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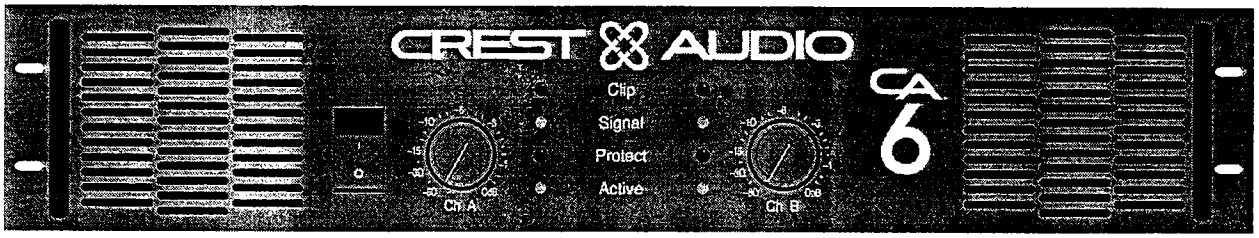
CREST AUDIO



CA Series

Power Amplifiers: CA4
CA6
CA9
CA12

Service Manual Release 1.1 8/96 **DOMESTIC**

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Crest Audio CA Series
Service Manual
Models CA4, CA-6, CA-9 and CA-12

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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.

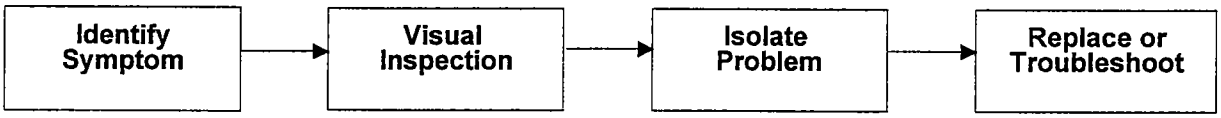
This manual and the procedures detailed within are intended for qualified technicians only! There are potentially lethal voltages present within an audio power amplifier, and it is the responsibility of the technician to exercise common safety practices to protect himself, his co-workers, and the end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

In particular, always exercise caution when working on an amplifier with the chassis cover removed. Do not leave it unattended 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.

1 INTRODUCTION

This service manual includes tests, calibrations, schematics, a full parts list/order form, and troubleshooting tips to assist you in the repair and maintenance of Crest Audio CA Series CA-2, CA-4, CA-6, CA-9 and CA-12 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. Good luck!



Glossary

Following is a list of terminology used in this manual.

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

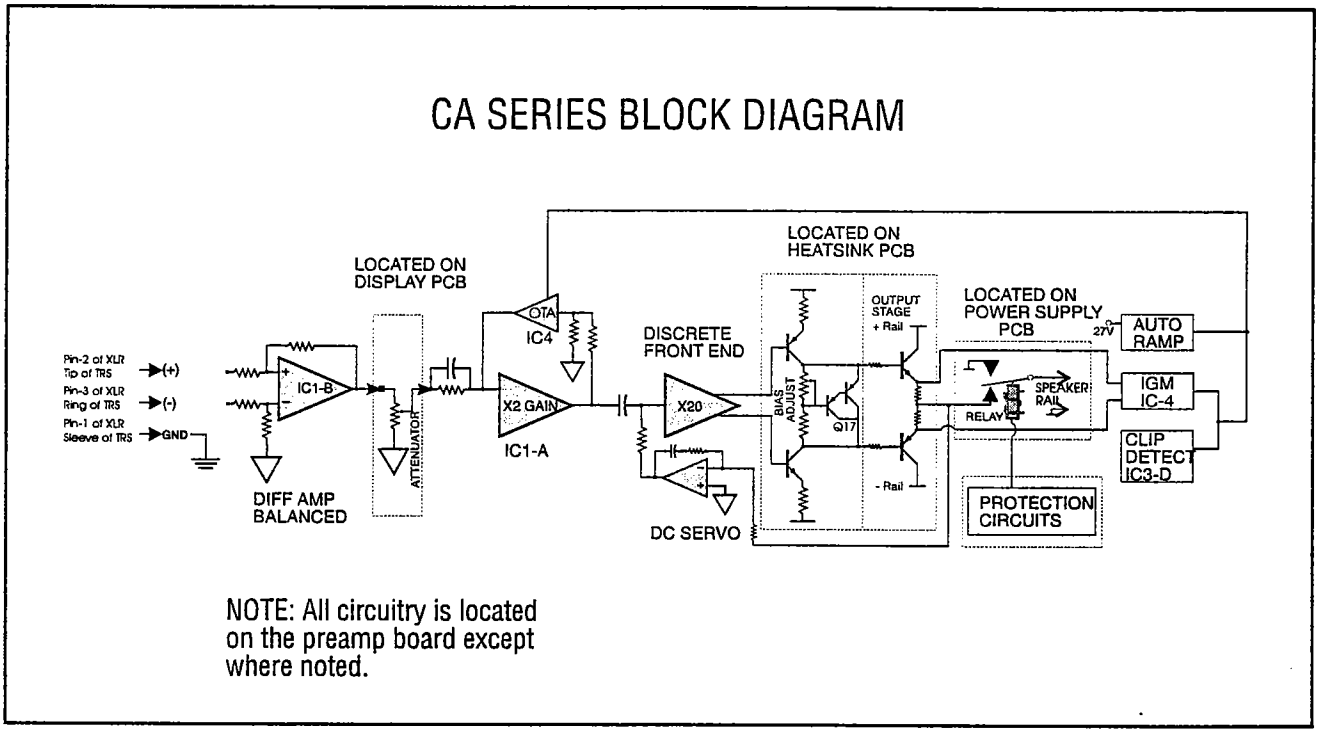
Chassis — The steel case or frame in which the modules, transformer, etc. are mounted.

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

2 CIRCUIT DESCRIPTION

Crest Audio CA Series models CA-4, CA-6, CA-9 and CA-12 amplifiers are fan-cooled and use bipolar output transistors. Physically, the CA-4, CA-6 and CA-9 are two rack spaces (3.5 inches; 8.89 cm) high and the CA-12 is three rack spaces (5.25 inches; 13.43 cm) high. The modular sub-assemblies which make up these amplifiers are mounted in a 14 gauge, folded and welded steel box-type chassis with a removable top cover.

Two rear-mounted cooling fans draw cooling air in from the rear and pressurize the chassis. Directly in front of the fans are the two output module heatsinks. Because the air pushed from the fan does not have to change direction abruptly or flow around any 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. A temperature sensing circuit, with a sensor on each module, monitors the temperatures of both heatsinks. This circuit, located on the power supply board, drives the cooling fans and varies the fan speed in proportion to the amount of cooling required.



The inputs

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

Crest Audio CA Series amplifiers use both female XLR connectors and 1/4 inch TRS connectors on the rear panel for inputs. Pin 1 on each XLR and the sleeve on each TRS is signal ground, pin 2 on each XLR and the tip on the TRS is the non-inverting (+), or "HOT", input and pin 3 on each XLR and the ring on the TRS is the inverting input (-), thus making a balanced input.

From the input connectors, the input signals are routed through a balanced input gain stage. After the input gain stage, the signals continue to a 3-pin mode select connector. (This connector, located internally on the input/preamp pcb, sets the amplifier to one of two operating modes; "stereo or "bridge", depending on the position of the mode select jumper). The "stereo" mode is normal two-channel operation, in which a signal at Channel A's input produces an 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 "bridge" mode, both outputs are driven from Channel A's input, the inverter circuit (on the preamp) reverses the polarity of the signal going into Channel B. This makes the two channels work in opposition, effectively making the two channels into a single mono amplifier with double the voltage swing. To "bridge", the load must be connected between Channel A and B's red output terminals referencing Channel B's red terminal as speaker (-). Mode select only acts on Channel B's signal never affecting the signal on Channel A.

The first active circuitry in the signal path is the balanced transformerless amplifier formed by operational amplifiers (op-amp) IC1B and IC2A OPA2604. The input stage presents a balanced input impedance of 20 kilohms.

In the middle

The signal is then routed to the input attenuators, or volume controls, located on the display board. It returns to op-amp IC3A and IC2B, set up as a unity gain stage. This is also where the clip limiting, IGM, muting, and Auto-Ramp circuits act on the signal. An operational transconductance amplifier, IC4, handles attenuation when necessary by shunting some of the signal off. When the OTA receives no control current from the clip limit, IGM, mute, or Auto-Ramp control circuits, it presents an ultra-high impedance at IC1A's non-inverting input, so the signal passes with no attenuation.

When attenuation is needed, the control current increases, in turn increasing the gain of the OTA, which lowers the impedance at the input of IC1A.

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 of the power supply and the output section of the amplifier. In order to understand *Crest class H,* the operation of the CA Series amplifiers, you must first understand the operation of *class AB* as described below.

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.

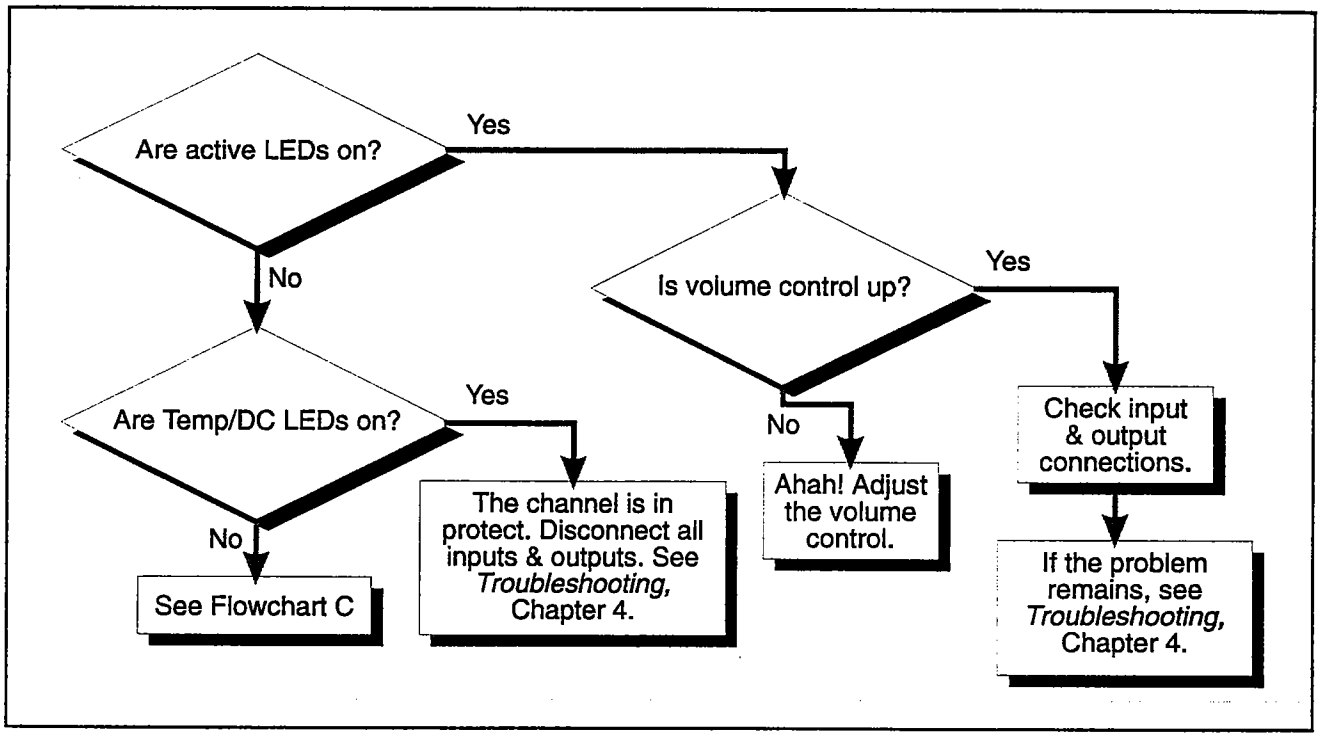
In *class AB*, the base-emitter junction of the transistors must be forward biased with a small DC voltage in order to reduce crossover distortion. When the bias voltage is applied, the transistors conduct allowing them to pass the full half of their respective portion of the waveform (positive or negative), thus reducing crossover distortion. In the Crest Audio CA Series amplifiers, trimpot VR1, located on the heatsink board, is used to set the bias point (30 mVDC emitter to emitter).

Crest Audio CA Series amplifiers operate 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.

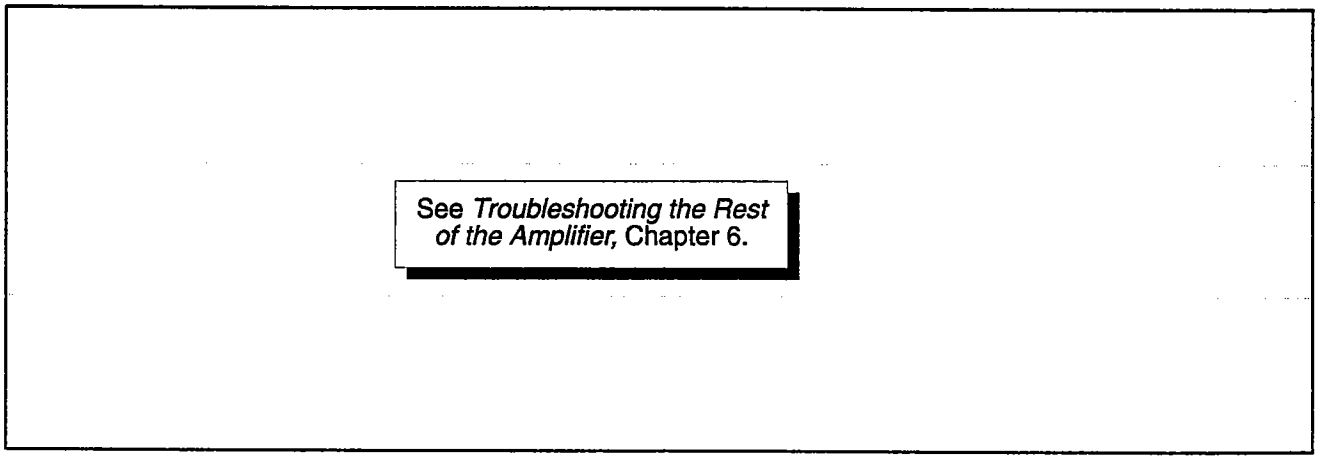
Until approximately the 1/3 power point the *class H* amplifier operates as *class AB*. Beyond this output level the high rail transistors conduct, thus modulating the low rails. This increases the efficiency of the amplifier as each transistor only "sees" the high rail DC voltage when the output is high enough (greater than 1/3rd power). See Fig 4-2 for a visual reference of an output signal showing the *Class H* modulated rails.

3 FLOWCHARTS FOR TROUBLESHOOTING

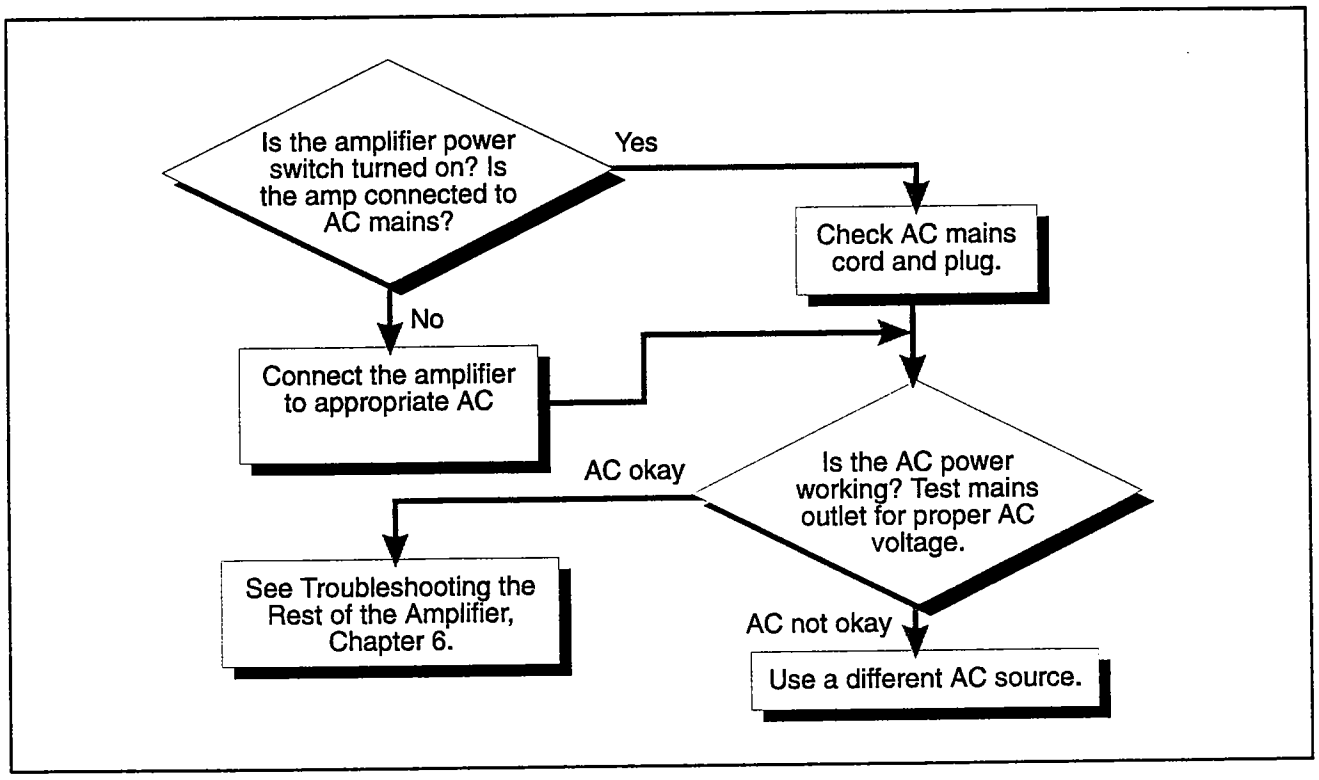
Flowchart A. Problem: No Sound



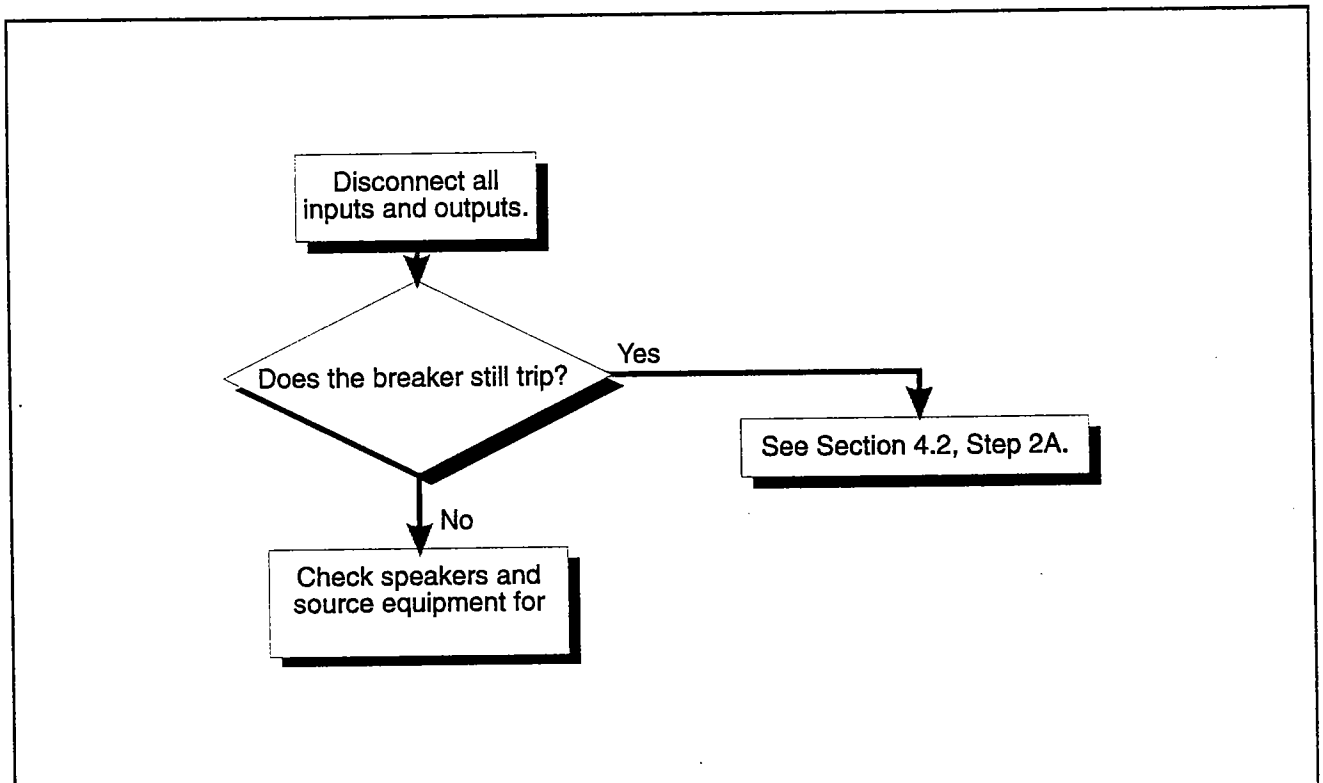
Flowchart B. Non Functioning Fan



Flowchart C. Problem: No LEDs on either channel



Flowchart D. 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 brush 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-head top cover screws. 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. 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, fans, and all modules and circuit boards are securely mounted in 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 one or more relays or capacitors are defective see Chapter 6.

4.2 Removing or replacing one or both output modules

Tools & materials needed:

*Phillips #1 screwdriver
*Pen or marker for labeling modules
*Clamp-on current probe (Fluke RS-1 or equivelent)
*Variac

Setup:

*Amplifier disconnected from AC mains

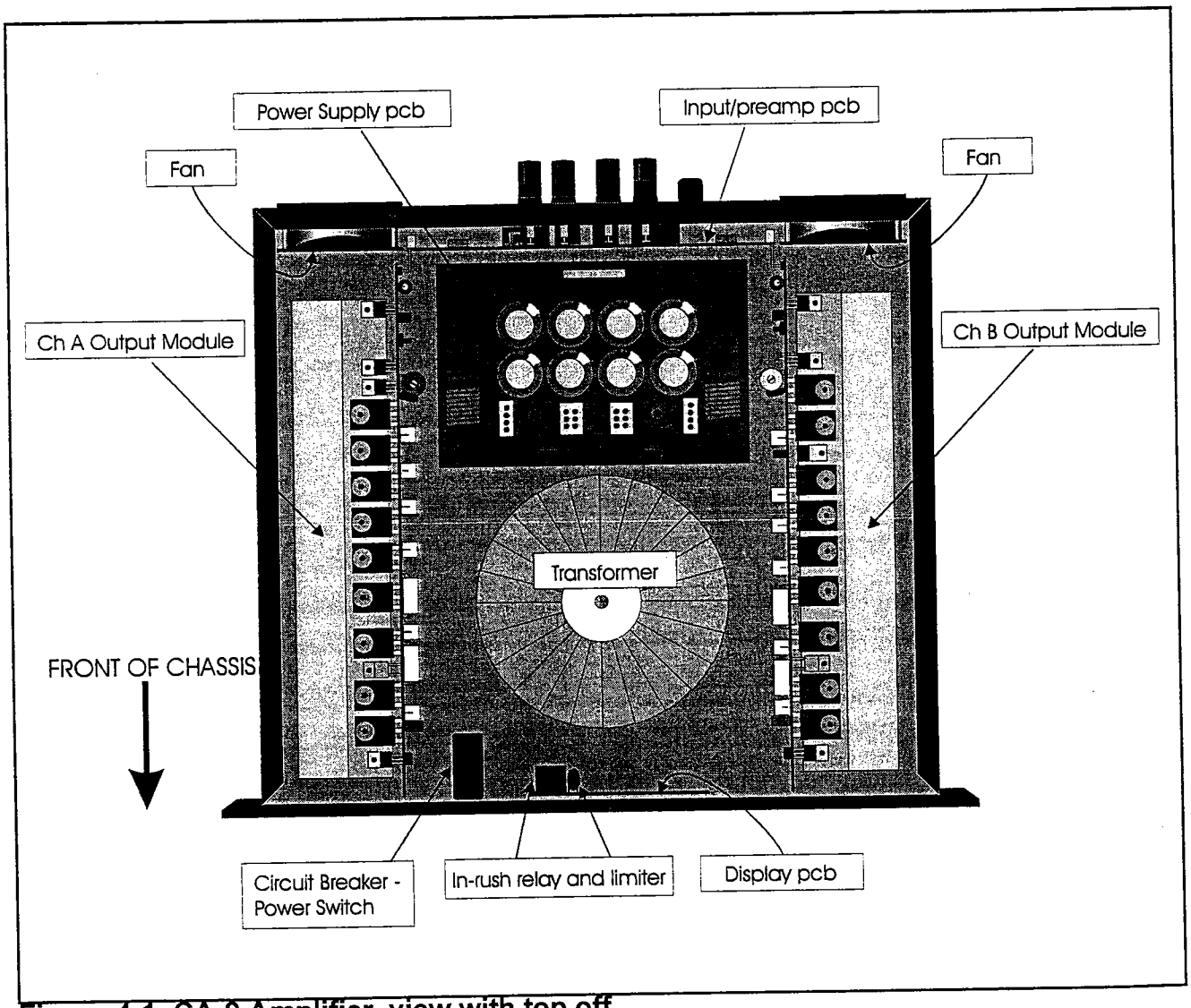


Figure 4-1. CA-9 Amplifier, view with top off

Procedure:

1. The output modules are mounted, on their side, with channel A on the left and channel B on the right side of the chassis as shown in Fig 4-1. Each heatsink is fastened to the bottom of the chassis with 3 screws. *Bypass step 2a unless your breaker is tripping at turn-on.*

2a. Referred from Flowchart B: 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. The result is usually shorted power transistors on the output module(s) or a power supply component failure/short. Shorted transistors will cause excessive current, in turn, tripping the breaker as will a shorted bridge rectifier or a shorted power supply capacitor (cap) in the power supply. The first step is to determine which channel is defective.

b. Locate the power supply/output connectors (Figure 4-1).

c. Be sure that the amplifier is disconnected from AC mains. Disconnect Channel A's power supply/output connector.

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

e. Set the Variac at zero volts.

f. With the amplifier's circuit breaker in the "on" position, plug the amplifier into the Variac. ***Note: While increasing the Variac, monitor your 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 somewhere in the amplifier; if not, continue.***

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 power supply/output connector.

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 bridge rectifiers, the output relays and power caps for shorts which will also cause excessive current thus, tripping the breaker (Chapter 6).

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 and possibly damage the preamp board and the wiring harness.

2. Lay the amplifier back down.

3. Label the channel A and B heatsinks for isolation purposes and so you can reinstall to their original position.

4. Unplug the temperature wires and disconnect the modules from the preamp by sliding them toward the front of the chassis. This will disconnect the 17-pin header on the modules from the preamp sockets. (See Fig. 4-1)

5. Remove the modules from the chassis.

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

7. If you find that you cannot repair the board, please call Crest Audio's Technical Services Department.

8. 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 and vice-versa.

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. Reconnect the power supply/output connectors. Be sure connectors are oriented properly and securely.

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

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

   If the problem stays on the same channel after swapping, 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, ie: 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 it's 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 TECHNICIANS!!

4.4.1 Preparation for full module test

Tools and materials needed:

*Phillips #1 screwdriver
*Dual trace oscilloscope
*Audio generator
*Variac
*Digital multimeter (Fluke 87 or equivalent 20kHz bandwidth meter)
*Distortion analyzer
*4 and 2-ohm resistor (1000 watt non-inductive Millwaukee or equivalent). Load resistors are available through Crest.

Setup:

*Variac set to zero (0) VAC.
*Amplifier turned off and disconnected from AC mains.

Procedure:

1. Install a "good" module into the "good" channel of the preamp. *Note: you can test one module at a time. Remember that if a channel's module is disconnected, that amplifier channel will stay in "protect" mode.*

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

3. Locate the two 390-ohm, 5 watt resistors at the back end (opposite the 17-pin header) of the heatsink board (R140, R141 See schematic). Keep in mind that the positive rail reference point is the outside lead of the 390-ohm resistor located on the left (positive, NPN) side of the heatsink board. The negative rail reference point is the outside lead of the 390-ohm resistor located on the right (negative, PNP) side of the heatsink board.

   Connect oscilloscope channel A to the negative (-) rail reference point. This connects directly to the emitters of the negative (-) rail output transistors.

   Connect oscilloscope channel B's probe to the output section at either lead of any fo the .33-ohm, 5 watt emitter resistors (R124, R126 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 reference points 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

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 around 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 the respective schematic. Notice that the positive rail uses 2SC3281 NPN power transistors and the negative rail uses 2SA1302 PNP power transistors.

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

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 1.5A, there is a short circuit somewhere in the amplifier, go to Section 4.2, Step 2a. If not, continue (or get coffee!).

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 nd Solutions", Subsection 5.1.1.

5. Carefully remove Channel A's oscilloscope probe from the negative rail reference point 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 (in the center of the screen). If this is so, continue to step 6. If not, see "Symptoms and Solutions", Chapter 5.

Step 6 is known as the "Heatsink Board Test"

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