# SECTION 5 - TROUBLESHOOTING

## INTRODUCTION

The R-90 Phonograph incorporates several modules which plug in for rapid service. The block diagram in Figure 5-6 shows the modules and the wiring between them. Figure 5-6, also, shows wiring between modules and components.

Troubleshoot logically so that your effort is not wasted by removing and replacing the wrong parts (If necessary, refer to the R-90 Programming Reference Guide in Section 2.). Most failures are caused by minor defects. The most likely causes of phonograph problems are:

1. Continuous or intermittent opens in a harness. The cause can be wiring, a terminal, or a bad terminal crimp.

   - Check that all plugs are firmly seated.

   - Check that connector pins are not bent, broken or pushed through the back of connectors when mated.

2. A defective module (See Table 5-1.).

## CONTINUOUS CREDIT

As an aid to troubleshooting, the phonograph may be programmed to play continuously. In this mode, the phonograph will play selections as long as selections are made (No money is needed.). To use this feature, enter the Programming Mode (Refer to Section 2, Programming The Credit And Selection System.) and enter "255" into Location "27".

Table 5-1 Replaceable Modules

| PART NO. | DESCRIPTION | NOTES |
|---|---|---|
| 4-07773-05 | Central Control Computer Circuit (C.C.C.) | Module contains Bd. Ass'y - C.C.C. 6-09738-05 |
| 4-07221-05 | Mechanism Control | Module contains Circuit Bd. Ass'y Mech. Control 6-08708-05 |
| 4-07706-03 | Power Supply | |
| 6-09928-01 | Digital Display | |

## ERROR CODES

Error codes with error messages and modular troubleshooting charts are provided for troubleshooting. Error messages contain information on fixing the problem or refer you to a location in the modular troubleshooting charts.

The computer can store up to 20 error codes in its battery backed-up memory. When an error occurs, the error code is displayed for three seconds on the Memorec display. Code is displayed on front display if error caused phonograph to shut down. When power is applied, the computer checks memory and if the computer finds error codes, the last code that occurred is displayed for three seconds on the Memorec display.

Multiple errors can be checked by using the 666 command in service mode. Each time 666 is typed, the next code in memory is displayed on the Memorec display. The display will go blank if 666 is typed (All codes will have been displayed before the screen goes blank.). Type more 666 commands if you want to look through codes again. Type 699 when the phonograph is repaired or any time you want to erase all error codes from memory.

Error Code Chart

**Note 1.** Use 666 to check for multiple errors before using the 699 command to erase all error codes.

Err0 Indicates "factory settings" for programming codes were loaded into ram (Memorec RESET and ADVANCE switches were both closed when power was applied.).

Err1 Checksum fault indicates "factory settings" for programming codes were loaded into ram when power was applied (Original data was in error.).

The reason data changed could be: a defective ass'y, severe electrical noise, lightning, low battery, etc. To remove Err1 code:

1. Put SERVICE switch to SERVICE position and wait 3 seconds for computer to enter programming mode.
2. If factory settings are desired, push: POPULAR key, key 2, key 5, and POPULAR key again. If factory settings are not desired, enter desired data at each programming location.
3. Put SERVICE switch to OFF and then back to SERVICE. If Computer returns to programming mode, replace computer ass'y.
4. See Note 1.
5. Type 699 to erase error codes.

Err2 Ram I.C. Z9 is defective. Replace the computer.

Err3 Rom I.C. Z7 is defective. Replace the computer.

Err4 Battery voltage is low. Replace the computer.

Err5 Wallbox serial signal (pin 4 of P4) always low.

1. Put the SERVICE switch OFF.

2. Unplug connector P4.

3. Put the SERVICE switch to SERVICE.

4. See Note 1.

5. Type 699 to clear all error codes.

6. Put the SERVICE switch to ON.

7. If the error still remains, replace the computer. If the error is gone, it was caused by a permanent or intermittent short in the wallbox cable or a defective wallbox.

Err6 Wallbox serial signal (pin 4 of P4) always high. Follow all seven steps given in Err5.

Err7 COIN switch #1 (pin 5 of P2) always low (COIN switch #1 is nickel switch in three coin acceptor.).

1. Put SERVICE switch to OFF.

2. Unplug Connector P2.

3. Put SERVICE switch to SERVICE.

4. See Note 1.

5. Type 699 to clear all error codes.

6. Put SERVICE switch to ON.

7. If error still remains, replace the computer. If the error is gone, it was caused by a permanent or intermittent short in coin switch harness or coin switch.

Err8 Coin switch #2 (pin 6 of P2) always low (Coin switch #2 is dime switch in three coin acceptor.). Follow all steps given in Err7.

Err9 Coin switch #3 (pin 7 of P2) always low (Coin switch #3 is the quarter switch in three coin acceptor.). Follow steps given in Err7.

Er10 Coin switch #4 (pin 3 of P2) always low (Coin switch #4 is not used in the three coin acceptor.). Follow steps given in Err7.

Er11 Dollar bill signal (pin 2 of P3) always high.

1. Put SERVICE switch to OFF.

2. Unplug connector P3.

3. Put SERVICE switch to SERVICE.

4. See Note 1.

5. Type 699 to clear all error codes.

6. Put SERVICE switch to ON.

7. If error still remains, replace the computer. If error is gone, it was caused by a short in the harness between the C.C.C. and the OBA-2 or a defective OBA-2 Control Unit.

Er12 More than one coin switch was closed simultaneously. Causes could be that a coin deflected and closed two switches or a customer violently shaking and (or) banging on the phonograph. If the cause was coin deflection, the customer will not receive credit for that coin.

Er13 Keyboard switch 0 always closed.

1. Put SERVICE switch to OFF.
2. Replace computer ass'y and unplug Keyboard from Digital Display.
3. Put SERVICE switch to SERVICE.
4. If no error occurs, go to step 5. If an error occurs, Digital Display is defective or harness between it and computer is shorted.
5. Put SERVICE to OFF, plug in Keyboard, and put SERVICE switch to SERVICE.
6. If no error occurs, the computer is defective. If an error occurs, Keyboard Ass'y has a shorted switch or harness between it and Display is shorted.
7. If the error still remains, replace the computer. If error is gone, continue with step 8.
8. Put SERVICE switch to OFF and plug in Connector P1.
9. Unplug the Keyboard from Digital Display and repeat steps 3 through 6.
10. If error still remains, Digital Display Ass'y is defective or harness between it and computer is shorted. If error is gone, the Keyboard Ass'y has a shorted switch or harness between it and the Display is shorted.

Er14 Keyboard switch 1 always closed. Follow steps given for Er13.

Er15 Keyboard switch 2 always closed. Follow the steps for Er13.

Er16 Keyboard switch 3 always closed. Follow the steps for Er13.

Er17 Keyboard switch 4 always closed. Follow the steps for Er13.

Er18 Keyboard switch 5 always closed. Follow the steps for Er13.

Er19 Keyboard switch 6 always closed. Follow the steps for Er13.

Er20 Keyboard switch 7 always closed. Follow the steps for Er13.

Er21 Keyboard switch 8 always closed. Follow the steps for Er13.

Er22 Keyboard switch 9 always closed. Follow the steps for Er13.

Er23 RESET switch on Keyboard always closed. Follow the steps for Er13.

Er24 POPULAR on Keyboard always closed. Follow the steps for Er13.

Er30 Skipped index pulse error indicates magazine was probably out of sync and played selections one or more record locations past record selected. Some possible causes are: Dirt buildup in magazine gear, Defective optical switch, or Mechanism control index ("I") potentiometer misadjusted.

1. Clean magazine gear. If error remains, do step 2.

2. Adjust Mechanism control index ("I") potentiometer. If error remains, do step 3.

3. Replace optical switch.

Er32 Indicates mechanism should have been searching for a selection, but 30 seconds elapsed and selection was not found. This error causes the phonograph to shut down until power is turned off and turned back on. Turn power on and refer to "Magazine does not rotate when a Selection is made" and "Magazine Rotates Continuously" in the TROUBLE column of the MODULAR TROUBLESHOOTING CHARTS.

Er33 Optical switch index signal (pin 10 of P6) has remained low (active) for more than 30 seconds. This error will cause the phonograph to shut down until power is turned off and turned back on. Turn power on and refer to "Magazine Rotates Continuously" in the TROUBLE column of the MODULAR TROUBLESHOOTING CHARTS.

Er34 Optical switch home signal (pin 11 of P6) has remained low (active) for more that 30 seconds. This error will cause the phonograph to shut down until power is turned off and turned back on. Turn power on and refer to "Magazine Rotates Continuously" in TROUBLE column of MODULAR TROUBLESHOOTING CHARTS.

Er35 A record has been playing for more than 5 minutes and TONE ARM CUTOFF SWITCH has not given a Cancel Signal (An automatic cancel has occurred.). Turn power on, make a selection, wait until it finishes playing, and then refer to "Record will not Cancel when Finished Playing" in TROUBLE column of MODULAR TROUBLESHOOTING CHARTS.

Er36 Cancel Signal (pin 1 of P6) is always low (active). Turn power on, make a selection, and refer to "Record Cancels Without Playing" in TROUBLE column of MODULAR TROUBLESHOOTING CHARTS.

Er37 Inner Cam Sw N.O. Contact signal (pin 5 of P6) should have been low (active) indicating that inner cam switch had closed; however, the signal stayed high (quiescent) longer than 30 seconds. This error will cause phonograph to shut down until power is turned off and turned back on. Turn power on and refer to "Transfer Starts when Power is applied and runs continuously" in TROUBLE column of MODULAR TROUBLESHOOTING CHARTS.

ER38 Transfer cycle started and Inner Cam Sw N.O. Contact signal should have gone high (quiescent) indicating that cam had moved off inner cam switch; however, it stayed low longer than 30 seconds. This error will cause phonograph to shut down until power is turned off and turned back on. Turn power on, make selection, and refer to "Transfer starts and runs continuously after selection is located" in TROUBLE column of MODULAR TROUBLESHOOTING CHARTS.

Er39 Transfer cycle started, cam moved off inner cam switch, and Outer Cam Sw record placed on turntable; however, the signal stayed high (quiescent) for longer than 30 seconds. This error will cause phonograph to shut down until power is turned off and turned back on. Turn power on and refer to "Transfer starts and runs continuously" in TROUBLE column of MODULAR TROUBLESHOOTING CHARTS.

## TROUBLESHOOTING CHARTS

One of the best ways to isolate a problem is to determine the exact state of the phonograph when the failure occurs. This means recording the condition of digital display, status LED's, gripper bow, detent pawl, magazine, cam switches, etc.

This information can help you identify the cause of intermittent or continuous failures.

Refer to Figure 5-1 for descriptions and locations of the LED's refered to in the MODULAR TROUBLESHOOTING CHART that follows.

The chart has the following three columns:

- The trouble column lists different types of failures.
- The symptom column shows the state of the phonograph when the failure occurs.
- The last column shows the probable cause.

Table 5-2 Modular Troubleshooting Chart.

| TROUBLE | SYMPTOM | PROBABLE CAUSE |
|---|---|---|
| Phonograph fails to operate when power is turned on | LED's on power supply and fluorescent lights fail to light | 1. Rear power switch off<br>2. Plug not in wall<br>3. Wall circuit is dead<br>4. 10 amp circuit breaker tripped<br>5. Wiring to rear power switch<br>6. Rear power switch |
| | LED's on power supply fail to light but fluorescent lamps lit | 1. 2 amp circuit breaker tripped<br>2. Power Supply<br>3. 28 VAC overload from mag., transfer, or T.T. motor |
| | "+8VDC" LED on power supply fails to light but lights when phono harness at power supply is unplugged | 1. Central Control Computer<br>2. Mech Control<br>3. Wallbox interface<br>4. On/Service/Off switch<br>5. Wiring<br><br>NOTE:<br>To locate problem reconnect phono harness and unplug connectors in order below. If +8VDC LED lights replace last unit unplugged.<br>1. Wallbox interface(J4)<br>2. Central Control Computer (J6)<br>3. Mech Control Harness (J205)<br>4. Mech Control (J206) |

| | | |
|---|---|---|
| | "+28VDC" LED on Power Supply fails to light but lights when Phono Harness at Power Supply is unplugged | 1. Mech Control Bd.<br>2. Detent Coil<br>3. Wiring |
| Magazine does not rotate when a Selection is made | "Mag. Motor" and "Detent" LED's on, detent is actuated | 1. Wiring to Mag. Motor<br>2. Magazine Motor<br>3. Mech Control Board |
| | "Mag. Motor" and "Detent" LED's on, Detent not actuated | 1. Wiring to Detent Coil<br>2. Detent coil<br>3. Mech Control Board<br>4. Inner Cam Switch N.C. Shorted to Common |
| | "Mag. Motor" LED OFF or "Detent" LED ON | 1. Wiring from Central Control Computer to Mech Control Board<br>2. Central Control Computer<br>3. Mech Control Board |
| Magazine rotates Continuously | "Mag. Motor LED OFF | 1. Wiring to Mag. Motor<br>2. Mech Control Board |
| | "Mag. Motor" LED ON, and "Opt. Sw. Index" LED not flashing, and/ or "Opt. Sw. Home" LED does not flash at record number 99. | 1. Optical Switch<br>2. Wiring to Optical Switch<br>3. Mech Control Board |
| | "Mag. Motor" LED on and both optical Optical Sw. LED's Normal | 1. Wiring from Central Control Computer to Mech Control Board<br>2. Central Control Computer<br>3. Mech Control Board |
| Magazine Stops at Wrong Record | Stops at random Record Anywhere in Magazine | 1. Faulty Optical Sw.<br>2. Wiring to Opt. Sw.<br>3. Heavy Dirt Buildup in Optical Switch |
| | Stops One or Two Records Before Record Selected | 1. Opt. Sw. Adjustment<br>2. Mag. Not Full of Records (out of balance)<br>3. Broken Sprag Lever Guide |
| | Stops One or Two Records After Record Selected | 1. Faultly Opt. Switch<br>2. Opt. Sw. Adjustment<br>3. Broken Sprag Gear<br>4. Sprag Linkage Binding |

| | | |
|---|---|---|
| | Stops One Half to One Record Position Off Before or After Record Selected | 1. Broken Sprag Gear<br>2. Broken Sprag Guide<br>3. Sprag Linkage Binding or Needs Adjustment |
| Record does not Transfer | "Tran. Motor" LED is ON | 1. Wiring to Transfer Motor<br>2. Mech Control Board<br>3. Transfer Motor |
| | "Tran. Motor" LED is OFF | 1. Wiring from Central Control Computer to Mech Control Board<br>2. Central Control Computer<br>3. Mech Control Board |
| | "Tran. Motor" LED comes on and transfer starts but LED and Motor turn off when cam leaves inner cam Switch | 1. Outer Cam Switch N.O. Shorted to Common<br>2. Central Control Computer<br>3. Mech Control Board |
| Transfer Starts when power is applied and runs continuously | "Tran. Motor" LED is OFF | 1. Mech Control Board<br>2. Wiring to Motor |
| | "Tran. Motor" LED is ON | 1. Central Control Computer<br>2. Mech Control Board<br>3. Wiring from Central Control Computer to Mech Control<br>4. Open Circuit-Inner Cam N.O. Contact<br>5. Open Circuit-Inner Cam Sw. Common |
| Transfer starts and runs continuously after selection is located | "Tran Motor" LED comes on when Motor starts and stays ON | 1. Wiring to Outer Cam Switch<br>2. Outer Cam Switch<br>3. Central Control Computer<br>4. Wiring From Central Control Computer to Mech Control<br>5. Mech Control Board<br>6. Inner Cam Sw. N.O. Contact Shorted to Common<br>7. Open Circuit-Outer Cam Sw. Common |
| No Sound | Always Muted | 1. Central Control Computer |
| No Mute During Scan | Motor Noise in Speakers | 1. Central Control Computer |

| | | |
|---|---|---|
| Turntable Motor does not run | "T.T. Motor" LED is ON | 1. Wiring to T.T. Motor<br>2. T.T. Motor<br>3. Mech Control |
| | "T.T. Motor" LED is OFF | 1. Wiring from Central Control Computer to Mech Control Board<br>2. Central Control Computer<br>3. Mech Control Board |
| Record will not Cancel when Finished Playing | "Cancel" LED is ON | 1. Wiring from Mech Control to Central Control Computer<br>2. Central Control Computer<br>3. Also see "Record Does Not Transfer" |
| | "Cancel" LED is OFF | 1. Wiring to Cancel Sw.<br>2. Cancel Switch<br>3. Mech Control Bd. |
| Record Cancels without playing | "Cancel" LED stays ON | 1. Short in Cancel Sw. Wiring<br>2. Cancel Switch<br>3. Mech Control Board |
| | "Cancel" LED flashes ON as Record Sets Down | 1. Auto Cancel Misadjusted |
| | "Cancel" LED does not flash | 1. Wiring to outer cam Switch<br>2. Outer Cam Switch<br>3. Wiring from Mech Control to Central Control Computer<br>4. Mech Control Board<br>5. Central Control Computer |
| Left Side of Record Plays When Right Side Selected | "Toggle" LED is ON | 1. Wiring to Toggle Coil(s)<br>2. Toggle Coil(s)<br>3. Mech. Control |
| | "Toggle" LED is OFF | 1. Wiring From Central Control Computer to Mech Control Board<br>2. Central Control Computer<br>3. Mech Control Board |

| | | |
|---|---|---|
| Money Counter or Play Counter Fails To Count | Fails To Count | 1. Wiring to Counter<br>2. Counter<br>3. Mech Control Board<br>4. Wiring From Central Control Computer to Mech Control<br>5. Central Control Computer |
| Phonograph is always in Service ("Memorec") Mode Of Operation | Record Number Times selected Display is always lit | 1. On/Service/Off Switch<br>2. "+8 on Signal" Wiring<br>3. Central Control Computer<br>4. Computer set for programming with the door closed (≡56=255). Use 999 to exit service mode. |
| Phonograph will not go into Service Mode of Operation | Record Number Times selected Display will not light when On/Service/Off Switch is in Service Position | 1. Central Control Computer<br>2. "+8 on Signal" Wiring<br>3. On/Service/Off Switch |
| No Credit | No Credit Given By Coins and Dollar Bill | 1. Central Control Computer |
| | No Credit Given by Coins but Dollar Bill Gives Credit | 1. Coin Sw. Common Wiring<br>2. Central Control Computer |
| | One Value of Coin Will not Give Credit | 1. Coin Rejected<br>2. Wiring To Coin Sw.<br>3. Coin Switch<br>4. Central Control Computer |
| | Dollar Bill Will Not Give Credit | 1. Bill Acceptor<br>2. Wiring To Bill Acceptor<br>3. Central Control Computer |
| Wrong Credit | Credit For Amount deposited does not agree with Price Card setting | 1. One or More Coins Did not register (See No Credit).<br>2. Central Control Computer Programmed wrong.<br>3. Central Control Computer |
| System Does Not Respond to Keyboard | "0 Credits on selection remaining display | 1. Insufficient Credit |

| | | |
|---|---|---|
| | Selection remaining, but certain keys do not work | 1. Shorted Keyboard Switch<br>2. Central Control Computer<br>3. Short in Keyboard Wiring |
| | Selections remaining, but entire keyboard does not work | 1. Wiring from Keyboard to Display Board<br>2. Keyboard<br>3. Digital Display Bd.<br>4. Central Control Computer |
| Digital Display does not work | Display Lights But Shows Wrong Information | 1. Wiring From Central Control Computer to Display<br>2. Digital Display<br>3. Central Control Computer |
| | "+8VDC" LED on Central Control Computer is lit but Display Digits and LED lamps will not Light | 1. Wiring From Central Control Computer to Digital Display<br>2. Digital Display<br>3. Central Control Computer |
| | Certain LED lamps and/ or Digits will not Work | 1. Wiring From Central Control Computer to Display<br>2. Digital Display<br>3. Central Control Computer |
| Miscellaneous Problems | Any malfunction not described above | 1. Main Power Supply<br>2. Central Control Computer |

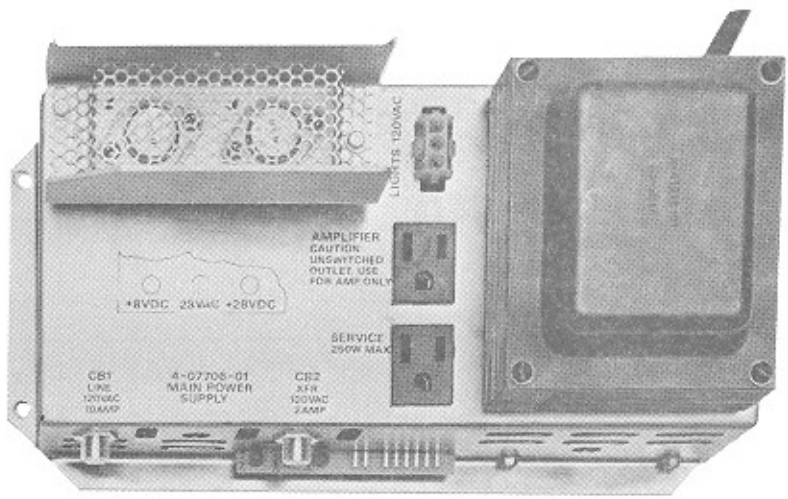
## STATUS LAMPS

Red indicator lamps are connected to various strategic points in the phonograph circuit to indicate status of power and signal circuits.

### Power Supply

+ 8 Volts DC
+28 Volts DC
28 Volts AC

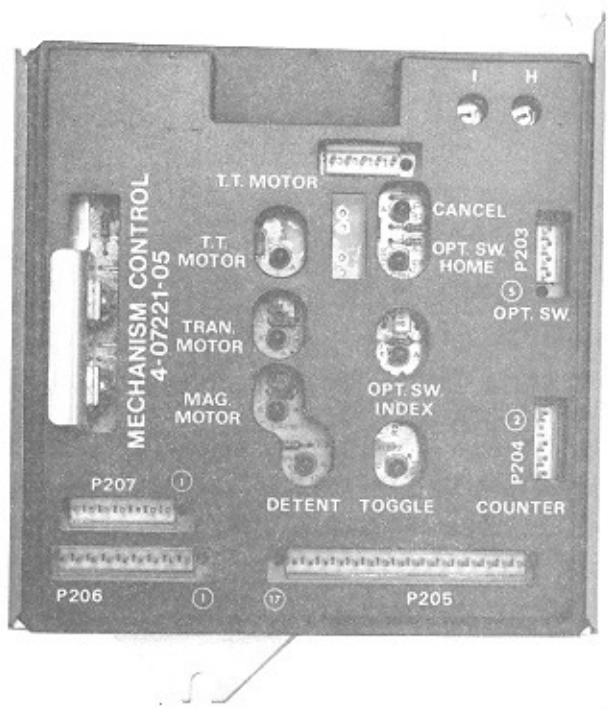
Shows presence of respective voltage and implies that there is no short on the lines.




MAIN POWER SUPPLY

Mechanism Control

| | |
|---|---|
| T.T. Motor | Lights when Turntable motor command is present. Motor should be running |
| Tran Motor | Lights when Transfer command is present. Transfer motor should be running. |
| Mag. Motor | Lights when Magazine Motor command is present - Motor should be running. |
| Detent | Lights when Detent command is present. Detent coil should be actuated. Detent disengaged. |
| Toggle | Lights when Toggle command is present. Toggle coils should be actuated. Both toggle pins moved to left. |
| Opt. Sw. Index | Lights when the Index section of the optical switch sees the tooth space of the magazine drive gear. Flickers when the magazine rotates. |
| Opt. Sw. Home | Lights when the Home section of the optical switch sees the hole in the magazine drive gear. Flashes when the magazine record position 99 passes the Transfer position. |
| Cancel | Lights when the cancel signal line is shorted to ground. |




MECH. CONTROL UNIT

## SOUND SYSTEM QUICK CHECK

Rowe solid state sound systems are service designed for fast, easy repair. The following check list will enable you to locate troubles with basic tools.

**Caution:** Do not plug in or unplug circuit boards with power on. Checks should be made with the changer in the record playing position. Perform all service checks in the order listed.

### No Sound - Both Channels

1. Power - Second Level

- Check that the amplifier is plugged-in and is receiving power from the junction box.
- Disconnect the mute plug.
- Press the circuit breaker reset pushbutton on the amplifier chassis to make sure that it is not tripped. The amplifier should cause an audible "thump" in the speakers when the power is turned on.

2. Volume Control

Disconnect the volume control plug from the amplifier chassis and short out pins 3 (common) to pins 1, 2 and 4, 5. Full volume indicates an open volume control or line. If full volume at all times is the problem and disconnecting the volume control plug does not kill the sound, replace the preamp board.

3. CARTRIDGE CONNECTIONS

Make sure that the stylus is not bent or broken; replace if necessary. With a selection playing, unplug the tone arm cable from the amplifier. Press your finger against the plug pins and check for a hum in both sound channels. If hum is present, check cartridge wiring against Figure 2-5 (Stereo Sound System), replace the cartridge if necessary.

4. EXTENSION SPEAKERS

To check if extension speakers are shorting out the amplifier, disconnect the extension speaker plug from the transformer package receptacle.

5. OUTPUT DEVICES

Visually inspect the driver board for blown fuses. If a fuse is blown, replace the associated output device. The two devices used in each channel are not interchangeable. Check the part number on the case and install an identical or equivalent replacement. Before mounting the device onto the heat sink, be sure that the heat sink surface is flat and no burrs are around the mounting holes to cause a short. Be sure that one, and only one, mica insulator is between the device and the heat sink and heat transfer compound (Spec.0-00053-00) is on both sides of insulator.

6. FILTER CAPACITORS

Check for +2/-2VDC in the amplifier power supply. Connect the negative meter lead to ground and check the voltage at the terminals of the large electrolytic filter capacitors located on the amplifier chassis next to the power transformer. When taking readings on the capacitor with the outer shell isolated from chassis to one of the shell tabs, check that the voltage on each capacitor terminal is the same. A lowered voltage at one of the capacitor pins indicates that the capacitor may be defective and should be replaced, or that the bridge rectifier is defective. Another indication of defective filter capacitors is excessive hum in the sound output.

7. PREAMP OUTPUT

Short all five of the volume control pins located on amp. Press your finger against pins 1 or 3 (outside pins) labeled PHONO CARTRIDGE INPUT, and check for approximately 1 VAC at preamp output (pins 3 or 5 of 13 pin

connector-chassis common). Replace the Preamp Board if voltage is not present. If voltage is present check the center pin of the Output Driver Board for approximately 16 VAC. If voltage is not present, make sure your finger is pressed against the same outside pin with respect to the channel that is being checked with the voltmeter.

**No Sound, Low Sound Or Distorted Sound Right Or Left Channel Only.**

Balance Control - Adjust control for equal sound from each channel. Leave in mid position if adjustment is not possible.

With a selection playing, reverse tone arm cable connections to the amplifier. If the sound switches channels, check cartridge connections against Figure 2-5 (Stereo Sound System). Replace the cartridge if connections are good. Make sure that the stylus is not bent or broken; replace if necessary.

Extension Speakers - See Step 4.

Output Devices - See Step 5.

Preamp - See Step 7.

Driver Boards - If one driver board is defective, switch input to "Mono" and use one good channel in emergency.

**Constant High Volume - Cannot Adjust**

Volume Control - Disconnect volume control plug from amplifier chassis. No sound indicates a short in the volume control line.

Preamp - If full volume is heard with control plug disconnected, replace the preamplifier board.

**Excessive Record Scratch**

Worn Records - Replace worn records

Damaged Stylus - Make sure that the stylus is not worn or broken; replace if necessary. Check stylus force.

**Treble Range Control Too High**

Reduce setting of control for worn or noisy records.

**Excessive Hum**

Open Shield - Be sure that shield or wires are not broken between cartridge and the amplifier input plug.

Cartridge Defective - Substitute a good cartridge.

Filter Capacitors - Check filter capacitor, parallel an extra 500 Mfd. 50V capacitor in chassis. If hum drops; replace capacitor.

If External Inputs are used, the equipment driving those inputs must not be tied to earth ground.