CrystalClear™ AC '97 PCI Audio Adapter Reference Design

FEATURES

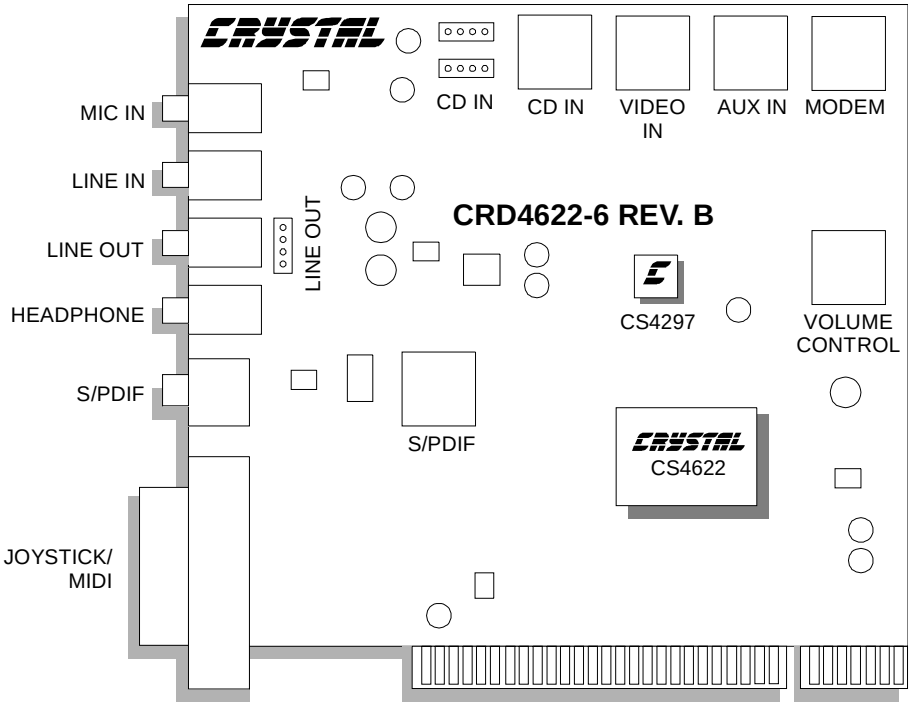
- **PCI Audio Accelerator add-in card designed to meet AC '97 specifications**
- **High quality, 2-layer, single sided adapter board**
- **CS4622/24 SoundFusion™ PCI Audio Accelerator**
- **CS4297 SoundFusion Audio Codec '97**
- **Complete suite of Analog and Digital I/O connections:**
- **External connections on the mounting bracket: Optical Digital Out, Headphone Out, Line Out, Line In, Mic In**
- **Internal connections on the board: Coaxial Digital In/Out, Modem Audio In/Out, CD Audio In, Video In, Aux In**
- **Sound Blaster Pro™ compatible, MPU-401 and Gameport interfaces**
- **Optional hardware volume control connector**
- **Meets or exceeds Microsoft's® PC 97, PC 98, and PC 99, both required and advanced, audio performance requirements.**

ORDERING INFO CRD4622-6

DESCRIPTION

The CRD4622-6 PCI add-in board reference design showcases Cirrus Logic's Crystal Audio AC '97 add-in card solution using the CS4622/24 SoundFusion Audio Accelerator and the CS4297 SoundFusion Audio Codec '97. This design is a PCI 2.1 compliant, variable height short card measuring only 4.2" high by 4.7" long.

The CRD4622-6 reference design includes a customer ready manufacturing kit. Included in the kit are a full set of schematic design files, PCB job files, PCB artwork files, 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.



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ANALOG CHARACTERISTICS The following preliminary results have been found when testing the CRD4622-6 with the Portable One Plus system from Audio Precision:

	Frequency response	Dynamic Range (A-weighted)	THD+N (-3 dB FS, unweighted)
Mic In to Line Out (A-A)	32.5 Hz...15 kHz (-3 dB)	91.4 dB FS A	-84 dB FS
Line In to Line Out (A-A)	12.5 Hz...20 kHz (-0.08 dB)	92.6 dB FS A	-89 dB FS
Line In to Line Out (A-D-A)	16.5 Hz...20 kHz (±0.1 dB)	84.5 dB FS A	-83 dB FS

Notes: V line in FS = 2 Vrms, V mic in FS = 125 mVrms, f = 1 kHz (sine), all gain registers set to 0 dB

GENERAL INFORMATION

The CRD4622-6 is a reference design of a production-grade AC '97 PCI Audio card using the CrystalClear CS4622/24 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 design can be based either on the CS4622 or the CS4624 PCI Audio Accelerator, which are functionally identical, except for the increased processing power available with the CS4622 and its ability to perform Dolby® Digital (AC-3®) decoding in hardware. Customers should base their decision as to which part to use on whether Dolby Digital (AC-3) decoding is required or not. The remainder of this document will refer to the CS4622 only, but every reference to this part is equally valid for the CS4624, except where noted.

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

The idea behind the two-chip solution is to have a separate audio controller chip connected to the PCI bus to accelerate increasingly popular audio processing functions such as Microsoft DirectX®, wavetable synthesis, and Dolby Digital (AC-3) decoding. A separate audio codec is connected to the controller for analog mixing and data conversion. Audio data is transferred between the controller chip and the audio codec through a standard digital interface called an AC Link at a 48 kHz frame rate. For more information on AC '97 and the AC Link, please consult the AC '97 specification [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 dynamic range 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 may be sent to the CS4622 over the PCI bus. The CS4622 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 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 CS4622 provides legacy games compatibility in hardware. DOS applications may directly address the legacy register set for SoundBlaster® and SoundBlaster Pro as well as the gameport. The CS4622 also provides an MPU-401 interface in native DOS. In this environment the CS4622 receives the MIDI data

directly from the PCI bus via legacy compatible I/O. The CS4622 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 that can degrade audio performance. The CRD4622-6 is FCC Class B certified for EMC emissions. Cirrus' analog design know-how has resulted in a board that preserves the exceptional analog performance of the CS4297.

REFERENCE DESIGN FEATURES

The CRD4622-6 reference design illustrates a high quality, 2-layer, single sided add-in card layout. The card is sectioned into two main parts: the CS4622 PCI Audio Accelerator (digital) section, and the CS4297 Audio Codec '97 (analog) section.

CS4622 PCI Audio Accelerator Section

The CS4622, a PCI 2.1 compliant device, is a bus mastering, 300 MIPS DSP optimized for audio signal processing. The CS4624 is a reduced cost version of the CS4622, providing 255 MIPS instead. An efficient on-chip DMA controller and stream processor DSP core provide a number of signal processing functions including:

- Hardware acceleration for Microstoft DirectSound™, DirectSound 3D™, and DirectShow™ API's
- 3-D positional processing for DirectSound 3D 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, wavetable synthesis with 64-note polyphony and chorus/reverb effects processing
- Dolby Digital (AC-3) 5.1 channel decoding which can be virtualized on two channels (CS4622 only)

The area around the CS4622 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 CS4622, refer to the CS4622 Data Sheet [3].

External EEPROM

The CS4622 EEPROM contains the required Subsystem Vendor ID and Subsystem ID values as well as two configuration registers which configure the software driver of the CS4622 to operate in AC '97 Link mode and enable the IEC 958 digital I/O ports. The CS4622 currently requires 8 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. Please call Cirrus Logic PC Products Audio Division at (512) 445-7222 to have a Subsystem ID assigned to a particular project. A utility, PCIRSRC.EXE, is supplied in this kit to download configuration and OEM specific data to the EEPROM.

For information regarding the programming and timing of the EEPROM, refer to the CS4622 Data Sheet [3].

Joystick/MIDI connection

The DB-15 connector allows a joystick and/or an external MIDI device to be connected to the CS4622. In the AC' 97 configuration, the CS4622 handles the joystick operation. The connector can also take MIDI data from an external source to the CS4622. A buffer circuit allows the CS4622 to drive an external MIDI interface.

Digital I/O

The CS4622 provides both, digital in and out in a format compatible with the consumer portion of IEC 958. An older version of this standard is also known as S/PDIF. The optical TOS-LINK output requires only a few additional components to hook up, but the optional RS422A compliant input/output requires a driver/receiver IC and a transformer to electrically isolate it from the rest of the board.

Hardware Volume Control

The hardware volume control feature of the CS4622 acts as a master volume control. There are no volume control buttons on the board, but a 4-pin (0.1 inch center) shrouded right-angled connector can be populated to provide a cable connection to buttons placed elsewhere in the system. The design allows for a volume up button and a volume down button. Pressing both buttons at the same time toggles the mute function.

Power Requirements

A Linear Technologies LT1117CST-3.3 voltage regulator derives the +3.3 V supply for the CS4622 and the CS4297 from the +5 V on the PCI connector. This regulator is unnecessary on mother boards with a +3.3 V supply, but was used in this reference design because the +3.3 V PCI bus power pins are not present on some older PCI bus connectors. The card is also designed to be used in a 5 V PCI connector [2]. Power consumption will vary based upon the processing tasks being executed. The maximum current requirement for the +3.3 V power supply is 300 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 various analog 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 of the audio section.

Power Requirements

The CS4297 requires both a digital +3.3 V and an analog +5 V supply. The digital power is supplied from the same LT1117CST-3.3 regulator that powers the CS4622.

A separate regulator is recommended for the analog voltage supply to provide good audio signal quality. A Motorola MC78M05ACDT is used to regulate the +12 V supply from the PCI bus down to a clean +5 V analog supply. This regulator can provide up to 500 mA of current, which is enough for the CS4297, the headphone amp, and the microphone pre-amp.

Audio Inputs and Outputs

A full feature set of the CS4297's analog I/O and the CS4622's digital I/O 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 In/Out
- Optical Digital Out
- Coaxial Digital In/Out

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

Line Out

The Line Out connection can either be made through the external 1/8" jack or the optional internal 4-pin (0.1 inch center) header. If the 1/8" jack is used, the internal 4-pin connector becomes disabled. This output can only drive input impedances greater than 10 kΩ.

- Maximum output level: 1 Vrms

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: 1.4 Vrms (no load); 1 Vrms (32 Ω load)
- Maximum output power: 35 mW/channel (32 Ω load)

Line In

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

- Maximum input level: 2 Vrms

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

CD Audio In

The CD Audio input provides a 4-pin (0.1 inch center) shrouded right-angled connector that is compatible with the SONY and ATAPI standards. To accommodate various legacy cable connections, two 4-pin (2 mm center) shrouded straight connectors that comply with the PANASONIC and MITSUMI standards respectively have been added as well. Populating more than one header is optional and only one of the headers should be connected to a driving source at any one time.

- Maximum input level: 2 Vrms
- Differential input using the CD Common pin as the ground

Aux In

- Internal 4-pin (0.1 inch center) shrouded right-angled connector
- Maximum input level: 2 Vrms

Video In

- Internal 4-pin (0.1 inch center) shrouded right-angled connector
- Maximum input level: 2 Vrms

Modem Audio Connection

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

- Maximum input level: 1 Vrms
- Maximum output level: 1 Vrms
- Minimum load impedance: 10 kΩ

Optical Digital Out

Digital out is provided through a Toshiba TOTX173 TOS-LINK jack on the board edge. The signal is IEC 958 and CP-1201 compliant.

Electrical Digital In/Out

Optional internal digital in and out connections are provided through a 4-pin (0.1 inch center) shrouded right-angled connector. Both the driving and receiving ends are IEC 958 and RS422A compliant.

SCHEMATIC DESCRIPTION

Figures 1 through 13 show the schematics for the CRD4622-6 card. This section will describe particular pages of the schematic that need to be discussed.

Figure 2: PCI Bus Interface

The +12 V power pin is fed directly to the analog power regulator. The +5 V power pins are buffered and decoupled through C96/97 and C100/101. The –12 V and +3.3 V supplies are not used in this design. The PCI 2.1 specification, chapter 4.4.2.1. requires each unused +3.3 V power pin to be AC-decoupled with an average of 0.01 µF per pin and trace lengths not to exceed ¼ inch [2]. A scheme of 7 caps, which are shared between the 12 power pins, has been devised to satisfy both of these requirements. The TDI and TDO pins are tied together according to PCI 2.1 spec, chapter 2.2.10.

Figure 4: CS4622

The 0.1 µF capacitors connected to the power pins of the CS4622 should be as close as possible to the chip. The inductor L8 is used to filter the power supply for the internal PLL circuit. R60 can be removed from a production design, and pin 65 can be connected directly to digital ground. R53 and R54 are termination resistors in the serial AC Link between the CS4297 and the CS4622. All unused input and bi-directional pins are tied to their respective inactive levels through 10 kΩ resistors.

Figure 5: MIDI and Joystick Interface

A buffer driver circuit is used on the MIDIOUT pin to provide the necessary 5 V TTL compatible output on the DB-15 connector. This circuit can be removed, and R37 populated to bypass the buffer driver circuit if a 3.3 V CMOS compatible output is sufficient. Pull-up resistors are required for the joystick buttons and the MIDI input. C44-47 and R28-30/36 provide the correct RC constant for the joystick coordinates and C48-51 de-bounce the joystick buttons. C48-51/54-58/61 also provide EMC protection on the external connector.

Figure 6: S/PDIF Interface

S/PDIF (IEC 958 consumer) output is available in both the optical and coaxial format. S/PDIF input is coaxial only. The coaxial input/output circuit uses a Texas Instruments SN75179B differential driver/receiver pair and a Schott Corporation 29398 digital audio transformer. This section may be omitted if no coaxial S/PDIF functionality is required. R85 must then be populated instead.

Figure 7: CS4297

A 10 µF 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 CS4297. For the best audio performance, the analog voltage regulator should be located near the CS4297. R20 and R21 are termination resistors in the serial AC Link between the CS4297 and the CS4622. NPO type capacitors should be used on all loading capacitors of audio signals to ensure minimal distortion. A population option for different footprints (HC49S and CA-301) has been provided for the clock crystal.

Figure 8: Analog Outputs

The line out is driven directly by the CS4297. A Philips TDA1308 low noise headphone amplifier IC drives the headphone out. This IC uses a single ended supply and is biased with Vref from the CS4297. R45/46 are added for short-circuit protection.

Figure 9: Analog Inputs

The inputs for AUX, VIDEO, CD, and LINE are passed through a divider circuit that reduces the voltage by 50% to allow connection of line level sources up to 2 Vrms. Each divider also contains some EMC filtering components and a 1 µF cap to AC-couple into the CS4297. An optional second cap of the same size may be connected in parallel

to improve low-end frequency response. Please note that 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 should be half of that of the other inputs.

The modem connection is both a mono input and output. The output is fed from the CS4297's MONO_OUT pin through a divider made of R66/67. 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 kΩ. The input is not divided to accommodate line level sources up to 1 Vrms.

Figure 13: Microphone Pre-amp and Bias

A Motorola MC33078D low noise dual op-amp is used to provide a +18 dB gain stage for the microphone and to buffer the phantom power supply for the mic. The phantom power is derived from the +5 V analog supply and buffered by U8A 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 as required by the PC 99 spec [6].

Component Selection

Great attention was given to the particular components used on the CRD4622-6 board with 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
- individual parts, no resistor packs
- all parts except connectors and the crystal are surface mount
- right-angled shrouded headers for all internal connections to provide sufficient headroom for the jacks and prevent wrong hookups by the user

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. The bill of materials has been optimized to reflect which parts are needed to pass the tests for compliance with FCC Part 15 Class B. Modifying this selection of components is likely to fail the board in EMC compliance tests and is therefore strongly discouraged.

GROUNDING AND LAYOUT

The routing of the CRD4622-6 provides a good example of how a PCI add-in card should look. 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 2.1 specification chapter 4.3.6. for information on routing PCI bus signals on a motherboard [2].

Partitioned Voltage and Ground Planes

The CRD4622-6 is partitioned into a digital and an analog section. Correspondingly, the ground plane is partitioned 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 PCB's 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.

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

CS4297 Layout Notes

Please 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.

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, CS4622/24 SoundFusion PCI Audio Accelerator Data Sheet, July 1998. *http://www.cirrus.com/products/overviews/cs4622.html*

4) Cirrus Logic, CS4297 SoundFusion Audio Codec '97 Data Sheet, July 1998. *http://www.cirrus.com/products/overviews/cs4297.html*

5) Steve Harris, Clif Sanchez, Personal Computer Audio Quality Measurements, Ver 0.5 *http://www.cirrus.com/products/papers/meas/meas.html*

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.

ADDENDUM

- Schematic drawings
- Layout drawings
- Bracket drawing
- Bill of materials

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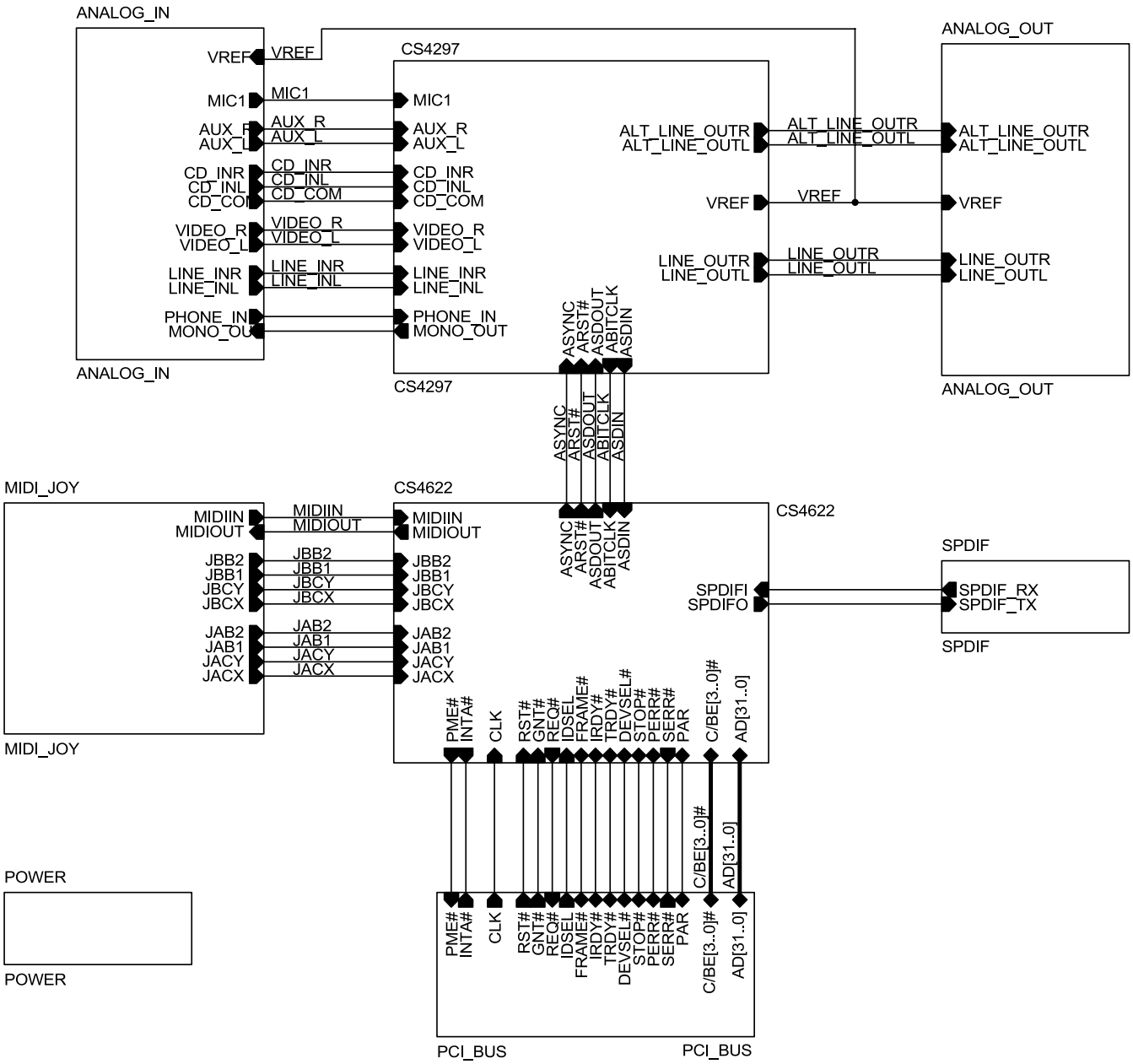

Figure 1. Block Diagram

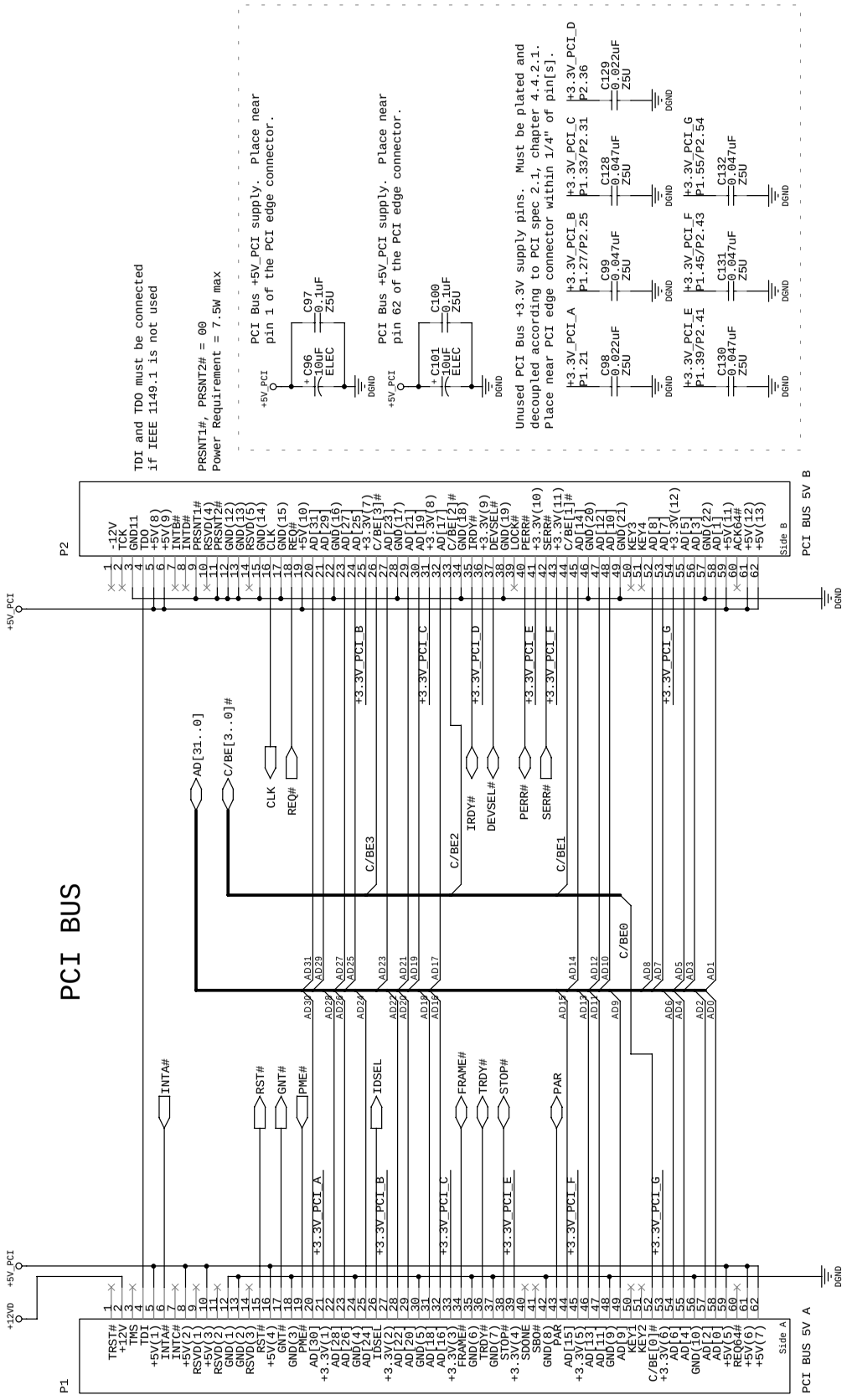

Figure 2. PCI Bus

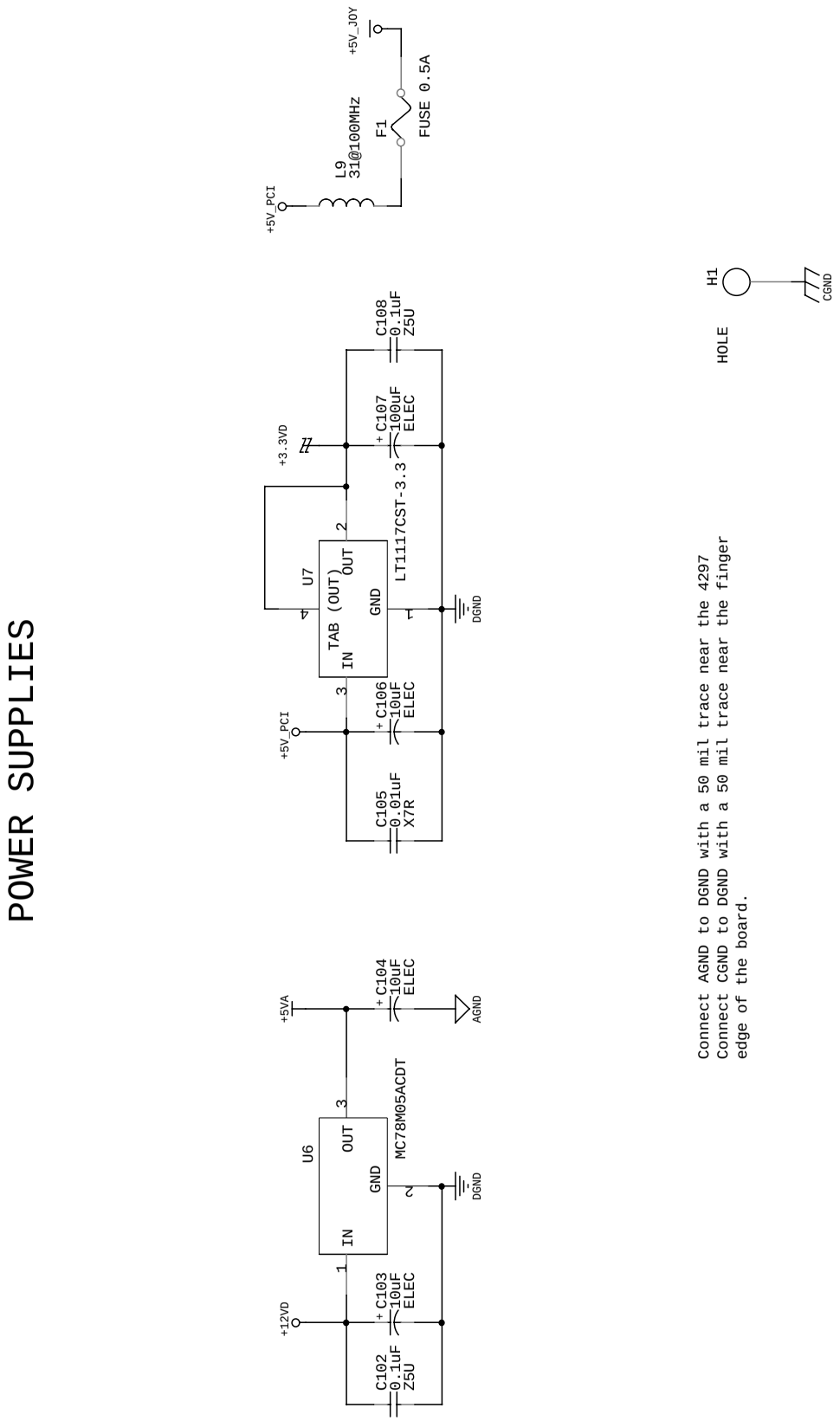

Figure 3. Power Supplies

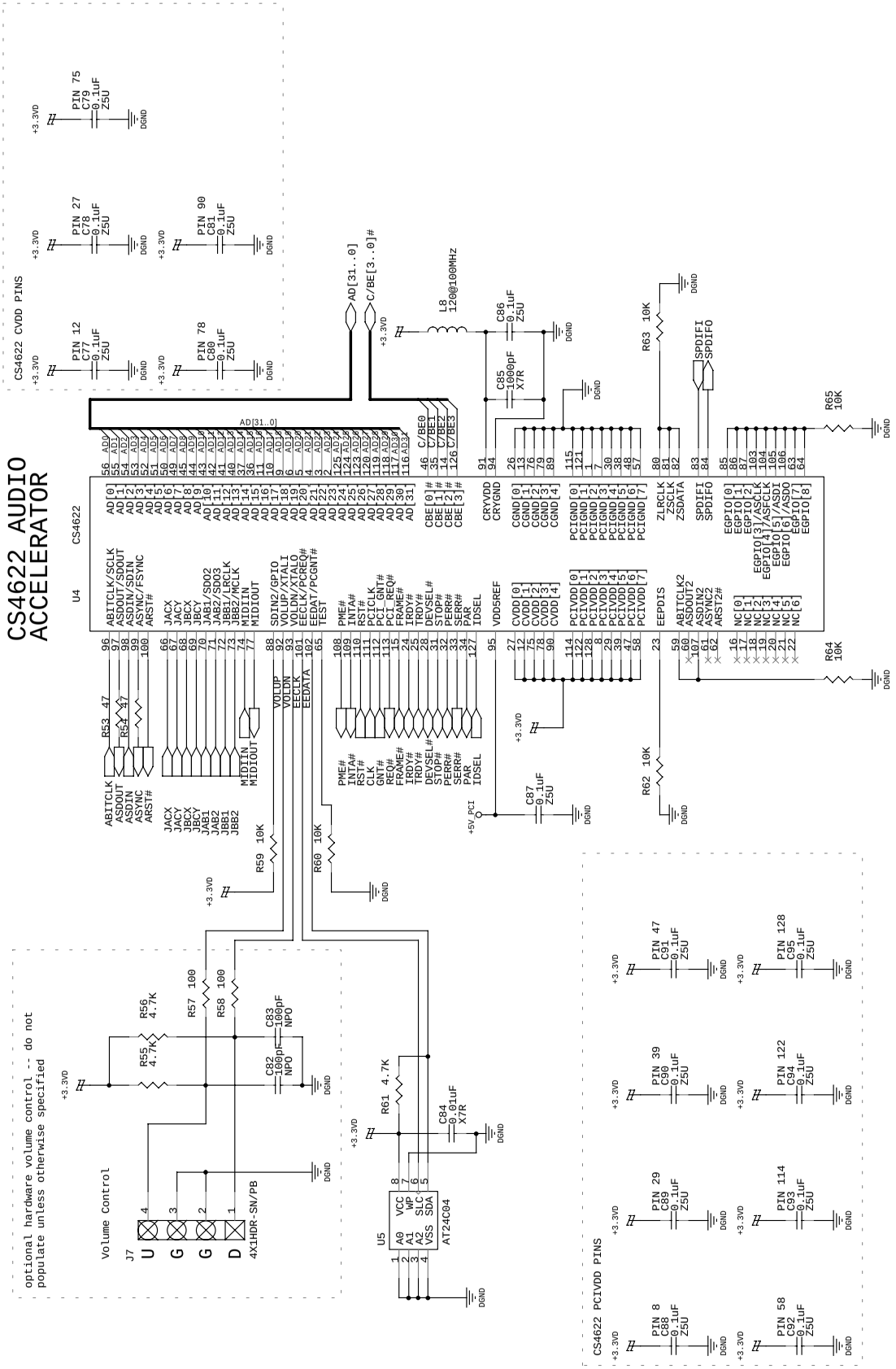

Figure 4. CS4622

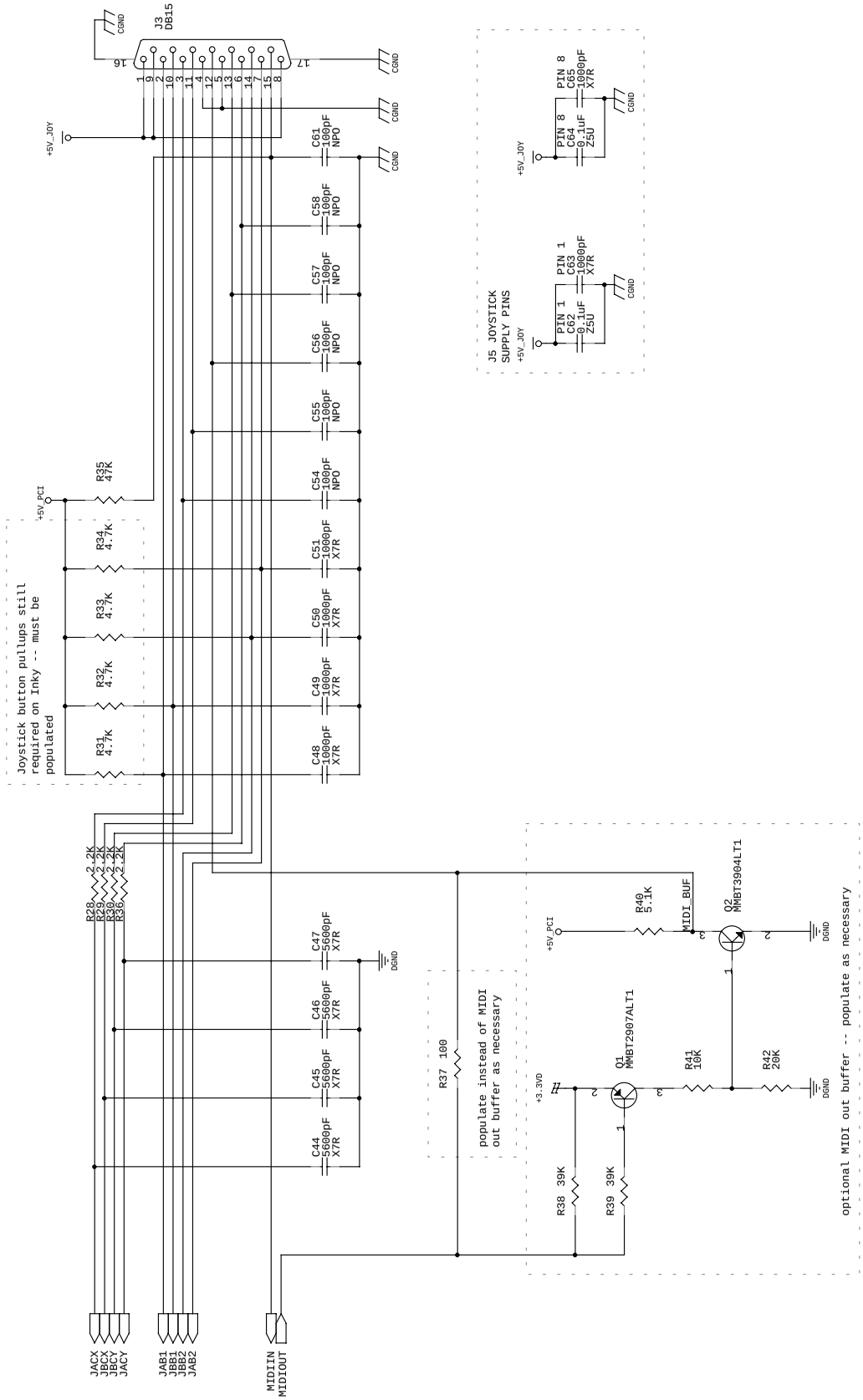

Figure 5. MIDI/Joystick Interface

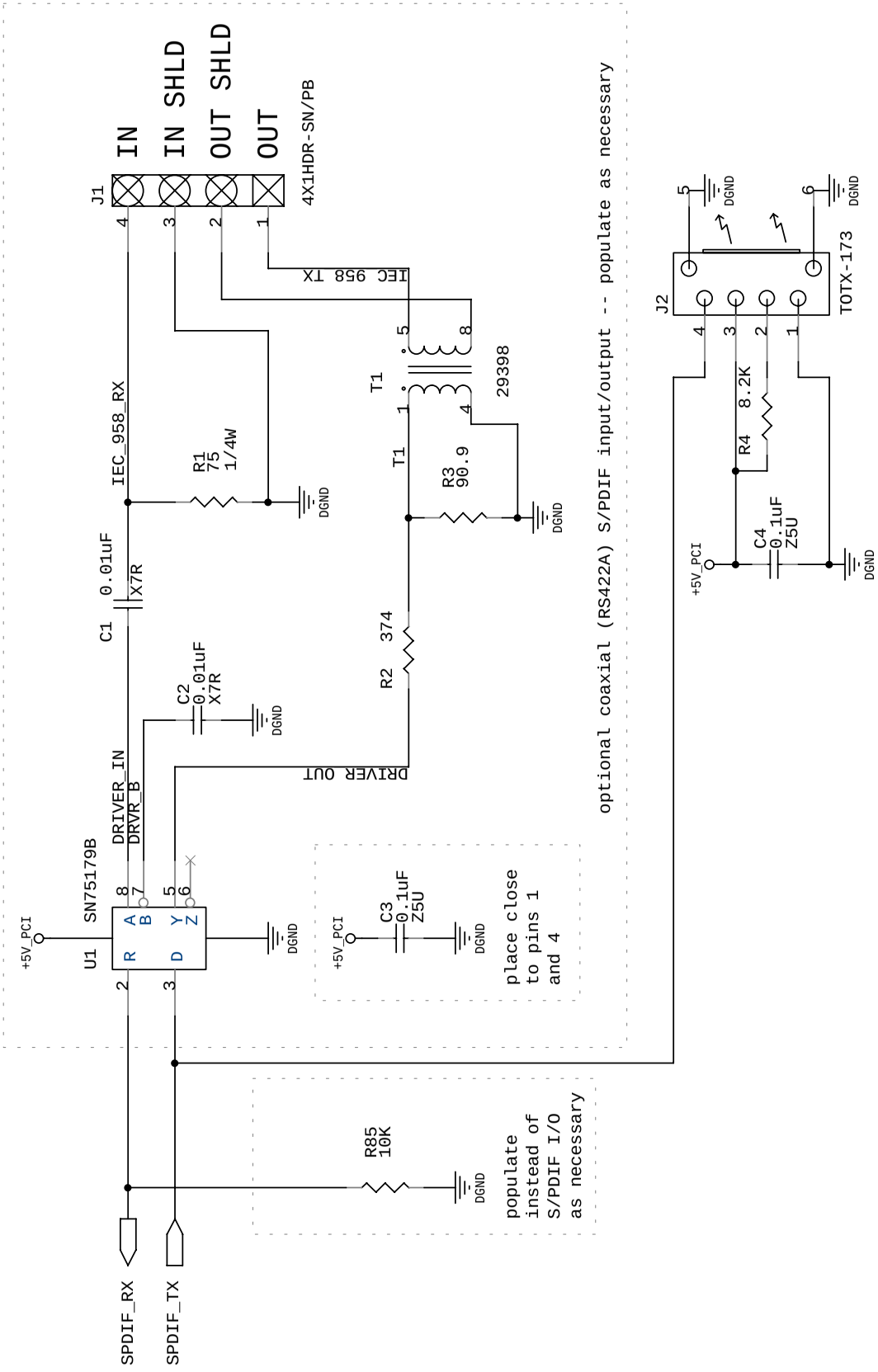

Figure 6. S/PDIF Interface

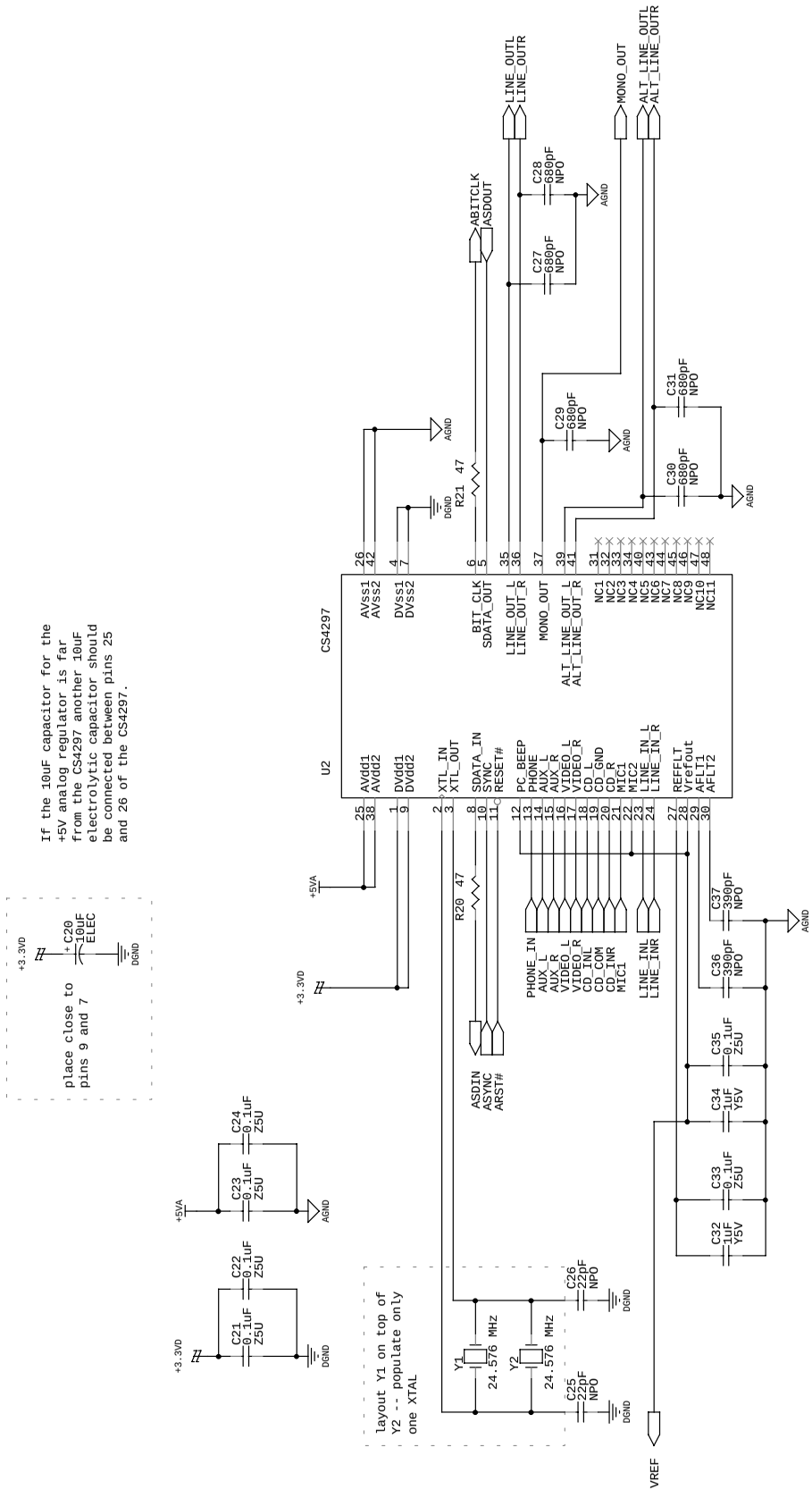

Figure 7. CS4297

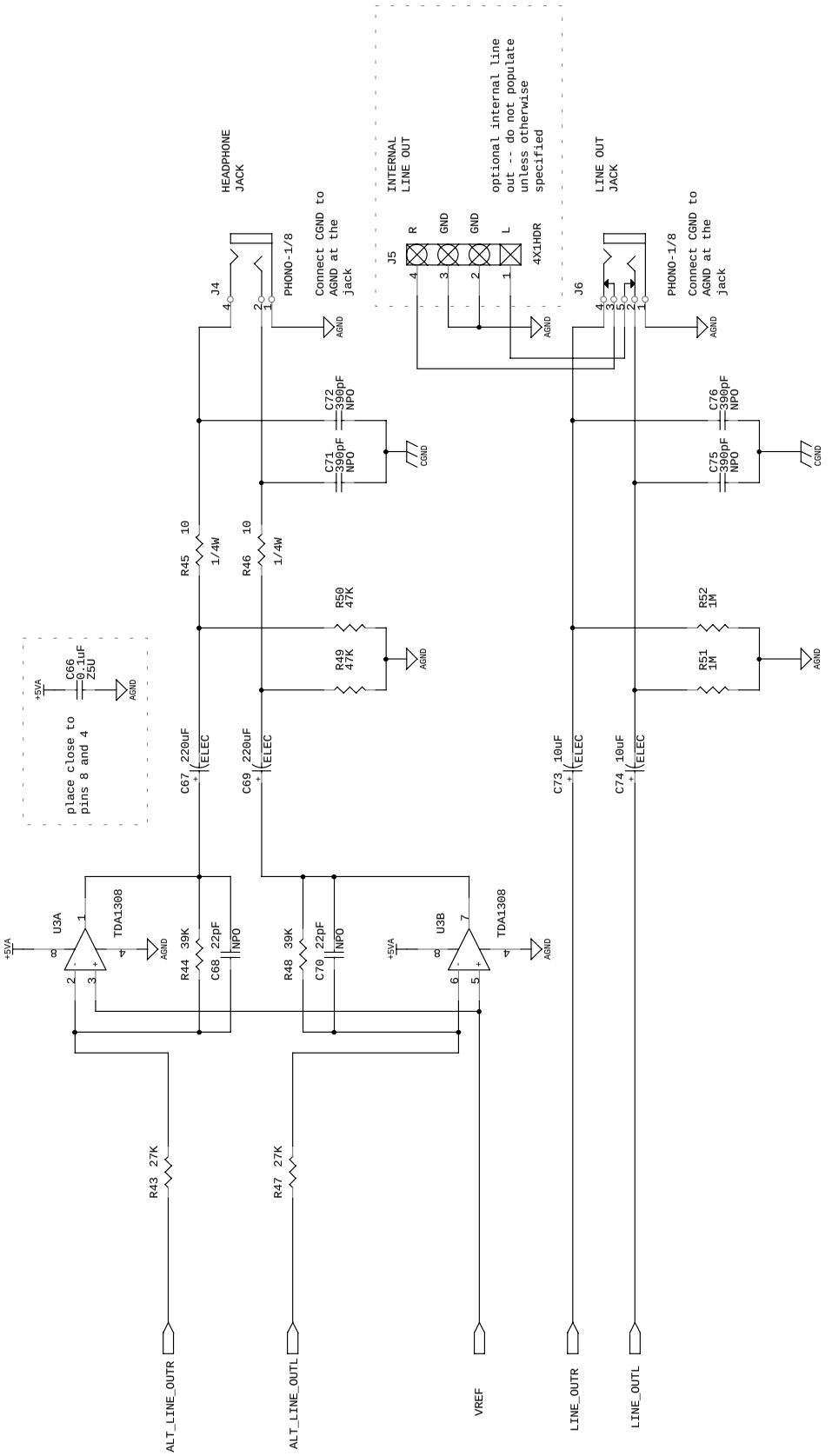

Figure 8. Analog Outputs

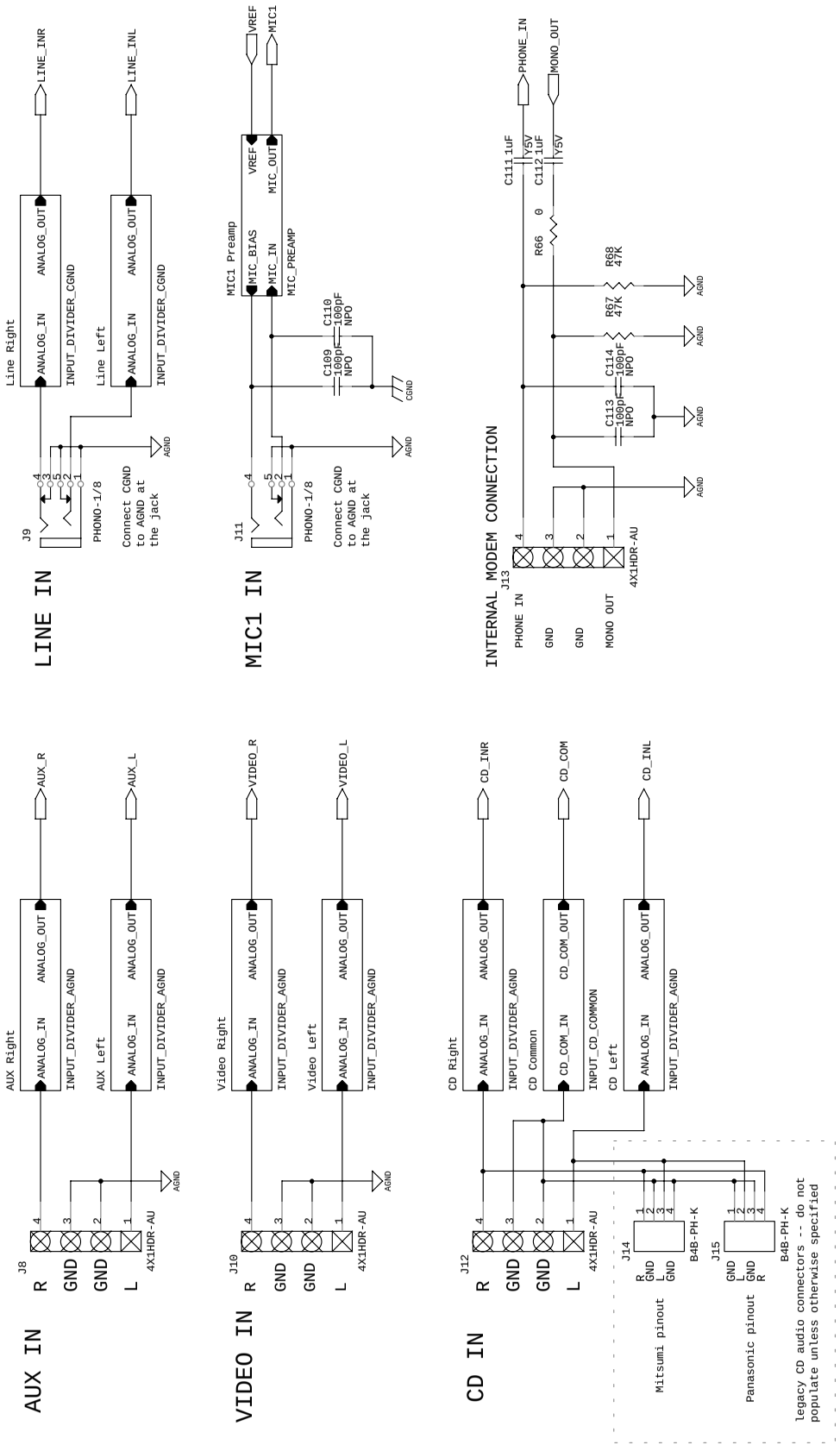

Figure 9. Analog Inputs

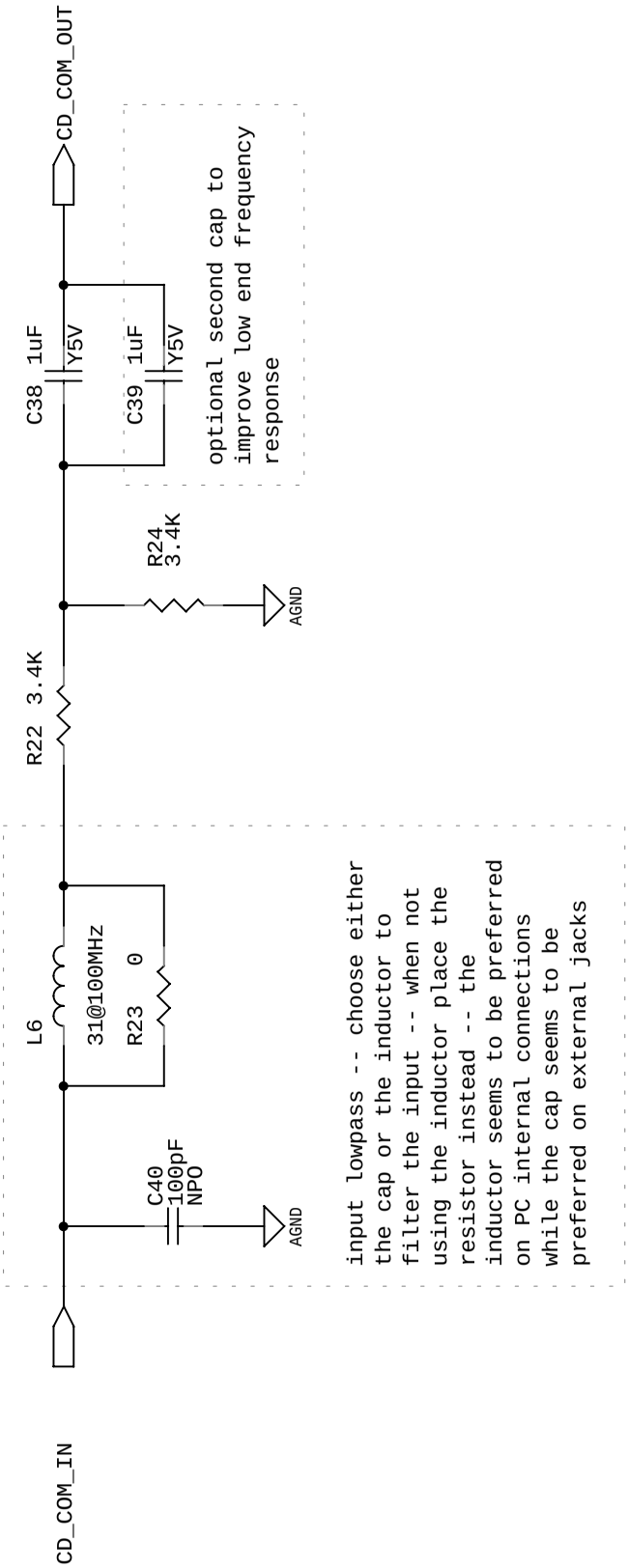

Figure 10. Input Divider CD Common

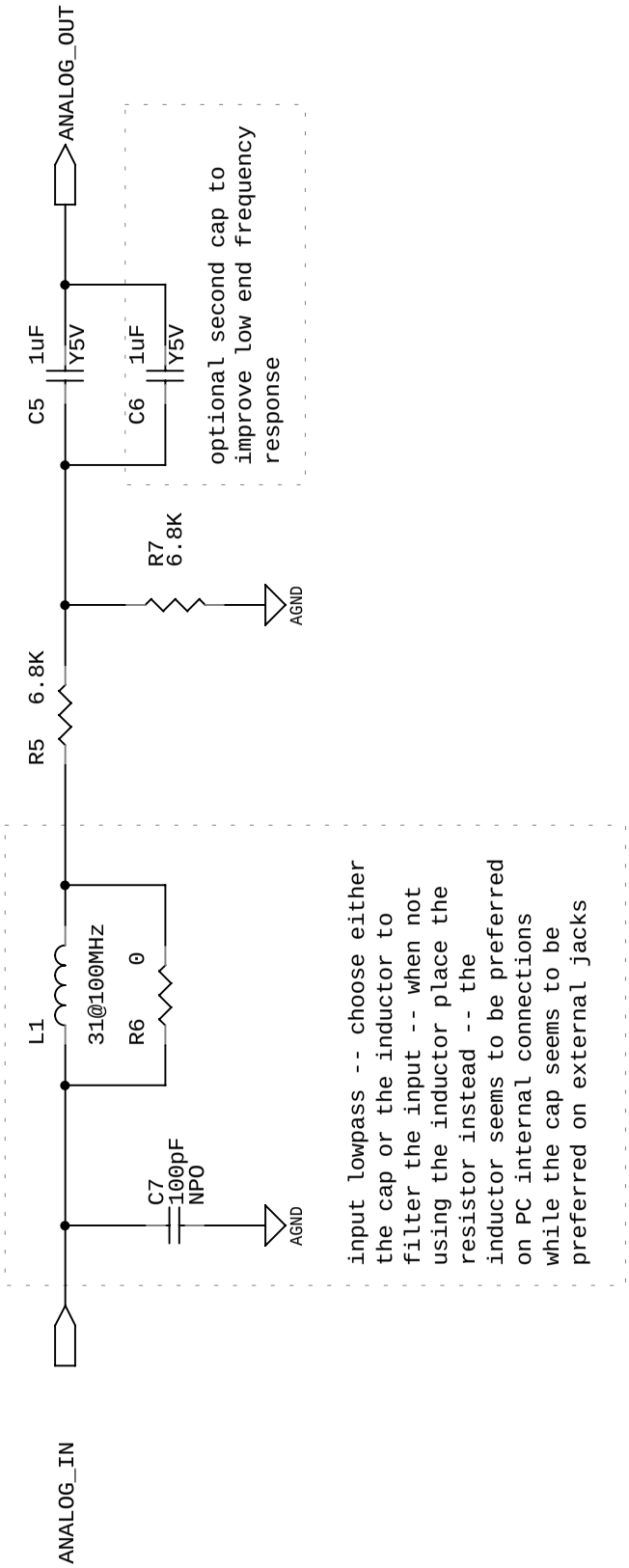

Figure 11. Input Divider AGND (only one path shown)

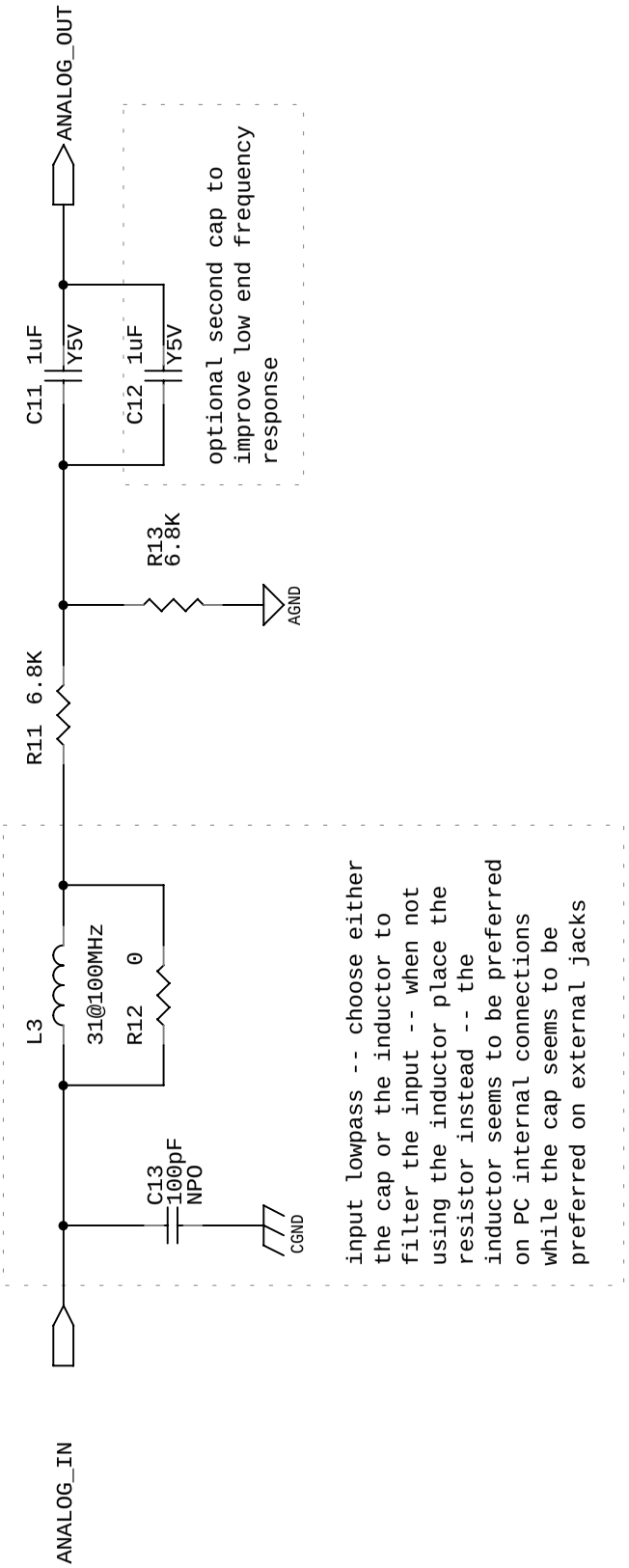

Figure 12. Input Divider CGND (only one path shown)

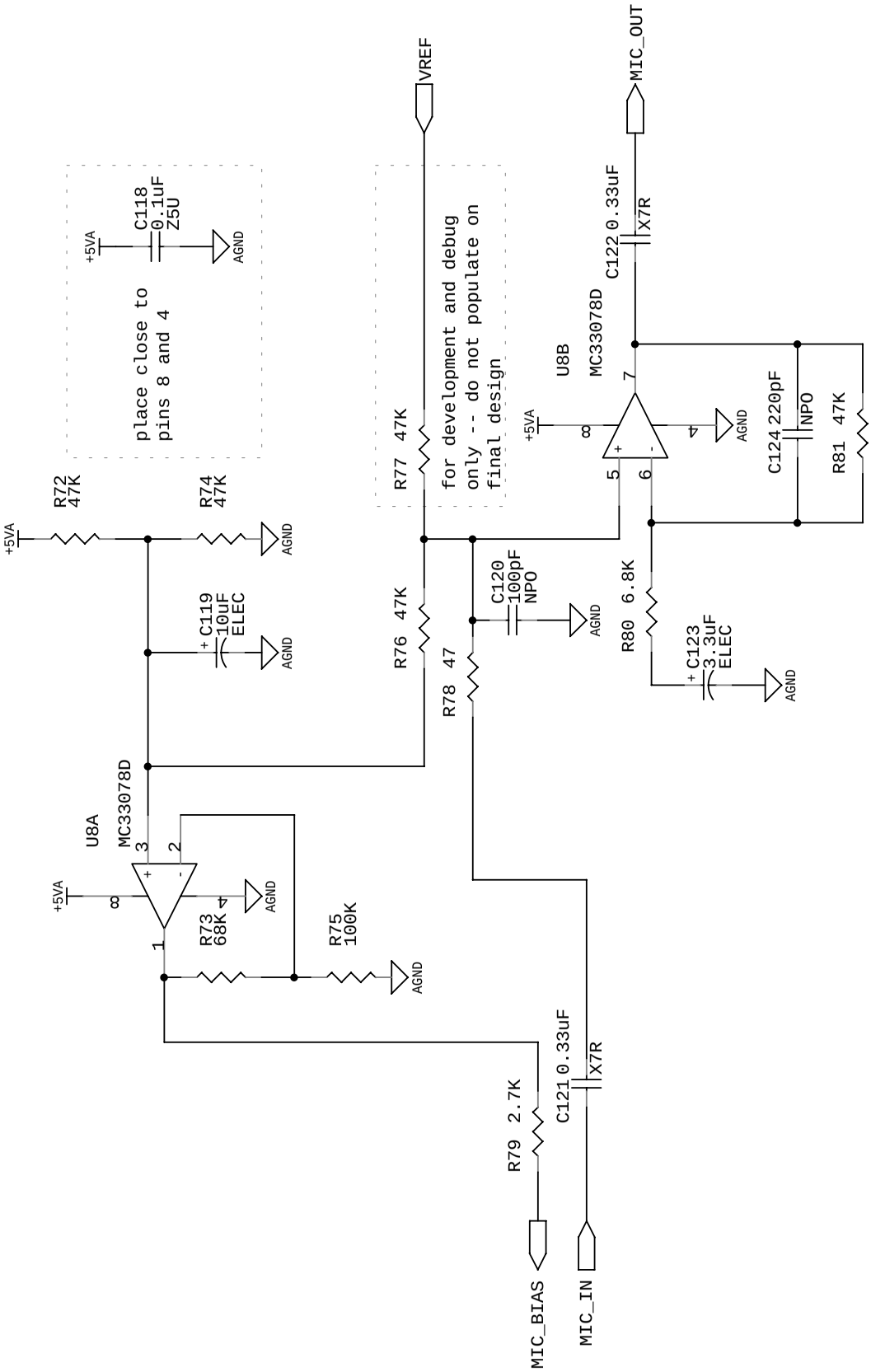

Figure 13. Mic Pre-amp and Bias

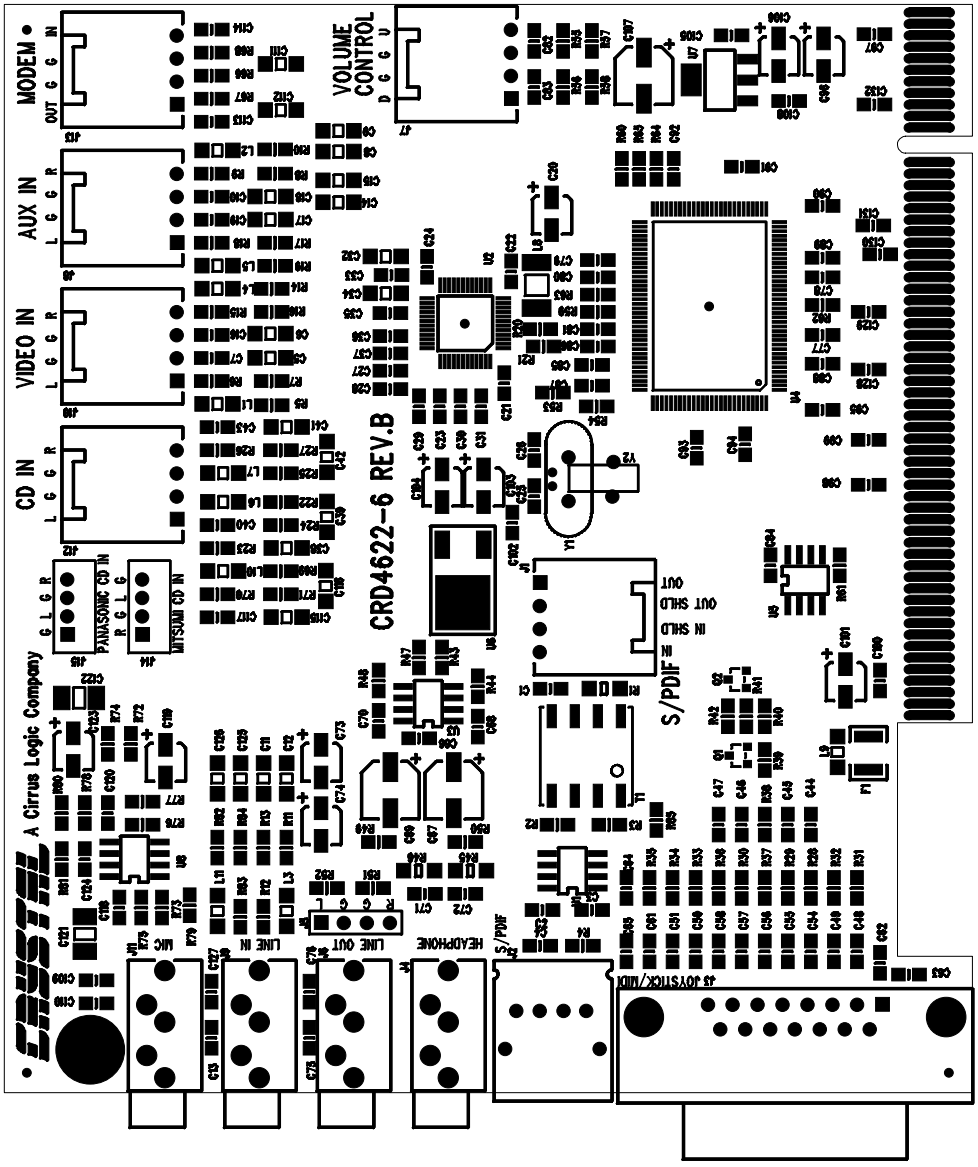

Figure 14. Assembly Drawing

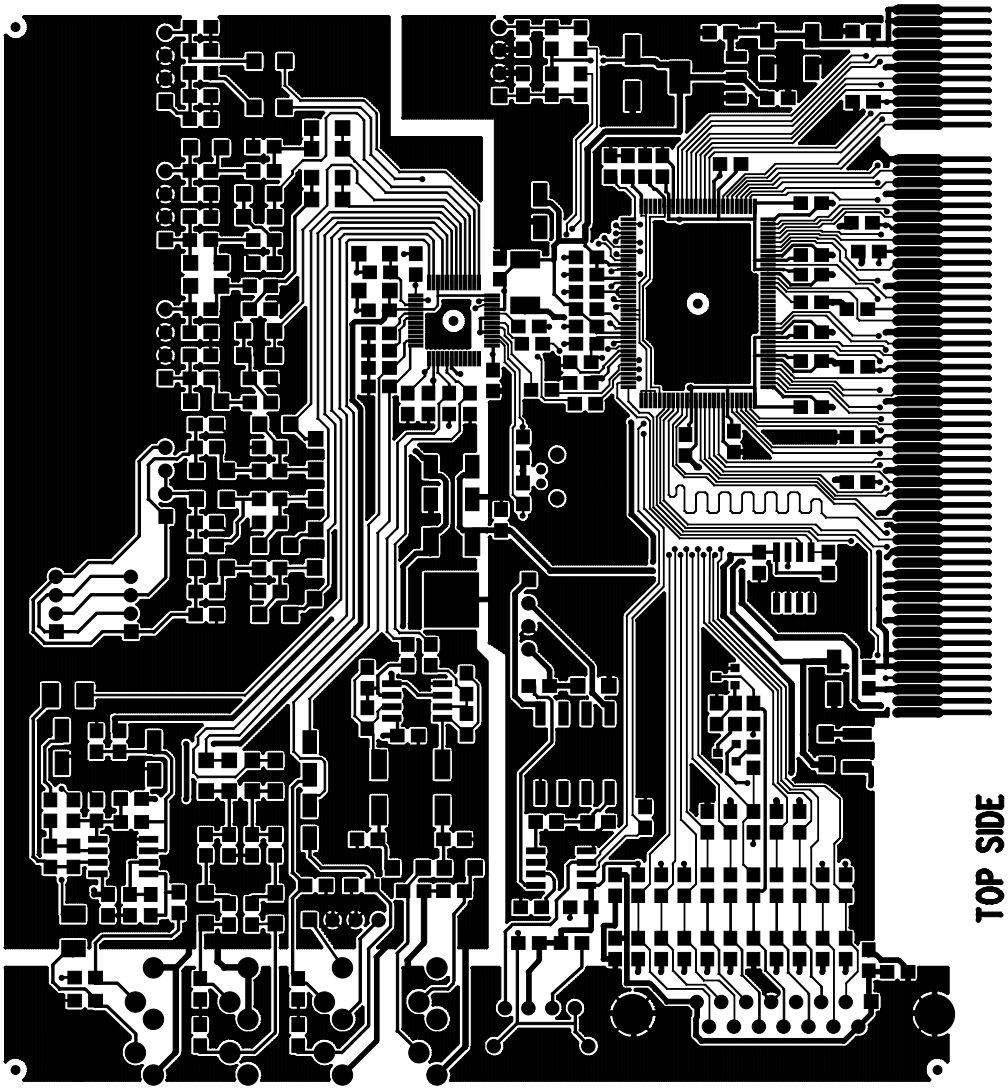

Figure 15. Top Layer

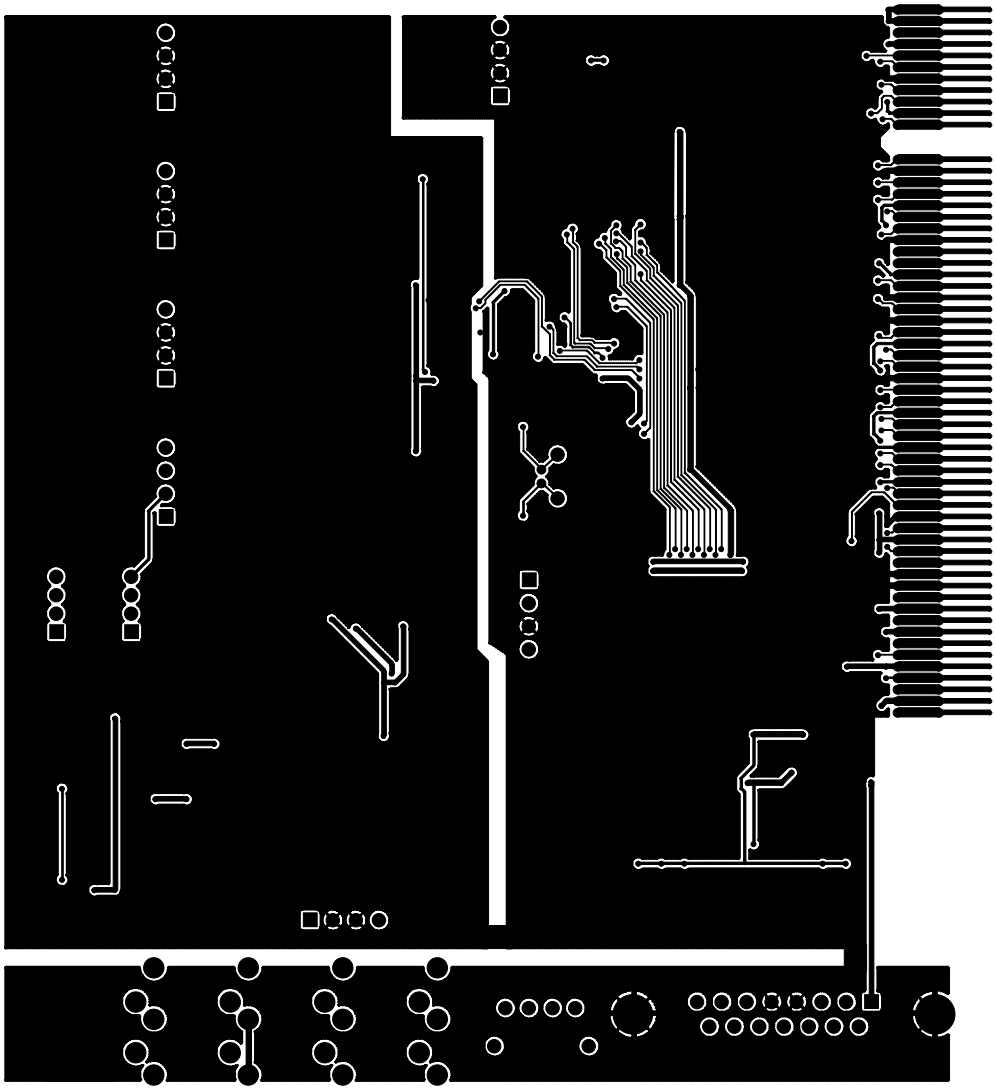

Figure 16. Bottom Layer

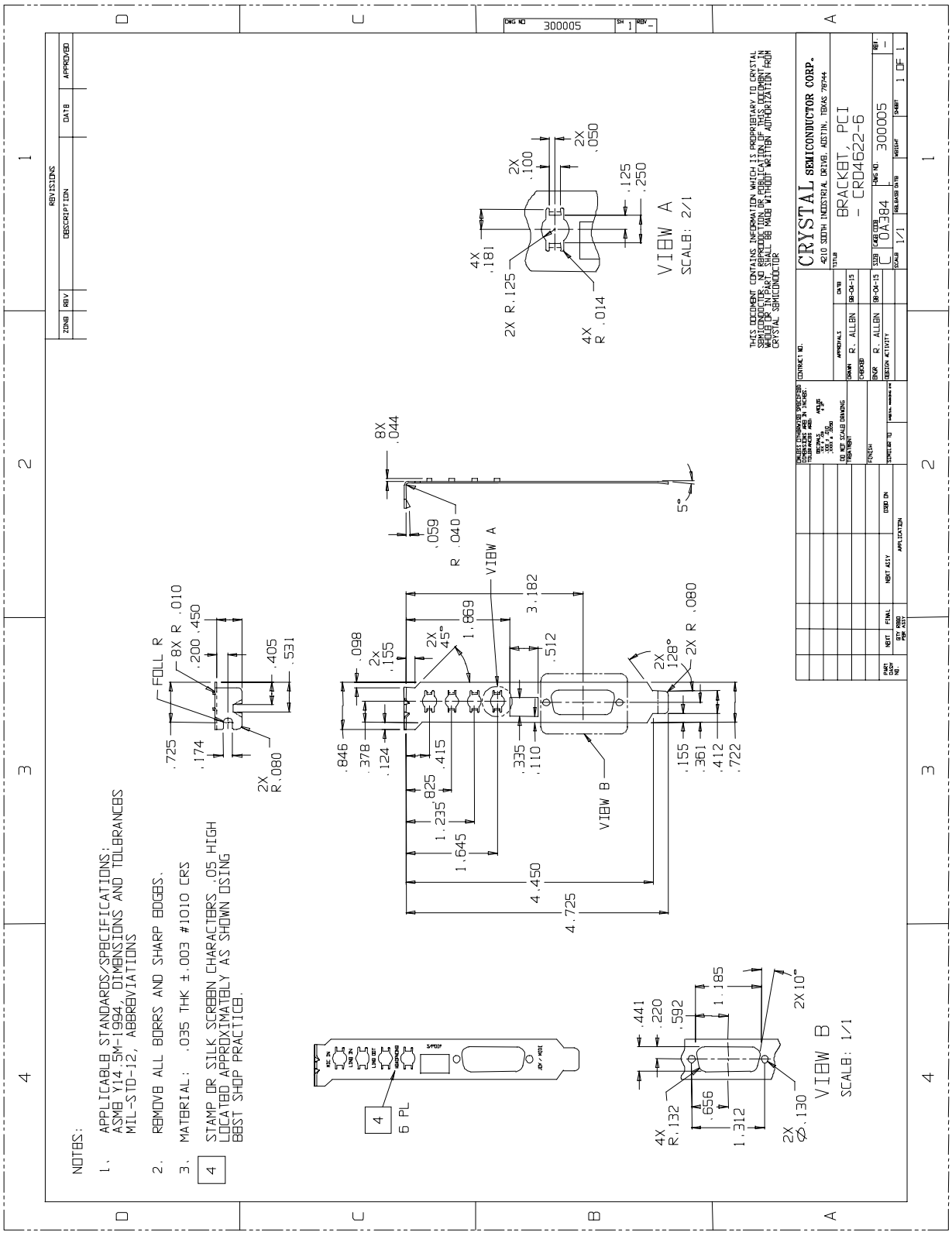

Figure 17. Bracket Drawing

BILL OF MATERIALS

CRD4622-6 Revised: Friday, May 29, 1998
Revision: B1C (EMC optimized)

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Item	Quantity	Reference	Value	Type	PCB Footprint	Manufacturer	Part Number	Description
1	4	C1,C2,C84,C105	0.01uF	X7R	CSN_0805	KEMET	C0805C103K5RAC	CAP, 0805, X7R, .01uF, 10%, 50V
2	31	C3,C4,C21,C22, C23,C24,C33,C35, C62,C64,C66,C77, C88,C89,C90,C91, C92,C93,C94,C95, C97,C100,C102, C108,C118	0.1uF	Z5U	CSN_0805	KEMET	C0805C104M5UAC	CAP, 0805, Z5U, .1uF, 20%, 50V
3	22	C5,C6,C8,C9,C11, C12,C14,C15,C17, C18,C32,C34,C38, C39,C41,C42, C111,C112,C115, C116,C125,C126	1uF	Y5V	CSN_1206	PHILIPS	12062F105M8BB0	CAP, 1206, Y5V, 1uF, 20%, 25V
4	22	C7,C10,C13,C16, C19,C40,C43,C54, C55,C56,C57,C58, C61,C82,C83, C109,C110,C113, C114,C117,C120, C127	100pF	NPO	CSN_0805	KEMET	C0805C101J5GAC	CAP, 0805, COG, 100pF, 5%, 50V
5	9	C20,C73,C74,C96, C101,C103,C104, C106,C119	10uF	ELEC	CSP_ELEC_170SQ	PANASONIC	ECE-V1CA100R	CAP, SMT B, ELEC, 10uF, 20%, 16V
6	4	C25,C26,C68,C70	22pF	NPO	CSN_0805	KEMET	C0805C220J5GAC	CAP, 0805, COG, 22pF, 5%, 50V
7	5	C27,C28,C29,C30, C31	680pF	NPO	CSN_0805	KEMET	C0805C681J5GAC	CAP, 0805, COG, 680pF, 5%, 50V
8	6	C36,C37,C71,C72, C75,C76	390pF	NPO	CSN_0805	KEMET	C0805C391J5GAC	CAP, 0805, COG, 390pF, 5%, 50V
9	4	C44,C45,C46,C47	5600pF	X7R	CSN_0805	KEMET	C0805C562K5RAC	CAP, 0805, X7R, 5600pF, 10%, 50V
10	7	C48,C49,C50,C51, C63,C65,C85	1000pF	X7R	CSN_0805	KEMET	C0805C102K5RAC	CAP, 0805, X7R, 1000pF, 10%, 50V
11	2	C67,C69	220uF	ELEC	CSP_ELEC_260SQ	PANASONIC	ECE-V0GA221P	CAP, SMT D, ELEC, 220uF, 20%, 4V
12	2	C98,C129	0.022uF	Z5U	CSN_0805	KEMET	C0805C223M5UAC	CAP, 0805, Z5U, .022uF, 20%, 50V
13	5	C99,C128,C130, C131,C132	0.047uF	Z5U	CSN_0805	KEMET	C0805C473M5UAC	CAP, 0805, Z5U, .047uF, 20%, 50V
14	1	C107	100uF	ELEC	CSP_ELEC_260SQ	PANASONIC	ECE-V0JA101P	CAP, SMT D, ELEC, 100uF, 20%, 6.3V
15	2	C121,C122	0.33uF	X7R	CSN_1210	KEMET	C1210C334K5RAC	CAP, 1210, X7R, .33uF, 10%, 50V
16	1	C123	3.3uF	ELEC	CSP_ELEC_170SQ	PANASONIC	ECE-V1HA3R3R	CAP, SMT B, ELEC, 3.3uF, 20%, 50V

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Item	Quantity	Reference	Value	Type	PCB Footprint	Manufacturer	Part Number	Description
17	1	C124	220pF	NPO	CSN_0805	KEMET	C0805C221J5GAC	CAP, 0805, COG, 220pF, 5%, 50V
18	1	F1	FUSE 0.5A	PPTC	FUSE_MINISMD050	RAYCHEM	miniSMD050-2	FUSE, SMT, 0.5A hold, 1.0A trip
19	1	H1	HOLE		HOLE			
20	2	J1,J7	4X1HDR-SN/PB		CON_MLX_70553	MOLEX	70553-0038	HDR, 4X1, 0.025" PIN, 0.1" CTR, 150u" SN/PB
21	1	J2	TOTX-173		TOTX173	TOSHIBA	TOTX173	CONN, OPTICAL TOSLINK TRANSMITTER
22	1	J3	DB15		CON_DA15F_RA	AMP	747845-3	CONN, 15D SHELL, FEMALE, RT ANGLE PC MOUNT
23	1	J4	PHONO-1/8		CON_STEREO_LZR	LZR ELECTRONICS	SJ373	CONN, 1/8" NON-SW. STEREO PHONE JACK
24	1	J5	4X1HDR		HDR4X1	SAMTEC	TSW-104-07-G-S	HDR, 4X1, 0.025" PIN, 0.1" CTR
25	2	J6,J9	PHONO-1/8		CON_STEREO_LZR	LZR ELECTRONICS	SJ372	CONN, 1/8" DOUBLE SW. STEREO PHONE JACK
26	4	J8,J10,J12,J13	4X1HDR-AU		CON_MLX_70553	MOLEX	70553-0003	HDR, 4X1, 0.025" PIN, 0.1" CTR, 15u" AU
27	1	J11	PHONO-1/8		CON_STEREO_LZR	LZR ELECTRONICS	SJ374	CONN, 1/8" SINGLE SW. STEREO PHONE JACK
28	2	J14,J15	B4B-PH-K		HDR4X1_080	JST	B4B-PH-K	HDR, 4 PIN SHROUDED, .08"
29	10	L1,L2,L3,L4,L5,L6, L7,L9,L10,L11	31@100MHz	FERRITE	IND_FB1206	TDK	HF50ACB321611-T	IND, FBEAD, 1206, 31@100MHz, 25%
30	1	L8	120@100MHz	FERRITE	IND_FB1812	TDK	HF30ACB453215-T	IND, FBEAD, 1812, 120@100MHz, 25%
31	1	P1	PCI BUS 5V A		PCI_BUS_5V_A			PCI BUS 5V SIDE A
32	1	P2	PCI BUS 5V B		PCI_BUS_5V_B			PCI BUS 5V SIDE B
33	1	Q1	MMBT2907ALT1		SOT23	NATIONAL	MMBT2907ALT1	TRAN, SO, PNP, SOT23
34	1	Q2	MMBT3904LT1		SOT23	NATIONAL	MMBT3904LT1	TRAN, SO, NPN, SOT23
35	1	R1	75	1/4W	RES_1206	PHILIPS	9C12063A75R0J	RES, SO, 1206, 75, 5%, 1/4W, METAL FILM
36	1	R2	374		RES_0805	PHILIPS	9C08052A3740F	RES, SO, 0805, 374, 1%, 1/10W, METAL FILM
37	1	R3	90.9		RES_0805	PHILIPS	9C08052A90R9F	RES, SO, 0805, 90.9, 1%, 1/10W, METAL FILM
38	1	R4	8.2K		RES_0805	PHILIPS	9C08052A8201J	RES, SO, 0805, 8.2K, 5%, 1/10W, METAL FILM
39	16	R5,R7,R8,R10, R11,R13,R14,R16, R17,R19,R25,R27, R69,R71,R82,R84	6.8K		RES_0805	PHILIPS	9C08052A6801F	RES, SO, 0805, 6.8K, 1%, 1/10W, METAL FILM
40	10	R6,R9,R12,R15, R18,R23,R26,R66, R70,R83	0		RES_0805	PHILIPS	9C08052A0R00J	RES, SO, 0805, 0, 5%, 1/10W, METAL FILM
41	5	R20,R21,R53,R54, R78	47		RES_0805	PHILIPS	9C08052A47R0J	RES, SO, 0805, 47, 5%, 1/10W, METAL FILM
42	2	R24,R22	3.4K		RES_0805	PHILIPS	9C08052A3401F	RES, SO, 0805, 3.4K, 1%, 1/10W, METAL FILM
43	4	R28,R29,R30,R36	2.2K		RES_0805	PHILIPS	9C08052A2201J	RES, SO, 0805, 2.2K, 5%, 1/10W, METAL FILM
44	7	R31,R32,R33,R34, R55,R56,R61	4.7K		RES_0805	PHILIPS	9C08052A4701J	RES, SO, 0805, 4.7K, 5%, 1/10W, METAL FILM
45	10	R35,R49,R50,R67, R68,R72,R74,R76, R77,R81	47K		RES_0805	PHILIPS	9C08052A4702J	RES, SO, 0805, 47K, 5%, 1/10W, METAL FILM
46	3	R37,R57,R58	100		RES_0805	PHILIPS	9C08052A1000J	RES, SO, 0805, 100, 5%, 1/10W, METAL FILM
47	4	R38,R39,R44,R48	39K		RES_0805	PHILIPS	9C08052A3902J	RES, SO, 0805, 39K, 5%, 1/10W, METAL FILM
48	1	R40	5.1K		RES_0805	PHILIPS	9C08052A5101J	RES, SO, 0805, 5.1K, 5%, 1/10W, METAL FILM

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Item	Quantity	Reference	Value	Type	PCB Footprint	Manufacturer	Part Number	Description
49	8	R41,R59,R60,R62, R63,R64,R65,R85	10K		RES_0805	PHILIPS	9C08052A1002J	RES, SO, 0805, 10K, 5%, 1/10W, METAL FILM
50	1	R42	20K		RES_0805	PHILIPS	9C08052A2002J	RES, SO, 0805, 20K, 5%, 1/10W, METAL FILM
51	2	R43,R47	27K		RES_0805	PHILIPS	9C08052A2702J	RES, SO, 0805, 27K, 5%, 1/10W, METAL FILM
52	2	R45,R46	10	1/4W	RES_1206	PHILIPS	9C12063A10R0J	RES, SO, 1206, 10, 5%, 1/4W, METAL FILM
53	2	R51,R52	1M		RES_0805	PHILIPS	9C08052A1004J	RES, SO, 0805, 1M, 5%, 1/10W, METAL FILM
54	1	R73	68K		RES_0805	PHILIPS	9C08052A6802J	RES, SO, 0805, 68K, 5%, 1/10W, METAL FILM
55	1	R75	100K		RES_0805	PHILIPS	9C08052A1003J	RES, SO, 0805, 100K, 5%, 1/10W, METAL FILM
56	1	R79	2.7K		RES_0805	PHILIPS	9C08052A2701J	RES, SO, 0805, 2.7K, 5%, 1/10W, METAL FILM
57	1	R80	6.8K		RES_0805	PHILIPS	9C08052A6801J	RES, SO, 0805, 6.8K, 5%, 1/10W, METAL FILM
58	1	T1	29398		XFR_SCT_29398	SCHOTT CORP	29398	DIGITAL AUDIO TRANSFORMER, SMT, 1 TO 10 MHZ
59	1	U1	SN75179B		SO8	TI	SN75179B	IC, SO, SOIC8, DIFF. DRIVER/RECEIVER PAIR
60	1	U2	CS4297		QFP48_7X7	CRYSTAL	CS4297-KQ	IC, SO, AC '97 SERIAL CODEC
61	1	U3	TDA1308		SO8	PHILIPS	TDA1308T	IC, SO, SOIC8, 1308, LOW NOISE HEADPHONE AMP
62	1	U4	CS4622		QFP128_14X20	CRYSTAL	CS4622-CQ	IC, SO, PCI Audio Accelerator
63	1	U5	AT24C04	512X8BIT	SO8	ATMEL	AT24C04N-10SC-2.7	IC, SO, SOIC8, EEPROM, 24C04, 512X8BIT, 2.7V
64	1	U6	MC78M05ACDT		DPAK	MOTOROLA	MC78M05ACDT	IC, SO, +5V REGULATOR, DPAK, 2%, 500mA
65	1	U7	LT1117CST-3.3		SOT223	LINEAR TECH	LT1117CST-3.3	IC, SO, +3.3V REGULATOR, SOT-223, 0.2%, 800mA
66	1	U8	MC33078D		SO8	MOTOROLA	MC33078D	IC, SO, SOIC8, 33078, DUAL OP AMP
67	1	Y1	24.576 MHz	PAR RES, FUND	XTL_HC49S	FOX	FS24.576	XTAL, 24.576MHz, HC49S, Fund Mode, Par Res
68	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
do not populate the following items:								
4	7	C7,C10,C16,C19, C40,C43,C117	100pF	NPO	CSN_0805	KEMET	C0805C101J5GAC	CAP, 0805, COG, 100pF, 5%, 50V
29	2	L3,L11	31@100MHz	FERRITE	IND_FB1206	TDK	HF50ACB321611-T	IND, FBEAD, 1206, 31@100MHz, 25%
40	7	R6,R9,R15,R18, R23,R26,R70	0		RES_0805	PHILIPS	9C08052A0R00J	RES, SO, 0805, 0, 5%, 1/10W, METAL FILM
45	1	R77	47K		RES_0805	PHILIPS	9C08052A4702J	RES, SO, 0805, 47K, 5%, 1/10W, METAL FILM
46	1	R37	100		RES_0805	PHILIPS	9C08052A1000J	RES, SO, 0805, 100, 5%, 1/10W, METAL FILM
49	1	R85	10K		RES_0805	PHILIPS	9C08052A1002J	RES, SO, 0805, 10K, 5%, 1/10W, METAL FILM
68	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

• Notes •

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