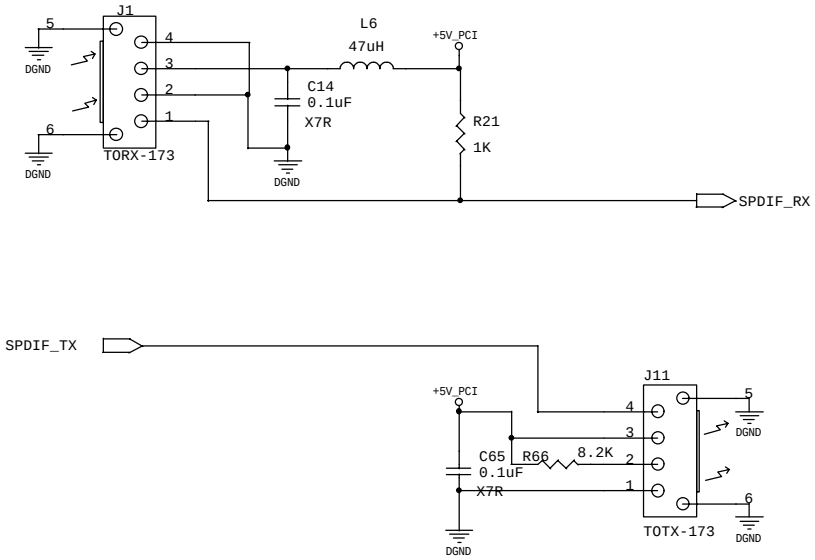

Figure 9. SDPIF

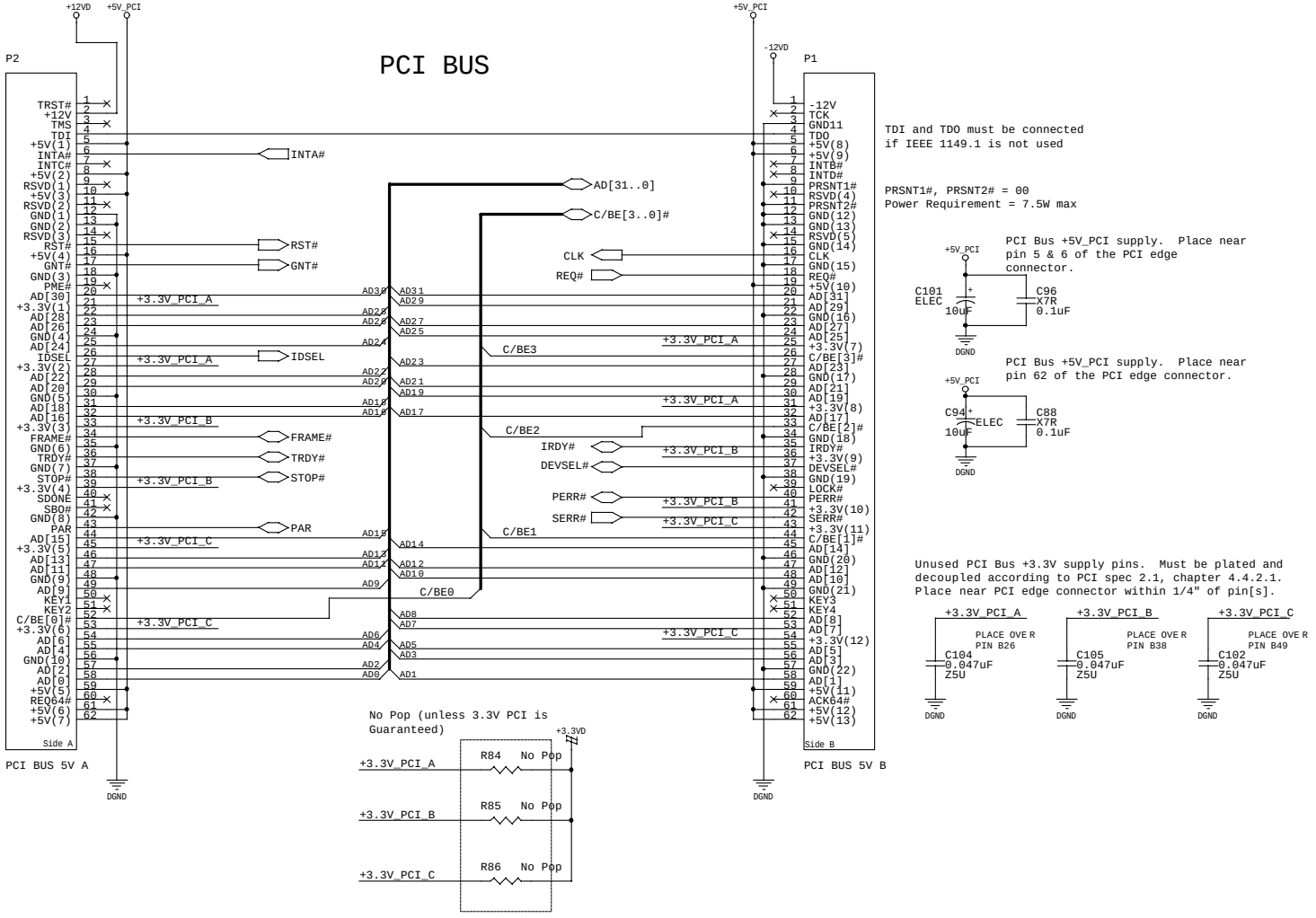

Figure 10. PCI Bus Connection

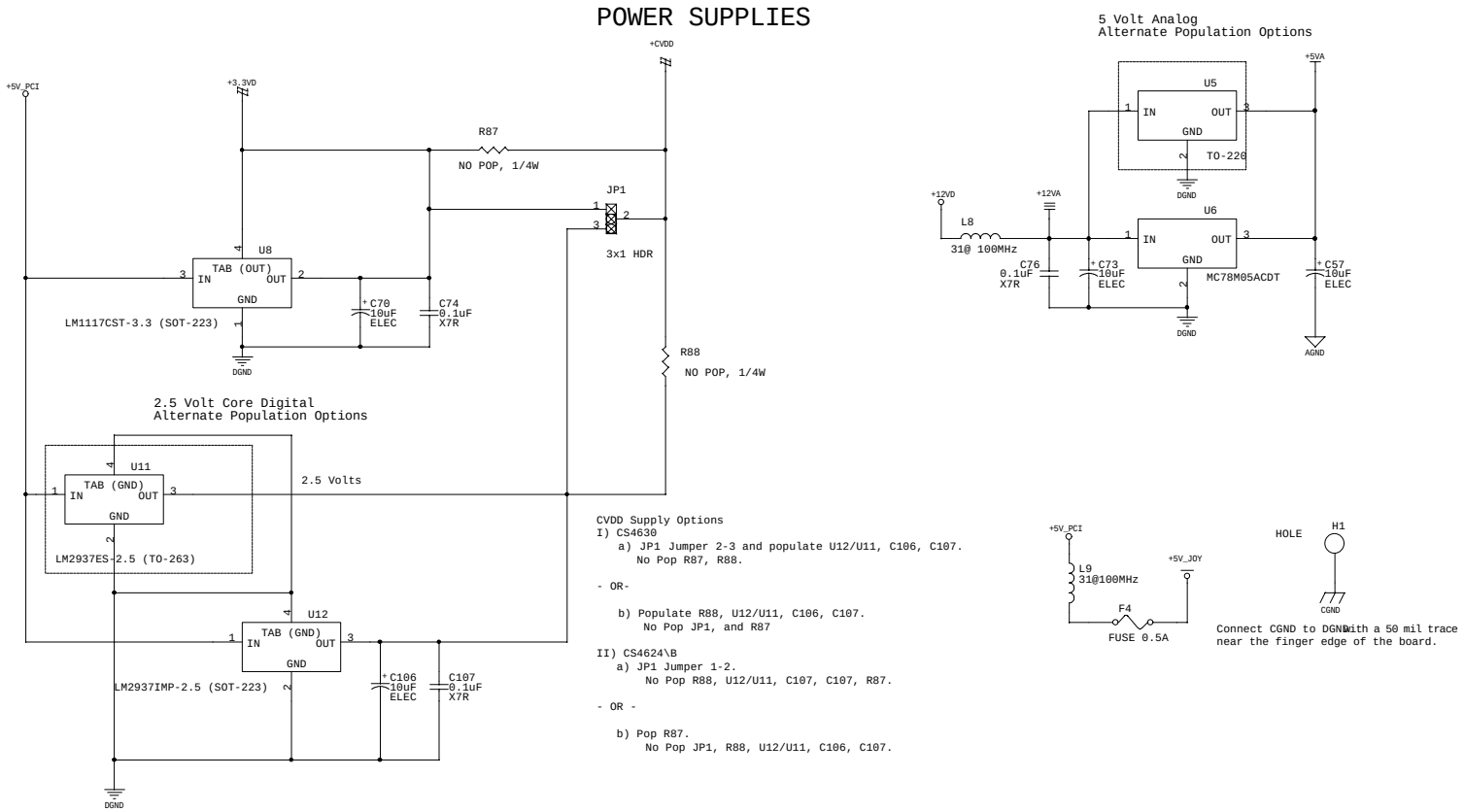

Figure 11. Power Supply

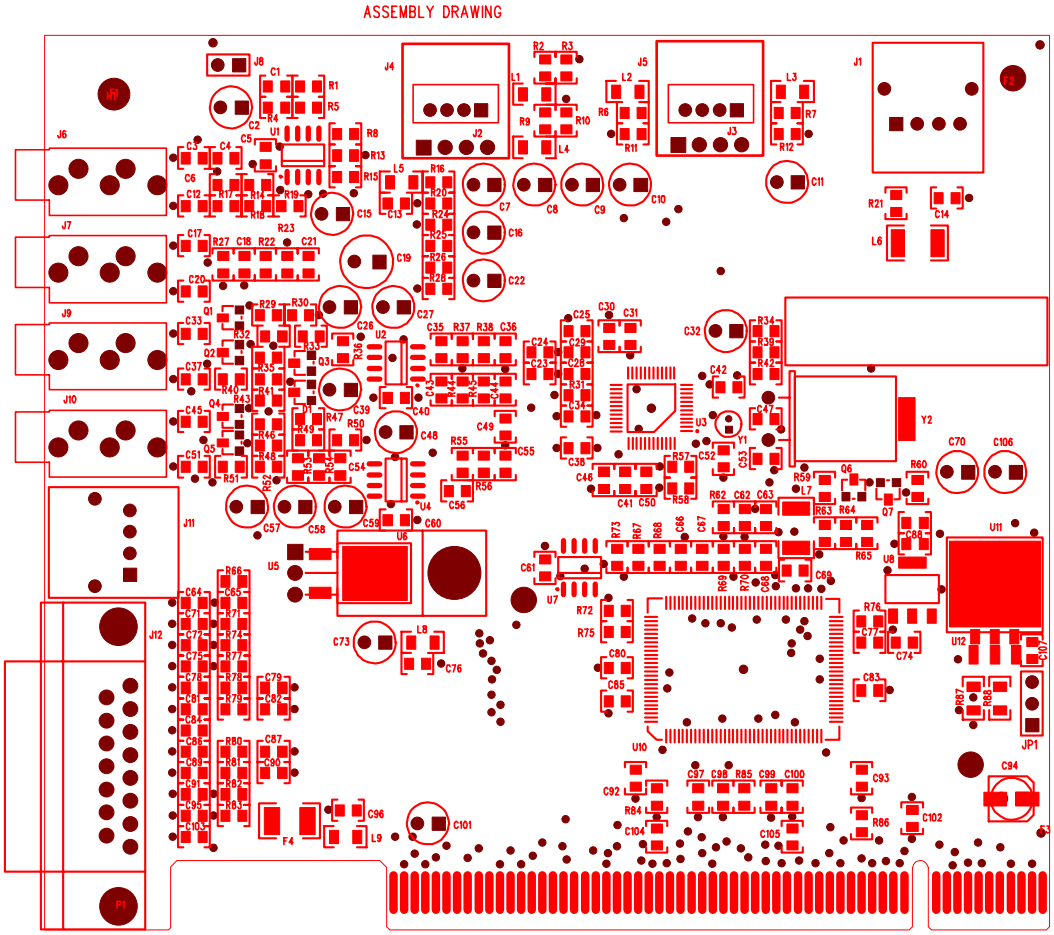

Figure 12. PCB Layout: Assembly Drawing

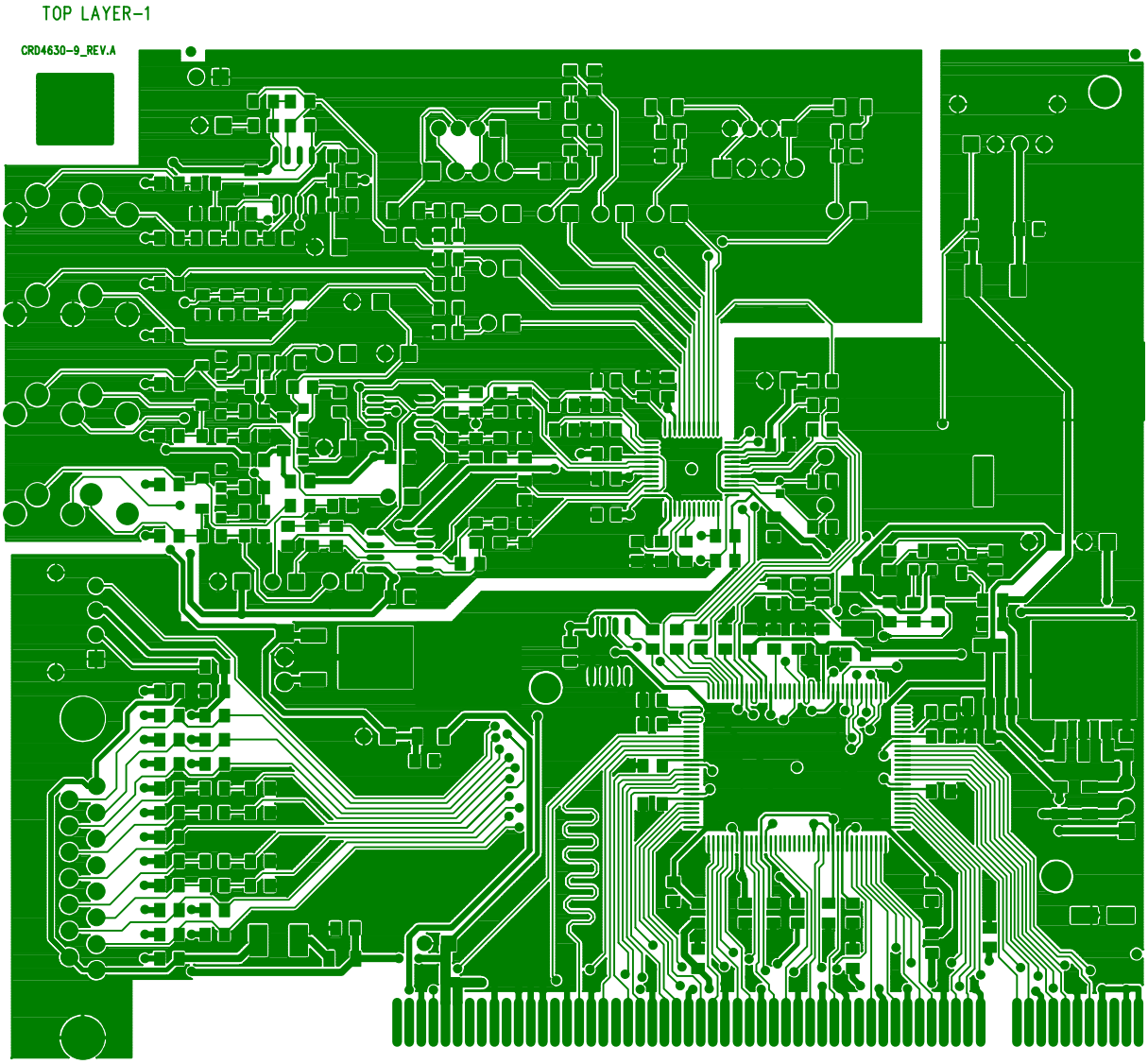

Figure 13. PCB Layout: Top Layer

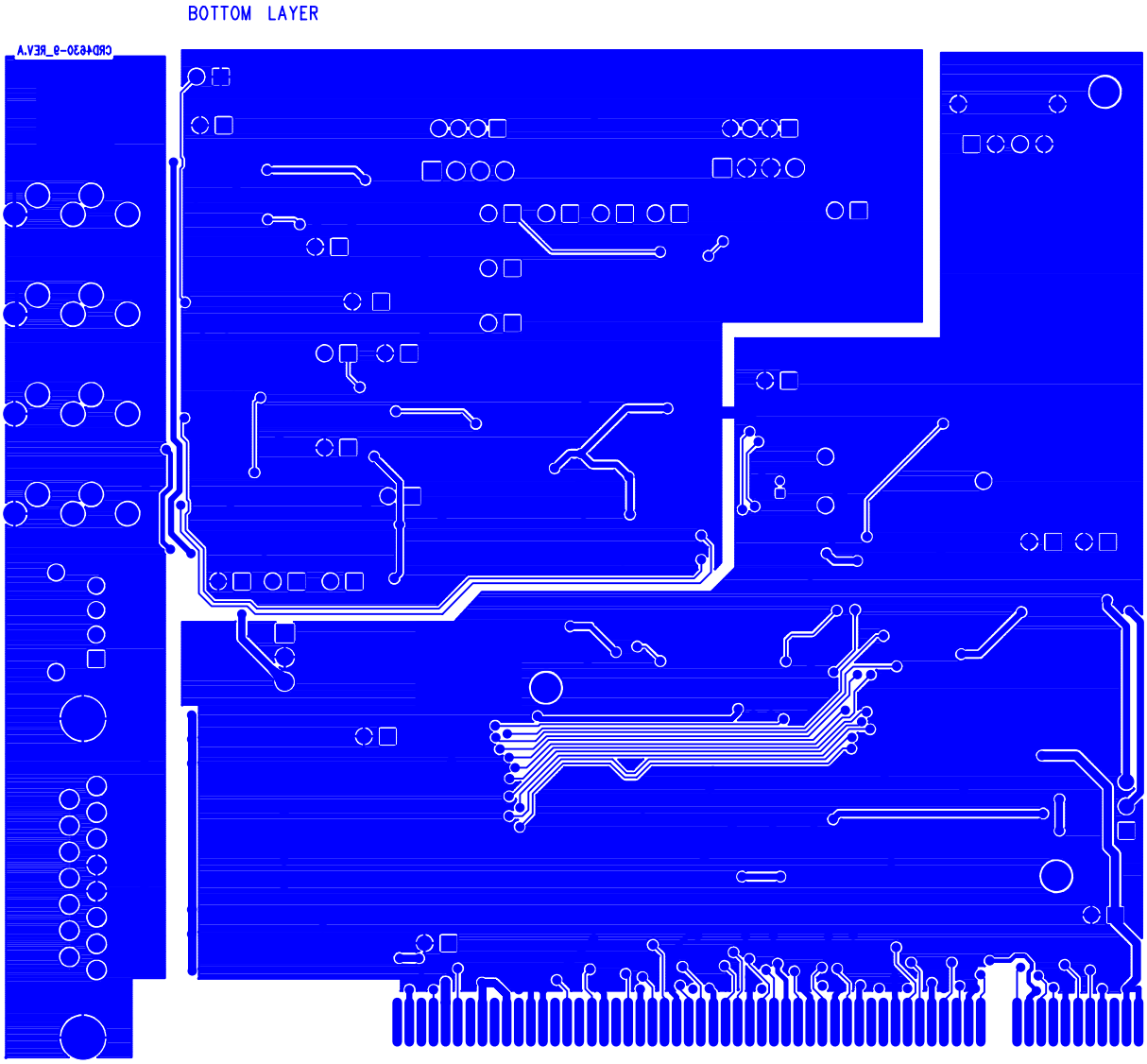

Figure 14. PCB Layout: Bottom Layer

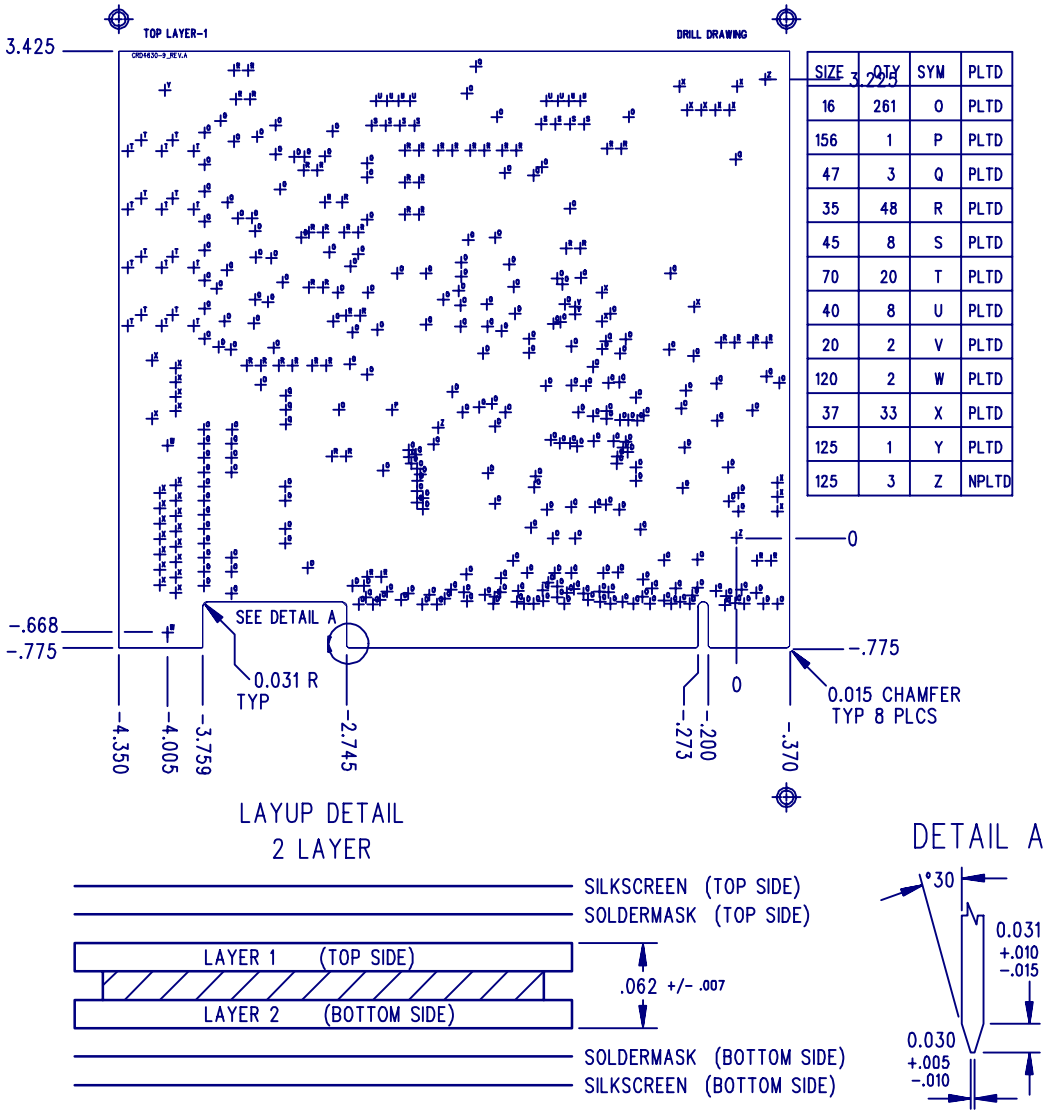

Figure 15. PCB Layout: Drill Drawing

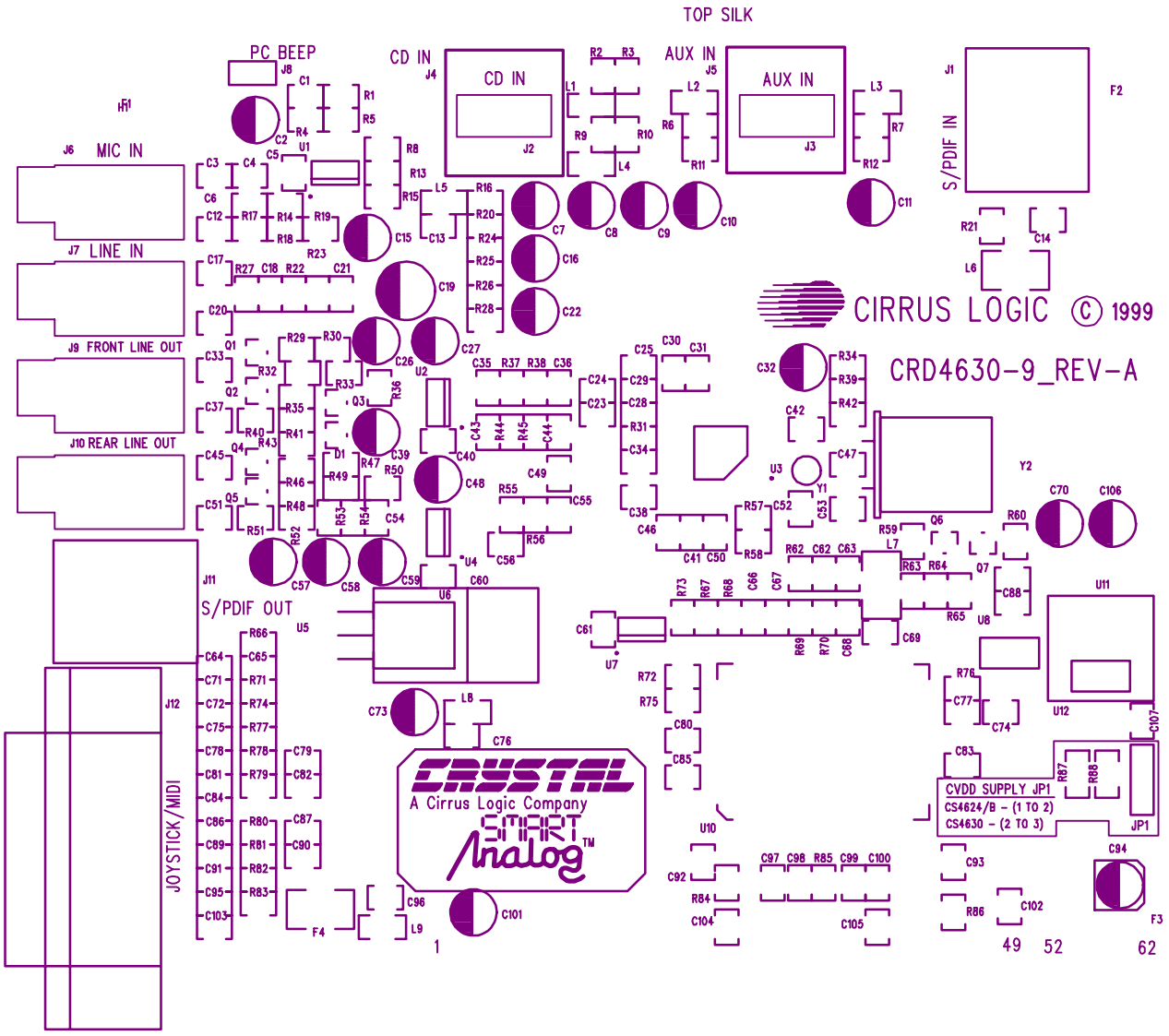

Figure 16. PCB Layout: Silkscreen

5. BILL OF MATERIALS

Item	Quantity	Reference	Description	Manufacturer	Manufacturer PN
1	1	C1	CAP,150pF,0805,5%,50V,NPO	PANASONIC	ECUV1H151JCG
2	14	C3,C12,C17,C20,C33,C37, C45,C51,C71,C78,C81,C84,C86,C89	CAP, 0805, COG, 100pF, 5%, 50V	PANASONIC	ECUV1H101JCG
3	39	C4,C5,C13,C14,C21,C24, C25,C31,C34,C38,C40,C41, C42,C52,C60,C61,C62,C64, C65,C66,C67,C68,C69,C74, C76,C77,C80,C83,C85,C88, C92,C93,C96,C97,C98,C99, C100,C103,C107	CAP, 0805, X7R, .1uF, 10%, 50V	KEMET	C0805C104K5RAC
5	No Pop	C6	CAP, 0805, X7R, .1uF, 10%, 50V	KEMET	C0805C104K5RAC
6	20	C2,C7,C8,C9,C10,C11,C15,C16,C22,C26,C27,C32,C39,C48,C57,C70,C73,C94,C101,C106	CAP,ELEC,10UF,TH,CASE A,20%,16V	PANASONIC	ECE-A16Z10
7	7	C18,C50,C63,C72,C75,C91,C95	CAP, 0805, X7R, 1000pF, 10%, 50V	KEMET	C0805C102K5RAC
8	No Pop	C19	CAP,ELEC,220UF,TH,CASE B,20%,16V	PANASONIC	ECA1CM221
9	2	C28,C23	CAP, 0805, COG, 1000pF, 5%, 50V	KEMET	C0805C102J5GAC
10	2	C58,C59	CAP,ELEC,100UF,TH,CASE A,20%,6.3V	PANASONIC	ECA1CM101
11	2	C29,C30	CAP,1.0UF,SO,0805,+80/-20%,16V,Y5V	MURATA	GRM40-6Y5V105Z016
12	6	C35,C43,C47,C53,C54,C56	CAP, 0805, COG, 22pF, 5%, 50V	KEMET	C0805C220J5GAC
13	4	C36,C44,C49,C55	CAP, 0805, COG, 680pF, 5%, 50V	KEMET	C0805C681J5GAC
14	1	C46	CAP, 0805, X7R, .01uF, 10%, 50V	KEMET	C0805C103K5RAC
15	4	C79,C82,C87,C90	CAP, 0805, X7R, 5600pF, 10%, 50V	KEMET	C0805C562K5RAC
16	3	C102,C104,C105	CAP, 0805, Z5U, .047uF, 20%, 50V	KEMET	C0805C473M5UAC
17	1	D1	DIODE, SOT-23, SMALL SIGNAL	MOTOROLA	MMBD7000LT1
18	1	F4	FUSE, SMT, 0.5A hold, 1.0A trip	RAYCHEM	miniSMD050-2
19	1	J1	OPTICAL TOSLINK RECIEVER	TOSHIBA	TORX-173
20	No Pop/Alternate (J4,J5)	J2,J3	HDR, 4 PIN SHROUDED, .08"	JST	B4B-PH-K
21	2	J5,J4	HDR, 4X1, 0.025" PIN, 0.1" CTR, 15u" AU	MOLEX	70553-0003
22	4	J6,J7,J9,J10	CONN, 1/8" DOUBLE SW. STEREO PHONE JACK	LZR ELECTRONICS	SJ372
23	1	J8	PTH HEADER (2) , 100mil	Samtek	TSW-102-07-G-S
24	1	J11	OPTICAL TOSLINK TRANSMITTER	TOSHIBA	TOTX-173
25	1	J12	CONN, 15D SHELL, FEMALE, RT ANGLE PC MOUNT	AMP	747845-3

26	1	JP1	PTH HEADER (3 terminal) , 100mil * See Mechanical Assembly	Samtek	TSW-103-07-G-S
27	7	L1,L2,L3,L4,L5,L8,L9	IND, FBEAD, 1206, 31@100MHz, 25%	TDK	HF50ACB321611-T
28	1	L7	IND,FBEAD,1812,120@100MHz,25%	TDK	HF30ACB453215-T
29	1	L6	IND,47uH,10%,210mA	SIEMENS	SIMID03-47uH
30	4	Q1,Q2,Q4,Q5	TRAN,NPN,SOT23,SMT	MOTOROLA	MMBT3904LT1
31	1	Q3	TRAN,PNP,SOT23,SMT	MOTOROLA	MMBT3906ALT1
32	No Pop	Q6	TRAN, SO, PNP, SOT23	MOTOROLA	MMBT2907ALT1
33	No Pop	Q7	TRAN, SO, NPN, SOT23	MOTOROLA	MMBT3904LT1
34	13	R1,R8,R13,R15,R30,R38, R41,R45,R50,R52,R53,R56, R71	RES, SO, 0805, 47K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A4702J
35	2	R3,R2	RES, SO, 0805, 3.4K, 1%, 1/10W, METAL FILM	PHILIPS	9C08052A3401F
36	13	R4,R6,R7,R9,R10,R11,R12, R16,R20,R24,R25,R26,R28	RES, SO, 0805, 6.8K, 1%, 1/10W, METAL FILM	PHILIPS	9C08052A6801F
37	No Pop (6)	R5,R14,R47,R84,R85,R86	RES, SO, 0805, 0, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A0R00J
38	1	R17	RES, SO, 0805, 2.7K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A2701J
39	1	R18	RES, SO, 0805, 68K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A6802J
40	3	R19,R31,R34	RES, SO, 0805, 100K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A1003J
41	1	R21	RES, SO, 0805, 1K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A1001J
42	2	R22,R23	RES, SO, 0805, 47K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A4702J
43	1	R27	RES, SO, 0805, 390, 1%, 1/10W, METAL FILM	PHILIPS	9C08052A3900F
44	4	R29,R35,R46,R48	RES, SO, 0805, 2.2K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A2201J
45	4	R32,R40,R49,R51	RES,10,SO,0805,5%,1/4W,METAL FILM	PHILIPS	9C08052A10R0J
46	3	R33,R36,R59	RES, SO, 0805, 10K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A1002J
47	No Pop	R59	RES, SO, 0805, 10K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A1002J
48	4	R37,R44,R54,R55	RES, SO, 0805, 68K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A6802J
49	4	R39,R42,R67,R68	RES, SO, 0805, 47, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A47R0J
50	1	R43	RES,0K,SO,0805,5%,1/10W,METAL FILM	PHILIPS	9C08052A00J
51	2	R58,R57	RES, SO, 0805, 470K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A4703J
52	No Pop	R60	RES, SO, 0805, 20K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A2002J
53	No Pop	R61	RES, SO, 0805, 5K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A5001J
54	6	R62,R69,R70,R72,R75,R76	RES, SO, 0805, 220K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A2203J
55	No Pop (2)	R63,R64	RES, SO, 0805, 39K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A3902J
56	1	R65	RES, SO, 0805, 100, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A1000J
57	1	R66	RES,8.2k,0805,5%,1/8W	Philips	9C08052A8201F
58	5	R73,R74,R77,R82,R83	RES, SO, 0805, 4.7K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A4701J

59	4	R78,R79,R80,R81	RES, SO, 0805, 2.2K, 5%, 1/10W, METAL FILM	PHILIPS	9C08052A2201J
60	No Pop (2)	R87, R88	RES, SO, 1206, 0 OHM, 5%, 1/4W, METAL FILM	PHILIPS	9C12062A00J
61	2	U1,U2	IC, SO, SOIC8, 33078, DUAL OP AMP	MOTOROLA	MC33078D
62	1	U3	4 Channel AC '97 Audio Codec, TQFP 48	CRYSTAL SEMICON-DUCTOR	CS4294-JQ/or KQ
63	1	U4	IC, SO, SOIC8, TDA1308, DUAL HP AMP	PHILIPS	TDA1308
64	No Pop Alter-nate (U6)	U5	IC, SO, +5V REGULATOR, TO-220, 2%, 500mA	MOTOROLA	MC78M05T
65	1	U6	IC, SO, +5V REGULATOR, DPAK, 2%, 500mA	MOTOROLA	MC78M05ACDT
66	1	U7	IC, SO, SOIC8, SERIAL EEPROM, 16 x 8, 2.5V	MICROCHIP	24LC00/SN
67	1	U8	IC, SO, +3.3V REGULATOR, SOT-223, 2%, 800mA	NATIONAL SEMICON-DUCTOR	LM1117MPX-3.3
68	1	U10	AC '97 PCI Audio Controller, 128 MQFP	CRYSTAL SEMICON-DUCTOR	CS4630-CM
69	No Pop Alter-nate (U12)	U11	IC, SO, +2.5V REGULATOR, TO-263, 2%, 500mA	NATIONAL SEMICON-DUCTOR	LM2937ES-2.5
70	1	U12	IC, SO, +2.5V REGULATOR, SOT-223, 2%, 400mA	NATIONAL SEMICON-DUCTOR	LM2937IMP-2.5
71	1	Y1	CRYSTAL, 24.576MHz, CA-301 TYPE, Fund Mode Par Res	EPSON	CA-301_24.576M-C
72	No Pop Alter-nate (Y1)	Y2	CRYSTAL, 24.576MHz, H49-US TYPE, Fund Mode Par Res	EPSON	ALT POP


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