COUNTERPOINT

SOLID - 2 and SOLID - 2A POWER AMPLIFIER

SERVICE MANUAL

MANUAL REVISION: B
PRINTED April 7, 1995

APPLIES TO SERIAL NUMBERS STARTING: 1S2000 or greater

For Technical Support, please contact
Technical Support
COUNTERPOINT ELECTRONIC SYSTEMS, INCORPORATED
AUDIO COMPONENTS DIVISION
2281 LAS PALMAS DRIVE
CARLSBAD, CA 92009
USA

Telefax: 619 431 5986 (U.S.A.)

1. CONTENTS

WARNINGS

Normal precautions should be observed when servicing this mains powered unit.

Safety regulations require that this unit should be restored to its original condition and that parts identical with those specified be used.

All ICs and many other semi-conductors are susceptible to electrostatic discharges (ESD). Careless handling during repair can reduce the life of a component drastically. When repairing make sure that you are connected with the same potential as the mass of the set via a wrist strap with resistance. Keep components and tools also at this potential.

GENERAL DESCRIPTION

The Solid-2 is a stereophonic high-fidelity audio power amplifier with a 200 watts per channel (8 ohm load) power rating.

Some early units, although essentially the same electrically, incorporated a somewhat narrower chassis, a different style of heatsink, and a cosmetically different audio output board. Technically, only these units are Solid-2's, with more recent production being "Solid-2A's". The differences being only cosmetic, the term "Solid-2" will be used in this manual to refer to both versions.

The amplifier module of the Solid-2 Power Amplifier consists of three sections: a constant-current cascoded FET differential amplifier input stage, a second stage differential transconductance amplifier with cascoded current mirror load, and a triple Darlington current amplifier output stage.

Power supply buffers provide low impedance voltages to the low level stages, and an integrated circuit DC servo controls output offset voltage.

All stages up to the output driver stage are biased Class AB. Only 14dB of overall negative feedback is used.

SPECIFICATIONS

.1 Output Power (load impedances below 2 ohms not recommended)
200 W into 8 ohms
400 W into 4 ohms
500 W into 2 ohms.

.2 Gain (voltage)
29.5dB.

.3 Input Sensitivity
per IHF: 87mV/1W
to rated power: 1.25V

.4 Input Impedance
100k, 220pF

.5 Frequency Response
1Hz to 100kHz, bandwidth limited

.6 Signal-to-Noise
93dB (10Hz-20kHz), referenced to 1W, IHF-weighted

.7 Harmonic Distortion (THD+N)
<0.2% / 200W

.8 Damping Factor (ref 8 Ω)
150 @ 1kHz, not less than 60 @ 20kHz

.9 Output Impedance
0.052 Ω

.10 Maximum Output Current
100 Amps peak, (20/480ms pulse).

.11 DC Offset
less than 10mV, servo-corrected.

.12 Signal Polarity (Absolute Phase).
Non-inverting.

.13 Power Requirements
150 W

Replacement Fuse Value (all fuses North American standard ¼" x 1¼" size except mains)

Mains: 10-amp slow (100-120VAC) (5x20mm)
6-amp slow (230VAC)

Speaker: 15-amp fast (10-amp fast in units shipped to Japan)

Rails: 20-amp fast

.14 Dimensions

Front Panel: 19 inches (48 cm) wide, 6.7inches (17 cm) tall, 19 inches (48 cm), ,

.15 Weight

67 Lbs (30 kg)

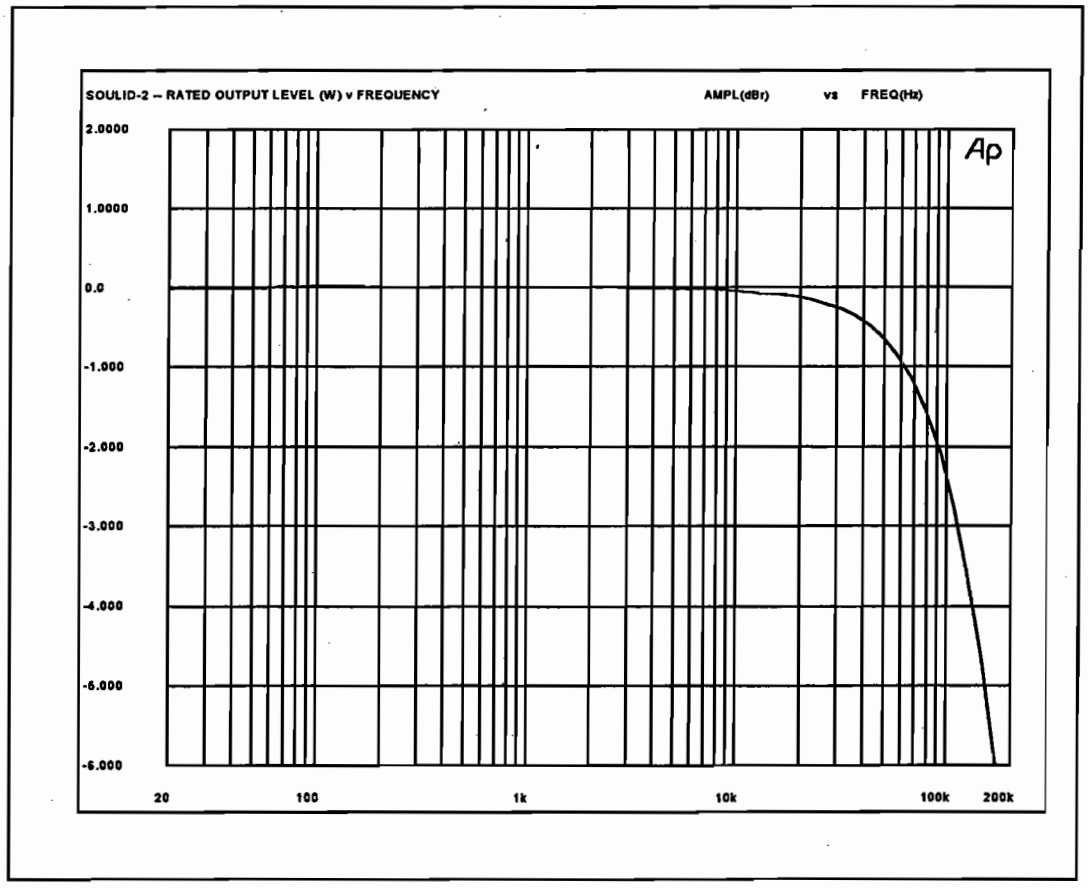


Figure 1 Rated output level / Frequency

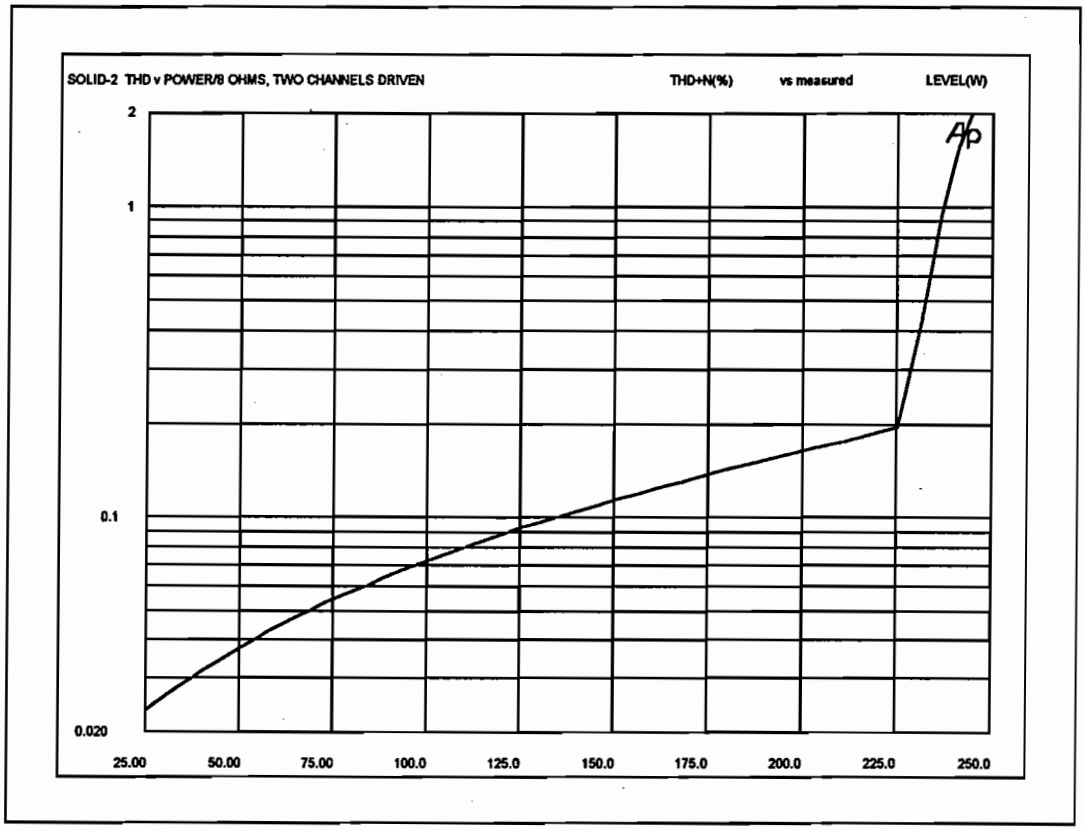
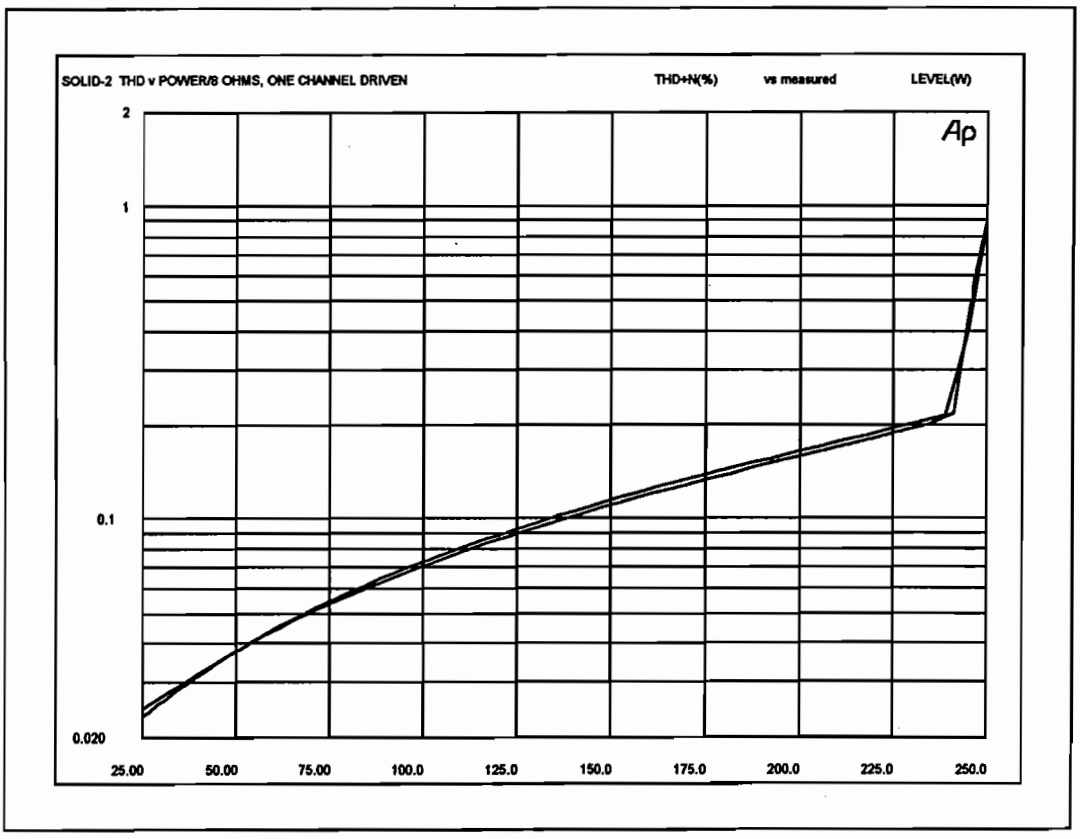


Figure 2 THD / Power into 8 Ohms with two channels driven



7Figure 3 *THD / Power into 8 Ohms with one channel driven*

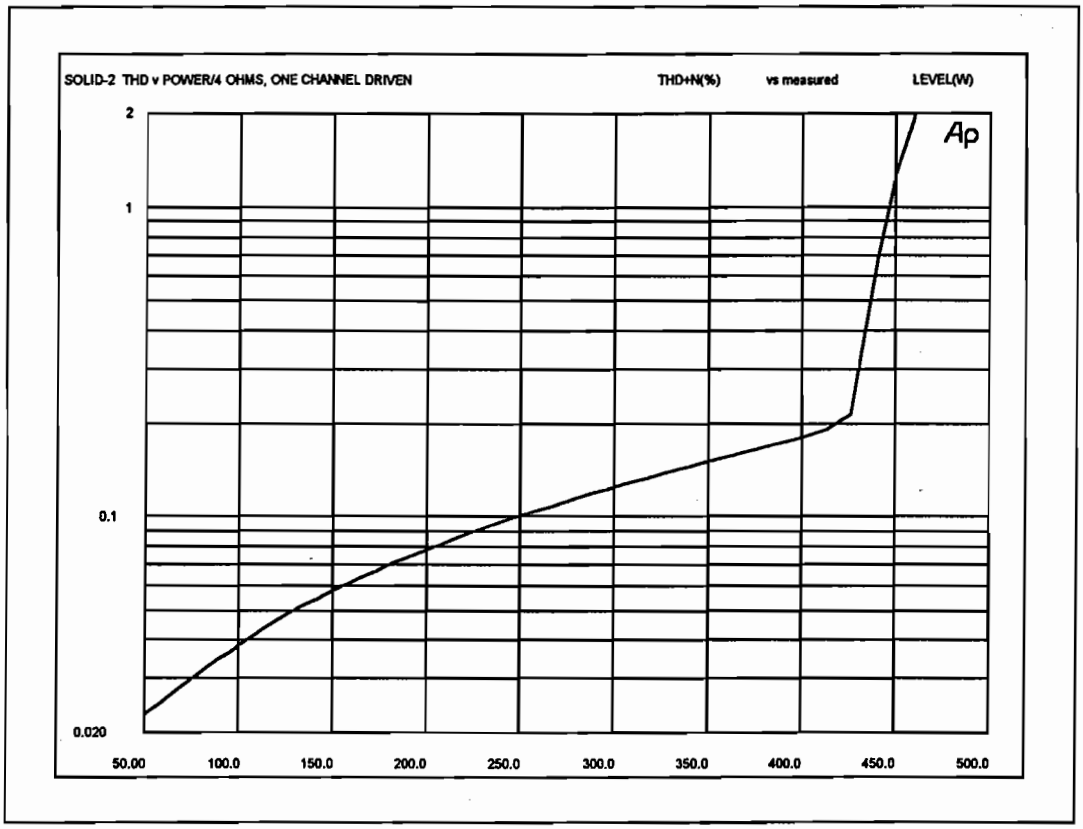


Figure 4 THD / Power into 4 Ohms with one channel driven

DETAILED CIRCUIT DESCRIPTIONS

Power Supply Board

The power supply board is fitted with a bridge rectifier and large smoothing capacitors; the left and right channel circuit boards are supplied with rectified and smoothed voltages from this board. The low level regulation is performed separately on each board.

Test Point	DC Voltage Left Channel	DC Voltage Right Channel
TP-I	+88 (loses ~ 1.8V through pilot lamp)	+90
TP-J	-90	-90
TP-N	-15	-15
TP-O	+15	+15

Amplifier Module

Each audio output printed wiring board is mounted directly to a heatsink at the side of the Solid-2 amplifier. The left and right PCBs are essentially mirror images of each other.

The input stage uses a dual monolithic FET, Q17, as the gain element. Drain voltage is established by resistors R25 and R26 driving cascoding transistors Q20 and Q21. This allows Q17 to withstand the high power supply voltages while improving linearity and bandwidth. The input FET is protected from overvoltage by the diodes D18 and D19. Stage gain is stabilized, linearity is improved, and bandwidth is further extended through the use of source degeneration resistors R19 and R20. Constant operating current is provided by Q18. Current is sensed by Q19, and Q18's base voltage is modulated to control the stage current.

The input stage's output signals are developed differentially across load resistors R23 and R24. These resistors also provide base bias voltage for second stage transistors Q22 and Q23. Local degeneration is provided by R27 and R28. Stage transconductance is controlled by the extremely high impedance of the current mirror load comprised of Q26 and Q27, which are cascoded by Q25 and Q24. Additional emitter degeneration is provided by R32 and R31 to improve linearity and balance. Overall gain is set by resistors R29 and R30.

The output stage uses three stages of fully complementary current amplification for high output impedance. Output stage bias voltage is developed by a complementary "Vbe multiplier" topology using Q14 and Q13. These transistors are mounted on the heatsink to provide thermal tracking of the output transistors and prohibit thermal runaway. Operating current of pre-driver transistors Q1 and Q2 is set by R1. Driver transistors Q3 and Q4 are biased through R10. Parallel output transistors Q5-12 offer improved

reliability with low impedance loads. Diodes D10 and D17 damp current spikes caused by highly inductive loads, while C1, R11, and Z1 preserve loop stability in the presence of highly reactive loads.

Overall feedback is taken from R35 and R41. In addition, capacitor C10 provides optimum high frequency damping to minimize transient overshoot. Any offset voltage appearing at the stage's output is sensed by R36. Capacitor C11 filters out any AC or signal components. Diodes D7 and D8 protect U1 against any high voltage signals. Operational amplifier U1 integrates any offset with a time constant set by C12 and R37. A resistive level attenuator, R38 and R41, provides enough range to control any expected offset while still offering sufficient low frequency extension for audio signals. R39, D9, and R40 provide the operating voltages for U1, which would otherwise be damaged by the high operating voltages used by the discrete circuitry.

Low power supply impedance over the audio range is maintained by emitter followers Q15 and Q16. These transistors buffer the reference voltage created by the diodes D1, D2, D6, (D3, D4, D5) and resistor R18 (R17) and filtered by C5 (C6), thus offering a high degree of isolation from the main supply. Capacitor C8 (C7) provides additional bypassing for high frequency signals. 20 Amp fuses protect the output devices.

Test Point	DC Voltage Left Channel	DC Voltage Right Channel
TP-B	0	0
TP-C	+84	+86
TP-D	+84	+86
TP-G	+1.1	+1.1
TP-H	-1.1	-1.1
TP-L	less than 100mV	less than 100mV

SERVICE DATA

Adjusting the Solid-2's bias:

This procedure should be performed whenever any output, pre-driver, or driver transistors are replaced.

- Disconnect the amplifier from the AC mains and wait 1 minute for the internal voltages to drop to zero.

- Remove one of the rail fuses and connect an ammeter across the fuse terminals. Alternately, you may install a 1-ohm resistor soldered in parallel with a opened (broken) fuse and install this into the fuse terminals--in this case, connect a DC voltmeter across the resistor and note that each milivolt measured represents a miliamp of current flowing.

- Connect the amplifier to an autotransformer (Variac) and increase the AC mains to nominal voltage. The output stage current may increase to a large value with low AC mains voltage, but will drop back to a lower level. Verify that less than 10mvdc apars across the output terminals of each channel when full mains voltage has been applied and the amplifier has settled for a few seconds.

- Use BIAS trimmer VR2 to set the output stage bias current to nominal value:

  Target bias value is 200mA (200mV across a 1-ohm resistor).

The bias current will move slowly above and below the target value due to the thermal delay of the heatsink. A ± 10mA change is normal.

- **Check the currents of all output transistors.** To do this, connect the a DVM's ground lead to the amplifier's hot output, the RED speaker terminal.

- Measure the bias currents of each of the output devices to ensure that all devices are sharing the total current reasonably equally. There are test points on the board, next to the emitter of each device.

- The Solid-2 has 8 output transistors per channel; test the NPN's (2SC3858) at TP 1,2,3 & 4; the PNP's (2SA1494) at TP 5,6,7, & 8. Each reading should be approximately 9 mVDC

- Note that half of the readings (NPN currents) will be positive and half (PNP) will be negative!

All readings should be within approximately 20%, i.e., the difference between the highest & lowest voltage reading should be less than 20% above the lowest reading. Differences much greater than this may indicate badly matched output devices or damaged emitter resistors.

- Reduce the Variac to 0V.
- Discharge rails with a suitable load resistor (15 Ohm, 10W).

Repair Procedures

1. General

   All the components in the Solid-2 are of the highest quality and should have a long trouble-free life since they are operated well below their manufacturer's rating. The following procedure may facilitate locating the source of trouble if the Solid-2 does not function properly.

2. Fuses

   There are seven fuses in the Solid-2. For replacement values, see the **Specifications** section of this manual.

   The mains fuse is located within the AC mains power inlet on the center of the amplifier's rear deck. Note that the power cord must be removed before the small tray carrying the fuse can be removed.

   The two speaker fuses are located next to the speaker connectors on the amplifier's rear deck.

   Each amplifier module has two rail fuses, located on the right and left channel circuit boards.

3. Same Problem in Both Channels

   The Solid-2 is a dual-mono amplifier. If it does not turn on, the problem must be in the AC mains/transformer primary circuitry. The circuitry is located under the central cover plate.

- Check the AC mains cable, the mains receptacle, the mains fuse, both over-temperature switches mounted on the heatsinks, and front-panel mains switch.
- Check the transformer to be certain that the primary has not failed. DC resistances for the Solid-2 are as follows:

  115 VAC operation - 0.17 ohms
  230VAC operation - 0.70 ohms

- Disconnect all connections to transformer secondary windings and recheck primary current (the tendency to blow fuses). If the transformer still draws too much current with all secondaries disconnected, it has failed and must be replaced.

- If the transformer has not failed, re-connect the secondaries one at a time until the problem occurs. Use trouble-shooting techniques to determine the failed components responsible for the excess current.

Check DC Operating Voltages

Careful use of the Schematic Diagrams and Circuit Board Layouts permits troubleshooting the Solid-2's circuitry. If a test point's voltage differs significantly from the correct voltage, all of the components wiring and voltage and resistance readings to ground associated with that circuitry and the circuitry preceding the test point should be made.

SERVICE BULLETINS

COUNTERPOINT

SERVICE BULLETIN

Model: Solid-2	**Affects Units:** Units with serial numbers below 5S2000

Bulletin #: S2-0194	**Date:** January 13, 1994
Approved by: J.M.Elliott	**Page:** 1 of 1

Scope: The original transistors cannot handle as much current as these new devices.

Purpose: To prevent failure of the transistors under fault conditions.
Upgrades performance to level of the Solid-2A.

Required Materials:

TIP50 (Motorola)	Quantity 2	Replaces 2SC3298
MJE 5731 (Motorola)	Quantity 2	Replaces 2SA1306

These parts can be supplied by Counterpoint on request, please quote the Service Bulletin number when ordering.

Supplied Documents: Drawings: 7S2501-D Amplifier Module Detail Schematic

Procedure: Disconnect the Solid-2 from the AC mains and remove the top cover.

Remove the heatsinks from the chassis, and lay the heatsinks down next to the sides of the amplifier.

Remove the 2SC3298 transistors (located towards the center of the heatsinks) and replace with TIP50 transistors.

Remove the 2SA1306 transistors (located towards the center of the heatsinks) and replace with MJE5731 transistors.

Re-assemble the heatsinks and then perform bias adjustments as per the service manual.

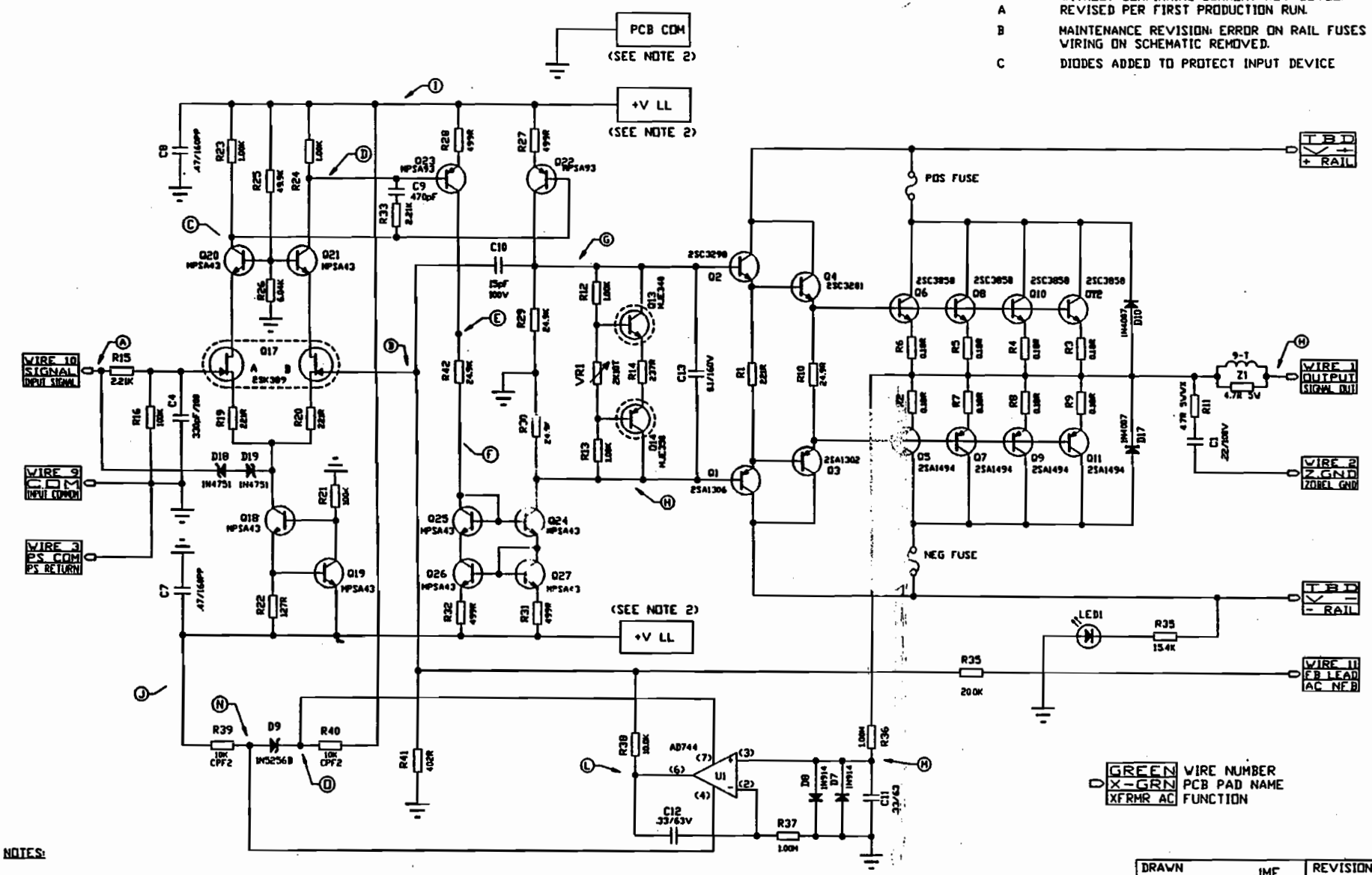
COUNTERPOINT ELECTRONIC SYSTEMS, INC.
2281 Las Palmas Drive • Carlsbad • California • 92009
Tel (619) 431 5050 • Fax (619) 431 5986

SCHEMATICS

Audio output board

Regulator for driver stages

REV	DESCRIPTION	DATE
-NONE-	FIRST ITERATION DRAWING FOR PROTOTYPING PURPOSES ONLY. DO NOT USE FOR PRODUCTION WITHOUT CONFIRMING CURRENT REV LEVEL.	2/92
A	REVISED PER FIRST PRODUCTION RUN.	10/92
B	MAINTENANCE REVISION: ERROR ON RAIL FUSES WIRING ON SCHEMATIC REMOVED.	11/93
C	DIODES ADDED TO PROTECT INPUT DEVICE	10/93



GREEN — WIRE NUMBER
X-GRN — PCB PAD NAME
XFRMR AC — FUNCTION

NOTES:

1. ONE CHANNEL SHOWN. COMPLETE SOLID-2 AMPLIFIER CONSISTS OF TWO AMPLIFIER CIRCUIT BOARDS, PVA S2-L-PCB AND S2-R-PCB; AND ONE S2-3-PSB POWER SUPPLY BOARD.
2. REFER TO DRAWING NUMBER 7S2-8 "LOW-LEVEL VOLTAGE REGULATION DIAGRAM" FOR DETAILS ON LOW-LEVEL VOLTAGE REGULATORS.
2. REFER TO DRAWING NUMBER 7S2-10 "WIRE INTERCONNECTION DIAGRAM" FOR DETAILS ON AMPLIFER WIRING HARNESSING.
3. REFERENCED VOLTAGES Ⓐ THROUGH Ⓝ REFER TO NORMAL DC OPERATING VOLTAGES AS SHOWN ON DRAWING NUMBER 7S2-1 "DC OPERATING VOLTAGES, PVA S2-L-PCB."
4. FOR DESCRIPTION OF CIRCUIT, REFER TO DRAWING NUMBER 7S1-2 "CIRCUIT DESCRIPTION, PVA S2-L-PCB."
5. FOR LIST OF FIELD-REPLACEABLE PARTS, REFER TO DRAWING NUMBER 7S2-3 "PARTS LIST OF MATERIALS, SOLID-2 AMPLIFIER."

PRINTED CIRCUIT BOARD:

1. SINGLE-SIDED VERSION
2. CPT/PN S2AMP-C R/L
3. LAYOUT REV L1

DRAWN	JME	REVISION	C
ON DATE	10/93	PRODUCT:	SOLID-2

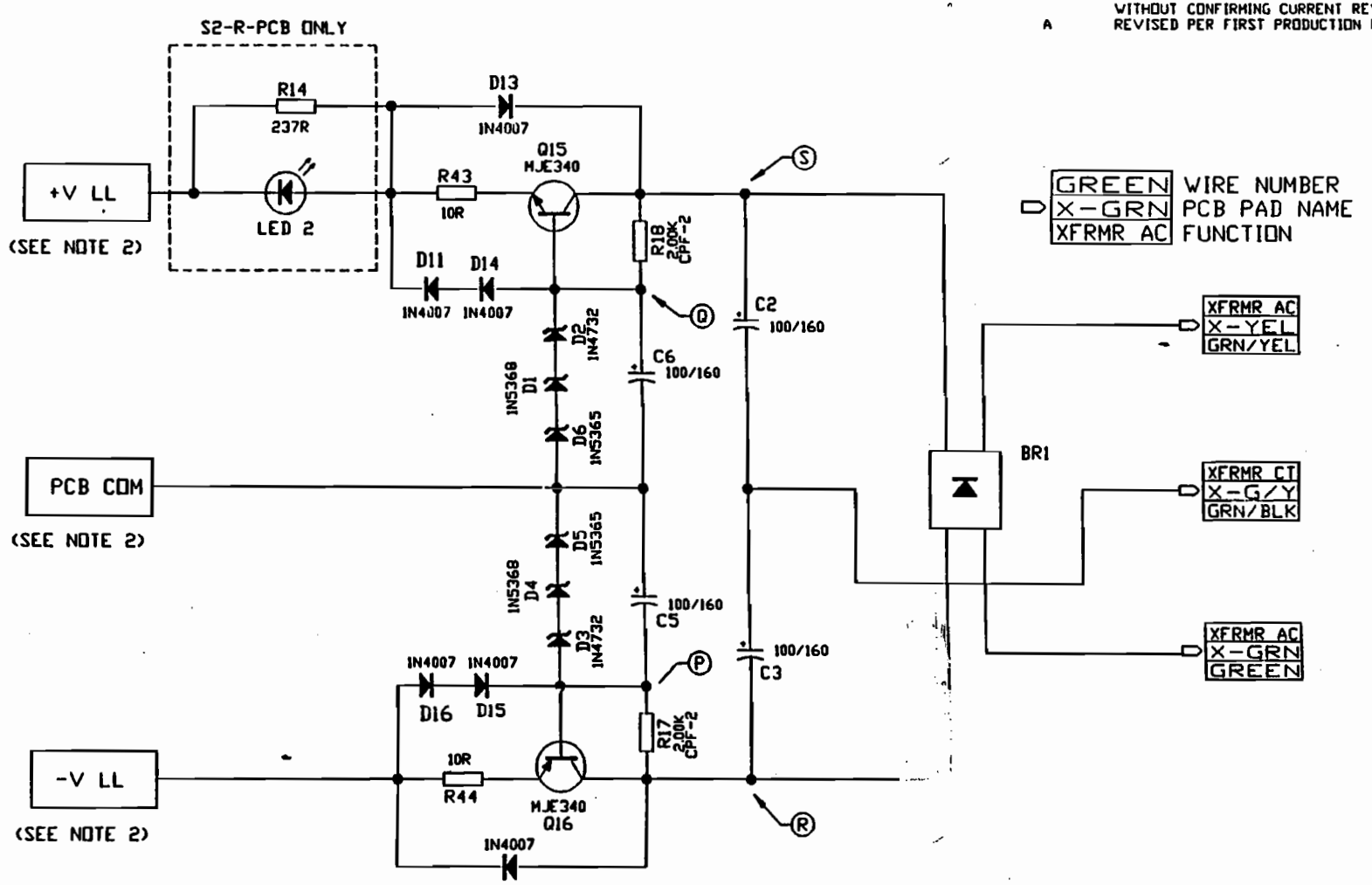
COUNTERPOINT

AMPLIFIER MODULE DETAIL SCHEMATIC

CAD FILE: AMP-C

DWG: 7S2501

REV	DESCRIPTION	DATE
-NONE-	FIRST ITERATION DRAWING FOR PROTOTYPING PURPOSES ONLY. DO NOT USE FOR PRODUCTION WITHOUT CONFIRMING CURRENT REV LEVEL.	2/92
A	REVISED PER FIRST PRODUCTION RUN.	10/92



NOTES:

1. SCHEMATIC DETAILS. COMPLETE SOLID-2 AMPLIFIER CONSISTS OF TWO AMPLIFIER CIRCUIT BOARDS, PWA S2-L-PCB AND S2-R-PCB; AND ONE S2-3-PSB POWER SUPPLY BOARD
2. REFER TO DRAWING NUMBER 7S2501 "AMPLIFIER MODULE DIAGRAM" FOR DETAILS ON AMPLIFIER CIRCUITRY.
2. REFER TO DRAWING NUMBER 7S2-10 "WIRE INTERCONNECTION DIAGRAM" FOR DETAILS ON AMPLIFIER WIRING HARNESSING.
3. REFERENCED VOLTAGES Ⓟ THROUGH Ⓢ REFER TO NORMAL DC OPERATING VOLTAGES AS SHOWN ON DRAWING NUMBER 7S2-1 "DC OPERATING VOLTAGES, PWA S2-L-PCB."
4. FOR DESCRIPTION OF CIRCUIT, REFER TO DRAWING NUMBER 7S1-2 "CIRCUIT DESCRIPTION, PWA S2-L-PCB."
5. FOR LIST OF FIELD-REPLACEABLE PARTS, REFER TO DRAWING NUMBER 7S2-3 "LIST OF MATERIALS, SOLID-2 AMPLIFIER."

DRAWN	JME	REVISION	A
ON DATE	10/92	PRODUCT:	SOLID-2

COUNTERPOINT

LOW-LEVEL REGULATION DETAIL SCHEMATIC

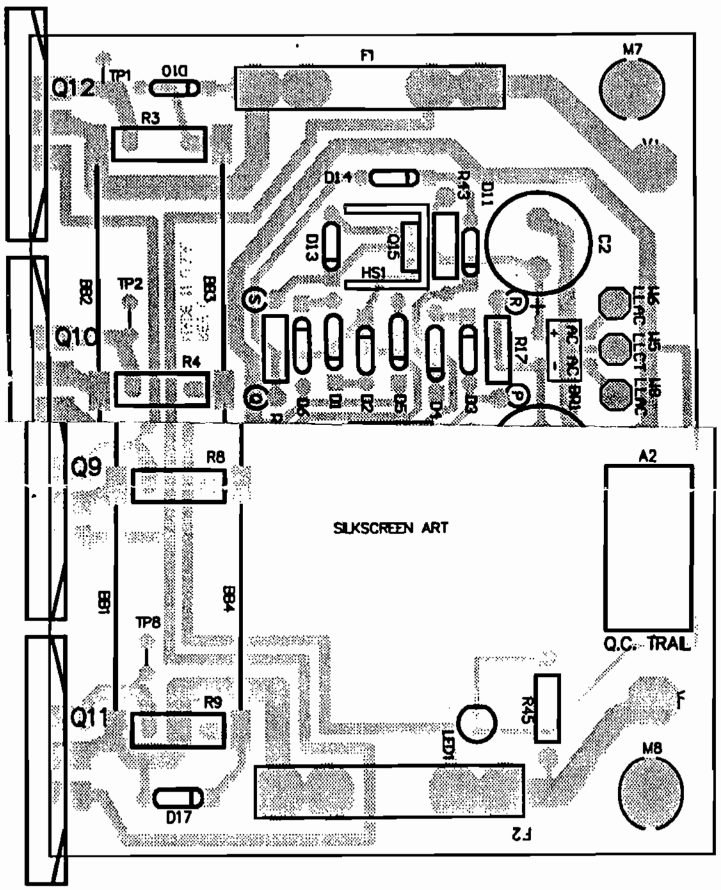
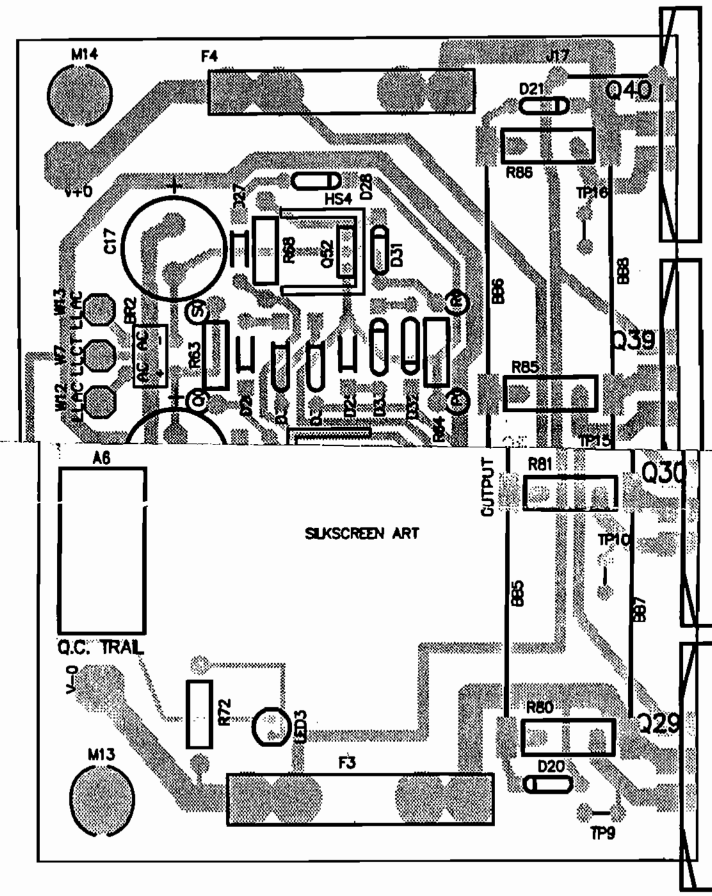
CAD FILE: S2LLREG

DWG: 7S2-8

PRINTED CIRCUIT BOARD LAYOUTS

Audio output board

Power supply board


Q12
TP1
R3
F1
M7
D14
R43
D11
C2
D13
Q15
HS1
BB2
BB3
TP2
Q10
R4
R17
Q9
R8
SILKSCREEN ART
A2
BB1
BB4
TP8
Q.C. TRAL
R45
LED1
Q11
R9
M8
D17
F2

M14
F4
J17
D21
Q40
R86
TP16
C17
HS4
D28
R68
Q52
D31
BB6
BB8
BR2
R63
Q39
R85
TP15
A6
OUTPUT
R81
Q30
SILKSCREEN ART
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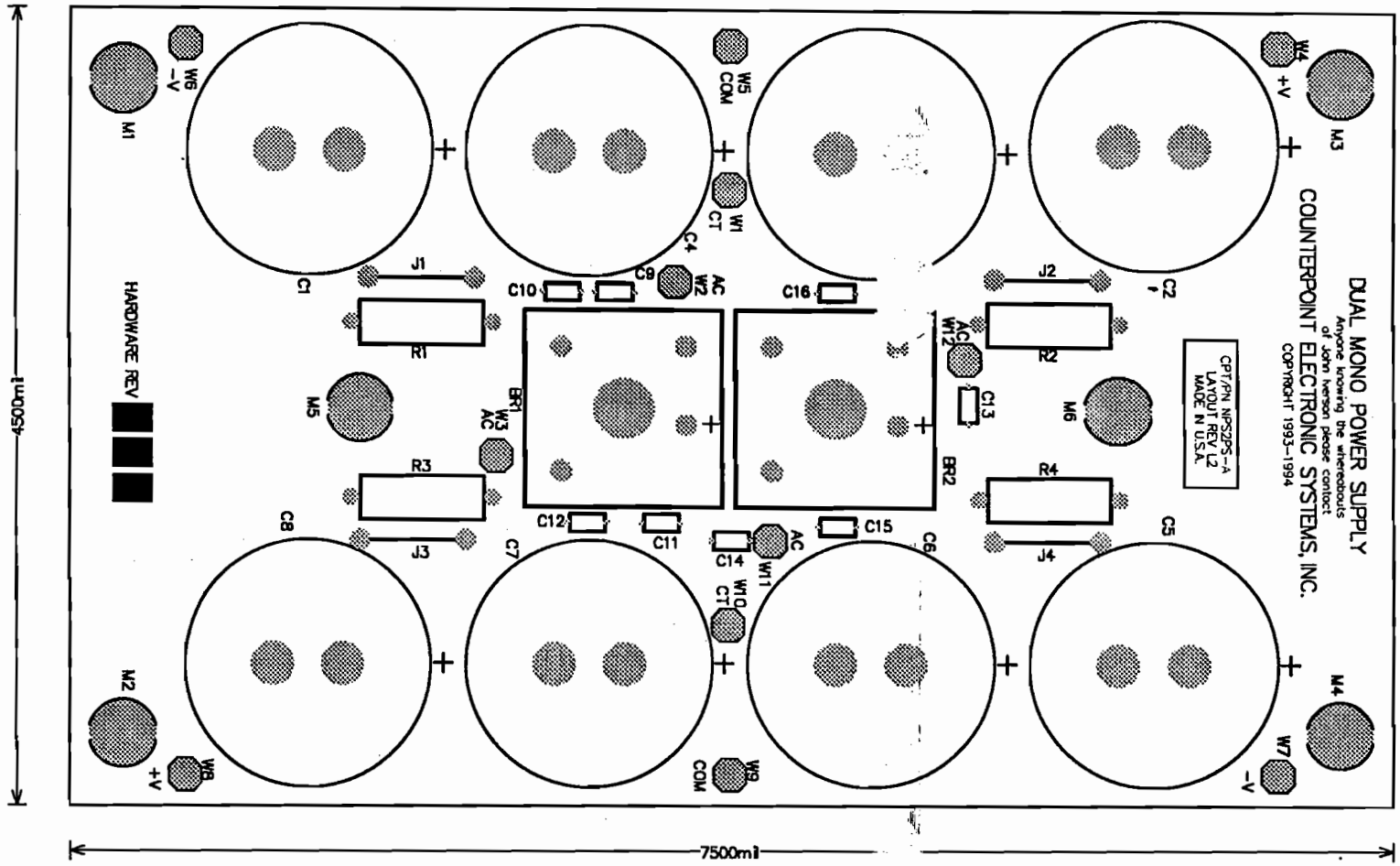
BB5
BB7
Q.C. TRAL
R72
LED3
R80
Q29
M13
F3
D20
TP9



BUILD TO COUNTERPOINT SPEC 4000
SINGLE-SIDED, NO SOLDER MASK
PLEASE RETURN DISKETTES

COUN POINT ELECTRONICS
CPT/ PS2PS-A
LAYO EV L2
Mech l Layer 1
17-D 1993

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Ease of use:	[ ]	[ ]	[ ]	[ ]
Accuracy:	[ ]	[ ]	[ ]	[ ]

Please list errors by section/page number. Include a marked-up copy of the page.

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Suggestions for improvement:_____

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Address_____

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11. REVISIONS

DATE	FROM	TO	CHANGES
4/7/95	A	B	Rail fuses changed from 15a to 20a Speaker fuses changed from 20a to 15a (except in Japan; there, speaker fuse changed to 10a)