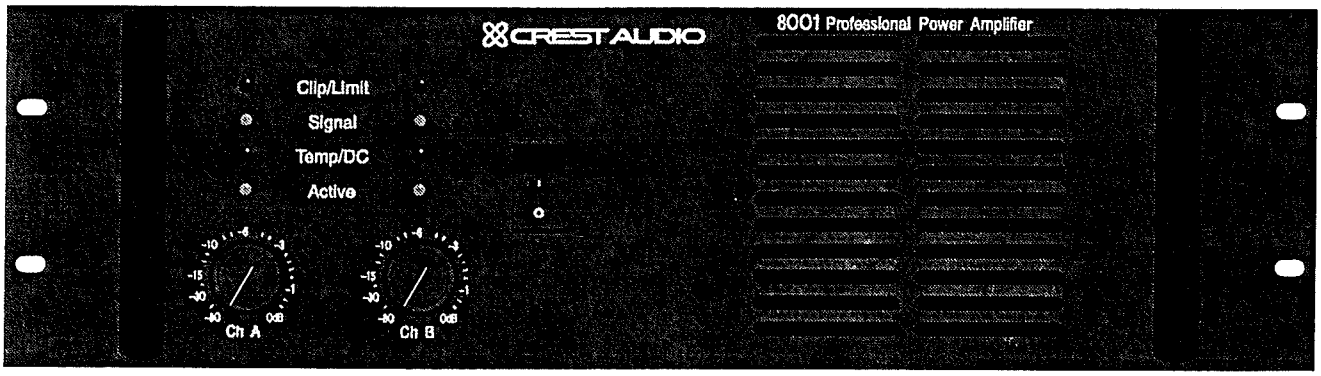
CREST AUDIO



Professional Series

Power Amplifiers

8001

Service Manual

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Crest Audio Professional Series
Service Manual
Model 8001

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This symbol, a lightning flash with arrowhead within an equilateral triangle, appears on the amplifier chassis to warn the user that uninsulated "dangerous voltages" are present within the enclosure that may pose a risk of electric shock.



This symbol, an exclamation point within an equilateral triangle, appears on the amplifier chassis to warn the user to follow important operating procedures and precautions detailed in the user manual.

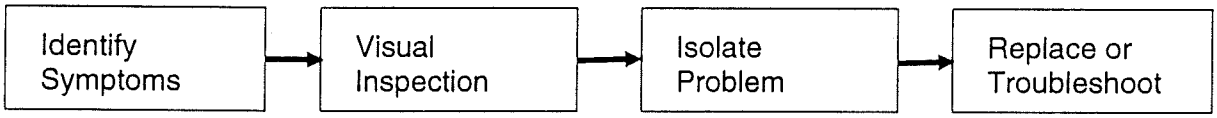
This manual and the procedures detailed within are intended for qualified technicians only! There are potentally lethal voltages present within an audio power amplifier, and it is the responsibility of the technician to exercise common safety practices to protect himself, his co-workers, and the end user.

In particular, always exercise caution when working on an amplifier with the chassis cover removed. Do not leave it unattanded while it is connected to the AC mains. Never expose the amplifier or your test equipment to rain or moisture, and never work on an amplifier while you are standing in, sitting in or otherwise in contact with, rain or moisture. Before starting any repair or troubleshooting procedure, read and understand completely the instructions for the procedure.

INTRODUCTION

This service manual includes tests, calibrations, schematics, a full parts list and troubleshooting tips to assist you in the repair and maintenance of Crest Audio Pro series 8001 amplifiers.

The first step in troubleshooting is to identify the symptom. The next step is a complete visual inspection. You may isolate the problem, trace it to a module, and swap it with a good module or continue troubleshooting down to component level. If you follow this manual step-by-step it will be that easy.



Glossary

Following is a list of terminology used in this manual.

Board — a printed circuit board, or "PCB."

Chassis — the steel case or frame in which the modules, transformer, etc. are mounted.

Harness — this term refers to all the wires, as a whole, which interconnect the boards carrying specific voltages, signals etc.

Rail A supply voltage, positive or negative, for a given section of circuitry. Class AB amplifiers utilize one bipolar pair of rails and Crest Class H amplifiers utilize two bipolar pairs of rails. In this manual the term is used mainly to describe the supplies for the power output section.

Transformer located at the front left of the chassis (behind the display board), it converts AC line voltage to the lower voltages used by the amplifier circuitry.

IGM *Instantaneous Gain Modulation. Used exclusively by Crest. See Circuit Description under "Preamp board".*

Auto Ramp See Circuit Description under "Preamp board."

DC Servo See Circuit Description under "Preamp board."

Class H See Chapter 2, *"The Outputs."*

Circuit Boards and Descriptions

Power Supply The 8001 power supply contains the filter/reservoir capacitors and bridge rectifiers. The filter/reservoir capacitors are mounted and located at the left rear of the chassis. The two bridge rectifiers are mounted to the metal transformer shield, located in the center of the chassis between the transformer and the output modules.

The AC voltage from the secondary of the transformer is applied to the bridge rectifiers which convert the AC voltage to a pulsating DC voltage. At this point, the pulsating DC voltage is filtered through the filter/reservoir capacitors, converting it to a smooth DC voltage used for the amplifier's rails.

Relay Board This board is mounted at the left rear of the chassis behind the power supply capacitors. The Relay Board contains the output relays, surge resistors, coils and output connectors.

The output relays (RL1 & RL2) are located in the circuit between the output modules and the output binding posts. When the amplifier goes into a protect mode, the relays open thus disconnecting the loudspeakers from the amplifier circuitry. The surge resistors (R5 & R6) along with the "slow start" relays (RL3 & RL4) act as an "in-rush" line current limiting circuit. When the amplifier is initially turned on the power supply capacitors are essentially a short-circuit. The "in-rush" circuit limits the initial surge current. When the power supply caps fully charge the "slow start" relays close thus, bypassing the surge resistors. At this time the output relays close.

Display Board This board is mounted at the front left corner of the chassis. It contains the following sections of circuitry:

LED Status Display - A channel's *Active LED* lights when the amplifier is on and the channel is not in a protection mode. The channel's *Temp/DC LED*, on the other hand, lights if the channel is in a protect mode. (A channel goes into protect when its temperature is excessive or when it has DC or excessive subsonic energy at its output; the protect mode shuts the channel off by opening its output relay, thus disconnecting the loudspeaker.) The *Signal LED* lights as long as an audio signal is present at the output of the channel's output module. *The Clip/Limit LED* lights if the channel output clips or if its IGM or clip limiting is activated.

Temperature Sense - During normal operation, the heatsink temperature is below 75°C and so the output voltage from the heatsink temperature sensor is less than 0.75 volts DC; pin 7 at IC1B is high and it switches transistor Q5 on to activate the output relay and turn the Active LED on. When the heatsink temperature rises above 75°C, pin 7 at IC1B goes low which turns Q5 off, opening the relay and turning the Temp/DC LED on.

DC Protect - Designed to protect your loudspeakers, this circuit opens a channel's output relay if it detects a DC voltage or excessive subsonic energy on it's output.

If a DC voltage greater than 0.1 volt is present at the output, the triac (TR1 for Channel A and TR2 for Channel B) turns on which opens the respective output relay and disconnects the load.

Attenuators - these are the two 5K potentiometers used for adjusting the input level. They are mounted on the display board located behind the left of the front panel. VR1 controls Channel A and VR2 controls Channel B.

Heatsink Board

These two boards, one per channel, contain the output transistors and their support circuitry (bias, Class H, temp. sensing etc.) and are located on the right side of the amplifier chassis. Each is mounted to an aluminum heatsink. (See Figure 1-1.)

Preamp Board

These two boards, one per channel, mate to the Heatsink Boards via a 17-pin Molex connector, a metal shield and mounting screws (see Fig. 1-1). There are two main versions of the Preamp Board: The older version (before March of 1991, serial numbers less than 9103N00) used a 6-pin Clairex CLM 5010 optocoupler for IGM current limiting and have a board identification number with the prefix 845. The newer version uses an NE5517AN operational transconductance amplifier (OTA) in place of the

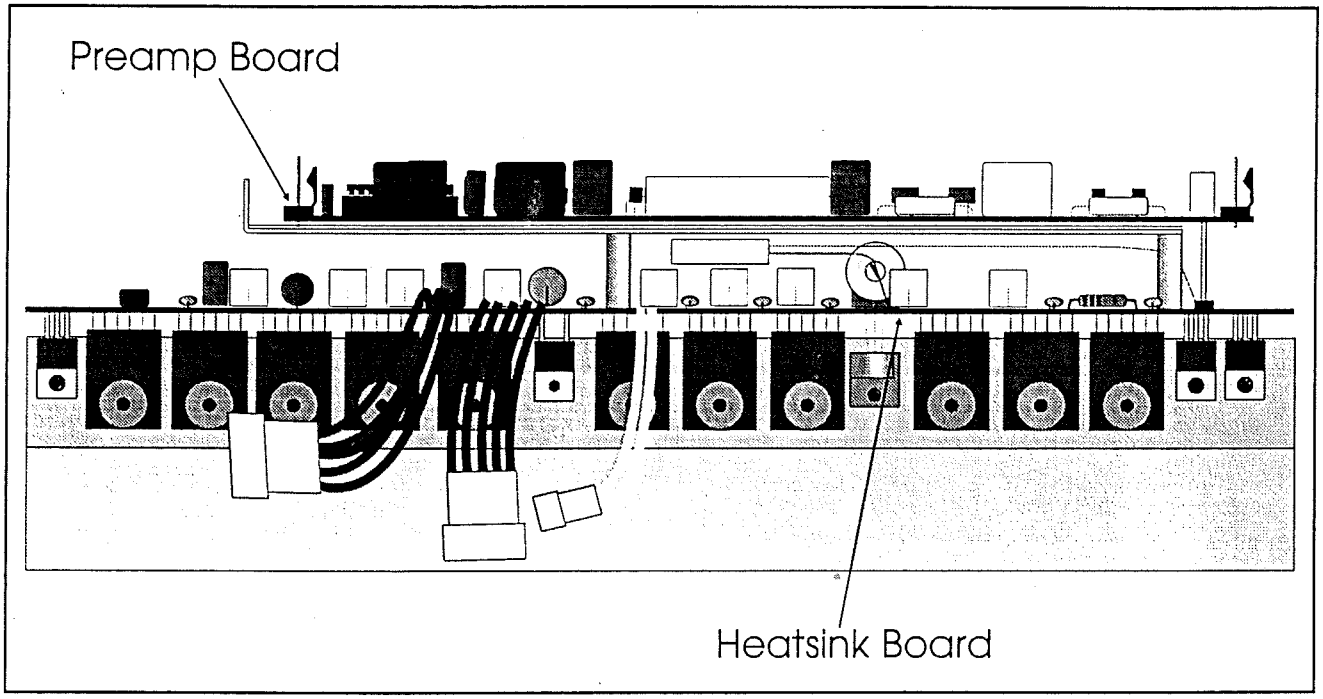


Figure 1-1 - Output Module

optocoupler and has a board identification number with the prefix 26C1124 (March 1991 and later, serial number 9103N00 and later).

The Preamp board contains the following circuitry:

IGM (Instantaneous Gain Modulation) - this circuit, developed and used exclusively by Crest, allows the amplifier to operate safely into any load. When the amplifier sees a load that overstresses the output stage, IGM attenuates the input thus reducing the output to a safe level. In amplifiers manufactured before March 1991 the IGM circuit uses a Clarex CLM5010 optocoupler (or *opto* for short) shown on the circuit diagrams as OC1. In amplifiers manufactured after March of 1991 the IGM circuit uses IC4, an Operational Transconductance Amplifier, or OTA.

Auto Ramp - this circuit, primarily consisting of Q1, Q2, and Q3, mutes the input signal at power-up by activating the OTA, or Opto, for full attenuation. Once the output relays close, the Auto Ramp circuit slowly releases the signal, "ramping" it up to full gain.

The Auto Ramp circuit will activate any time the relays open or the amplifier goes into a protect mode.

Clip Limit - This circuit prevents the amplifier from being driven into hard clipping. By sensing when the output voltage approaches the rail voltages, IC3D activates the OTA, or opto, to reduce the gain until the amplifier is no longer clipping.

DC Servo - This circuit provides a negative feedback for any DC offsets present, thus cancelling them out. The components that make up this circuit are: IC2A, R18, R17, and C9 on the newer style Preamp Boards and IC2A, R45, R26 and C6 on the older style Preamps.

The amplifier **Front End** is a fully discrete, bipolar, complementary differential amplifier which provides drive signals with the correct DC offsets for driving the output section.

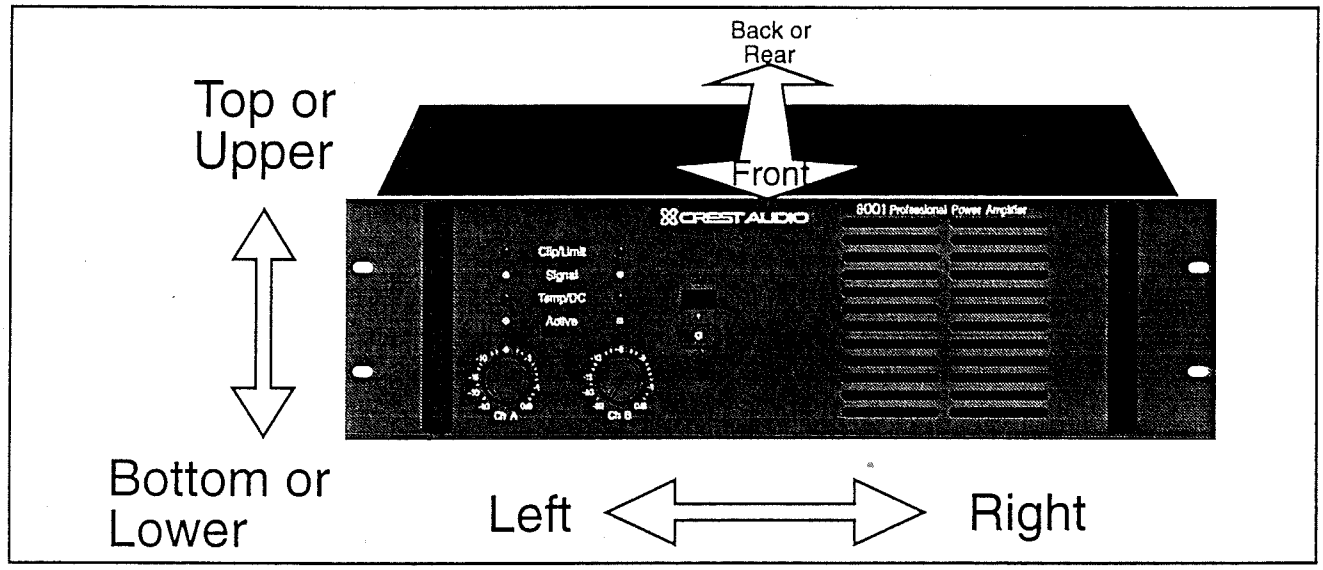


Figure 1-2 - Amplifier direction

Directions

Figure 1-2 shows the conventions used in this manual for identifying areas and locations in and on the amplifier. All references to left and right in this manual are as viewed from the front of the amplifier. For example, the attenuators or volume controls would be said to be located on the front left of the amplifier.

2 CIRCUIT DESCRIPTION

The Crest Audio Professional Series model 8001 amplifier is fan-cooled and uses bipolar output transistors. Physically, it is three rack spaces (5.25 inches; 13.43 cm) high and features a heavy duty folded and welded steel box-type chassis with a removable top cover.

A rear-mounted cooling fan draws cooling air in and pressurizes the chassis. Directly in front of the fan are the two output module heatsinks, which lie back-to-back to form a "tunnel." Because the air pushed from the fan does not have to change direction abruptly or flow around any major obstructions, the airflow remains relatively laminar (that is, free of turbulence), which minimizes back pressure and enhances efficiency. Small ridges in the heatsink surface, as well as mounting screws protruding into the cooling airflow, induce microturbulence to ensure good heat transfer along the length of the heatsink. The air from the output module heatsinks exhausts through the front panel slots. An array of small exhaust holes at the front of the left side of the chassis allows some cooling airflow for the power transformer and the power supply. For thermal protection, the transformer as well as the heatsinks include temperature sensing circuitry.

The inputs

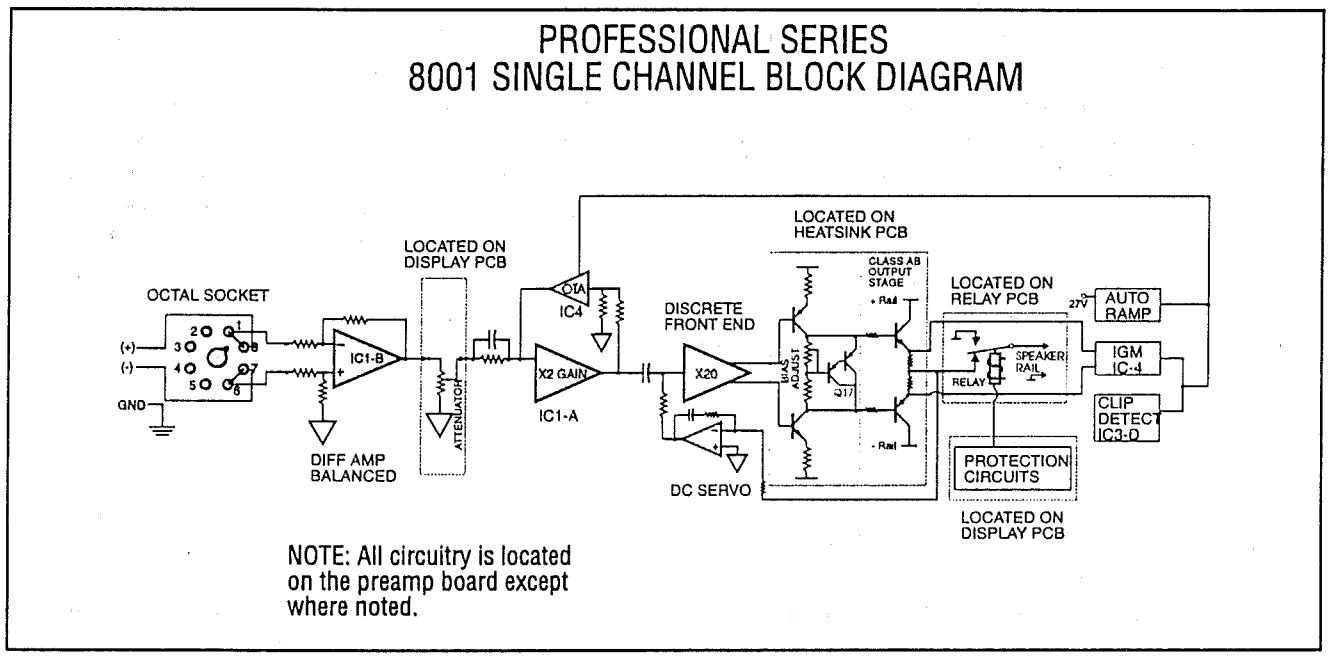


Figure 2-1. Amplifier block diagram

Figure 2-1 is a block diagram of the signal path, from input to output, of the Crest Audio Professional Series 8001amplifier.

Crest Audio Professional Series amplifiers use female XLR connectors on the rear panel for inputs. Pin 1 on each XLR is signal ground, pin 2 the inverting input and pin 3 the non-inverting, or "hot," input. From

the XLRs, the input signals are routed through the octal accessory sockets, which are also mounted on the rear panel. If no accessories are being used in the sockets, small jumpers must be used to connect pin 1 to pin 8 for the inverting input and pin 6 to pin 7 for the non-inverting input. These jumpers are factory-installed. If they are lost or damaged you can make new ones from #10 AWG (4 mm) solid, tinned copper wire or order the Crest authorized replacement parts from the factory.

NOTE: Starting with serial number #9212M00 the 8001 amplifiers will include octal accessory sockets. Amplifiers of earlier manufacture **do not** include octal accessory sockets; for these, simply omit the sockets when following the signal path.

After the octal accessory sockets, the signal continues to the mode select switch. This switch, located just above the input connectors, sets the amplifier to one of three operating modes: "stereo," "parallel," or "bridged." The "stereo" mode is normal two-channel operation, in which a signal at Channel A's input produces an analogous amplified signal at Channel A's output, and likewise, a signal at Channel B's input produces an amplified signal at Channel B's output. In "parallel" operation, both outputs are driven from Channel A's input; Channel B's input is unused. **NOTE: Parallel mode does not imply that the outputs of the amplifier can be wired in parallel!!** In "bridged" operation, both outputs are also driven from Channel A, except that the mode switch reverses the polarity of the signal going into Channel B's circuitry; this makes the two channels work in opposition, effectively making the two channels into a single monaural amplifier with double the voltage swing. To "bridge," the load must be connected between Channel A and B's red (hot) output terminals. The mode select switch only acts on Channel B and never affects the signal on Channel A.

The first active circuitry in the signal path, assuming no octal socket accessories are in use, is the balanced transformerless amplifier formed by operational amplifier (op-amp) IC1B, along with five resistors (R9A, R9B, R9C, R9D, and R10 on the old version and SIP1A, SIP1B, SIP1C, SIP1D, and R12 on the newer version implemented in 1991), and two capacitors (old version: C3 and C4; new version: C4 and C6). Shielded-pair cable in the wiring harness carries the signal from the input board to the preamp board, where the input stage lies. Note that in this differential configuration, the non-inverting input of the power amplifier enters the inverting input of the op-amp and vice-versa. The two paralleled resistor-capacitor pairs provide a 6-dB per octave high-frequency rolloff starting at 500 kHz to filter RF interference. Four diodes protect the input stage from excessive differential and common-mode input voltages. The input stage presents a balanced input impedance of greater than 20 kilohms. **NOTE: As of August 93' (s/n#9307XXX) R12 on the Preamp has been removed from the circuit.**

In the middle

The signal leaves the preamp board and is routed to the input attenuators, or volume controls, located on the display board. It returns to op-amp IC1A, set up as a +6 dB gain stage. This is also where the clip limiting, IGM, muting, and Auto-Ramp circuits act on the signal. On the older preamp boards, the attenuation was performed by the photoresistor section of a Clairex CLM5010 opto-isolator connected across the feedback resistor R16, with the op-amp configured as an inverting amplifier. When no attenuation is taking place, the resistance of the photoresistor is high enough that it is essentially out of the circuit and thus has no effect on the signal. When clip limiting, IGM, muting, or Auto-Ramp is triggered, their respective control circuits draw current through the internal LED in the CLM5010. The light reduces the resistance of the photoresistor and thus also reduces the signal gain. On the newer preamp board version, an operational transconductance amplifier, IC4, handles attenuation when necessary by shunting some of the signal off resistor R13, which is in series with the input of IC1A, set up as a non-inverting amplifier. When the OTA re-

ceives no control current from the clip limit, IGM, mute, or Auto-Ramp control circuits, it has zero gain and draws no signal, presenting an ultra-high impedance at IC1A's non-inverting input, so the signal passes through R13 with no attenuation.

When attenuation is needed, the control current increases, in turn increasing the gain of the OTA, which lowers the impedance seen at the R13-IC1A junction. R13 and the OTA together then act as a voltage divider.

The signal is coupled through a capacitor to the junction of two resistors. One resistor sends the feedback signal from the servo circuitry, centered around op-amp IC2A. The combined audio and feedback signals continue through the other resistor into the amplifier front end, which provides the drive for the output section.

The outputs

Amplifiers are used in many types of electronic equipment. Basically, their function is to provide gain to an input signal, but how the signal is amplified and how the amplified signal is used varies. For this reason amplifiers have been divided into several *classes of operation.* An amplifier *class* simply refers to the configuration which is used in the power supply and the output section of the amplifier. In order to understand Crest *class H,* the operation of the 8001, you must first understand the operation of *class AB* as described below.

Crest Audio Professional Series 3301 and 4601 operate in *class AB*. The *class AB* power supply utilizes a single, bipolar DC *rail* (power supply voltage) configuration, one positive and one negative. The positive rail supplies a DC voltage for the positive swing (NPN) power transistors, and the negative rail supplies a DC voltage for the negative swing (PNP) power transistors.

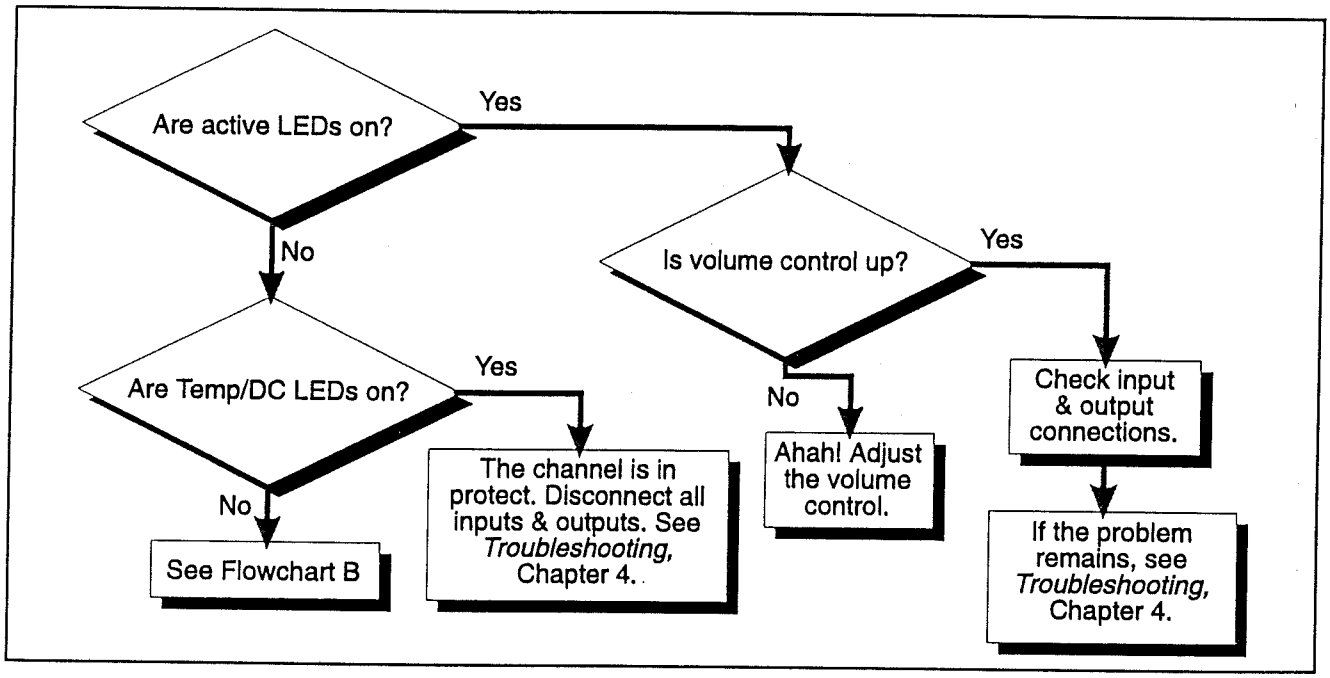
In *class AB*, the base-emitter junction of the transistors must be forward biased with a small DC voltage in order to reduce crossover distortion. With the bias voltage applied, the transistors conduct allowing them to pass the full half of their respective portion of the waveform (positive or negative), thus reducing crossover distortion. In the Crest Audio Professional Series amplifiers, trimpot VR1, located on the heatsink board, is used to set the bias.

Crest Audio Professional Series 8001 operates in *class H*. The Crest *class H* power supply utilizes a dual, bipolar DC rail configuration with low and high voltages; one positive and one negative low rail and one positive and one negative high rail.

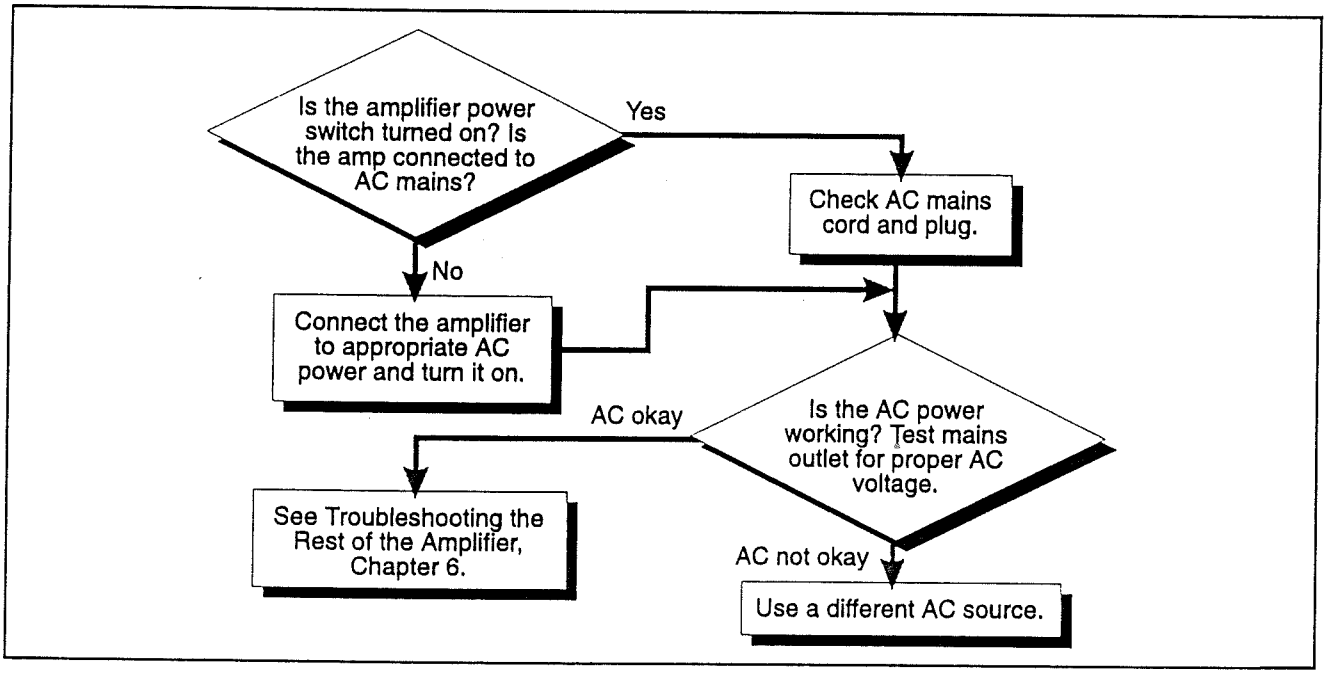
Until approximately the 1/3 power point the *class H* amplifier operates as *class AB*. Beyond this output level, the high rail transistors conduct, thus modulating the low rails. This increases the efficiency of the amplifier because less power supply energy goes unused. See Figure 4-3 in Chapter 4 for a visual oscilloscope example of *class H* operation.

3 FLOWCHARTS FOR TROUBLESHOOTING

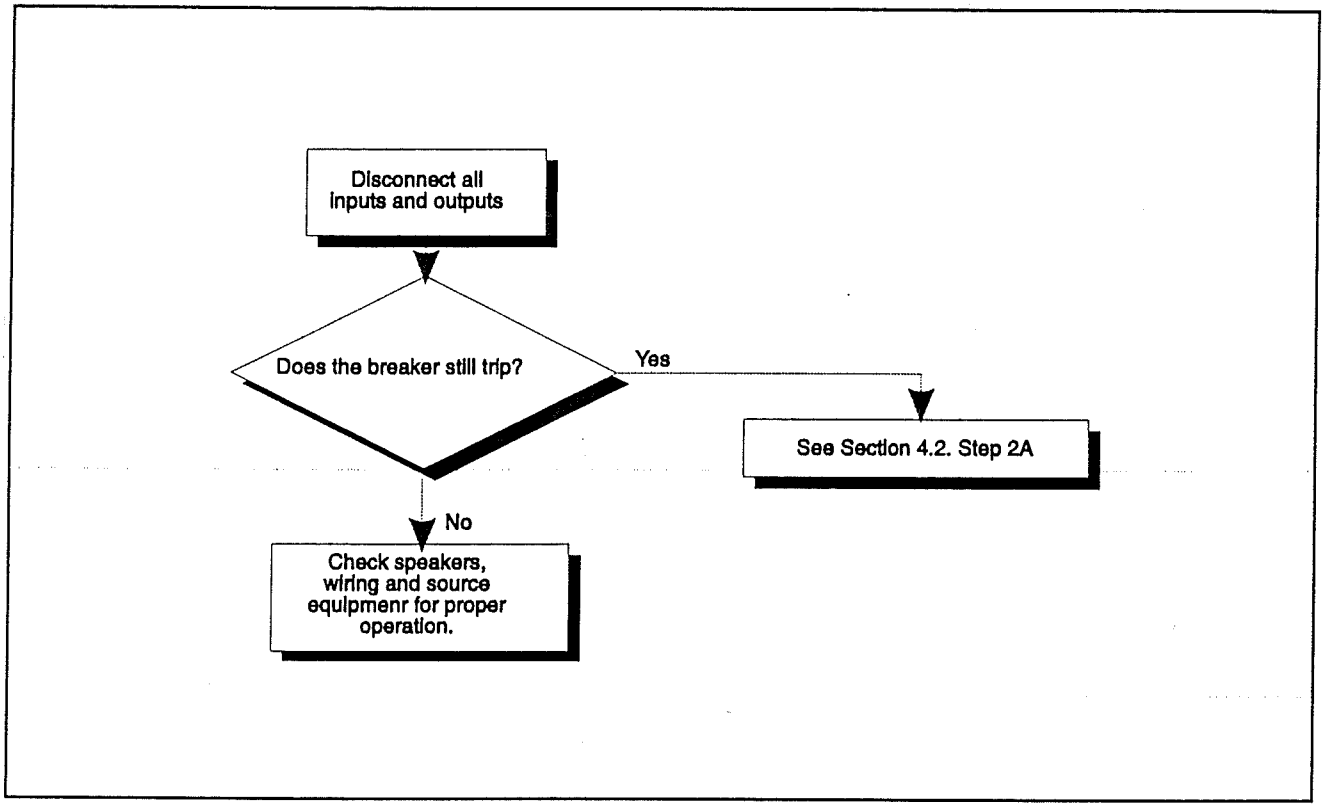
Flowchart A. Problem: No Sound



Flowchart B. Problem: No LEDs on either channel



Flowchart C. Problem: Breaker trips at turn on



4 TROUBLESHOOTING & REPAIRING THE OUTPUT MODULES

4.1 Visual inspection

Tools & materials needed:

- ✔ Phillips #1 and #2 screwdrivers.
- ✔ Low or medium-pressure compressed air, water vapor removed, or compressed air in a can.
- ✔ Short, medium bristled artists or horsehair brush.
- ✔ Methanol alcohol or a non-corrosive, non-lubricant solvent.

Setup:

- ✔ Amplifier disconnected from AC mains.

Procedure:

1. Remove all of the Phillips top cover screws. If the amplifier has a toroidal transformer, remove the transformers upper mounting screw, which is the large Phillips-head screw toward the left side of the top cover. Remove the top cover.

   Note: Visual inspection is essential! Keep in mind that repairs may have been attempted by non-qualified persons. Also, debris may have entered the chassis through the ventilation holes during use.

2. Check for dirt and debris within the amplifier. If the fan filter is in place, make sure it is clean enough to allow sufficient air flow; if necessary, wash the filter element with soap and water or, if necessary, order Crest authorized replacement filters. Use compressed air (water vapor removed) or compressed air in a can to clear dust from the heatsink fins and anywhere else in the amplifier chassis.

3. Check for any type of conductive debris inside the amplifier chassis. Be thorough! A stray piece of metal or wire can cause intermittent short circuits or even seriously damage components.

4. Check the wiring harnesses for broken or pinched wires, loose connectors, intermittent short circuits, damaged insulation, etc.

5. Make sure the breaker/power switch, transformer, fan, and all modules and circuit boards are securely mounted to the chassis.

6. Check for burn marks, especially on printed circuit boards. If you find any, investigate the severity of the damage. Using a short, medium-bristled artists or horsehair brush, carefully clean the area with methanol alcohol or a non-corrosive, non-lubricant solvent. If a circuit board has a hole burned in it or a foil trace lifted or destroyed, it must be replaced.

If the burn mark can be cleaned away and you find no damage to the printed circuit board, the board need not be replaced; only the damaged components need to be replaced.

Always check the continuity of any questionable foil traces.

7. Inspect the power supply capacitors and relays; damage to these components is usually visually apparent. If you suspect that any relays or capacitors are defective see Chapter 6, Step 18.

4.2 Removing or replacing one or both output modules

CAUTION: Before removing or installing any Modules/connectors, disconnect the amplifier from the AC mains and measure the DC supply voltages across each of the power supply capacitors. If your measurement on any of the caps is greater than

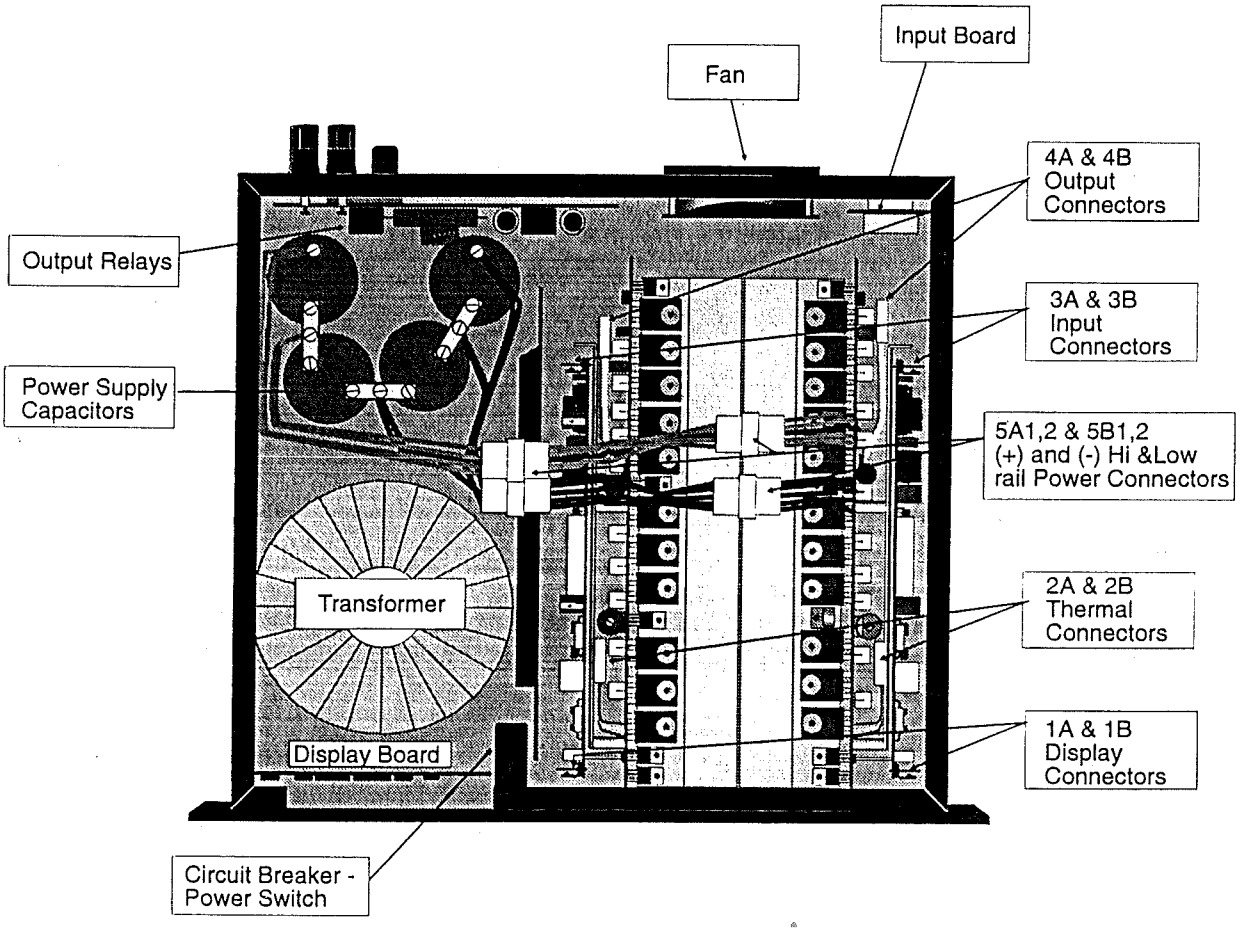


Figure 4-1. 8001 Amplifier, view with top off

10VDC, connect a 100-ohm,100 watt resistor across the applicable caps to discharge them for your safety. Remember to remove the discharge resistor immediately after discharging! DO NOT POWER UP THE AMPLIFIER WITH THE DISCHARGE RESISTOR CONNECTED.

Tools & materials needed:

- ✔ Phillips #1 screwdriver (If the amplifier has a toroidal transformer, you need a #2 screwdriver also.)
- ✔ A means of labeling the modules and boards: masking tape and pen, permanent marker, etc.
- ✔ 100Ω, 100-watt resistor.
- ✔ Clamp-on current probe (Fluke Y801, Amprobe RS-1, or equivalent.)
- ✔ Variac

Setup:

- ✔ Amplifier disconnected from AC mains.

Procedure:

1. The output modules are mounted back-to-back on the right half of the amplifier. Each heatsink is fastened to the bottom of the chassis with three screws. (Bypass step 2A unless your breaker is tripping at turn-on)

2A. **Referred from Flowchart C: Breaker trips at turn on.**

a. Isolate the Problem

In most cases when the breaker trips as you try to power up the amplifier, the problem is a fault on an output module or the power supply section. The result is usually shorted power transistors on the output module(s) or a power supply component failure. Shorted transistors, as well as a shorted bridge rectifier or power supply capacitor, will draw excessive current, in turn, tripping the breaker. The first step is to determine where the problem lies.

b. Locate the output and rail connectors (Figure 4-1, items 4 and 5).

c. Be sure that the amplifier is disconnected from AC mains. Disconnect Channel A's output and rail connectors.

d. Connect the clamp-on current probe across either wire connected to the circuit breaker.

e. Set Variac at zero volts.

f. With the amplifier's circuit breaker in the "on" position, connect the amplifier mains cable to the Variac.

Note: While increasing the Variac, monitor the current probe reading. The maximum, no load, quiescent current draw should be 1.5 amperes AC. If you are seeing a steady increase in current beyond this level, there is a short circuit present somewhere in the amplifier.

g. Bring the Variac up to 60 volts. Does the breaker still trip? If not, you know that the problem is located on Channel A's output module. If the breaker still trips, bring the Variac down to zero

volts and repeat steps 3-7, this time reconnect Channel A and disconnect Channel B's output and rail connectors.

If the current level is acceptable and the breaker no longer trips with Channel B's output module disconnected, then you know that the problem is located on Channel B's output circuitry. Also , check the power supply bridge rectifiers, the output relays and the power supply capacitors for shorts which will also draw excessive current thus, tripping the circuit breaker (see Chapter 6, Steps 17-22).

h. Continue with Section 4.2 to remove the modules from the chassis, then see section 4.4.3, "Troubleshooting Defective Output Modules" for tips.

i. Tip the amplifier up onto its left side and remove the six module screws on the bottom of the amplifier. Do not turn the amplifier upside-down to reach the screws, because the output modules will drop directly on the wiring harness and possibly damage it.

2. Lay the amplifier back down.

3. Label the Channel A and B heatsinks and preamp boards for isolation purposes and so you can later reinstall them to their original position.

4. Lift the right (Channel B) module about 1 cm or ½ inch, and slide it to the left to engage the heatsink fins together with Channel A's fins. This will make the modules easier to lift out of the chassis later.

5. Disconnect all wiring to the modules: (See Figure 4-1)
   1A and 1B—Display connectors
   2A and 2B—Thermal connectors
   3A and 3B—Input connectors
   4A and 4B—Output connectors
   5A1,2 and 5B1,2 - Rail connectors

6. Unscrew the plastic harness retainers on the top front of each heatsink.

7. Lift the two modules together and remove them from the chassis.

8. Before continuing, visually inspect the heatsink and preamp boards for any obvious defects, burns, damaged components, etc.

9. If you find that you cannot repair the board, please call Crest Audio for service.

10. If you are replacing or reinstalling the modules, reassembly is the reverse of disassembly.

4.3 Locating and Isolating a Problem

If one channel is not functioning, determine whether the problem exists on the output module or elsewhere in the amplifier.

Procedure:

1. Use the procedure in Section 4.2 for removing the output modules from the chassis.

The next step is to swap the two output modules to see if the problem stays on the same channel.

2. Because the modules will be turned over, what was originally the top side of each module will become the bottom. You must redirect the three-wire (black–yellow–red) thermal harness/connector as well as the rail wires/connectors on each module so they are routed toward the top and can be properly connected. You must remove the preamp board from each module in order to reroute the harnesses to the other side. When re-mounting the preamp board to the heatsink board, be extremely careful not to pinch any of the wires with the preamp mounting screws.

3. Reinstall the modules into the chassis, with the module that was originally Channel A now on the right and the one that was Channel B now on the left (**SEE SECTION 4.2 WARNING!**). Reconnect the display, thermal, input, output and rail connectors. Be sure all connectors are oriented properly and connected securely. **Do not offset connectors!**

4. Connect the amplifier's AC mains cable to the appropriate line voltage. Turn the amplifier on.

5. If the problem has moved over to the other channel, you have isolated it to that module. See Section 4.4, 'Troubleshooting Output Modules.'

   If the problem stays on the same Channel after swapping the modules, then you can assume that the problem lies elsewhere in the amplifier. See Chapter 6.

4.4 Troubleshooting Output Modules

If you have a spare output module that you know is good, e.g., a factory replacement, you should use it as a reference for troubleshooting a defective one. If you do not have a spare, but one amplifier channel appears to work properly, you can confirm its operation by performing a full module test (Sections 4.4.1 and 4.4.2) and use it as a reference. Use the chassis as a test fixture.



Repairs should be attempted only by qualified technical persons!!

4.4.1 Preparation for full module test

Tools and materials needed:

- ✔ Dual-trace oscilloscope
- ✔ Audio generator
- ✔ Professional Series module extension cables (available from Crest Audio)
- ✔ Heatsink board test module (available from Crest Audio)
- ✔ Variac
- ✔ Digital multimeter (Fluke 87 or equivalent 20 kHz bandwidth multimeter.)
- ✔ Distortion analyzer

✔ 4Ω and 2Ω resistor (1000 watt non-inductive Millwaukee or equivalent.) Load resistors are available through Crest Audio.
✔ Phillips #1 screwdriver

Setup:

✔ Variac set to 0 volts.
✔ Amplifier turned off and disconnected from AC mains.
✔ Both output modules removed from the chassis.

Procedure:

1. Disassemble the "good" module: remove the two screws which secure the preamp board to the heatsink board and separate the preamp board from the rest of the module. Place the "good" module (minus the preamp board), heatsink down, on the bench at a minimum of 6 inches to the right of the chassis, with its 17-pin header (Figure 4-1, items 1A and 1B) closest to you. ***NOTE: When reassembling the Output Modules, be sure that the fish-paper insulator sits between the preamp board and the metal shield, with the washers in place, before securing the screws!***



Do not let the heatsink or the 17-pin connector touch the chassis!

2. Using the module extension cables, connect Channel B's output and rail connectors to the "good" heatsink board. Connect the thermal connector.

3. Set up the oscilloscope for viewing both channels of the scope. Use "DC" settings for each channel. Use the horizontal and vertical position controls to set the oscilloscope Channels A & B to the "0" position, so the traces run horizontally across the center of the screen.

4. Locate the two 0.2-ohm 5-watt resistors (R150 and R151; see component layout #1) at the back end (opposite the 17-pin header) of the heatsink board. Keep in mind that the positive rail reference point will be the outside lead of the 0.2-ohm resistor located on the right (black or positive R151) side of the board. The negative rail reference point will be the outside lead of the 0.2-ohm resistor located on the left (green or negative R150) side of the board.

   Connect oscilloscope Channel A to the negative rail of the heatsink board by attaching its probe to the outside lead of the 0.2-ohm resistor on the left (green or negative) side of the board. This connects directly to the emitters of the negative rail transistors.

   Connect oscilloscope Channel B's probe to the output section at either lead of any of the 0.33-ohm 5-watt emitter resistors (R124, 126, etc.).

   Note: During this test Channel B's oscilloscope probe should remain connected to the output section of the module under test. Channel A's oscilloscope probe will be moved from the positive rail to the negative rail as the test progresses.

Continue with Subsection 4.4.2.

4.4.2 Full module test

Tools and materials needed:

✔ As in subsection 4.4.1
✔ Clamp-on current probe (Fluke Y801, Amprobe RS-1, or equivalent)

Setup:

✔ Perform procedure in subsection 4.4.1.
✔ Set the digital multimeter to AC volts and connect it across the Variac output.
✔ Connect the clamp on current probe across either wire connected to the circuit breaker.

Procedure:

1. Familiarize yourself with the heatsink board. Examine the positive and negative rail circuitry and compare it to schematic #1. Notice that the positive rail uses 2SC3281 NPN (black) power transistors. The negative rail uses 2SA1302 PNP (green) power transistors.

2. Set the Variac to zero (0) volts AC. Connect the amplifier AC mains cable to the Variac receptacle and turn on the amplifier power switch.

3. Slowly increase the Variac to 40 volts output while monitoring the current probe reading. The maximum, no load, quiescent current draw should be 1.5 amperes AC. If you see a steady increase in current beyond 1.5 amperes, there is a short circuit somewhere in the amplifier. See Section 4.2, Step 2a. If not, continue.

4. Carefully observe the oscilloscope screen. Channel B on the oscilloscope should remain at 0 volts (in the center of the screen).

   Channel A on the oscilloscope should show an increasing negative (-) DC voltage.If so, continue to step 5. If not, see "Symptoms and Solutions", Subsection 5.1.1

5. Carefully remove Channel A's oscilloscope probe from the negative rail and connect it to the positive (+) rail reference point (Subsection 4.4.1, Step 4). At this time Channel A on the oscilloscope should show an increase in positive (+) DC voltage. Channel B's oscilloscope channel should always remain at 0 volts DC (in the center of the screen). If this is so, continue to Step 6. If not, see "Symptoms and Solutions," Subsection 5.1.1.

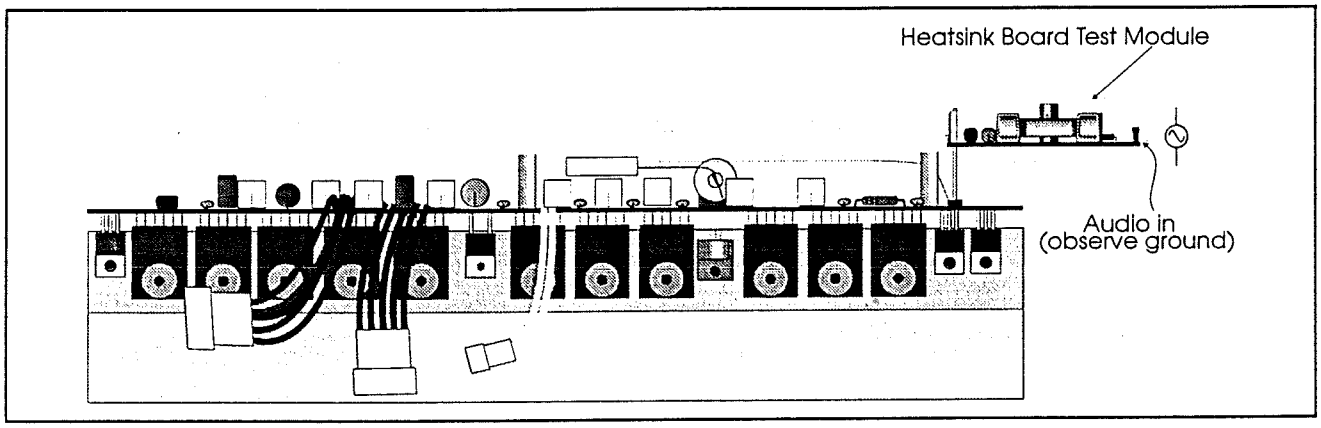


Figure 4-2 Heatsink Board test setup

*Step 6 is known as the "**Heatsink Board Test**"*

6. **Turn the Variac off to zero volts.** *Wait a minute before you continue to let the power supply capacitors discharge.*

   Set the signal generator for a 2 kHz, 10 VAC sine wave.

   Connect the "Heatsink Board Test Module" to the 17-pin male connector located at the front of the Heatsink Board and while observing ground, connect the signal generator to the test points (Figure 4-2).

   Bring the Variac up to 40 volts while carefully observing the oscilloscope screen.

   Channel B on the oscilloscope will remain connected to the output section of the Heatsink Board; therefore, if this heatsink board is operating correctly you should see a smooth, undistorted 2 kHz sine wave on oscilloscope Channel B.

   Channel A on the oscilloscope should show an increase in negative (-) or positive (+) DC voltage (depending on which reference point it is connected to).

   At this point you should see the rails modulating in sequence with the respective positive or negative peak of the output sine wave (Figure 4-3). You should notice that by attenuating the input to below the 1/3 power point, the high rails will turn off.

   If everything is ok, turn the Variac off . *Wait a minute before you continue to let the power supply capacitors discharge.* Remove the "Heatsink Board Test Module".

   If any changes, other than those described, occur see"Symptoms and Solutions" subsection 5.1.2.

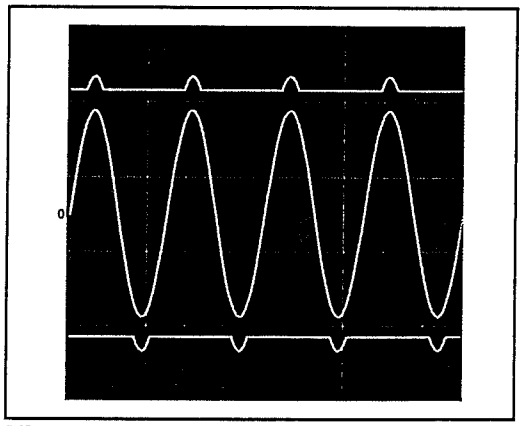


Figure 4-3 - Class H

Steps 7 and 8 are a ***"Signal Flow Test".***

7. Connect the "assumed good" Preamp board to the Heatsink board under test (via the 17-pin connector) and connect Channel B's input and display connectors (Fig. 4-1). Set the audio signal generator for a 2 kHz sine wave with a 1 volt balanced output. Use a male XLR input connector with pin 3 as (+) non-inverting (hot), pin 2 as (-) inverting and pin 1 as ground. For use with an unbalanced signal source, tie the inverting (out-of-phase) input (pin 2) to ground (pin 1) inside the XLR plug. Apply the signal to Channel B's input XLR on the rear panel or the amplifier.

   Set the mode select switch (on the back of the amplifier) to the 'STEREO' position and Channel B's attenuator control to 0 dB (full clockwise).

8. Slowly increase the Variac output up to 40 volts while carefully observing the oscilloscope screen.

   Channel "B" on the oscilloscope should always remain at zero (0) in the center of the screen.

Channel "A" on the oscilloscope should show an increasing positive DC voltage if it is connected to the positive rail reference point or an increasing negative DC voltage if it is connected to the negative rail reference point. If this is so, bring the variac up to full line voltage (120 VAC or 220/240 VAC).

As you near full line voltage, the relays should click on, turning the amplifier on and passing the 2 kHz sine wave on to oscilloscope Channel "B". Channel A on the oscilloscope should now show the positive or negative high rails turning on synchronously with the signal (depending on which reference point you are connected to). This is Class H operation (figure 4-3).

If any changes other than described occur, see Symptoms and Solutions, Chapter 5, subsection 5.1.3.

NOTE: Standard Gain is 40x (+32 dB); Therefore, with a 1 volt (+5.7 dBv) input and the attenuator at 0 dB, the output with no load should be 40 volts. If so, continue to step 9.

CUSTOM GAIN REFERENCE CHART FOR THE PRO-SERIES.

AMPLIFIER GAIN SETTINGS (New style preamps s/n#9103N00 and higher)

STANDARD PROFESSIONAL SERIES GAIN = 32 dB (x40)

GAIN	SIP1A	SIP1B	SIP1C	SIP1D	R12	R14	R32	R35
32 dB x40	10k	10k	10k	10k	20k	10k	1.5k	.75k
29 dB x28	10k	10k	10k	10k	20k	24.9k	1k	1k
26 dB x20	10k	10k	10k	10k	20k	open	1k	1k
23 dB x14	14.3k	10k	14.3k	14.3k	34.8k	open	1k	1k
16 dB x6.3	10k	3.16k	10k	3.16k	37.9k	open	1k	1k

NOTES: Any gain that requires SIP1A thru SIP1D to be 10k should use the standard SIP resistor package. Other configurations are to be done with discrete resistors in its place. All of these resistors must be 0.1% tolerance to maintain CMRR. All changes take place on the preamp board.

Steps 9 through 11 is the setting of the output transistor bias. The bias can only be set properly while the amplifier is at room temperature, with no signal applied.

9. Set the front panel attenuator control to -80 dB (completely counterclockwise).

10. Connect a DC voltmeter across the 0.33 ohm 5 watt emitter resistors (Figure 4-4) closest to the front end of the heatsink board. (R110 and R122)

11. Adjust trimpot VR2 to 5.0–5.5 mVDC for model 8001.

If you cannot obtain the correct voltage, see Symptoms and Solutions, Subsection 5.1.4.

Steps 12 through 16 test the module's THD as well as its ability to deliver power into a load.

12. Set the attenuator control to 0 dB.

13. Connect the distortion analyzer to Channel B's output binding posts. Reference the black post as ground.

14. Briefly apply a 4-ohm load across Channel B's output at the binding posts located on the rear panel. On the oscilloscope screen, the rails and output sine wave should not change in shape.

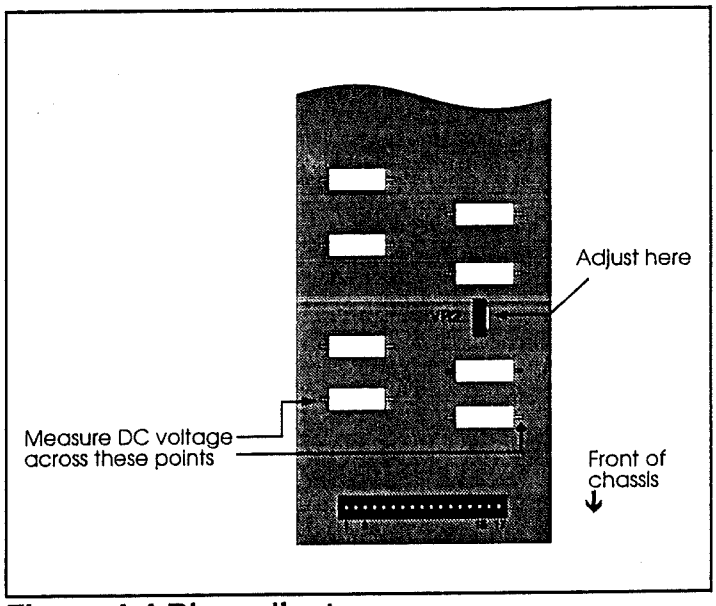


Figure 4-4 Bias adjust

Connect the load for a maximum of 30 seconds; remember the module has no cooling airflow when it is out of the chassis!

15. Adjust the input level so that the output is just below clipping. Measure THD with and without the 4 ohm load applied at the various frequencies listed in the following THD tables. **Make sure the output is not visibly clipping!**

THD TABLE

Model 8001

Frequency	THD with no load	THD with a 4Ω load
20 Hz	.020%	.025%
2 kHz	.025%	.030%
10 kHz	.040%	.045%
20 kHz	.040%	.050%

If everything is OK, continue. If not, see Symptoms and Solutions, Subsection 5.1.5.

16. Connect an AC voltmeter across Channel B's output. Apply a 2-ohm load across the output at the rear panel binding posts for a maximum of 30 seconds and measure the output voltage and calculate the power.

    Check your measurements against the power level table below.

    Observe the oscilloscope; the sine wave should not clip during this test.

To calculate power, use the formula: $Power = \frac{Voltage^2}{Load\ Resistance}$

Model	Voltage @ 2Ω	Power ±5%
8001	50 - 52.5 VRMS	1300W @2Ω

If the module passes this test, continue. If not, see Symptoms and Solutions, Section 5.1.6.

Steps 17 through 20 check for ***voltage on the heatsink and for DC offset.***

17. Connect the voltmeter between the module's heatsink and a suitable ground on the chassis. ***Make sure the heatsink and chassis do not touch!***

18. Check for both DC and AC voltages. There should be no DC voltage between the heatsink and the chassis and no more than 10 volts AC. If your measurements exceed these limits, see Symptoms and Solutions, Subsection 5.1.7.

19. Turn the Variac off to zero (0) volts output. *Wait a minute before you continue to let the power supply capacitors discharge*

20. Disconnect the output load and the input signal. Turn the Variac back up to full line voltage output. Measure the DC voltage across Channel B's rear panel outputs.

    If you measure more than +10 mV of DC offset, try replacing IC2 on the preamp board. This integrated circuit is an RC4559 dual op-amp, and it may sometimes have a small DC offset voltage at its output. The amplifier's DC protection circuit will shut the channel off if the DC offset exceeds 0.1 volt.

If the module passes all of these tests, then it is in good working order. Now you can use it as a reference in troubleshooting a bad one; the procedure is detailed in the following sections.

5 SYMPTOMS AND SOLUTIONS

5.1 Troubleshooting a defective output module

Tools and Materials needed:

- ✔ Dual-trace oscilloscope
- ✔ Audio generator
- ✔ Professional Series module extension cables (available from Crest Audio)
- ✔ Variac
- ✔ Digital multimeter (with a bandwidth of 20 kHz or greater.)
- ✔ Distortion analyzer
- ✔ 4Ω and 2Ω resistor (1000 watt non-inductive Milwaukee or equivalent)
- ✔ Output module, tested and in good working order, for comparison

Setup:

- ✔ Variac set to 0.
- ✔ Amplifier turned off and disconnected from AC mains.
- ✔ Good output module installed and connected in the chassis as Channel A.
- ✔ Defective module removed from the chassis.

Procedure:

Again you will use the chassis as a test fixture. Channel A is the reference, and Channel B the device under test.

1. Place the defective output module on the bench at a minimum of 6 inches to the right of the chassis, with the 17-pin header closest to you. Remove the preamp board from the module. Use set up and procedure steps from subsection 4.4.1 .

Continue the test on the defective module by following the procedure in subsection 4.4.2. If you encounter any problems, the instructions will direct you to the appropriate troubleshooting guide.

In the tests described in subsections 4.4.1 through 4.4.3, you identified any symptoms and performed visual inspections. The following instructions help you isolate the problems and correct them by replacement or component-level repair.

5.1.1 Referred from 4.4.2, Step 4—voltage on output

1. If Channel B's oscilloscope trace shows an offset (not staying in the center at 0), the problem is probably located on one of the supply rails.

   If the trace appears to be attached to the positive (+) rail or is rising in positive DC voltage, then the problem exists somewhere in the circuitry of the positive rail on the heatsink board.

If the trace appears to be attached to the negative (-) rail or is rising in negative DC voltage, then the problem exists somewhere in the circuitry of the negative rail of the heatsink board.

2. Troubleshoot the circuit at the component level:

   Turn the Variac off to zero (0) volts output and wait a full minute for the power supply capacitors to discharge.

   Disconnect the output connector from the heatsink board

   Locate the problem area of circuitry on the board's positive or negative rail (as determined in step 1). See the heatsink board schematic #1.

   Use an ohmmeter or diode/transistor tester to test the components.

   If the output has a positive offset or is latched to the positive rail, start by checking for forward bias readings on the power transistors 2SC3281 NPN (black). If the offset or latch is on the negative rail, check PNP (green) 2SA1302 transistors.

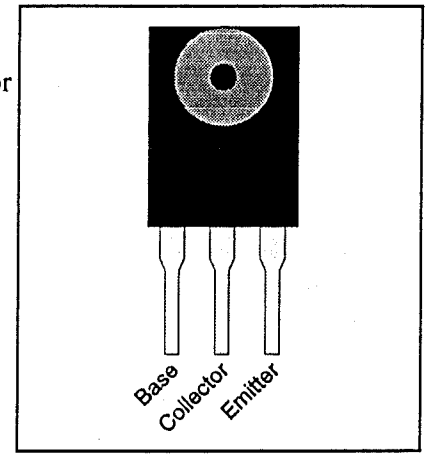


Figure 5-1 Power transistor front view and pinout

The legs of the transistors mounted on the heatsink are ***base, collector,*** *and* ***emitter,*** *from left to right (Figure 5-1). If there is a shorted device on either rail, all of the devices will show either a short or a very low resistance, because all of the emitters of the low rail are connected through 0.33 ohm 5 watt resistors, all of the bases are connected through 2.2 ohm 1 watt resistors, and all of the collectors are connected together on the board (Figure 5-2).*

The high rail transistor emitters are connected together through 0.2 ohm 5 watt resistors and the bases and collectors are connected together on the board; therefore, if one device is shorted they will all measure very low or zero ohms also.

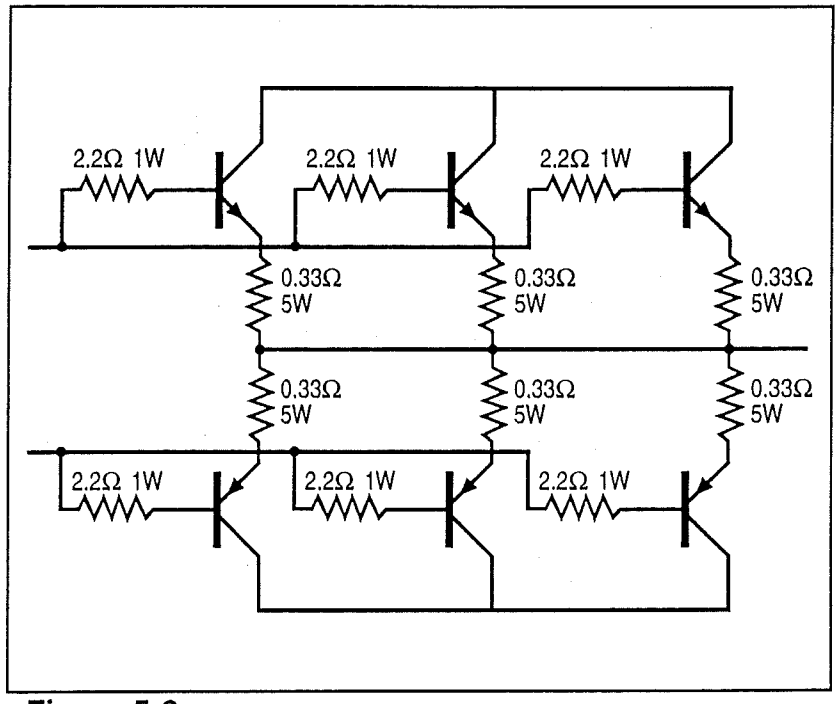


Figure 5-2

3. If there is a short from emitter to collector:

To determine which devices are bad, use a soldering iron to lift one leg of each emitter resistor. This removes each device from the circuit. Measure the emitter-collector resistance on each device.

If the emitter-collector resistance on an out-of-circuit transistor measures as a short circuit, then it is damaged and must be replaced. Check each transistor out-of-circuit and remove all defective ones by unscrewing the torque screws and unsoldering the transistors from the top of the board. If you find shorted devices be sure to check the value of all emitter resistors as well.

4. If there is a short from collector to base:

   Use a soldering iron to lift one leg of each 2.2 ohm base resistor. This removes the base of each transistor from the circuit and allows you to locate the bad device(s). Check the base-collector resistance of each transistor and replace any that measure as a short.

5. If the transistors test OK:

   Unsolder and lift one leg of each diode on the board. Check them with an ohmmeter or diode tester; they should each indicate infinite resistance when reverse biased and approximately 500 ohms when forward biased. Replace any that are damaged.

   Check the circuit board for open foil traces.

6. Using an ohmmeter, check the resistors, especially if you found some damaged transistors; often, a failure severe enough to destroy transistors will also damage surrounding resistors, particularly the base and emitter resistors.

Voltage on the heatsink will also cause high and low rail problems.

5.1.2 Referred from 4.4.2, Step 6—failed the "Heatsink Board Test"

1. If the output sinewave (Channel B on the scope) appears to be distorted during the negative cycle, you can assume that the problem is located somewhere in the circuitry of the positive low rail. If the positive cycle appears distorted, you can assume that the problem is in the circuitry of the negative low rail. Refer to schematic #1.

   REMEMBER! THE CLASS H OSCILLOSCOPE DRAWING IN FIGURE 4-3 SHOWS THE OUTPUT SINE WAVE AS WELL AS **BOTH** OF THE VOLTAGE RAILS. YOU ARE MONITORING THE OUTPUT BUT ONLY ONE OF THE RAILS AT A TIME.

2. If the high rails appear distorted or are not modulating as shown in figure 4-3, then the problem probably exists somewhere in the circuitry of the respective (+ or -) defective high rail. Refer to schematic #1.

See subsection 5.1.1, steps 2 - 6 for troubleshooting tips.

5.1.3 Referred from 4.4.2, Step 7—failed signal flow test

If Channel B's trace on the oscilloscope (module output) shows a latch or DC offset with the preamp board attached to the heatsink board, the problem probably lies on the preamp board. However, there may also be a defective component on the heatsink board that you may have overlooked.

1. Turn the Variac off.

2. Replace the suspect preamp board with the good preamp board from the other module. Make sure it is connected properly to the heatsink board.

3. Perform Step 7 and 8 (the "Signal Flow test") from subsection 4.4.2. If the problem no longer exists, then the "bad" preamp board requires troubleshooting. If the problem still exists, double check the heatsink board operation. See subsection 4.4.2 step 6.

4. First check the transistor circuitry in the amplifier front end section of the preamp board circuitry (see Figure 5-3). This section provides the signal drives for the heatsink board.

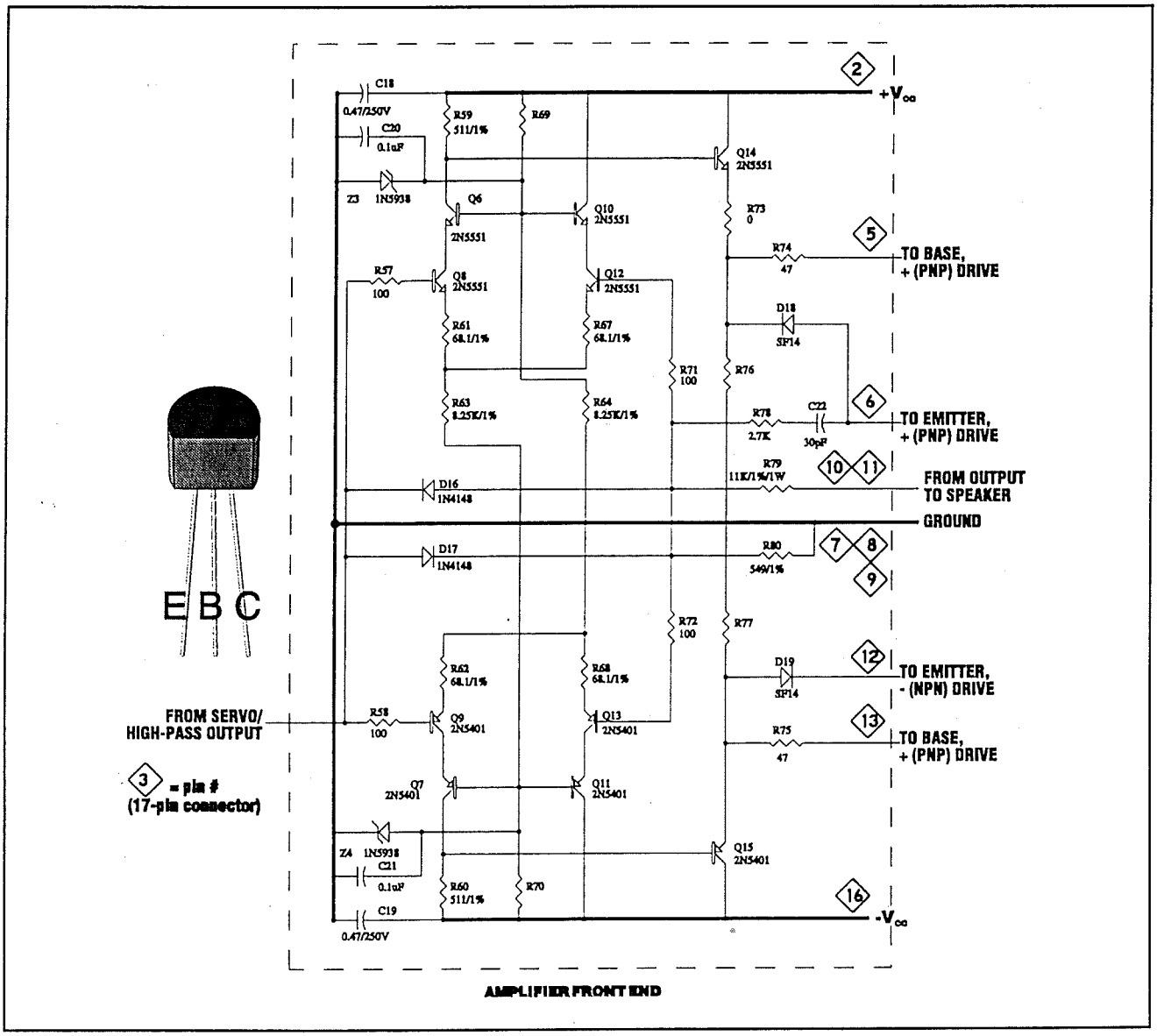


Figure 5-3 Preamp Front End circuitry

5. Turn the Variac off and wait a full minute for the power supply capacitors to discharge. Remove the preamp board from the heatsink board. Using an ohm-meter or diode tester check for open or shorted transistors or diodes.

   Use this section, the block diagram (Chapter 2 fig 2-1), and the preamp board circuit description to isolate the problem area on the preamp.

   On the older preamp board version which uses an opto-coupler - (used up to Serial Number #9103N00):

IC1: an NE5532 dual op-amp (originally this IC was an LF353; it was replaced in later production runs by the NE5532 to improve performance), which is the active component in the actively balanced input and the subsequent gain stage.

IC2: an RC4559N dual op-amp, which lies in the servo circuitry and also detects signal at the channel output.

IC3: also an RC4559N; it serves as the limit detector and the clip detector.

IC4: an LM393N dual comparator, which operates the current limiter circuitry.

On the newer preamp board, which has an operational transconductance amplifier - *(used after Serial Number #9103N00):*

IC1: an NE5532 dual op-amp; it is the active component in the actively balanced input and the subsequent gain stage.

IC2: an RC4559N dual op-amp, which lies in the servo circuitry and also detects signal at the channel output.

IC3: an LM339N quad comparator,which operates the current limiter circuitry, the attenuator driver, and the clip detector.

IC4: an NE5517AN dual operational transconductance amplifier, which attenuates the signal when the channel is clip limiting, in IGM, or in Auto-Ramp.

6. Using an ohmmeter or in-circuit transistor tester, check all the transistors and diodes in the faulty section of circuitry, on the preamp. Transistors Q6, Q8, Q10, Q12, and Q14 are 2N5551 NPNs, while Q7, Q9, Q11, Q13, and Q15 are 2N5401 PNPs. Diodes D18 and D19 are type SF14. Zener diodes Z1 and Z2 are type 1N5353B, and Z3 and Z4 are type 1N5938B.

7. Remember to use an ohmmeter to test resistors for proper values as they may have shorted or burned open.

If you turn the Variac up to full mains voltage and the channel stays in protect but the module output shows no latch check for voltage between the chassis and the heatsink. If there is no voltage on the heatsink, go back and thoroughly check the board which you are troubleshooting. Something may have been overlooked.

5.1.4 Referred from 4.4.2, Step 9—cannot bias properly

1. If you cannot set the bias on the module as described, make sure the AC power to the amplifier is shut off and it is unplugged. Disconnect the defective module from the amplifier.

   Locate the bias adjust circuit, located on the heatsink board, consisting primarily of Q17, VR2 etc. Using an ohmmeter, check VR2, a 250 ohm trimpot on the heatsink board, for proper value and operation. As you rotate the wiper of VR2, the resistance should change smoothly, with no interruptions, dropouts, or short circuits.

   If VR2's resistance at any wiper position is infinite, or if its resistance stays constant as you rotate the wiper, replace VR2.

   If VR2's resistance changes roughly or erratically as you rotate the wiper, try using contact cleaner. Give it a few seconds to soak in, then check the trimpot again. If the problem remains, replace VR2.

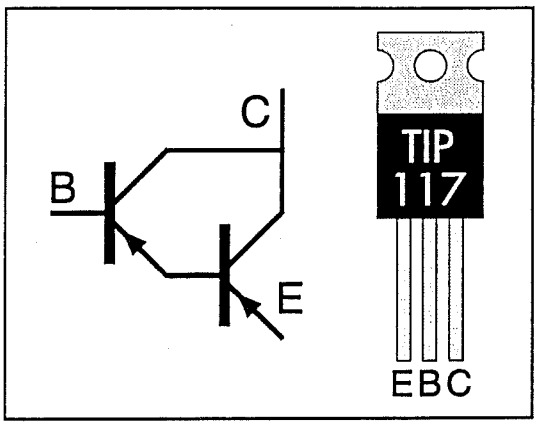


Figure 5-4 Darlington pair transistor, front view.

2. Using an ohmmeter or in-circuit transistor tester, check Q17 (Figure 5-4), a TIP117 Darlington pair transistor, replace it if necessary.

Remember that as a Darlington pair, the transistor has two base-emitter junctions in series between the base and the emitter.

3. Connect the amplifier to the Variac and slowly turn up the voltage to approximately 40 volts. Check for voltage between the heatsink and the amplifier chassis. Because the heatsink is completely isolated electrically from the heatsink and preamp boards, there should be no voltage on it. If you find an AC or DC voltage between the heatsink and the chassis, see subsection 5.1.7.

5.1.5 Referred from 4.4.2, Step 12—excessive THD + N

1. First, make sure the module is biased properly (see Subsection 4.4.2, Steps 9 through 11).

   Note: If your distortion analyzer has a 400 Hz high-pass filter, use it. If the THD + N drops to an acceptable level with the 400 Hz filter in, then you know that the distortion is below 400 Hz, probably caused by line related hum. You can first assume that there is an open ground somewhere in the wiring harness or in the chassis. If not, continue.

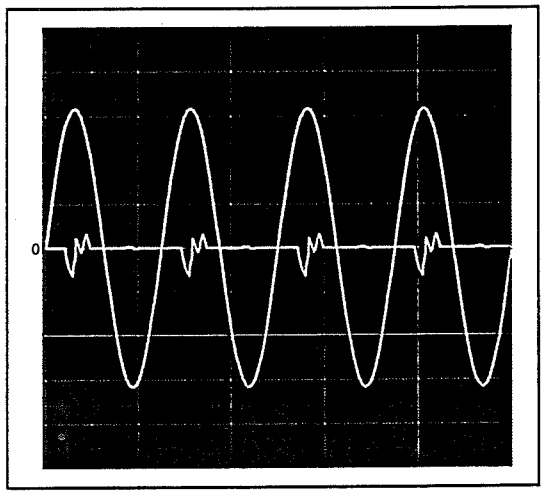


Figure 5-5 THD

Distortion can have a number of causes. To help track down its source, observe the analyzer output (the distortion product) on one oscilloscope channel and the channel's output signal on another. Excessive distortion products that are synchronous with either the positive halves of the waveform or the negative halves, and not both, indicate a problem in the respective positive or negative circuitry of the module. For example, Figure 5-5 shows an excessive distortion product that occurs simultaneously with the positive peaks, but not the negatives; this indicates a problem in the positive circuitry in either the preamp board or the heatsink board. You must investigate further to isolate the THD problem to either board.

Note: Be sure that the amplifier is getting proper line voltage. Starving or overloading the supply will cause high THD.

2. Turn the Variac off and swap the preamp board with one that is known to be good.

3. Turn the Variac back up to 40 volts. If the distortion problem remains, then the heatsink board is defective. If the excessive distortion disappears, the problem lies on the preamp board.

4. Turn the Variac off again and return the original preamp board to the module under test. Continue below with the appropriate measures: Step 5 if the preamp board is defective, or Step 6 if the heatsink board is defective.

5. *Tracing excessive THD in the preamp board:*

   Swap IC4, the NE5517AN dual operational tranconductance amplifier (OTA). Turn up the Variac and see if the excessive THD disappears. If not, turn off the Variac and continue. (For the older preamp boards, try swapping the optocoupler, OC1.)

   Check Z1, Z2, both 1N5353 and check Z3, & Z4, both 1N5938 zener diodes, with an ohmmeter or diode tester. Turn the Variac up to full mains voltage and check Z1 and Z2 for 16-volt regulation and Z3 and Z4 for 36-volt regulation.

   Turn off the Variac and check D18 and D19, both SF14 diodes, with an ohmmeter or diode tester.

   Continue checking transistors, diodes, resistors, etc., particularly those associated with the polarity that exhibits the distortion problem. For example, if the excessive THD occurs on the positive halves of the waveform, check transistors Q6, Q8, Q10, Q12, and Q14, as well as resistors R57, R59, R61, R63, etc.

6. *Tracing excessive THD in the heatsink board:*

   With the Variac turned off and the board disconnected from the amplifier, check all components, starting with the resistors. An open or shorted resistor can cause high THD, as can a faulty diode, capacitor, or transistor.

   Reconnect the heatsink board, turn up the Variac and check for voltage between the heatsink and the chassis. There should be none, but if there is, it may be the cause of the excessive distortion. See Subsection 5.1.7.

   Does the excessive THD occur only with a load on the channel output? Premature clipping on either the positive or the negative waveform peaks (Figure 5-6) that disappears when the output load is

disconnected indicates a likely power supply problem, a zener diode problem, or output transistor problem. Turn off the Variac and check the power supply bridge rectifier(s). All four diodes of the bridge rectifier must be in working condition; replace the rectifier if necessary (see Chapter 6 step 17). Turn the Variac up to full AC mains voltage and check the voltage drop across the zener diodes Z8 and Z9. The voltage drop across these two 1N5927s must be 12 volts DC, ±1%; replace any failed or out-of-tolerance zeners. Check the affected output transistors see Subsection 5.1.1, Steps 2 through 5.

5.1.6 Referred from 4.4.2, Step 16—insufficient output power

1. If the channel will not produce enough output power into 2 ohms with reference to the output power chart, observe the output waveform on the oscilloscope as you apply the load.

2. Does the signal clip prematurely on only positive or negative peaks (Figure 5-6)? If so, check the power transistors associated with that rail (one or more may be defective) as well as zener diodes Z8 and Z9 on the heatsink board, and the bridge rectifier(s) in the power supply. Follow the tips from Subsection 5.1.5, Step 6.

3. Try swapping the current limiter comparator IC (LM393N on the older board version; LM339N on the newer one) from the preamp board with a new IC or one from the "good" preamp board.

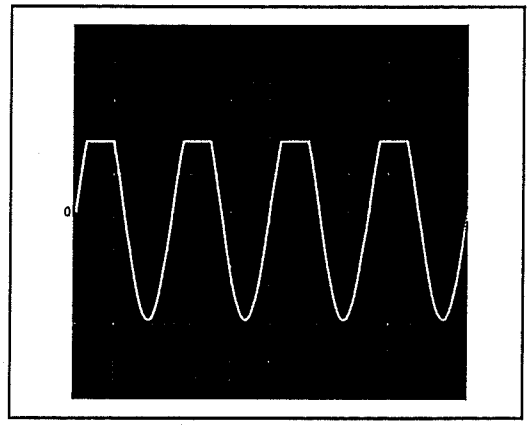


Figure 5-6 Premature clipping

5.1.7 Referred from 4.4.2, Step 17—voltage on the heatsink

1. Turn the Variac off. Make sure the heatsink of the module under test is not touching the chassis.

2. Set the Variac to 40 volts AC.

The transistors are fastened to the heatsink for heat dissipation. The bottom surface of each transistor's flat case connects to the collector. To insulate the collector voltage from the grounded heatsink, either a strip of green coolsil or individual mica washers with silicone thermal grease are used. Sometimes these insulators become damaged with age, through repeated expansion and contraction, causing collector current leakage onto the heatsink.

3. Connect the voltmeter between the amplifier chassis (ground) and the heatsink. If you find the heatsink has a positive DC voltage with respect to chassis ground, the problem lies with the NPN (black) transistors, which are associated with the positive rail. If it has a negative voltage, the problem is the PNP (green) transistors.

4. Leave the Variac set to 40 volts AC. Using a $\frac{3}{32}$" (2.4 mm) hex driver with an **INSULATED HANDLE**, begin loosening the mounting screws of the suspect transistors one by one while observing the voltmeter reading. Once you unscrew the transistor that is shorting to the heatsink, the voltage between ground and the heatsink will disappear.

5. Turn the Variac off to zero volts. *Wait a minute before you continue to let the power supply capacitors to discharge.*

6. Completely remove the mounting screw of the shorting transistor. Carefully lift the transistor away from heatsink.

7. Check the insulator underneath the transistor for rips, holes, or debris. Clear away anything that may have caused a puncture in the insulator.

8. Replace the coolsil or mica. If a mica washer is used, coat both the heatsink area and the device with a thin film of silicone thermal grease first.

9. Replace the transistor's mounting screw. Tighten the mounting screws of the large power transistors to 15 lb.-in (1.7 N-m). Over tightening will damage the mica and/or deform the coolsil insulator. Carefully hand- tighten the mounting screws of the smaller devices enough to hold firmly without crushing the shoulder washer, which would short the device to the heatsink. Replace the shoulder washer if it is damaged. (Figure 5-7)

Step 10 is necessary because more than one transistor may be shorted to the heatsink.

10. Repeat Steps 2 and 3 to test for voltage on the heatsink. Repeat this procedure as necessary until no voltage remains on the heatsink.

Remember! There should be no DC voltage—positive or negative—and no more than 10 volts AC present on the heatsink with respect to chassis ground.

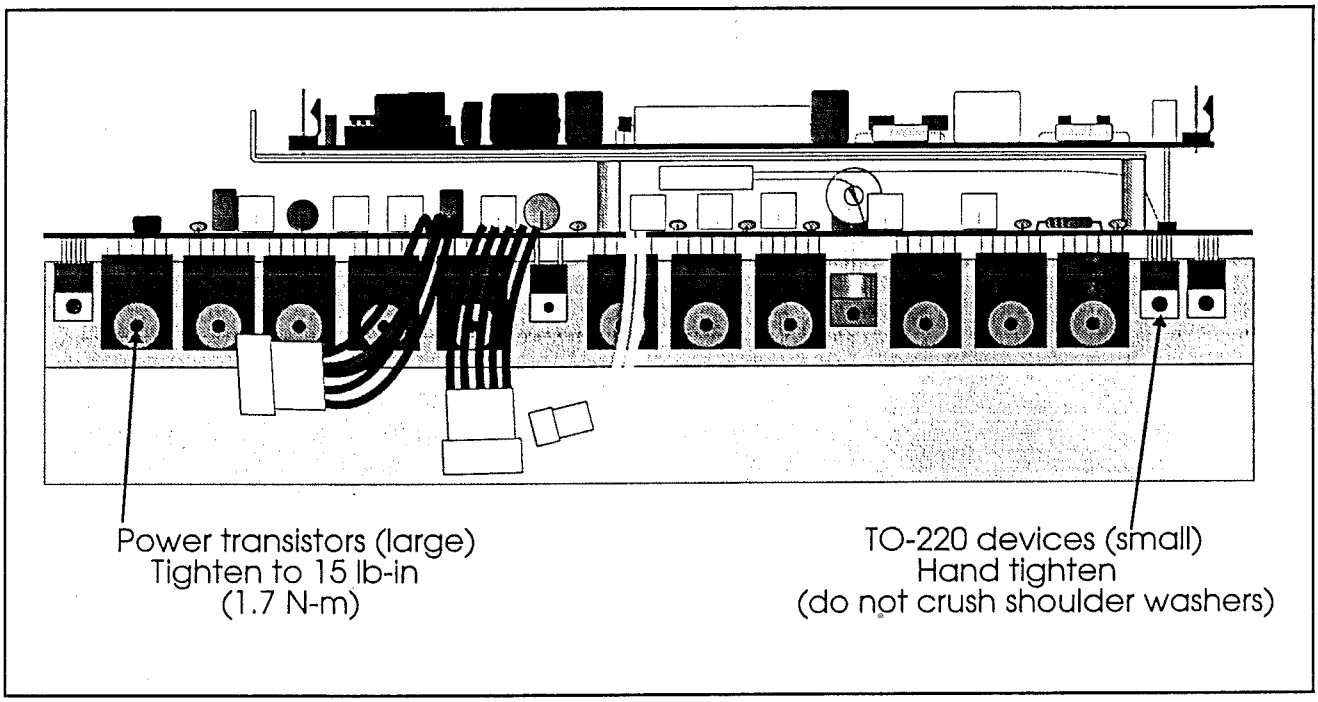


Figure 5-7 Transistor mounts

6 TROUBLESHOOTING THE REST OF THE AMPLIFIER

Tools and materials needed:

- ✔ Philips #1 screwdriver (if the amplifier has a toroidal transformer, you will need a #2 also)
- ✔ 1/8" (3.15 mm) right angle hex key
- ✔ Multimeter (with a bandwidth of 20k or greater)
- ✔ Variac

6.1 Symptom: No audio, LEDs not lit on one/both channels (Steps 1–25) One or both channels stays in "protect" (Steps 1–25) Audio okay, LEDs not lit on one channel only (Steps 3–14)

Setup:

- ✔ Variac set to 0 VAC (off)
- ✔ Amplifier turned off
- ✔ Top cover removed from the amplifier. See subsection 4.1 for setup and procedure.

First check the power supply rails.

1. Plug the amplifier into the Variac. Turn on the amplifier and adjust the Variac output to 40 volts AC.

2. Measure the Low DC rail voltages, with respect to the amplifier chassis ground, at points 1 (where the red/black wires attach to the power supply caps.) and 2 (where the green/black wires attach to the power supply caps.)

   Measure the Hi DC rail voltages, with respect to the amplifier chassis ground, at points 3 (where the red wires attach to the power supply caps) and 4 (where the green wires attach to the power supply caps.) as shown in Figure 6-1.

   If the power supply is functioning properly, you should measure approximate voltages as listed in the following table:

8001	(+) Low rail Point 1	(-) Low rail Point 2	(+) Hi rail Point 3	(-) Hi rail Point 4
120 volt amp	+24 VDC	-24 VDC	+44 VDC	-44 VDC
240 volt amp	+12 VDC	-12 VDC	+22 VDC	-22 VDC

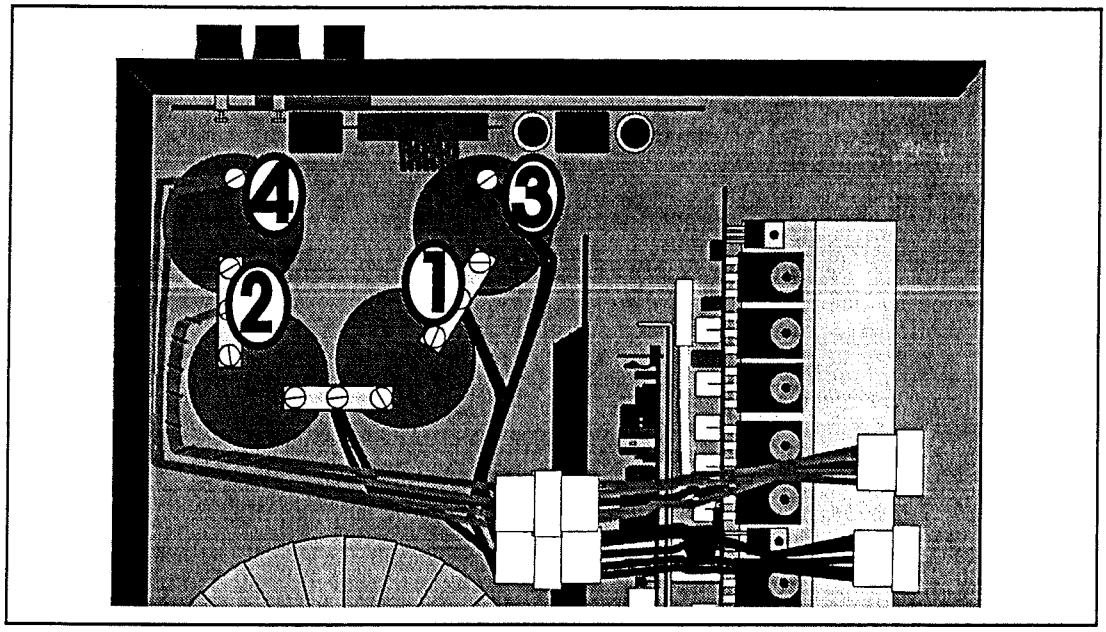


Figure 6-1 DC Rail voltage points

If the power supply voltages measure correctly, continue with testing the display board. If not, go to Step 16.

Next, check the display board. It stands directly behind the front panel and holds the LEDs and the attenuator controls.

3. Using your voltmeter set on the DC scale, check the following points: Reference Schematic #3

   a) Connect the ground lead of your voltmeter to audio ground, located at pin 12 on the 13-pin male connector at the top on the back of the display board, M12. (With respect to the front of the amplifier - pin 1 is far left.)

   b) Locate M5 which is the 15 pin connector on the left backside of the display board. With respect to audio ground; measure the voltage at pin 15. You should measure approximately 35 volts DC. If no voltage is present, turn the variac off to zero 0 volts and move onto step c. If voltage is present on pin - 15 of M5, with respect to audio ground measure the voltage at pin 1 of M12 (13 pin male at top backside of display board). You should measure approximately 18vdc. If you measure a low voltage, or none at all, then you can assume that the problem is located in the wiring harness, see steps 15-18.

   c) Remove the 3 amp-mini fuse located at the left rear of the display board and check it for continuity. If the fuse has burned open (infinite resistance); first replace it. Repeat step B. If refuse burns open again you need to find out why. (see step 4)

4. Turn the Variac off.

To remove the display board, you must first remove the front panel.

Using a ⅛" (3.15 mm) right angle hex key, remove the six front panel screws. Remove the two Philips head screws above and below the circuit breaker and remove the front panel.

BE EXTREMELY CAUTIOUS WITH THE CIRCUIT BREAKER UN-MOUNTED. DO NOT LET EITHER TAB OF THE BREAKER TOUCH THE CHASSIS. YOU COULD BE ELECTROCUTED AND PERMANENT DAMAGE COULD BE DONE TO THE AMPLIFIER.

5. Disconnect the two 15-pin connectors at the sides of the display board and the two 3-pin connectors at the bottom.

   If the amplifier is fitted with a NexSys controller card, which would be piggybacked on the display board, lift it up to separate it from the display board and separate it from the harness.

6. Remove the display board's four mounting screws.

7. Lift the display board out from the chassis.

Before continuing, visually inspect the display board for obvious defects, burns, etc. In the unlikely event that a board is damaged beyond repair, please call Crest Audio for service.

8. If the fuse had blown, first check BR1, an RS202 bridge rectifier with an ohmmeter or diode tester. Replace it if necessary.

In the display board circuitry, BR1 lies right after the fuse. If you have no LED's and the amplifier power supply passes all the tests (you checked it in Steps 1 through 3) but the fuse has blown, BR1 is probably shorted. If not, continue component level troubleshooting.

9. Check IC1, an LM614CN quad op-amp by replacing it with a new one. Set the display board back into the chassis and reconnect it.

   Place the display board fuse back in its holder; use a new one, if necessary. Turn the Variac up and turn the amplifier on. If one Channel's LEDs are not yet lighting properly, or Channel(s) is/are staying in a protect mode, turn the Variac off, remove the display board, and continue troubleshooting further with Step 10.

10. Use an ohmmeter, in-circuit transistor tester, or diode tester to check the LEDs, diodes, and transistors common to the respective malfunctioning Channel(s) on the display board. Replace any components that are defective.

11. Place the display board back into the chassis and reattach all of the connectors. Insert and tighten the four mounting screws.

    If the LEDs work on both channels and neither channel remains in protect after the amplifier is turned on, check the amplifier's audio performance to see if it requires any further repair.

If the LEDs work on both channels but one or both channels remain in protect when the amplifier is turned on, go to Chapter 4, Troubleshooting and Repairing the Output Modules, to test and, if necessary, repair the output modules. After that, continue with Step 14, below.

12. If one or both channels stay in protect and the output module(s), power supply, and display board work properly, the wiring harness is the most likely suspect.

Next, test the wiring harness.

13. Visually inspect the wiring harness for broken wires, loose pins in the sockets, broken or punctured wire insulations, etc. In particular, check anywhere that a harness wire may have been pinched between the chassis and the top cover, heatsink, etc.

14. If you find any signs of physical damage or otherwise suspect an open circuit in a harness wire or connector, check it with an ohmmeter. Repair or replace any damaged harness components.

Next, check the power supply.

15. Turn the amplifier on and turn up the variac to full line voltage. Measure the positive and negative Hi and Low rail voltages (see Figure 6-1, points 1, 2, 3 and 4). High Rails at full mains = +/-135VDC. Low Rails at full mains = +/-67VDC.

16. If the negative and positive voltages do not match to within approximately one volt, the power supply has a problem. Turn off the amplifier and the Variac and wait a minute to allow the power supply capacitors to discharge.

    If a rail voltage is lagging, check the suspect bridge rectifier (BR1 for the positive rails and BR2 for the negative rails-both ED2101 rectifiers), using an ohmmeter or diode tester. Replace any that are faulty. If the rectifiers are ok, inspect each power supply capacitor for visual-apparant damage or possible short circuit.

To replace a defective rectifier(s), you must remove the transformer shield .

17. Remove the three Phillips head screws from the bottom center of the chassis as well as the two front panel hex screws which hold the shield in place.

    Remove and **LABEL** the wires/connectors which are mounted to the rectifier terminals so you can reinstall them correctly. Also remove the output module rail connectors as they will be in the way of the rectifiers.

    While being extremely careful not to damage any wires in the harness, lift the shield upward to remove it from the chassis.

    Determine which rectifier(s) needs to be replaced and remove it's mounting screw and nut. Keep in mind the original position of the rectifier so that you can reinstall it correctly.

To replace a defective power supply capacitor.

UNPLUG THE AMPLIFIER AND BE SURE THAT THE POWER SUPPLY CAPACITORS ARE COMPLETELY DISCHARGED! CHECK THEM WITH A VOLTMETER!! SEE WARNING SECTION 4.2!!

In order to fully discharge the capacitors, make sure that all of the output module rail connectors are connected then wait approximately a minute.

18. First determine which capacitor(s) needs to be replaced and remove the rail wires/connectors from the screw terminals.

    Each capacitor is secured in place by a clamp which is directly mounted to the bottom of the chassis. Each clamp uses three Phillips head screws, mounted from the bottom therefore, removal of these screws will enable you to lift the defective cap(s) out of the chassis. Again, be careful not to damage any wires in the harness.

19. Re-test the rail voltages.

Check the output relays .

20. Turn the amplifier and Variac off and wait a minute to allow the power supply capacitors to discharge.

21. Use an ohmmeter to measure the resistance between ground and each output module's white wire. A short circuit to ground at either point indicates a probable defective output relay.

To replace an output relay remove the relay board..

22. The first step is to remove the power supply capacitor at the far left rear corner of the chassis. The relay board can't be removed with this cap in place. See step #20 above for removal.

    Next, remove all eight binding post-nuts from the far left of the relay board as well as the two Phillips head screws on the rear panel. Disconnect the 5-pin connector. Observing the harness, carefully lift the board upward to remove.

    First, using an ohmmeter, determine which relay(s) are defective by checking to see that the normally open contacts aren't shorted and that the normally closed contacts aren't open.

    Desolder the defective relay(s) from the bottom of the board and replace them with new.

If you need any additional assistance, please contact CREST AUDIO. Our technical support team will be happy to assist you.

Thank you for spending time in Crest Audio's neighborhood... See Ya.