

**FEATURES**

- 32-bit, PCI Audio Accelerator add-in card designed to meet AC '97 specifications
- Sound Blaster Pro™ compatible, MPU-401 and Gameport interfaces
- 2-layer low cost single sided adapter board
- CS4614 SoundFusion™ PCI Audio Accelerator and CS4297 SoundFusion™ Audio Codec '97
- Complete suite of Analog I/O connections:
  - Line In, Line Out, Mic In, Modem audio connection, CD Audio In, Video In and Aux In
- Joystick/MIDI Interface
- Meets or exceeds Microsoft's® PC'97 and PC'98 , both required and advanced, audio performance requirements.

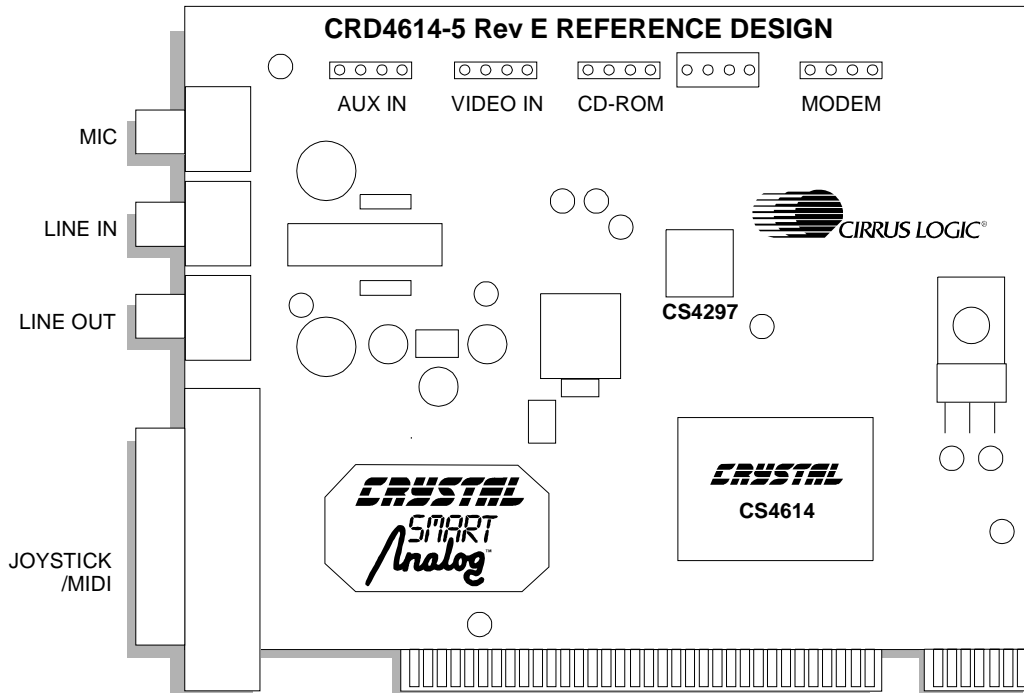
**ORDERING INFO**  
CMK4614-5

**CrystalClear™**  
**AC '97 Low Cost PCI Audio**  
**Adapter Reference Design**

**DESCRIPTION**

The CRD4614-5 low cost PCI add-in board reference design showcases Cirrus Logic's Crystal Audio AC '97 CS4614 SoundFusion Audio Accelerator and the CS4297 SoundFusion Audio Codec '97. This design is a PCI 2.1 compliant, variable-height, short card measuring only 3.1 inches high by 4.7 inches long.

The CRD4614-5 reference design includes a customer ready manufacturing kit. In the kit are full schematic and library design files, PWB job files, and PWB artwork files. The design is production ready as is, or can be easily modified to incorporate specific OEM value-add. Documentation source files are available to assist the OEM to quickly provide an accurate end user manual.



## ANALOG CHARACTERISTICS

	Frequency response	Dynamic Range (A-weighted)	THD+N (-3dBFS, unweighted)
<b>Mic In to Line Out(A-A)</b> <sup>2</sup>	100Hz(-3dB)..20kHz(-1dB)	88dB FS A	-82dB FS
<b>Line In to Line Out(A-A)</b> <sup>3</sup>	10Hz..20kHz(-0.5dB)	93.5dB FS A	-89dB FS

Notes: 1. These preliminary CRD4614-5 audio measurements were taken using the Portable One Plus system from Audio Precision.

2. Vmic\_in FS = 125mVrms, f=1kHz (sine), +20dB internal gain set, all other gain registers set to 0dB.

3. Vline\_in FS= 1Vrms, f=1kHz(sine), all gain registers set to 0dB.

## GENERAL INFORMATION

The CRD4614-5 is a reference design of a production-grade AC '97 PCI Audio card using the CrystalClear CS4614 SoundFusion PCI Audio Accelerator and the CS4297 SoundFusion Audio Codec '97. These two integrated circuits demonstrate Cirrus' powerful DSP controller and unsurpassed CrystalClear audio quality in a single PCI add-in card reference design. The CRD4614-5 audio measurements meet or exceed Microsoft's PC'97 and PC'98, both required and advanced, audio performance requirements.

Today's multimedia applications demand high quality PC audio and numerous audio connections. To meet this demand, Intel® defined the AC '97 (Audio Codec '97) specification that defines a two chip audio solution [1].

The advantage of a two chip audio solution is that the analog section of a system can be completely separated from the noisy digital environment of a personal computer. A 5-wire digital link is all that is required to connect the audio codec to the PCI bus-based AC'97 controller. This allows the audio section to reach the required signal to noise ratio of ~90 dB while making the layout and placement of the audio section easier to implement.

In the Windows 95 environment, a MIDI stream and a number of simultaneous audio streams from Windows 95 applications can be sent to the CS4614 over the PCI bus. The CS4614 performs

hardware accelerated audio stream mixing and processing, including sample rate conversion, 3D positional audio processing and wavetable synthesis, then sends the output stream over the AC '97 Link to the CS4297. The CS4297 performs the Digital-to-Analog Conversion (DAC) for this digital audio output stream and also provides multiple analog audio inputs and outputs, analog mixing and Analog-to-Digital Conversion (ADC).

In the native DOS environment, the CS4614 provides legacy games compatibility in hardware. DOS applications may directly address the legacy register set for SoundBlaster Pro compatibility, an integrated FM synthesizer, as well as the gameport.

The CS4614 also provides an MPU-401 interface in native DOS. In this environment the CS4614 receives the MIDI data through legacy compatible I/O. The CS4614 performs the wavetable synthesis function and sends the synthesized audio stream to the CS4297 via the AC Link for digital to analog conversion.

This card is designed to provide the highest possible functionality, along with industry leading audio performance at a low manufacturing cost. Care was taken with component placement and signal routing to minimize sources which can degrade audio performance. Cirrus' analog design know-how has resulted in a board which preserves the exceptional analog performance of the CS4614 and CS4297.

## REFERENCE DESIGN FEATURES

The CRD4614-5 reference design illustrates a low cost two-layer, single sided add-in card layout. The card is sectioned into three main parts: the CS4614 PCI Audio Accelerator section, the CS4297 Audio Codec '97 section, and the Analog I/O section.

### CS4614 PCI Audio Accelerator Section

The CS4614, a PCI 2.1 compliant device, is a bus mastering, 255 MIPS DSP optimized for audio signal processing. An efficient on-chip DMA controller and stream processor DSP core provide a number of signal processing functions including:

- Hardware acceleration for Windows 95 DirectSound®, DirectSound3D®, DirectShow™ and Aureal A3D API's
- 3-D positional processing for DirectSound3D API calls using HRTF-based 3D algorithms
- Mixing and sample rate conversion for multiple concurrent 2D and 3D digital audio streams
- Concurrent General MIDI compliant, wave-table synthesis with 64-note polyphony and chorus/reverb effects processing

The area around the CS4614 includes the required bypass capacitors, PLL power supply filter components, an EEPROM, the components for the joystick connection and a buffer circuit for the external MIDI connection. The layout of this section complies with the PCI specification version 2.1 [2] for add-in cards. Please refer to the schematic and layout sections of this document for more information. For more information on the CS4614, refer to the CS4614 Data Sheet [3].

### *Joystick/MIDI connection*

The DB-15 connector allows a joystick or an external MIDI device to be connected to the CS4614. In the AC '97 configuration, the CS4614 handles the joystick operation. The external connection can

also take MIDI data from an external source to the CS4614. A buffer circuit allows the MIDIOUT pin of the CS4614 to drive an external MIDI input.

### *External EEPROM*

The CS4614 EEPROM contains the required Subsystem Vendor ID and Subsystem ID values as well as two configuration registers which configure the software driver of the CS4614 to operate in AC '97 link mode. The CS4614 currently requires 7 data bytes in the EEPROM for configuration. The PCI Special Interest Group assigns manufacturers a Subsystem Vendor ID. To meet WHQL™ standards, the Subsystem ID must be a non-zero value.

A utility, PCIRSRC.EXE, is supplied in this kit to download configuration and OEM specific data to the EEPROM.

Please call Cirrus Logic PC Products Audio Division at (512) 445-7222 to have a Subsystem ID assigned to a particular project.

For information regarding the programming and timing of the EEPROM, refer to the CS4614 Data Sheet [3].

### *Power Requirements*

3.3 V power for the CS4614 is generated from the +5 V on the PCI connector and regulated to +3.3 V using a low dropout linear voltage regulator. This is required since all PCI slots are not guaranteed to have +3.3 V power pins available in the PCI connector slot. The maximum current requirement for the +3.3 V power supply is 225 mA with a typical operating current in the 150-200 mA range during normal audio processing tasks.

### CS4297 Audio Codec '97 Section

This section contains the components for the Mic In, Line In, and Line Out audio connections. It also includes a 24.576 MHz crystal that acts as the master clock in an AC '97 configuration. The capacitors required for the CS4297 and their placement are discussed in the CS4297 Data Sheet[4]. Refer

to the *Grounding and Layout* section of the data sheet for the recommended routing the audio section.

### **Power Requirements**

A Motorola MC78L05CDT regulates the PCI +12 V supply down to provide a clean +5 V analog supply for the CS4297. A power regulator is recommended for the analog voltage supply to provide good audio signal quality. The MC78L05CDT regulator can provide up to 100 mA of current, which is enough power for the CS4297 and associated analog circuitry.

### **Analog I/O Section**

The CS4297 has many analog inputs and outputs that may or may not be used depending on the system's application. Unused inputs should be tied to Vrefout (pin 28) or capacitively coupled to the analog ground plane. The analog section contains the components for a headphone amplifier or power amplifier as a stuff option.

The Modem Audio, CD ROM, Video In and Aux In headers are also part of the Analog I/O section. Each header has a few resistors and capacitors associated with it. The header and its associated components may or may not be necessary depending on the audio inputs implemented.

### **Audio Inputs and Outputs**

A full feature set of the CS4297's analog I/O is represented on the reference design card through internal headers and external connectors:

- Line Out
- Mic In
- Line In
- CD ROM In
- Modem audio connection
- Aux In
- Video In

Three external 1/8" jacks and four internal header connections are used for analog inputs and outputs.

### **Line Out**

The output of the CS4297 is capable of driving impedances greater than 10 k $\Omega$  with a maximum output voltage of 1 Vrms. These loads are generally self powered speakers. Two additional population options are available. The first option is a low-noise, low distortion amplifier for driving headphones, typically impedances greater than 32  $\Omega$ . The second option is a power amplifier for driving 8  $\Omega$  or 4  $\Omega$  speakers. The Line Out connection is through the external 1/8" jack.

- Maximum output level: 1 Vrms

#### *Headphone Amp output option:*

- Capable of driving low impedance loads such as 32  $\Omega$  headphones
- Maximum output level: 2.0 Vrms

#### *Power Amp output option:*

- Capable of driving low impedance loads such as 4  $\Omega$  or 8  $\Omega$  speakers
- Maximum output level: 2.9 Vrms into 4  $\Omega$  or 8  $\Omega$

### **Mic In**

The Microphone In 1/8" jack provides a single-ended microphone input (as opposed to differential), supporting most common types of dynamic or phantom powered microphones. The microphone input provides no signal amplification, but a 20 dB gain block inside the CS4297 can be software enabled (the "Boost" button in the Windows input applet) if signal levels are too low. In many cases, the additional "Boost" will be required with the CRD4614-5 implementation in order to achieve a desirable audio level.

- Supports 3-pin phantom power and dynamic microphones

- Microphone power is provided on the ring connection of the 1/8" stereo jack

### ***Line In***

The Line In 1/8" jack provides an input to the Line In pins of the CS4297.

- Maximum input level: 1 Vrms

### ***CD ROM In***

The CD-ROM audio input headers are connected in parallel, which means only one can be active at a time. The first header is a 4 pin (0.1 inch center) shrouded connector that fits most CD ROM audio adapter cables. The second is a 4 pin (2 mm center) shrouded connector. The OEM will need to make it clear to end users which one to use, or delete the unused connector entirely.

- Maximum input level: 1 Vrms
- Differential input using the CD common pin as the ground
- 0.1 inch connector wired as:
  - Pin 1 : Left Channel
  - Pin 2 : Analog Ground
  - Pin 3 : Analog Ground
  - Pin 4 : Right Channel
- 2 mm connector wired as:
  - Pin 1 : Right Channel
  - Pin 2 : Analog Ground
  - Pin 3 : Left Channel
  - Pin 4 : Analog Ground

### ***Modem Audio Connection***

The Modem audio header provides an audio interface between the sound card and a modem. The Mono Out signal from the CRD4614-5 transfers audio to the Modem, and Phone In receives audio from the modem.

- Internal 4 pin header (0.1 inch center)

- Wired as:
  - Pin 1 : Phone\_In (from modem)
  - Pin 2 : Analog Ground
  - Pin 3 : Analog Ground
  - Pin 4 : Mono\_Out (to modem)
- Phone\_In maximum input level : 1 Vrms
- Mono\_Out maximum output level: 0.7 Vrms

### ***Aux In***

- Internal 4 pin header (0.1 inch center)
- Wired as:
  - Pin 1 : Left Channel
  - Pin 2 : Analog Ground
  - Pin 3 : Analog Ground
  - Pin 4 : Right Channel
- Maximum input level: 1 Vrms

### ***Video In***

- Internal 4 pin header (0.1 inch center)
  - Wired as:
    - Pin 1 : Left Channel
    - Pin 2 : Analog Ground
    - Pin 3 : Analog Ground
    - Pin 4 : Right Channel
- Maximum input level: 1 Vrms

## **SCHEMATIC DESCRIPTION**

Figures 1 through 8 show the schematics for the CRD4614-5 card. This section will describe particular pages of the schematic that need to be discussed.

### **Figure 2 : CS4614 PCI Accelerator**

The 0.1  $\mu$ F capacitors connected to the power pins of the CS4614 should be as close as possible to the chip. L3, C56, and C57 are used to filter the power supply for the internal PLL circuit. R19 and R20

are termination resistors in the serial AC link between the CS4297 and the CS4614. The low drop out voltage regulator, the Micrel MIC2920A, is used to provide the required +3.3 V to the CS4614 in the absence of +3.3V on the PCI bus. Two packaging options are supported. U8 is a SOT-223 surface mount package, and U9 is a TO-220 pin-in-hole package. Zero ohm resistors are provided as a stuffing option if +3.3V is known to be available on the PCI bus.

### Figure 3 : CS4297 AC'97 Audio Codec

For the best audio performance, the analog voltage regulator, an MC78L05, should be located near the CS4297. Two packaging options are supported. U2 is an SO8 surface mount package, and U3 is a TO-92 pin-in-hole package. R17 and R18 are termination resistors in the serial AC link between the CS4297 and the CS4614. NPO-type capacitors should be used on all loading capacitors of audio signals to ensure minimal added distortion. Two footprints are also provided for the crystal, XTAL. A CA-301 pin-in-hole footprint, Y1, for miniature crystals, and a standard HC-49U package, Y2, which can be bent over and soldered to the card.

### Figure 4 : Line In, Mic In, CD-ROM In

The 220 pF capacitors on these input lines are provided for EMC suppression. These may be removed if EMC testing determines they are not required.

1  $\mu$ F capacitors are used on the Line In circuit to decrease the low-end frequency corner. Notice the absence of a voltage divider on these inputs. The maximum signal level that can be apply to these inputs is 1 Vrms.

Phantom power, derived from the clean +5VA, is applied to the “ring” of the Mic In jack. A 10  $\mu$ F capacitor is added for additional filtering. If a microphone that requires phantom power on “tip” is shipped with this product by the OEM, then R3 should be populated and R2 removed. Note that

populating R3 is not compliant with PC-99 Audio Specifications.

An additional CD-ROM connector footprint, J2, is provided to support the legacy 2mm, Panasonic style, analog connector. Since J1 and J2 are in parallel, only one CD-ROM audio cable can be installed. It is recommended that only one connector be installed at build time. If both are populated for maximum flexibility, care should be taken by the OEM to notify users that only one device can be attached.

### Figure 5 : Aux In, Video In, Modem

The 220 pF capacitors on these input lines are provided for EMC suppression. These may be removed if EMC testing determines they are not required.

No standard exists for the internal modem connector. R34, R35, and R36 are added in case voltage dividers are required to adjust signal levels.

### Figure 6 : Line Out, Headphone Amp, Power Amp

Three population options are provided for audio out. The first population option is a headphone amplifier, the Motorola MC1458, which is capable of driving stereo headphones with impedances greater than 32  $\Omega$  or powered speakers. A jumper must be installed across pins 2 & 3 of J7 and J9 for proper operation. The headphone amp can be bypassed by the OEM or customer by installing the jumper across pins 1 & 2 of J7 and J9.

The second population option is the addition of a power amplifier, the Philips TDA1517P. This op amp is capable of driving 4 or 8  $\Omega$  speakers as well as headphones and powered speakers with a marginal decrease in audio performance. A jumper must be installed across pins 2 & 3 of J7 and J9 for proper operation. The power amp can be bypassed by the OEM or customer by installing a jumper across pins 1 & 2 of J7 and J9.

The third and least expensive option is to not populate either the headphone amp or power amp. This option is the least flexible since only powered speakers can be driven. A jumper must be installed across pins 1 & 2 of J7 and J9 for proper operation.

### Figure 7 : MIDI and Joystick Connection

A buffer driver circuit is used on the MIDIOUT pin to provide necessary 5V TTL compatible output on the DB-15 connector. This circuit can be removed, and R37 populated to bypass the buffer circuit if a 3.3V compatible output is sufficient. Pull-up resistors are required for the joystick buttons and the MIDI input. L4, C72, C77, C78, C79 are provided for EMC suppression and can be removed if EMC testing shows they are not required. Replace L4 with a 0 ohm resistor. C73 - C76 and C80 - C83 are functional to the joystick circuitry as well as provide for EMC suppression and therefore must not be removed.

### Figure 8 : 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  $\mu$ F capacitor [2]. Seven 0.1  $\mu$ F capacitors in parallel provide the required capacitance for the +3.3 V power pins. Zero ohm resistors R43 and R44 can be used to omit the +3.3V regulator if this voltage is known to be provided on the PCI bus.

### Component Selection

Great attention was given to the particular components used on the CRD4614-5 board with costs, performance, and package selection as the most important factors. Listed are some of the guidelines used in the selection of components:

- all capacitors greater than 1  $\mu$ F will be pin in hole aluminum type.
- no components smaller than 0805 package
- use single package components - no resistor pacs

- 8 pin devices will be in surface mount packages.
- the TDA1517P power amp will be pin in hole package
- dual footprint for XTAL. Standard H49U with GND pad and small circular CA-301 pin in hole package
- Dual footprint for +5 V and +3.3 V regulators. Surface mount and pin in hole packages are supported.

### EMC Components

A number of capacitors and inductors are included to help the board meet EMC compliance tests, such as FCC Part 15. These components are outlined in the schematic. They may or may not be needed in a particular design, so the footprints are added in case they are necessary. EMC testing should show where problem areas exist, and components can be added to those areas. EMC components can also be removed in areas that do not show problems.

### GROUNDING AND LAYOUT

The component layout and signal routing of the CRD4614-5 provides a good example of how to layout a 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  $\pm$  0.1 inch.
- The PCI CLK signal must drive only one load.

Please refer to the PCI 2.1 Specification[2], Section 4.3.6, for information on routing PCI bus signals on a motherboard.

## Partitioned Voltage and Ground Planes

The CRD4614-5 is partitioned into a digital and analog section to keep digital and analog ground currents from crossing. Ground currents from digital signals are inherently noisy with respect to analog signals and should be isolated from the audio section. The first rule in laying out mixed signal PCBs is to keep all digital signals over the digital ground plane and all analog signals over the analog ground plane. When digital and analog signals cross planes, they introduce noise into the audio section reducing performance.

The pinout of the CS4297 allows the ground split to completely separate digital signals on one side and analog signals on the other. This split is located very close to the CS4297 so analog and digital ground return currents originating from the CS4297 may flow through their respective ground planes. A bridge is made across the split to maintain the proper reference potential for each ground plane.

The area around the crystal oscillator and the two XTAL signals should be filled with copper on the top and bottom sides and attached to digital ground. This ground plane serves to keep noise from coupling onto these pins. All data converters are highly susceptible to noise on the crystal pins.

A separate chassis ground is also used for EMC purposes. All of the components that are for EMC compliance are referenced to this plane. The chassis ground plane is connected to the analog ground plane at the external jacks. Chassis ground is also connected to digital ground near the joystick connector.


## CS4297 Layout Notes

Refer to the CS4297 Data Sheet[4] on how the area under the chip should be partitioned and how the bypass capacitors should be placed. Pay close attention to the suggestions for the bypass capacitors on REFFLT, AFLT1, AFLT2 and the power supply capacitors. The pinout of the CS4297 is designed to keep digital and analog signals from crossing when laying out the board.

### Schematic & Layout Review Service

Confirm Optimum  
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Before Building Your Board.

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Call Applications Engineering.



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**REFERENCES**

- 1) Intel, Audio Codec '97 Component Specification, Revision 1.03, September 15, 1996.  
<http://developer.intel.com/pc-supp/platform/ac97/>
- 2) PCI Special Interest Group, PCI Local Bus Specification, Revision 2.1, June 1, 1995.  
<http://www.pcisig.com/>
- 3) Cirrus Logic, CS4614 SoundFusion PCI Audio Accelerator Data Sheet  
<http://www.cirrus.com/products/overviews/cs4614.html>
- 4) Cirrus Logic, CS4297 SoundFusion Audio Codec '97 Data Sheet  
<http://www.cirrus.com/products/overviews/cs4297.html>
- 5) Steve Harris, Clif Sanchez, Personal Computer Audio Quality Measurements, Ver 0.5  
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- 6) Microsoft, PC Design Guidelines,  
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- 7) M. Montrose. Printed Circuit Board Design Techniques for EMC Compliance, IEEE Press, New York: 1996.

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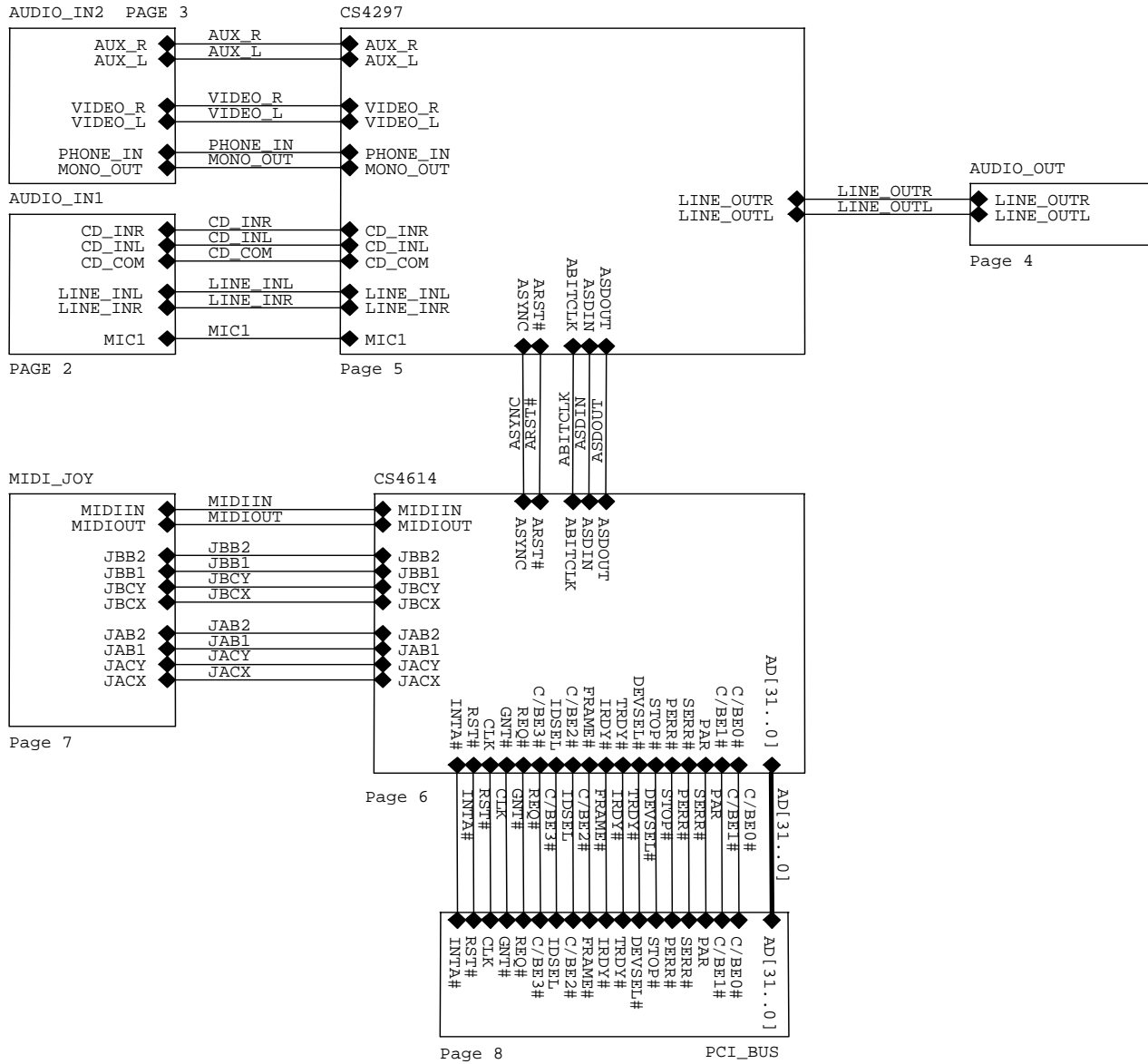
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**Figure 1. Block Diagram of CRD4614-5**

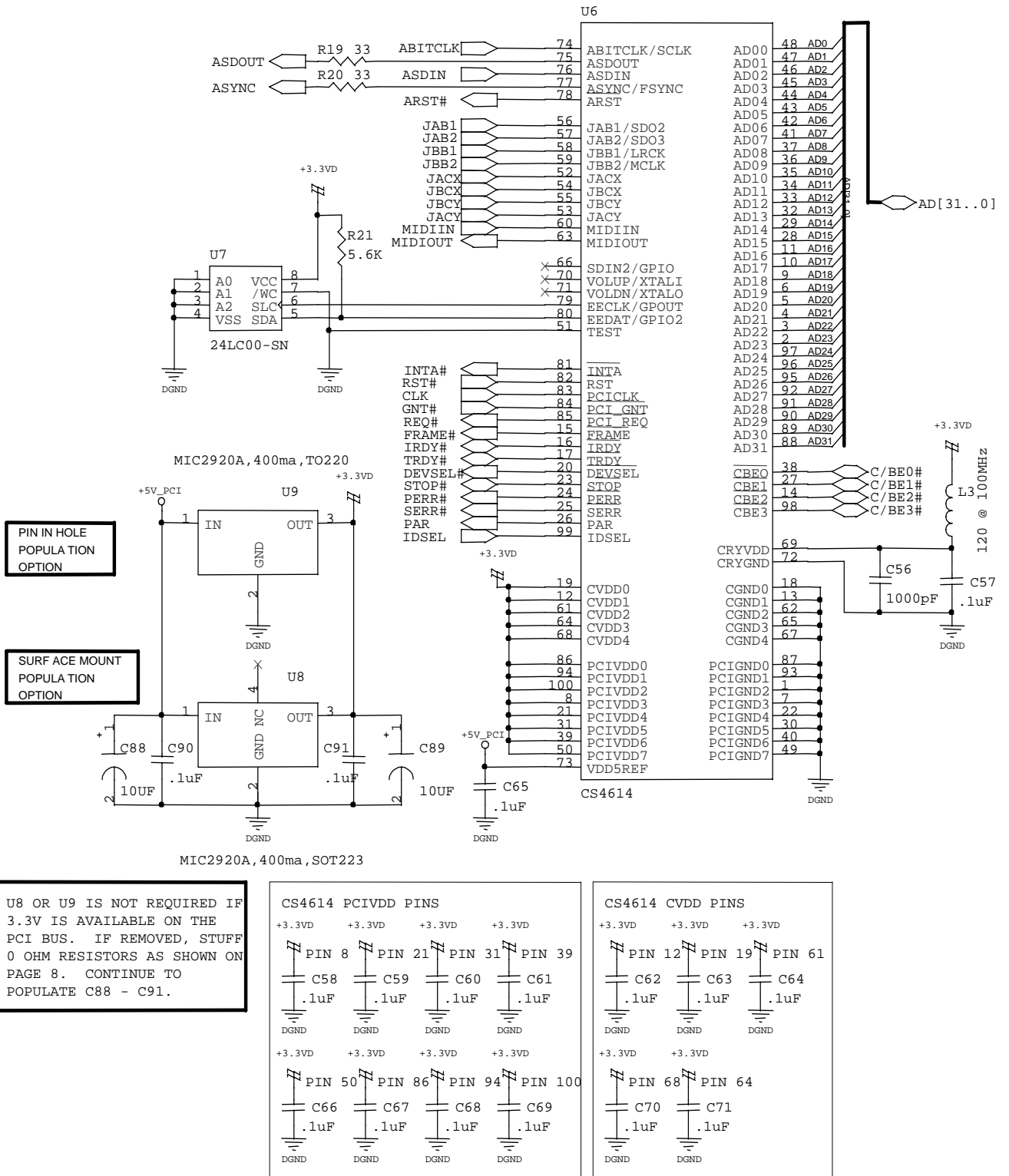
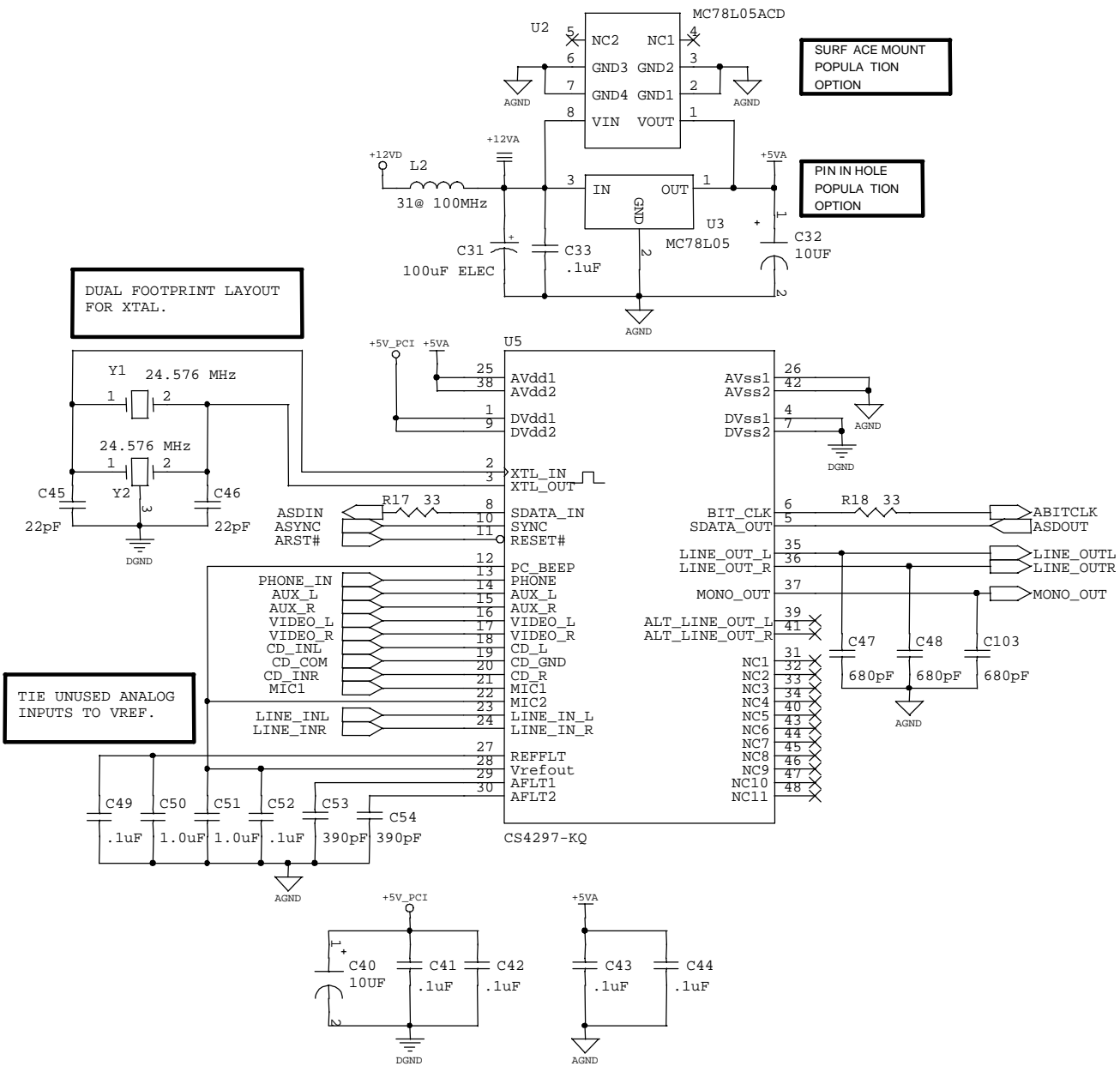
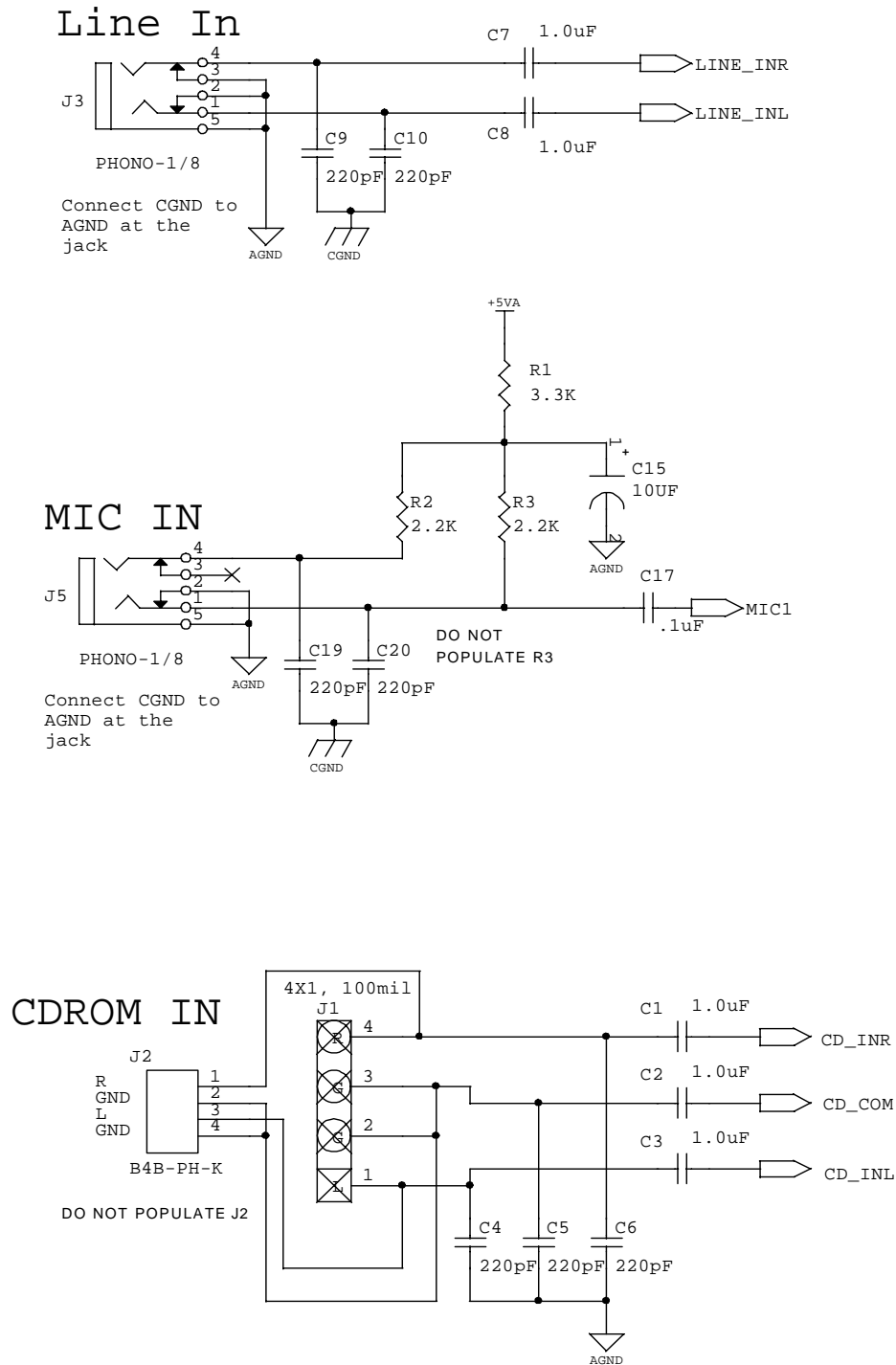


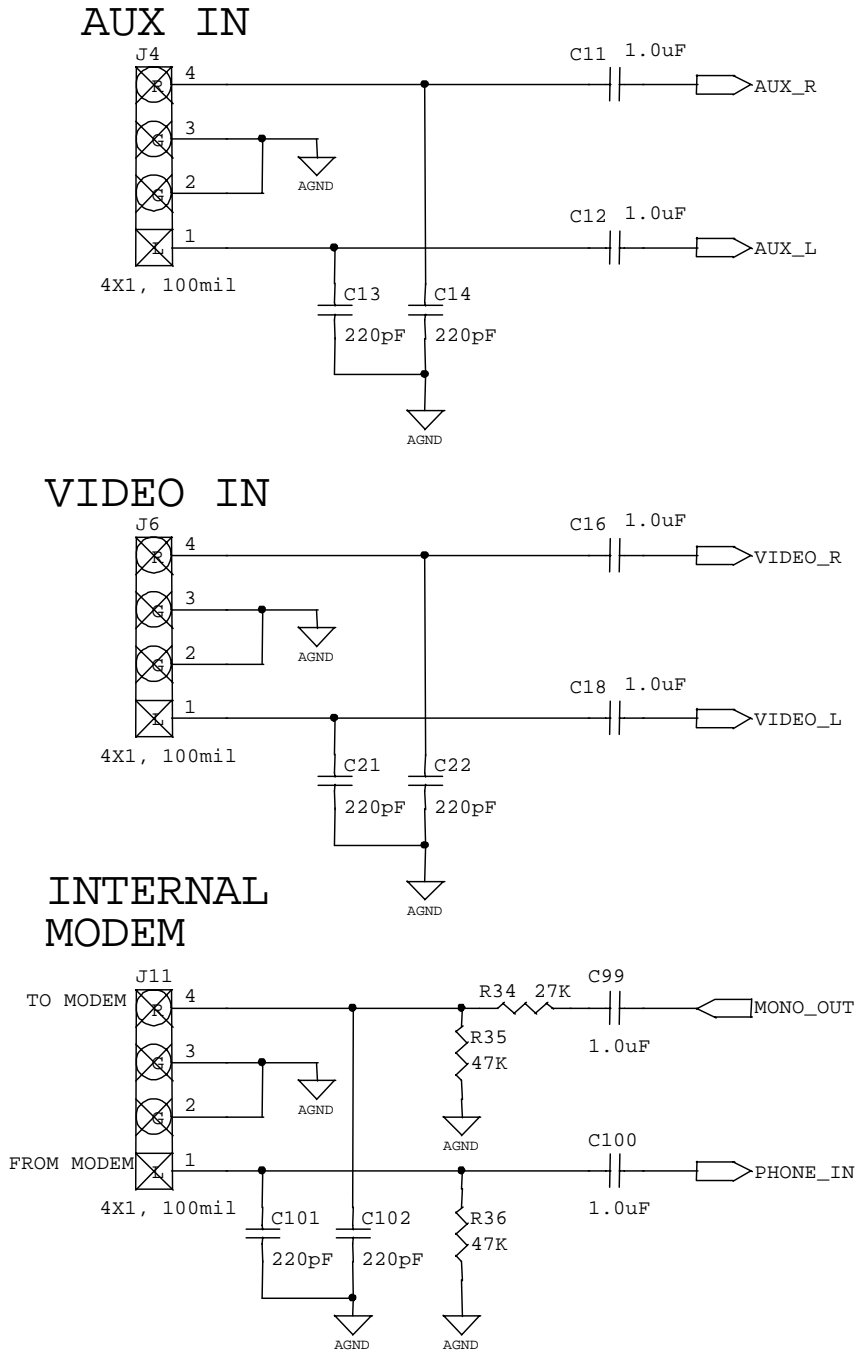
Figure 2. CS4614 PCI Audio Accelerator and Digital Power



**Figure 3. CS4297 AC'97 Audio Codec and Analog Power**



**Figure 4. Line In, Mic In, CD-ROM In**



**Figure 5. Aux In, Video In, Internal Modem**

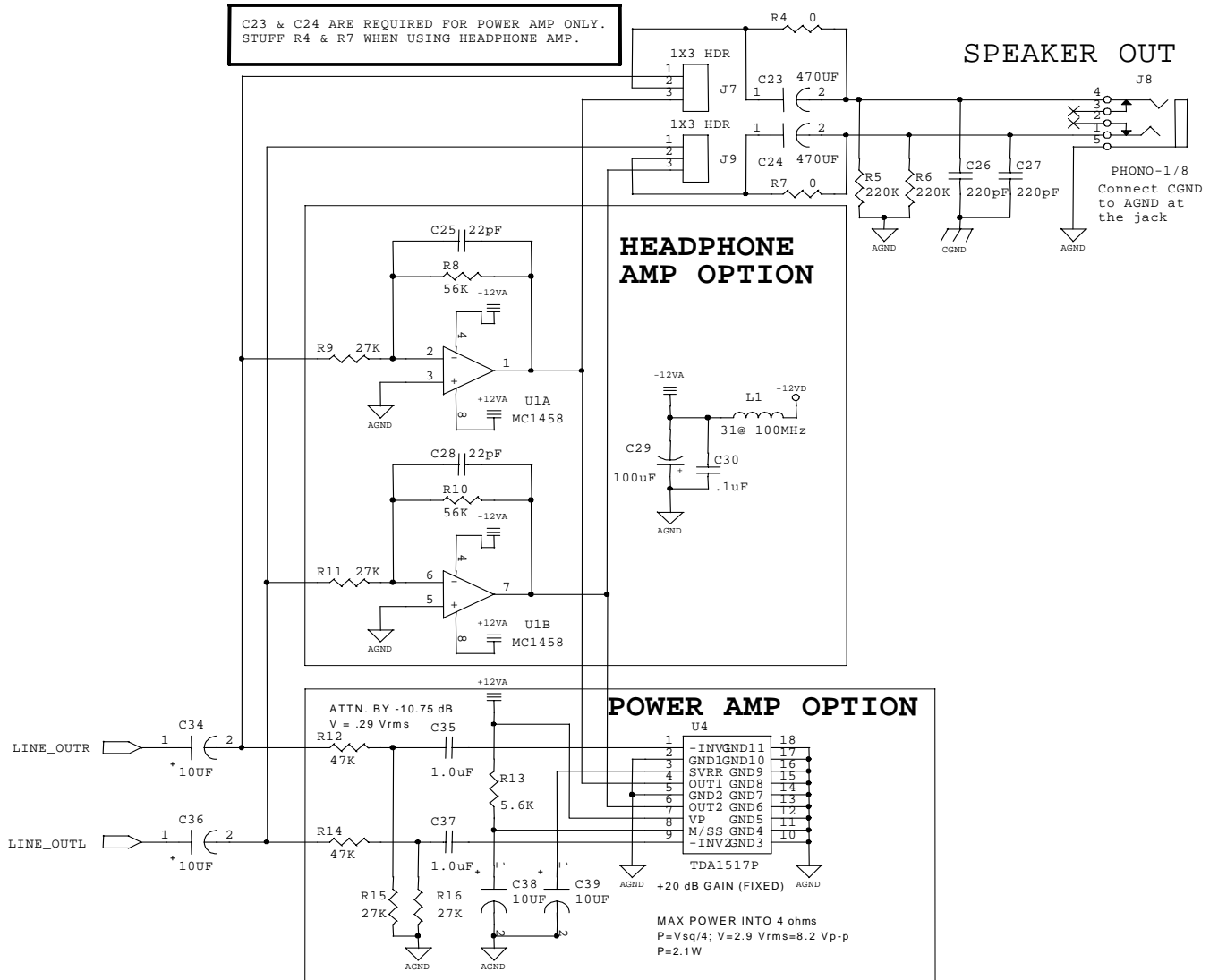
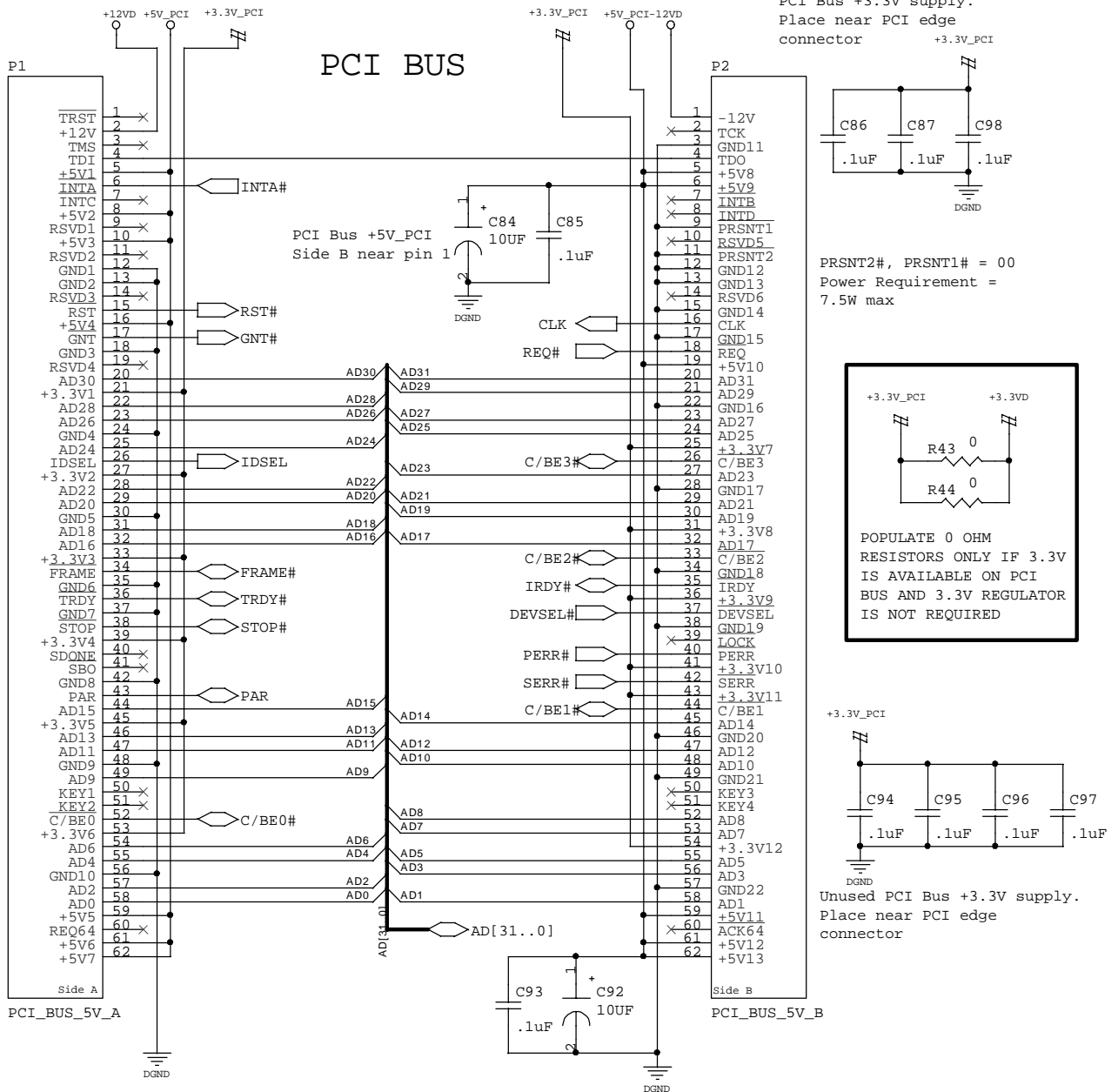


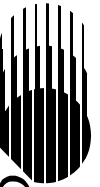
Figure 6. Line Out, Headphone Amp, Power Amp







**Figure 8. PCI Bus**



CIRRUS LOGIC

CrystalClear™ AC '97 Low Cost PCI Audio Adapter

CRD4614-5

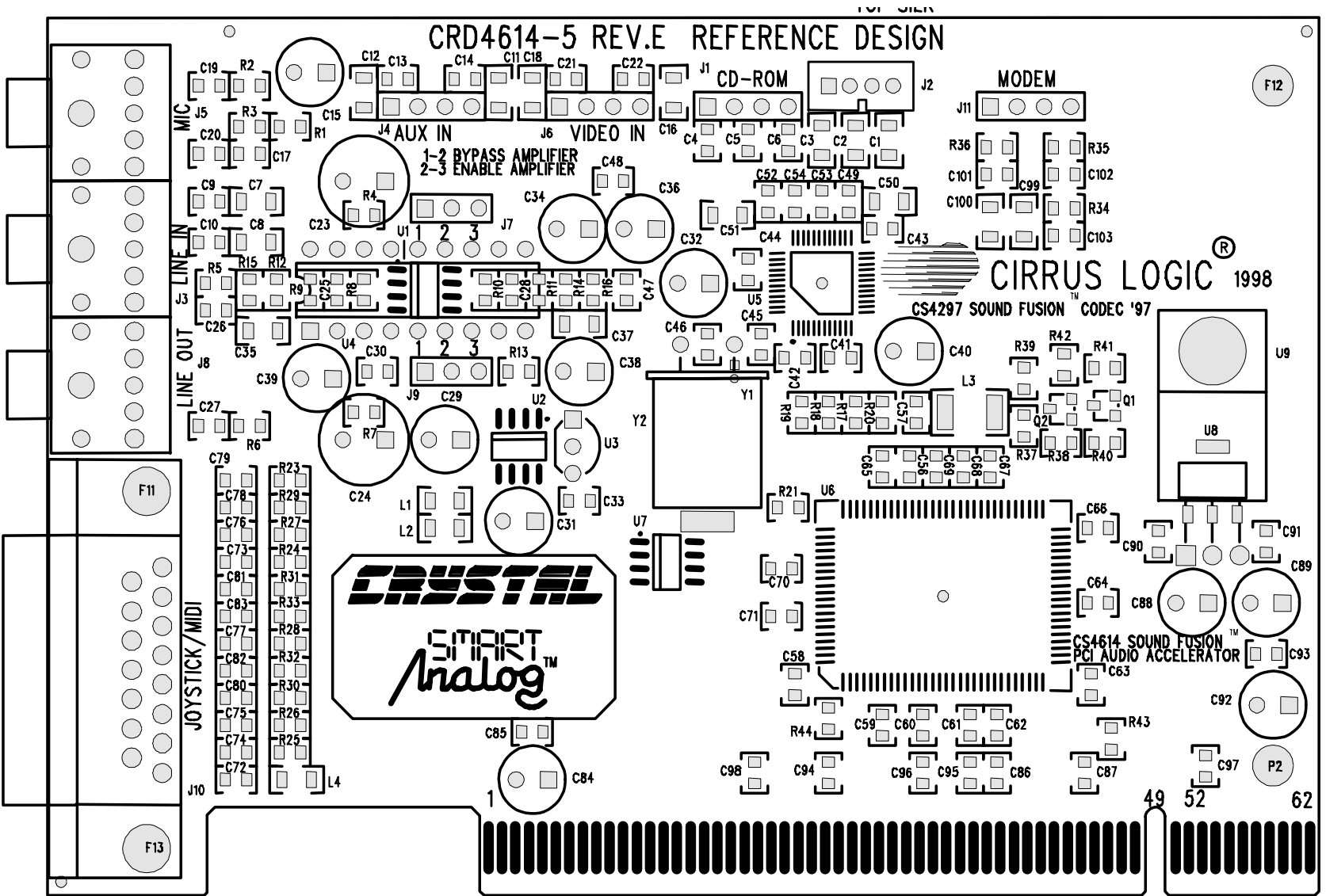


Figure 9. Assembly Drawing

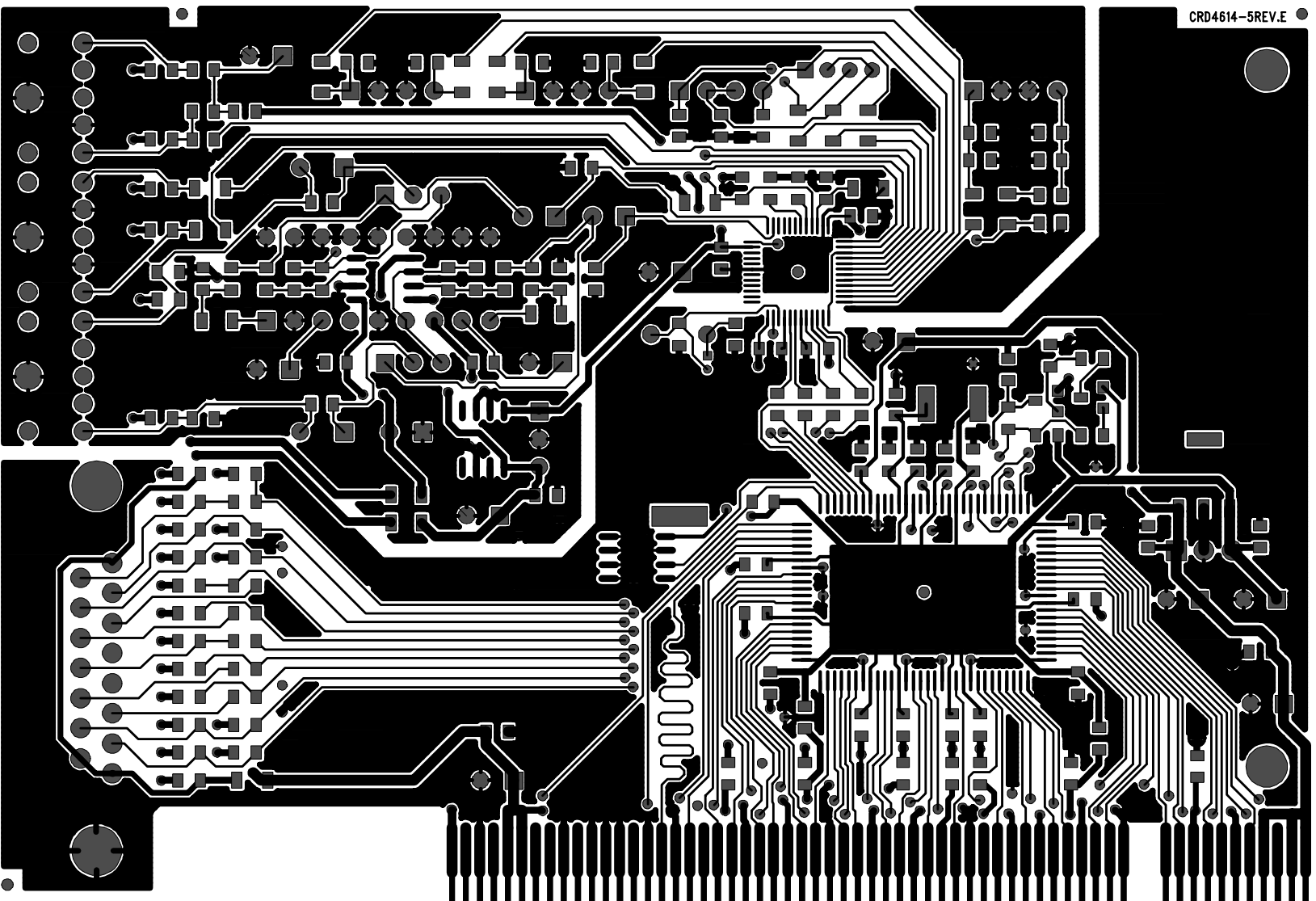
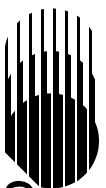


Figure 10. Top Layer

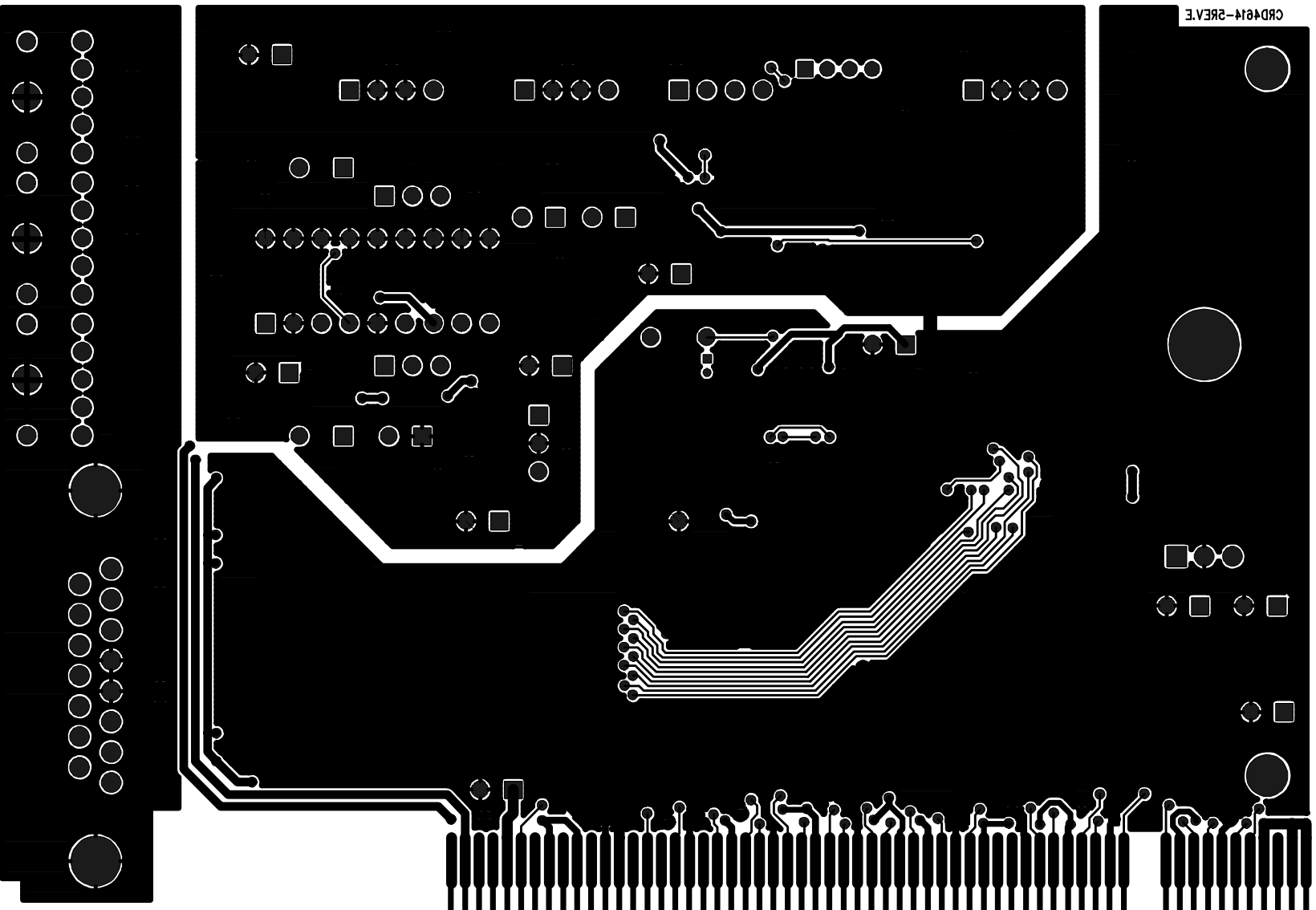
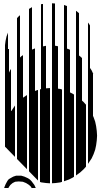


Figure 11. Bottom Layer



14. SURFACE MOUNT PAD SOLDER PLATING MUST BE FLAT TO A MAXIMUM OF .003" ABOVE BOARD SURFACE.
13. PLATE EDGE CONNECTOR, .0003" MINIMUM GOLD THICKNESS OVER .0002" MINIMUM LOW STRESS NICKEL.
12. .060" MAXIMUM RADIUS ON ALL INSIDE CORNERS.
11. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M.
10. FABRICATE IN ACCORDANCE WITH IPC-ML-950C, CLASS 2.
9. BOARD SHALL MEET THE REQUIREMENTS OF UL796 WITH A FLAMMABILITY RATING OF 94V-0. VENDOR'S UL LOGO OR DESIGNATION SHALL BE LOCATED ON SOLDER SIDE OF BOARD.
8. REMOVE ALL BURRS AND BREAK SHARP EDGES .015 MAX.
7. SILKSCREEN COMPONENT SIDE USING WHITE EPOXY INK.
6. WARP OR TWIST OF BOARD SHALL NOT EXCEED .010 INCH PER INCH.
5. APPLY SOLDERMASK OVER BARE COPPER. SOLDERMASK TO BE PER IPC-SM-840, TYPE A, CLASS 3, COLOR: TRANSPARENT BLUE. ALL EXPOSED CONDUCTIVE SURFACES TO BE SOLDER COATED.
4. CONDUCTOR WIDTHS AND SPACING SHALL BE WITHIN +/- 20% OF ARTWORK ORIGINALS.
3. ALL HOLES SHALL BE LOCATED WITHIN .003" DIAMETER OF TRUE POSITION. LAYER TO LAYER REGISTRATION SHALL BE WITHIN .003". ALL HOLES SURROUNDED BY LAND SHALL HAVE A MINIMUM ANNULAR RING OF .003.
2. UNLESS OTHERWISE SPECIFIED ALL HOLE DIMENSIONS APPLY AFTER PLATING. ALL PLATED THROUGH HOLES TO HAVE A MINIMUM OF .001" COPPER.
1. MATERIAL: COPPER CLAD PLASTIC SHEET PER MIL-P-1394/4 GFN FINISHED COPPER WEIGHT SHALL BE 1 OZ. COPPER ON INTERNAL SIGNAL LAYERS, 2 OZ. COPPER ON PLANE LAYERS, OUTER LAYERS TO BE 2 OZ. FINISHED. LAMINATE USING PRE-PREG MATERIAL PER MIL-P-13949/12, TYPE PC-GF. OVERALL BOARD THICKNESS TO BE .062 +/- .007

NOTES: UNLESS OTHERWISE SPECIFIED

SIZE	QTY	SYM	PLTD
16	252	P	PLTD
20	2	Q	PLTD
40	16	R	PLTD
156	1	S	PLTD
35	40	T	PLTD
63	9	U	NPLTD
67	3	V	PLTD
47	15	W	PLTD
120	2	X	PLTD
37	39	Y	PLTD
125	2	Z	PLTD

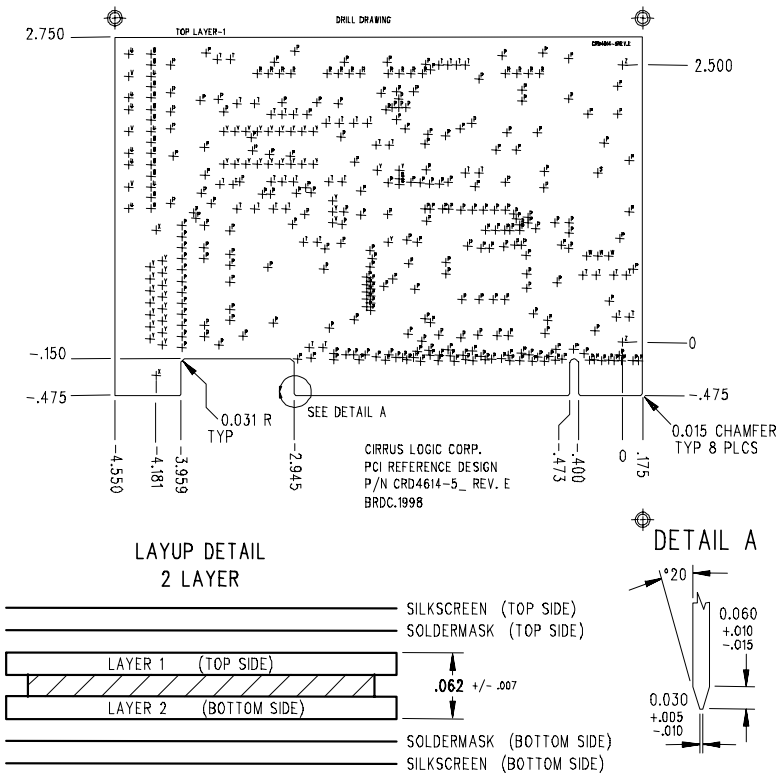
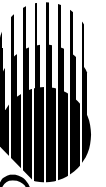


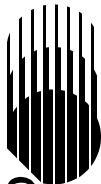
Figure 12. Drill Drawing and Manufacturing Instructions

## BILL OF MATERIALS

CRD4614-5C_H							
Item	Qty	Reference	Part Description	Type	Package	Manf.	Part Number
1	9	C15,C32,C34,C36,C40,C84, C88-89,C92	ALUM ELECT,10uF,20%,16V,POL	CAP	PIH	PANASONIC	ECA-1CM100
2	2	C29,C31	ALUM ELECT,100uF,20%,16V,POL	CAP	PIH	PANASONIC	ECA-1CM101
3	13	C1-3,C7-8,C11-12,C16,C18, C50-51,C99-100	CERM CAP,1.0uF,16V,Y5V	CAP	SMT-1206	MURATA	GRM42- 6Y5V105Z016BL
4	37	C17,C30,C33,C41-44,C49, C52,C57-72,C79,C85-87, C90-91,C93-98	CERM CAP,.1uF,10%,50V,X7R	CAP	SMT-0805	KEMET	C0805C104K5RAC
5	4	C25,C28,C45,C46	CERM CAP,22pF,5%,50V,COG	CAP	SMT-0805	KEMET	C0805C220J5GAC
6	17	C4-6,C9-10,C13-14,C19-22, C26-27,C77-78,C101-102	CERM CAP,220pF,5%,50V,COG	CAP	SMT-0805	KEMET	C0805C221J5GAC
7	2	C53,C54	CERM CAP,390pF,5%,50V,COG	CAP	SMT-0805	KEMET	C0805C391J5GAC
8	2	C47,C48	CERM CAP,680pF,5%,50V,COG	CAP	SMT-0805	KEMET	C0805C681J5GAC
9	5	C56,C73,C74,C75,C76	CERM CAP,1000pF,5%,50V,COG	CAP	SMT-0805	KEMET	C0805C102J5GAC
10	4	C80,C81,C82,C83	CERM CAP,5600pF,10%,50V,X7R	CAP	SMT-0805	KEMET	C0805C562K5RAC
11	3	J3,J5,J8	1/8" PHONO JACK	CONN	PIH-5	A/D ELECT.	AJ-3056A-5P
12	4	J1,J4,J6,J11	HDR 4X1, .1"CTR,VERT. CONN.	CONN	PIH-4	SAMTEC	TSW-104-07-T-S
13	2	J9,J7	HDR 3X1, .1"CTR,VERT. CONN.	CONN	PIH-3	SAMTEC	TSW-103-07-T-S
14	1	J10	15-PIN D CONN,FEMALE	CONN	DB15	AMP	747845-3
15	3	L1,L2,L4	EMI FILTER (31 ohms@100MHz)	IND	SMT-1206	TDK	HF50ACB-321611T
16	1	L3	EMI FILTER (120 ohms@100MHz)	IND	SMT-1812	TDK	HF30ACB-453215T
17	2	R4,R7	0 ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805000J
18	5	R2,R30-33	2.2K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805222J
19	1	R1	3.3K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805332J
20	3	R9,R11,R34	27K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805273J

Table 1. Headphone Amp Population Option Bill of Material



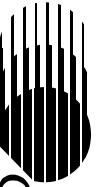


CRD4614-5C_H							
Item	Qty	Reference	Part Description	Type	Package	Manf.	Part Number
21	2	R35,R36	47K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805473J
22	2	R5,R6	220K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805224J
23	6	R17,R18,R19,R20,R28,R29	33 ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805330J
24	6	R21,R23-R27	5.6K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805562J
25	2	R8,R10	56K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805563J
26	2	R38,R40	39K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805393J
27	1	R39	5.1K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805512J
28	1	R41	10K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805103J
29	1	R42	20K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805203J
30	1	Q1	PNP TRANSISTOR	TRANS	SOT-23	MOTOROLA	MMBT2907ALT1
31	1	Q2	NPN TRANSISTOR	TRANS	SOT-23	MOTOROLA	MMBT3904LT1
32	1	U5	AC'97 CODEC - CS4297-KQ	IC	TQFP-48	CRYSTAL	CS4297
33	1	U6	PCI AUDIO ACCELERATOR	IC	MQFP-100	CRYSTAL	CS4614
34	1	U1	DUAL HEADPHONE AMP	IC	SO8	MOTOROLA	MC1458
35	1	U7	CMOS SERIAL EEPROM, 128 Bit	MEM	SO8	MICROCHIP	24LC00-SN
36	1	U3	5V POS. VOLT. REG., 100ma	VREG	PIH-3	MOTOROLA	MC78L05AC
37	1	U9	5V TO 3.3V CONVERTER, 400ma	VREG	TO220	MICREL	MIC2920A-3.3BT
38	1	Y1	XTL-24.576MHZ/U,FUND,PAR RES	XTAL	PIH	EPSON	CA-301_24.576M-C
39	2	PLACE ON PINS 2 & 3 OF J7 AND J9	2 PIN SHUNT FOR J7 & J9				
40	1		BRACKET				
41	1		RAW CARD, 2-LAYER,3.5" X 4.75"				

Table 1. (cont.) Headphone Amp Population Option Bill of Material

CRD4614-5C_P							
Item	Qty	Reference	Part Description	Type	Package	Manf.	Part Number
1	11	C15,C32,C34,C36,C38-40, C84,C88-89,C92	ALUM ELECT,10uF,20%,16V,POL	CAP	PIH	PANASONIC	ECA-1CM100
2	1	C31	ALUM ELECT,100uF,20%,16V,POL	CAP	PIH	PANASONIC	ECA-1CM101
3	2	C23,C24	ALUM ELECT,470uF,20%,10V,POL	CAP	PIH	PANASONIC	ECA-1AM471
4	15	C1-3,C7-8,C11-12,C16,C18, C35,C37,C50-51,C99-100	CERM CAP,1.0uF,16V,Y5V	CAP	SMT-1206	MURATA	GRM42-6Y5V105Z016BL
5	36	C17,C33,C41-44,C49,C52, C57-72,C79,C85-87,C90-91, C93-98	CERM CAP,.1uF,10%,50V,X7R	CAP	SMT-0805	KEMET	C0805C104K5RAC
6	2	C45,C46	CERM CAP,22pF,5%,50V,COG	CAP	SMT-0805	KEMET	C0805C220J5GAC
7	17	C4-6,C9-10,C13-14,C19-22, C26-27,C77-78,C101-102	CERM CAP,220pF,5%,50V,COG	CAP	SMT-0805	KEMET	C0805C221J5GAC
8	2	C53,C54	CERM CAP,390pF,5%,50V,COG	CAP	SMT-0805	KEMET	C0805C391J5GAC
9	2	C47,C48	CERM CAP,680pF,5%,50V,COG	CAP	SMT-0805	KEMET	C0805C681J5GAC
10	5	C56,C73,C74,C75,C76	CERM CAP,1000pF,5%,50V,COG	CAP	SMT-0805	KEMET	C0805C102J5GAC
11	4	C80,C81,C82,C83	CERM CAP,5600pF,10%,50V,X7R	CAP	SMT-0805	KEMET	C0805C562K5RAC
12	3	J3,J5,J8	1/8" PHONO JACK	CONN	PIH-5	AID ELECT.	AJ-3056A-5P
13	4	J1,J4,J6,J11	HDR 4X1, .1"CTR,VERT. CONN.	CONN	PIH-4	SAMTEC	TSW-104-07-T-S
14	2	J9,J7	HDR 3X1, .1"CTR,VERT. CONN.	CONN	PIH-3	SAMTEC	TSW-103-07-T-S
15	1	J10	15-PIN D CONN,FEMALE	CONN	DB15	AMP	747845-3
16	2	L2,L4	EMI FILTER (31 ohms@100MHz)	IND	SMT-1206	TDK	HF50ACB-321611T
17	1	L3	EMI FILTER (120 ohms@100MHz)	IND	SMT-1812	TDK	HF30ACB-453215T
18	5	R2,R30-33	2.2K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805222J
19	1	R1	3.3K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805332J
20	3	R15,R16,R34	27K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805273J

Table 2. Power Amp Population Option Bill of Material

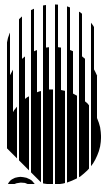


CIRRUS LOGIC

CrystalClear™ AC '97 Low Cost PCI Audio Adapter

CRD4614-5





CRD4614-5C_P							
Item	Qty	Reference	Part Description	Type	Package	Manf.	Part Number
21	4	R12,R14,R35,R36	47K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805473J
22	2	R5,R6	220K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805224J
23	6	R17,R18,R19,R20,R28,R29	33 ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805330J
24	7	R13,R21,R23-R27	5.6K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805562J
25	2	R38,R40	39K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805393J
26	1	R39	5.1K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805512J
27	1	R41	10K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805103J
28	1	R42	20K ohm FILM RES.,5%,1/10W	RES	SMT-0805	DALE	CRCW0805203J
29	1	Q1	PNP TRANSISTOR	TRANS	SOT-23	MOTOROLA	MMBT2907ALT1
30	1	Q2	NPN TRANSISTOR	TRANS	SOT-23	MOTOROLA	MMBT3904LT1
31	1	U5	AC'97 CODEC - CS4297-KQ	IC	TQFP-48	CRYSTAL	CS4297
32	1	U6	PCI AUDIO ACCELERATOR	IC	MQFP-100	CRYSTAL	CS4614
33	1	U4	2 x 6W POWER AMP	IC	DIP-18	PHILIPS	TDA1517P
34	1	U7	CMOS SERIAL EEPROM, 128 Bit	MEM	SO8	MICROCHIP	24LC00-SN
35	1	U3	5V POS. VOLT. REG., 100ma	VREG	PIH-3	MOTOROLA	MC78L05AC
36	1	U9	5V TO 3.3V CONVERTER, 400ma	VREG	TO220	MICREL	MIC2920A-3.3BT
37	1	Y1	XTL-24.576MHZ/U,FUND,PAR RES	XTAL	PIH	EPSON	CA-301_24.576M-C
38	2	PLACE ON PINS 2 & 3 OF J7 AND J9	2 PIN JUMPER FOR J7 & J9				
39	1		BRACKET				
40	1		RAW CARD, 2-LAYER,3.5" X 4.75"				

Table 2. (cont.) Power Amp Population Option Bill of Material

SMART  
Analog™