

CrystalClear™ AC '97 AMR Reference Design

Features

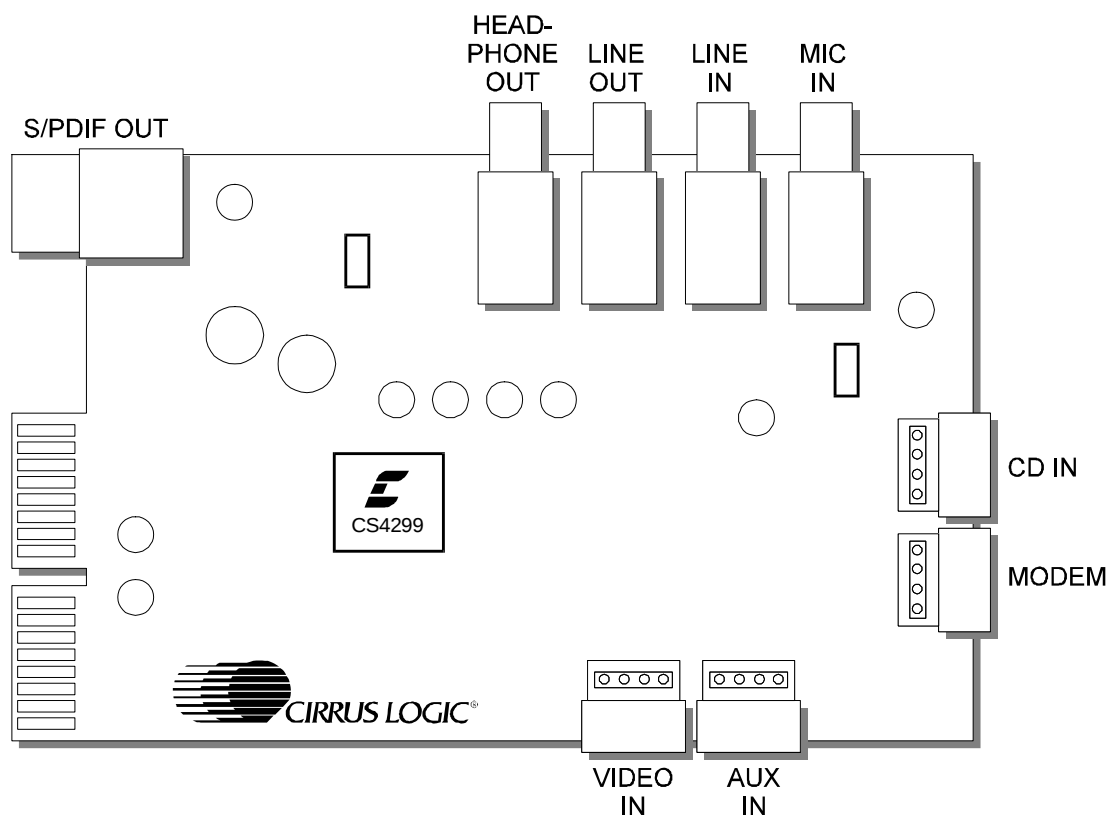
- AMR Audio Codec add-in card designed to meet the Intel[®] Audio/Modem Riser Specification
- High quality, low cost, 2-layer, single sided adapter board
- CS4299 SoundFusion[®] Audio Codec '97
- Complete suite of Analog and Digital I/O connections:
 - Line In, Line Out, Mic In, Modem Audio connection, CD Audio In, Video In, Aux In, Headphone Out and Optical Digital Out
- Meets or exceeds Microsoft's PC 97, PC 98, and PC 99, both required and advanced, audio performance requirements.

Description

The CRD4299-1 AMR add-in board reference design showcases Cirrus Logic's Crystal Audio AC '97 CS4299 SoundFusion, and is Audio/Modem Riser Specification[2], compliant. The CRD4299-1 AMR card is 2.7" high by 3.6" long.

The CRD4299-1 AMR reference design includes a customer ready manufacturing kit. Included in the kit are a full set of schematic design files (OrCAD[®] 7.2 format), PCB job files (PADS[®] ASCII), PCB artwork files (Gerber), bracket drawings, and bill of materials. The design is production ready as is, or can be easily modified to incorporate specific OEM changes. Documentation source files are available to assist the OEM to quickly provide an accurate end user manual.

ORDERING INFO CRD4299-1 AMR



Preliminary Product Information

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

TABLE OF CONTENTS

1. GENERAL INFORMATION	4
2. REFERENCE DESIGN FEATURES	4
2.1 Digital Audio Out	4
2.2 CS4299 Audio Codec '97	4
2.2.1 Power Requirements	5
2.3 Analog I/O	5
2.4 Audio I/O	5
2.4.1 Line Out	5
2.4.2 Headphone Out	5
2.4.3 Line In	5
2.4.4 Mic In	5
2.4.5 CD Audio In	6
2.4.6 Aux In	6
2.4.7 Video In	6
2.4.8 Modem Audio Connection	6
3. SCHEMATIC DESCRIPTION	7
3.1 Figure 11: Block Diagram	7
3.2 Figure 12: AMR Bus Interface	7
3.3 Figure 13: Power Supply	7
3.4 Figure 14: CS4299 AC '97 Audio Codec	7
3.5 Figure 15: Analog Inputs	7
3.6 Figure 16: Audio Outputs	8
3.7 Figure 17: Microphone Pre-amp and Bias	8
3.8 Component Selection	8
3.9 EMC Components	8
4. GROUNDING AND LAYOUT	9
4.1 Partitioned Voltage and Ground Planes	9
4.2 CS4299 Layout Notes	9
5. AUDIO PERFORMANCE EVALUATION	10
5.1 Plots	10
6. REFERENCES	17
7. ADDENDUM	17
8. BILL OF MATERIALS	25

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LIST OF FIGURES

Figure 1. Full Duplex (A-D-PC-D-A): Line In/Out Frequency Response	10
Figure 2. Full Duplex (A-D-PC-D-A): Line In/Out Dynamic Range	10
Figure 3. Full Duplex (A-D-PC-D-A): Line In/Out THD+N vs. Frequency	11
Figure 4. Analog Mixer (A-A): Line In/Out Frequency Response	11
Figure 5. Analog Mixer (A-A): Line In/Out Dynamic Range	12
Figure 6. Analog Mixer (A-A): Line In/Out THD+N vs. Frequency	12
Figure 7. Analog Mixer (A-A): Mic In/Line Out Frequency Response	13
Figure 8. Analog Mixer (A-A): Mic In/Line Out Dynamic Range	13
Figure 9. Analog Mixer (A-A): Mic In/Line Out THD+N vs. Frequency	14
Figure 10. Analog Mixer (A-A): Line In/Out Crosstalk vs. Frequency	14
Figure 11. Block Diagram	16
Figure 12. AMR Bus	17
Figure 13. Power Supplies	18
Figure 14. CS4299	19
Figure 15. Audio In	20
Figure 16. Audio Out	21
Figure 17. Mic Pre-Amp	22
Figure 18. Assembly Drawing	23
Figure 19. Top Layer	24
Figure 20. Bottom Layer	25
Figure 21. Bracket Drawing	26

LIST OF TABLES

Table 1. Reference Designators	9
Table 2. Microphone Support Specifications.....	9
Table 3. Full Duplex Specifications	9
Table 4. Analog Mixer, Line In to Line Out Specifications.....	9
Table 5. Analog Mixer, Mic In to Line Out Specifications.....	9

1. GENERAL INFORMATION

The CRD4299-1 AMR is a production-grade AMR audio card reference design using the CS4299 SoundFusion Audio Codec '97. The design supports the functionally compatible CS4299, CS4297A, or CS4297 AC '97 SoundFusion Audio Codecs.

The AMR board advantage lies in the complete separation of the analog section 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 dynamic range of ~90 dB FS A while making the layout and placement of the audio section easier to implement. The CS4299 performs the Digital-to-Analog Conversion (DAC) for the digital audio output stream and also provides multiple analog audio inputs and outputs, analog mixing and Analog-to-Digital Conversion (ADC).

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 that can degrade audio performance. Cirrus' analog design know-how has resulted in a board that preserves the exceptional analog performance of the CS4299.

2. REFERENCE DESIGN FEATURES

The CRD4299-1 AMR reference design illustrates a high quality, low cost two-layer add-in card layout. The card is sectioned into three main parts: the *AMR bus* section, the *CS4299 Audio Codec '97* section, and the *Analog I/O* section.

2.1 Digital Audio Out

The AMR bus provides digital out in a format compatible with the consumer portion of IEC 958. An older version of this standard is also known as SPDIF. Depending upon the codec, the SPDIF signal originates either from the AMR bus or the co-

dec. Digital out is provided through a Toshiba TOTX173 optical TOS-LINK jack on the board edge. There are many advantages in using a fiber optic link versus the traditional coaxial link. Fiber optic is a non-metallic insulator thereby preventing ground loops and electromagnetic interference. For signal transmission, it offers low attenuation, high bandwidth, low propagation delay, low bit error rates, small size, and cost efficiency. The signal is IEC 958 and CP-1201 compliant.

2.2 CS4299 Audio Codec '97

The CS4299 is a mixed-signal serial Codec based on the AC '97 specification revision 2.1 [1]. It is designed to be paired with a digital controller, located on the PCI bus. The AC '97 Controller is responsible for all communications between the CS4299 and the rest of the system. The CS4299 functions as an analog mixer, a stereo ADC, a stereo DAC, and a control and digital audio stream interface to the AC '97 controller.

The CS4299 contains two distinct functional sections: digital and analog. The digital section includes the AC-link registers, power management support, SYNC detection circuitry, AC-link serial port interface logic, and the 24.576 MHz crystal master clock. The analog section includes the analog input multiplexer (mux), stereo input mixer, stereo output mixer, mono output mixer, stereo ADC, stereo DAC, and analog volume controls. For more information refer to the CS4299 Datasheet [3]. The capacitors required for the CS4299 and their placement are discussed in the CS4299 Datasheet [3]. Refer to the *Grounding and Layout* section of the data sheet for the recommended routing of the audio section.

2.2.1 Power Requirements

The CS4299 requires both a digital +3.3 V and an analog +5 V supply. The digital power is supplied from the AMR bus. A voltage regulator is recommended for the analog supply. A Motorola

MC78L05 regulates the AMR +12 V supply down to provide a clean +5 V analog supply for the CS4299. The MC78L05 regulator can provide adequate current, which is enough for the CS4299 and associated analog circuitry.

2.3 Analog I/O

The CS4299 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 AC coupled via a 0.1 μ F capacitor to the analog ground plane. The analog section contains the components for a headphone amplifier. The Modem Audio, CD In, Audio In, and Aux In headers are also part of the Analog I/O section. The header and its associated components may or may not be necessary depending on the audio inputs implemented.

2.4 Audio I/O

A full feature set of the CS4299's analog I/O and digital out is represented on the reference design card through internal and external connectors:

- Line Out
- Headphone Out
- Line In
- Mic In
- CD Audio In
- Aux In
- Video In
- Modem Audio connection
- Optical Digital Out

Four external 1/8" jacks, one external TOS-LINK jack, and four internal header connections are used for analog and digital inputs and outputs.

2.4.1 Line Out

The output of the CS4299 is capable of driving impedances greater than 10 k Ω with a maximum out-

put voltage of 1 Vrms. The Line Out connection is made via an external 1/8" jack.

- Maximum output level: 1 Vrms

2.4.2 Headphone Out

An external 1/8" jack is provided for a headphone connection. This output is driven by an amplifier for low impedance loads such as 32 Ω headphones.

- Maximum output level: 2.0 Vrms (no load); 1.5 Vrms (32 Ω load)
- Maximum output power: 70 mW/channel (32 Ω load)

2.4.3 Line In

The Line In 1/8" jack provides an input to the Line In pins of the CS4299.

- Maximum input level: 2 Vrms

2.4.4 Mic In

The Microphone In 1/8" jack provides an input to a microphone pre-amplifier circuit that applies 18 dB of gain to the signal.

- Maximum input level:
 - Microphone Boost enabled: 12.5 mVrms
 - Microphone Boost disabled: 125 mVrms
- Supports 3-pin electret (power on ring) and 2-pin dynamic microphones

2.4.5 CD Audio In

The CD Audio input provides a 4-pin (0.1 inch center) right-angled connector that is compatible with the SONY standards and ATAPI.

- Maximum input level: 2 Vrms
- Pseudo differential input using the CD Common pin as the ground
- 0.1 inch connector wired as:
 - Pin 1 : Left Channel
 - Pin 2 : Common return

- Pin 3 : Common return
- Pin 4 : Right Channel

2.4.6 Aux In

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

2.4.7 Video In

- Internal 4-pin (0.1 inch center) right-angled connector
 - Pin 1 : Left Channel
 - Pin 2 : Analog Ground
 - Pin 3 : Analog Ground
 - Pin 4 : Right Channel
- Maximum input level: 2 Vrms

2.4.8 Modem Audio Connection

The modem audio connection can be made through the internal 4-pin (0.1 inch center) right-angled connector. This connector carries both a mono input and a mono output.

- Internal 4 pin header (0.1 inch center)
 - Pin 1 : Mono Out (to modem)
 - Pin 2 : Analog Ground
 - Pin 3 : Analog Ground
 - Pin 4 : Phone In (from modem)
- Maximum input level: 1 Vrms
- Maximum output level: 1 Vrms
- Minimum load impedance: 10 k Ω

3. SCHEMATIC DESCRIPTION

Figures 11 through 17 show the schematics for the CRD4299-1 AMR card. This section will describe particular pages of the schematic that need to be discussed.

3.1 Figure 11: Block Diagram

The block diagram is an interconnection overview between schematic pages.

3.2 Figure 12: AMR Bus Interface

The +5 V power pin is decoupled through C1 and supplies power for the SPDIF_OUT circuit. All ground pins are tied to digital ground except for B2, which is tied to analog ground.

The AC-link, which consists of ASDOUT, ARST#, ASYNC, ASDIN, and ABITCLK, transfers digital audio data between the audio codec and the host. PC_BEEP_BUS routes the beep/speaker signal from the motherboard to the audio subsystem, for use in hearing POST codes (refer to the *Intel Audio/Modem Riser Specification* [2]).

The PRIMARY_DN# signal indicates the presence or the absence of a primary codec on the motherboard. The MSTRCLK is the 24.576 MHz master clock for the AC '97 link. Populate R51 when the Codec is the primary codec. Populate R50 when the Codec is the secondary codec.

The CS4297 does not support S/PDIF. In this case, R3 should be populated so the S/PDIF signal originates from the AMR bus. For a CS4297A/99, by populating R2 instead of R3, the S/PDIF signal originates from the codec, bypassing the AMR bus.

3.3 Figure 13: Power Supply

The CS4299 requires both a digital +3.3 V and an analog +5 V supply. The digital power is supplied from the AMR bus. A separate regulator is recommended for the analog voltage supply to provide good audio signal quality. A Motorola MC78L05 regulates the +12 V supply from the AMR bus

down to a clean +5 V analog supply. Two packaging options are supported, where U5 is an SO8 surface mount package and U4 is a TO-92 pin-in-hole package. The -12 V power pin is decoupled through C73/C74, and supplies power to the headphone circuit.

3.4 Figure 14: CS4299 AC '97 Audio Codec

For the best audio performance, the analog voltage regulator, an MC78L05, is located near the CS4299. A 10 μ F electrolytic capacitor should be added next to pins 25 and 26 if the capacitor connected to the output of the power regulator is located far away from the CS4299. All filtering capacitors of audio signals are NPO-type to ensure minimal added distortion. Two footprints are provided for the crystal: a CA-301 pin-in-hole footprint, Y1, for miniature crystal; and a short height HC-49S package, Y2. R47 is a termination resistor in the serial AC-link between the CS4299 and the AMR bus.

3.5 Figure 15: Analog Inputs

The inputs for AUX, VIDEO, CD, and LINE are passed through voltage dividers that reduce the levels by 6 dB to allow connection of line level sources up to 2 Vrms. The 220 pF capacitors are provided on Line_In, Mic_In, CD_In, Aux_In, Video_In, and Internal Modem connection for EMC suppression. These may be removed if EMC testing determines they are not required. 1 μ F AC-coupling capacitors are used on the Line_In, Mic_In, CD_In, Aux_In, Video_In, and Internal Modem circuit to minimize the low frequency roll-off. The internal CD audio connection utilizes a pseudo-differential interface with CD_GND as the

common return path for both the left and right channels. Therefore, the input impedance of this block is half of that of the other inputs.

The modem connection is both a mono input and output. The output is fed from the CS4299's MONO_OUT pin through a divider made of R22/23. The divider ratio is preset to 0 dB for an output voltage of 1 Vrms. If a lower output voltage is desired, the resistors can be replaced with appropriate values, as long as the total load on the output is kept greater than 10 k Ω . The input is not divided to accommodate line level sources up to 1 Vrms.

3.6 Figure 16: Audio Outputs

The line out is driven directly by the CS4299. The headphone out amplifier, a Motorola MC1458, is capable of driving stereo headphones with impedances greater than 32 Ω or powered speakers. R37/38 are added for short-circuit protection. An optical S/PDIF (IEC 958 consumer) output is also supported.

3.7 Figure 17: Microphone Pre-amp and Bias

A Motorola MC33078D low noise dual op-amp provides an +18 dB gain stage for the microphone and buffers the phantom power supply for the mic. The phantom power is derived from the +5 V analog supply and buffered by U1A to provide a maximum of 4.2 V with no load and a minimum of 2.0 V under a 0.8 mA load on the ring. Hardware rolloffs were implemented at 60 kHz and 15 kHz as recommended by the *PC 99 System Design Guide*, Chapter 17, Audio Components [5].

3.8 Component Selection

Great attention was given to the particular components on the CRD4299-1 AMR 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
- Use single package components, no resistor packs
- Right-angled headers for all internal connections to provide sufficient headroom for the jacks
- Dual footprint for XTAL. HC-49S, and small circular CA-301 pin-in-hole package
- Dual footprint for +5 V regulator. Surface mount and pin-in-hole package are supported.

3.9 EMC Components

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

4. GROUNDING AND LAYOUT

4.1 Partitioned Voltage and Ground Planes

The pinout of the CS4299 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 CS4299 so analog and digital ground return currents originating from the CS4299 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 is 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 provides a reference plane for all of the EMC components. The chassis ground plane is connected to the analog ground plane at the external jacks.

4.2 CS4299 Layout Notes

Please refer to the CS4299 Datasheet [3] 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 CS4299 is designed to keep digital and analog signals from crossing when laying out the board.

5. AUDIO PERFORMANCE EVALUATION

In the below reference designators, the letters in parenthesis designate the full-scale value for that particular I/O. These reference designators are used in the following tables to help clarify which full-scale value applies to the particular measurement. Values referenced to digital numbers on the PC are listed with the (d) suffix.

5.1 Plots

In the following plots, stereo measurements have two sets of data per plot and two vertical axes. Above each vertical axis is a label indicating a channel that relates to that axis. The data set extends beyond the vertical axis to indicate its association with that axis. Using Figure 1 as an example, the top set of data extends beyond the right vertical axis, which is labeled at the top “RIGHT”, indicating that the top set of data is the right channel and associated with the right vertical axis. Likewise, the bottom set of data extends beyond the left vertical axis which is labeled at the top “LEFT”, indicating that the bottom set of data is the left channel and associated with the left vertical axis.

Signal Name	Connector	Maximum Voltage	Reference Designator	Imp. (k Ω)
Line In (A-D-PC-D-A)	Jack	2.376 V _{RMS}	0 dB FS (li)	
Line In (A-A)	Jack	2.142 V _{RMS}	0 dB FS (li)	
Mic In	Jack	0.128 V _{RMS}	0 dB FS (mi)	
Line Out	Jack	1.021 V _{RMS}	0 dB FS (lo)	N/A

Table 1. Reference Designators

Microphones Supported	Support	Comments
3-Pin Phantom Power (power on ring)	Yes	
2-Pin Dynamic	Yes	
2-Pin Phantom Power (power on tip)		

Table 2. Microphone Support Specifications

Full Duplex (A-D-PC-D-A): Line In to Line Out	Reference	Left	Right	Units	Figures
Dynamic Range		-91.4	-91.4	dB FS A (lo)	99 - 1NXL
THD+N	-3 dB FS (li)	-85.2	-85.2	dB FS (lo)	99 - 1DXL
Frequency Response	Ac = -0.4 dB	20-20k	20-20k	Hz	99 - 1MXL

NOTE: TM004: combined test used in lieu of TM002 and TM003

Table 3. Full Duplex Specifications

Analog Mixer (A-A): Line In to Line Out	Reference	Left	Right	Units	Figures
Dynamic Range		-95.8	-95.7	dB FS A (lo)	99 - 1NAL
THD+N	-3 dB FS (li)	-92.9	-92.9	dB FS (lo)	99 - 1DAL
Frequency Response	Ac = +/-0.2 dB	20-20k	20-20k	Hz	99 - 1MAL
Crosstalk	f = 10 kHz	-66.8	-66.5	dB FS (lo)	99 - 1CAL

Table 4. Analog Mixer, Line In to Line Out Specifications

Analog Mixer (A-A): Mic In to Line Out	Reference	Left	Right	Units	Figures
Dynamic Range	Gain = 0 dB	-94.1	N/A	dB FS A (lo)	99 - 1NAM
THD+N	-3 dB FS (mi)	-91.3	N/A	dB FS (lo)	99 - 1DAM
Frequency Response	Ac = -3 dB	50-15k	N/A	Hz	99 - 1MAM

NOTE: Mic In is Mono

Table 5. Analog Mixer, Mic In to Line Out Specifications

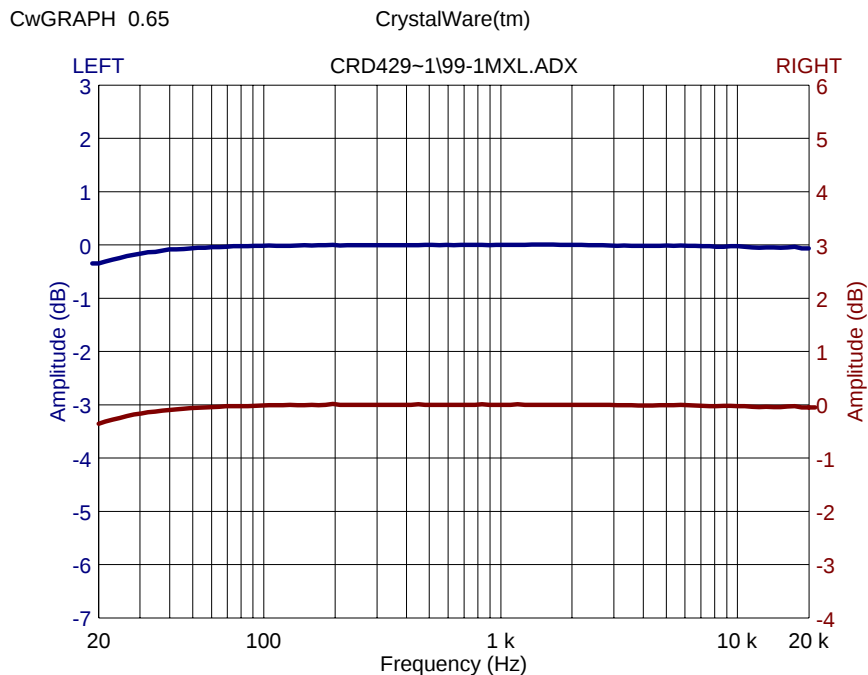


Figure 1. Full Duplex (A-D-PC-D-A): Line In/Out Frequency Response

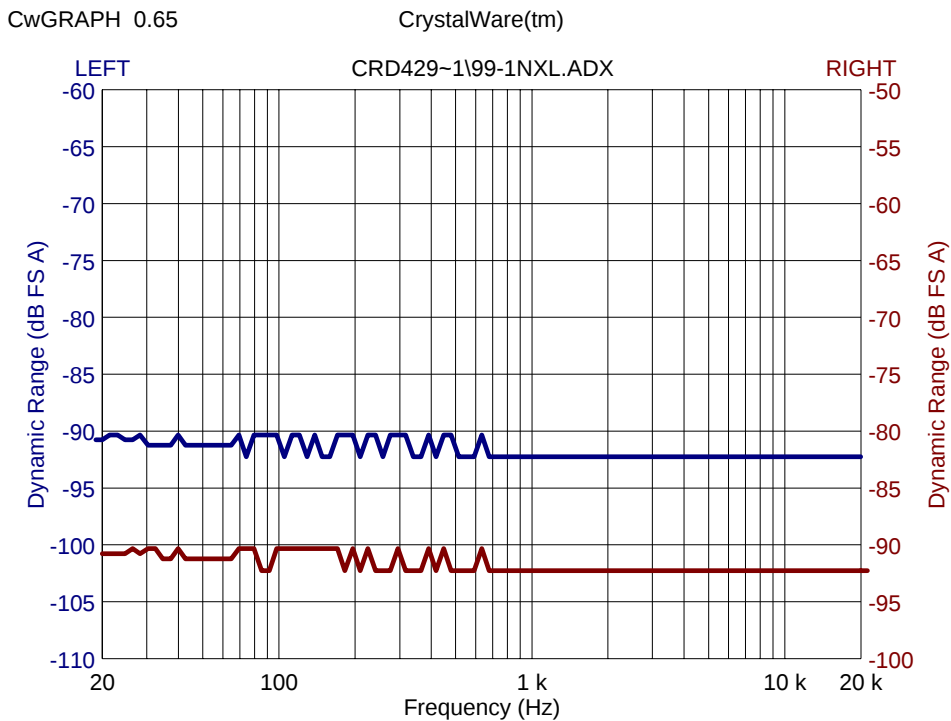


Figure 2. Full Duplex (A-D-PC-D-A): Line In/Out Dynamic Range

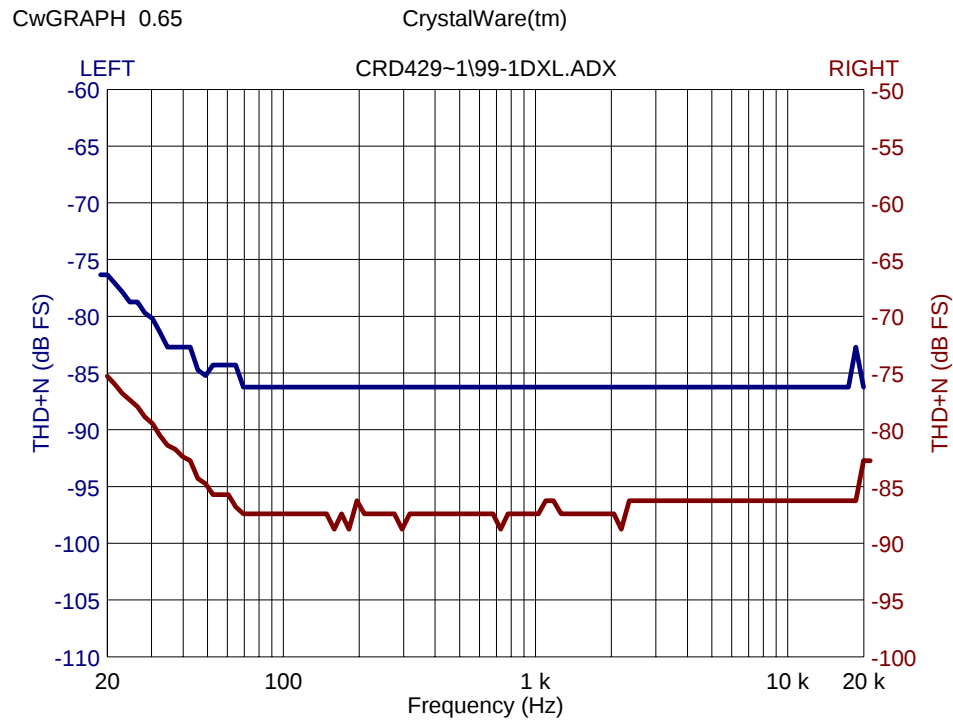


Figure 3. Full Duplex (A-D-PC-D-A): Line In/Out THD+N vs. Frequency

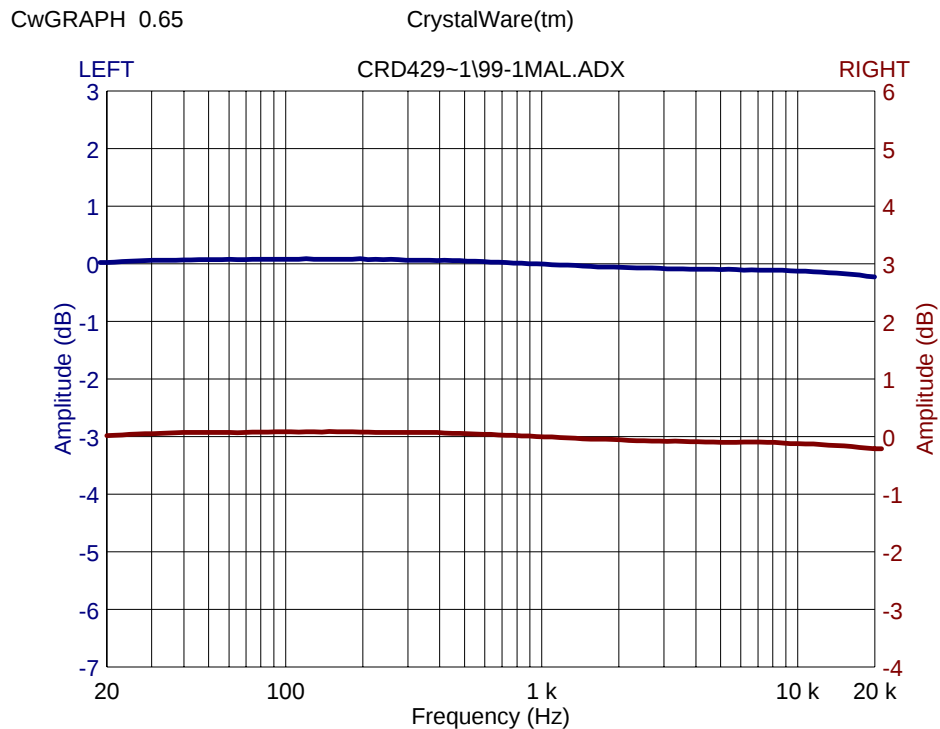


Figure 4. Analog Mixer (A-A): Line In/Out Frequency Response

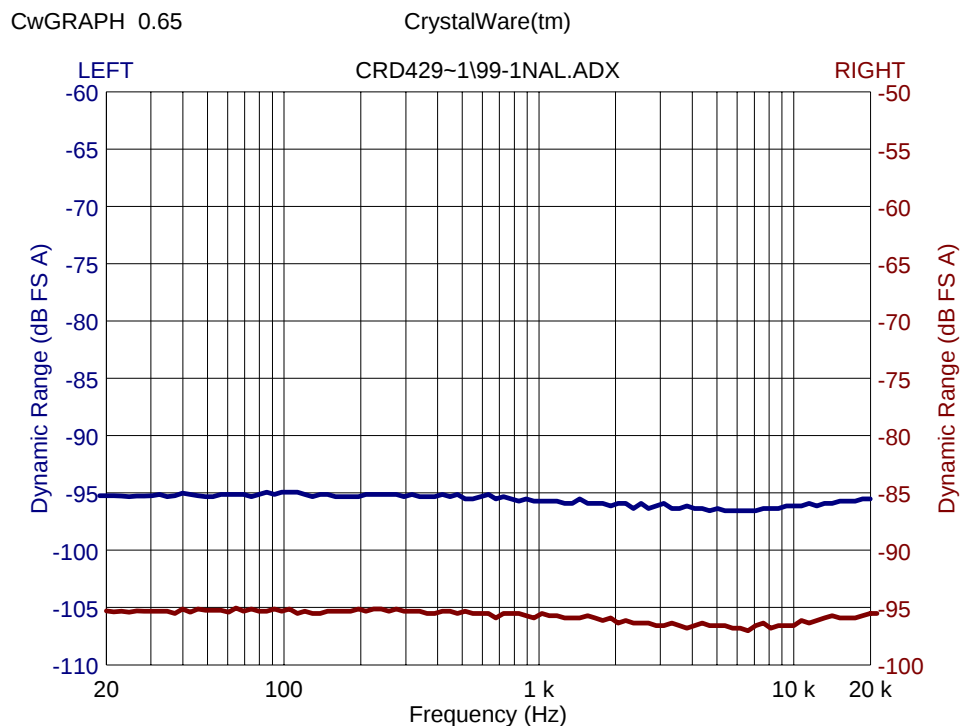


Figure 5. Analog Mixer (A-A): Line In/Out Dynamic Range

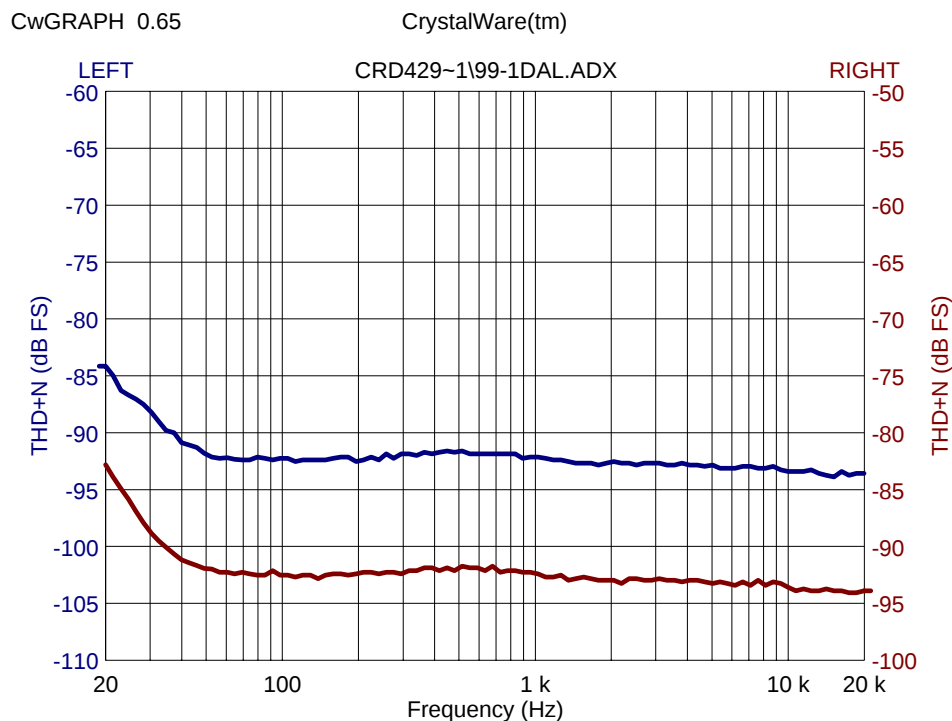


Figure 6. Analog Mixer (A-A): Line In/Out THD+N vs. Frequency

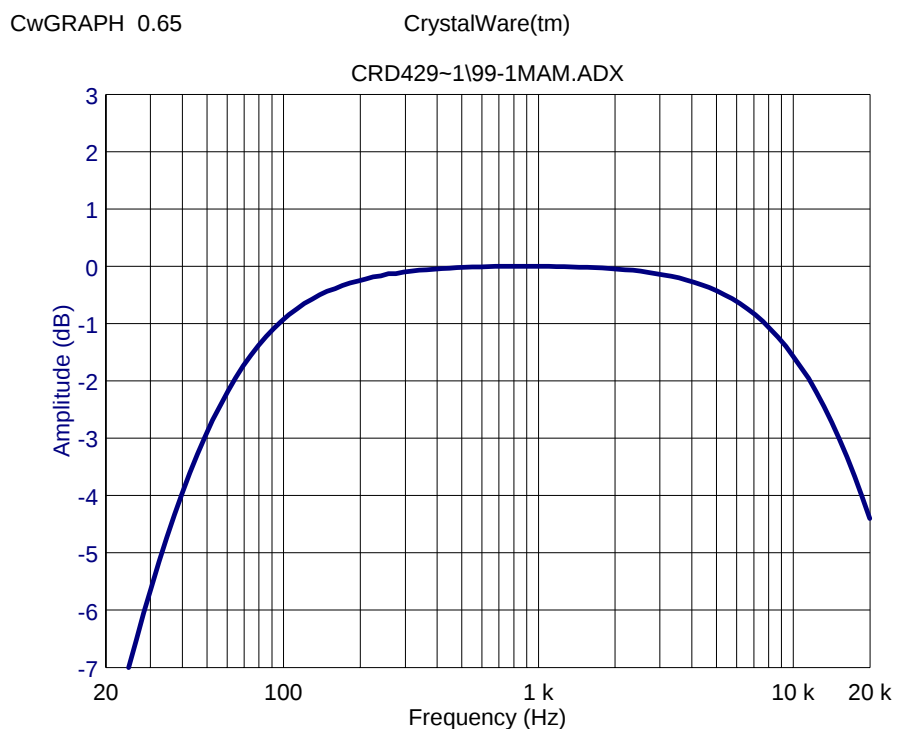


Figure 7. Analog Mixer (A-A): Mic In/Line Out Frequency Response

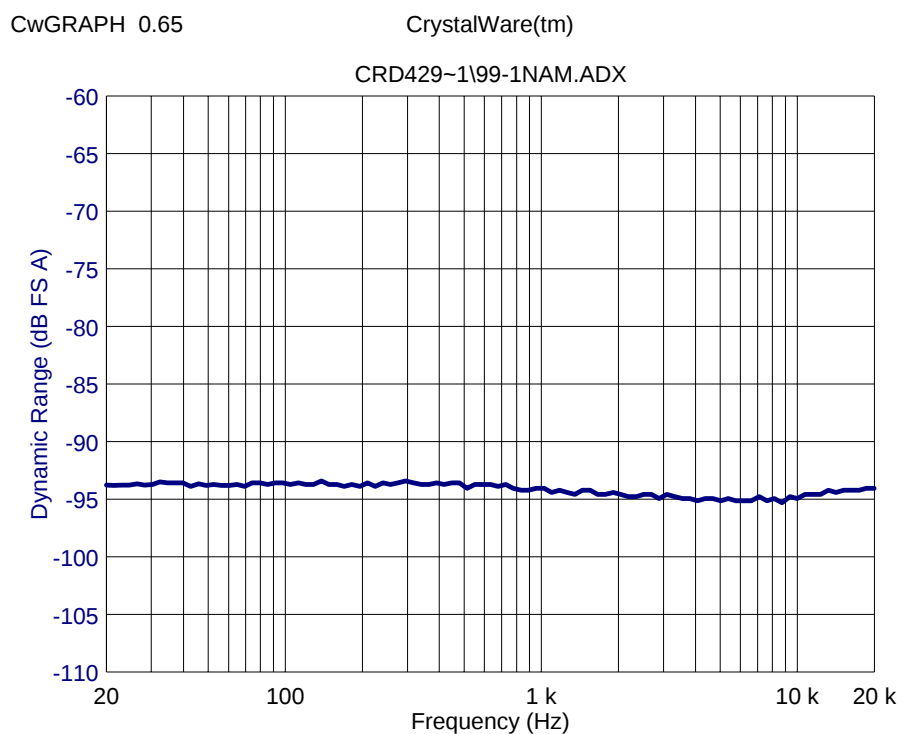


Figure 8. Analog Mixer (A-A): Mic In/Line Out Dynamic Range

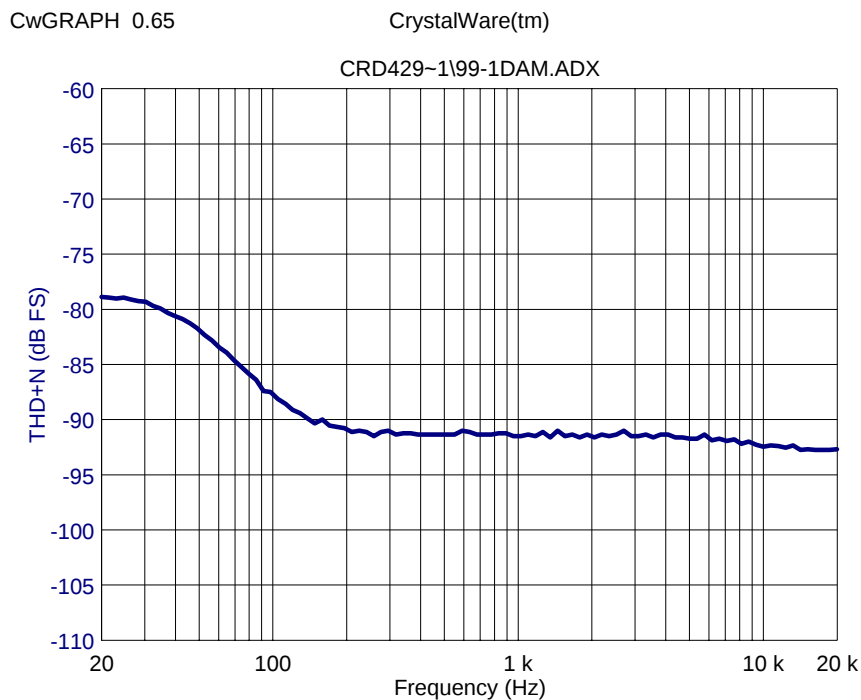


Figure 9. Analog Mixer (A-A): Mic In/Line Out THD+N vs. Frequency

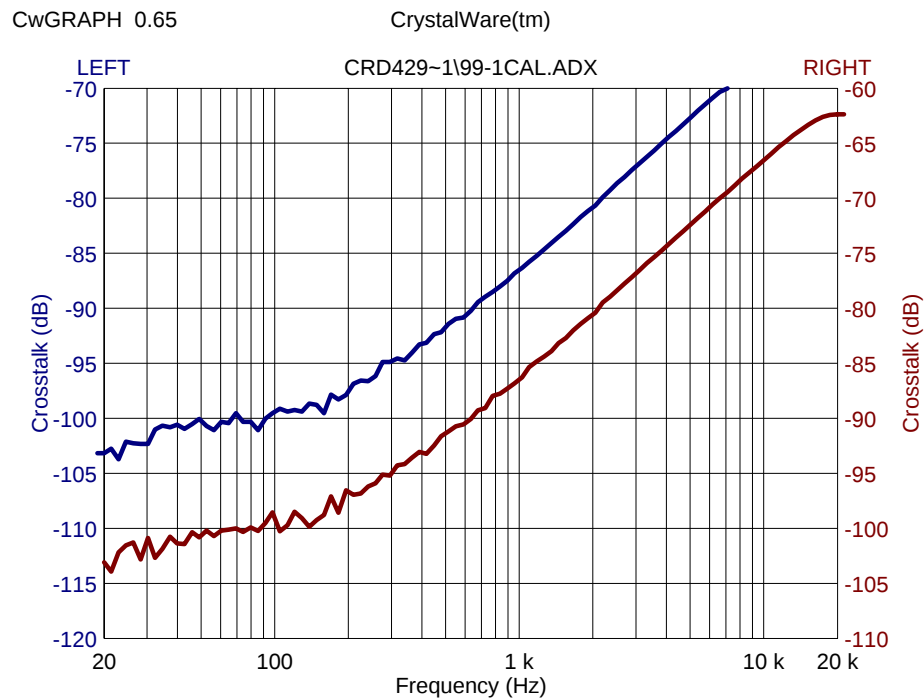
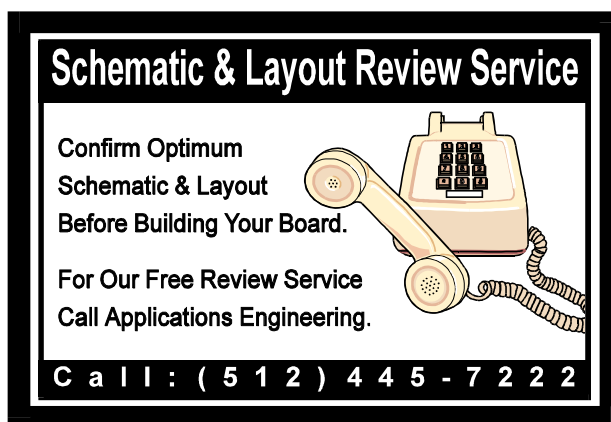


Figure 10. Analog Mixer (A-A): Line In/Out Crosstalk vs. Frequency

6. REFERENCES

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7. SCHEMATIC, LAYOUT, AND BRACKET DRAWINGS

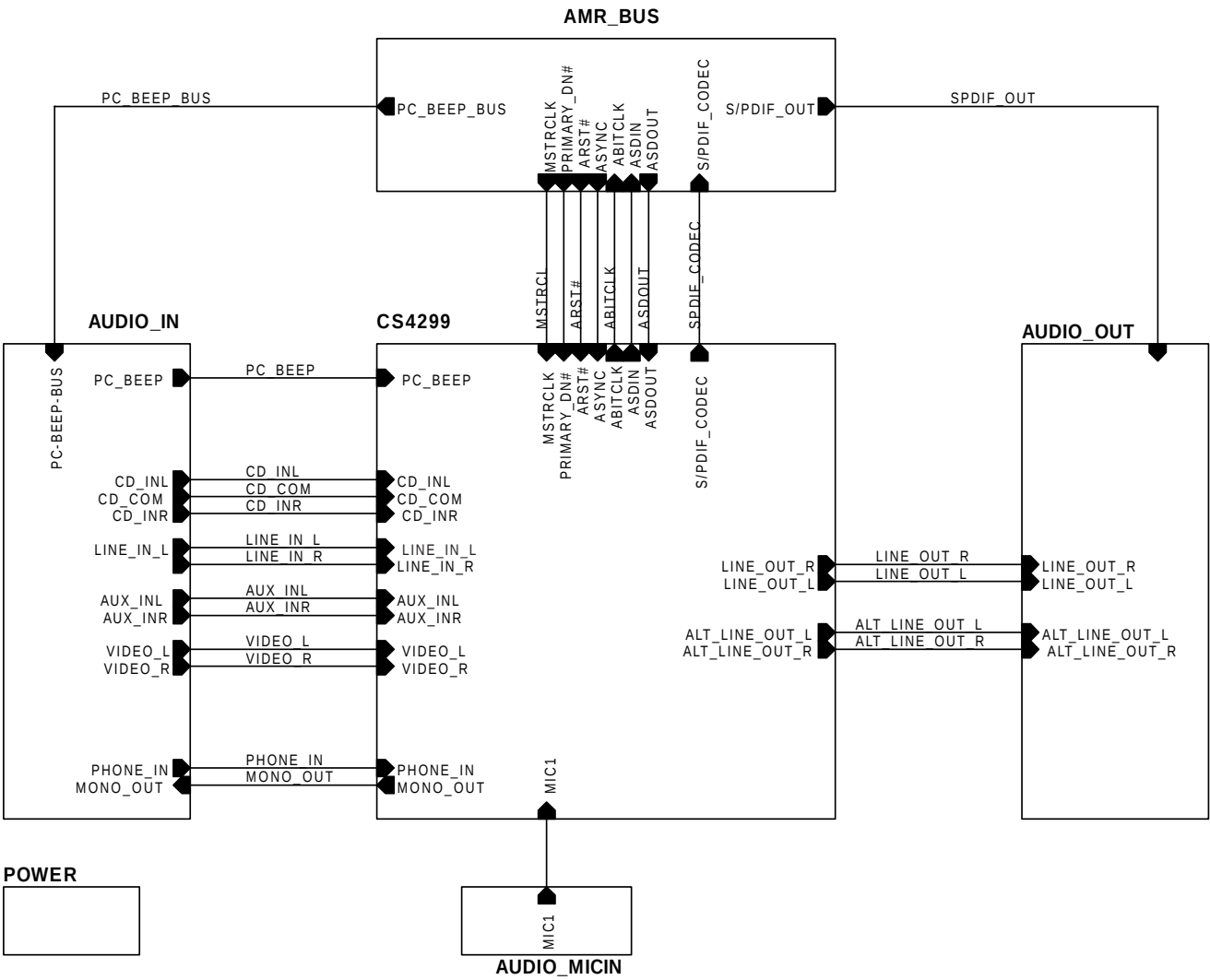


Figure 11. Block Diagram

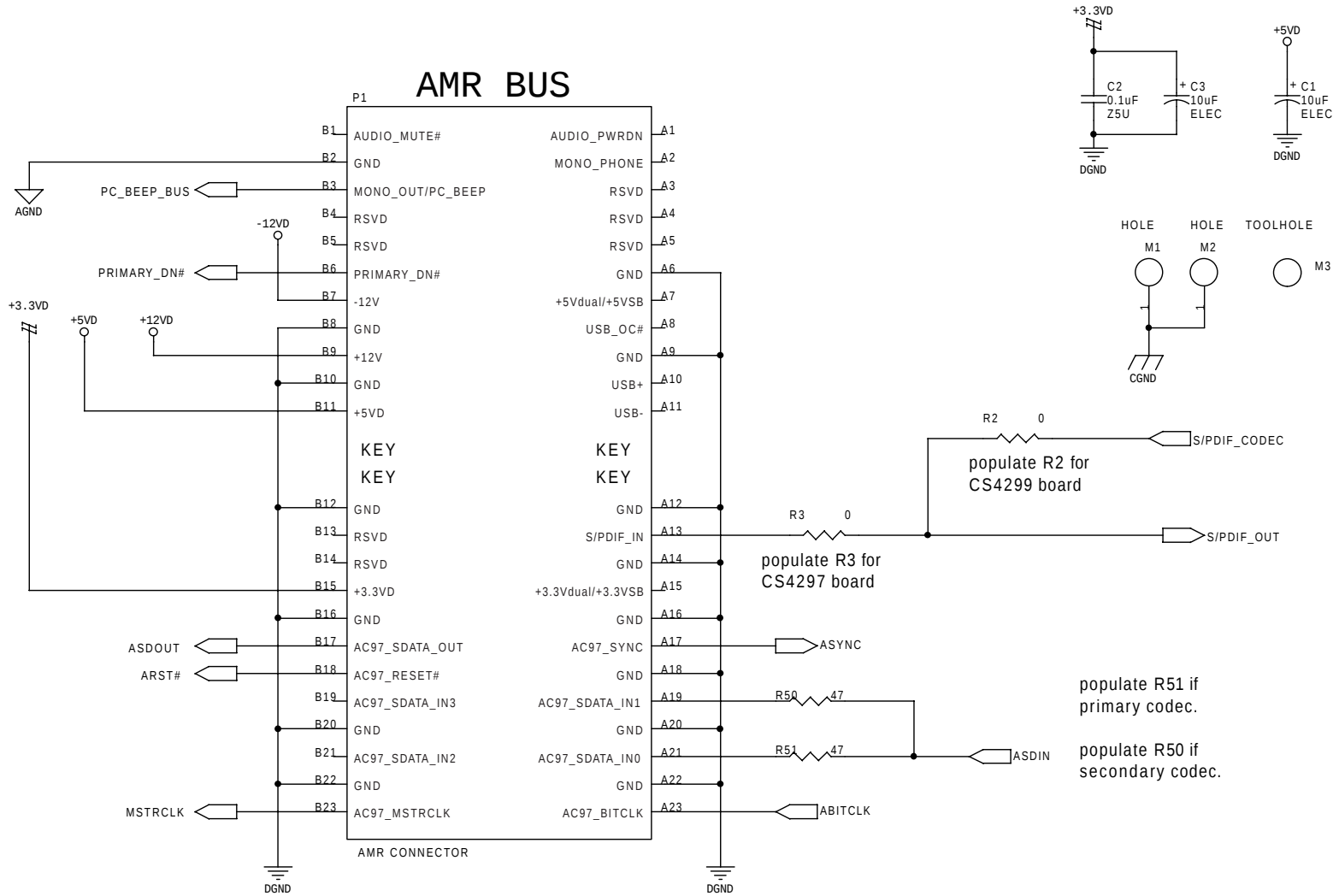
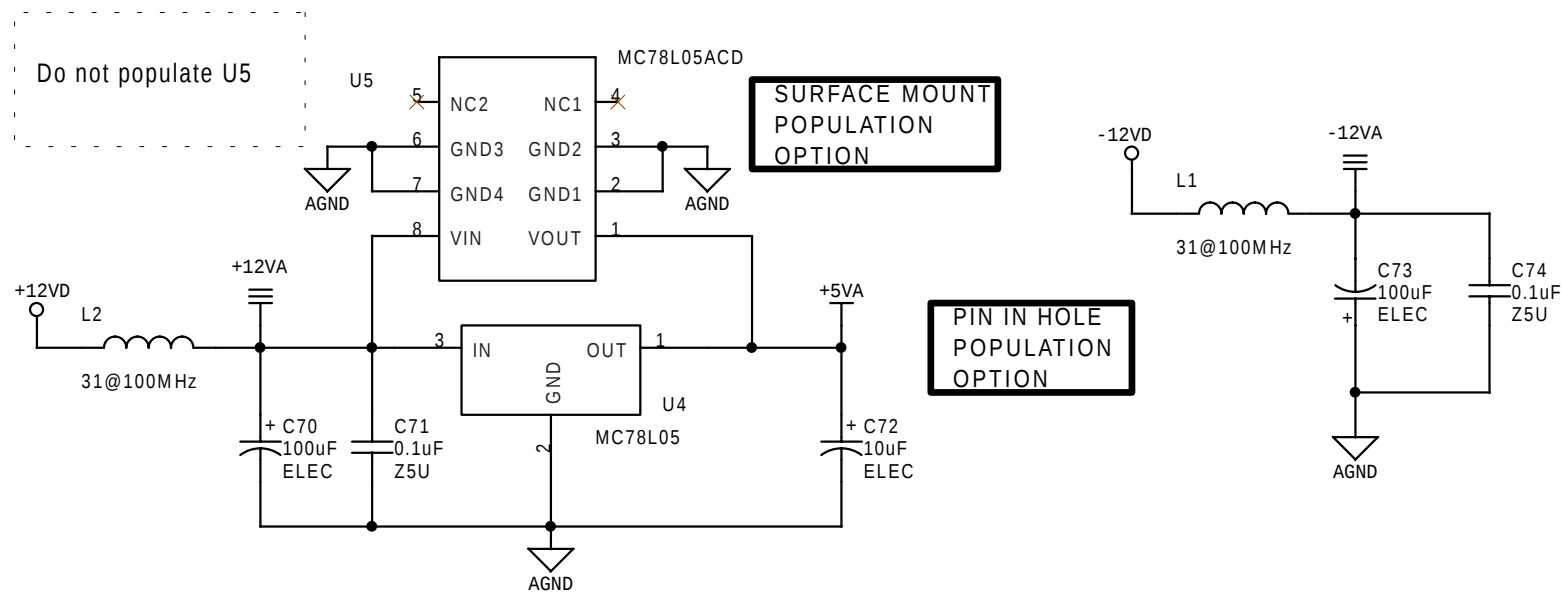


Figure 12. AMR Bus

POWER SUPPLIES



Connect AGND to DGND with a 50 mil trace near the 4297
Connect CGND to DGND with a 50 mil trace near the finger
edge of the board.

Figure 13. Power Supplies

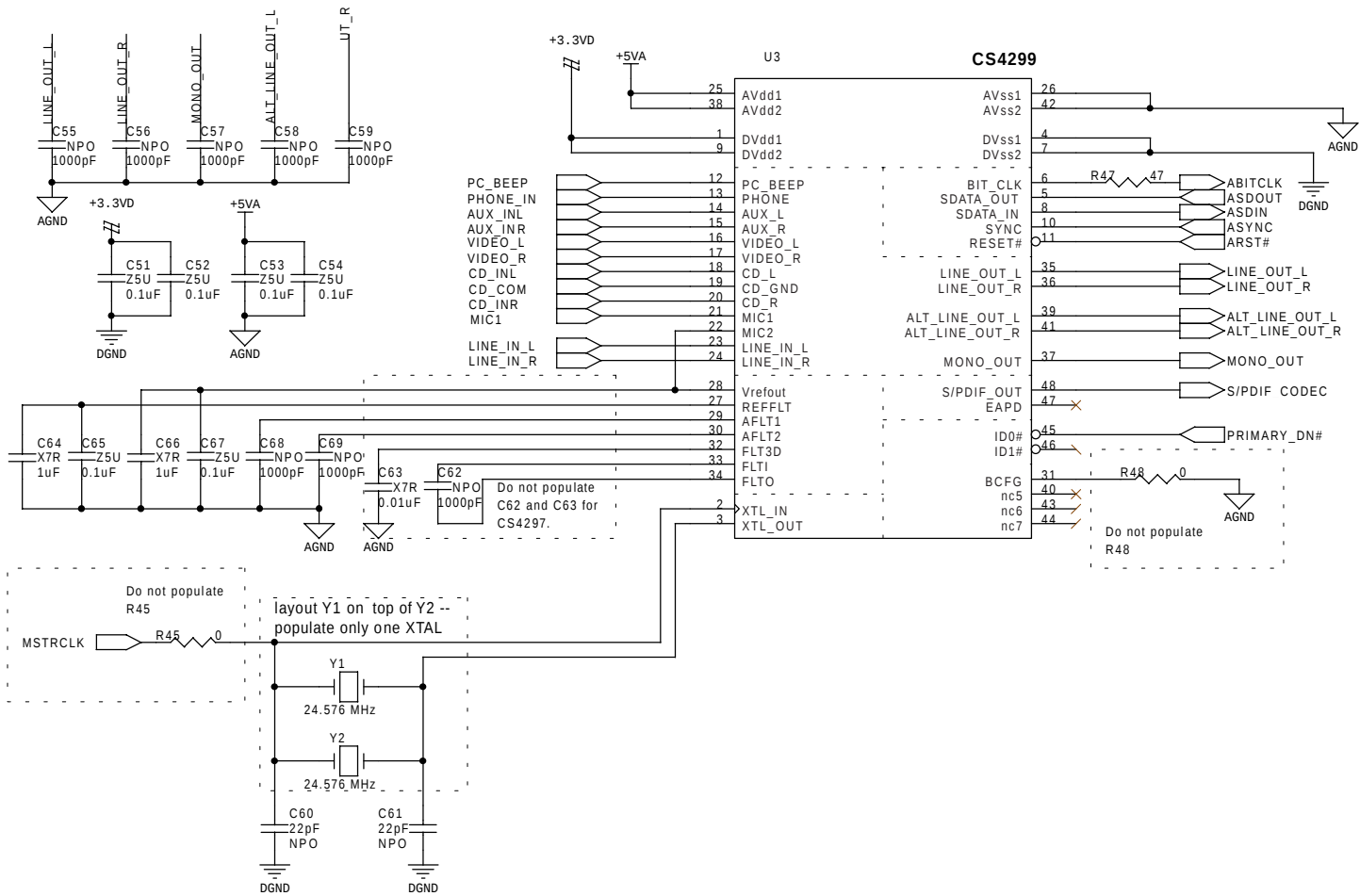


Figure 14. CS4299

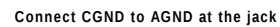
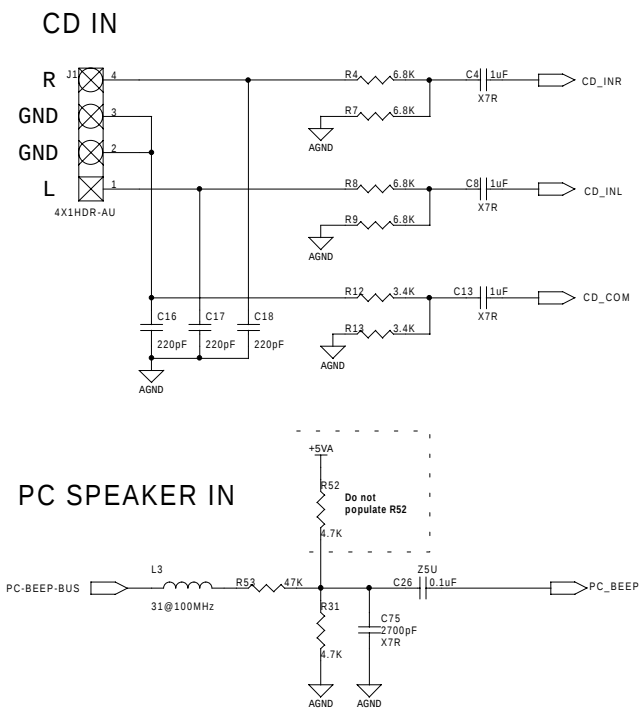


Figure 15. Audio In



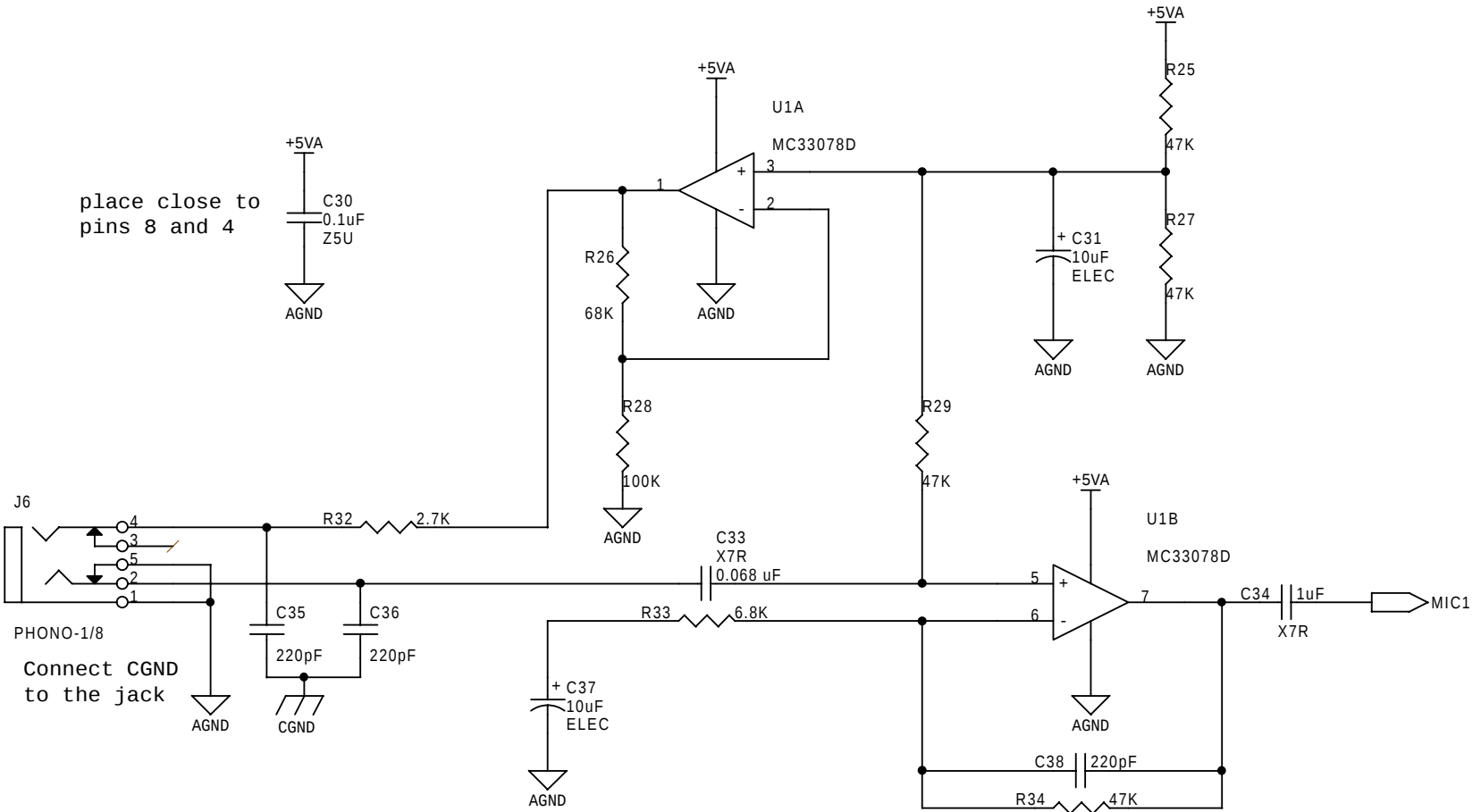


Figure 16. Audio Out

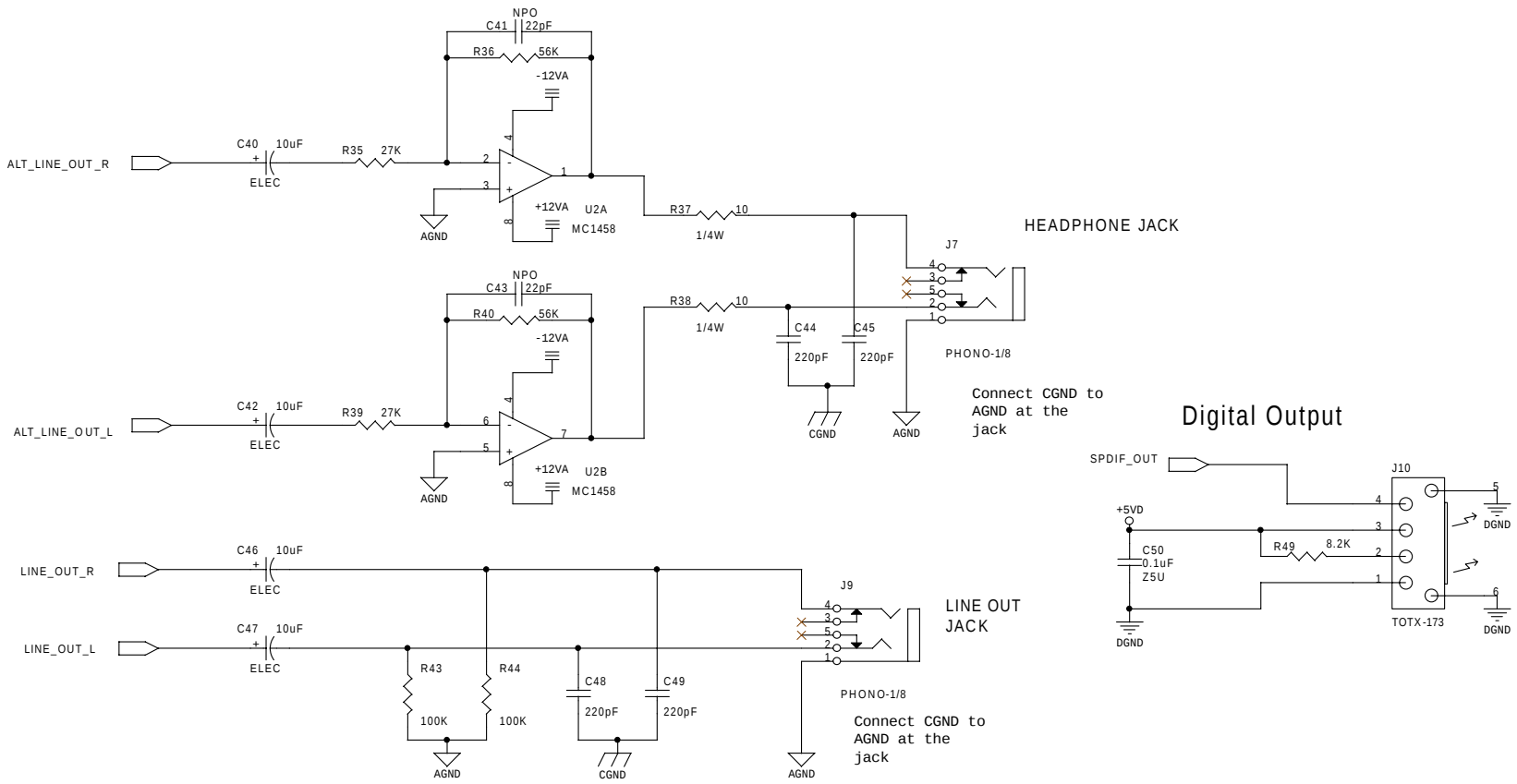


Figure 17. Mic Pre-Amp

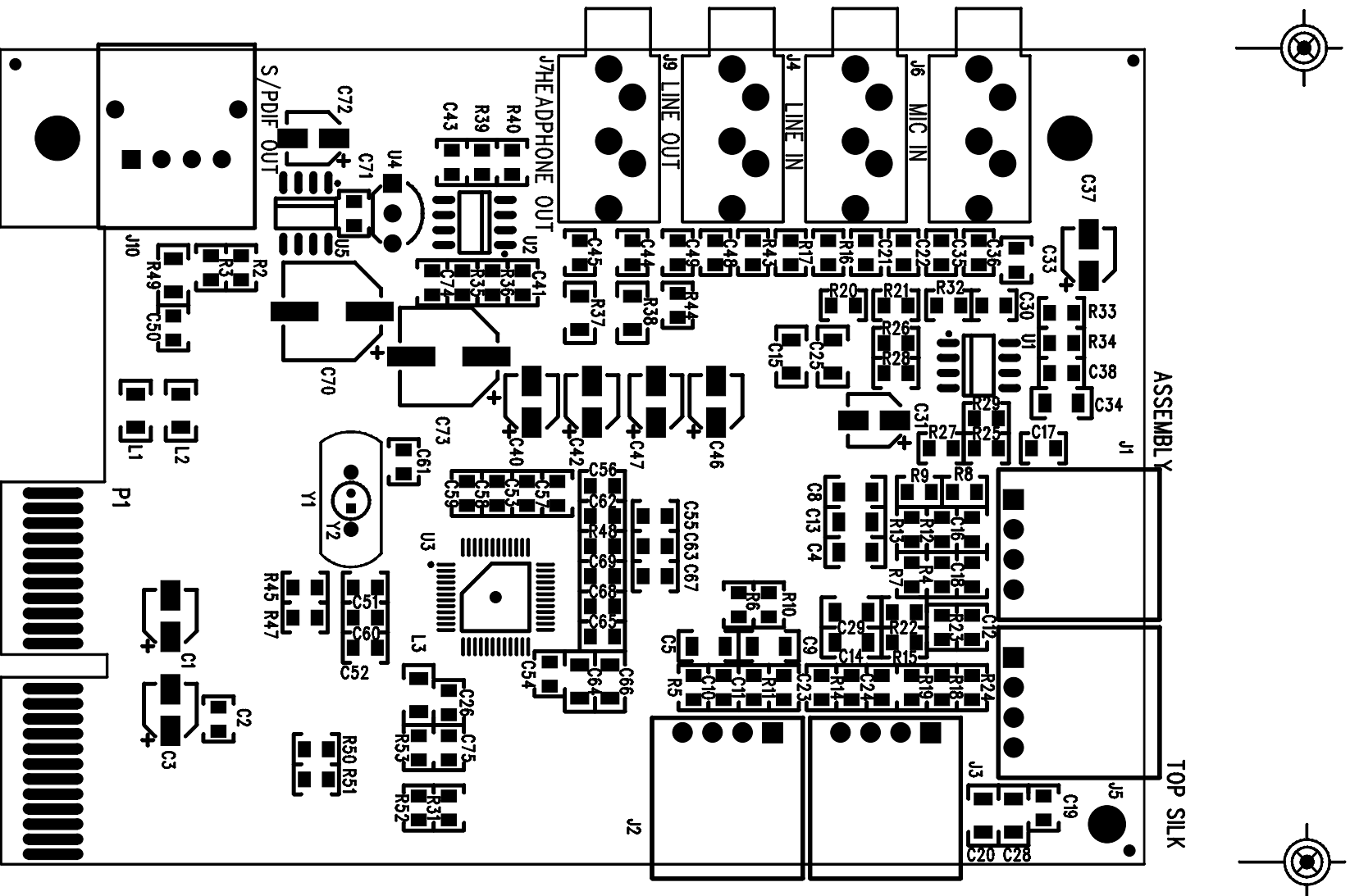
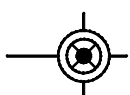
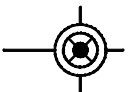


Figure 18. Assembly Drawing



TOP LAYER-1

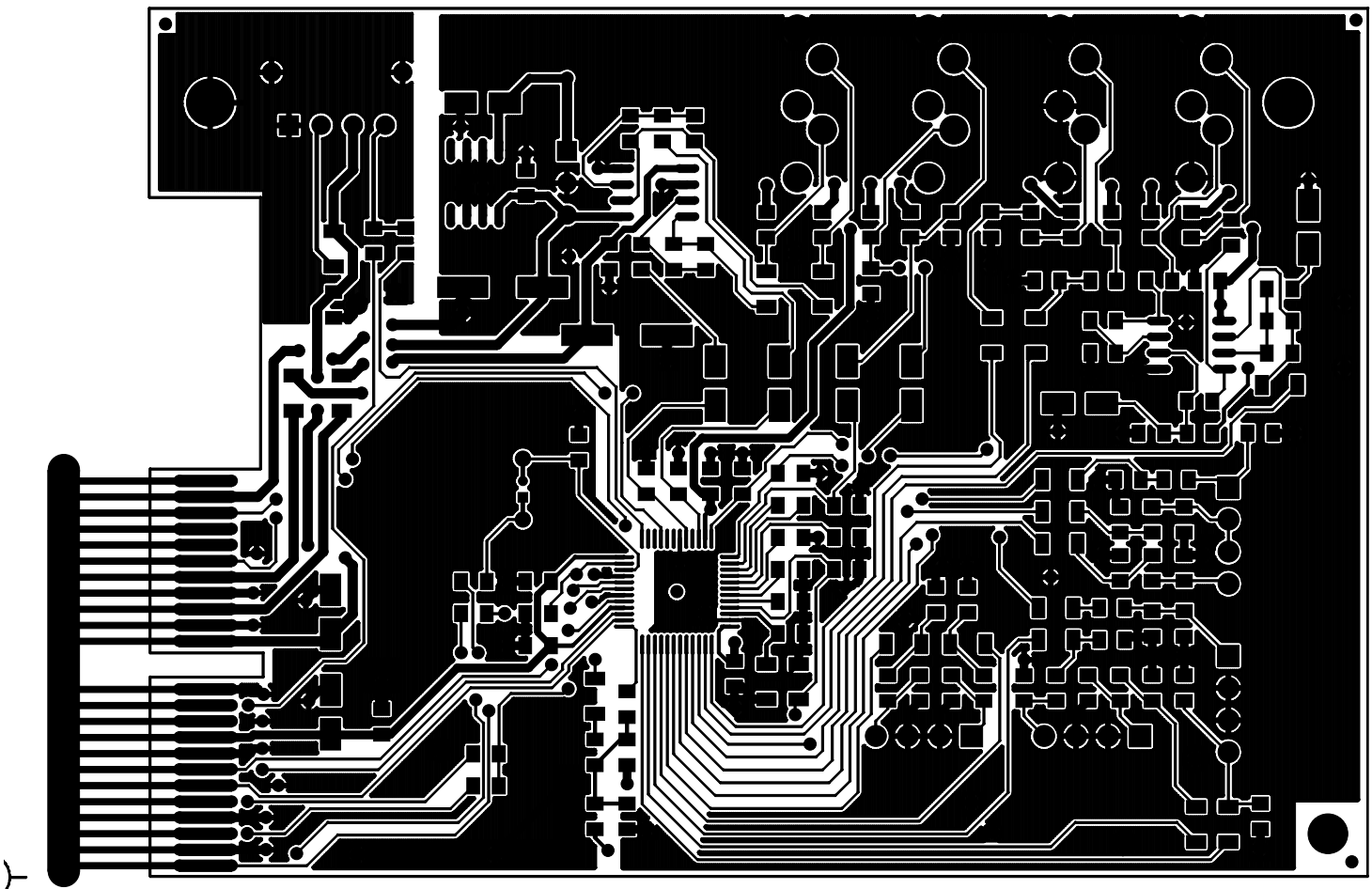
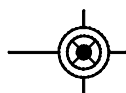
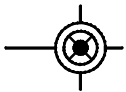


Figure 19. Top Layer



BOTTOM LAYER-2

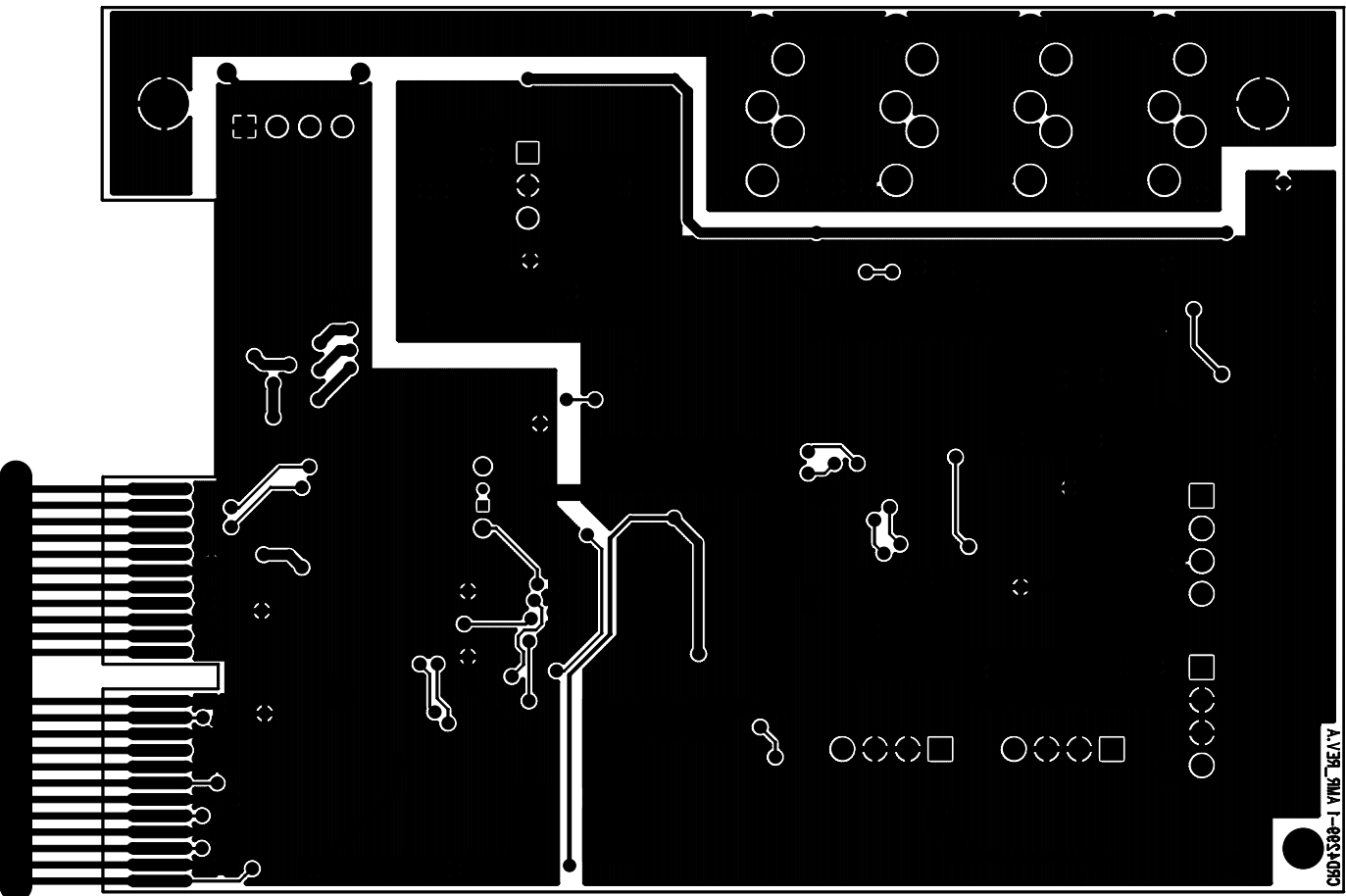


Figure 20. Bottom Layer

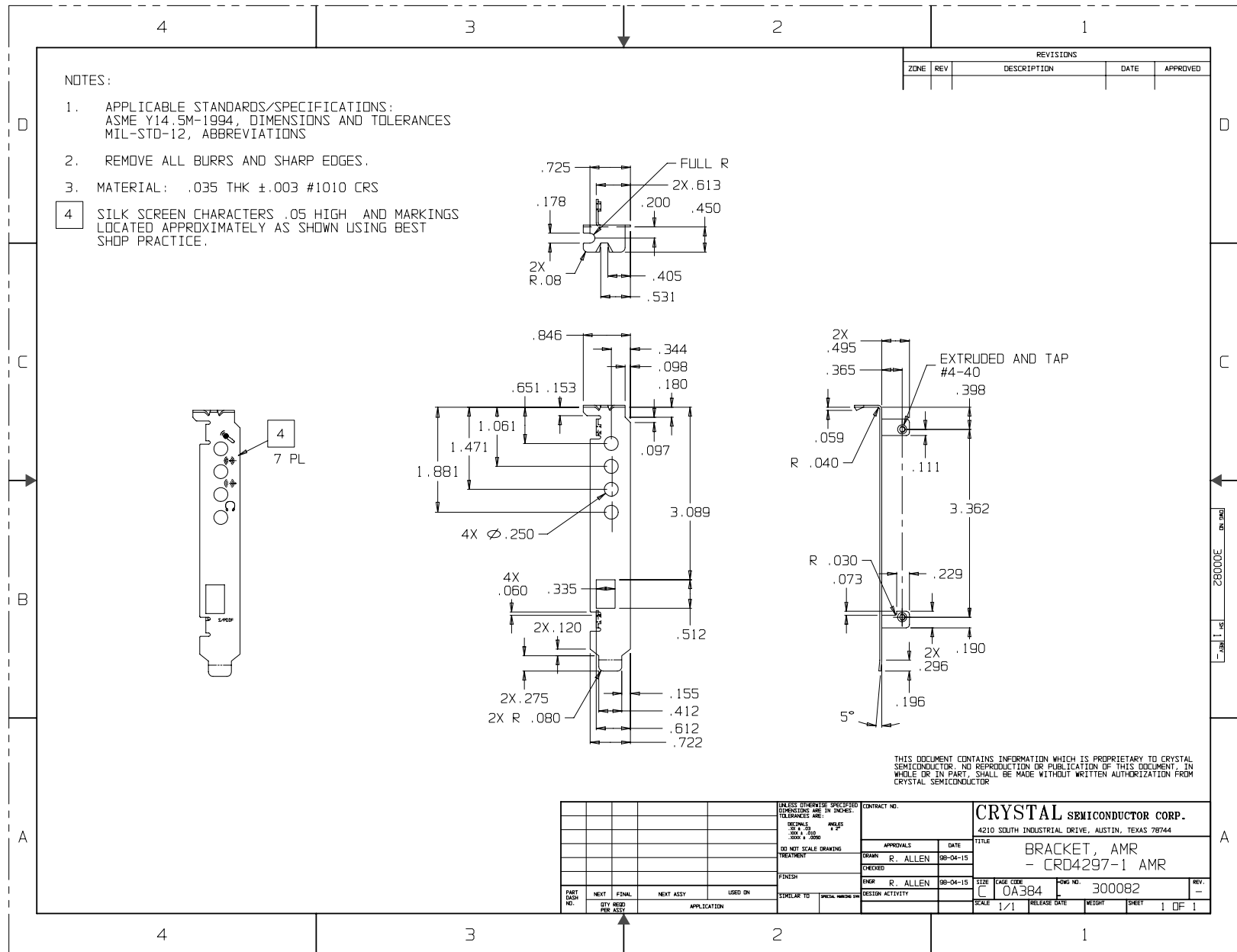


Figure 21. Bracket Drawing



8. BILL OF MATERIALS

CRD4299-AMR

Item	Qty	Reference	Value	Type	PCB Footprint	Mnfr	Part Number	Description
1	9	C1,C3,C31,C37,C40,C42,C46,C47,C72	10uF	ELEC	CSP_ELEC_B	PANASONIC	ECA-1CM100	ALUM ELEC, 10uF, 20%, 16V,POL
2	12	C2,C26,C30,C50,C51,C52,C53,C54,C65,C67,C71,C74	0.1uF	Z5U	CSN_0805	KEMET	C0805C104M5UAC	CAP, 0805, Z5U, .1uF, 20%, 50V
3	14	C4,C5,C8,C9,C13,C14,C15,C20,C25,C28,C29,C34,C64,C66	1uF	X7R	CSN_1206	VENKEL	C1206X7R500-105KNE	CAP, 1206, X7R, 1uF, 10%, 25V
4	18	C10,C11,C12,C16,C17,C18,C19,C21,C22,C23,C24,C35,C36,C38,C44,C45,C48,C49	220pF	COG	SMT_0805	KEMET	C0805C221J5GAC	CERM CAP,220pF,5%,50V,COG
5	1	C33	0.068 uF	X7R	CSN_0805	KEMET	C0805C683K5RAC	CAP, 0805, X7R, 68000pF, 10%, 50V
6	4	C41,C43,C60,C61	22pF	NPO	CSN_0805	KEMET	C0805C220J5GAC	CAP, 0805, COG, 22pF, 5%, 50V
7	8	C55,C56,C57,C58,C59,C62,C68,C69	1000pF	NPO	SMT_0805	KEMET	C0805C102J5GAC	CERM CAP, 1000pF, 5%, 50V,COG
8	1	C63	0.01uF	X7R	CSN_0805	KEMET	C0805C103K5RAC	CERM CAP, .01uF, 10%, 50V,X7R
9	2	C70,C73	100uF	ELEC	CSP_ELEC_E	PANASONIC	ECE-V1CA101P	CAP, SMT E, ELEC, 100uF, 20%, 16V
10	1	C75	2700pF	X7R	CSN_0805	KEMET	C0805C272K5RAC	CAP, 0805, X7R, 2700pF, 10%, 50V
11	4	J1,J2,J3,J5	4X1HDR-AU		CON_MLX_70553	MOLEX	70553-0003	HDR, 4X1, 0.025" PIN, 0.1" CTR, 15u" AU
12	4	J4,J6,J7,J9	PHONO-1/8		CON_STEREO_LZR	LZR ELEC-TRONICS	SJ372	CONN, 1/8" DOUBLE SW. STEREO PHONE JACK
13	1	J10	TOTX-173		TOTX173	TOSHIBA	TOTX173	OPTICAL TOSLINK TRANSMITTER
14	3	L1,L2,L3	31@100MHz	FERRITE	IND_FB1206	TDK	HF50ACB321611-T	IND, FBEAD, 1206, 31@100MHz, 25%
15	2	M1,M2	HOLE					
16	1	M3	TOOLHOLE		TOOLHOLE			
17	1	P1	AMR CON-NECTOR		AMR5V-46			
18	2	R2,R22	0	RES	RES_0805	PHILIPS	9C08052A0R00J	RES, SO, 0805, 0, 5%, 1/10W, METAL FILM
19	17	R4,R5,R6,R7,R8,R9,R10,R11,R14,R15,R16,R17,R18,R19,R20,R21,R33	6.8K	RES	RES_0805	PHILIPS	9C08052A6801F	RES, SO, 0805, 6.8K, 1%, 1/10W, METAL FILM
20	2	R12,R13	3.4K	RES	RES_0805	PHILIPS	9C08052A3401F	RES, SO, 0805, 3.4K, 1%, 1/10W, METAL FILM
21	7	R23,R24,R25,R27,R29,R34,R53	47K	RES	RES_0805	PHILIPS	9C08052A4702J	RES, SO, 0805, 47K, 5%, 1/10W, METAL FILM
22	1	R26	68K	RES	RES_0805	PHILIPS	9C08052A6802J	RES, SO, 0805, 68K, 5%, 1/10W, METAL FILM



Item	Qty	Reference	Value	Type	PCB Footprint	Mnfr	Part Number	Description
23	3	R28,R43,R44	100K	RES	RES_0805	PHILIPS	9C08052A1003J	RES, SO, 0805, 100K, 5%, 1/10W, METAL FILM
24	1	R31	4.7K	RES	RES_0805	PHILIPS	9C08052A4701J	RES, SO, 0805, 4.7K, 5%, 1/10W, METAL FILM
25	1	R32	2.7K	RES	RES_0805	PHILIPS	9C08052A2701J	RES, SO, 0805, 2.7K, 5%, 1/10W, METAL FILM
26	2	R35,R39	27K	RES	RES_0805	PHILIPS	9C08052A2702J	RES,27K,SO,0805,5%,1/10W,METAL FILM
27	2	R36,R40	56K	RES	RES_0805	PHILIPS	9C08052A5602J	RES,56K,SO,0805,5%,1/10W,METAL FILM
28	2	R37,R38	10	RES	RES_1206	PHILIPS	9C12063A10R0J	RES, SO, 1206, 10, 5%, 1/4W, METAL FILM
29	2	R47,R51	47	RES	RES_0805	PHILIPS	9C08052A47R0J	RES, SO, 0805, 47, 5%, 1/10W, METAL FILM
30	1	R49	8.2K	RES	RES_1206	Philips	9C12063A820J	RES,8.2k,SM1206,5%,1/4W
31	1	U1	MC33078D	DUAL OP AMP	SO8	MOTOROLA	MC33078D	IC, SO, SOIC8, 33078, DUAL OP AMP
32	1	U2	MC1458	DUAL HP OP AMP	SO8	MOTOROLA	MC1458	DUAL HEADPHONE AMP
33	1	U3	CS4299	IC	QFP48_7X7	CRYSTAL SEMICONDS.	CS4299-KQ	IC, TQFP, AC '97 2.1 SERIAL CODEC W/ SRC
34	1	U4	MC78L05	V REG	TO-92	MOTOROLA	MC78L05AC	5V POS.VOLT.REG., 100ma
35	1	Y1	24.576 MHz	PAR RES, FUND	XTL_HC49S	FOX	FS24.576	XTAL, 24.576MHz, HC49S, Fund Mode, Par Res

Do Not Populate

1	1	R50	47	RES	RES_0805	PHILIPS	9C08052A47R0J	RES, SO, 0805, 47, 5%, 1/10W, METAL FILM
2	1	R52	4.7K	RES	RES_0805	PHILIPS	9C08052A4701J	RES, SO, 0805, 4.7K, 5%, 1/10W, METAL FILM
3	2	R45,R48,R3	0	RES	RES_0805	PHILIPS	9C08052A0R00J	RES, SO, 0805, 0, 5%, 1/10W, METAL FILM
5	1	Y2	24.576 MHz	PAR RES, FUND	XTL_CA301	EPSON	CA-301_24.576M-C	XTAL, 24.576MHz, CA-301, Fund Mode, Par Res
6	1	U5	MC78L05ACD	V REG	SO8	MOTOROLA	MC78L05ACD	5V POS. VOLT. REG., 100ma



• Notes •

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