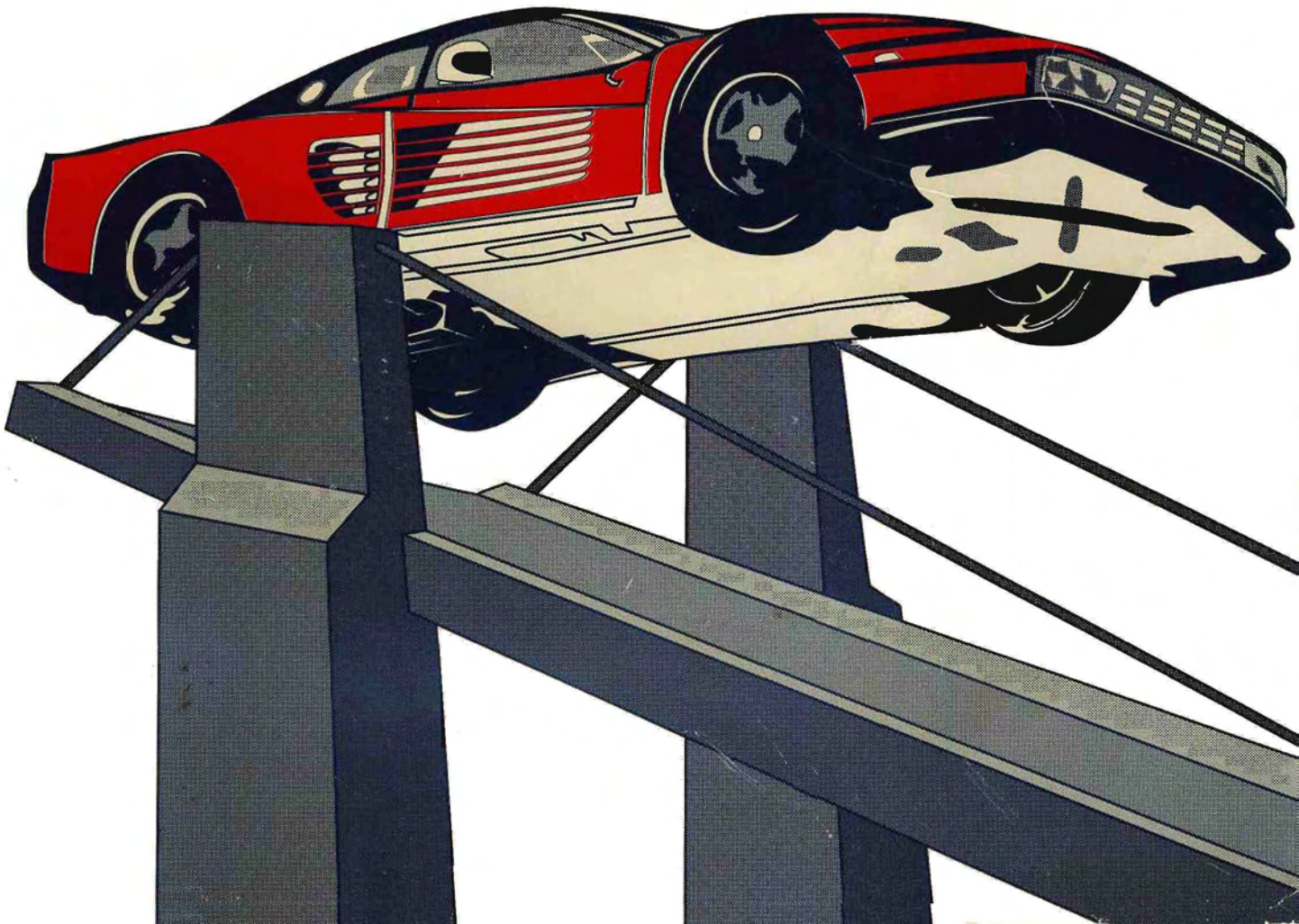
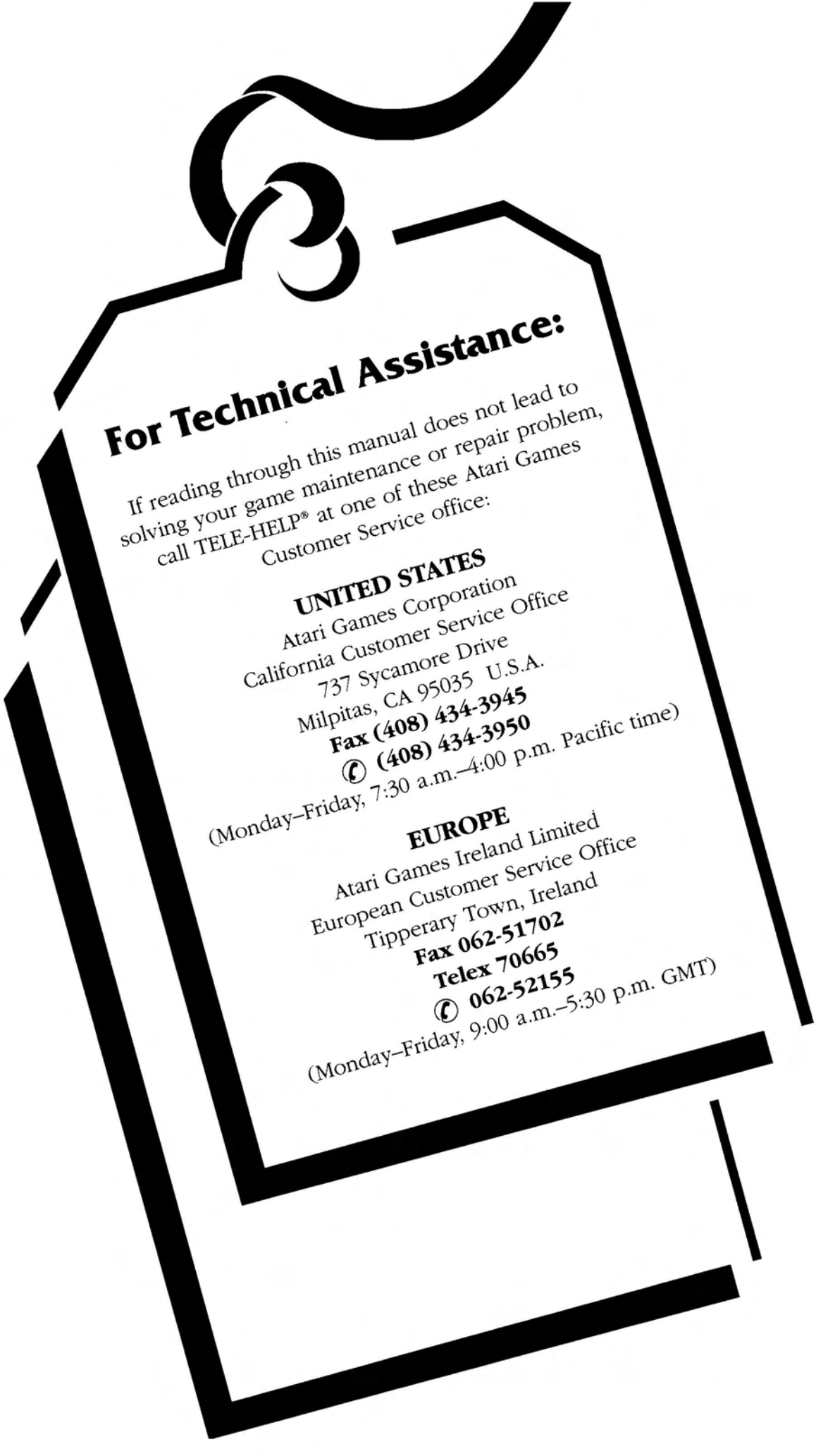
TM-327
1st printing

ATARI®
GAMES

Hard Drivin'™

Operator's Manual





For Technical Assistance:

If reading through this manual does not lead to solving your game maintenance or repair problem, call TELE-HELP® at one of these Atari Games Customer Service office:

UNITED STATES

Atari Games Corporation
California Customer Service Office
737 Sycamore Drive
Milpitas, CA 95035 U.S.A.
Fax (408) 434-3945
✆ **(408) 434-3950**
(Monday–Friday, 7:30 a.m.–4:00 p.m. Pacific time)

EUROPE

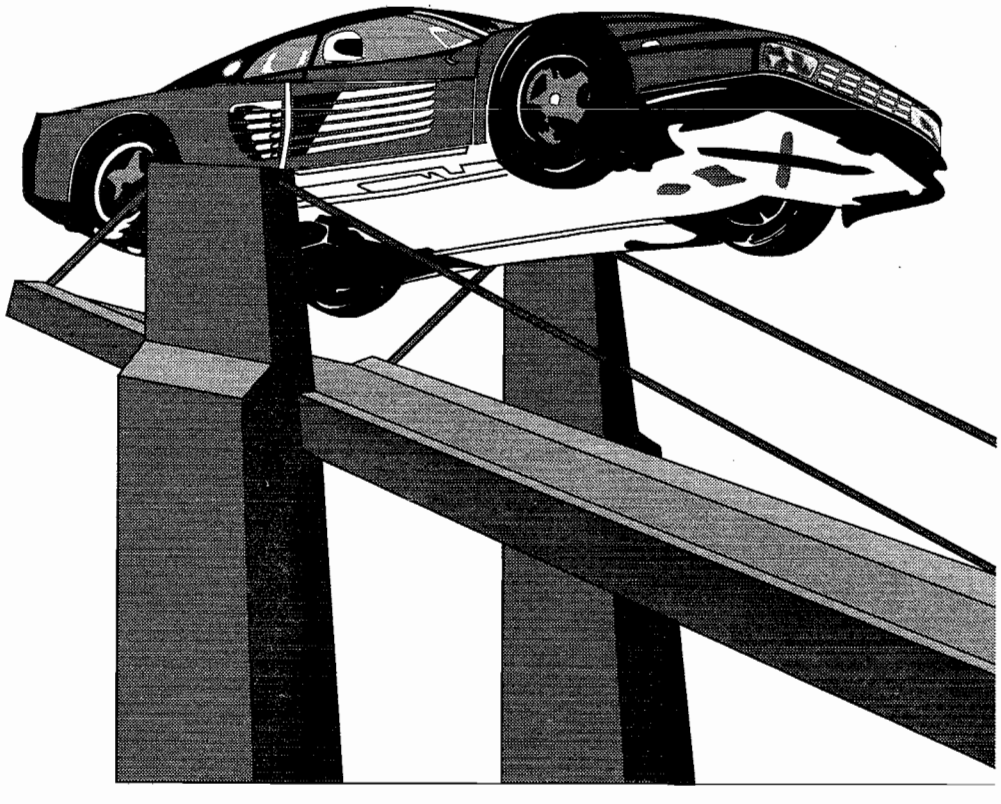
Atari Games Ireland Limited
European Customer Service Office
Tipperary Town, Ireland
Fax 062-51702
Telex 70665
✆ **062-52155**
(Monday–Friday, 9:00 a.m.–5:30 p.m. GMT)

ATARI®
GAMES

Hard Drivin'™

Operator's Manual

with Illustrated Parts Lists



Patents are pending on several parts of the Hard Drivin' simulator.

Published by:
Atari Games Corporation
675 Sycamore Drive
P.O. Box 361110
Milpitas, California 95035

Printed in the U.S.A **1T**

Produced by the Atari Games Technical Publications Department.

Technical Writing: Rosalind Hutton
Editing and Design: Andrea Dencker
Illustration: Mary Ohanessian Sumner

Notice Regarding Non-Atari® Parts

WARNING

Use of non-Atari parts or modifications of any Atari game circuitry may adversely affect the safety of your game, and may cause injury to you and your players.

You may void the game warranty (printed on the inside back cover of this manual) if you do any of the following:

- Substitute non-Atari parts in the game.
- Modify or alter any circuits in the game by using kits or parts *not* supplied by Atari Games Corporation.

NOTE

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of Federal Communications Commission (FCC) Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area or modification to this equipment is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference. If you suspect interference from an Atari game at your location, check the following:

- All ground wires in the game are properly connected as shown in the game wiring diagram.
- The power cord is properly plugged into a grounded three-wire outlet.
- On games provided with an Electromagnetic Interference (EMI) ground cage, be sure that the game printed-circuit boards (PCBs) are properly installed on the EMI ground cage and that the end board is securely installed with **all** screws in place and tightened.

If you are still unable to solve the interference problem, please contact Customer Service at Atari Games Corporation. See the inside front cover of this manual for service in your area.

Table of Contents

1 Set Up

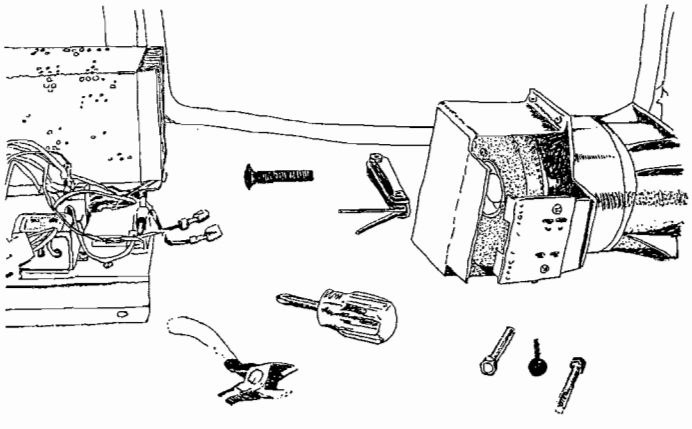
2 Self-Test and Diagnostics

3 Maintenance

4 Illustrated Parts Lists

Statistics Sheet

List of Illustrations



List of Tables

Safety Summary

The following safety precautions apply to all game operators and service personnel. Specific warnings and cautions will be found in this manual whenever they apply.

WARNING

Properly Ground the Game. Players may receive an electrical shock if this game is not properly grounded! To avoid electrical shock, do not plug in the game until it has been inspected and properly grounded. This game should only be plugged into a grounded three-wire outlet. If you have only a two-wire outlet, we recommend you hire a licensed electrician to install a three-wire grounded outlet. If the control panel is not properly grounded, players may receive an electrical shock! After servicing any part on the control panel, check that the grounding wire is firmly secured to the inside of the control panel. After you have checked this, lock up the game.

AC Power Connection. Before you plug in the game, be sure that the game's power supply can accept the AC line voltage in your location. The line voltage requirements are listed in the first chapter of this manual.

Disconnect Power During Repairs. To avoid electrical shock, disconnect the game from the AC power before removing or repairing any part of the game. If you remove or repair the video display, be very careful to avoid electrical shock. High voltages continue to exist even after power is disconnected in the display circuitry and the cathode-ray tube (CRT). Do not touch the internal parts of the display with your hands or with metal objects! Always discharge the high voltage from the CRT before servicing it. Do this after you disconnect it from the power source. First, attach one end of a large, well-insulated, 18-gauge jumper wire to ground. Then momentarily touch the free end of the grounded jumper wire to the CRT anode by sliding the wire under the anode cap. Wait two minutes and do this again.

Use Only Atari Parts. To maintain the safety of your Atari game, use only Atari parts when you repair it. Using non-Atari parts or modifying the game circuitry may be dangerous, and could injure you and your players.

Handle the CRT With Care. If you drop the CRT and it breaks, it may implode! Shattered glass from the implosion can fly six feet or more.

Use the Proper Fuses. To avoid electrical shock, use replacement fuses which are specified in the parts list for this game. Replacement fuses must match those replaced in fuse type, voltage rating, and current rating. In addition, the fuse cover must be in place during game operation.

CAUTION

Properly Attach All Connectors. Make sure that the connectors on each printed circuit board (PCB) are properly plugged in. The connectors are keyed to fit only one way. If they do not slip on easily, do not force them. If you reverse a connector, it may damage your game and void your warranty.

Ensure the Proper AC Line Frequency. Video games manufactured for operation on 60 Hz line power (used in the United States) must not be operated in countries with 50 Hz line power (used in Europe). If a 60 Hz machine operates on 50 Hz line power, the fluorescent line ballast transformer will overheat and cause a potential fire hazard. Check the product identification label on your machine for the line frequency required.

ABOUT NOTES, CAUTIONS, AND WARNINGS

In Atari publications, notes, cautions and warnings have the following meaning:

NOTE — A highlighted piece of information.

CAUTION — Equipment and/or parts can be damaged or destroyed if instructions are not followed. You will void the warranty on Atari printed-circuit boards, parts thereon, and video displays if equipment or parts are damaged or destroyed due to failure of following instructions.

WARNING — Players and/or technicians can be killed or injured if instructions are not followed.

Chapter 1

Set-Up

How to Use This Manual

This manual is written for operators and service personnel, and provides information for setting up, driving, testing, and maintaining your Hard Drivin'™ simulator.

The manual is divided into the following chapters:

- Chapter 1 contains set-up and simulator driving information.
- Chapter 2 contains self-test procedures and additional diagnostic tests. The self-test is *very important* in the Hard Drivin' simulator. You can troubleshoot all the boards, main circuits, and controls using the more than 60 screens. You should regularly check the boards and the controls using the tests in the self-test to keep your simulator in top condition and at top earnings.
- Chapter 3 contains preventive maintenance, repair procedures, flowcharts, and troubleshooting tables for each control. If you have problems with your simulator, use this chapter to troubleshoot and to repair your simulator. Be sure to perform the preventive maintenance to keep your simulator in good repair to maximize your earnings.
- Chapter 4 contains the illustrated parts lists.

Operating the Simulator

To maximize your income from the Hard Drivin' simulator, be sure the drivers know that the simulator is designed to be driven like a real car.

To be sure the drivers get the maximum realism from Hard Drivin' you should regularly do the automated self-test, and check the operation of the controls with the *Control Inputs* screen in the self-test. By using these two tests, you can keep your game operating in top condition by finding and fixing problems immediately, before earnings drop off. These tests are described in detail in Chapter 2.

NOTE

If you are installing a new board set or controls in your simulator, you must go through the Set Controls *screen in the self-test. This is explained in Chapter 2.*

If you turn on your simulator and you see a screen that says Initialize Pot Inputs *instead of the attraction screens, then you also must reset the controls by doing what the screens say.*

Inspecting the Simulator

WARNING

To avoid electrical shock, do not plug in the cabinet until it has been properly inspected and set up for the line voltage in your area.

This cabinet should be connected to a grounded three-wire outlet only. If you have only two-wire outlets, we recommend that you hire a licensed electrician to install grounded outlets. Drivers can receive an electrical shock if the cabinet is not properly grounded.

Please inspect your Hard Drivin' simulator carefully to ensure that the simulator is complete and was delivered to you in good condition.

Inspect the cabinet and seat as follows:

1. Examine the exterior of the cabinet for dents, chips, or broken parts.
2. Open the lower service door and the small top service panel. (Leave this top panel open so you can install the attraction sign.) Unlock and open the coin doors. Inspect the interior of the cabinet as follows:
   a. Ensure that all plug-in connectors on the cabinet harnesses are firmly plugged in. Do not force connectors together. The connectors are keyed so they fit only in the proper orientation. A reversed connector can damage a printed-circuit board (PCB) and will void your warranty.
   b. Ensure that all plug-in integrated circuits on each PCB are firmly plugged into their sockets.
   c. Inspect the power cord for any cuts or dents in the insulation.
   d. Inspect the power supply. Make sure that the correct fuses are installed. Check that the harness is plugged in correctly and that the fuse block cover is mounted in place. Check that the green ground wires are connected.
   e. Inspect other major sub-assemblies, such as the video display, printed-circuit boards (PCBs), and speaker. Make sure that they are mounted securely and that the ground wires are connected.

Table 1-1 Simulator Specifications

Characteristic	Specification
Power Consumption	635 W maximum
Fuse Rating	7 Amps
Line Voltage	102 to 132 VAC
Ambient Temperature	5° to 38° C (37° to 100° F)
Humidity	Not to exceed 95% relative
Width	31 1/2 in. (81 cm.)
Depth (seat in)	62 1/2 in. (160 cm.)
Height	77 in. (197 cm.)
Weight	750 lbs. (341 kg.)

Installing the Attraction Sign Assembly

The attraction sign assembly is shipped separately from the simulator.

The hardware for assembling the sign and for mounting it on the simulator is shipped in the cash box. This hardware consists of ten 1/4-20 button-head screws 2 inches long with black washers. Mount the sign on the back of the cabinet as shown in Figure 1-1.

1. Lay the attraction sign face down on a clean surface where it won't be scratched.
2. Lay the H-shaped attraction frame on top of the sign. Put the short ends of the H on top of the sign. The harness connection in the leg should be *facing* the sign. Attach the attraction sign harness to the attraction frame harness. Push the extra wires inside the leg of the attraction frame.
3. Install the six screws and washers through the at-

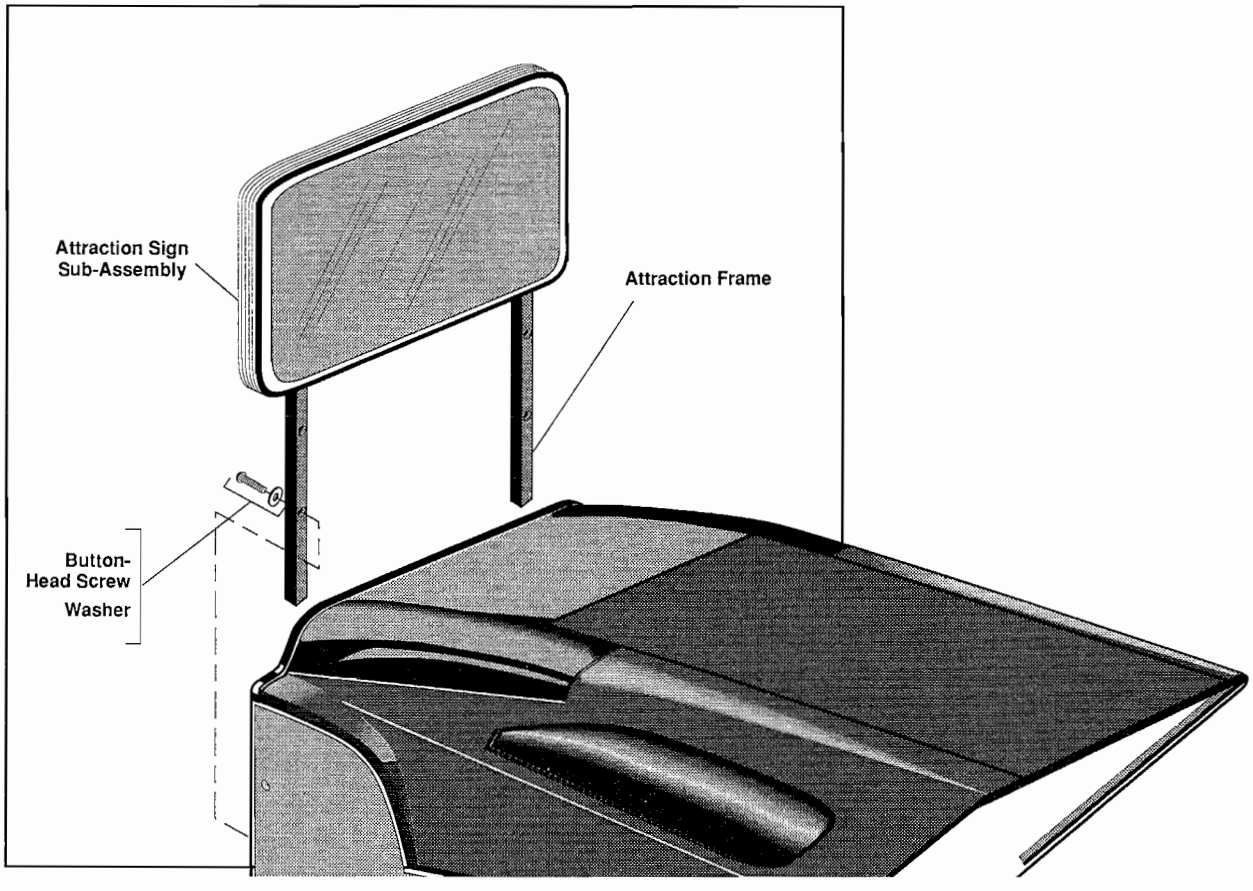


Figure 1-1 Attraction Sign Installation

traction frame and into the attraction sign. Tighten the screws.

Now install the attraction sign assembly on the back of the simulator. You need the other four 1/4-20 two-inch long screws and four flat washers.

4. Open the small top rear panel of the simulator. Push the cabinet harness out through the hole in the upper corner of the back. Make sure it does not catch on the motor amplifier assembly.
5. Connect the simulator harness to the connector in the left leg of the sign. Now push the extra wiring harness back inside the simulator. Be careful that it does not lie on the motor amplifier assembly.
6. Put the attraction sign against the cabinet and line up the four holes in the legs with the four holes in the cabinet.
7. Put the button-head screws and black washers into the legs and screw them into the threaded holes.

Adjust the Glides

When you have located the simulator in the arcade, be sure to screw out the adjustable glides in the base to support it. The Hard Drivin' simulator is heavy; if you do not lower the glides, the casters may be damaged. Also, when you move the simulator, make sure that you retract the glides.

Control and Switch Locations

Power On/Off Switch

The power on/off switch is located at the bottom rear of the cabinet.

Volume Control

The volume control is located behind the upper coin door.

Self-Test Switch

The self-test switch located behind the upper coin door. See Chapter 2 for a complete description of the self-test.

Auxiliary Coin Switches

An auxiliary coin switch is located on the component bracket behind the upper coin door. Use the auxiliary coin switch to give drivers coin credits.

Coin Counter

The coin counter is located behind the upper coin door. The coin counter records the number of coins deposited. (It does not count credits given by the auxiliary coin switch.)

Setting the Coin and Game Options

The Hard Drivin' coin and game options are set in the Self-Test. Refer to Chapter 2 for the recommended settings and the procedure for setting the options.

Simulator Systems

The Hard Drivin' simulator uses seven PCBs to give the realistic look and feel to the driving. These are the main PCB, the ADSP PCB, the motor amplifier PCB (with two motor amplifier driver PCBs), the shifter PCB, the brake PCB, the audio and power PCB (mounted on the power supply assembly), and the sound PCB. These PCBs control simulator software, the video display, and the controls.

The main PCB, which is the largest, contains the 68010, the GSP, and the MSP microprocessor systems. The 68010 has program RAM and ROM.. The GSP (Graphic Systems Processor) microprocessor system controls the video RAMs (VRAMs). The MSP (Model Systems Processor) microprocessor system performs all the math functions.

The ADSP board and the sound board are mounted with the main PCB. The Motor Amplifier PCB is mounted in a heatsink assembly located on the the driver's left. It controls the steering wheel motor. The Shifter Amplifier PCB is located on the driver's right and controls the gear shifter effects. The Brake PCB is located on the back of the brake and clutch pedal assembly and controls the braking effects.

Maximizing Earnings

For maximum earnings, you should regularly maintain your hard drivin simulator following the instructions in Table 3-1, in Chapter 3.

Also, when you set up the simulator and when you collect money you should perform the automated self-test and check the operation of the controls in the *Control Inputs* screen in the self-test.

Simulator Driving

This section describes the features and driving of the Hard Drivin' simulator.

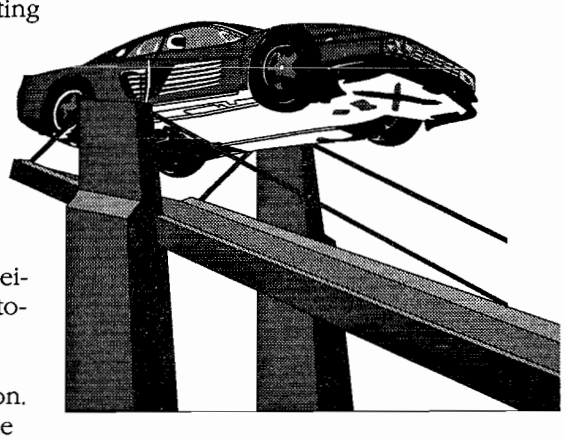
Introduction

Slide into the contoured seat and adjust it to fit the length of your arms and legs. Place your feet on pedals of the gas and clutch, try your hand on the stick shift. Select manual or automatic transmission, turn the ignition key and you're off!

It's the ride of your life. You feel the tires grip the road as you take a wide turn at high speed. The feedback steering alerts you of the smallest change in the road. You catch air as you fly the draw bridge and land on the down ramp. You are in control as the car holds the road on the vertical loop.

Driving Mode

Hard Drivin' might look like an arcade game but it drives like a real car. For the best lap times, drive Hard Drivin' as if it were a real car. The major difference between Hard Drivin' and a real car is that Hard Drivin' is much safer to drive. A player can test the limits of our car and his skill with no risk of personal injury, and follow a course that does not exist anywhere in the real world.



After inserting the proper number of coins to start the game, the player can select either an automatic or manual transmission. Turning the ignition key starts the game.

Drivers can choose between the two different types of tracks—the stunt track or the speed track—by following the posted signs on the road. Each player has a certain (operator-selectable) amount of time to reach a checkpoint or the finish line. Crossing checkpoints and the finish line will reward the player with (operator-selectable) bonus driving time.

With Hard Drivin' a player can test drive a high-powered sports car on a real stunt course. He can jump a draw bridge, negotiate a high-speed banked turn and drive a 360-degree vertical loop. These thrilling stunts, among others, provide the ultimate realistic driving experience.

Or maybe high-speed driving is a particular player's type of excitement. He can "put the pedal to the metal" and try to keep control around the corners, weaving in and out of traffic while avoiding oncoming cars. All this, and more, await the player behind the wheel of Hard Drivin'.

All drivers will especially enjoy the unique instant replay feature on Hard Drivin'. Each crash sequence is recorded by the game and replayed. Not only will the driver find this entertaining, but it is also informative. The instant replay shows the driver exactly what he did wrong and why he crashed. (If a driver wants to skip the instant replay, he can press the abort switch or turn the key when the replay starts.)

Skilled drivers will find the ultimate competition in the "challenge" lap (or "grudge match" as we at Atari Games like to call it). The game remembers the path of the car driven by the best driver on record. When a driver beats the qualifying lap time, he challenges the car of the past winner in a head-to-head race.

Hard Drivin' is equipped with center-feel steering with continuous force feedback, adjustable swivel seat, gas, brake and clutch pedals, four-speed stick shift, and a medium-resolution monitor.

After-market options include a dollar bill acceptor and an overhead display assembly. A limited edition of right-hand-drive Hard Drivin' games will be available from the factory. Contact your local Atari distributor for further information about after-market accessories.

N O T E S

Chapter 2

Self-Test and Diagnostics

The *Hard Drivin'* simulator is a complex machine. To keep it at peak efficiency and maximum earnings, you should regularly check the functioning of the controls, RAMs, ROMs, PCBs, and microprocessor systems. You can check all of these things when you switch on the self-test. Also in the self-test, you can check the video display, the statistics, and set the internal clock.

If you cannot use the self-test because the screen is dark, you can use a DIP switch on the main PCB to find the source of the problem. Also, you can check various signals on the main PCB with the LEDs if you are having electronic problems due to a malfunctioning circuit on the main PCB.

You should regularly check the following screens and information. We recommend you check these when you first set up the simulator, each time you collect money, or when the simulator is not functioning correctly.

- Check the automated self-test, which you enter automatically when you turn on the self-test. It takes about 5 minutes to run. It checks the program RAMs and ROMs, the video RAMs, color RAMs, the MSP microprocessor system, the ADSP PCB, and the sound PCB.
- Check the *Control Inputs* screen, which you choose from the *Test Menu* screen. This shows the voltage input to the main PCB from the steering wheel, brake pedal, gas pedal, clutch pedal, seat, and shifter. This screen makes it easy to check whether the controls are functioning correctly.

NOTE

If the control inputs are not right, your earnings may drop since players will not get a realistic driving feel from the simulator.

- Check the *Statistics, Histogram,* and *Games Played by Day and Hour* screens which show the statistical information about how and when your simulator is being played.

Table 2-1 shows you what tests and screens to use at different times and for different problems.

Table 2-1 Using the Self-Test Screens and Diagnostics

Problem or Type	Explanation
Automated Self-Test	When you switch on the self-test, the automated self-test is performed. This tests the program RAM and ROM and the PCBs. You can skip the self-test by turning and holding the key as soon as you enter the self-test. If you cannot run the self-test at all, use the DIP switch diagnostics, explained at the end of this chapter.
Test Menu	Appears after the automated self-test. You can select tests to be performed and information to be displayed from this screen.
Regular Maintenance	On a regular basis, do the following: 1. Do the automated self-test. 2. Check the *Operator Screens*. 3. Go to the *Control Inputs* screen to test the controls.
Game Set-Up	When you first set up your game, do the following: 1. Do the automated self-test. 2. Make sure the options on the *Operator Screens* are set correctly for your location, or set to the defaults. 3. Go to the *Control Inputs* screen to test the controls. 4. Set the clock, if necessary, using the *Set Time* screen.
Control Problem	1. Do the *Set Controls* screens. 2. If that does not correct the problem, go to the *Control Inputs* screen and see if the input from the control changes as you use the control. 3. Go to Chapter 3 and check the troubleshooting table and maintenance information for that control. 4. If the shifter, brake, clutch, or seat potentiometer is broken and you cannot fix it immediately, but still want to operate the game, turn off the control circuit in the *Disable Broken Controls* screen.
Video Display Problem	1. Try the *Monitor Test Patterns* screens. 2. If you cannot go into the self-test or the screen is dark, use the DIP switch diagnostics.
Electronics Problems	1. Do the automated self-test. 2. Choose the *Special Functions* screen that applies to your problems: the GSP, MSP, program ROM, ADSP board or sound board test.
Game Clock	Use the *Set Time* screen to set the internal game clock. This time is used in the statistics screen that shows games played by day and time and in the schedule for clearing the high score table.
Cannot Enter the Self-Test	Use the DIP switches and the LEDs.

Automated Self-Test

When you enter the self-test, the simulator automatically tests the program ROM and RAM, the video RAM, the color RAM, the MSP microprocessor system, the ADSP board, and the sound board. This check takes about five minutes (unless you bypass the test as described in the next paragraph).

NOTE

If you do not see anything on the video display screen, you may have a video display problem or a simulator system problem. See DIP Switch *at the end of this chapter to diagnose the problem.*

If you do not want to wait for the systems and PCBs to be tested, then skip these tests by turning and holding the key switch on for a few seconds while in the program ROM and RAM screen, Figure 2-1. If you want to go to the attract mode, just turn off the self-test switch.

Program ROM and RAM Test

When you enter self-test, the simulator tests the program ROM and RAM. The screen in Figure 2-1 shows the results of a program ROM and RAM test.

The top of the screen shows the ROM test result. The numbers on the left and the letters on the top of the screen show the locations of the ROMs on the main PCB. If a white box appears, then the ROM at that location was good. If an empty box appears (as shown

at 200U and 210U), then the ROM at that location was bad. If nothing appears, then nothing was tested at that location.

The RAM is tested after the ROM. If the RAMs have no errors, then you see the message *Program RAM OK.* If the test finds an error, then you see *Bad Program RAM At* with the bad RAM location listed.

This screen disappears after a few seconds and the self-test continues. However, the screen with the results of the complete self-test, shown in Figure 2-2, will show the message *Bad Program ROM* (or *Bad Program RAM*) if it found an error in the program ROMs or RAMs.

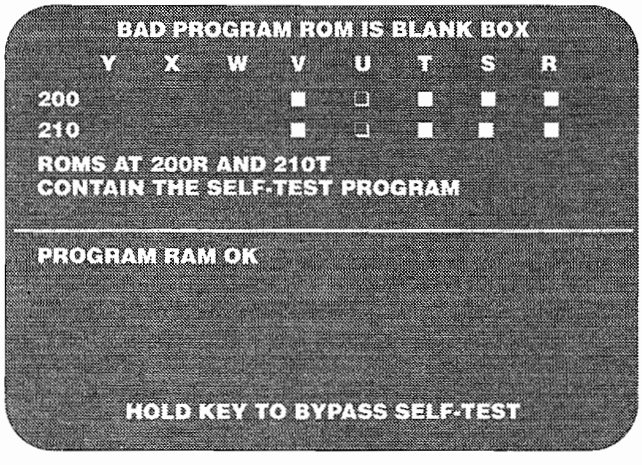


Figure 2-1 Program ROM and RAM Test

Microprocessor and Board Tests

After checking the program RAM and ROM, the automated self-test checks the video RAM and color RAM in the GSP system, the MSP DRAM, the ADSP board, and the sound board. (For more information about these systems, see the *Simulator Systems* section in Chapter 1.) You will see Figure 2-2 when the test finishes, which takes four or five minutes.

If the system or board is good, you will see *OK* after the test name. If it is bad, the word *Bad* precedes the name of the board or system (except for the ADSP board test, which gives more information). If you have a bad system or board, then choose the *Special Functions* item from the test menu, choose the system or board tests from the submenu, and read the description of the tests in this chapter.

A brief description of each microprocessor and board test performed in the self-test is below.

PROGRAM ROM: Described above.

PROGRAM RAM: Described above.

GSP VRAM: Uses the Simple GSP VRAM Test. (Described in the section *Main Board GSP Tests.*)

GSP COLOR RAM: Uses the GSP Color RAM Test. (Described in the section *Main Board GSP Tests.*)

MSP DRAM: Uses the MSP Verify Test. (Described in the section *Main Board MSP Tests.*)

ADSP Board: Tests the ADSP board memory and the ADSP-2100. Most of the error messages are self-explanatory. *Does Not Respond* generally indicates a missing board.

Sound Board: Tests ROM and RAM functions on the sound board. If any of them are bad, you will see the message *Bad Sound Board* on the screen.

Figure 2-2 Microprocessor and Board Tests

Test Menu Screens

After the microprocessor test is completed or you have bypassed it, turn the key to see the test menu screens. Turn the key once to see the screen with the instructions for moving and choosing in the test menu,

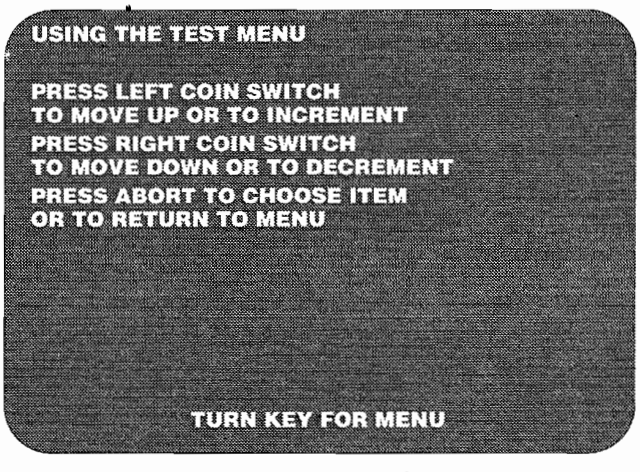


Figure 2-3 Instructions for Test Menu

shown in Figure 2-3. Turn the key again to see the test menu.

To move down the menu, press the left coin switch. To move up the menu, press the right coin switch. You can choose the test menu item with white letters by pressing the abort button.

The test menu, is shown in Figure 2-4, is the primary screen in the self-test. Use this screen to choose screens and tests in the self-test. Choosing any item on this test menu causes a new screen on that subject to appear. This new screen may have additional screens to choose or all the information may appear on that screen. Table 2-4 shows all the screens that appear in the self-test.

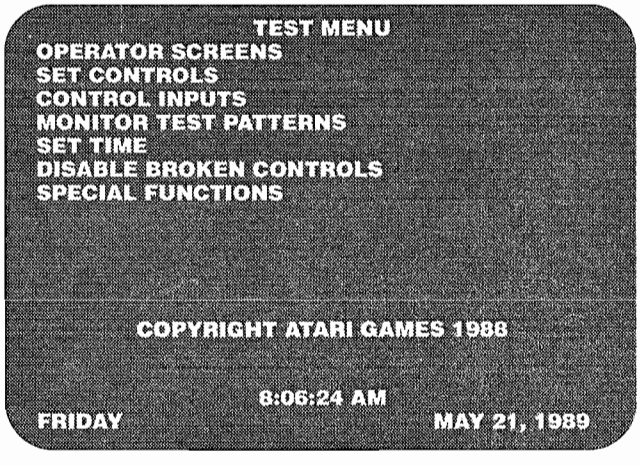


Figure 2-4 Test Menu

Operator Screens

Choose the Operator Screens in the test menu by turning the key while the words *Operator Screens* are in white. (For information about moving in and choosing from the menu, see the section above.)

Once you choose *Operator Screens* you must proceed through the next screens. In the last screen you can return to the test menu. To look at any screen again, first go through all the screens, return to the test menu and again select Operator Screens.

These are the screens in the operator screens submenu:

- Coin Options
- Game Options
- Game Statistics
- Histogram of Game Times
- Games Played by Day and Hour

Coin Options

The coin options are on the first operator screen (see Figure 2-5). To move and choose in this screen, do the following:

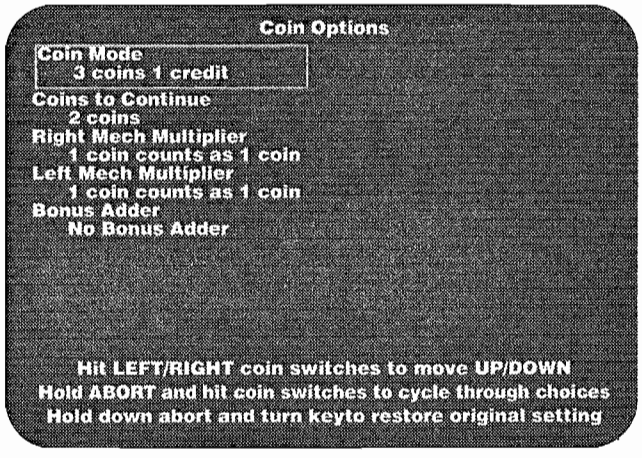


Figure 2-5 Coin Options

- To move up or down the list, press the right or left coin switch.
- To change a setting, press the abort button and a coin switch.
- To return to the setting that was originally on the screen, press the abort button and turn the key.
- To exit the screen, turn the key.

You can change an option when it is enclosed in the blue box. The default setting of each option is green. The other settings are blue when the option is selected. (The other settings are white when the option is

Table 2-2 Coin Option Settings

Option	Available Settings
Coin Mode	1 coin/1 credit
	2 coins/1 credit
	3 coins/1 credit ♦
	4 coins/1 credit
Coins to Continue	1 coin
	2 coins
	3 coins
	4 coins
Right Mech Multiplier	1 coin counts as 1 coin ♦
	6 coins count as 1 coin
	5 coins count as 1 coin
	4 coins count as 1 coin
Left Mech Multiplier	1 coin counts as 1 coin ♦
	1 coin counts as 2 coins
Bonus Adder	No bonus adder ♦
	2 coins give 1 extra coin
	4 coins give 1 extra coin
	4 coins give 2 extra coins
	5 coins give 1 extra coin
	3 coins give 1 extra coin
	Free Play

♦ *Manufacturer's recommended settings*

not selected.) All of the possible settings are shown in Table 2-2.

The coin options are explained below.

- *Coin Mode* is the number of coins required for one credit.
- *Coins to Continue* is the number of coins required to continue the driving session.
- *Right Mech Multiplier* is the number of coins each coin counts as in the right coin mechanism.
- *Left Mech Multiplier* is the number of coins each coin counts as in the left coin mechanism.
- *Bonus Adder* lets you choose bonus coins, no bonus, or free play.

Game Options

Use this screen to set the game difficulty and various other operator options explained below. The screen is shown in Figure 2-6, and a table of the options is shown in Table 2-3.

To move and choose in this screen, do the following:

- To move up or down the list, press the right or left coin switch.
- To change a setting, press the abort button and a coin switch.
- To return to the setting that was originally on the screen, press the abort button and turn the key.
- To exit the screen, turn the key.

You can change an option when it is inside the blue box. The default setting of each option is green. The other settings are blue when the option is selected. (The other settings are white when the option is *not* selected.)

- *Game Difficulty* sets the game difficulty for the drivers. The setting are shown in Table 2-3, and give different amounts of time in the *easy, medium, hard,* and *very hard* settings. The *custom* setting lets you choose the actual amount of time the players receive. We suggest you use the preset factory settings.
- *Steering During Attract Mode* allows you turn the movement of the steering wheel on or off in the attract mode.
- *Steering Wheel Force* is the amount of force exerted by the steering assembly motor on the steering wheel.
- *High Score Name Censor* controls a program to censor names entered on the high score table. The program works by deleting letters in possibly objectionable words in the high score table.
- *Clear High Score Table* clears the high score table at the time chosen. You can choose not to clear the table, clear it now, clear every week, or clear every two weeks. If you choose clear every week or clear every two weeks it will be cleared the first time the simulator is powered up after midnight on Wednesday if you have your simulator clock set correctly. Otherwise, it will clear whenever the internal clock says it is Wednesday.

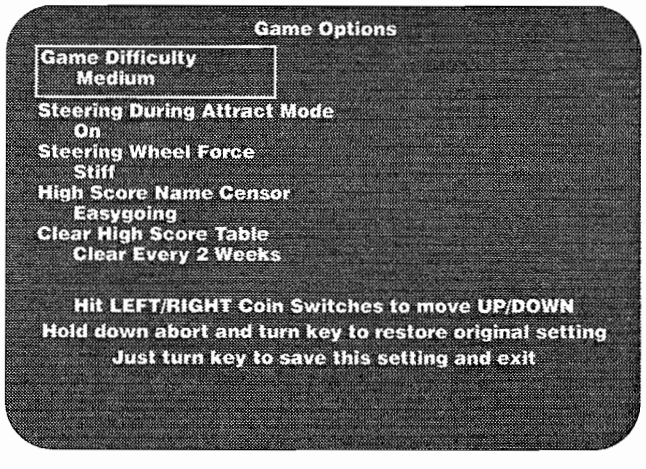


Figure 2-6 Game Options

Table 2-3 Game Option Settings

Option	Available Settings
Game Difficulty	Easy Medium ♦ Hard Very Hard Custom
Steering During Attract Mode	On ♦ Off
Steering Wheel Force	Very Light Light Medium Stiff ♦
High Score Name Censor	Easygoing ♦ Strict
Clear High Score Table	Don't Clear Clear Now Clear Every Week Clear Every 2 Weeks ♦

♦ *Manufacturer's recommended settings*

Custom Game Options

This screen is shown in Figure 2-7. Choose *Custom* under *Game Difficulty* to see this screen. You can choose the amount of time each driver is given for each lap instead of using the *Game Difficulty* options available.

Table 2-4 All Screens Appearing in the Self-Test

Screen	Use
Automated Self Test	
Program RAM and ROM	Tests the program RAM and ROM.
Automated Self-Test Results	Shows results of the program RAM and ROM, VRAM, color RAM, MSP DRAM, ADSP PCB and sound PCB tests.
Test Menu Screens	
Instructions for Test Menu	
Test Menu	List of available tests and information you can choose.
Operator Screens	
Coin Options	
Game Options	
Custom Game Options	Use preset game options first.
Statistics	
Histograms	
Games Played by Day and Hour	Be sure the clock is set correctly so you can get maximum use from this screen.
Set Controls	Use if you are having any control problems or replace or repair a control or a PCB.
Initialize Pot Inputs	
Initialize Steering Limits	
Initialize Shifter Limits	
Initialize Seat Limits	
Initialize Force Brake	
Control Inputs	Check this screen *regularly* to make sure your controls are operating correctly.
Monitor Test Patterns	Use these screens to check the performance of your video display.
Color Bars	
Monitor Brightness	
Grey Scale	
B/W Grid	
B/W Dots	
Diagonal Lines	
Full Screen Grey	
Full Screen White	
Full Screen Red	
Full Screen Green	
Full Screen Blue	
Monitor High Voltage Test	
Scrolling Test	
Set Clock	Set the time so that you can get maximum use from the *Games Played By Day and Hour* screen and so that the high score table reset will occur at the right time.
Disable Broken Controls	If you cannot repair a broken shifter, brake, clutch or seat potentiometer immediately, you can disable that control's circuit so you can continue to operate the game. *Repair the broken control as soon as possible. Use this screen only as a temporary measure.*
Special Functions	
Main Board GSP Tests	Use this screen if you have a VRAM failure in the automated self-test.
VRAM Simple Test	
VRAM Verify Test	
VRAM Complete Test	
Test VRAM for Display Errors	
Color RAM	
VRAM Shift Register Test	

Table 2-4 All Screens Appearing in the Self-Test, Continued

Screen	Use
Main Board MSP Tests	Use this screen if the MSP system failed the automated self-test.
MSP Verify Test	
MSP Complete Test	
Main Board Controls	Shows much the same information as the *Control Inputs* screen, but has additional tests for the steering wheel and for line voltage calibration.
Pots: 8 Bit	Shows the gas pedal, clutch pedal, seat movement, shifter movement, steering wheel movement (not force), line voltage and the shifter force input to the main PCB.
Pots: 12 Bit	Shows the steering wheel force input (not movement) and the brake force input to the main PCB.
Steering Wheel	Tests to use if the steering wheel does not work. See the steering wheel flow charts in Chapter 3 for their use.
Send Force	Use this test as directed in the flowchart in Chapter 3.
Sine Wave	
Square Wave	
Triangle Wave	Use this test as directed in the flowchart in Chapter 3.
Closed Loop Test	
Line Voltage Calibration	Calibrates the line voltage display in the self-test.
Opto Test	For factory use only.
Life Test	For factory use only.
Shifter	Use this screen if the shifter is not functioning correctly.
Main Board ROM Checksums	Use this test if the program ROMs failed the automated self-test.
Main Board ZRAM Tests	Check the ZRAMs. Use this if all the controls are operating erratically or the statistics are not being kept correctly.
ADSP Board Tests	Use this test if the ADSP board failed the automated self-test.
ADSP RAM	
2100 Test	
ADSP IRQs	
Graphics ROM Checksums	
Scope Loops	
Seq Input Memory Reads	
Seq Input Mem ADR Writes	
Seq Output Writes, Buf 1	
Seq Output ADR Writes, Buf 1	
Seq Output Writes, Buf 2	
Seq Output ADR Writes, Buf 2	
Toggle MPAGE	
Toggle XPAGE	
Sound Board Tests	Use this test if the sound board failed the automated self-test.
Sound Board Self-Test	
Play Sounds	
Sound Board ROM Checksums	
Sound Board Program RAMs	
Sound Board Program ROMs	
COMRAM	
320 RAM	

NOTE

Always use the preset Game Difficulty *settings before you use the settings on the* Custom *game options.*

If you choose a preset game difficulty option, the custom time settings will be the same as the preset times. With this screen, you can adjust the time permitted for the first lap and for each additional lap separately.

To move and choose in this screen, do the following:

- To move up or down the list, press the right or left coin switch.
- To change a setting, press the abort button and a coin switch.
- To return to the setting that was originally on the screen, press the abort button and turn the key.
- To exit the screen, turn the key.

You can change an option when it is inside the blue box. The default setting of each option is green. The other settings are blue when the option is selected. (The other settings are white when the option is *not* selected.) All of the possible settings are shown in Table 2-5.

The custom game options are explained below.

- *Initial Time* is the amount of time always given for one driving session.
- *First Extended Time* is the amount of time given if the driver crosses the finish line before the initial time is up.
- *Second Extended Time* is the amount of time given if the driver crosses the finish line before the time is up on his second lap.
- *Extended Time After Second* is the amount of time given when the driver crosses the finish line before the time is up after the first two laps.

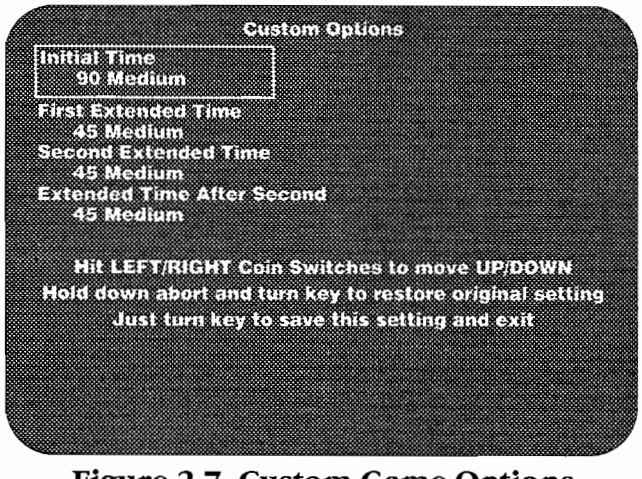


Figure 2-7 Custom Game Options

Table 2-5 Custom Game Option Settings

Option	Available Settings (in Seconds)
Initial Time	72 76 78 Very Hard 80 82 84 Hard 86 88 90 Medium 92 94 96 Easy 98 100 102
First Extended Time	37 38 39 Very Hard 40 41 42 Hard 43 44 45 Medium 46 47 48 Easy 49 50 51 52
Second Extended Time	37 38 39 Very Hard 40 41 42 Hard 43 44 45 Medium 46 47 48 Easy 49 50 51 52
Extended Time After Second	37 38 39 Very Hard 40 41 42 Hard 43 44 45 Medium 46 47 48 Easy 49 50 51 52

Statistics

The statistics screen is shown in Figure 2-8. The statistics are collected from the last time the statistics screen was cleared. Write this information on the statistics sheet in the back of this manual to assist in maximizing your profit.

To move to the next screen, just turn the key. To clear the statistics, press and hold the abort button and turn the key at the same time.

The statistics the simulator collects are explained below.

- *Left Coins* shows the number of coins counted in the left coin mechanism.
- *Right Coins* shows the number of coins counted in the right coin mechanism.
- *Idle Mins* shows the number of minutes the simulator has been idle.
- *Active Mins* shows the number of minutes the simulator has been played.
- *Xtnded Plays* shows the total number of times drivers received at least one additional lap.
- *1-X Games* shows the number of times drivers crossed the finish line one time and did not complete a second lap.
- *2-X Games* shows the number of times drivers crossed the finish line two times and did not complete a third lap.

- *N-X Games* shows the number of times drivers crossed the finish line three times and continued to drive.
- *Auto Games* shows the number of times drivers chose to drive the car with an automatic transmission instead of a manual shift.
- *Error Count* shows the number of errors counted in the erasable memory. If you have a count of more than 75, you should have your simulator serviced by a qualified service technician.
- *Total Games* shows the number of unique games played, regardless of how additional laps a driver received.
- *Laps by Track* is numbers of laps, completed or not, on each track. The first number is the common track at the beginning, before the driver chooses the stunt track or the speed track. The second number is the speed track and the third number is the stunt track. See the example after *No X Games by Track.*
- *Xtnded Plays by Track* is the number of additional laps given to drivers if they complete the track before the time allotted. (These laps, when added together, are the same as the number of laps in *Xtnded Plays.*)

  These additional laps does not need to be completed to be counted. The first number is the common track at the beginning, before the driver chooses the stunt track or the speed track. The second number is the speed track and the third number is the stunt track. This is statistic is useful to see which track drivers are choosing and driving well on. See the example after *No X Games by Track.*
- *No X Games by Track* is the number of times the drivers did not get extended games on either track. If the numbers here are very high (in proportion to the *Laps by Track* statistic), then the *Game Difficulty* setting may be too hard. The first number is the common track at the beginning, before the driver chooses the stunt track or the speed track. The second number is the speed track and the third number is the stunt track.

The following examples show how these three statistics are counted.

If a driver chooses the speed track and completed it before the time allotted, started driving the second lap on the speed track, but ran out of time, and did not put in any more coins, you would see the following statistics:

Laps By Track	0	2	0
Xtnded Plays by Track	0	1	0
No X Games by Track	0	0	0

If a second driver chooses the stunt track and does not complete the track before time is up, his statistics will be added to the first driver's as follows:

Laps By Track	0	2	1
Xtnded Plays by Track	0	1	0
No X Games by Track	0	0	1

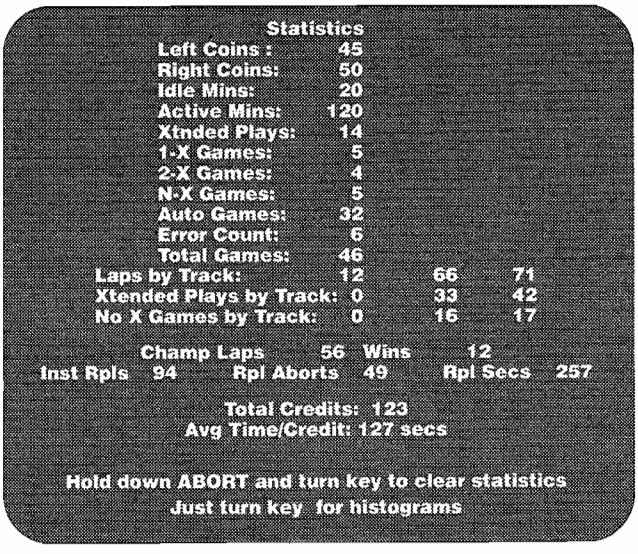


Figure 2-8 Statistics

- *Champ Laps* is the number of times drivers qualify to race a championship lap.
- *Wins* is the number of times drivers win championship laps.
- *Inst Rpls* is the total number of instant replays. If this number is very high, the drivers should probably be reminded they will be most successful if they drive the Hard Drivin' simulator like a real car.
- *Rpl Abort* is the number of times the drivers pressed the abort button to cut the instant replay short.
- *Rpl Secs* is the total number of seconds the simulator is in the replay mode.
- *Total Credits* is calculated by multiplying the coins by the credit setting you chose in Coin Mode.
- *Avg Time Per Credit* is the average amount of time in seconds that each credit gave.

Histogram

The histogram screen shows the length of driving time in seconds and the how many times the simulator was driven . The screen is shown in Figure 2-9. Write these numbers on the statistics sheet in the back of this manual to assist in maximizing your profit.

To move to the next screen, just turn the key. To clear the histograms, press and hold the abort button and turn the key at the same time.

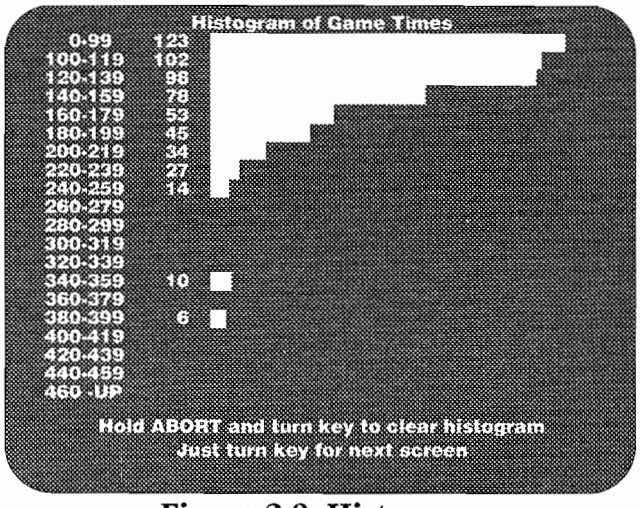


Figure 2-9 Histogram

Games Played By Day and Hour

This screen, illustrated in Figure 2-10, shows the number of games played in every hour in each day. The information on this screen relies on the clock being set correctly. You can easily check the accuracy of the clock setting by looking at the time, day, and date shown on the bottom of the test menu screen. If the time is incorrect, follow the instructions in the *Set Clock* section to set the clock.

Write the simulator driving information on the statistics sheet in the back of this manual to assist you in maximizing your profit. To clear the screen, press and hold the abort button and turn the key at the same time. To return to the self-test menu, turn the key. If you want to see any screens again, select Operator Screens on the test menu.

Set Controls Screens

If you are having problems with any control in the simulator, use these screens first before doing any other troubleshooting or repairs. These screens allow you to set the beginning and ending points of the control input to the main PCB. Often, resetting these points will solve the control problem you have. If it does not, then you should check the *Control Inputs* screen, described below.

If you do repair a control, when you put the control back in the simulator, go through the *Set Contro l* screens. If you install a new board or a new control, you must go through the *Set Control* screens too.

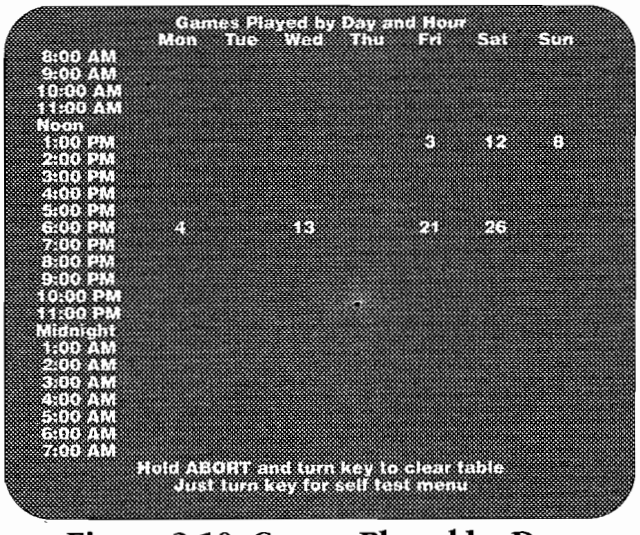


Figure 2-10 Games Played by Day and Hour

NOTE

If you take a control out of the simulator for repair or maintenance, you must go through all the Set Controls *screens after you replace it. If you do not, the simulator will not operate correctly.*

If you have never used the self-test, then read pages 2-2 to 2-5 to find out how to see these screens.

After you choose *Set Controls*, simply do what the screens say. You must reset all the controls after you start the screens. The first screen initializes all potentiometers in the simulator. (The steering wheel, shifter, seat, gas, and brake have potentiometers.) The next screens initialize the limits for the steering wheel,

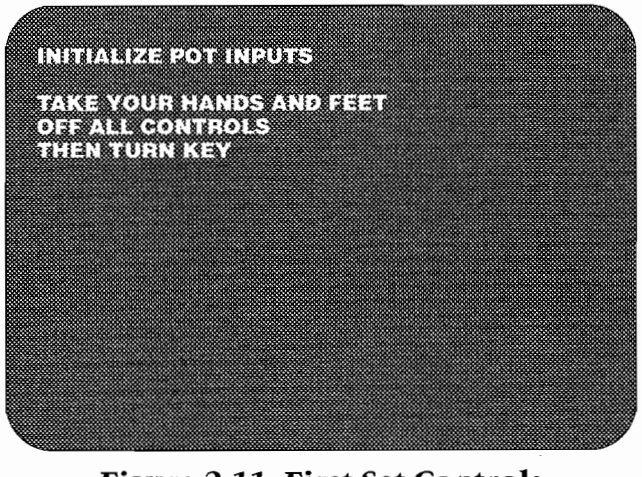


Figure 2-11 First Set Controls Screen—Initialize Potentiometers

shifter, seat, and brake. The numbers on each screen are for factory use.

NOTE

When you initialize the brake, the instructions say to "step firmly" on the brake. Do not stomp on the brake or gently press it. Either one will cause the brake to have incorrect limits, and the players will be frustrated when they use the brake.

The first screen of the *Set Controls* screens is shown in Figure 2-11.

Control Inputs Screen

Check this screen as part of your regular maintenance to be sure your controls are operating correctly.

This screen shows the voltage inputs from the control potentiometers to the A/D converter circuit on the main PCB. As you use a control, the line length on the screen changes, showing the change in the voltage input from the potentiometer. If the line length does not change, you have a problem with that control, the connections, the harness, or the A/D converter circuit.

If you have a problem, do the *Set Controls* screen first to see if that solves the problem. If this does not solve the problem, check the *Maintenance* chapter for troubleshooting and repair information before you take the control out of the simulator for repair.

The *Control Inputs* screen is shown in Figure 2-12.

The first two controls on the screen are the *Steering Wheel* force and *Brake Force*. These lines measure the force with which the steering wheel is turned and the brake is pushed. As you turn the steering wheel counterclockwise, the line disappears. As you push harder and harder on the brake, its line disappears. In both these controls, 0 Volts from the control is a very short line on the screen (or no line) and 5 Volts is almost eight full lines drawn across the screen.

Below these two lines are inputs from the gas pedal, clutch pedal, seat movement, shifter (front to back), shifter (left to right), steering wheel position, line voltage, and shifter force. The line voltage varies at 60 Hz. You cannot test the line voltage.

As you use the controls, the lines should become longer and shorter. If the line does not move, then see Chapter 3 for more information. In these controls, which all feed into the 8-Bit A/D circuit on the main PCB, 0 Volts appears as a very short line (or no line)

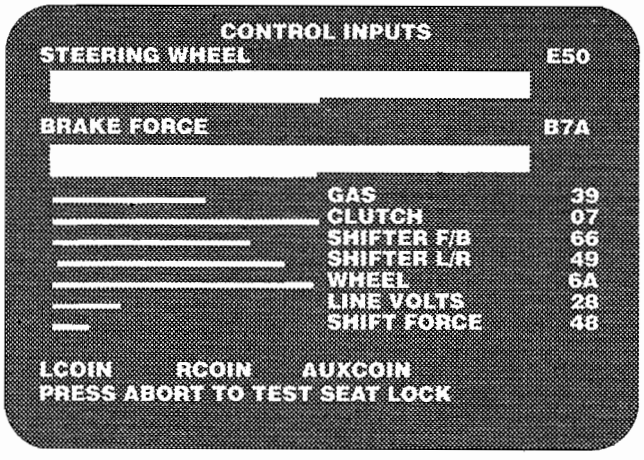


Figure 2-12 Control Inputs Screen

and 5 Volts appears as a line halfway across the screen.

At the bottom of the screen, you can check the left and right coin mechanism, the auxiliary coin switch behind the coin door, and the seat magnet.

The seat magnet locks the seat while driving and unlocks in the attract mode, or when the seat adjust button is pressed. With the seat magnet test you can determine whether the seat is locking and the magnet is good.

If the seat locks in this test, but has not been functioning correctly then you probably have a problem with the switch, not the magnet. If the seat does *not* lock, then you probably have a problem with the harness or the magnet.

Monitor Test Patterns

Use this item to see thirteen screens for checking the video display, the color RAMs and the GSP, which controls the video RAMs (VRAMs) and the video output. Some screen can be used to adjust the video display. To move through the screens, press the coin switches.

- *Color Bars* screen shows from left to right, the colors white, yellow, light blue, green, purple, red, blue, and grey. If the colors are incorrect, see your video display manual included with the simulator for adjustment procedures.
- *Monitor Brightness* checks the adjustment of the video display brightness.
- *Grey Scale* screen shows a white line on the left, then black shading to white across the screen.
- *B/W Dots* screen can be used to check convergence and focus.

- *B/W Grid* screen, shows a black background and a white grid pattern to check convergence. The grid lines should be straight within 3.0 mm. If you need to adjust the convergence, see the video display manual included with the simulator.
- *Diagonal Lines* screen can be used to check video display linearity.
- *Full Screen* Color Screens test the color purity in the color RAMs and the display. The test displays a grey, white, red, green, and then blue screen. Each screen should be a rectangle of color, with no curving at the corners and no lines in the raster. If it does not, see your video display manual included with the simulator for adjustment procedures.
- *Monitor High Voltage Test* screens switch between a white screen and a grey screen. If the high voltage to the display is regulated properly, the sides of the screen will fluctuate about 3/4-inch between the white and grey screens.
- *Scrolling Test* screen checks the scrolling mechanism in the GSP.

Set Clock Screen

Choose this item if you want to set the clock, turn the clock on, or turn it off. The clock should be set correctly so statistics on the operator screen *Games Played by Day and Time* will give the proper information and the high score table will be cleared on Wednesday.

You may need to turn on the clock if the simulator has a program crash. Turn off the clock only if you plan to store the simulator more than six months. The clock has a lithium battery that should last more than five years if the simulator is in normal use.

To turn off the clock, choose *Clock Off* from the clock submenu, shown in Figure 2-13. To turn on the clock, choose *Start Clock* from the menu. In about two seconds, the clock will start.

If the clock is losing or gaining time, then use *Clock Faster* or *Clock Slower* to adjust the calibration of the clock.

Choose the item you need from the menu by using the right and left coin switches. Change the item setting by turning the key until you see the correct time.

The items on the clock menu are explained below.

- *Exit* returns you to the test menu.
- *Inc Hours* changes the hour setting ahead.
- *Inc Minutes* changes the minute setting ahead.
- *Inc Seconds* changes the second setting ahead.

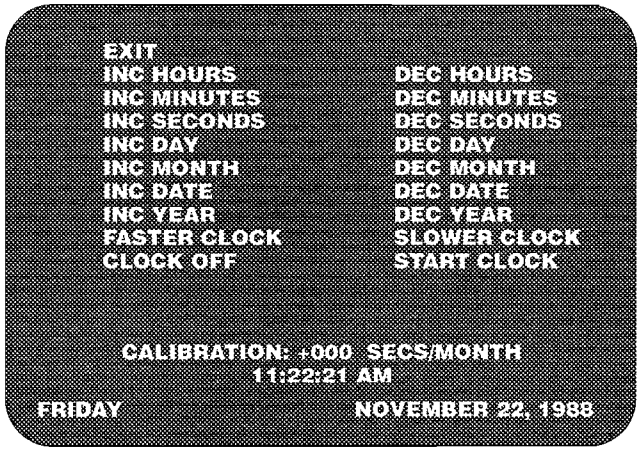


Figure 2-13 Set Clock Screen

- *Inc Day* changes the day of the week (for example, Monday or Tuesday) setting ahead.
- *Inc Month* changes the month setting ahead.
- *Inc Date* changes the date setting ahead.
- *Inc Year* changes the year setting ahead.
- *Faster Clock* changes the calibration setting ahead. Each increase in the calibration setting makes the clock run about 5 seconds faster per month.
- *Clock Off* turns the clock off.
- *Dec Hours* changes the hour setting back.
- *Dec Minutes* changes the minute setting back.
- *Dec Seconds* changes the second setting back.
- *Dec Day* changes the day of the week (for example, Monday or Tuesday) setting back.
- *Dec Month* changes the month setting back.
- *Dec Date* changes the date setting back.
- *Dec Year* changes the year setting back.
- *Slower Clock* changes the calibration setting back. Each decrease in the calibration setting makes the clock run about 5 seconds slower per month.
- *Start Clock* starts the clock.

Disable Broken Controls Screen

Use this screen if you have a broken shifter, brake pedal, clutch pedal, or seat potentiometer and cannot fix it immediately. Before you use this screen try the *Set Controls* screens to see if that will solve the problem.

Disable these controls *only* as a *temporary* measure so you can continue to operate the simulator while wait-

ing for parts. If you disable a control, the realistic driving feel of the simulator is lost for that control. Earnings could potentially drop.

When you disable a control, the control circuit is overridden, and the simulator compensates for the loss of the control so that you can continue to operate the simulator.

Special Functions Screens

The items on this screen menu, shown in Figure 2-14, should be used if you need more information about systems or boards that failed the Program RAM and ROM Test or the Board and Microprocessor Test at the beginning of the self-test. You can also test the steering wheel, the shifter, and the non-volatile RAM that holds the clock settings and the statistics.

The *Special Functions* screen is explained below.

- *Exit* returns you to the test menu.
- *Main Board GSP Tests* should be used if you get the message *Bad GSP VRAM* or *Bad GSP Color RAM* at the beginning of the self-test.
- *Main Board MSP Tests* should be used if you get the message *Bad MSP DRAM* at the beginning of the self-test.
- *Main Board Controls* gives you most of the same information as provided in the *Control Inputs* screen. However, some steering wheel tests and a line voltage calibration screen have been added.
- *Main Board ROM Checksums* should be used if you get the message *Bad Program ROM* at the beginning of the self-test.
- *Main Board ZRAM Tests* should be used if your controls settings are changing or erratic after you used the *Set Controls* screen or if you suspect the simulator is not keeping the statistics correctly.
- *ADSP Board Tests* should be used if you get any message other than *ADSP Board OK* for the ADSP board test at the beginning of the self-test.
- *Sound Board Tests* should be used if you get the message *Bad Sound Board* at the beginning of the self-test. However, many of the sound board tests require schematics and an oscilloscope.

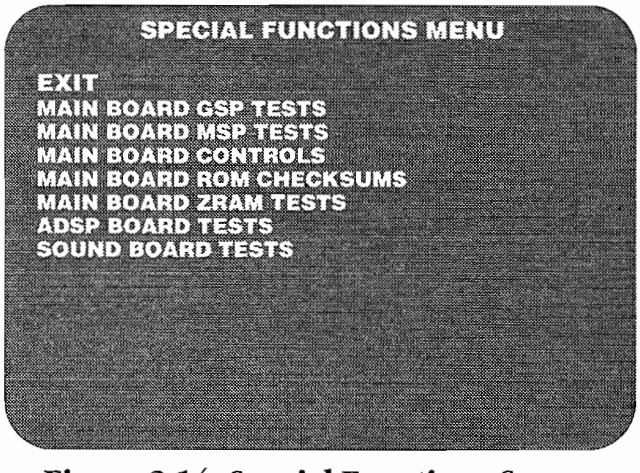


Figure 2-14 Special Functions Screen

Main Board GSP Tests

If the automated self-test reports bad VRAMs, choose *Main Board GSP Tests* and you will see the screen in Figure 2-15.

First run the VRAM Simple Test. It will give you the location of the bad VRAMs. If the VRAMs pass this test, but you think the simulator has a bad VRAM, run the VRAM verify test.

- *VRAM Simple Test* is the same test that is run at the beginning of the self-test. It is run by the 68010 through the GSP interface and detects open or shorted address or data lines or missing parts. The results are displayed on-screen with a picture showing the VRAM section of the main board. The good parts are shown in green and the bad parts are shown in red. If an entire section is shown as bad, the problem may be with a buffer associated with that section. The test takes about 30 seconds.
- *VRAM Verify Test* is a complete memory test run by the GSP. The results are reported on the screen like in the simple test. The test takes about three minutes to run.

  Since the GSP program resides in the VRAM and runs the test, a single bad VRAM will probably cause the GSP program to crash. If the program does not run, the 68010 will time out and report that all the VRAMs are bad. Actually, probably only

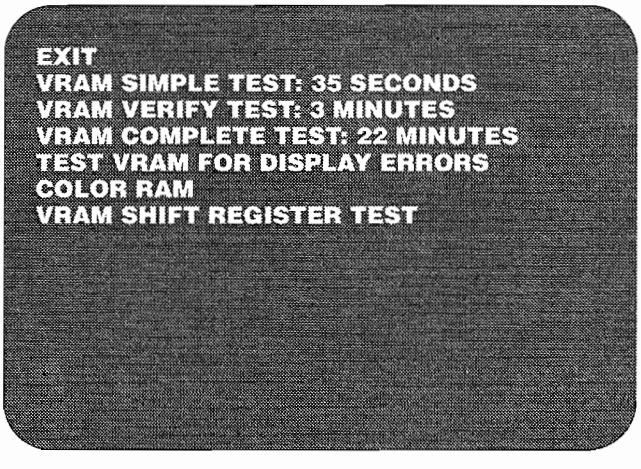


Figure 2-15 GSP Tests Screen

one VRAM is bad and you should run the VRAM complete test to find out which one is bad.

If the test does run and report that the VRAMs are good, then the VRAMs should be good.

If the VRAM verify test fails, but the VRAM simple test shows the all the VRAMs are good, you should also run the VRAM complete test.

- *VRAM Complete Test* is a complete memory test but the 68010 runs it through the GSP interface. Because the 68010 runs the test, a bad VRAM will not cause the test to crash. The test reports any VRAMs that are bad on the screen at the end of the test. This test takes at least 22 minutes to run.
- *Test VRAM for Display Errors* checks to see if there are any video display problems.
- *Color RAM* is the same test that is performed at the beginning of the self-test. It tests the color RAM and reports the results.
- *VRAM Shift Register Test* test the shift register section of the the video RAMs.

Main Board MSP Tests

Use this item if the MSP microprocessor fails the Microprocessor and Board Tests performed when you enter the self-test.

Choose *Main Board MSP Tests* and you will see the screen shown in Figure 2-16. Run the MSP Verify Test, and if necessary, the MSP Complete Test.

The items in the MSP Test screen are explained below.

- *Exit* returns to the test menu.
- *MSP Verify Test* tests the MSP DRAMs. This is the first test you should run if the MSP microprocessor failed Microprocessor and Board tests. The test is run by the MSP out of the DRAM; almost any DRAM problem will cause an error message to appear on the screen.

  In twenty seconds, the test displays the results as a picture of the main board with the good parts shown in green, the bad parts shown in red, and the integrated circuits that are not DRAMs and *not* tested shown in blue. If two DRAMs are colored red, then the problem could be the buffer associated with the pair.

  If this test does not isolate the MSP problem, then try the MSP Complete Test.
- *MSP Complete Test* is run by the 68010 through the MSP interface. It thoroughly tests the DRAMs and can detect nearly any problem that could develop. The test takes 2 minutes or longer if it finds errors.

  The test displays the results as a picture of the main board with the good parts shown in green, the bad parts shown in red, and the integrated circuits that are not DRAMs and *not* tested shown in blue. If two VRAMs are colored red, then the problem could be the buffer associated with the pair.

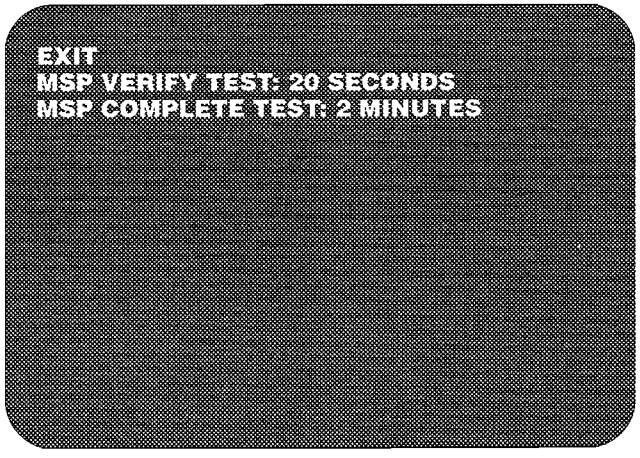


Figure 2-16 MSP Tests Screen

Main Board Controls

This screen provides more information about the controls than shown in the *Control Inputs* screen. The items on the screen are described below and shown in Figure 2-17. After you choose any item on this screen and go to that item, you can return to this screen by turning the key.

The first two items on the screen are the same as are shown the *Control Inputs* screen. These are the voltage inputs from the potentiometers on the controls to the A/D Converter. As you use a control, you can see the voltage input from the potentiometer to the A/D converter change. If the voltage does not change, you should check that control according to the procedures in Chapter 3, *Maintenance and Troubleshooting*.

- The controls under the heading *Pots: 8-Bit* feed

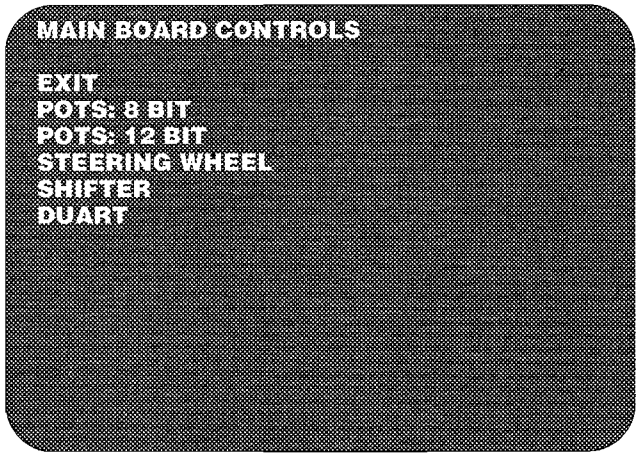


Figure 2-17 Main Board Controls Screen

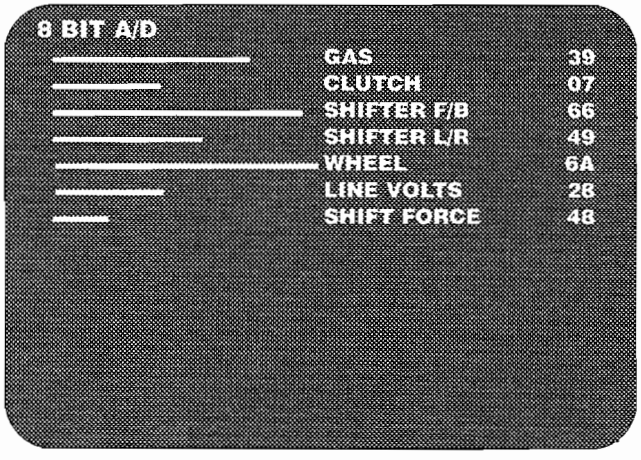


Figure 2-18 Pots: 8-Bit Screen

into the 8-Bit A/D converter circuit on the main PCB. (See Figure 2-18.) These are the gas pedal, clutch pedal, seat movement, shifter (front to back), shifter (left to right), steering wheel position, and shifter force.

As you use the controls, the lines should become longer and shorter. If the line does not move, then you have a problem with the control, the connection or the A/D Converter circuit on the main PCB.

In these controls, 0 Volts appears as a very short line (or no line) and 5 Volts appears as a line halfway across the screen.

- The *Steering Wheel* force and *Brake Force* under the heading *Pots: 12-Bit* feed into the 12 Bit A/D converter circuit on the main PCB. (See Figure 2-19.) These lines measure the force with which the steering wheel is turned and the brake is pushed.

  As you turn the steering wheel counterclockwise, the line disappears. As you push harder and harder on the brake, its line disappears too. If the line does not move, then you have a problem with the control, the connection, or the A/D Converter circuit on the main PCB.

  In both these controls, 0 Volts from the control is a very short line on the screen (or no line) and 5 Volts is almost eight full lines drawn across the screen.

  The two lines on the bottom of this screen are not used.

- *Steering Wheel* has a submenu explained below and shown in Figure 2-21.
- *Shifter* screen is described below and shown in Figure 2-22. To enter the shifter screen, you must quickly turn the key. If you turn it slowly, you may not be able to enter the test.
- *Duart* does not apply to this simulator.

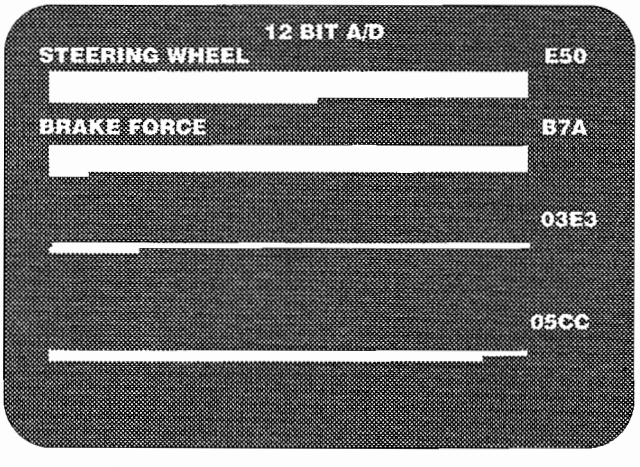


Figure 2-19 Pots: 12-Bit Screen

Steering Wheel Submenu

Use these item if you believe you have a problem with the steering assembly or the steering motor amplifier PCB The screen is shown in Figure 2-21.

CAUTION

Do not attempt to service the motor amplifier assembly, which drives the steering assembly and is mounted on the left side of the cabinet. The assembly contains high voltage.

If you think the problem is with the motor amplifier assembly return the assembly to Atari Games for servicing.

To move through the menu and the screens, use the coin switches. To exit the screens, push both coin switches down.

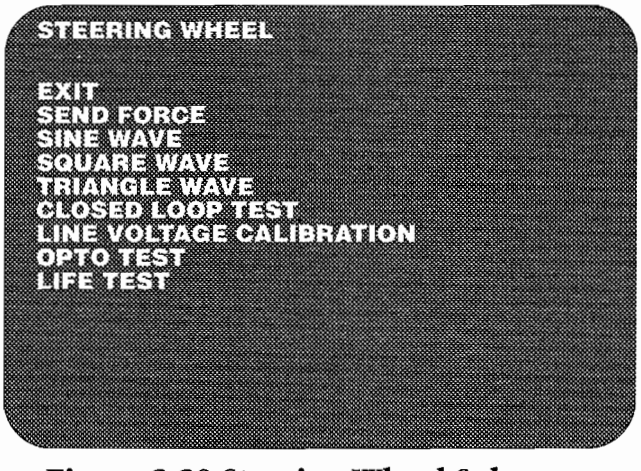


Figure 2-20 Steering Wheel Submenu Screen

- *Exit* returns to Main Board Controls.
- *Send Force* sends a steady force to the Motor Amplifier PCB. See Figure 2-21.
- *Sine Wave* sends a sine wave force to the Motor Amplifier PCB. This screen is similar to Figure 2-21.
- *Square Wave* sends a square wave force to the Motor Amplifier PCB. This screen is similar to Figure 2-21.
- *Triangle Wave* sends a triangle wave force to the Motor Amplifier PCB. This screen is similar to Figure 2-21.
- *Closed Loop Test* reads the steering wheel position and sends a force to the steering wheel motor amplifier PCB to simulate a simple spring.
- *Line Voltage Calibration* can be used to calibrate the simulator voltage reading to the line voltage reading. Put a voltmeter on the line, then set the voltage on this screen to match.
- *Opto Test* is a test used by manufacturing.
- *Life Test* is a test used by manufacturing quality assurance.

CAUTION

Do not use the Life Test. *It is used only for factory testing of potentiometers. If you leave the simulator in this test for a long period of time, you can destroy your steering assembly potentiometer.*

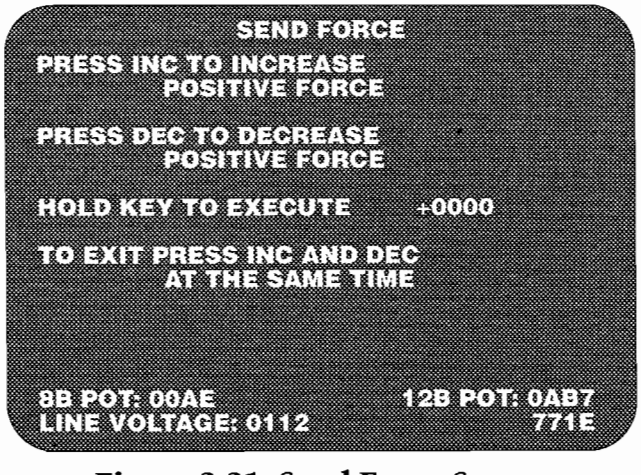


Figure 2-21 Send Force Screen

Shifter Test Screen

Use this screen if you think you have a problem with the shifter However, first see the shifter flowchart in Chapter 3, so you can use this screen effectively. If you need to repair the shifter or the shifter PCB, see the shifter section in Chapter 3 for further information.The shifter screen is shown in Figure 2-22.

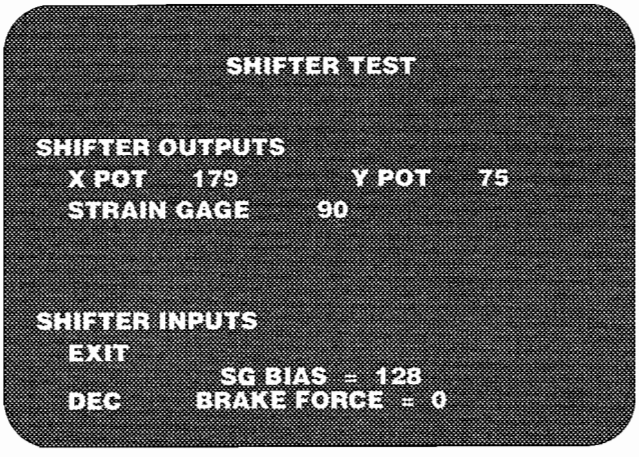


Figure 2-22 Shifter Screen

You may have some difficulty entering this screen when you turn the key. If you quickly turn the key, you will see the shifter screen in Figure 2-22. If you hold the key too long, you will see *Shifter Test Quit.* Just try again if this happens if you see this screen.

Under shifter outputs, you can see the voltage outputs change as you push the shifter from left to right and front to back. These numbers show the change in the voltage input from the the potentiometers to the 8-bit A/D converter circuit on the main PCB

The X pot number should change as you move the handle from left to right. The Y pot number should change as you move the shifter front to back. The strain gage should be 90, and when you push the shifter forward into first or third gear, the number should go higher. It changes very quickly so watch carefully for it.

Under *Shifter Inputs,* you can exit the screen by turning the key, or you can press the coin switches to increment and decrement the *SG Bias* (strain gauge bias) and shifter *Brake Force.* (This brake is the internal shifter brake, not the simulator brake.)

Change the inputs to the strain gauge and the brake force as directed in the shifter flowchart in Chapter 3.

Main Board ROM Checksums

This item checks the main board program ROMs for errors. Use this test if you have a Bad Program ROM message on the self-test screen or you suspect program ROM failure. To exit this screen, turn the key.

When the checksum test is complete you will see a

hexadecimal number following each ROM as shown on the screen in Figure 2-23. The first two digits in each hexadecimal number can be any number, but the last two digits must be the ones shown in Figure 2-23. If they are not, then the ROM is bad or it is not on the board.

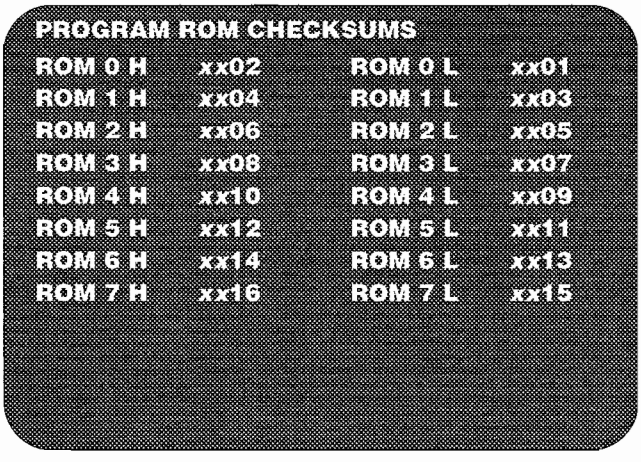


Figure 2-23 ROM Checksums

Main Board ZRAM Test

This test checks the non-volatile RAM where the simulator statistics and control set-up values are kept. Use this to check the ZRAMs if you think the statistics are incorrect or the control settings have the wrong values or do not keep the correct settings after being set with the *Set Controls* screens.

If the simulator loses power or is reset while it is in this test, then both the statistics and the control setting will be lost. If this happens, use the *Set Controls* item from the main menu to reset the controls. The statistics cannot be restored.

Figure 2-24 ADSP Board Tests

ADSP Board Tests

Use this item if the ADSP board fails the Microprocessor and Board Tests performed when you enter the self-test.

Select *ADSP Board Tests* from the test menu and you will see the screen in Figure 2-24. The items on the screen are explained below.

- *Exit* returns to the test menu.
- *ADSP RAM* tests the memory on the ADSP board. The test takes a few minutes to run and then displays a picture of the main board with the good parts shown in green, the bad parts shown in red, and the integrated circuits that are not RAMs and not tested shown in blue. If two RAMs are colored

Table 2-6 ADSP Scope Loop Diagnostic Tests

Test	Function
Seq Input Memory Reads	Reads the sequential input memory. The counters 9L, 9K, 9J, and 9H are incremented in a binary sequence from SRA0 to SRA15.
Seq Input Mem ADR Writes	Writes to the sequential input memory. The data written to the counters 9L, 9K, 9J, and 9H is incremented in a binary sequence from SRA0 to SRA15.
Seq Output Writes, Buf 1	Writes to the Sequential Output Memory 1. The outputs of the counters 4D, 4C, 4B, and 4A are incremented in a binary sequence from ASA0 to ASA12.
Seq Output ADR Writes, Buf 1	Writes the address to the Sequential Output Memory 1. Data written to the counters 4D,4C, 4B, and 4A is incremented in a binary sequence from ASA0 to ASA12.
Seq Output Writes, Buf 2	Writes the address to the Sequential Output Memory 2. The outputs of the counters 4E, 4F, 4H, and 4J are incremented in a binary sequence from BSA0 to BSA12.
Seq Output ADR Writes, Buf 2	Writes the address to the Sequential Output Memory 1. Data written to the counters 4D, 4C, 4B, and 4A is incremented in a binary sequence from ASA0 to ASA12.
Toggle MPAGE	The MPAGE at 7L, Pin 5, alternates between 0 and 1.
Toggle XPAGE	The XPAGE at 6K, Pin 5, alternates between 0 and 1.

red, then the problem could be the buffer associated with the pair.

- *2100 Test* checks the response of the 2100 integrated circuit on the ADSP board by copying data from one location to another using a 2100 program.
- *IRQ Test* checks if the ADSP can generate interrupts for the 68010.
- *ROM Checksums* tests the graphic ROMs on the ADSP board. When the checksum test is complete you will have a hexadecimal number following each ROM shown on the screen in Figure 2-25. The first two digits in each hexadecimal number can be anything, but the last two digits must be the ones shown in Figure 2-25. If they are not, then the ROM is bad or it is not on the board.
- *Scope Loops* shows a menu with hardware diagnostic tests to be used with an oscilloscope. The tests are shown in Table 2-6.

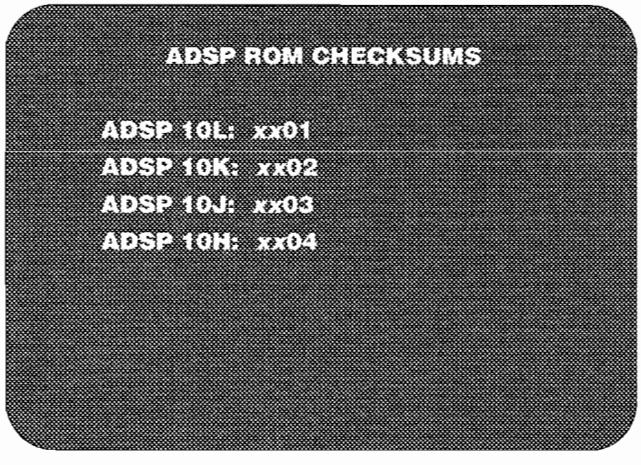


Figure 2-25 ADSP ROM Checksums Tests

Sound Board

Use these tests if the sound board failed the Microprocessor and Board Tests performed when you entered the self-test.

If the Sound Board failed the test, select this item from the test menu. You will see the screen shown in Figure 2-26. Many of the tests require an oscilloscope and schematics. These are indicated on the list below. All the items are explained below.

- *Exit* returns to the test menu.
- *Play Sounds* takes you to the *Requesting Sound Screen.* Follow the instructions on the screen to hear the sounds.
- *Self-Test* performs the same test that was used in the Microprocessor and Board tests. These are the sound program ROM, sound program RAM, COMRAM, and 320 RAM tests.

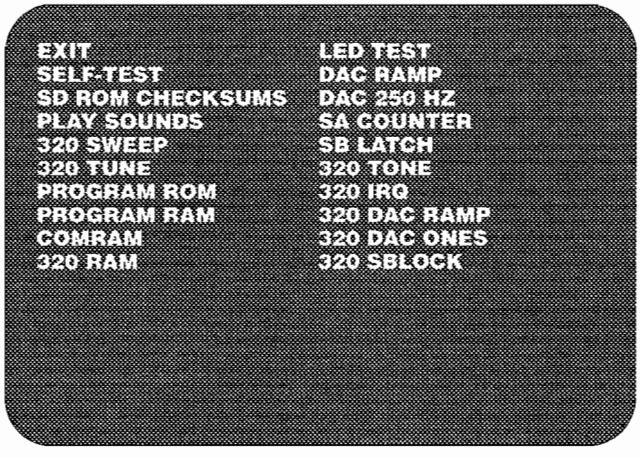


Figure 2-26 Sound Board Tests

- *SD ROM Checksums* displays the location of the ROM, a hexadecimal number, and then the results of the check. See Figure 2-27. The results can be the following:

  NL—Nothing is loaded in that socket.

  BAD—The ROM is bad.

  OK—The ROM is OK.

  PROG DEV—The ROM is a program development ROM. You do not need to do anything about this message.

320 Sweep—Runs a program in the sound board 32010 to generate a sine wave sweep from 20 Hz to 9 KHz (requires oscilloscope).

320 Tune—Runs a program in the sound board 32010 to play a tune.

Program ROM—Tests the sound board program ROMs with the sound board 32010 and reports the results on the screen.

Program RAM—Tests the sound board program RAMs

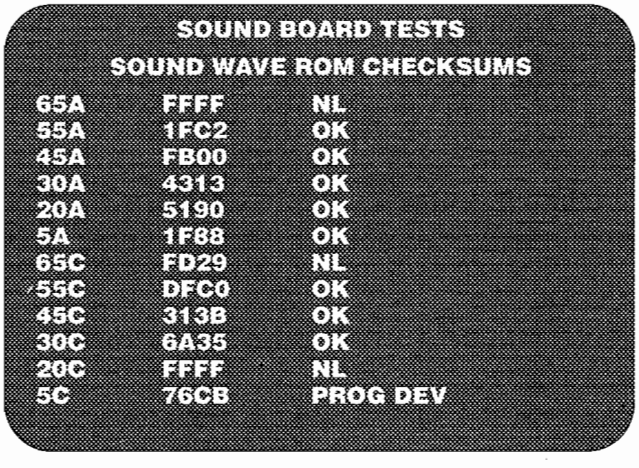


Figure 2-27 Sound Board Sound Wave ROM Checksums

with the sound board 32010 and reports the results on the screen.

COMRAM—Tests the sound board communications RAM with the sound board 68000 and reports the results on the screen.

320 RAM—Tests the sound board 32010 Program RAM with the sound board 68000 and reports the results on the screen.

LED Test—Flashes the Test LED with the sound board 68000.

DAC Ramp—Writes to every DAC value with the sound board 68000. The sawtooth frequency is about 60 Hz (requires oscilloscope).

DAC 250 Hz—Writes to every fourth DAC value with the sound board 68000. The sawtooth frequency is about 250 Hz (requires oscilloscope).

SA Counter—Creates an oscilloscope loop for the sound address counter (requires oscilloscope).

SB Latch—Creates an oscilloscope loop for the sound block latch (requires oscilloscope).

320 Tone—Plays a sine wave tone created by the 32010 (requires oscilloscope).

320 IRQ—Generates interrupts with the 32010 which are recognized by the 68000 (requires oscilloscope).

320 DAC Ramp—The sound board 32010 ramps the DAC (requires oscilloscope).

320 DAC Ones—The sound board 32010 writes walking ones through the DAC latch (requires oscilloscope).

320 SBLOCK—The sound board 32010 writes increasing addresses to the Sound Block Latch (requires oscilloscope).

LEDs on the Main PCB

The LEDs (light emitting diodes) on the main PCB show you the status of various signals on the main PCB. Using the LEDs, you check signals from various circuits going to the 68010 processor. The state of the signals is indicated by the LEDs on the main simulator board which flash or stay lighted.

Figure 2-28 shows the location of the LEDs on the main PCB. Table 2-7 shows the the possible status of the LEDs, with an explanation of what they indicate.

DIP Switches

If you try to enter the self-test, but nothing appears on the screen, use the DIP switch tests. The information from these diagnostic tests will help you find the problem so you get your simulator working again.

Before you begin with these following tests, be sure that the problem is in the simulator hardware, not in the video display. If you have a completely dark screen, check the following:

- Do you have power to the video display?
- Are the video display's filaments lit?
- Do you have high voltage to the video display?

If the answer to any of these is no, then you have a problem in the video display. Check the video display service manual included with your simulator for the suggested procedure.

Table 2-7 LED Status

LED	Indicates	Status
Run LED	State of 68010 HALT signal.	*On* when 68010 is running. *Off* when 68010 processor is not running. *Flashing at 2 Hz* if the 68010 cannot run. (The watch-dog and clock must be running.) (The Run LED is *on* in game mode.)
DTACK LED	State of 68010 DTACK (data acknowledge) signal.	*On* when the 68010 processor is running and the timing circuit is probably operating. *Flashes at 2 Hz* when the 68010 processor cannot run. (The watchdog and processor clock must be running.) (The DTACK LED is *on* in game mode.)
Clock LED	State of the 68010 processor clock signal.	*On* when the game board is on. *Off* if the processor clock signal is stuck high or low.
IRQS LED	State of all 68010 interrupts.	*On* in the game mode. *Off* in hardware diagnostic mode and the early part of self-test. *Off* if no interrupts are occurring or any interrupt signal is stuck low.

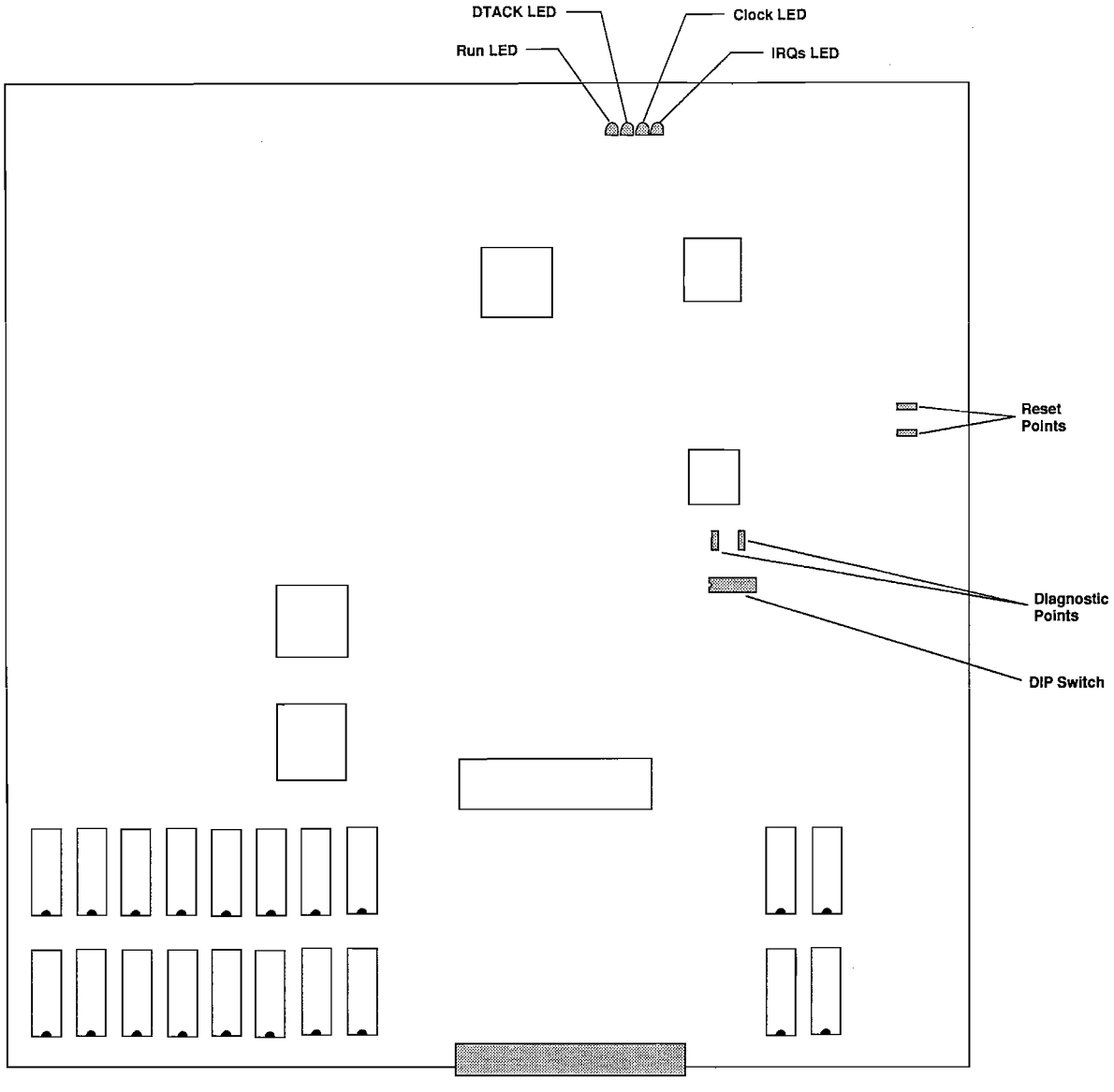


Figure 2-28 DIP Switch and LED Locations on the Main PCB

If you are sure that the problem is not with the video display, then try the DIP switch diagnostics shown in Table 2-8. These tests isolate various ICs and systems for troubleshooting. The results of the tests are indicated by the main board LEDs or on the video display screen.

The DIP switch settings for each test are shown in Table 2-9, along with the explanation of the test and the results.

To set the DIP switches for the tests:

1. Put a jumper across the DIAGN test points, shown on Figure 2-28.
2. Select the diagnostic test you want to use with the DIP switch settings.
3. Turn on the self-test switch.
4. Put a jumper momentarily across the RESET test points, shown in Figure 2-28.

To change to another DIP switch test:

1. Change the DIP switch settings.
2. Put a jumper momentarily across the RESET test points, shown in Figure 2-28.

To end the DIP switch testing:

1. Take the jumper off the DIAGN test points.
2. Put a jumper momentarily across the RESET test points.

The DIP switch settings are *off* in the top position when the main PCB board is in the simulator.

Table 2-8 Using the DIP Switches

Type of Test	Purpose and Results	DIP Switch Settings 1 2 3 4 5 6 7 8
	Watchdog, Test Program ROMs, Test Menu RAMs, and LED Tests	
Uncleared Watchdog	Puts the 68010 in a loop. Does *not* clear the watchdog counter. The program RAM does not need to work. If the watchdog is working, the run LED, DTACK LED, and IRQs LED flash at 2 Hz and the clock LED is on.	X X 0 0 0 0 0 0
Cleared Watchdog	Puts the 68010 in a loop. Clears the watchdog counter. The program RAM does not need to work. If the watchdog is working, the run LED, clock LED, DTACK LED and IRQs LED are on.	X X 0 0 0 0 0 1
Test LEDs	Tests the test LEDs. The program RAM does not need to work. If the test LEDs are working, they flash at 2 Hz.	X X 0 0 0 0 1 1
Test Program ROM 0	Tests ROM 0 H and 0 L, which hold the test program. (This test takes about 5 seconds.) LED 1 and LED 2 flash together if both ROMs are good. If ROM 0 L is bad, LED 1 does not flash. If ROM 0 H is bad, LED 2 does not flash.	X X 0 0 0 1 1 1
Test Menu RAM 0	Tests RAM 0 H and 0 L, which run the test menu. (This test takes about 5 seconds.) LED 1 and LED 2 flash together if both RAMs are good. If RAM 0 L is bad, LED 1 does not flash. If RAM 0 H is bad, LED 2 does not flash.	X X 0 0 1 1 1 1
	GSP Tests	
GSP Communications	Tests if the 68010 can communicate with the GSP, which produces the video. If the GSP responds, the LEDs flash together. If the GSP does *not* respond, LED 1 and 2 flash alternately.	X X 0 1 1 1 1 1
Red Screen	Produces a red screen from the color RAM, regardless of GSP VRAM input. Use this to check the red video outputs.	X X 0 1 1 1 1 0
Green Screen	Produces a green screen from the color RAM, regardless of GSP VRAM input. Use this to check the greenvideo outputs.	X X 0 1 1 1 0 0
Blue Screen	Produces a blue screen from the color RAM, regardless of GSP VRAM input. Use this to check the blue video outputs.	X X 0 1 1 0 0 0
GSP Memory Fill	Does a very slow GSP memory fill so you can test the pixel scanner.	X X 0 1 0 0 0 0
GSP VRAM Verify	Performs the GSP VRAM verify test. (This test is also in the self-test.)	X X 1 0 0 0 0 0
	ROM and RAM Tests	
ROM Test Loop	The results are displayed on the screen.	X X 1 0 0 0 0 1
RAM Test Loop	The results are displayed on the screen.	X X 1 0 0 0 1 1
	MSP Tests	
MSP Interface	Tests the MSP interface. Results are displayed on the screen.	X X 1 0 0 1 1 1
MSP Auto Increment	Tests the MSP auto-increment. Results are displayed on the screen.	X X 1 0 1 1 1 1
MSP Interrupts	Tests the MSP interrupts (IRQs). Results are displayed on the screen.	X X 1 1 1 1 1 1
MSP DRAM Verify	Performs the MSP DRAM verify test. (This test is also in the self-test.) The results are displayed on the screen.	X X 1 1 1 1 1 0
	Bus Error Test	
BERR	The DTACK timer times out and generates a bus error (BERR) signal. The results are displayed on the screen.	X X 1 1 1 1 0 0

1=On; 0=Off; X=Doesn't Matter.

N O T E S

Chapter 3

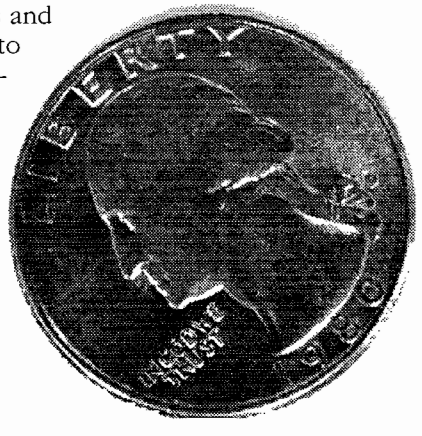
Maintenance and Troubleshooting

This chapter includes maintenance, repair, and troubleshooting information for your Hard Drivin'™ simulator. The maintenance and inspection schedule is shown first, and then a table of general troubleshooting information for the entire simulator. (A troubleshooting table for each mechanical part is shown in the section for that part.) A table of the voltage levels and test points for each PCB follows this troubleshooting table. The rest of the chapter has the repair and maintenance procedures for each part. These are arranged by the name of that part.

Because of the complexity of the simulator, the hardware and software are very closely related. Generally, you can determine how a mechanical part is working by checking the *Control Inputs* test screen in the self-test. You get more information about the operation of some controls from the *Main Board Controls* menu screen.

If you are having problems with a mechanical assembly, always keep in mind your connections may not be good or you may have an electronic hardware problem. Check the *Control Inputs* screen to narrow down the source of the problem. Also, before you take a control out of the simulator to test or repair it, first perform the *Set Controls* screens in the self-test, then test the control. This can correct many electronic and electromechanical problems.

If after using these tests and screens, you decide to repair a part, the procedures for removal, disassembly, and repair are provided in this chapter for most parts. If a part is mentioned, but not illustrated, refer to Chapter 4, *Illustrated Parts Lists*, for information.



Maintaining and Inspecting

Preventive maintenance includes inspecting, cleaning, lubricating, and tightening hardware. Preventive maintenance should be performed regularly, so the simulator stays in top condition, major problems are avoided, and you maximize your earnings. Preventive maintenance tasks and intervals are shown in Table 3-1.

NOTE

If you repair any control in the simulator, then when you replace it you must enter the self-test and go through the Set Controls *screens. If you do not do this, then your simulator may not function correctly.*

Maintaining Your Simulator

For the best performance from your Hard Drivin' simulator, you should check and maintain your simulator according to the times and tasks shown in Table 3-1. How to perform these items is explained later in this chapter, in the section for that part. You may want to perform these tasks more often if the simulator is heavily used.

Table 3-2 is the first of ten troubleshooting tables in this chapter. Use this table if *all* of your controls are acting erratically or not responding. If just one control is not functioning, go to the section in this chapter on that control and read the troubleshooting information there.

Table 3-3 contains the voltage levels to the boards and the test points for those voltage levels. Problems with controls, video, and software may be caused by low voltages to the boards associated with them.

Dashboard

Removing the Dashboard

Remove the dashboard to service the steering wheel or to replace the switches. See Figure 3-1.

WARNING

The dashboard weighs about 40 pounds. Be careful when you are removing it.

1. Turn off the power and unplug the game.
2. Take off the under-dash cover. This is a cover above the brake and clutch pedals which covers the end of the steering assembly. It is held in place by two Phillips-head screws. See Figure 4-1 for an illustration.

Table 3-1 Maintenance and Inspection Items

Part	When to Check	What to Check and Maintain
Steering Wheel	Every 3 months	Grease threads. Check the rubber stops and tighten the screws that hold the stops on.
		Make sure the potentiometer bushing has a very light coat of grease.
		Make sure the stop assembly on the motor shaft is tight on the shaft.
		To prevent injuries, replace the steering wheel if the rim and spoke padding is worn out.
Key Switch	Every 3 months	Lightly oil the spring and shaft.
Brake and Clutch Pedals	Every 3 months	Oil all bearings. Check the switch and switch actuator distance.
Shifter	Every 3 months	Check the shifter boot for damage. Make sure the foam in the boot is in place.
Gas Pedal	Every 6 months	Spray the pivot pin, spring cable, and pulley with dry Teflon spray.
Coin Mechanism	Every 6 months	Clean.
Interior Components	Every 3 months	Clean.
Game Exterior	Every 6 weeks	Take off the video display shield and clean the shield and the face of the video display. Carbon particles emitted by the steering motor collect on the shield and video display, obscuring the view.
		Make sure the glides are down. The casters may be damaged if the glides are not used.
		Be sure the rubber stop behind the clutch on the firewall is still on.

Table 3-2 Troubleshooting All Controls

Problem	Solution
All controls do not respond or respond erratically.	1. Go through the *Set Controls* screens in the self-test. 2. Have you recently installed a new PCB or new controls? If so, you must go through the *Set Controls* screens in the self-test. 3. Check the ZRAMs in the self-test for errors. 4. The simulator may have lost power during a ZRAM test. Go through the *Set Controls* screen in the self-test.

3. Remove the four nuts on either side of the dashboard and take out the carriage bolts.

NOTE

Do not remove the four tamperproof screws around the steering wheel unless you are replacing the steering assembly. In that case, remove the bolts only after the dashboard is out of the simulator.

4. Remove the two tamperproof screws in the middle of the dashboard.
5. Unlock the bottom service door to reach the nuts on the carriage bolts underneath the dashboard at the rear. Take off the nuts and washers.
6. Also from the rear, disconnect the four connectors from the dashboard to the simulator harness.
7. Remove the two Phillips-head screws on front and the six Phillips-head screws under the dashboard.
8. The dashboard is now supported by the top lip and the side panels. Sit in the simulator seat and pull the dashboard forward and out of the simulator onto your lap.

Installing the Dashboard

1. Sit in the seat with the dashboard in your lap. Pull the seat towards the video display. Lift up the dashboard and slide it on the side panels towards

Table 3-3 Voltage Inputs and Test Points on the Simulator PCBs

PCB	Voltage	Test Points	Source and Purpose
Main	+5±0.1 VDC	+5V2	+5 V Switching Power Supply
Main	+15±0.6 VDC	+15V1	Regulated and supplied by the APU PCB. Used by the 12-bit A/D converter and runs the +12 VDC regulator.
Main	-22 VDC	-22V1	Unregulated and supplied by the APU PCB. Runs the -5V regulator.
Main	+12±0.5 VDC	+C127	Regulated and comes from the -22 VDC supply. Used by the 12-bit A/D converter and the sound PCB.
ADSP	+5 VDC	+5V1 or +5V2	Regulated and supplied from the Main PCB through the interface cable.
Sound	+5 VDC	+5V2	Supplied and regulated by the main PCB through the sound power cable. Used by the logic circuitry.
Sound	+12 VDC	105B Pin 4	Supplied and regulated by the main PCB through the sound power cable. Used by the analog circuitry.
Sound	-5 VDC	5R Pin 4	Supplied and regulated by the main PCB through the sound power cable. Used by the analog circuitry.
Sound	+5 VDC	+5V2	Supplied and regulated by the main PCB through the interface cable.
Sound	-15 VDC	105B Pin 11	Supplied by the APU PCB through the main PCB. Used by the 12-bit D/A converter on the sound PCB
APU	+14VDC	See schematics	Used by the coin counters and the audio amps on the APU PCB.
APU	-14VDC	See schematics	Used by audio amps on the APU PCB.
APU	-22VDC	See schematics	Used by the main PCB.
APU	+15VDC	See schematics	Regulated; used by the main PCB.

the mounting area.

2. Feed the dashboard harnesses through the front panel cutouts. Push the dashboard into place.
3. With one person holding the dashboard, another person can put the carriage bolts in on either side. The person sitting in the simulator can then put on the washers and the nuts.
3. Go around to the back of the simulator and connect the steering assembly and the switch harnesses to the simulator harness. Then install the two carriage bolts with washers and nuts under the dashboard at the rear.
4. Install the two tamperproof screws and washers. Finally install the eight Phillips-head screws.

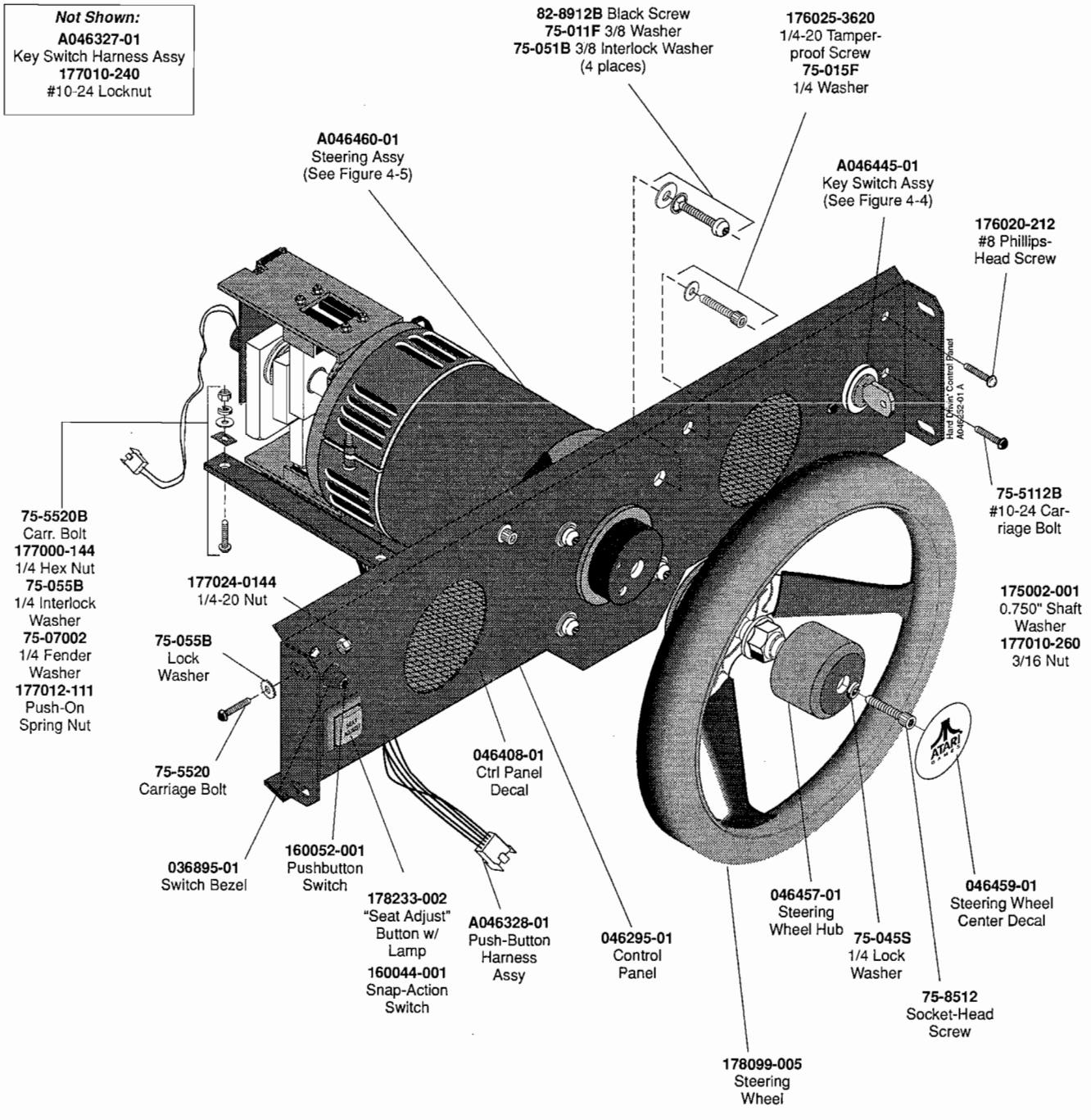


Figure 3-1 Removing and Installing the Dashboard

5. Install the under-dash cover above the brake and clutch pedals. Screw in the two Phillips-head screws that hold it in place.
6. Close and lock the service door.

Steering Assembly

If you have problems with the steering assembly, check the troubleshooting suggestions in Table 3-4. Always perform the *Set Controls* screens in the self-test. If that doesn't work, then check the *Control Inputs* screen.

Greasing the Steering Assembly

The steering assembly threads and stop should be greased regularly according to the maintenance schedule, and if turning the steering wheel becomes difficult (and the problem is not the steering motor).

1. Take out the dashboard. See the procedure in the section *Removing the Dashboard.*
2. Grease the large threads on the stop assembly. See Figure 3-5.
3. Put the dashboard back in. See the procedure in the section *Installing the Dashboard.*

Replacing the Steering Assembly Potentiometer

Replace the potentiometer after you have followed the flowcharts in Figures 3-2, 3-3, or 3-4 and have decided that the source of the problem is the potentiometer. You also should replace the potentiometer if the steering wheel can spin freely in one direction or another with no end stop. (In this case, also replace the stop assembly.)

1. Take out the dashboard. Follow the instructions in the section *Removing the Dashboard.*
2. The steering wheel is illustrated in Figure 3-5 Loosen the set screw that holds the potentiometer shaft in place. Remove the nut that holds the potentiometer in the potentiometer bracket. Take out the potentiometer. If the small spring that holds the potentiometer bracket on the stop bracket is broken, replace it too.
3. Solder the wiring harness to the new potentiometer. Connect the wires in this order: red nearest the shaft, clear in the middle, and black at the end.

CAUTION

It is very important that you follow the instructions for installing the new potentiometer. If you do not, you might destro y the potentiometer.

Table 3-4 Troubleshooting the Steering Assembly

Problem	Solution
Steering wheel does not respond or responds erratically.	1. Go through the *Set Controls* screens in the self-test. 2. Check the Control Inputs screen to see if the potentiometer input to the board is functioning correctly. The line under Steering Wheel should smoothly appear and disappear as you turn the wheel. 3. Check the connections to the potentiometer and to the motor. 4. Check voltage level to main PCB. See Table 3-3.
Steering wheel is difficult to turn.	Grease the threads. Check the steering assembly for broken parts. Check the motor bearings by turning the shaft and seeing if it spins freely.
Steering has no feedback.	1. Try the *Set Controls* screens in the self-test. 2. See Figure 3-2 to determine the cause of the problem.
Steering is very jerky.	Some jerkiness is OK. 1. Try the *Set Controls* screens in the self-test. 2. If you think the steering is very jerky, see Figure 3-4 for more information.
Steering wheel is turned all the way to one side or the other during play and stays there.	1. Try the *Set Controls* screens in the self-test. 2. See Figure 3-3 for more information.
Steering wheel can spin more than three times around.	Replace the stop assembly and the potentiometer.

Figure 3-2 Steering Wheel Has No Feedback and You Have Tried the *Set Controls* Screens

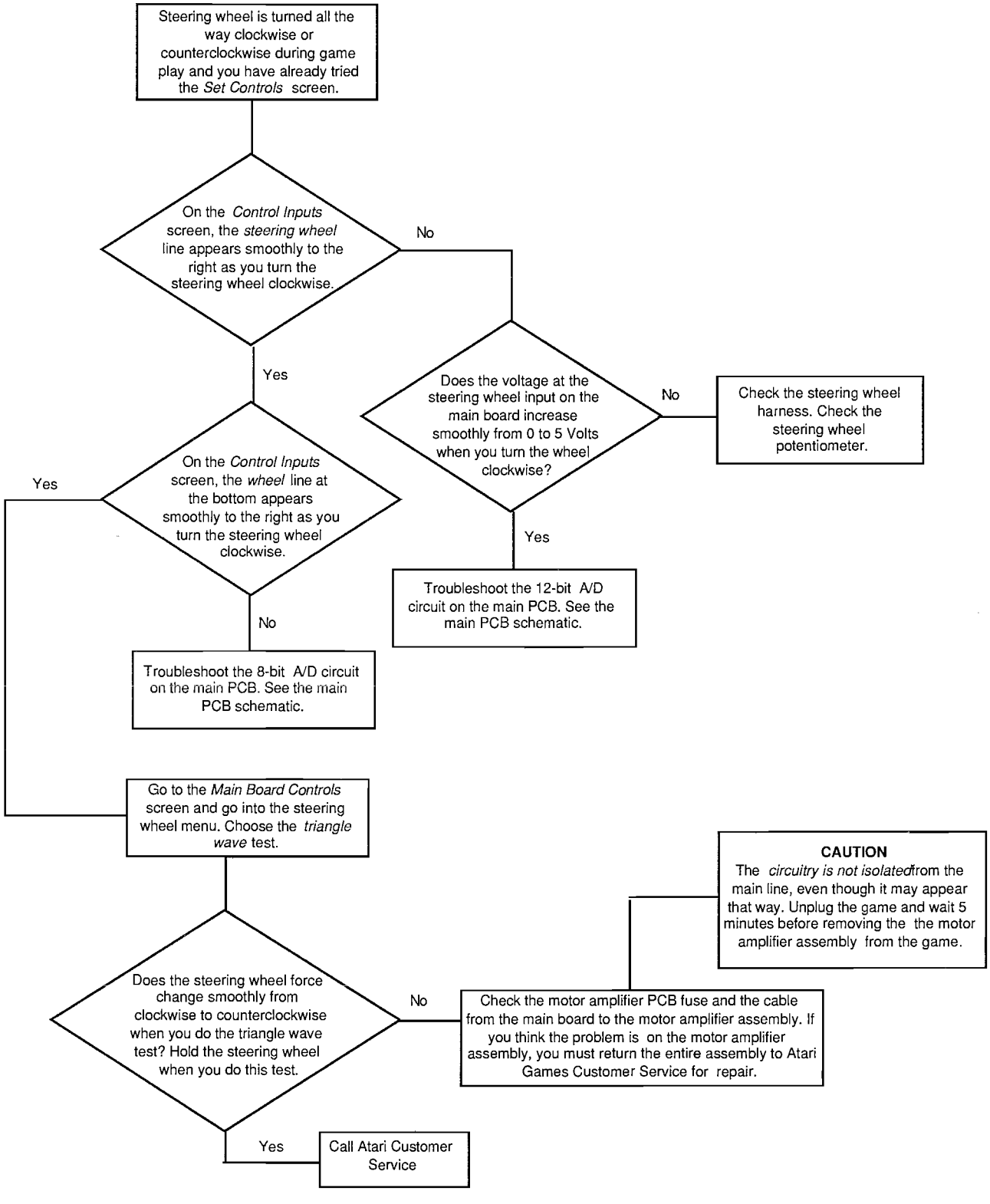


Figure 3-3 Steering Wheel is Turned All the Way to One Side or the Other and You Have Tried the *Set Controls* Screens

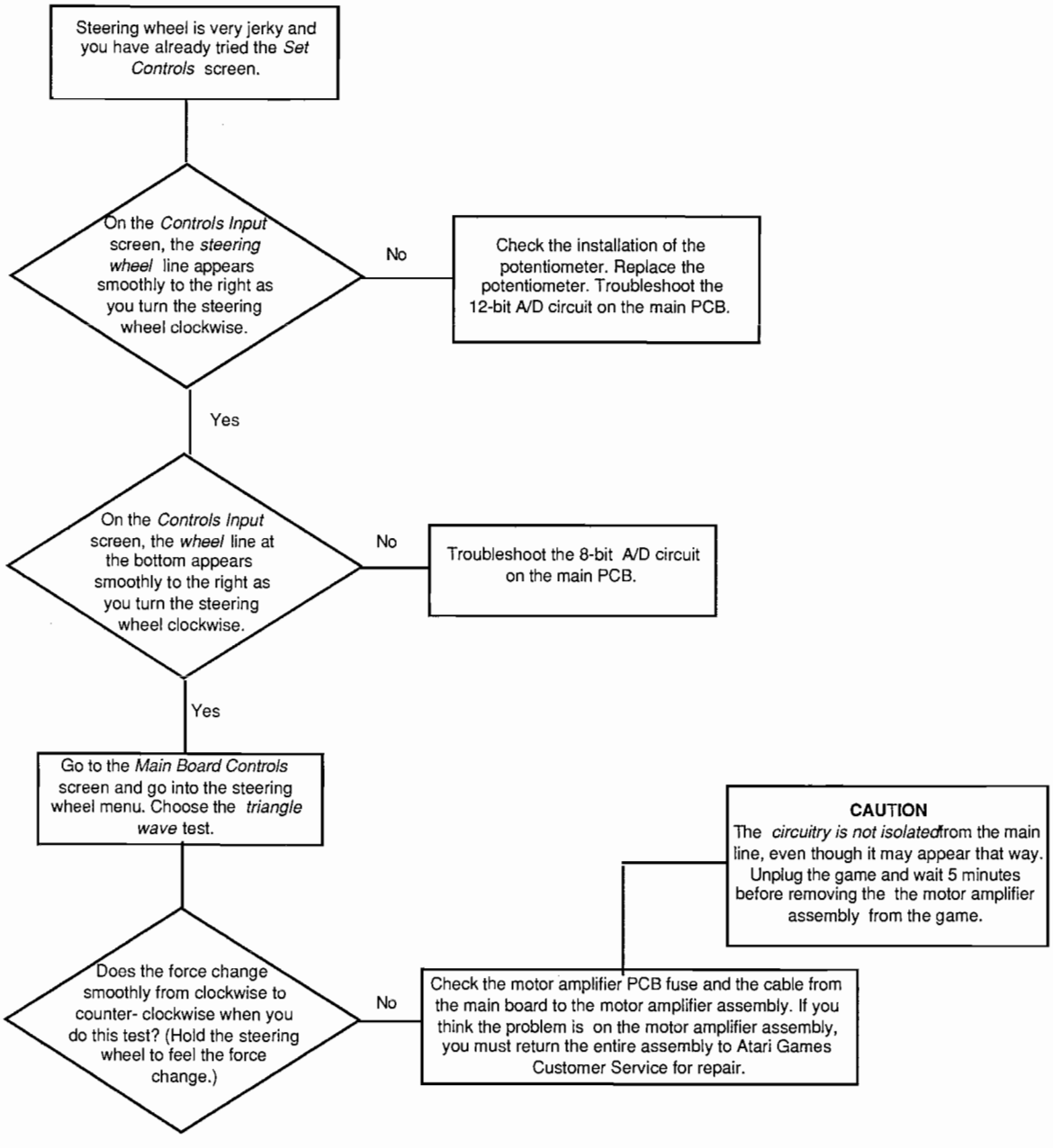


Figure 3-4 Steering Wheel Is Very Jerky and You Have Tried the *Set Controls* Screens

4 Hold the new potentiometer with the shaft facing you and turn its shaft as far as it can go in the counterclockwise direction. Then turn the shaft back about 15 degrees clockwise.

5. Face the stop bracket on the end of the motor; then turn the motor shaft as far as it will go in the clockwise direction.

6. Install the potentiometer in the potentiometer bracket on the end of the motor with the flat of the potentiometer shaft under the set screw and the potentiometer key in the keyhole in the bracket. If the flat part of the shaft is not under the set screw, then repeat steps 5 and 6.

7. Put the lock washer and nut on the potentiometer bracket and tighten the nut. Be sure you do not turn the potentiometer shaft from the position at which you set it.

8. Insert the potentiometer shaft into the motor shaft; tighten the socket-head set screw.

9. Check the alignment of the potentiometer and the motor by very carefully turning the steering wheel as far as it will go clockwise and counterclockwise. Check to see that the potentiometer does not come to its own stop, but continues to turn as far as the

steering wheel turns in both directions. If the potentiometer does come to its own stop, then do steps 4 through 8 again.

10. Put the dashboard back in the simulator, following the instructions in the section *Installing the Dashboard.*
11. Go to the *Set Controls* screens in the self-test and re-initialize all the controls.

NOTE

You must go through the Set Controls *screens in the self-test because the steering wheel has been repaired. If you do not do this, the simulator will not function correctly.*

Replacing the Steering Wheel Motor

Replace the steering wheel motor if you have followed the flowchart in Figure 3-2 and determined that the motor is the source of the problem. Another reason to replace the motor is if the steering wheel is very difficult to turn and the problem is not lubrication or the mechanical parts.

Before you replace the motor, check the harness connections to make sure they are good.

1. Take out the dashboard. Follow the instructions in the section *Removing the Dashboard.*
2. The steering wheel is shown in Figure 3-5. Do not take the steering assembly off the dashboard yet.
3. Carefully peel off the Atari Games decal on the hub of the steering wheel.
4. Unscrew the socket-head screw under the decal. Remove the screw, the washer and the hub cover.
5. Remove the large nut under the hub cover with a 1 1/16-inch socket. The nut is tightened to 50 foot-pounds.
6. Take off the washer and the steering wheel.
7. At the other end of the steering assembly, remove the potentiometer from the end of the shaft by loosening the set screw at the end of the shaft. Take off the potentiometer and the potentiometer bracket.
8. Remove the nut at the end of the motor shaft which holds the stops on the shaft. This nut also requires a 1 1/16-inch socket and is torqued to 50 foot-pounds. Remove the washer.
9. Remove the four tamperproof screws that hold the steering assembly on the dashboard. Take the steering assembly off the dashboard.
10. Use a puller to loosen the stop assembly on the tapered shaft. You cannot remove the stop assembly until you take the stop bracket off.
11. Remove the four socket-head screws and washers that hold the stop bracket on the motor. Pull the stop bracket and the stop assembly off the motor shaft.
12. Do the following tasks before you re-assemble the parts on the new motor:
    a. Check the round stops on the corners of the large rectangular stops. Make sure the round stops are not cracked or broken.
    b. Tighten the socket-head screws that hold the rubber stops in place.
    c. Generously grease the threads.
    d. Check the spring that holds the potentiometer shaft on the stop bracket. If it is broken, replace it.
13. Put the threaded center stop into the holes in sides of the stop bracket. Push the stop bracket and the stop assembly on the shaft of the new motor. (The nut on the end of the shaft will properly tighten the stop assembly.) Make sure you position the key slot over the key.
14. Screw the four socket-head screws and washers into the stop bracket and motor. Make sure you reconnect the ground wire, with the wide washer, under the top left screw.
15. Replace the nut and the washer at the end of the motor shaft that holds the stops on the shaft. Torque the nut to 50 foot-pounds.
16. Set up the potentiometer position and shaft position. Hold the potentiometer with the shaft facing you and turn its shaft as far as it can go in the counterclockwise direction. Then turn the shaft back about 15 degrees clockwise.
17. Face the stop bracket on the end of the motor; then turn the motor shaft as far as it will go in the clockwise direction.
18. Install the potentiometer in the potentiometer bracket on the end of the motor with the flat of the potentiometer shaft under the set screw and the potentiometer key in the keyhole in the bracket. If the flat part of the shaft is not under the set screw, then repeat steps 16 and 17.
19. Put the lock washer and nut on the potentiometer bracket and tighten the nut. Be sure you do not turn the potentiometer shaft from the position at which you set it.
20. Insert the potentiometer shaft into the motor shaft; tighten the socket-head set screw.

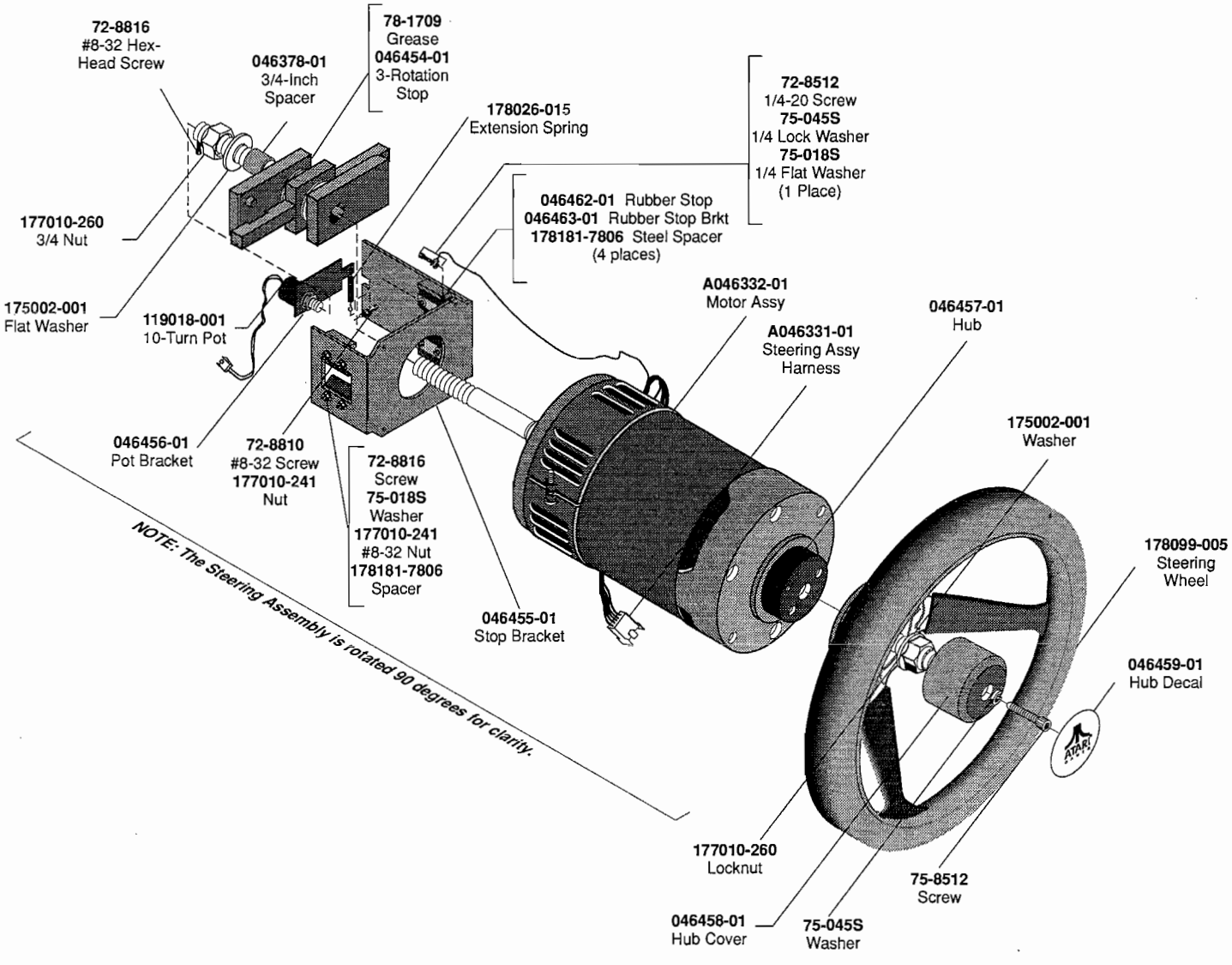


Figure 3-5 Maintaining the Steering Wheel

21. Check the alignment of the potentiometer and the motor by very carefully turning the steering wheel as far as it will go clockwise and counterclockwise. Check to see that the potentiometer does not come to its own stop, but continues to turn as far as the steering wheel turns in both directions. If the potentiometer does come to its own stop, then do steps 15 through 20 again.
22. Using the four tamperproof screws, install the steering assembly on the dashboard. Tighten the nuts on the carriage bolts securely so the steering assembly will not twist on the dashboard.
23. Install the steering wheel on the steering hub. Make sure the hole in the steering wheel goes over the alignment stud on the hub. (See Figure 3-5.)
24. Put on the washer and the large nut. Torque the nut to 50 foot-pounds.
25. Install the hub cover, split-lock washer, and the socket-head screw. Put Loktite on the screw before installing it and then tighten it to 95 inch-pounds.
26. Replace the Atari Games decal on the hub.
27. Put the dashboard back in the simulator, following the instructions in the section *Installing the Dashboard.*
28. Go to the *Set Controls* screens in the self-test and re-initialize all the controls.

NOTE

You must go through the Set Controls *screens in the self-test because the steering wheel has been repaired. If you do not do this, the simulator may not function correctly.*

Replacing the Steering Wheel Stop

It is very unlikely that the steering wheel stop will have to be replaced. If it does, follow the instructions in *Replacing the Steering Wheel Motor* for assembly and disassembly.

Key Switch Assembly

Table 3-5 lists the few things that can go wrong with the key switch assembly. You should regularly oil the assembly.

Oiling the Key Switch Assembly

The key switch bezel ring and shaft should be oiled regularly, or when turning the key switch becomes difficult or the key squeaks.

1. Take out the dashboard. See the procedure in the section *Removing the Dashboard.*
2. Lightly oil the bezel, shaft, and spring of the key switch. See Figure 3-6. Check to make sure the spring is not broken. If it is, then replace the spring following the procedure under Repairing the Key Switch.
3. Put the dashboard back in. See the procedure in the section *Installing the Dashboard.*

Replacing the Spring in the Key Switch Assembly

1. Remove the dashboard. Follow the procedure in the section *Removing the Dashboard.*
2. Take the key switch assembly off the dashboard by removing the two carriage bolts and locknuts.
3. Start disassembling the key switch by removing the retaining ring from the back of the case.
4. Loosen the socket head screw on the brass actuator with a 5/32-inch Allen head wrench. This screw tightens the actuator on the shaft.
5. Remove the other retaining ring inside of the case. Pull out the key. Take out the brass actuator, the old spring, and the nylon washer.
6. Put one end of the spring into the hole in the side of the case. Push the shaft back into the case far enough to mount the spring on the shaft. You may have to cut the legs of the spring to the correct length so that they do not interfere with the operation of the assembly.
7. Put the brass actuator into the case. The pin on the actuator should face the key and be on the opposite side of the assembly from the switch. Catch the free end of the spring under the pin. Install the nylon washer and the actuator on the shaft.
8. Push the shaft through the case and install the two retaining rings. Position the actuator on the shaft so that it lines up with the roller on the switch. Tighten the socket-head screw on the actuator.
9. When the brass actuator is against the case opposite the switch, the key should be straight up and down. If the key isn't straight up and down, loosen the screw on the actuator. Turn the key until it is straight up and down. Tighten the screw on the actuator to hold it in place on the shaft.
10. Now turn the key so the actuator is against the case on the same side as the switch. Release the key, hold the actuator against the switch, and adjust the position of the switch. The switch must be close enough so that the actuator engages the

Table 3-5 Troubleshooting the Key Switch

Problem	Solution
Key does not return when turned and has no resistance.	Key switch actuator may be loose. Key switch spring may need to be replaced.
Key turns more that 90°.	Key switch actuator is loose; tighten the screw on the actuator.
Key turns, but nothing happens.	Check the key snap-action switch, switch connectors, key switch actuator setting, and harness connections.
Key squeaks when turned.	Oil the bezel ring and shaft.

Not Shown:
172020-0814
Spring Pin
72-8006
#10-32 Socket-Head Screw
75-040S
#10 Split-Lock Washer

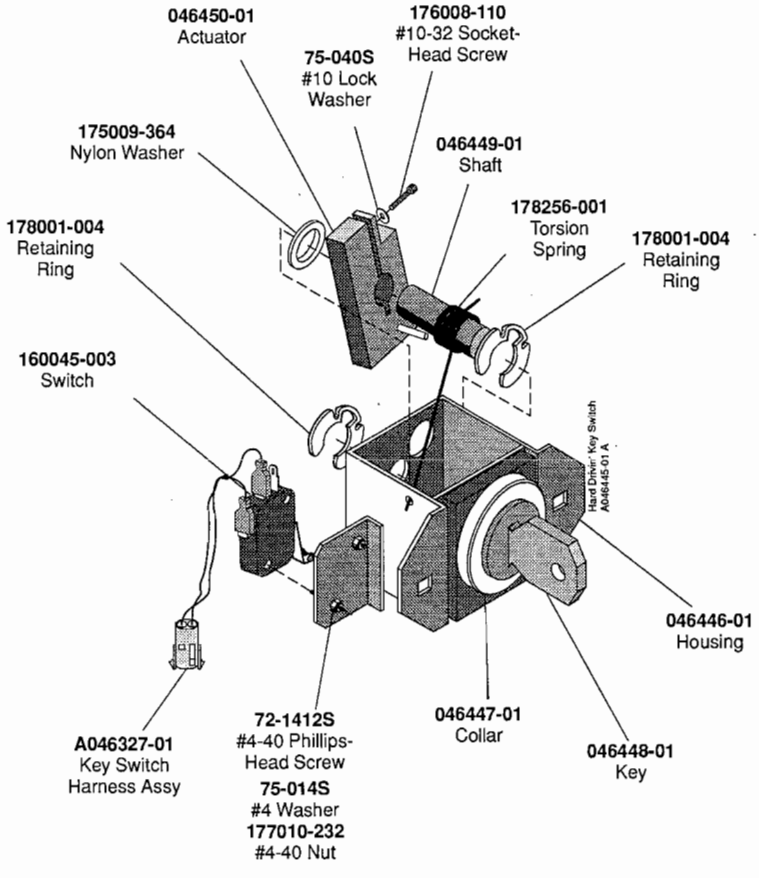


Figure 3-6 Maintaining the Key Switch Assembly

switch, but not so close that the actuator can make it click twice when the key is turned.

11. Release the actuator and try turning the key to make sure that this is the correct setting. Tighten the screws on the switch when the distance is correct.
12. Put the key switch assembly back on the dashboard. Install the dashboard as described in the section *Installing the Dashboard.*

Tightening the Screw in the Key Switch Assembly Actuator

1. Remove the dashboard. Follow the procedure in the section *Removing the Dashboard.*
2. Position the actuator on the shaft so that it lines up with the roller on the switch. Tighten the socket-head screw on the actuator with a 5/32-inch Allen head wrench so the actuator does not rotate anymore.
3. When the actuator is against the case opposite the switch, the key should be straight up and down. If the key isn't straight up and down, loosen the

screw on the actuator. Turn the key until it is straight up and down. Tighten the screw on the actuator to hold it in place on the shaft.

4. Now turn the key so the actuator is against the case on the same side as the switch. Release the key, hold the actuator against the switch, and adjust the position of the switch. The switch must be close enough so that the actuator engages the switch, but not so close that the actuator can make it click twice when the key is turned.
5. Release the actuator and try turning the key to make sure that this is the correct setting. Tighten the screws on the switch when the distance is correct.
6. Install the dashboard as described in the section *Installing the Dashboard.*

Replacing the Switch on the Key Switch Assembly

The key switch assembly is shown in Figure 3-6.

1. Remove the dashboard. Follow the procedure in the section *Removing the Dashboard.*
2. Take the key switch off the dashboard by removing the two carriage bolts and locknuts.
3. Remove the two Phillips-head screws that hold the snap-action switch on the key switch assembly. Take off the switch. Take the harness off the switch.
4. Install the switch on the assembly, but do not tighten the screws. The roller on the switch should be facing in towards the brass switch actuator.
5. When the brass actuator is against the case opposite the switch, the key should be straight up and down. If the key isn't straight up and down, loosen the screw on the actuator. Turn the key until it is straight up and down. Tighten the screw on the actuator to hold it in place on the shaft.
6. Now turn the key so the actuator is against the case on the same side as the switch. Release the key and hold the actuator against the switch with your hand. Adjust the position of the switch. The switch must be close enough so that the actuator engages the switch, but not so close that the actuator can make it click twice when the key is turned.
7. Release the actuator and turn the key to make sure that this is the correct setting. Tighten the screws on the switch when the distance is correct.
8. Put the harness on the new switch. The black wire must connect to the C (or COM) terminal, and the white wire must connect to the NO terminal.

NOTE

If these wires are connected to the wrong terminals, the simulator will not operate correctly.

---

9. Put the key switch assembly back into the dashboard and install the dashboard as described in the section *Installing the Dashboard.*

Clutch Pedal

The clutch is part of the clutch and brake pedal assembly. The clutch potentiometer is actually located on the brake side of the assembly, but is attached to the clutch.

If you have trouble with the clutch, check the suggestions in the Table 3-6, *Troubleshooting the Clutch Pedal.* Always perform the *Set Controls* screens first.

If you need to repair the clutch, but you cannot do so immediately, you can disable the clutch circuit. By doing this, you can continue to operate the game although the control is not working properly. The software will compensate for the non-functioning control. *This is only a temporary measure. The clutch should be repaired as soon as possible.* To disable the circuit, go to the *Disable Broken Controls* screen in the self-test and disable the clutch.

Table 3-6 Troubleshooting the Clutch Pedal

Problem	Solution
Clutch does not work or works erratically.	1. Perform the *Set Controls* screens in the self-test. 2. Follow the flowchart in Figure 3-7 to find the cause of the problem. 3. Check connections. 4. Check voltage level to the main PCB. See Table 3-3.
Does not return.	1. Check the bearings. 2. The springs may be broken or weak.

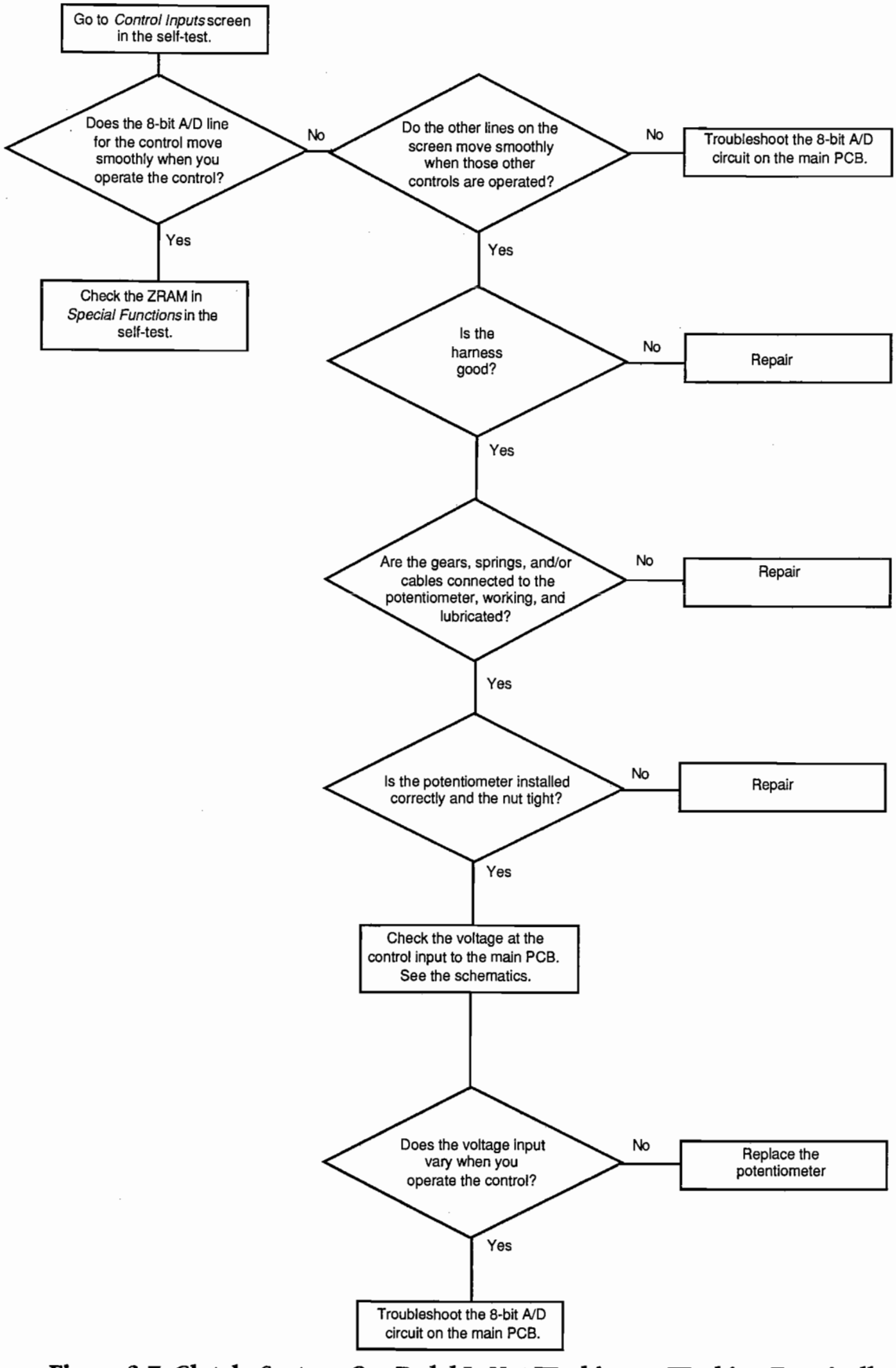


Figure 3-7 Clutch, Seat, or Gas Pedal Is Not Working or Working Erratically and You Have Tried the *Set Controls* Screens

Oiling the Clutch and Brake Pedals

You can oil six of the pedal bearings from the back of the simulator without taking the pedal assembly out. However, you must take the pedals out of the simulator to reach the other two. We recommend that you remove the pedal assembly to oil all the points so you do not get oil on the PCBs below the pedals.

1. Remove the pedals from the simulator. First, take off the cover above the pedal assembly in the front of the simulator. Use a Phillips screwdriver to remove the four screws that hold the cover on.
2. Unlock the bottom service door. Take off the harness connector to the pedal.
3. The back of the pedal assembly is above the main board. Remove the four nuts and fender washers holding the pedal assembly to the cabinet. After you remove the nuts, the pedals will continue to hang in the same position.
4. Go to the front. Holding the pedal shafts, twist and pull the assembly counterclockwise to avoid the bottom of the dashboard.
5. Put light oil on the eight bearing points illustrated in Figure 3-8.
6. Check the following on the brake switch and actuator.
   a. Can you push the brake pedal 1/4 to 1/2 inch before you feel resistance? If you feel resistance before this point, check the bearings to see if they are moving freely. If the bearings are moving, adjust the nut on the brake spring return shaft so that the pedal has at least 1/4 inch of free play.
   b. Does the pedal return to its resting location? If not, check if the return spring is broken or the bearings are binding.
   c. Does the brake pedal move at least 1/4 inch before the switch clicks? If not, adjust the clamp on the white plastic actuator until you have 1/4 inch of play in the pedal. Make sure the switch clicks before you feel resistance on the pedal.
7. Put the pedal assembly back in the simulator. Install the fender washers and the locknuts. Re-connect the simulator harness.

Replacing the Clutch Potentiometer

Do not replace the potentiometer until you have performed the *Set Controls* screens. If that does not solve the problem, follow the flowchart in Figure 3-7 to make sure that the potentiometer is the problem.

1. Take off the cover above the pedal assembly in the front of the simulator. Use a Phillips screwdriver to remove the four screws that hold the cover on the cabinet.
2. Unlock the bottom rear service door. The back of the pedal assembly is above the main PCB. Disconnect the simulator harness from the assembly. Remove the washers and nuts holding the pedal assembly to the cabinet. After you remove the nuts, the pedals will continue to hang in the same position.
3. Go to the front of the simulator. Holding the pedal shafts, twist and pull the assembly counterclockwise to avoid the bottom of the dashboard.
4. See Figure 3-8 for an illustration of the pedals. The clutch potentiometer is on the end of a small gear and is mounted on the brake side of the pedal assembly. Loosen the locknut on the potentiometer with a 1/2-inch flat wrench.
5. Loosen the set screw on the small gear with a 3/32-inch Allen wrench.
6. Take off the gear, nut, washer, and potentiometer. Take the wires off the potentiometer.
7. With the shaft of the new potentiometer facing you and the terminals pointing up, solder the black wire on the left terminal, the yellow on the middle, and the red to the right terminal.
8. Put on the new potentiometer. Make sure the key on the potentiometer is inserted into the key hole in the assembly frame. The potentiometer terminals must point up. Put the nut and washer on, but do not tighten the nut all the way.
9. Put the gear on the potentiometer shaft. The set screw must be straight up and located on the flat part of the shaft. Make sure that the gear completely meshes with and is directly over the gear below. Tighten the set screw. Tighten the nut on the potentiometer.
10. Carefully press the clutch pedal and make sure that the potentiometer does not reach its stop before the pedal reaches its own stop. If it does, re-install the potentiometer, following steps 8 and 9.
11. Put the pedal assembly back in the simulator. Install the fender washers and the locknuts. Re-connect the simulator harness.
12. Now switch on the self-test and go through the *Set Controls* screens.

NOTE

You must enter the self-test and go through the Set Controls *screens because you have repaired the pedal assembly. Otherwise the simulator will not function correctly.*

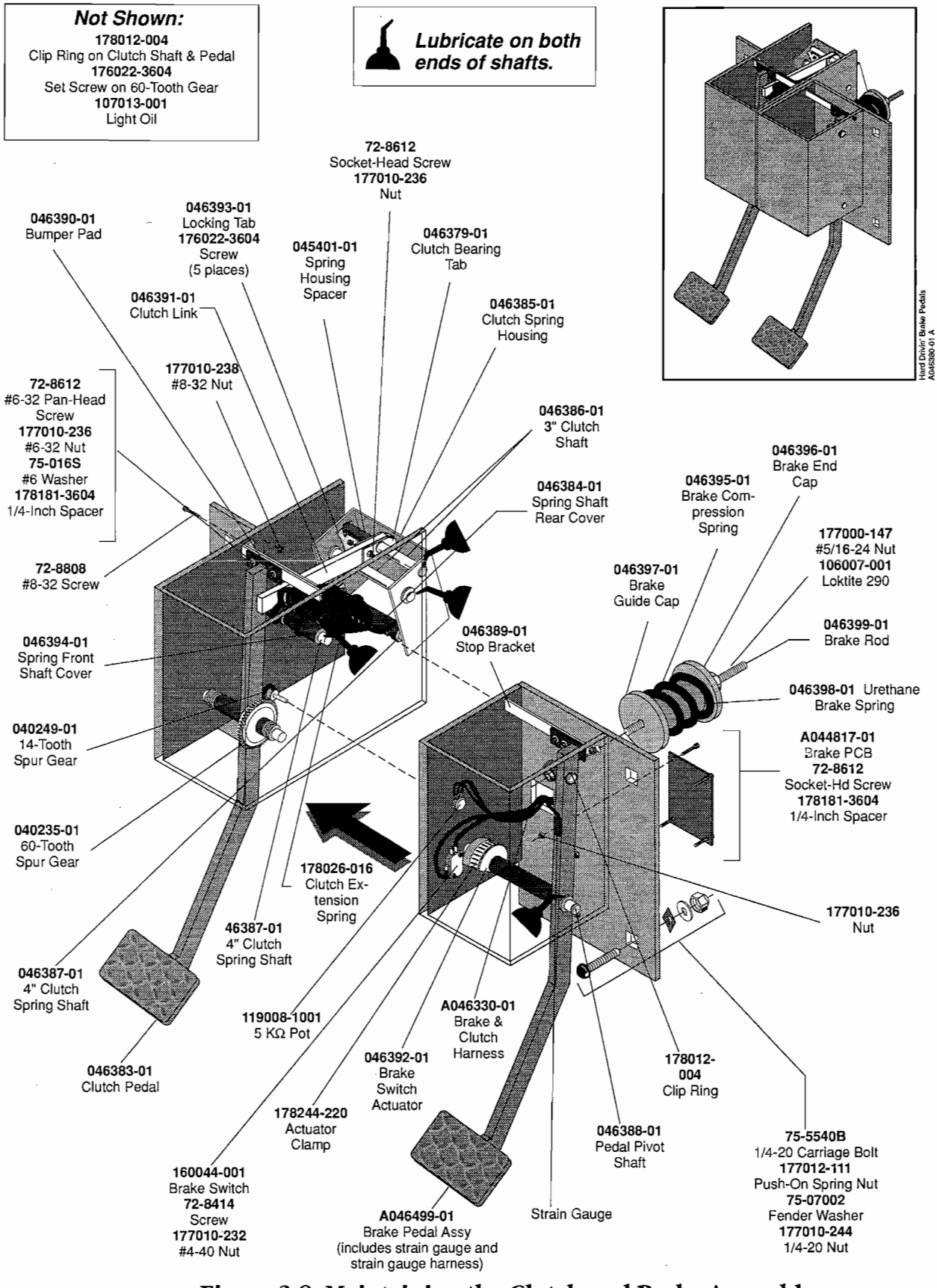


Figure 3-8 Maintaining the Clutch and Brake Assembly

Replacing the Clutch Springs

Replace the clutch springs if the clutch does not return to position and the springs are weak or broken. See Figure 3-8 for an illustration of the pedals. The clutch springs are the two large side-by-side metal springs.

1. Take off the cover above the pedal assembly in the front of the simulator. Use a Phillips screwdriver to remove the four screws that hold the cover on the cabinet.
2. Open the bottom rear service door. The back of the pedal assembly is above the main board. Disconnect the simulator harness from the assembly. Remove the washers and nuts holding the pedal assembly to the cabinet. After you remove the nuts, the pedals will continue to hang in the same position.
3. Go to the front of the simulator. Holding the pedal shafts, twist and pull the assembly counterclockwise to avoid the bottom of the dashboard.
4. Remove the metal stop bracket with the rubber bumper pads attached to it. Take out the two socket-head screws, one on either side, which hold the bracket to the frame. (You do not need to remove the rubber bumper pads.) Pull the stop bracket out the assembly.
5. Take off the locking tabs on the end of the spring shafts. Use an Allen wrench to remove the socket-head screws on the tabs.
6. Push the shafts through the assembly frame and remove the springs.
7. Install the new springs, making sure the ends are located in the cut-out areas on the nylon shaft covers.
8. Push the spring shafts back into place and reinstall the locking tabs.
9. Install the stop bracket. Make sure the pedal shafts are resting on the rubber bumpers.
10. Put the pedal assembly back in the simulator. Install the fender washers and the locknuts. Re-connect the simulator harness.
11. Now switch on the self-test and go through the *Set Controls* screens.

NOTE

Enter the self-test and go through the Set Controls *screens when you replace the pedal assembly. Otherwise the simulator will not function correctly.*

Brake Pedal

The brake is part of the clutch and brake pedal assembly. If you are have trouble with the brake, check the suggestions in the Table 3-7, *Troubleshooting the Brake Pedal.* Always perform the *Set Controls* screens first.

Table 3-7 Troubleshooting the Brake Pedal

Problem	Solution
Brake does not work or is working erratically.	1. Go through the *Set Controls* screens in the self-test. 2. Check the F4 fuse on the power supply. (If this fuse is blown, the shifter will not work either.) 3. Check the brake force on the 12-bit A/D item in the *Control Inputs* screen. As you press down on the brake, the line should disappear, proportionate to how much force you are putting on the brake. 4. Check the harness connections. 5. Check the distance adjustment for the switch actuator. 6. Check the switch. a. The connections to the brake snap-action switch are incorrect. Harness connections should be on C and NC. b. Check the switch with an ohmmeter as described in *Checking and Adjusting the Brake.* 7. Check the brake PCB. 8. Check the strain gauge by connecting an ohmmeter as described in *Replacing the Brake Pedal and Strain Gauge.* 9. Check voltage level to the main PCB. See Table 3-3.

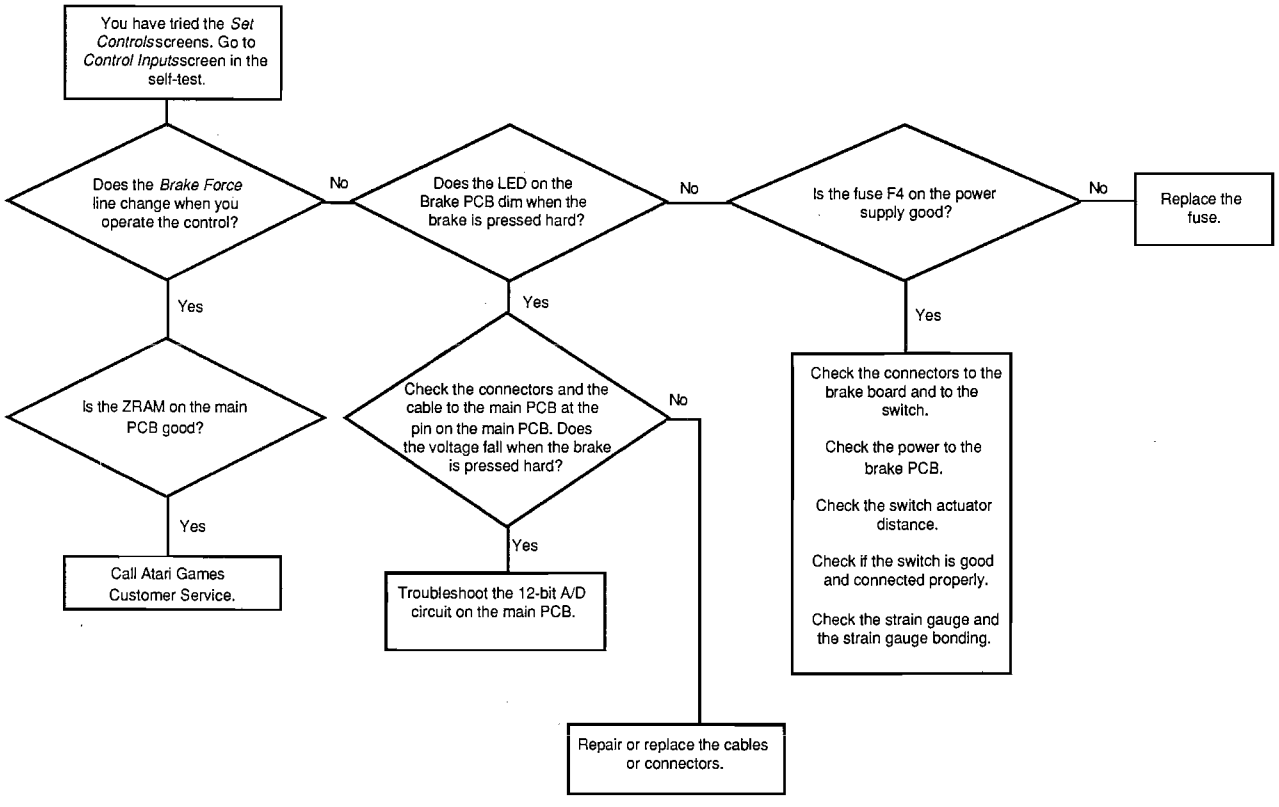


Figure 3-9 Brake is Not Working or Working Erratically and You Have Tried the *Set Controls* Screens

Oiling the Brake Bearings

Follow the procedure under *Oiling the Clutch and Brake Bearings*. While you have the clutch and brake pedal assembly out, also check the actuator and resistance settings on the brake, explained in *Oiling the Clutch and Brake Bearings*.

Maintaining the Brake

These are the routine procedures you should do every three months and whenever you have the pedal assembly out of the game

1. Take off the cover above the pedal assembly in the front of the simulator. Use a Phillips screwdriver to remove the four screws that hold the cover on the cabinet.
2. Open the lower rear service door. The back of the pedal assembly is above the main PCB. Disconnect the simulator harness from the assembly. Remove the washers and nuts holding the pedal assembly to the cabinet. After you remove the nuts, the pedals will continue to hang in the same position.
3. Go to the front of the simulator. Holding the pedal shafts, twist and pull the assembly counterclockwise to avoid the bottom of the dashboard.
4. See Figure 3-8 for an illustration of the pedal assembly. The brake switch is located on the inside wall, under the switch actuator. Check the following:
   a. Check the actuator adjustment. You should be able to move the pedal at least 1/4 inch before the switch clicks. If not, adjust the clamp on the white plastic actuator until you have 1/4 inch of play in the pedal. Make sure the switch clicks before you feel resistance on the pedal.
   b. Resistance on the pedal should begin after the switch clicks, but no further than 1/2 inch from the starting point. If you feel resistance before this point, check if the bearings are moving. If the bearings are moving freely, adjust the nut on the brake spring return shaft so that the pedal has at least 1/4 inch of free play, and the switch clicks before the resistance begins.

Repairing the Brake

The brake may not function for several reasons. Before you do any repairs, always perform the *Set Controls* screens in the self-test; then try the brake to see if this corrects the problem. If not, then follow the flowchart in Figure 3-9. The test procedures mentioned in the flowchart are explained below.

If the brake must be repaired, but you cannot repair it immediately and you want to continue to use your game, you can disable the brake circuit. *This is only a temporary measure. You should repair the brake as soon as possible.*

To disable the brake circuit, go to the *Disable Broken Controls* screen in the self-test and choose the brake.

Check Switch, Switch Actuator and Pedal Movement

If the brake is not working at all, you should check the following. (Check the flowchart in Figure 3-9.)

1. Check the actuator adjustment. You should be able to move the pedal for at least 1/4 inch before the switch clicks. If not, adjust the clamp on the white plastic actuator until you have 1/4 inch of play in the pedal. Make sure the switch clicks before you feel resistance on the pedal.
2. Resistance on the pedal should begin after the switch clicks, but no further than 1/2 inch from the starting point. If you feel resistance before this point, check if the bearings are moving. If the bearings are moving freely, adjust the nut on the brake spring return shaft so that the pedal has at least 1/4 inch of free play, and the switch clicks before the resistance begins.
3. If the pedal does not return to its resting location, check if the return spring is broken or if the bearings are not moving.
4. Check the switch. Disconnect the connector from the Brake PCB and connect an ohmmeter across pins 6 and 7 of the harness connector. If the switch is good, the switch is *closed* when the pedal is *not* pressed, and is *open* when the pedal is pressed.

Strain Gauge

Check the strain gauge in the self-test on the *Control Inputs* screen. The strain gauge response is measured under the *Force Brake* item. The harder you press on the brake, the more that the brake force line will disappear. (The position of the brake is not measured in this test.)

To check the strain gauge, remove the connector from the brake PCB in the back of the simulator and put an ohmmeter across pins 1 and 2 of the harness connector. If the ohmmeter does not measure 350 Ω ± 10%, then replace the strain gauge and brake pedal.

If the ohmmeter does measure 350 Ω ± 10%, then check the bonding. Attach a digital volt-ohmmeter to pins 1 and 2 and have someone press very hard on the brake. If the resistance does *not* change as the pressure on the brake pedal changes, then the bonding has failed. If the resistance does change, then your problem is elsewhere.

If either the strain gauge or the strain gauge bonding has failed, you must replace the brake pedal.

Replacing the Brake Switch

Before you replace the brake switch, do the *Set Controls* screens in the self-test, follow the flowchart in Figure 3-9, and the steps under *Repairing the Brake*. If you are sure that the problem is the switch, do the following procedure.

1. With the pedal assembly out of the simulator, remove the two nuts that hold the switch against the wall. Take out the screws and the switch.
2. Replace the switch in the same position, with the terminals pointing towards the top of the pedal assembly. After the nuts and screws are installed and the switch is in place, adjust the actuator position so that the brake pedal has at least 1/4 inch of play in it before the switch clicks. Loosen or tighten the clamp on the white plastic actuator to adjust this distance. Also make sure that the switch clicks before you feel resistance when you push the pedal.
3. Re-connect the wiring assembly to the switch. The two wires attach to the C and NC terminals. If you attach the wires to the wrong terminals, the brake will not work correctly.
4. Put the pedal assembly back in the simulator. Install the fender washers and the locknuts. Re-connect the simulator harness.
5. Now switch on the self-test and go through the *Set Controls* screens.

NOTE

You must enter the self-test and go through the Set Controls *screens since you have repaired the brake. Otherwise the simulator will not function correctly.*

Replacing the Brake Strain Gauge and Pedal

Before you replace the strain gauge, do the *Set Controls* screens in the self-test, follow the flowchart in Figure 3-9, and the steps under *Repairing the Brake*. If you are sure that the problem is the strain gauge or the bonding, do the following procedure.

The strain gauge is mounted on the pedal at the factory because special bonding techniques are required. Therefore, you must replace the strain gauge and the pedal together.

1. To replace the brake pedal, take off the cover above the pedal assembly in the front of the simu-

lator. Use a Phillips screwdriver to remove the four screws that hold the cover on the cabinet.

2. Open the lower rear service door. The back of the pedal assembly is above the main PCB. Disconnect the simulator harness from the assembly. Remove the washers and nuts holding the pedal assembly to the cabinet. After you remove the nuts, the pedals will continue to hang in the same position.
3. Go to the front of the simulator. Holding the pedal shafts, twist and pull the assembly counterclockwise to avoid the bottom of the dashboard.
4. Disconnect the strain gauge wires from the Brake PCB. See Figure 3-8 for an illustration of the pedals.
5. Remove the metal stop bracket with the rubber bumper pads attached to it by taking out the two screws, one on either side, which hold the bracket to the frame. (You do not need to remove the rubber bumper pads.) Pull the stop bracket out the assembly.
6. Remove the retaining ring at the top of the brake shaft that holds the shaft and brake springs together.
7. Take off the locking tab on the end of the pedal pivot shaft. Use a 3/16-inch Allen wrench to remove the socket-head screw.
8. Push the pivot shaft towards the clutch. Remove the brake pedal and strain gauge.
9. Put the new brake pedal into position. Push the pivot shaft through the brake shaft and into the case. Install the locking tab and the socket-head screw.
10. Replace the retaining ring at the top of the brake shaft that holds the shaft and the brake springs together.
11. Replace the metal stop bracket. Put in the two screws that hold the bracket to the frame.
12. Re-connect the strain gauge wires to the Brake PCB.
13. Check the following to make sure the brake is set up properly:
    a. Check the actuator adjustment. You should be able to move the pedal at least 1/4 inch before the switch clicks. If not, adjust the clamp on the white plastic actuator until you have 1/4 inch of play in the pedal. Make sure the switch clicks before you feel resistance on the pedal.
    b. Resistance on the pedal should begin after the switch clicks, but no further than 1/2 inch from the starting point. If you feel resistance before this point, check if the bearings are moving. If the bearings are moving freely, adjust the nut on the brake spring return shaft so that the pedal has at least 1/4 inch of free play, and the switch clicks before the resistance begins.
14. Put the pedal assembly back in the simulator. Install the fender washers and the locknuts. Re-connect the simulator harness.
15. Now switch on the self-test and go through the *Set Controls* screens.

NOTE

Enter the self-test and go through the Set Controls *screens since you have replaced the strain gauge. Otherwise the simulator will not function correctly.*

Gas Pedal Assembly

The gas pedal assembly is an assembly of springs, a cable, a pulley, and a potentiometer. The most likely cause of failure is the pulley cable breaking or unwinding. Check the suggestions in Table 3-8 before repairing the gas pedal.

Lubricating the Gas Pedal

Maintain the gas pedal assembly by lubricating at the points shown in Figure 3-8.

1. From the front of the cabinet, unscrew the seven Phillips-head screws and pull the gas pedal assembly forward. Disconnect the simulator harness from the assembly. Take the assembly out.
2. Lubricate the pivot pin and surrounding area, the spring cable, and pulley with dry Teflon spray. Check to be sure that the cable is wound correctly (see the section *Rewinding the Gas Pedal Pulley Cable).*
3. Put the gas pedal back in the simulator and re-connect it to the simulator harness connector. Screw in the Phillips-head screws that hold it in the simulator.

Rewinding the Gas Pedal Pulley Cable

The pulley cable may become disconnected during normal use. Also if you remove or replace the cable spring, you may also have to rewind the pulley cable. Be careful not cut or fray the cable when you remove or replace it.

1. Remove the pedal assembly from the simulator by taking out the seven Phillips-head screws that hold the pedal assembly box in the simulator. Disconnect the pedal from the simulator harness.

2. Lay the pedal assembly on the bench, with the extension spring pointing up at the back. See Figure 3-8 for an illustration of the pedal.
3. Put one end of the cable around the hook on the pedal. Thread the rest of the cable up through the hole in the base plate.
4. Wrap the cable around the pulley counterclockwise to the cap screw. Put the cable through the notch and wrap it once, clockwise, around the cap screw in the pulley. (This screw must be at the top of the pulley. If it is not, turn the pulley so it is.)
5. Bring the cable back through the notch and wrap it twice around the pulley. Be careful not to wrap the cable over itself. Hook the circular lug onto the cable spring. The spring should be stretched out. Try pushing the pedal a few times to make sure the cable returns the pedal to the rest position.
6. Lubricate the pivot pin, springs, cable, and pulley with dry Teflon spray.
7. Install the pedal in the simulator and re-connect the harness. Make sure the ground wire is attached.
8. Go to the *Set Controls* screens in the self-test and re-initialize all the controls.

NOTE

You must go through the Set Controls *screens in the self-test because the pedal has been repaired. Otherwise, the simulator will not function correctly.*

Replacing the Gas Pedal Cable Spring

The gas pedal cable spring may break. Before you replace the spring, first make sure the cable is wound correctly around the pulley since this is a likely cause of gas pedal failure.

1. Remove the pedal assembly from the simulator by taking out the seven Phillips-head screws that hold the pedal assembly box in the simulator. Disconnect the pedal from the simulator harness.
2. Lay the pedal assembly on the bench, with the extension spring pointing up at the back. See Figure 3-8 for an illustration of the pedal.
3. Disconnect the cable from the cable spring. Remove the spring and replace it.
4. Wind the cable around the pulley correctly before you put it on the spring. If the cable is frayed or cut, replace it.
5. Put one end of the cable around the hook on the pedal. Then thread it through the hole in the base plate.
6. Wrap the cable around the pulley counterclockwise on the left side of the pulley to the cap screw. Put the cable through the notch and wrap it once, clockwise, around the cap screw in the pulley. (This screw must be at the top of the pulley. If it is not, turn the pulley so it is.)
7. Bring the cable back through the notch and wrap it twice around the pulley. Be careful not to wrap the cable over itself. Hook the circular lug onto the cable spring. The spring should be stretched out. Try pushing the pedal a few times to make sure the cable returns the pedal to the rest position.
8. Lubricate the pivot pin, springs, cable, and pulley with dry Teflon spray.
9. Install the pedal in the simulator and re-connect the harness. Make sure the ground wire is attached.
10. Go to the *Set Controls* screens in the self-test and re-initialize all the controls.

Table 3-8 Troubleshooting the Gas Pedal Assembly

Problem	Solution
Gas pedal does not work or works erratically.	1. Go through the *Set Controls* screen in the self-test. 2. If that doesn't work, see Figure 3-7 for more information. 3. Check the Control Inputs screen. If the gas line does not change as you press the pedal down, then you may need to replace the potentiometer, rewind or replace the pulley cable, or replace a broken spring. 4. Check voltage level to boards. See Table 3-3.
Does not return to rest position.	1. Is the gas pedal lubricated? Follow the procedure under *Lubricating the Gas Pedal.* 2. Check the pulley cable. 3. Check for a broken extension spring, shown in Figure 3-9.

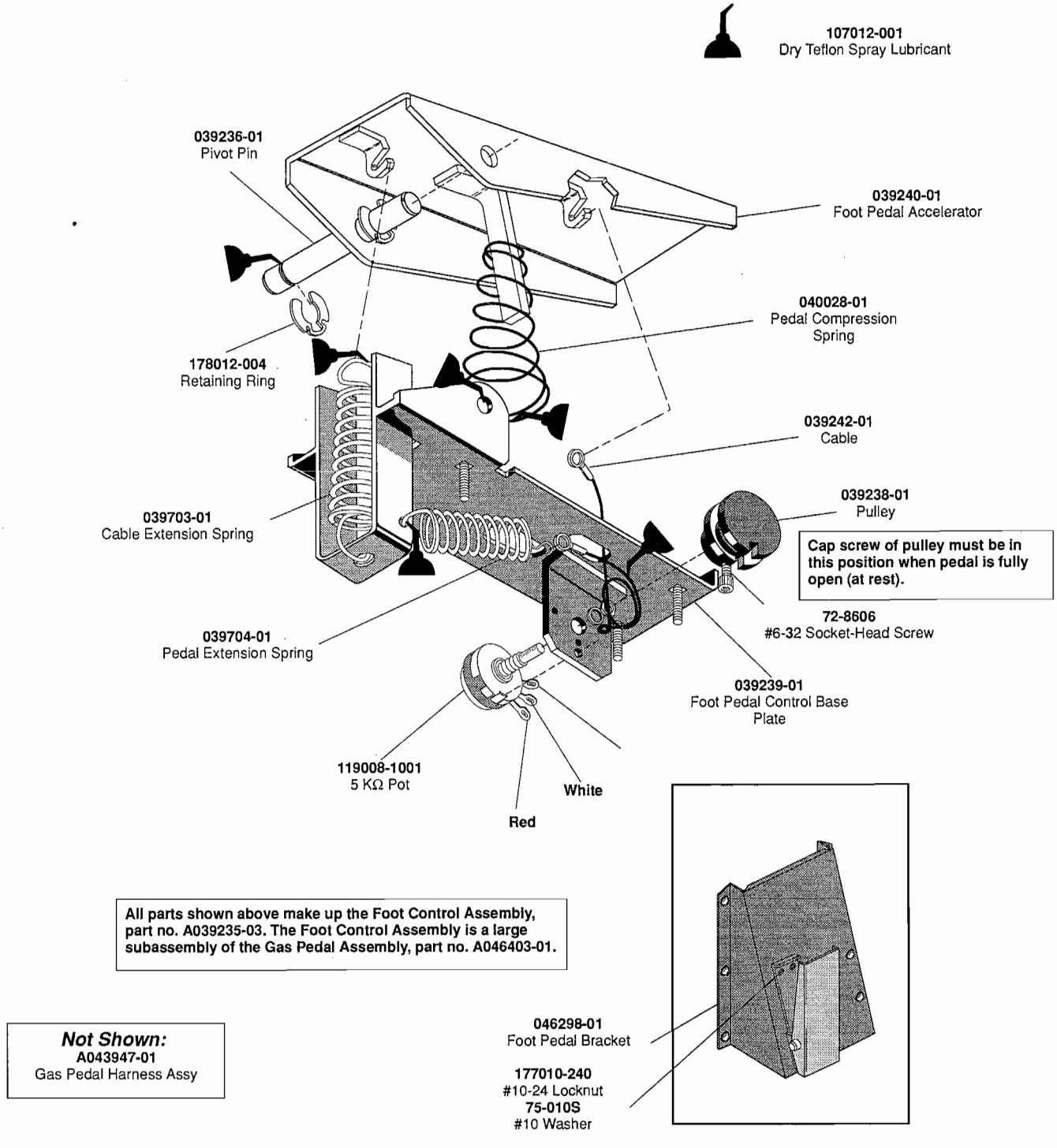


Figure 3-10 Maintaining the Gas Pedal

Replacing the Gas Pedal Potentiometer

Replace the potentiometer if you have followed the flowchart in Figure 3-7 and decided that the potentiometer must be replaced. When you take the gas pedal out of the simulator, first check if the springs are broken or if the cable is broken or unwound from the pulley before you replace the potentiometer.

1. Remove the pedal assembly from the simulator by taking out the seven Phillips-head screws that hold the pedal assembly box in the simulator. Disconnect the pedal from the simulator harness.
2. Lay the pedal assembly on the bench, with the extension spring pointing up at the back. See Figure 3-9 for an illustration of the pedal.
3. Disconnect the cable from the cable spring. Loosen the cap nut on the pulley and remove the pulley from the potentiometer shaft.
4. Take off the potentiometer by removing the locknut with a 1/2-inch wrench. Take the wires off the potentiometer.
5. Put a new potentiometer on the bracket in the base plate, with the three terminals facing towards you and the flat of the potentiometer shaft facing up. Tighten the nut.
6. Solder the harness wires onto the potentiometer in this order: red on the left terminal, white on the middle, and black on the right.
7. Put the pulley on the potentiometer shaft and tighten the set screw in the hub on the flat of the potentiometer shaft.
8. Re-connect one end of the cable to the hook on the pedal. Thread the rest of the cable up through the hole in the base plate.
9. Start wrapping the cable around the pulley counterclockwise to the set screw. Put the cable through the notch and wrap it once, clockwise, around the cap screw in the pulley.
10. Bring the cable back through the notch and wrap it twice around the pulley counterclockwise. Be careful not to wrap the cable over itself. Hook the circular lug onto the cable spring. The spring should be stretched out. Try pushing the pedal a few times to make sure the cable returns the pedal to the rest position.
11. Lubricate the pivot pin, springs, cable, and pulley with dry Teflon spray.
12. Install the pedal in the simulator and re-connect the harness. Make sure the ground wire is attached.
13. Go to the *Set Controls* screens in the self-test and re-initialize all the controls.

NOTE

You must go through the Set Controls *screens in the self-test because you replaced the potentiometer. The simulator will not function correctly if you do not set the controls.*

Replacing a Broken Compression or Extension Spring on the Gas Pedal

It is very unlikely that either of these springs will be sprung or fatigued. However, if either are, follow the instructions below.

1. Take the cable off the cable spring.
2. Remove the two retaining rings from either end of the pivot pin and take out the pivot pin.
3. Take out the springs. If you are replacing the compression spring, be sure that the large end of the spring is against the base plate when you put the pedal assembly together again.
4. Reassemble the gas pedal assembly. Rewind the pulley cable in the following way:
   a. Re-connect one end of the cable to the hook on the pedal. Thread the rest of the cable up through the hole in the base plate.
   b. Start wrapping the cable around the pulley counterclockwise to the set screw. Put the cable through the notch and wrap it once, clockwise, around the cap screw in the pulley.
   c. Bring the cable back through the notch and wrap it twice around the pulley counterclockwise. Be careful not to wrap the cable over itself. Hook the circular lug onto the cable spring. The spring should be stretched out. Try pushing the pedal a few times to make sure the cable returns the pedal to the rest position.
5. Lubricate the pivot pin, springs, cable, and pulley with dry Teflon spray before you put the assembly back in the simulator.
6. Install the pedal in the simulator and re-connect the harness. Make sure the ground wire is attached.
7. Go to the *Set Controls* screens in the self-test and re-initialize all the controls.

Shifter Assembly

If you have problems with the shifter, check the suggestions in Table 3-9, *Troubleshooting the Shifter Assembly.*

If the shifter is not working properly and you cannot repair it immediately, go to the screen *Disable Broken Controls* in the self-test. Disable the shifter circuit so you can continue to operate the simulator. *This is only a temporary measure.* You should repair the shifter as soon as possible.

Installing a New Shifter Boot

The shifter is shown in Figure 3-12.

1. Loosen the self-locking screw in the shifter knob and take off the knob.
2. Remove the four tamperproof screws that hold the boot cover plate on the shifter case. Lift off the boot and the cover plate.
3. Take the foam out of the boot.
4. Install the foam in the new boot. Replace the boot.
5. Install the cover plate and the screws. Put the knob back on.

Replacing a Shifter Potentiometer

If the shifter is acting erratically, follow the flowchart in Figure 3-10 to make sure that the problem is with the potentiometers. However, always tighten the screw on the end of the roll link and the pitch link before you replace the potentiometer. Do the *Set Controls* screens in the self-test to see if this solves your problem.

The shifter is shown in Figure 3-12.

1. To work on the shifter you need to take the shifter out of the its case. Leave the case in the simulator.
2. Loosen the self-locking screw in the shifter knob and take off the knob.
3. Remove the four tamperproof screws that hold the boot cover plate on the shifter case. Lift off the boot with the foam inside it, the cover plate, and the shifter gate, which has the shift pattern in it.
4. Remove the screw on the tie wrap that holds the clutch harness on the side of the case.
5. Unscrew the nut on the carriage bolt on the left side of the case and slip the long thin pitch bar off the bolt.
6. Looking down inside the shifter case, push the shifter forward and back. The shifter turns on a pivot shaft which has a cotter pin on its right side. Pull out the cotter pin.
7. Push the pivot shaft out of the shifter case through the hole on the outside of the cabinet. Use a screwdriver or a pencil. Disconnect the six-pin connector on the simulator harness from the shifter. Lift the shifter assembly out of the case.
8. Before you replace a potentiometer, first try tightening the locknut on the end of the roll link and the pitch link. Check the shoulder screws on the thin roll bar and pitch bar. They should be tight, but allow free movement of the bar and attached link. Tightening these nuts and screws may solve your problem.
9. Disconnect the harness from the potentiometer that you are replacing. Loosen the nut on the potentiometer shaft with a 1/2-inch flat wrench. Remove the potentiometer.
10. Solder the harness to the new potentiometer. With the shaft facing you and the terminals pointing down, solder the black wire to the left terminal, the white to the middle, and the red to the right.
11. Install the new potentiometer, making sure to put the potentiometer key in the key slot in the shifter. Tighten the nut.
12. Put the shifter assembly back in the case. Attach the pitch bar to the carriage bolt at the top of the case with the locknut.
13. Attach the simulator harness assembly. Install the screw through the tie wrap on the clutch harness on the side of the shifter case.

Table 3-9 Troubleshooting the Shifter Assembly

Shifter does not work or works erratically.	1. Go through the *Set Controls* screen in the self-test. 2. See Figure 3-10 to determine the cause of the problem. 3. Check voltage level to the main PCB. See Table 3-3. 4. Check the F4 fuse on the power supply. (If this is blown, then the brake pedal will not work either.)
Moves in and out of gear freely without using the clutch.	Check the shifter PCB and magnet.
Shifter squeaks and squeals.	Some noise is normal. If you think the noise is excessive, replace the magnet or the magnet plate.

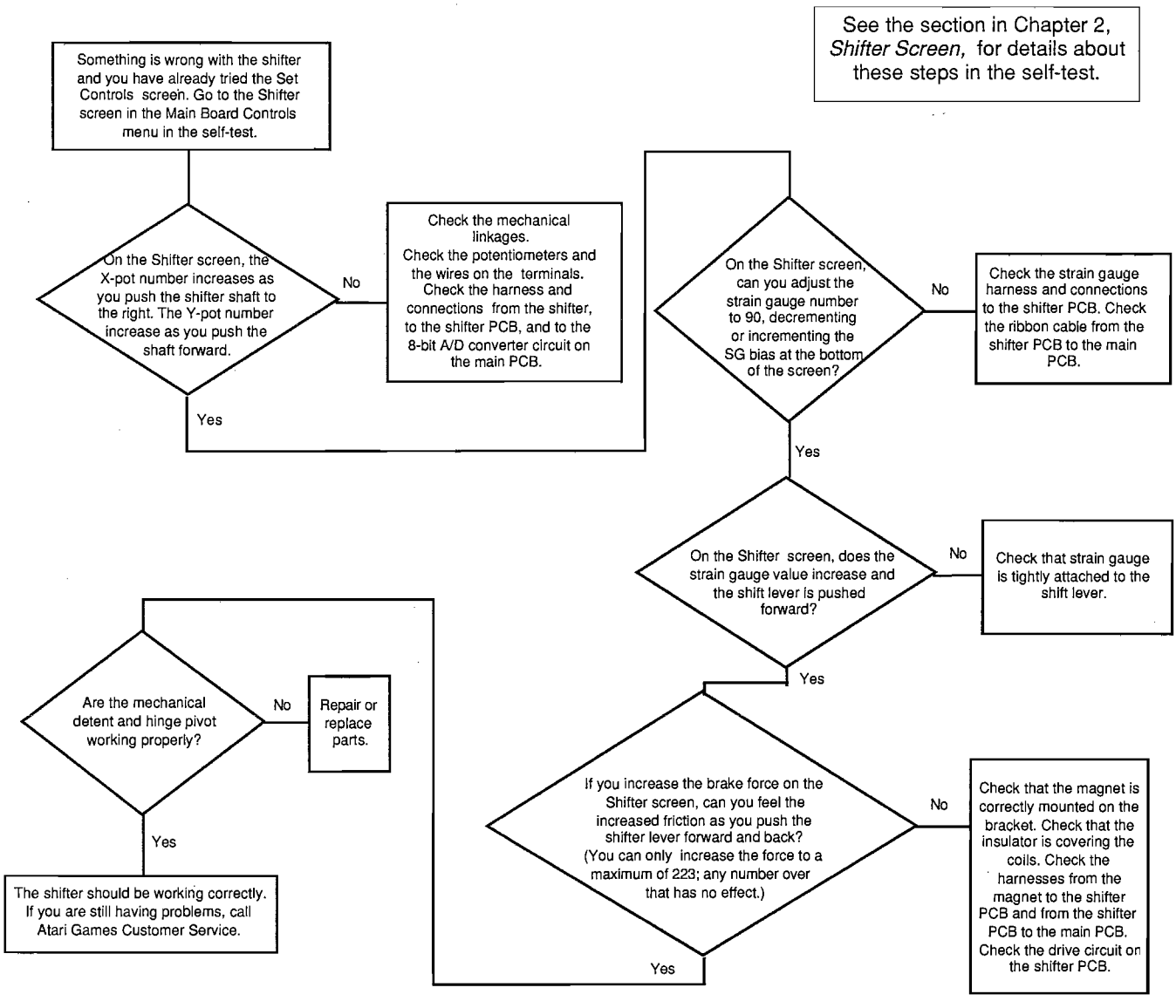


Figure 3-11 Shifter Is Not Working or Working Erratically And You Have Already Tried the *Set Controls* Screens

12. Line up the tube for the pivot shaft on the assembly with the holes in the case for the pivot shaft. Push the pivot shaft through the holes from the inside of the cabinet. Keep the slotted end of the pivot shaft facing towards you.
13. Once the pivot shaft is all the way through the case, use a screwdriver on the slotted end to turn the shaft until the holes in the shaft line up with the holes in the tube. Put in the cotter pin. Do not bend the legs of the cotter pin.
14. Put the shifter gate back on, with the latch and the spring facing down. Then put the boot and the foam on, then the boot cover plate. Install the four tamperproof screws. Install the knob.
15. Go into the self-test and perform the *Set Controls* screens.

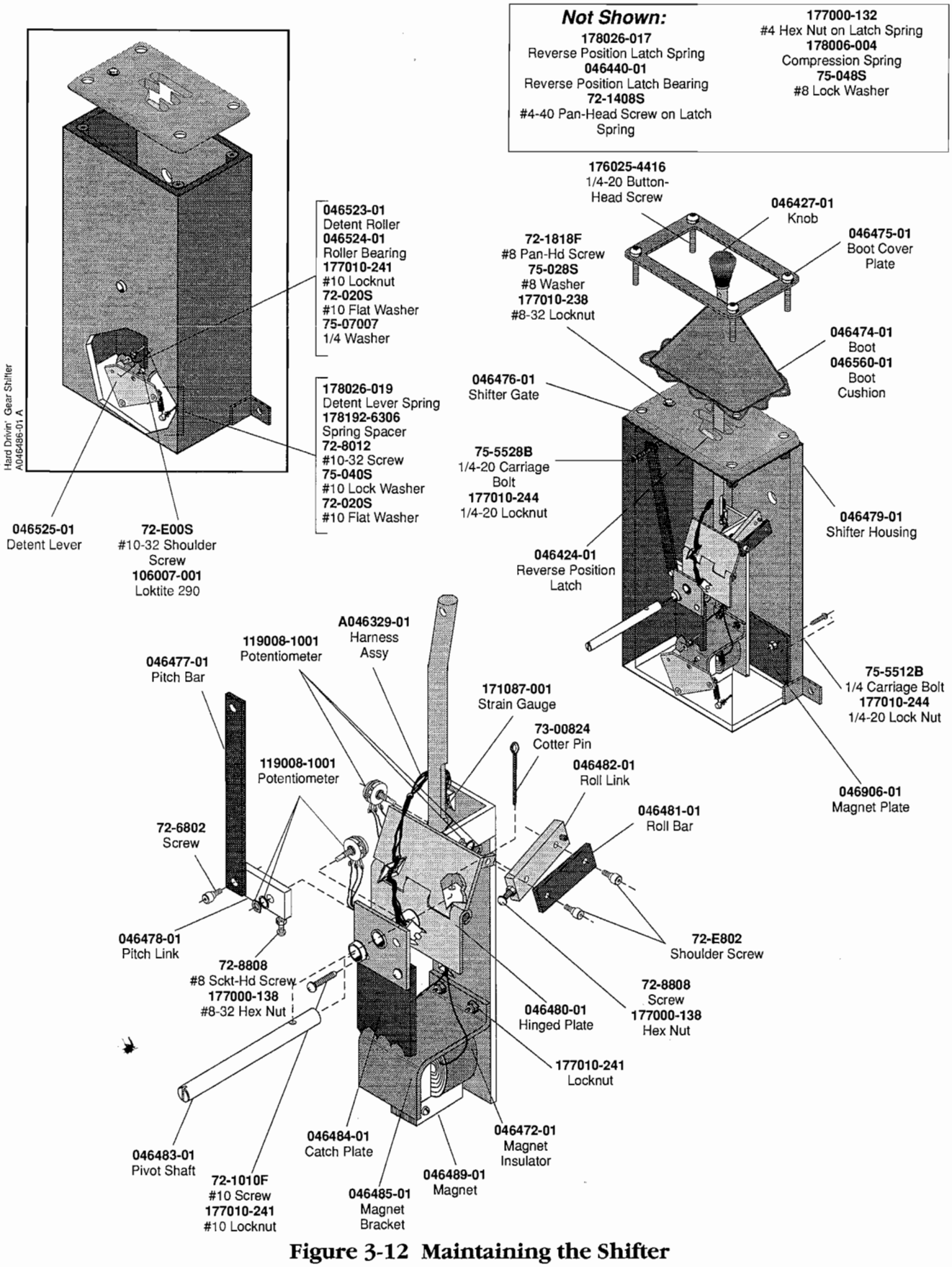


Figure 3-12 Maintaining the Shifter

NOTE

You must perform the Set Controls *screens because you replaced the potentiometer. Otherwise the simulator will not operate correctly.*

Replacing the Shifter Magnet or Plate

If the shifter is squeaking or squealing excessively you may need to replace the magnet or the plate it rides on. To determine which one to replace, take the shifter out of its case, as described below, and check the condition of the magnet and the magnet plate. The shifter is shown in Figure 3-12.

1. Loosen the self-locking screw in the shifter knob and take off the knob.
2. Remove the four tamperproof screws that hold the boot cover plate on the shifter case. Lift off the boot with the foam, the cover plate, and the shifter gate, which has the shift pattern in it.
3. Unscrew the nut on the carriage bolt on the left side of the case and take the long thin pitch bar off the bolt.
4. Looking down inside the shifter case, push the shifter forward and back. The shifter turns on a pivot shaft which has a cotter pin on its right side. Pull out the cotter pin.
5. Push the pivot shaft out of the shifter case through the hole on the outside of the cabinet. Use a screwdriver or a pencil. Disconnect the six-pin connector on the simulator harness from the shifter. Lift the shifter assembly out of the case.

Check the face of the magnet. If the laminates are separated or damaged, replace the magnet. If the magnet laminates look OK, then you should replace the plate that the magnet rides on.

Replacing the Magnet

1. Disconnect the wiring from the magnet to the shifter harness.
2. Unscrew the two locknuts that hold the magnet bracket on the hinged plate assembly. Remove the bracket, magnet, spring, and insulator.
3. Put the new magnet with the insulator in the bracket with the spring. Install the bracket on the hinged plate assembly and screw on the locknuts.
4. Connect the magnet connectors to the shifter harness.

Replacing the Magnet Plate

1. Remove the two locknuts that hold the plate in place on the side of the clutch case. Take out the plate.
2. Put in the new plate with the smooth finished side out. Tighten the locknuts to hold it.

Installing the Shifter Assembly in the Case

1. Put the shifter assembly back in the case. Attach the pitch bar to the carriage bolt at the top of the case. Attach the simulator harness assembly.
2. Line up the tube for the pivot shaft on the assembly with the holes in the case for the pivot shaft. Push the pivot shaft through the holes from the inside of the cabinet. Keep the slotted end of the pivot shaft facing towards you.
3. Once the pivot shaft is all the way through the case, use a screwdriver on the slotted end to turn the shaft until the holes in the shaft line up with the holes in the tube. Put in the cotter pin. Do not bend the legs of the cotter pin.
4. Put the shifter gate back on, with the latch and the spring facing down. Then put the boot with the foam and boot cover plate on. Install the four tamperproof screws. Install the knob.

Seat Assembly

The movement of the seat is controlled by the seat adjust button on the dashboard and by the simulator itself. When the simulator is in the attract mode, the seat moves freely. When the key is turned to start the drive, the seat is locked, unless the seat adjust button is pushed and held while the seat is moved.

For safety reasons, the seat can be pushed out of the simulator only so fast, so spectators won't be hurt. If the driver pushes the seat very hard to get out, the seat magnet will engage and slow the seat as it turns out of the simulator.

The seat assembly should not require many repairs, and does not require any regular maintenance, other than checking for obstructions around the seat movement area. If you have difficulties with the seat, check Table 3-10, *Troubleshooting the Seat Assembly.*

Replacing the Seat Rod End Bearings

Replace both rod ends if you have difficulty rotating the seat, or the seat squeaks as it rotates. The seat assembly is shown in Figure 3-15.

1. Take off both end plates of the mounting box. Each end plate is held on by four tamperproof screws. Also remove the bottom cover on the mounting box.
2. The rod ends are attached to the pivot blocks with shoulder screws. Use an Allen-head wrench and a flat wrench to remove the screws and nuts.
3. Take out the rod ends and the pivot arm. Remove both rod ends from the pivot arm. Save the nut on the right rod end.
4. Insert the right rod end into the pivot arm with the nut on the threads. The left rod end has left-hand threads and will not fit on the right end.
5. Carefully set the rod ends and pivot arm length to the following dimensions. These dimensions must be set correctly so that the assembly operates properly.
   - The distance between the center point of the left rod end to the point where it goes into the end of the pivot arm must be exactly 1.25 inches for clearance.
   - From the center of the hole in one rod end to the center of the hole in the other rod end should be exactly 11.25 inches.
6. Do not tighten the nut on the right rod end yet.
7. Put the rod ends and pivot arm into the seat mounting box, with the right rod end on the right side as you face the simulator. Tighten the socket-head screws and nuts to hold the rod ends on the pivot blocks.
8. Turn the mounting box until it is parallel to the front of the simulator. The seat mounting platform should be square with the mounting box now. If it is not, then rotate the pivot arm until it is. When everything is square, tighten the nut on the right rod end against the pivot arm. Check the alignment again to make sure the mounting box is parallel to the front of the simulator and the seat mounting platform is square with the box.
9. Install the end plates of the mounting box with the tamperproof screws. Put the bottom cover back on.

Replacing Bearings on the Seat Pivot

These are the bearings that allow the seat to turn. Replace the seat pivot bearings if the seat twists or jiggles excessively or you can pull the seat up and down. The seat assembly is shown in Figure 3-15.

1. To get to the bearings, you must take the left end plate off the mounting box, underneath the seat. The end plate is held on by four tamperproof screws.
2. Using a punch, hammer out the spring pin in the seat pivot.
3. When the pin is out of the seat pivot, pull up on the seat and remove it.
4. You may need to take the seat mounting box to a machine shop to do the following items:
   a. Remove the old bearings. (They have been press fitted.)
   b. Cut down one of the new bearings to 0.6 inch long. This will be the bottom bearing. (You can use a bearing on the bottom that has not been cut down, but it may catch someone's foot.)

Table 3-10 Troubleshooting the Seat Assembly

Action is erratic.	1. Go through the *Set Controls* screen in the self-test. 2. See Figure 3-7, 3-12, or 3-13 to determine the cause of the problem. 3. Check voltage level to the main PCB. See Table 3-3.
Does not turn easily, does not push in and out, or squeaks.	1. Check for obstructions on the simulator floor and inside the bottom of the simulator. 2. Check the rod end bearings. 3. Check the shaft bearings on the seat shaft. 4. Check the main seat bearings. 5. Check the gears on the seat assembly.
Seat does not lock in place when it should.	1. Go through the *Set Controls* screen in the self-test. 2. See Figure 3-12 to find out the cause. 3. Check the APU PCB.
Seat is locked when it should not be.	1. Go through the *Set Controls* screen in the self-test. 2. See Figure 3-14 to find out the cause. 3. Check the APU PCB.
Seat jiggles or twists excessively, and can be pulled up and down.	Does the seat alone do this, or do the seat and the mounting arm jiggle and twist together? If only the seat does it, replace the bearings on the seat pivot. If both the seat and the mounting arm jiggle, twist, and move up and down, replace the main seat bearings.

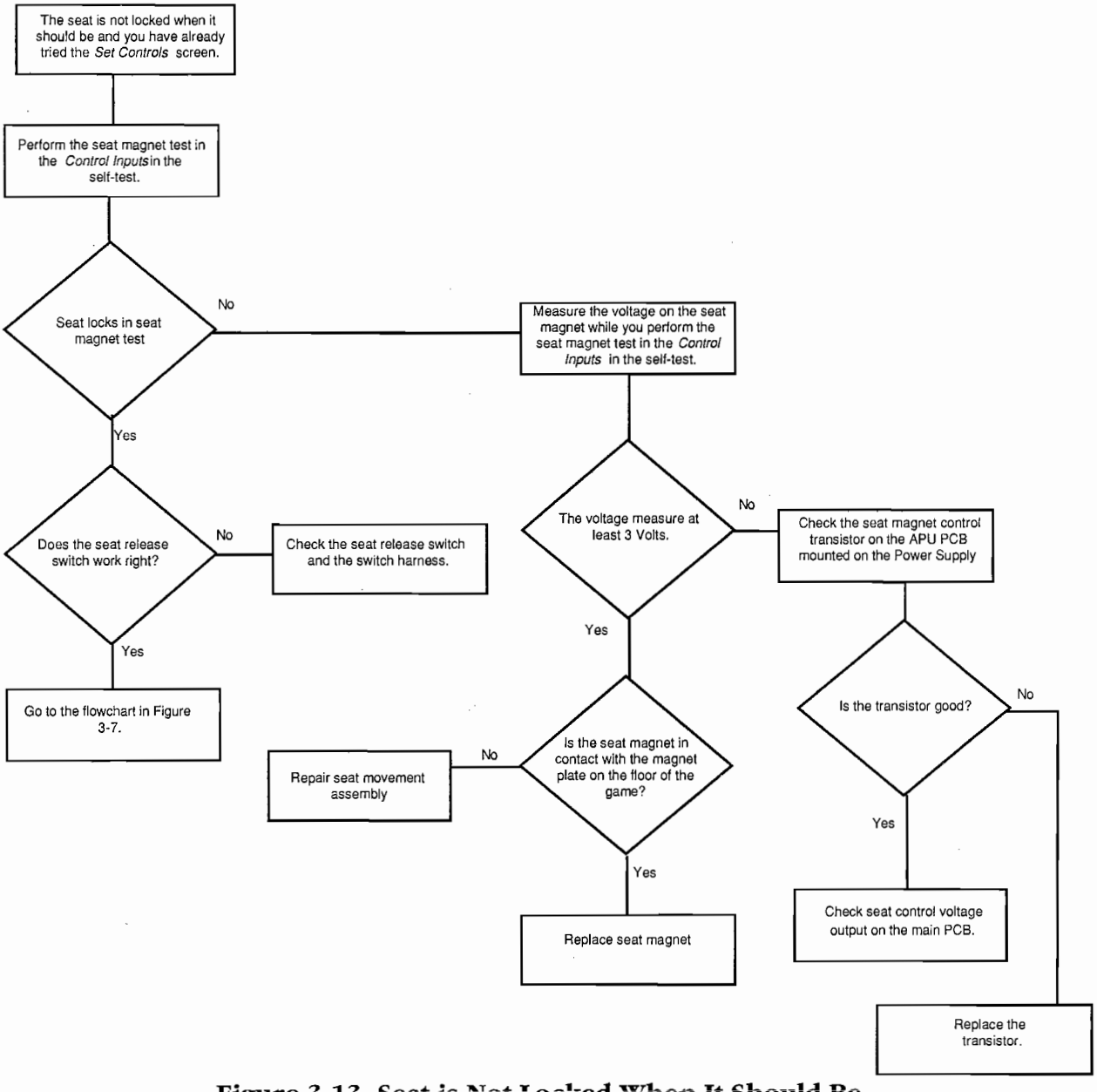


Figure 3-13 Seat is Not Locked When It Should Be And You Have Already Tried the *Set Controls* Screens

c. Turn the bearings, if necessary, to press them on the pivot of the seat mounting plate.

d. The inner diameter of the bearings should be turned so that:

- The shaft with a diameter of 1.249 inches should rotate freely when a torque of 10 inch pounds is applied.
- The shaft with a diameter of 1.254 inches must *not* be able to pass through the bearings.

5. Insert the pivot through the new top bearing, the spacer tube, the pivot block, two washers, and the new bottom bearing.
6. Line up the holes for the spring pin in the seat pivot with the holes in the pivot block. Make sure the seat is facing the right direction. Put in the spring pin. (You might want to use a 3/8-inch shaft or shoulder screw to hold the alignment while you are putting in the spring pin.) When the pin is in, make sure it is is flush with the outer edges of the pivot block.
7. Put the end plate back on and install the four tamperproof screws.

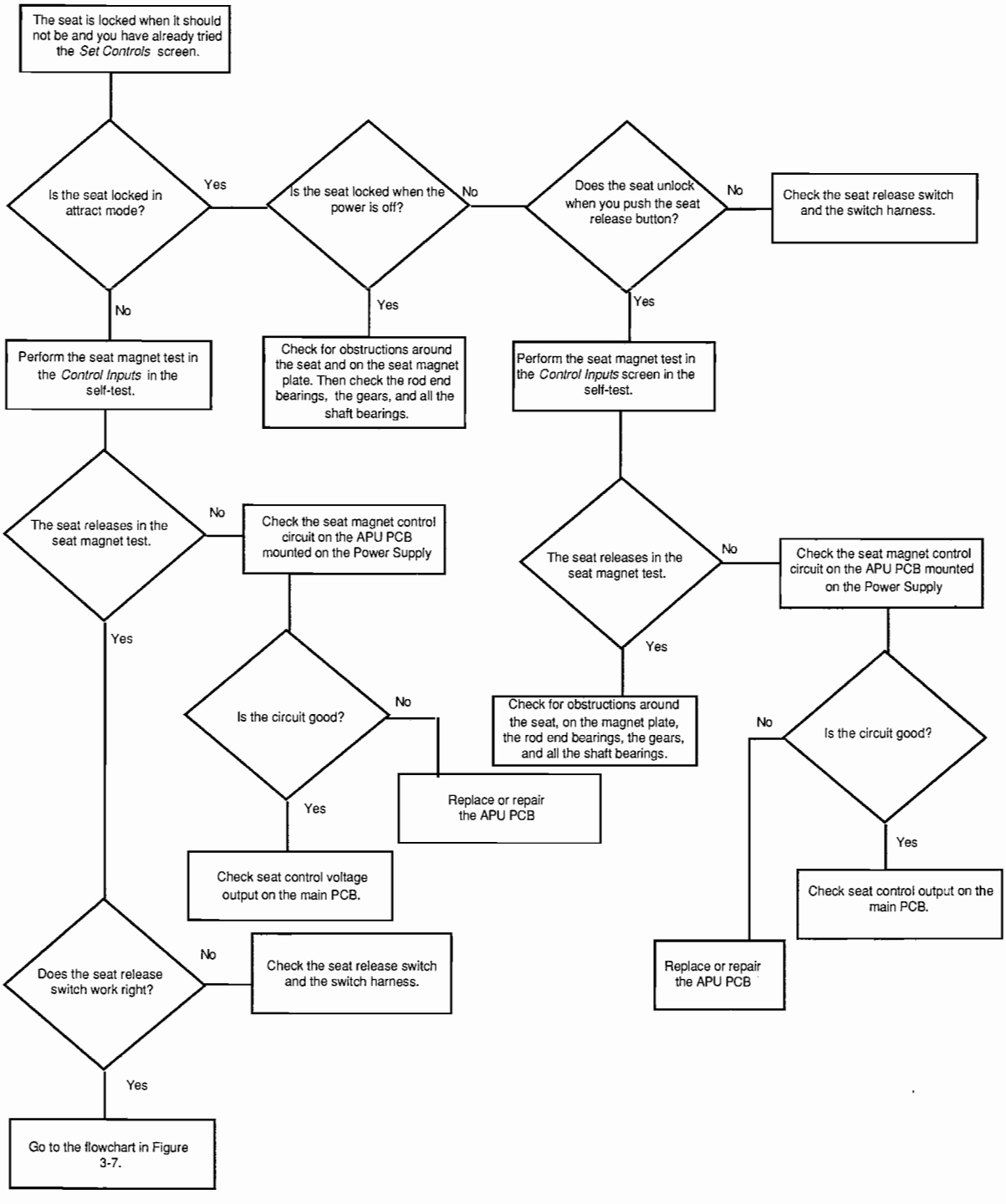


Figure 3-14 Seat is Locked When It Should Not Be And You Have Already Tried the *Set Controls* Screens

Replacing the Main Seat Bearings

These bearings are between the base of the simulator and the seat mounting arm. Replace them if the seat mounting arm is twisting or jiggling or you can pull the arm up and down. The seat assembly is shown in Figure 3-15.

To replace these bearings you must remove the simulator floor and take out the seat assembly. You will need another person to help you.

1. Take out the Phillips-head screws on the back edge of the floor trim, which is the strip of metal across the middle of the floor. Remove the three Phillips-head screws along the front of the simulator under the rubber floor mat.
2. Turn the seat out of the simulator as far as it will go. Pry up the floor by using two screwdrivers on the front corner of the floor to lift and pry.
3. Before you can take out the seat mechanism, you must take out the coin module and the shifter. Open the top and bottom coin doors and take off the four locknuts on the carriage bolts on the side of the cabinet.
4. Disconnect the simulator harness from the coin module. Remove the bolts and the coin module.
5. Now take out the shifter. Loosen the self-locking screw in the shifter knob and take off the knob.
6. Remove the four tamperproof screws that hold the boot cover plate on the shifter case. Lift off the boot with the foam, the cover plate, and the shifter gate. Disconnect the shifter harness.
7. Take off the locknuts on the two tamperproof screws and the two carriage bolts that hold the shifter on the side of the cabinet and remove the screws. Remove the shifter.
8. Disconnect the simulator harness from the seat assembly. Remove all the screws and nuts that hold the seat assembly in the simulator. Tip the seat back until the seat frame clear the floor. Push the seat assembly towards the pedals until the assembly is out from under the floor.

CAUTION

The gears and potentiometer are on the bottom of the assembly under the floor in front of the license plate. Do not damage these parts when you push the seat assembly forward and up.

9 When the assembly is clear of the floor, pull the assembly out of the simulator.

WARNING

The seat assembly is heavy. Be careful.

10. Take off both end plates of the mounting box on the seat assembly. Each end plate is held on by four tamperproof screws. Also remove the bottom cover on the mounting block.
11. Remove the rod ends and the pivot arm from the pivot block inside the mounting box. The rod ends are attached to the pivot blocks with shoulder screws. Use an Allen-head wrench and a flat wrench to remove the screws and nuts. Take out the rod ends and pivot arm and lay the assembly aside.
12. Remove the potentiometer bracket with the potentiometer gear and small gear from the bottom of the seat assembly.
13. Remove the large half gear on the bottom of the main shaft. You may want to turn the assembly on its side to do this.
14. Using a punch, hammer out the spring pin in the bottom of the main shaft in the magnet arm. Remove the magnet arm.
15. Turn the seat until you can pull the seat mounting box off the seat assembly.
16. You may need to take the welded seat assembly to a machine shop to do the following items:
    a. Remove the old bearings. (They have been press fitted).
    b. Turn the bearings, if necessary, to press them into the main shaft on the seat.
    c. The inner diameter of the bearings should be turned so that:
       - The shaft with a diameter of 1.624 inches should rotate freely when a torque of 10 inch pounds is applied.
       - The shaft with a diameter of 1.629 inches must *not* be able to pass through the bearings.
17. Press the bearings in. (It is not necessary to oil the bearings because they are oil-impregnated.) Insert the main shaft through the top bearing, the shaft holder, the bottom bearing, and the magnet arm.
18. Line up the hole in the shaft for the spring pin with the holes in the magnet arm. Make sure the seat is facing the right direction. Install the spring pin.
19. Put the rod ends and pivot arm assembly back into the seat mounting box, with the right rod end on the right side. Tighten the shoulder screws and nuts to hold the rod ends on the pivot blocks. Do not install the end plates or the bottom cover on

the mounting box until the seat assembly is back in the simulator, since you must check the alignment with the seat in the simulator.

20. Install the potentiometer bracket tightly on the bottom of the assembly. The potentiometer and the gears must be lined up correctly so the seat will work right. Turn the small gear until its set screw on the potentiometer shaft is directly below the center terminal on the potentiometer.
21. Turn the seat so that when you install the large half gear, the flat edge of the large half gear is opposite the small gear and is parallel to the sides of the assembly. Put the gear on tightly.
22. Lift the assembly into the simulator. Push it forward and back to ease it into position, under the floor. Be careful not to damage the gears and the potentiometer.
23. Install all the screws and nuts that hold the seat assembly in the simulator.
24. Reinstall the coin box and re-connect the harness.
25. Put the shifter back in the simulator. Put the locknuts on the tamperproof screws and the carriage bolts. Re-connect the harness.
26. Put the shifter gate back on, with the latch and the spring facing down. Then put the boot with the foam and boot cover plate on. Install the four tamperproof screws in the cover plate. Install the knob.
27. Re-install the floor. Put in the screws in the front of the floor and the screws in the metal floor trim.
28. Turn the mounting box until the seat mounting platform is square with the mounting box and parallel to the sides of the simulator. If it is not, then rotate the pivot arm until it is. When everything is square, tighten the nut on the right rod end against the pivot arm. Check this alignment again to make sure the mounting box is parallel to the front of the simulator and the seat mounting platform is square with the box.
29. Install the end plates of the mounting box with the tamperproof screws. Put the bottom cover back on.
30. Enter the self-test, go to the *Set Controls* screens, and re-initialize all the controls.

NOTE

You must go through the Set Controls *screen in the self-test because the seat assembly has been repaired. If you do not do this, the seat will not function correctly.*

Replacing the Gears on the Seat Assembly

If the seat is not turning easily or at all, do the following:

- Check for obstructions on the simulator floor and on the magnet plate below the floor. (You will have to pry up the floor to do this. Follow steps 1 and 2 in *Replacing the Main Seat Bearing* for information about doing this.)
- Check the rod end bearings to make sure they are turning.
- Check for broken or missing gears. Lift up the simulator or turn it on its side, with the seat high, and look through the hole in the bottom of the simulator at the gears.

WARNING

This simulator weighs 750 pounds. Be extremely careful when you lift it, turn it, or work on it so that it does not fall.

In the hole directly underneath the main seat shaft, you can see two gears. The small gear is mounted on the potentiometer. The large gear is mounted on the bottom of the main shaft.

If the gears are broken, cracked, or missing, you must replace them. You do not need to oil the bearings.

Replacing the Small Gear

1. Remove socket-head screws which hold the potentiometer bracket in the simulator and bring the potentiometer bracket and the small gear out of the simulator. See Figure 3-15.
2. Loosen the small set screw on the small gear hub. Use a 5/64-inch Allen wrench. Pull off the gear.
3. To put the new new gear on, first put the potentiometer back on the bracket, if you have removed it.
4. Install the bracket back in the game. Make sure the socket-head screws on the bracket are tight so it will not fall off.
5. Turn the potentiometer until the flat of the potentiometer shaft is directly below the center terminal.
6. Turn the seat so that the flat edge of the large half gear is opposite the potentiometer and is parallel to the sides of the simulator.
7. Put the new gear on the potentiometer shaft. Do not turn the shaft while you are putting the gear on. Put Loktite on the set screw. Tighten the set screw.

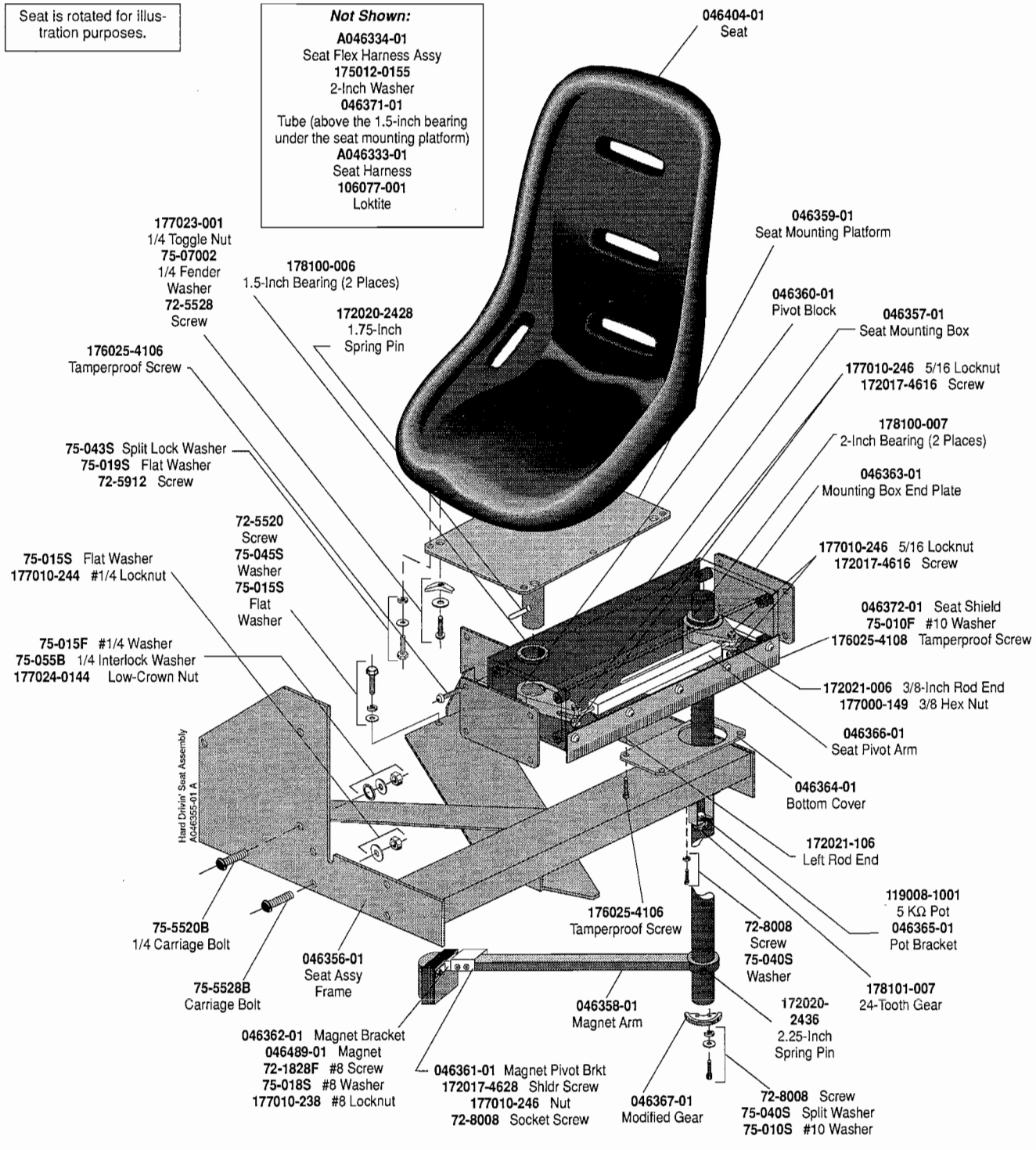


Figure 3-15 Maintaining the Seat Assembly

8. Put the simulator back on the floor.
9. Go into the self-test and perform the *Set Controls* screens so the seat will operate properly.

NOTE

You must go through the Set Controls *screen in the self-test. If you do not do this, the seat will not function correctly.*

Replacing the Large Gear

1. Rotate the seat so it will not move.
2. Remove the two socket-head screws holding the large gear on the main shaft. Take off the gear.
3. Install the new gear. Make sure that is meshes with the small gear. Tighten the socket-head screws well so the gear will not fall off.
4. If the seat did not turn or move while you were replacing this gear, you are done. If the seat did move, do the following:
   a. Take out the potentiometer bracket. Turn the gear until its set screw is directly below the center terminal on the potentiometer.
   b. Turn the seat so that the flat edge of the large half gear is parallel to the front of the simulator and is opposite to the place where the potentiometer bracket is installed.
   c. Install the potentiometer bracket back in the simulator. Make sure the gears do not turn from the position they are set in. Tighten the socket-head screws on the bracket.
   d. Put the simulator back on the floor.
5. Go into the self-test and perform the *Set Controls* screens so the seat will operate properly.

Replacing the Magnet on the Seat Assembly

Before you replace the magnet because the seat is not locking, go through the flowchart in Figure 3-13 to determine the source of the problem. If your problem persists, check to see if the magnet has the correct resistance. If the magnet is working, you should measure 2 Ω resistance across it.

1. Remove the floor trim, which is the strip of metal across the middle of the floor. Take out the Phillips-head screws on the back of the trim.
2. Remove the three Phillips-head screws along the front of the simulator under the rubber floor mat. Turn the seat out of the simulator as far as it will go. Pry up the floor.
3. Turn the seat so you can see the magnet. The magnet is attached to the arm by a bracket that permits the magnet to move very freely. Before replacing the magnet, check to see that the harness to the magnet is properly connected, since that could be a cause of magnet failure.
4. If the magnet must be replaced, unscrew the two Phillips-head screws that hold the magnet on the magnet bracket and disconnect the harness.
5. Discard all the hardware that came with the new magnet and install the magnet with the Phillips-head screws and nuts. Re-connect the harness.
6. Re-install the floor. Insert the screws that hold the floor and the metal floor trim in the simulator.

Replacing the Seat Potentiometer

Before you replace the seat potentiometer, go through the *Set Controls* screens in the self-test. If this doesn't fix the problem, do the following:

- If your problem is with erratic operation, then follow the flowchart in Figure 3-7.
- If the seat is not locking when it should, follow the flowchart in Figure 3-13.
- If the seat is locking when it should not, follow the flowchart in Figure 3-14.

If the seat potentiometer is not working properly and you cannot repair it immediately, go to the screen *Disable Broken Controls* in the self-test. Disable the seat potentiometer circuit so you can continue to operate the simulator. *This is only a temporary measure .* You should repair the seat potentiometer as soon as possible.

The potentiometer is mounted next to the end of the main shaft on the seat. The potentiometer has soldered connections, so you will need a soldering gun. The seat is shown in Figure 3-15.

To work on the gears, turn the simulator on its side or securely prop up the front of the simulator. In either case, you will need help, since the simulator is very heavy. You may find it easier to work on the simulator by turning it on its side, with the corner with the seat bearings high.

WARNING

This simulator weighs 750 pounds. Be extremely careful when you lift it, turn it, or work on it so that it does not fall.

---

1. In the hole directly underneath the main seat shaft, you can see two gears. The small gear is mounted

on the potentiometer, which is on the potentiometer bracket. Remove the socket-head screws that hold the potentiometer bracket in the simulator and bring the potentiometer bracket out of the simulator.

2. Loosen the set screw on the small gear hub. Use a 5/64-inch Allen wrench.
3. Loosen the locknut on the potentiometer shaft and take the potentiometer out of the bracket. Take off the harness wires. Leave the ground wire attached to the bracket.
4. Put the new potentiometer in the bracket, making sure you put the key in the hole in the bracket. The connectors should be on the same side as the ground wire bracket. Tighten the nut on the shaft.
5. Bend the potentiometer connectors up, but not so they touch the bracket. Solder on the wires in the following order: black nearest the ground wire, yellow in the middle, and red on the other side.
6. To put the new gear on, first put the potentiometer on the bracket, if you have removed it.
7. Install the bracket back in the game. Make sure the socket-head screws on the bracket are tight so it will not fall off.
8. Turn the potentiometer until the flat of the potentiometer shaft is directly below the center terminal.
9. Turn the seat so that the flat edge of the large half gear is opposite the potentiometer and is parallel to the sides of the simulator.
10. Put the new gear on the potentiometer shaft. Do not turn the shaft while you are putting the gear on. Put Loktite on the set screw. Tighten the set screw.
11. Put the simulator back on the floor.
12. Go into the self-test and perform the *Set Controls* screens so the seat will operate properly.

NOTE

You must go through the Set Controls *screen in the self-test. If you do not do this, the seat will not function correctly.*

Video Display

If you are having problems with the video display, check the suggestions in Table 3-11, *Troubleshooting the Video Display,* before you remove the display.

Removing the Video Display

Perform the following procedure to remove the video display. (See Figure 3-16.)

1. Turn the simulator power off and wait two minutes. Leave the power cord plugged in.

WARNING

High Voltage

The video display contains lethal high voltages. To avoid injury, do not attempt to service this display until you observe all precautions necessary for working on high-voltage equipment.

X-Radiation

The video display has been designed to minimize X-radiation. However, to avoid possible exposure to soft X-radiation, never modify the high-voltage circuitry.

Implosion Hazard

The cathode-ray tube may implode if struck or dropped. Shattered glass may cause injury within a 6-foot radius. Use care when handling the display.

---

2. While you are waiting, remove the six screws that hold the small top service panel on the simulator.
3. Disconnect the simulator harness to the attraction sign. Remove the larger outside panel attached to the attraction sign by taking off the carriage bolts that hold the panel on the simulator.
4. Discharge the high voltage from the cathode-ray tube (CRT). The display assembly contains a circuit for discharging the high voltage to ground when power is removed. However, to make certain, always discharge the display as follows:

Table 3-11 Troubleshooting the Video Display

Problem	Solution
Any problem.	Determine if the problem is with the display or the simulator hardware. Perform the self-test. If you cannot perform the self-test, use the DIP switch diagnostics to narrow down the source of the problem.
	Check the voltage level to the video display PCB.
Convergence, purity or color problems.	Check the video display settings with the Monitor Test Screens in the self-test.

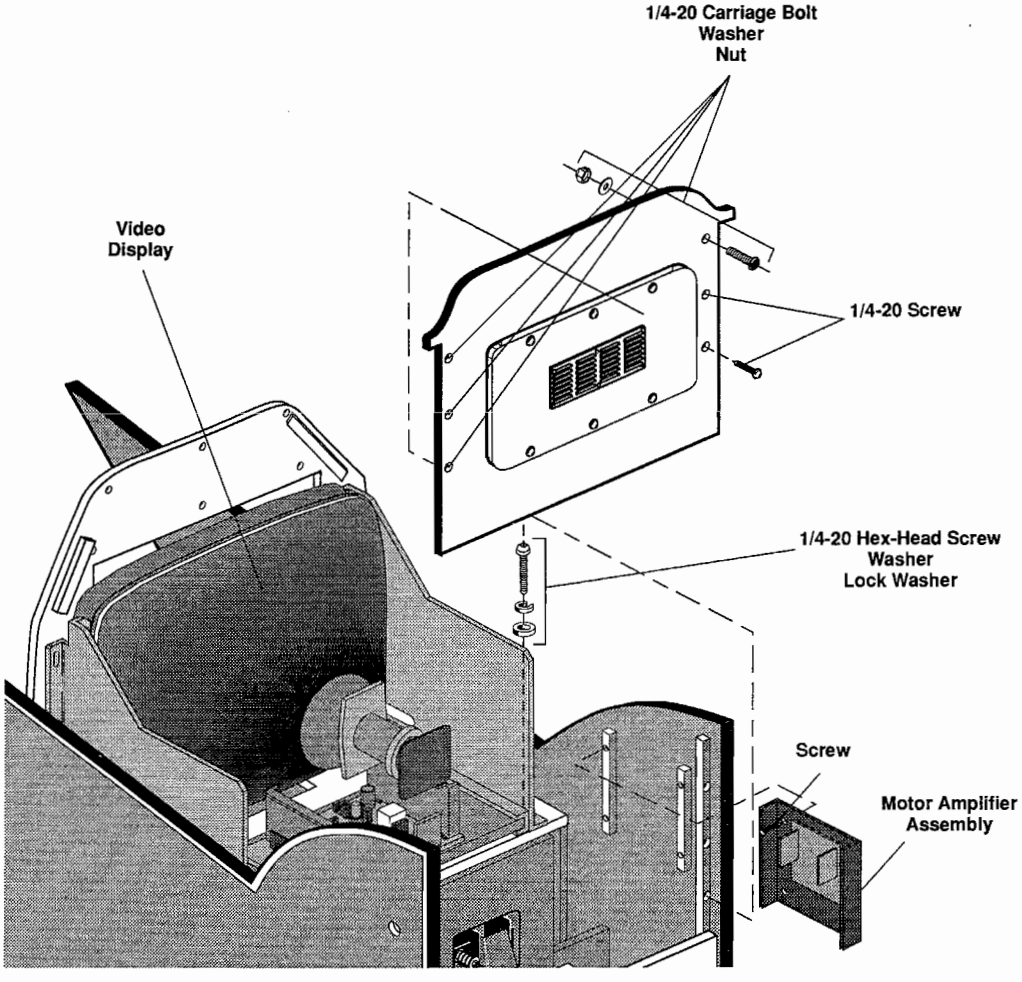


Figure 3-16 Removing the Video Display

a. Attach one end of a solid 18-gauge wire to a well-insulated screwdriver or wooden handle.

b. Attach the other. end of the wire to an earth ground.

c. Quickly touch the blade end of the screwdriver to the CRT anode by sliding it under the anode cap.

d. Wait two minutes and repeat part c.

5. Disconnect the video display harness connectors from the display.
6. Remove the motor amplifier PCB and heat sink assembly from the cabinet side.
7. Remove the four screws and washers that hold the video display on the shelf.
8. Pull the video display out of the back of the cabinet.

WARNING

When you take the video display out of the cabinet, do not drop it!

To make the removal easier, we recommend that two people work together to remove the display. You should wear gloves to protect your hands from the sheet-metal edges.

---

9. Replace the video display as described in the following procedure.

Replacing the Video Display

Perform the following procedure to replace the video display in the cabinet. (See Figure 3-16.)

1. Carefully lift the video display onto the display shelf in the cabinet.

NOTE

When you replace the cathode-ray tube and yoke as a single unit, adjust the brightness, size, and centering as described in the display manual. Check the purity and convergence according to the display manual instructions, but adjust both only if required.

2. Position the display so that the four holes in the video display mounting brackets line up with the four holes in the video display shelf.
3. Loosely install the four hex-head screws and washers through the mounting brackets and into the video display shelf.
4. Push the video display forward against the bezel.
5. Tighten the screws. Be sure that the display is centered horizontally in the bezel.
6. Install the motor amplifier PCB and heatsink on the cabinet side.
7. Connect the display harnesses to the display.
8. Replace the large and small top service panels.

Motor Amplifier Assembly

Removing the Motor Amplifier Assembly

1. Turn the simulator power off and wait two minutes. Leave the power cord plugged in.

WARNING

The PCBs in this assembly contain lethal high voltages. To avoid injury, do not attempt to service this display until you observe all precautions necessary for working on high-voltage equipment.

2. Unplug the power cord.
3. Take off the harness to the boards.
4. Remove the entire assembly from the cabinet. Do not remove the PCBs from the heat sink.
5. Send the entire assembly back to Atari Games Customer Service for trade-in.

Static-Sensitive Devices

Replacing Static-Sensitive Devices

Be careful when you are working with static-sensitive devices on the simulator PCBs. These can be microprocessors, field-effect transistors (FET), complementary metal-oxide semiconductors (CMOS), and other large-scale integration (LSI) devices that use metal-oxide semiconductor (MOS) technology.

Static charge that has built up in your body can cause a static-sensitive device to fail. Leakage from an improperly grounded soldering iron can also cause a static-sensitive device to fail.

Before you handle a static-sensitive device or a PCB with such devices attached to it, ground any static voltage that may have accumulated in your body by touching an object that has been earth grounded. When you solder a static-sensitive device, use a soldering iron with a properly grounded three-wire cord.

Before you replace a static-sensitive device, make sure it is actually defective. A static-sensitive device can appear defective due to leakage on a PCB. To make sure a device is defective, ground any static voltages as described in the paragraph above. Clean both sides of the PCB with flux remover or an eraser. For discrete FETs, clean thoroughly between the gate, drain, and source leads. Then test the device.

If you are replacing a static sensitive device, new static-sensitive devices may be packaged in conductive foam or may have a protective shorting wire attached to the pins. Remove the conductive foam just prior to inserting the device into its socket or soldering it to a PCB. Remove the shorting wire only after the device is inserted into its socket or after all the leads are soldered in place.

Speakers

If you are having problems with a speaker, check the suggestions in Table 3-12, *Troubleshooting the Speakers*, before you replace it.

Removing a Speaker

1. Turn the simulator power off.
2. Remove the dashboard, following the directions in the section *Removing the Dashboard*.

CAUTION

Be careful when handling the speaker. The cone material is fragile and can be easily damaged.

3. Remove and replace the speaker.
4. Install the dashboard, following the directions in the section *Installing the Dashboard.*

Cleaning the Coin Mechanism

Use a soft-bristled brush to remove loose dust or foreign material from the coin mechanism. A toothbrush can be used to remove any stubborn build-up of residue in the coin path. After cleaning the coin mechanism, blow out all of the dust with compressed air.

Cleaning the Interior Components

Perform the following procedure to clean the components inside the cabinet.

1. Open the small top service panel and bottom service door.

WARNING

Turn off the simulator power, but do not unplug the power cord before cleaning inside the cabinet. The power cord provides a ground path for stray static voltages that can be present on the cleaning tools.

2. Discharge the high voltage from the cathode-ray tube (CRT) before proceeding. The display assembly contains a circuit for discharging the high voltage to ground when power is removed. However, to make certain, always discharge the display as follows:
   a. Attach one end of a solid gauge wire to a well-insulated screwdriver or wooden handle.
   b. Attach the other end of the wire to an earth ground.
   c. Quickly touch the blade end of the screwdriver to the CRT anode by sliding it under the anode cap.
   d. Wait two minutes and repeat part c.
3. Use a vacuum cleaner with a soft long-bristled brush attachment or use a soft-bristled paint brush to remove loose dirt and dust accumulated on the inside of the cabinet. Be sure to clean the electrical components thoroughly (power supply, PCB assemblies, video display, etc.).

CAUTION

Be extremely careful when cleaning the electrical components inside the cabinet. Avoid touching the electrical components with any solid object other than the soft bristles of the vacuum attachment or paint brush.

Table 3-12 Troubleshooting the Speakers

Problem	Solution
No sound	Make sure the volume is turned up.
	If the volume is turned up, do the following:
	Do the self-test to make sure you do not have a sound PCB problem.
	Check the voltage level to the sound PCB.
	Check the wiring.
	Replace the speaker if defective.
	If none of the above work, the problem may be on the APU PCB or the main PCB.

Chapter 4

Illustrated Parts Lists

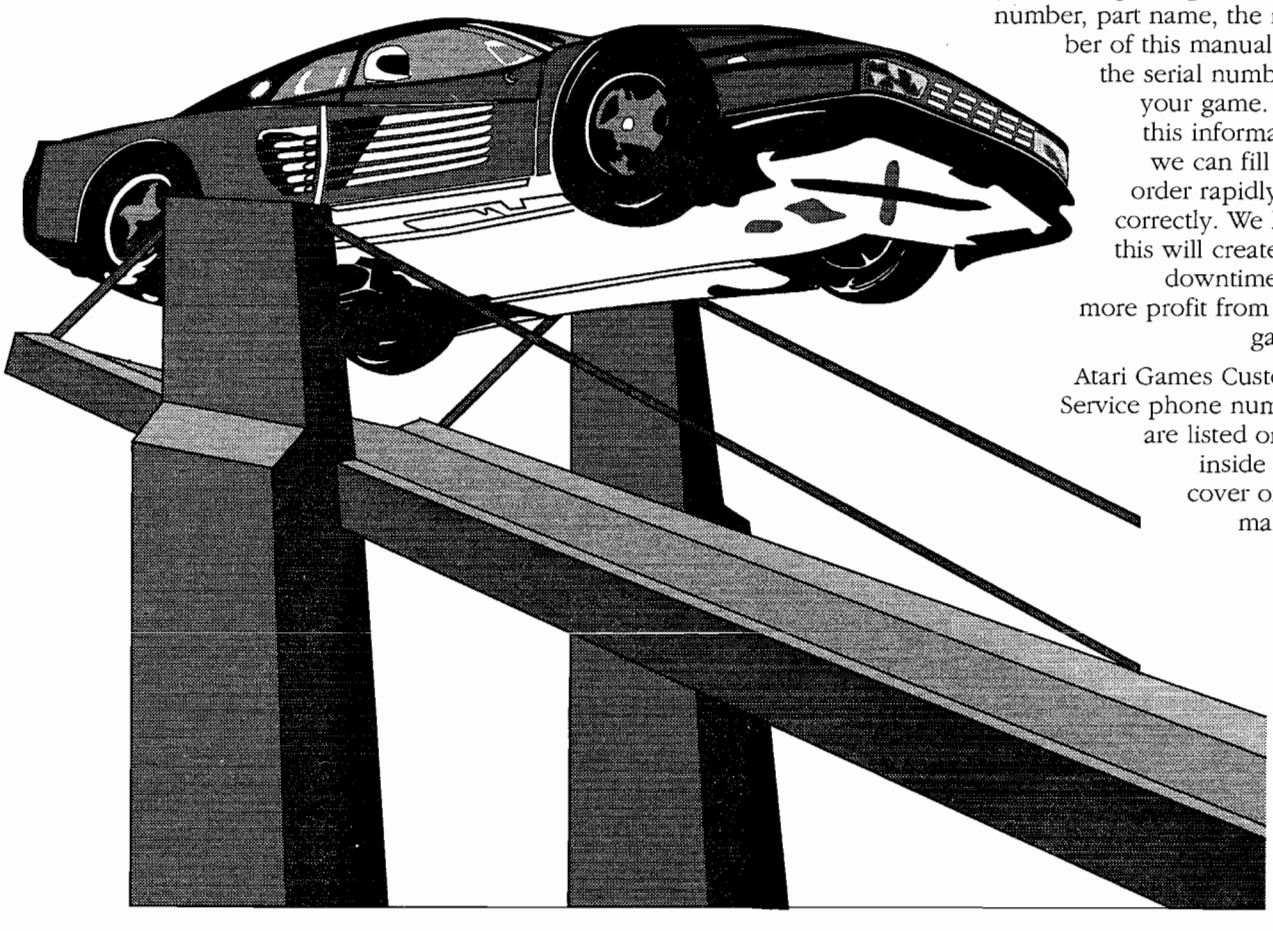
This chapter provides information you need to order parts for your game.

The parts lists (except for the PCB parts lists) are arranged alphanumerically by Atari part number. All A-prefix numbers, which are assemblies, come first. Next are part numbers with six numbers followed by a hyphen (000598- through 201000-). Ending the list are part numbers with a two-number designation followed by a hyphen (00- through 99-).

The PCB parts lists are arranged in alphabetical order by component. Within each section the parts are arranged numerically by part number.

When you order parts, give the part number, part name, the number of this manual, and the serial number of your game. With this information, we can fill your order rapidly and correctly. We hope this will create less downtime and more profit from your games.

Atari Games Customer Service phone numbers are listed on the inside front cover of this manual.



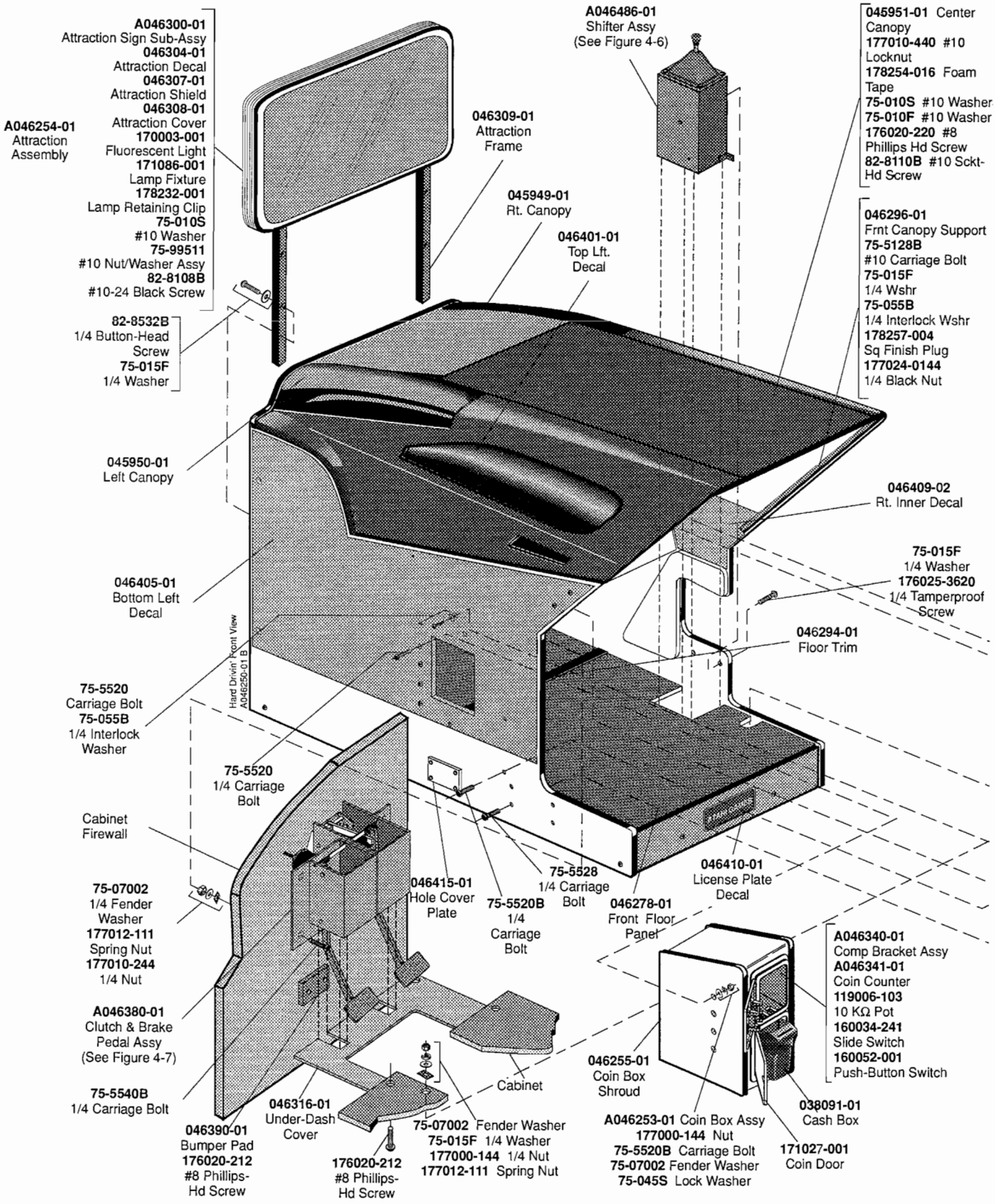
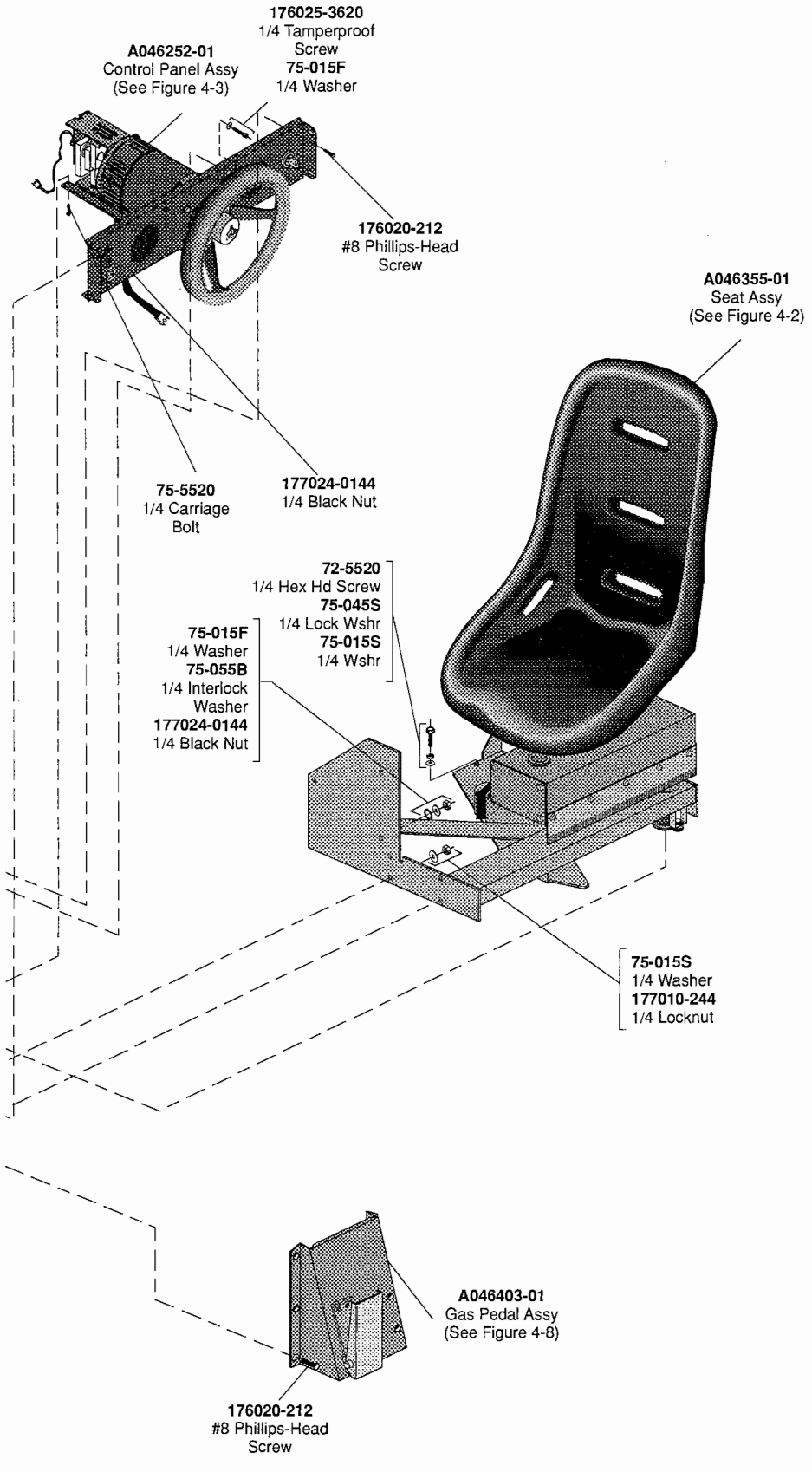


Figure 4-1 Cabinet-Mounted Assemblies, Front View A046250-01 B



Not Shown:

A043705-01
Fan Cord Assy
A046338-01
Attraction Harness Assy
A046321-01
Main Harness Assy
A046322-01
Power Harness Assy
A046323-01
AC Harness Assy
A046324-01
Video Harness Assy
A046325-01
Motor Interconnect Harness Assy
A046326-01
PCB Interconnect Harness Assy
A046335-01
Shifter Ribbon Cable Assy
A046336-01
Motor Ribbon Cable Assy
A046337-01
PCB Ribbon Cable Assy
A039254-01
Component Bracket Harness Assy
046401-02
Top Rt. Decal
046409-01
Lft. Inner Decal
148007-104
Speaker
178126-002
Tamperproof Hex Key Driver

75-015F
1/4 Black Washer
82-8532B
1/4 Button-Hd Screw
(holding attraction frame to attraction sign sub-assy)

Figure 4-1 Cabinet-Mounted Assemblies, Front View, Continued
A046250-01 B

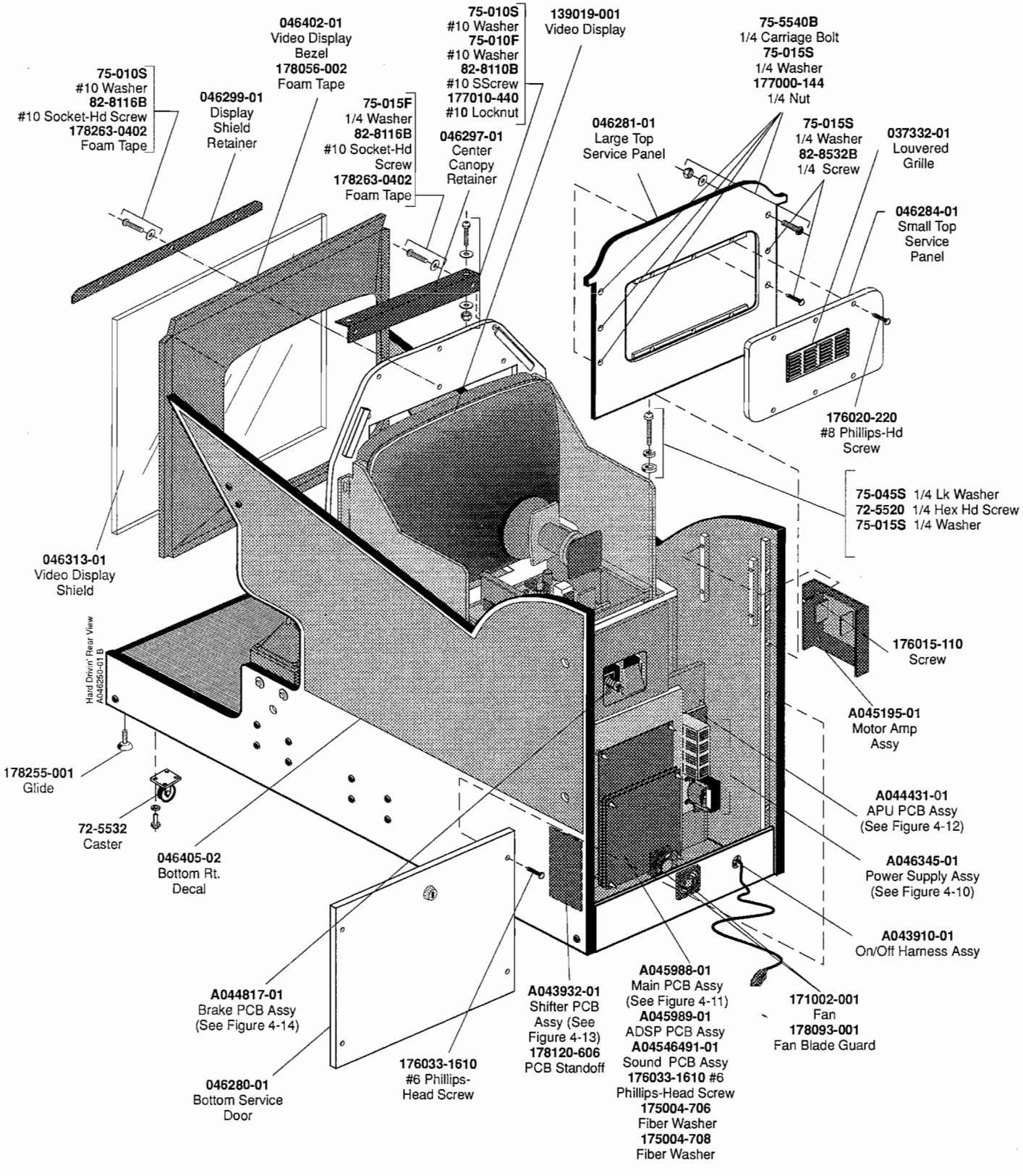


Figure 4-1 Cabinet-Mounted Assemblies, Rear View A046250-01 B

Cabinet-Mounted Assemblies
Parts List

Part No.	Description
A043705-01	12-Inch Fan Cord Assembly
A043910-01	On/Off Harness Assembly
A043932-01	Shifter PCB Assembly (See Figure 4-13)
A044431-01	APU PCB Assembly (mounted on Power Supply Assembly) (See Figure 4-12)
A044817-01	Brake PCB Assembly (mounted on Clutch and Brake Assembly) (See Figure 4-14)
A045195-01	Motor Amplifier Assembly
A045988-01	Hard Drivin' Main PCB Assembly (See Figure 4-11)
A045989-01	ADSP PCB Assembly
A046252-01	Control Panel Assembly (See Figure 4-3)
A046253-01	Coin Box Assembly
A046254-01	Attraction Assembly. Replaceable Parts:
A046300-01	Attraction Sign Sub-Assembly
A046338-01	Attraction Harness Assembly
046304-01	Attraction Decal
046307-01	Attraction Shield
046308-01	Attraction Cover
170003-001	18-Inch, 15 Watt Fluorescent Light
171086-001	18-Inch Fluorescent Lamp Fixture
178232-001	Fluorescent Lamp Retaining Clip
75-010S	#10 Washer
75-99511	#10 Nut/Washer Assembly
82-8108B	#10-24 x 1/2-Inch Black Screw
A046256-01	Cabinet
A046321-01	Main Harness Assembly
A046322-01	Power Harness Assembly
A046323-01	AC Harness Assembly
A046324-01	Video Harness Assembly
A046325-01	Motor Interconnect Harness Assembly
A046326-01	PCB Interconnect Harness Assembly
A046335-01	Ribbon Cable Assembly to the Shifter
A046336-01	Ribbon Cable Assembly to the Motor
A046337-01	Ribbon Cable Assembly to the PCBs
A046340-01	Component Bracket Assembly
A039254-01	Component Bracket Harness Assembly
A046341-01	Coin Counter Assembly
119006-103	10 KΩ Potentiometer Audio Taper
160034-241	Slide Switch
160052-001	Push-Button Switch
A046345-01	Power Supply Assembly (See Figure 4-10)
A046355-01	Seat Assembly (See Figure 4-2)
A046380-01	Clutch And Brake Pedal Assembly (See Figure 4-7)
A046403-01	Gas Pedal Assembly (See Figure 4-8)
A046486-01	Shifter Assembly (See Figure 6-6)
A046491-01	Sound PCB Assembly
038091-01	Cash Box

Part No.	Description
045949-01	Right Canopy
045950-01	Left Canopy
045951-01	Center Canopy
046255-01	Coin Box Shroud
046278-01	Front Floor Panel
046280-01	Bottom Service Door
046281-01	Large Top Service Panel
046284-01	Small Top Service Panel
046294-01	Floor Trim
046296-01	Front Canopy Support
046297-01	Center Canopy Retainer
046299-01	Display Shield Retainer
046309-01	Attraction Frame
046313-01	Monitor Shield
046316-01	Under-Dash Cover
046390-01	Bumper Pad
046401-01	Top Left Decal
046401-02	Top Right Decal
046402-01	Video Display Bezel
046405-01	Bottom Left Decal
046405-02	Bottom Right Decal
046409-01	Left Inner Decal
046409-02	Right Inner Decal
046410-01	Number Plate Decal
046415-01	Hole Cover Plate
139019-001	25-Inch Framed Color Raster, Medium Resolution Video Display
148007-104	4 1/2-Inch Diameter, 8Ω, 10W Shielded Speaker
171002-001	Exhaust Fan
171027-001	Coin Door (See Figure 4-9)
175004-706	.154 I.D., .375 O.D. Fiber Washer
175004-708	.190 I.D., .640 O.D. Fiber Washer
176020-208	#8 x 1/2-Inch Black Phillips-Head Screw
176020-212	#8 x 3/4-Inch Black Phillips-Head Screw
176020-220	#8 x 1 1/4-Inch Black Phillips-Head Screw
176025-3620	1/4 Black Tamperproof Screw
176033-1610	#6 x 5/8-Inch Phillips-Head Screw
177000-144	1/4 Hex Nut
177010-244	1/4-20 Polymer Locknut
177010-440	#10-24 Polymer Locknut
177012-111	Push On Spring Nut
177024-0144	1/4-20 Low Crown Black Nut
178056-002	1/2-Inch Wide Foam Tape
178093-001	Fan Blade Guard
178120-606	PCB Standoff
178126-002	Tamperproof Hex Key Driver
178254-016	Double-Coated Acrylic Foam Tape

Cabinet-Mounted Assemblies
Parts List

Part No.	Description
178255-001	Adjustable Swivel Glide
178257-004	Black Square Finish Plug
178263-0402	1/4-Inch Wide Foam Tape
178263-0604	3/8-Inch Wide Foam Tape
72-5116	#10-24 Hex Head Screw
72-5520	1/4-20 x 1 1/4 Hex Head Screw
72-5532	4 1/2-Inch Swivel Caster
72-5528	1/4 x 3/4 Inch Hex Head Screw
75-010F	#10 Flat Black Washer
75-010S	#10 Flat Washer
75-015F	1/4 Steel Flat Black Washer
75-015S	1/4 Flat Washer
75-040S	#10 Steel Split-Lock Washer
75-045S	1/4 Steel Split-Lock Washer
75-055B	1/4 Steel Black Oxide Interlock Washer
75-5128B	#10-24 x 1 3/4-Inch Black Carriage Bolt
75-5520B	1/4-20 x 1 1/4-Inch Round Head, Square Neck Black Carriage Bolt
75-5528B	1/4-20 x 1 1/2-Inch Round Head, Square Neck Black Carriage Bolt
75-5540B	1/4-20 x 2 1/2-Inch Black Carriage Bolt
75-07002	1/4 Fender Washer
75-99516	#6-32 Nut/Washer Assembly
75-99518	#8-32 Nut/Washer Assembly
82-8110B	#10-24 x 5/8-Inch Black Hex Socket Button-Head Screw
82-8116B	#10-24 x 1-Inch Black Hex Socket Button-Head Screw
82-8532B	1/4-20 x 2-Inch Black Button-Head Screw
	Documentation for the Hard Drivin' game:
SP-327	Hard Drivin' Schematic Package
ST-327	Hard Drivin' Self-Test Label
TM-295	Wells-Gardner 25-Inch, Med Res, Color Display Service Manual (for Model 25K5515)
TM-327	Hard Drivin' Operator's Manual

N O T E S

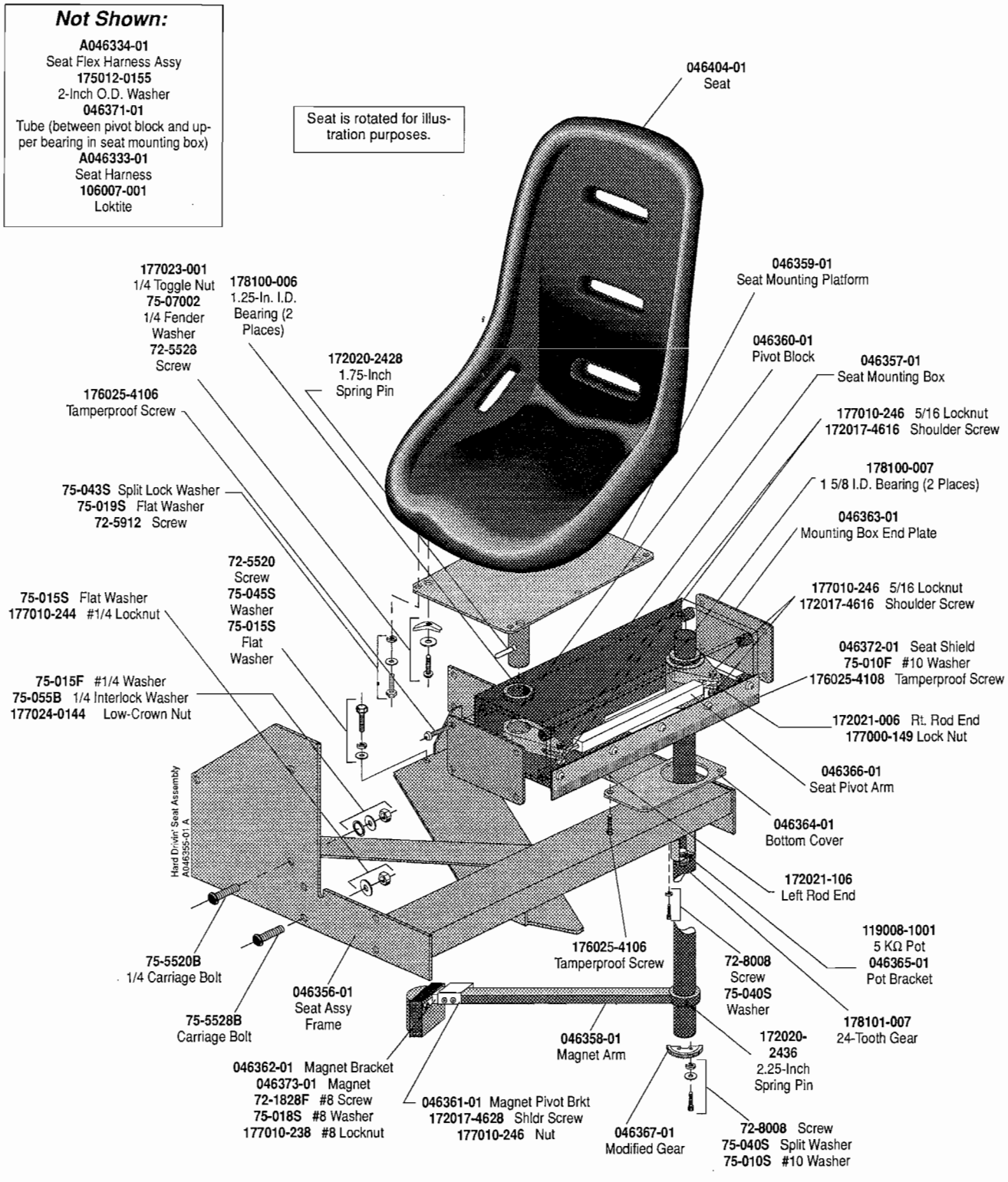


Figure 4-2 Seat Assembly A046355-01 A

Seat Assembly
Parts List

Part No.	Description
A046333-01	Seat Harness Assembly
A046334-01	Seat Flex Harness Assembly
046356-01	Metal Seat Frame
046357-01	Seat Mounting Box
046358-01	Magnet Arm
046359-01	Seat Mounting Platform
046360-01	Seat Pivot
046361-01	Magnet Pivot Bracket
046362-01	Magnet Bracket
046363-01	Mounting Box End Plate
046364-01	Bottom Cover for Mounting Box
046365-01	Potentiometer Bracket
046366-01	Seat Pivot Arm
046367-01	Modified Gear
046371-01	Tube
046372-01	Seat Shield
046404-01	Seat
046373-01	Magnet
106007-001	Loktite 290
119008-1001	5 KΩ Potentiometer
172017-4616	5/16-18 x 1-Inch Long Shoulder Socket-Head Screw
172017-4628	5/16-18 x 1.75-Inch Long Shoulder Socket-Head Screw
172020-2428	.375-Inch Diameter x 1.75-Inch Slotted Spring Pin
172020-2436	.375-Inch Diameter x 2.25-Inch Slotted Spring Pin
172021-006	3/8-Inch Diameter, 3/8-24 Rod End
172021-106	3/8-Inch Diameter, 3/8-24 Rod End—Left Hand Thread
175012-0155	2.0-Inch O.D. Washer

Part No.	Description
176025-4106	#10-32 x 3/8-Inch Tamperproof Screw
176025-4108	#10-32 x 1/2-Inch Tamperproof Screw
177000-149	3/8-24 Hex Nut
177010-238	#8-32 Polymer Locknut
177010-244	#1/4-20 Polymer Locknut
177010-246	5/16-18 Polymer Lock Nut
177023-001	1/4-20 Toggle Nut
177024-0144	Low-Crown Nut
178100-007	1 5/8-Inch I.D. Bronze Bearing
178100-006	1.25-Inch I.D. Bronze Bearing
178101-007	24-Tooth Spur Gear
72-1828F	#8-32 x 1 3/4-Inch Phillips-Head Screw
72-5516	#1/4-20 x 1-Inch Hex-Head Screw
72-5528	#1/4-20 x 1 3/4-Inch Hex-Head Screw
72-5520	1/4-20 x 1 1/4-Inch Hex-Head Screw
72-5912	5/16-18 x 3/4-Inch Hex-Head Screw
72-8008	#10-32 x 1/2-Inch Socket-Head Screw
75-010F	#10 Flat Black Washer
75-010S	#10 Flat Washer
75-015F	#1/4 Flat Black Steel Washer
75-015S	#1/4 Flat Washer
75-018S	#8 Flat Washer
75-019S	5/16 Flat Steel Washer
75-040S	#10 Split Lock Washer
75-043S	5/16 Steel Split-Lock Washer
75-045S	1/4 Steel Split-Lock Washer
75-055B	1/4 Interlock Washer
75-5520B	1/4-20 x 1 1/4-Inch Round Head, Square Neck Black Carriage Bolt
75-5528B	1/4-20 x 1 1/2-Inch Round Head, Square Neck Black Carriage Bolt
75-07002	1/4 Fender Washer

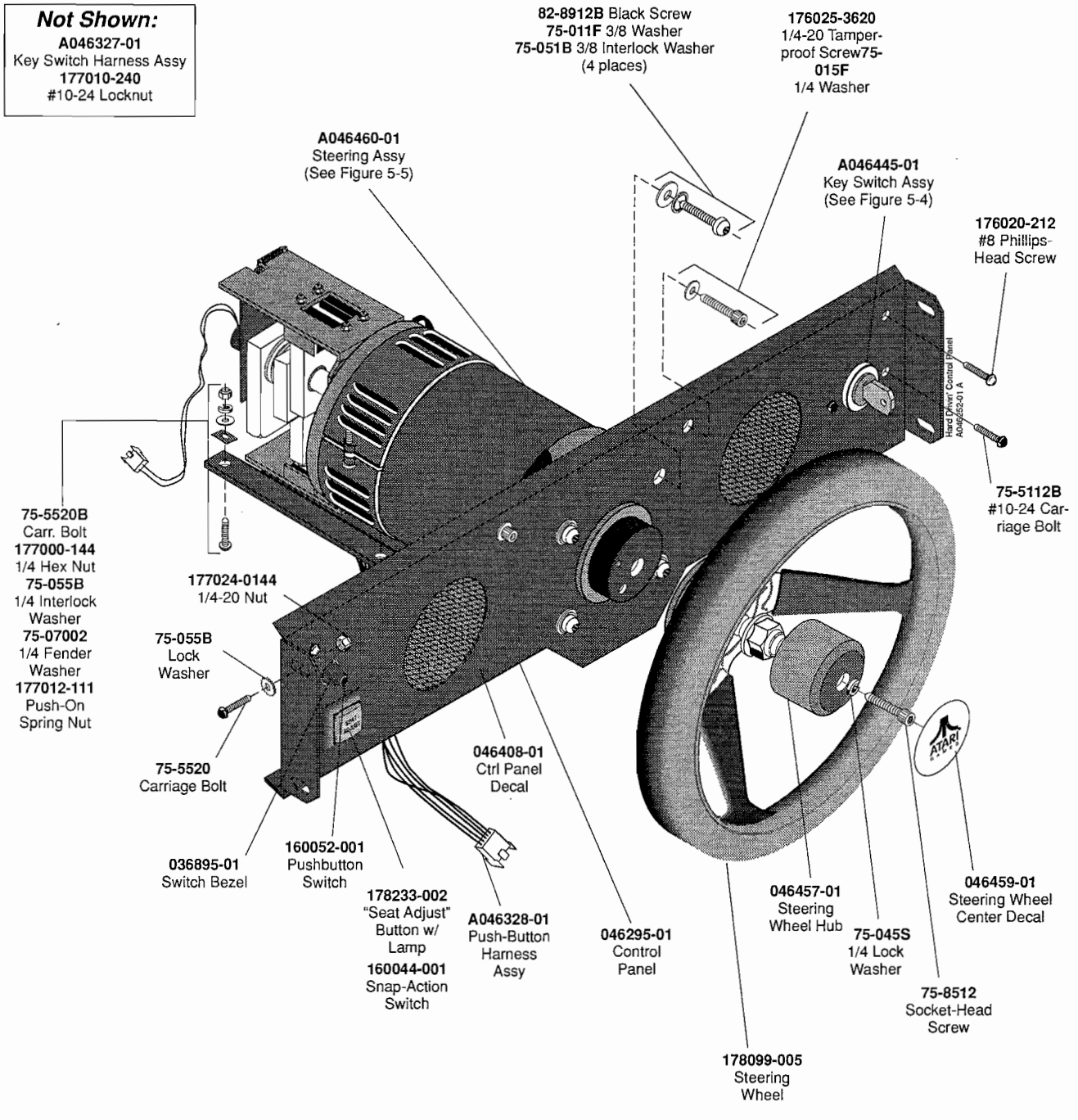


Figure 4-3 Dashboard Assembly A046252-01 A

Dashboard Assembly
Parts List

Part No.	Description
A046327-01	Key Switch Harness Assembly
A046328-01	Push Button Harness Assembly
A046445-01	Key Switch Assembly
A046460-01	Steering Assembly
036895-01	Push Button Switch Bezel
046295-01	Control Panel
046408-01	Control Panel Decal
160044-001	5V/5mA SPDT Snap-Action Switch
160052-001	Red, Lighted, SPDT Pushbutton Switch
176020-212	8 x 3/4-Inch Phillips-Head Screw
176025-3620	1/4-20 x 1 1/4-Inch Black Tamperproof Screw
177000-144	1/4 Hex Nut
177010-240	#10-24 Polymer Locknut
177012-111	Push-On Spring Nut
177024-0144	1/4-20 Low Crown Nut
178233-002	6.3 V "Seat Adjust" Button With Lamp Assembly
72-8512	1/4-20 x 3/4-Inch Socket-Head Screw
75-011F	3/8 Flat Black Washer
75-015F	1/4 Flat Steel Washer
75-045S	1/4 Split-Lock Washer
75-051B	3/8 Black Interlock Washer
75-055B	1/4 Interlock Washer
75-5108B	#10-24 x 1/2-Inch Black Carriage Bolt
75-5112B	#10-24 x 5/8-Inch Carriage Bolt
75-5520B	1/4-20 x 1 1/4-Inch Black Carriage Bolt
75-07002	1/4 Fender Washer
82-8912B	3/8-16 x 3/4-Inch Black Button-Head Screw

Not Shown:

172020-0814
Spring Pin
72-8006
#10-32 Socket-Head Screw
75-040S
#10 Split-Lock Washer

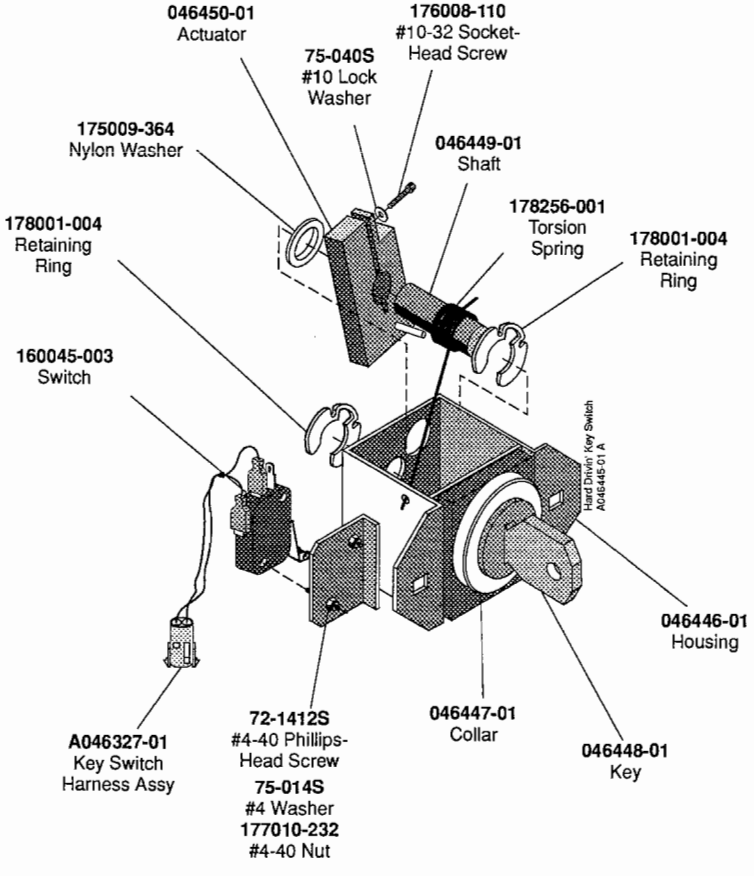


Figure 4-4 Key Switch Assembly A046445-01 B

Key Switch Assembly
Parts List

Part No.	Description
046446-01	Housing
046447-01	Collar
046448-01	Key
046449-01	Shaft
046450-01	Actuator
160045-003	SPDT Switch
172020-0814	0.125-Inch x 0.875-Inch Slotted Spring Pin
176008-110	#10-32 x 5/8-Inch Nyloc Socket-Head Screw

Part No.	Description
177010-232	#4-40 Nut
175009-364	Nylon Washer
178001-004	1/2-Inch Retaining Ring
178256-001	Torsion Spring
72-1412S	#4-40 x 3/4-Inch Phillips-Head Screw
72-8006	#10-32 x 3/8-Inch Socket-Head Screw
75-014S	#4 Flat Washer
75-040S	#10 Split-Lock Washer

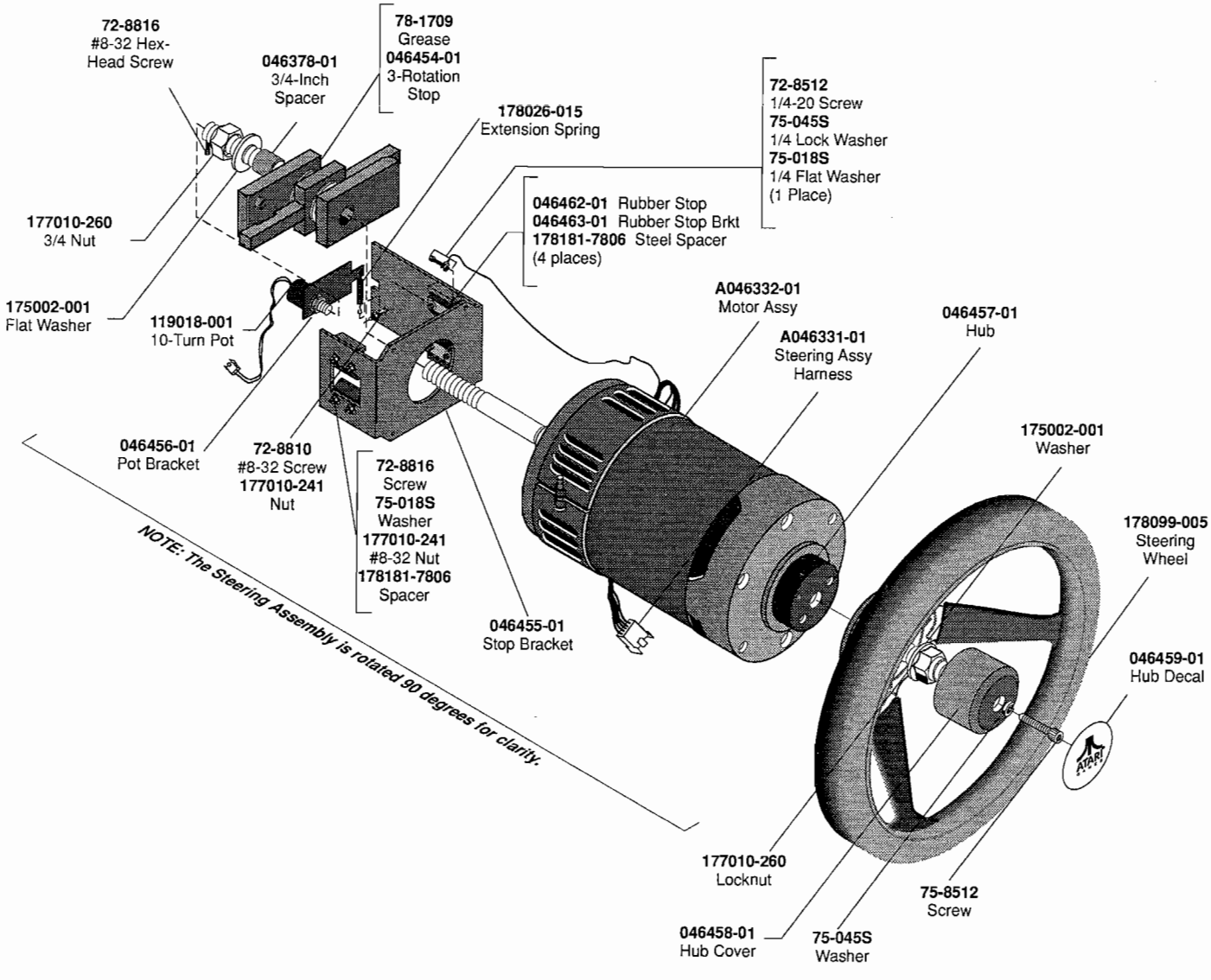


Figure 4-5 Steering Assembly
A046460-01 A

Steering Assembly Parts List

Part No.	Description
A046331-01	Steering Assembly Harness
A046332-01	Motor Assembly
046378-01	3/4-Inch Spacer
046454-01	3-Rotation Stop
046455-01	Stop Bracket
046456-01	Potentiometer Bracket
046457-01	Steering Wheel Hub
046458-01	Hub Cover
046459-01	Steering Wheel Hub Decal
046462-01	Rubber Stop
046463-01	Rubber Stop Bracket
119018-001	10-Turn Potentiometer
175002-001	0.750-Inch Flat Shaft Washer
176022-3806	#8-32 x 3/8-Inch Thread Lock Hex-Head Screw

Part No.	Description
177010-241	#8-32 Nyloc Nut
177010-260	3/4-16 Nyloc Nut
177011-260	3/4-16 Thin Nyloc Nut
178026-015	3/16-Inch O.D. x 1 3/8-Inch Extension Spring
178099-005	12-Inch Steering Wheel
178181-7806	3/8-Inch Long Steel Spacer
72-8512	1/4-20 x 3/4-Inch Hex-Head Screw
72-8806	#8-32 x 3/8-Inch Hex-Head Screw
72-8810	#8-32 x 5/8-Inch Hex-Head Screw
72-8816	#8-32 x 1-Inch Hex-Head Screw
75-015S	1/4 Flat Washer (for ground wire
75-018S	#8 Flat Washer
75-045S	1/4 Split-Lock Washer
78-1709	Grease

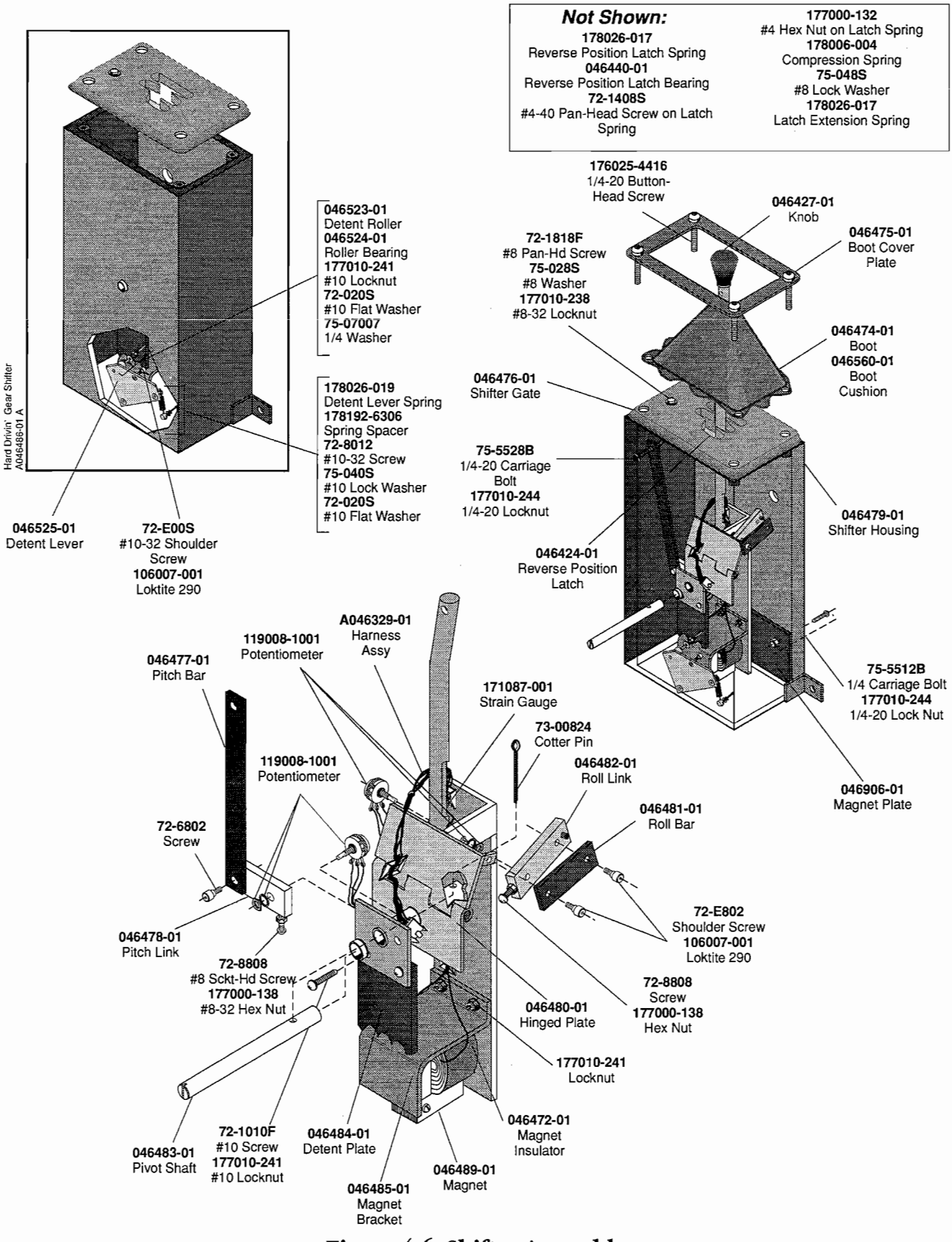


Figure 4-6 Shifter Assembly A046486-01 A

Shifter Assembly
Parts List

Part No.	Description
A046329-01	Harness Assembly
046424-01	Reverse Position Latch
046427-01	Knob
046440-01	Reverse Position Latch Bearing
046472-01	Magnet Insulator
046474-01	Boot
046475-01	Boot Cover Plate
046476-01	Shifter Gate
046477-01	Pitch Bar
046478-01	Pitch Link
046479-01	Shifter Housing
046480-01	Hinged Plate (assembled at factory with strain gauge)
046481-01	Roll Bar
046482-01	Roll Link
046483-01	Pivot Shaft
046484-01	Detent Plate
046485-01	Magnet Bracket
046489-01	Magnet
046523-01	Detent Roller
046524-01	Roller Bearing
046525-01	Detent Lever
046560-01	Boot Cushion
046906-01	Magnet Plate
106007-001	Loktite 290
119008-1001	5 KΩ Potentiometer
171087-001	Strain Gauge (assembled at factory with hinged plate)
176024-4108	#10-32 x 1/2-Inch Self-Locking Button-Head Screw

Part No.	Description
177000-132	#4 Hex Nut
177000-136	#6-32 Hex Nut
177000-138	#8-32 Hex Nut
177010-238	#8-32 Polymer Locknut
177010-241	#10-32 Polymer Locknut
177010-244	1/4-20 Polymer Locknut
178006-004	Compression Spring
178026-017	Reverse Position Latch Spring
178026-019	Detent Lever Spring
178192-6306	Spring Spacer
72-020S	#10 Flat Washer
72-1010F	#10-32 x 5/8-Inch Pan-Head Screw
72-1408S	#4-40 x 1/2-Inch Pan-Head Screw
72-1608F	#6-32 x 1/2-Inch Pan-Head Screw
72-1818F	#8-32 x 1 1/8-Inch Pan-Head Screw
72-8806	#8-32 x 3/8-Inch Socket-Head Screw
72-8808	#8-32 x 1/2-Inch Socket-Head Screw
72-8810	#8-32 x 5/8-Inch Socket-Head Screw
72-8012	#10-32 x 3/4-Inch Socket-Head Screw
72-E00S	#10-32 x .312-Inch Shoulder Screw
72-E802	0.187-Inch O.D. Shoulder Screw
73-00824	1/8-Inch Diameter x 1 1/2-Inch Cotter Pin
75-028S	#8 Flat Washer
75-040S	#10 Lock Washer
75-048S	#8 Lock Washer
75-07007	1/4 Flat Washer
75-5512B	1/4-20 x 3/4-Inch Carriage Bolt
75-5528B	1/4-20 x 1 3/4-Inch Carriage Bolt

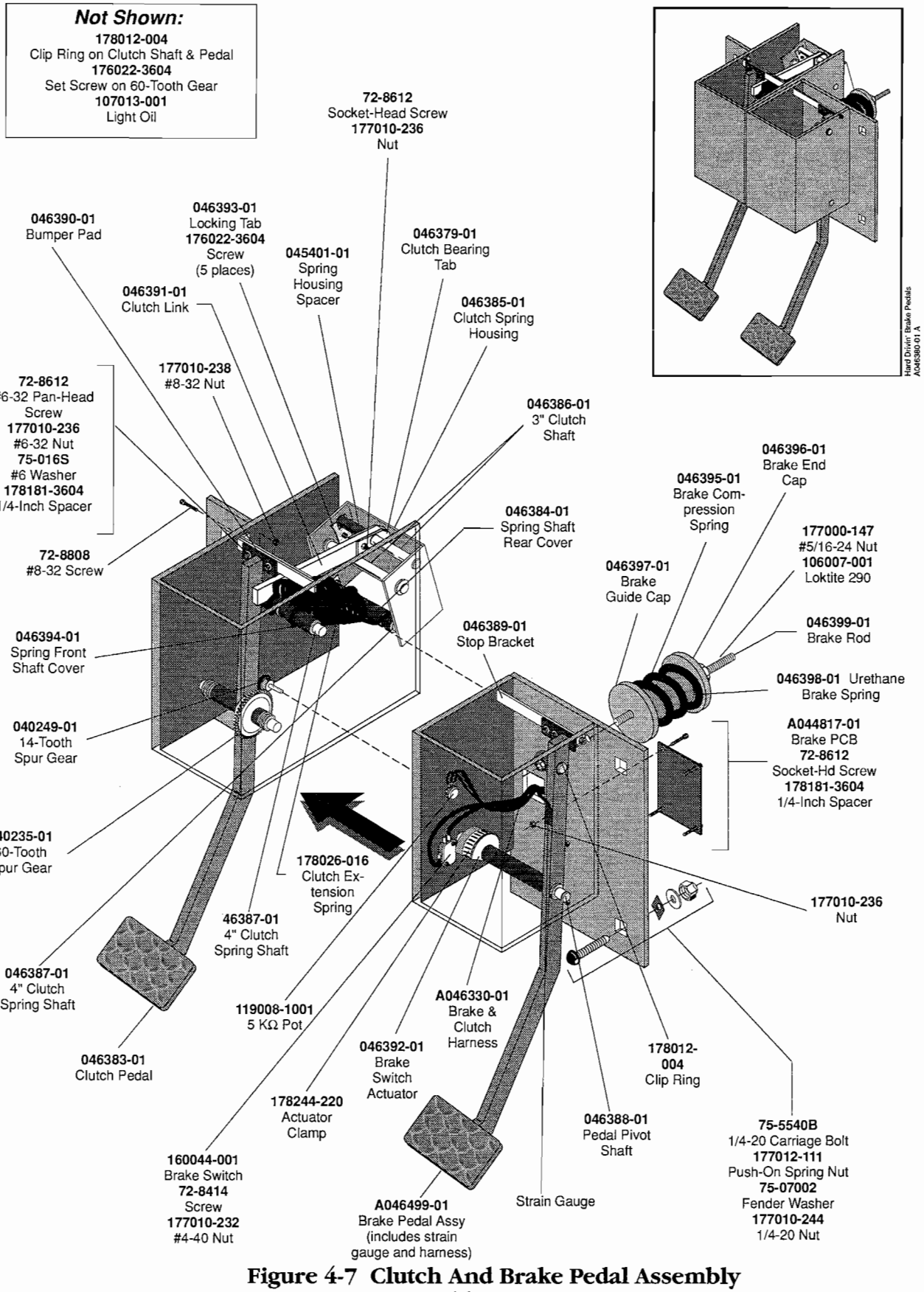


Figure 4-7 Clutch And Brake Pedal Assembly A046380-01 A

Clutch and Brake Pedal Assembly
Parts List

Part No.	Description
A044817-01	Brake PCB Assembly
A046330-01	Brake/Clutch Harness Assembly
A046499-01	Brake Pedal Assembly (includes strain gauge and strain gauge harness)
040249-01	14-Tooth Spur Gear with Hub (Acceptable substitute is part no. 046050-02 when used with part no. 72-8404, screw cap, and part no. 106007-001, adhesive.)
045401-01	Spring Housing Spacer (Acceptable substitutes are part nos. 178266-6620, 178266-3620, 178266-7620, 178266-0620, 178266-2620.)
046379-01	Clutch Bearing Tab
046383-01	Clutch Pedal
046384-01	Cover over Rear Spring Shaft
046385-01	Clutch Spring Housing
046386-01	3-Inch Clutch Shaft
046387-01	4-Inch Clutch Shaft
046388-01	Pedal Pivot Shaft
046389-01	Stop Bracket
046390-01	Bumper Pad
046391-01	Clutch Link
046392-01	Brake Switch Actuator
046393-01	Locking Tab
046394-01	Cover over the Front Spring Shaft
046395-01	Brake Compression Spring
046396-01	Brake End Cap
046397-01	Brake Guide Cap

Part No.	Description
046398-01	Urethane Brake Spring
046399-01	Brake Rod
106007-001	Loktite 290
107013-001	Light Oil
119008-1001	5 KΩ Clutch Potentiometer
160044-001	Snap-Action Brake Switch
171087-001	Strain Gauge (assembled at factory with brake pedal and shaft)
176022-3604	#6-32 x 1/4-Inch Socket-Head Screw
177000-147	#5/16-24 Nut
177010-232	#4-40 Nyloc Nut
177010-236	#6-32 Nyloc Nut
177010-238	#8-32 Nyloc Nut
177010-244	1/4-20 Nyloc Nut
177012-111	Push-On Spring Nut
178012-004	3/8-Inch Diameter Clip Ring
178026-016	Clutch Extension Spring
178181-3604	1/4-Inch Spacer
178244-220	Actuator Clamp
72-8412	#4-40 x 3/4-Inch Socket-Head Screw
72-8612	#6-32 x 3/4-Inch Pan-Head Screw
72-8808	#8-32 x 1/2-Inch Pan-Head Screw
75-015S	1/4 Flat Washer
75-016S	#6 Flat Washer
175-5520B	1/4-20 x 1 1/4-Inch Black Carriage Bolt
75-5540B	1/4-20 x 2 1/2-Inch Carriage Bolt
75-07002	Fender Washer

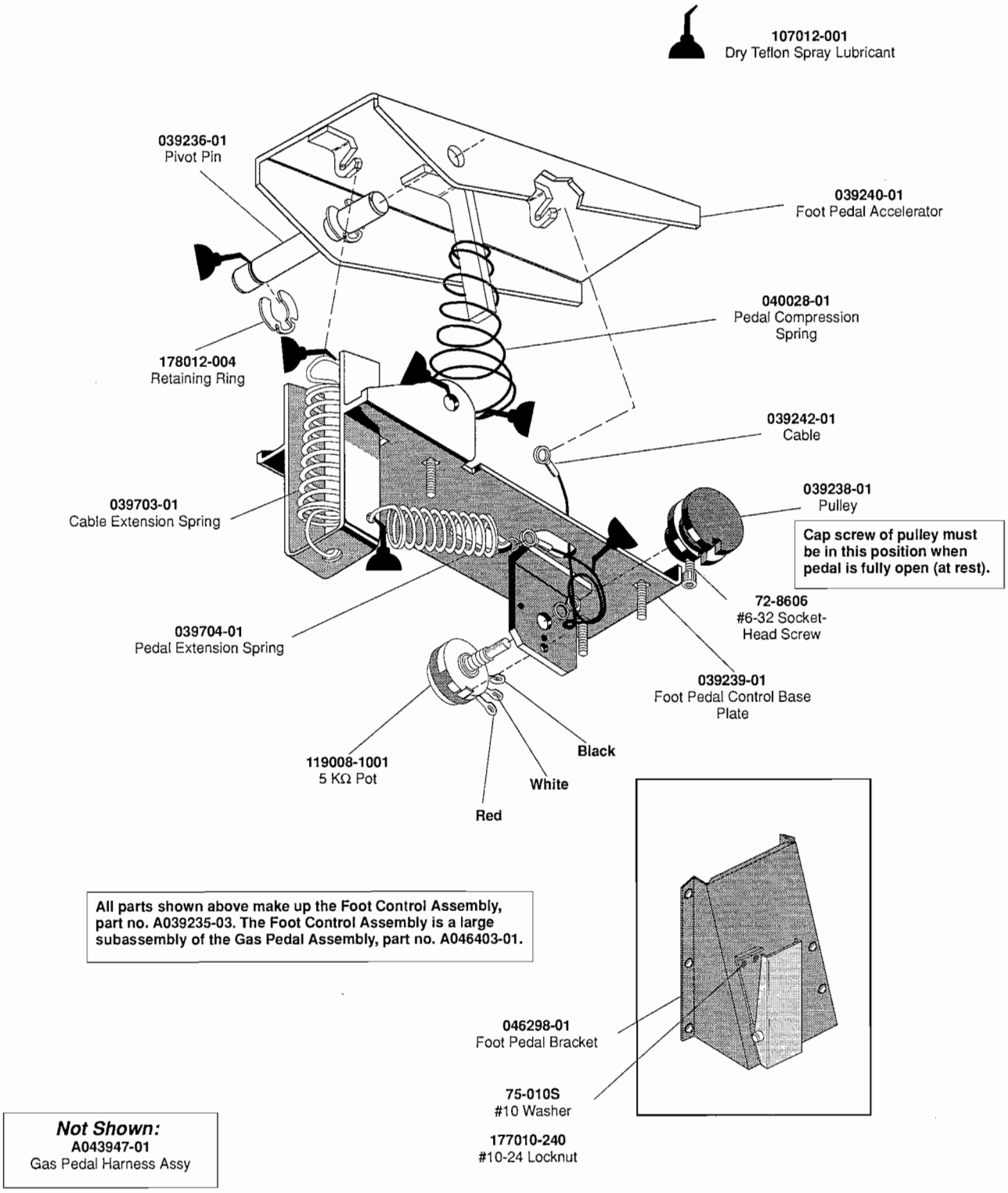


Figure 4-8 Gas Pedal Assembly A046403-01 E

Gas Pedal Assembly
Parts List

Part No.	Description
A039235-03	Foot Control Assembly. Replaceable Parts:
039236-01	Pivot Pin
039238-01	Pulley
039239-01	Foot Pedal Control Base Plate
039240-01	Foot Pedal Accelerator
039242-01	Cable
039703-01	Cable Extension Spring
039704-01	Pedal Extension Spring
040028-01	Pedal Compression Spring

Part No.	Description
107012-001	Dry Teflon Spray Lubricant
178012-004	Retaining Ring for 3/8-Inch-Diameter Shaft
119008-1001	5 KΩ Potentiometer
72-8606	#6-32 x .38-Inch Socket-Head Screw
A043947-01	Gas Pedal Harness Assembly
046298-01	Foot Pedal Bracket
177010-240	#10-24 Polymer Locknut
75-010S	#10 Flat Washer

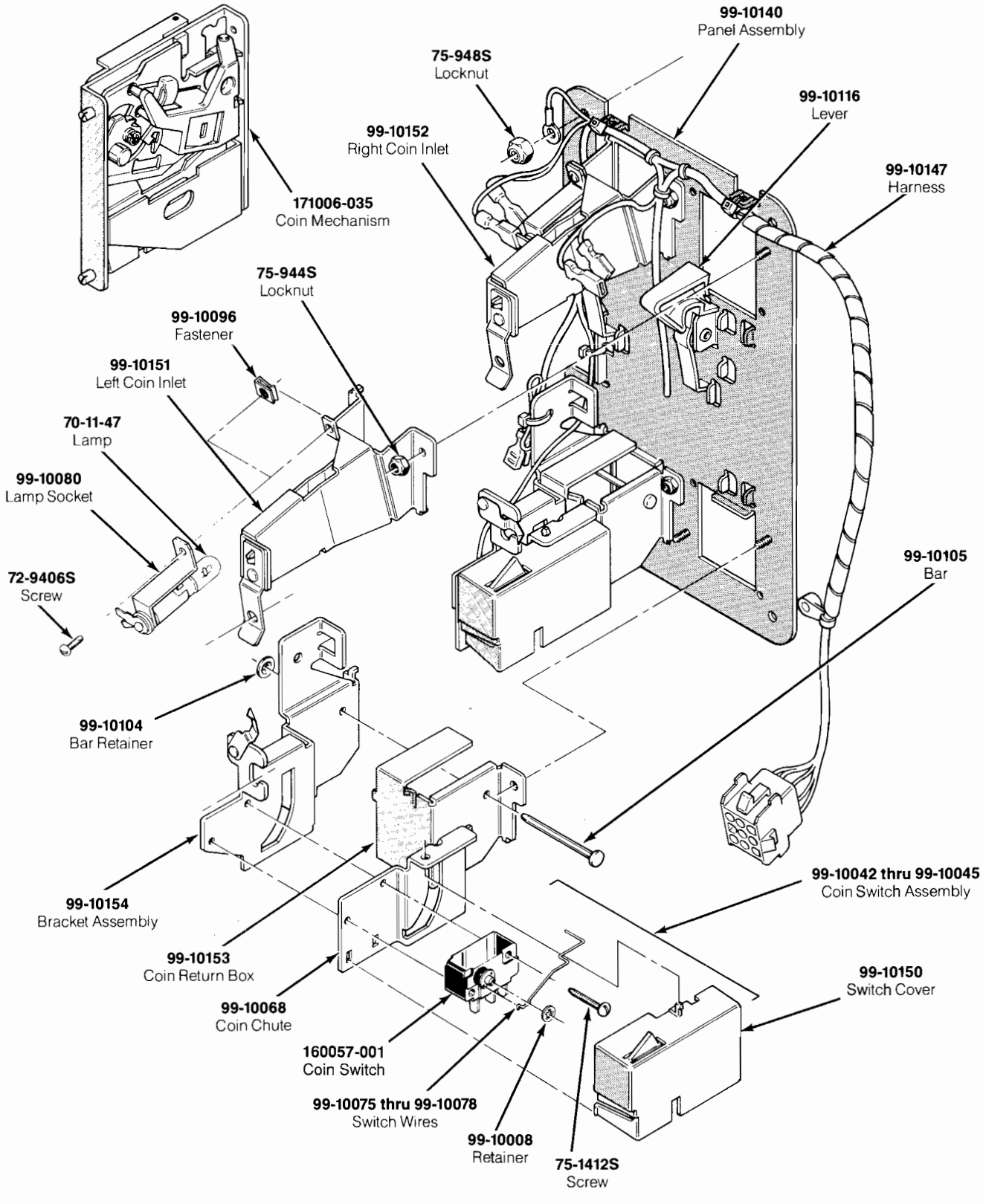


Figure 4-9 Coin Acceptors, Inc. Coin Door Assembly 171027-001 A

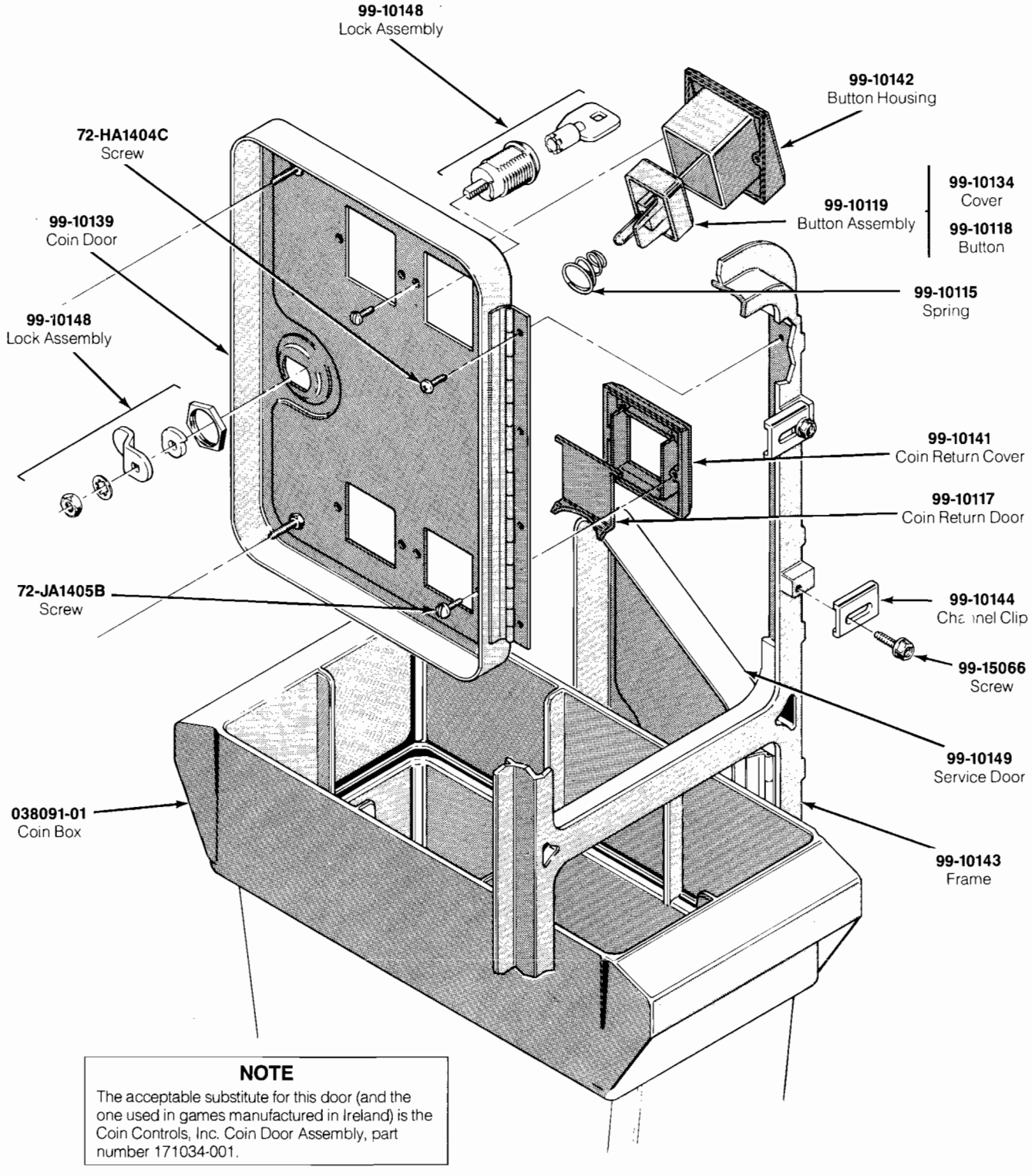


Figure 4-9 Coin Acceptors, Inc. Coin Door Assembly, Continued
171027-001 A

Coin Acceptors , Inc. Coin Door Assembly
Parts List

Part No.	Description
160057-001	Coin Switch
70-11-47	Miniature Bayonet Lamp
72-9406S	#4-40 x 3/8-Inch Truss-Head Screw
72-HA1404C	#4-40 x 1/4-Inch Pan-Head Screw
72-JA1405B	#4-40 x .31-Inch Pan-Head Screw
75-1412S	#4-40 x 3/4-Inch Pan-Head Screw
75-994S	#4-40 Locknut
99-10008	Retainer
99-10042	Coin Switch Assembly for Belgian 5 Fr and U.S. 25¢
99-10043	Coin Switch Assembly for German 1 DM, Japanese 100 Yen, Swiss 1 Fr
99-10044	Coin Switch Assembly for German 2 DM, Italian 100 L, U.S. $1.00
99-10045	Coin Switch Assembly for Australian $.20, German 5 DM, British 10 P
99-10068	Coin Return Chute
99-10075	Switch Wire (included in coin switch assembly 99-10043)
99-10076	Switch Wire (included in coin switch assembly 99-10042)
99-10077	Switch Wire (included in coin switch assembly 99-10044)
99-10078	Switch Wire (included in coin switch assembly 99-10045)
99-10080	Lamp Socket
99-10081	Key Holder
99-10096	Fastener
99-10104	Bar Retainer
99-10105	Bar
99-10115	Spring
99-10116	Plastic Coin Return Lever
99-10117	Steel Coin Return Door
99-10139	Coin Door
99-10140	Coin Door Inner-Panel Assembly
99-10141	Die-Cast Coin Return Cover
99-10143	Coin Door Frame
99-10144	Channel Clip
99-10147	Harness
99-10148	Lock Assembly
99-10149	Service Door
99-10150	Switch Cover
99-10151	Left Coin Inlet
99-10152	Right Coin Inlet
99-10153	Coin Return Box
99-10154	Bracket Assembly
99-10160	1-Inch Wide Die-Cast Coin Inlet Housing
99-10161	25¢ Amber Side-Entry Coin Button Assembly
99-15066	Screw for Clamp
171006-035	Metal Coin Mechanism for U.S. 25¢

N O T E S

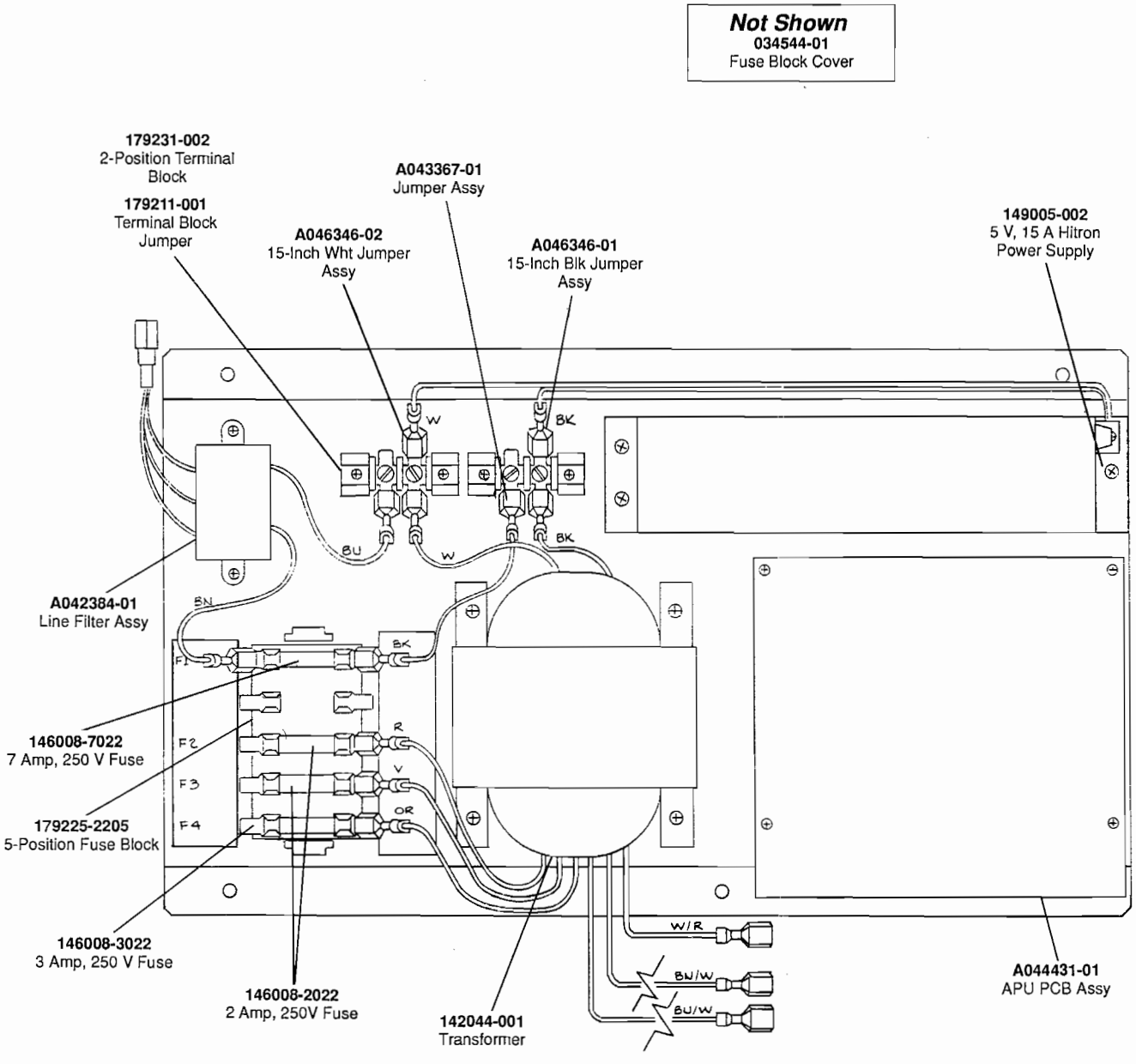


Figure 4-10 Power Supply Assembly A046345-01 A

Power Supply Assembly
Parts List

Part No.	Description
A042384-01	Line Filter Assembly
A043367-01	Jumper Assembly
A044431-01	Hard Drivin' Audio Power Unit (APU) PCB Assembly
A046346-01	15-Inch Black Jumper Assembly
A046346-02	15-Inch White Jumper Assembly
034544-01	Fuse Block Cover
142044-001	Transformer
146008-2022	2 Amp, 250V Slow Blow Fuse
146008-3022	3 Amp, 250 V, Slow Blow Fuse
146008-6272	6.25 Amp, 250 V, Slow Blow Fuse
149005-002	5 V, 15 A Hitron Switching Power Supply (see below)
179211-001	Terminal Block Jumper
179225-2205	5-Position Fuse Block
179231-002	2-Position Terminal Block

Hitron 5V, 15 A Switching Power Supply Sub-Assembly
Parts List

Part No.	Description
	Transistors
99-211002	Transistor, NPN, 2SC1413A
99-211003	Transistor, NPN, PE8050B
99-211004	Transistor, PNP, PE8550B
99-211062	Transistor, 2SD725
99-211063	Transistor, Pe8550B
	Diodes
99-211005	Diode, Schottky, S10SC4M
99-211006	Diode, Fast Recovery, 30DF1
99-211007	Diode, Zener, 1N752A
99-211008	Diode, Rectifier, 1N4006
99-211009	Diode, Fast Recovery, Rpg10B
99-211010	Diode, Fast Recovery, Rpg10K
99-211011	Diode, Fast Recovery, Rpg15B
99-211012	Diode, Switching, 1N4148
99-211064	Diode, S15SC4M
99-211076	Diode, 31DQ04
99-211013	Rectifier, Silicon Controlled, S2800
	Resistors
99-211014	Potentiometer, Trimming, 3K Ohm
99-211015	Resistor, Wire Wound, 50 Ohm, 5%, 2W
99-211016	Resistor, Wire Wound, 150 Ohm, 5%, 2W
99-211017	Resistor, Wire Wound, 33 Ohm, 5%, 2W
99-211018	Resistor, Wire Wound, 0.47 Ohm, 5%, 2W
99-211019	Resistor, Wire Wound, 120 Ohm, 5%, 2W
99-211020	Thermistor, 0.5 Ohm, 5%, 5W
99-211021	Resistor, 2.2K Ohm, 2%, 1/4W
99-211022	Resistor, Carbon Film, 330 Ohm, 5%, 1/2W
99-211023	Resistor, Carbon Film, 270 Ohm, 5%, 1/2W
99-211024	Resistor, Carbon Film, 470 Ohm, 5%, 1/4W
99-211025	Resistor, Carbon Film, 47 Ohm, 5%, 1/4W
99-211026	Resistor, Carbon Film, 330 Ohm, 5%, 1/4W
99-211027	Resistor, Carbon Film, 5.6 Ohm, 5%, 1/4W
99-211028	Resistor, Carbon Film, 8.2 Ohm, 5%, 1/4W
99-211029	Resistor, Carbon Film, 10 Ohm, 5%, 1/4W
99-211030	Resistor, Carbon Film, 39 Ohm, 5%, 1/4W
99-211031	Resistor, Carbon Film, 56 Ohm, 5%, 1/4W
99-211032	Resistor, Carbon Film, 1K Ohm, 5%, 1/4W
99-211033	Resistor, Metal Film, 2K Ohm, 2%, 1/4W
99-211034	Resistor, Carbon Film, 180K Ohm, 5%, 1W
99-211035	Resistor, Carbon Film, 2K Ohm, 5%, 1/4W
99-211065	Resistor, Wire Wound, 27 Ohm, 5%, 2W
99-211066	Resistor, Carbon Film, 6.8 Ohm, 5%, 1/2W
99-211067	Resistor, Carbon Film, 12 Ohm, 5%, 1/4W
99-211068	Resistor.Carbon Film, 2.4 Ohm, 5%, 1/2W
99-211077	Resistor, 470 Ohm, 1/2W, 5%
99-211078	Resistor, 120K Ohm, 1W, 5%
	Capacitors
99-211036	Capacitor, Metal Film, 0.047UF, 250V
99-211037	Capacitor, Metal Film, 0.22UF, 100V
99-211038	Capacitor, Metal Film, 0.1UF, 400V
99-211039	Capacitor, Metal Film, 0.022UF, 100V
99-211040	Capacitor, Ceramic, 1800PF, 2KV, Z5V
99-211041	Capacitor, Ceramic, 0.01UF, 1KV, Z5U
99-211042	Capacitor, Ceramic, 0.001UF, 2KV
99-211043	Capacitor, Ceramic, 470PF, 1KV, Z5P
99-211044	Capacitor, Electrolytic, 470UF, 25V
99-211045	Capacitor, Electrolytic, 220UF, 25V
99-211046	Capacitor, Electrolytic, 100UF, 200V
99-211047	Capacitor, Electrolytic, 1000UF, 25V
99-211048	Capacitor, Electrolytic, 2200UF, 16V
99-211049	Capacitor, Ceramic, 4700UF, 400V

Hitron Power Supply Sub-Assembly, Continued
Parts List

Part No.	Description
99-211069	Capacitor, Electrolytic, 2200UF, 16V
99-211070	Capacitor, Electrolytic, 220UF, 25V
99-211079	Capacitor, De7100F22M
99-211080	Capacitor, 1000UF, 35V
99-211081	Capacitor, 470UF, 25V
99-211082	Capacitor, 220UF, 16V
99-211090	Capacitor, Ceramic, 1000PF, 2KV
99-211091	Capacitor, Electrolytic, 2200UF, 10V
	Inductors
99-211050	Inductor, 7UH
99-211051	Inductor, 7UH, 35MM
99-211052	Inductor, 15MH
99-211053	Inductor, 1.5MH
99-211054	Inductor, 2.2UH
99-211071	Inductor, 9.8UH
99-211084	Inductor, 8UH
99-211085	Inductor, 9.8UH
99-211086	Inductor, 0.75MH
99-211087	Inductor, 2.2UH
99-211088	Inductor, 60MH

Part No.	Description
	Transformers
99-211075	Transformer, Power
99-211083	Transformer, Power
99-211089	Transformer, 4.75MH
99-211092	Transformer
99-211055	Transformer
	Miscellaneous
99-211001	Regulator, UA431AWC
99-211056	Fuse, 2A, 250V
99-211057	Terminal Block, 8CKT
99-211058	Fuse, 2A, 250V, Semko
99-211059	Heatsink
99-211060	Fuse Holder, 6.35MM
99-211061	Heatsink, 1.5MM
99-211072	Fuse Holder, 5.2X20
99-211073	Fuse, 2A, 125V
99-211074	Terminal Block, 9CKT

N O T E S

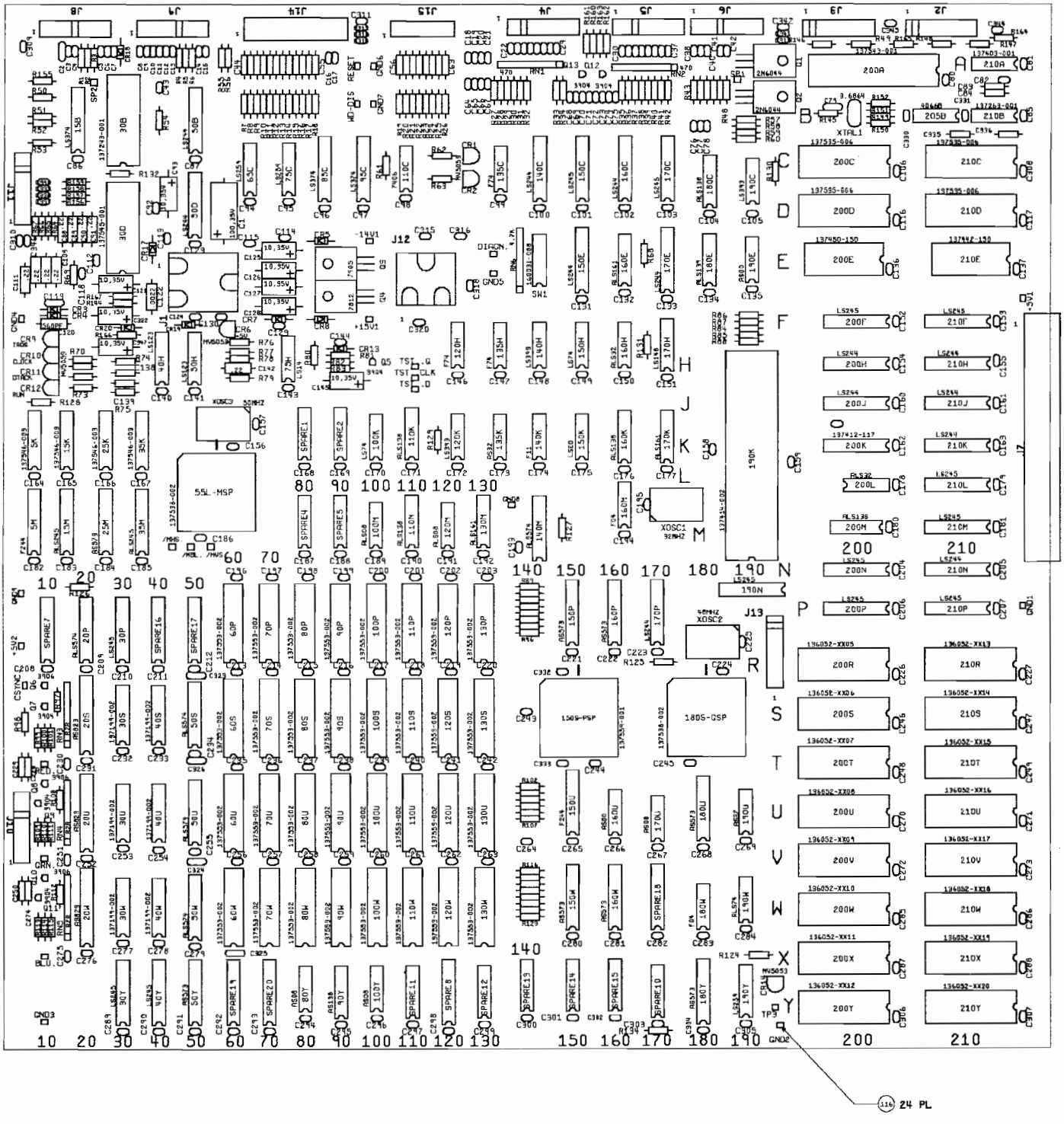


Figure 4-11 Hard Drivin' Main PCB Assembly
A044425-01 C

Hard Drivin' Main PCB Assembly
Parts List

Designator	Description	Part No.
	Integrated Circuits	
5K	Integrated Circuit, 4464, 64K X 4, DRAM	137546-003
5M	Integrated Circuit, 74F244	137502-001
15B	Integrated Circuit, 74LS374	137144-001
15K	Integrated Circuit, 4464, 64K X 4, DRAM	137546-003
15M	Integrated Circuit, 74ALS245	137440-001
20P	Integrated Circuit, 74ALS574	137548-001
20S, 20U	Integrated Circuit, 74AS823	137513-001
20W	Integrated Circuit, 74AS823	137513-001
25K	Integrated Circuit, 4464, 64K X 4, DRAM	137546-003
25M	Integrated Circuit, 74AS573	137547-001
30B	Integrated Circuit, ADC0809	137243-001
30D	Integrated Circuit, AD7582	137545-001
30P	Integrated Circuit, 74LS245	137134-001
30S, 30U	Integrated Circuit, 2149, 45 nsec	137199-002
30W	Integrated Circuit, 2149, 45 nsec	137199-002
30Y	Integrated Circuit, 74LS245	137134-001
35K	Integrated Circuit, 4464, 64K X 4, DRAM	137546-003
35M	Integrated Circuit, 74ALS245	137440-001
40H	Integrated Circuit, 74LS123	137268-001
40S, 40U	Integrated Circuit, 2149, 45 nsec	137199-002
40Y	Integrated Circuit, 74LS245	137134-001
50B, 50D	Integrated Circuit, 74LS244	137038-001
50H	Integrated Circuit, 74LS123	137268-001
50S, 50U	Integrated Circuit, 74ALS574	137548-001
50W	Integrated Circuit, 74ALS574	137548-001
50Y	Integrated Circuit, 74AS573	137547-001
55L-MSP	Integrated Circuit, 34010-50	137538-002
60P, 60S	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
60U, 60W	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
65C	Integrated Circuit, 74LS259	137137-001
70P, 70S	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
70U, 70W	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
75C	Integrated Circuit, 74LS259	137137-001
75H	Integrated Circuit, 74LS14	137056-001
80P, 80S	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
80U, 80W	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
80Y	Integrated Circuit, 74AS08	137484-001
85C	Integrated Circuit, 74LS374	137144-001
90P, 90S	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
90U, 90W	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-00290Y
	Integrated Circuit, 74AS138	137522-001
95C	Integrated Circuit, 74LS374	137144-001
100K	Integrated Circuit, 74LS74	137023-001
100M	Integrated Circuit, 74ALS08	137460-001
100P, 100S	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
100U, 100W	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
100Y	Integrated Circuit, 74AS08	137484-001
110C	Integrated Circuit, 7406	137052-001
110K, 110M	Integrated Circuit, 74ALS138	137517-001
110P, 110S	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
110U, 110W	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
120H	Integrated Circuit, 74F74	137436-001
120K	Integrated Circuit, 74LS393	137146-001
120M	Integrated Circuit, 74ALS08	137460-001
120P, 120S	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
120U, 120W	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
130M	Integrated Circuit, 74ALS161	137470-001
130P, 130S	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
130U, 130W	Integrated Circuit, VRAM, 64KX4, 150 nsec (Acceptable substitute is part no. 137553-001, Integrated Circuit, 64X4, VRAM, 120 nsec.)	137553-002
135C, 135H	Integrated Circuit, 74F74	137436-001
135K	Integrated Circuit, 74AS32	137487-001
140C	Integrated Circuit, 74LS244	137038-001
140H	Integrated Circuit, 74LS393	137146-001
140K	Integrated Circuit, 74F11	137583-001
140M	Integrated Circuit, 74ALS574	137548-001
150C	Integrated Circuit, 74LS245	137134-001

Hard Drivin' Main PCB Assembly
Parts List

Designator	Description	Part No.
150E	Integrated Circuit, 74LS244	137038-001
150H	Integrated Circuit, 74LS74	137023-001
150K	Integrated Circuit, 74LS20	137060-001
150P	Integrated Circuit, 74AS573	137547-001
150S-PSP	Integrated Circuit, 34012-50	137559-001
150U	Integrated Circuit, 74F244	137502-001
150W	Integrated Circuit, 74AS573	137547-001
160C	Integrated Circuit, 74LS244	137038-001
160E	Integrated Circuit, 74ALS161	137470-001
160H	Integrated Circuit, 74ALS32	137464-001
160K	Integrated Circuit, 74ALS138	137517-001
160M	Integrated Circuit, 74F04	137437-001
160P	Integrated Circuit, 74AS573	137547-001
160U	Integrated Circuit, 74AS00	137480-001
160W	Integrated Circuit, 74AS573	137547-001
170C	Integrated Circuit, 74LS245	137134-001
170E	Integrated Circuit, 74LS244	137038-001
170H	Integrated Circuit, 74LS148	137417-001
170K	Integrated Circuit, 74ALS161	137470-001
170P	Integrated Circuit, 74LS244	137038-001
170U	Integrated Circuit, 74AS08	137484-001
180C	Integrated Circuit, 74ALS138	137517-001
180E	Integrated Circuit, 74ALS139	137467-001
180S-GSP	Integrated Circuit, 34010-50	137538-002
180U	Integrated Circuit, 74AS573	137547-001
180W	Integrated Circuit, 74F04	137437-001
180Y	Integrated Circuit, 74AS573	137547-001
190C	Integrated Circuit, 74LS393	137146-001
190E	Integrated Circuit, 74AS00	137480-001
190K	Integrated Circuit, 68010	137414-002
190N	Integrated Circuit, 74LS245	137134-001
190U	Integrated Circuit, 74AS32	137487-001
190W	Integrated Circuit, 74ALS74	137156-001
190Y	Integrated Circuit, 74LS259	137137-001
200A	Integrated Circuit, 68681	137543-001
200C, 200D	Integrated Circuit, RAM, 8KX8, 150 nsec	137535-006
200E	Integrated Circuit, 48T02-15, RAM	137540-150
200F	Integrated Circuit, 74LS245	137134-001
200H, 200J	Integrated Circuit, 74LS244	137038-001
200K	Integrated Circuit, Slapstic 17	137412-117
200L	Integrated Circuit, 74ALS32	137464-001
200M	Integrated Circuit, 74ALS138	137517-001
200N, 200P	Integrated Circuit, 74LS245	137134-001
200R	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1105
200S	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1106
200T	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1107
200U	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1108
200V	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1109
200W	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1110
200X	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1111
200Y	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1112
205B	Integrated Circuit, 4066B	137580-001
210A	Integrated Circuit, MC1488	137403-001
210B	Integrated Circuit, MC1489AL	137263-001
210C	Integrated Circuit, RAM, 8KX8, 150 nsec	137535-006
210D	Integrated Circuit, RAM, 8KX8, 150 nsec	137535-006
210E	Integrated Circuit, 48Z02-15, RAM	137442-150
210F	Integrated Circuit, 74LS245	137134-001
210H	Integrated Circuit, 74LS244	137038-001
210J	Integrated Circuit, 74LS244	137038-001
210K	Integrated Circuit, 74LS244	137038-001
210L	Integrated Circuit, 74LS245	137134-001
210M	Integrated Circuit, 74LS245	137134-001
210N	Integrated Circuit, 74LS244	137038-001
210P	Integrated Circuit, 74LS245	137134-001
210R	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1113
210S	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1114
210T	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1115
210U	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1116
210V	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1117
210W	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1118
210X	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1119
210Y	Integrated Circuit, PR EPROM, 421, 137444-200	136052-1120
	Capacitors	
C1	Capacitor, 100 µF, 35 V, Electrolytic	124000-107
C2	Capacitor, .01 µF, 50 V, Ceramic	122002-103
C3-C43	Capacitor, .1 µF, 50 V, Ceramic	122002-104

Hard Drivin' Main PCB Assembly
Parts List, Continued

Designator	Description	Part No.
C44-C63	Capacitor, .001 µF, 50 V, ±10%	122015-102
C64-C78	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C79	Capacitor, 10 pF, 100 V, Ceramic	122016-100
C80-C82	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C83, C84	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C85-C87	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C88-C91	Capacitor, .22 µF, 50 V, Ceramic	122015-224
C92	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C93	Capacitor, 10 µF, 35 V, Electrolytic	124000-106
C94-C106	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C108-C111	Capacitor, .22 µF, 50 V, Ceramic	122015-224
C112-C118	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C119	Capacitor, 3900 pF, 50 V, Ceramic	122020-392
C120	Capacitor, 560 pF, 50 V, Ceramic	122020-561
C121	Capacitor, 10 µF, 35 V, Electrolytic	124000-106
C122	Capacitor, .0022 µF, 100 V, Plastic	121022-222
C123	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C124	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C125-C128	Capacitor, 10 µF, 35 V, Electrolytic	124000-106
C129-C137	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C138	Capacitor, 1000 pF, 100 V, Ceramic	122016-102
C139	Capacitor, 1000 pF, 100 V, Ceramic	122016-102
C140	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C141	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C142	Capacitor, .22 µF, 50 V, Ceramic	122015-224
C143	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C144	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C145	Capacitor, 10 µF, 35 V, Electrolytic	124000-106
C146-C227	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C228	Capacitor, .001 µF, 50 V, ±10%	122015-102
C229	Capacitor, 47 pF, 100 V, Ceramic	122016-470
C230-C249	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C250	Capacitor, 47 pF, 100 V, Ceramic	122016-470
C251-C273	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C274	Capacitor, 47 pF, 100 V, Ceramic	122016-470
C275-C320	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C322	Capacitor, 10 µF, 35 V, Electrolytic	124000-106
C323-C326	Capacitor, 10 pF, 100 V, Ceramic	122016-100
C330-C333	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C335	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C336	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C337-C342	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C344-C346	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C347	Capacitor, 10 µF, 35 V, Electrolytic	124000-106
	Diodes	
CR1, CR2	Diode, MV5053, Light Emitting	131027-002
CR3, CR4	Diode, 1N914	131052-001
CR5	Diode, 1N4002	131048-002
CR6	Diode, MV5053, Light Emitting	131027-002
CR7, CR8	Diode, 1N4002	131048-002
CR9-CR12	Diode, MV5053, Light Emitting	131027-002
CR13	Diode, 1N4002	131048-002
CR14	Diode, MV5053, Light Emitting	131027-002
CR17	Diode, 1N4733 A, 5.1 V, Zener	131009-206
CR18, CR19	Diode, 1N4002	131048-002
CR20	Diode, 1N4742 A, 12 V, Zener	131009-215
	Transistors	
Q1, Q2	Transistor, 2N6044	133042-001
Q3	Integrated Circuit, 7905	137581-001
Q4	Integrated Circuit, 7812	137597-001
Q5	Transistor, 2N3904	133041-001
Q6	Transistor, 2N3906	133040-001
Q7	Transistor, 2N3904	133041-001
Q8	Transistor, 2N3906	133040-001
Q9	Transistor, 2N3904	133041-001
Q10	Transistor, 2N3906	133040-001
Q11-Q13	Transistor, 2N3904	133041-001
	Resistors	
R1-R26	Resistor, 100 Ω, ±5%, 1/4 W	110000-101
R27-R45	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R46-R48	Resistor, 470 Ω, ±5%, 1/4 W	110000-471
R49-R54	Resistor, 4.7 K Ω, ±5%, 1/4 W	110000-472
R55, R56	Resistor, 100, ±5%, 1/4 W	110000-101
R57, R58	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R61	Resistor, 4.7 K Ω, ±5%, 1/4 W	110000-472
R62, R63	Resistor, 220 Ω, ±5%, 1/4 W	110000-221
R64-R67	Resistor, 5.6 K Ω, ±5%, 1/4 W	110000-562
R68	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R69	Resistor, Metal Film, 56 K Ω, ±1% 1/4 W	110011-5602
R70-R73	Resistor, 220 Ω, ±5%, 1/4 W	110000-221
R74, R75	Resistor, 10 K Ω, ±5%, 1/4 W	110000-103
R76	Resistor, 220 Ω, ±5%, 1/4 W	110000-221
R77, R78	Resistor, 4.7 K Ω, ±5%, 1/4 W	110000-472
R79	Resistor, 47 K Ω, ±5%, 1/4 W	110000-473
R80, R81	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R82, R83	Resistor, 470 Ω, ±5%, 1/4 W	110000-471
R84-R88	Resistor, 10 K Ω, ±5%, 1/4 W	110000-103
R89-R96	Resistor, 33 Ω, ±5%, 1/4 W	110000-330
R98-R101	Resistor, 100 Ω, ±5%, 1/4 W	110000-101
R102-R107	Resistor, 33 Ω, ±5%, 1/4 W	110000-330
R109-R111	Resistor, 100 Ω, ±5%, 1/4 W	110000-101
R113-R115	Resistor, 100 Ω, ±5%, 1/4 W	110000-101

Hard Drivin' Main PCB Assembly
Parts List, Continued

Designator	Description	Part No.
R116-R123	Resistor, 33 Ω, ±5%, 1/4 W	110000-330
R124	Resistor, 220 Ω, ±5%, 1/4 W	110000-221
R125-R131	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R132	Resistor, 4.7 K Ω, ±5%, 1/4 W	110000-472
R134	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R144	Resistor, 620 Ω, ±5%, 1/4 W	110000-621
R145, R146	Resistor, 10 K Ω, ±5%, 1/4 W	110000-103
R147, R148	Resistor, 100 K Ω, ±5%, 1/4 W	110000-104
R149, R150	Resistor, 10 K Ω, ±5%, 1/4 W	110000-103
R151, R152	Resistor, 220 Ω, ±5%, 1/4 W	110000-221
R155	Resistor, 0 Ω, ±5%, 1/4 W	110005-001
R156-R159	Resistor, 5.6 K Ω, ±5%, 1/4 W	110000-562
R160, R161	Resistor, 10 K Ω, ±5%, 1/4 W	110000-103
R162, R163	Resistor, 150 Ω, ±5%, 1/4 W	110000-151
R164, R165	Resistor, 10 Ω, ±5%, 1/4 W	110000-100
R166	Resistor, 68 Ω, ±5%, 1/4 W	110000-680
R167	Resistor, 91 Ω, ±5%, 1/4 W	110000-910
RN1, RN2	Resistor Network, 470X9, ±5%, 1/8 W, SIP(10PIN)	118010-471
RN3-RN5	Resistor Network, R2R Ladder	118015-001
RN6	Resistor Network, 4.7KX9, ±5%, 1/8 W, SIP(10PIN)	118010-472

Designator	Description	Part No.
	Crystals	
XOSC1	Osc, 32MHZ	144008-002
XOSC2	Crystal, 48 Mhz, Oscillator Module	144008-003
XOSC3	Crystal, 50 Mhz, Oscillator Module	144008-005
XTAL1	Crystal, 3.6864, Standup	144000-011
	Miscellaneous	
	Socket, 28 Pin, .600"	179257-028
	Socket, 68 Pin	179237-068
	Socket, 64 Pin, .900"	179256-064
	Socket, 40 Pin, .600"	179257-040
	Socket, 20 Pin	179259-020
	Socket, 24 Pin, .600"	179257-024
	Test Point	179051-001
J1	Connector, 12 Circuit, Header .250 Ctr	179069-012
J2-J6	Connector, 11 Circuit, Header, .100 Ctr	179118-011
J7	Connector, 60 Circuit, Header, .100 Ctr	179021-060
J8-J11	Connector, 11 Circuit, Header, .100 Ctr	179118-011
J12	Connector, 9 Circuit, Header, .250 Ctr	179069-009
J14	Connector, 26 Circuit, Header, .1 X . 1 Dual	179261-026
J15	Connector, 16 Circuit, Header, .1 X . 1 Dual	179261-016
SW1	Switch, 8 Pos DIP	160031-008

N O T E S

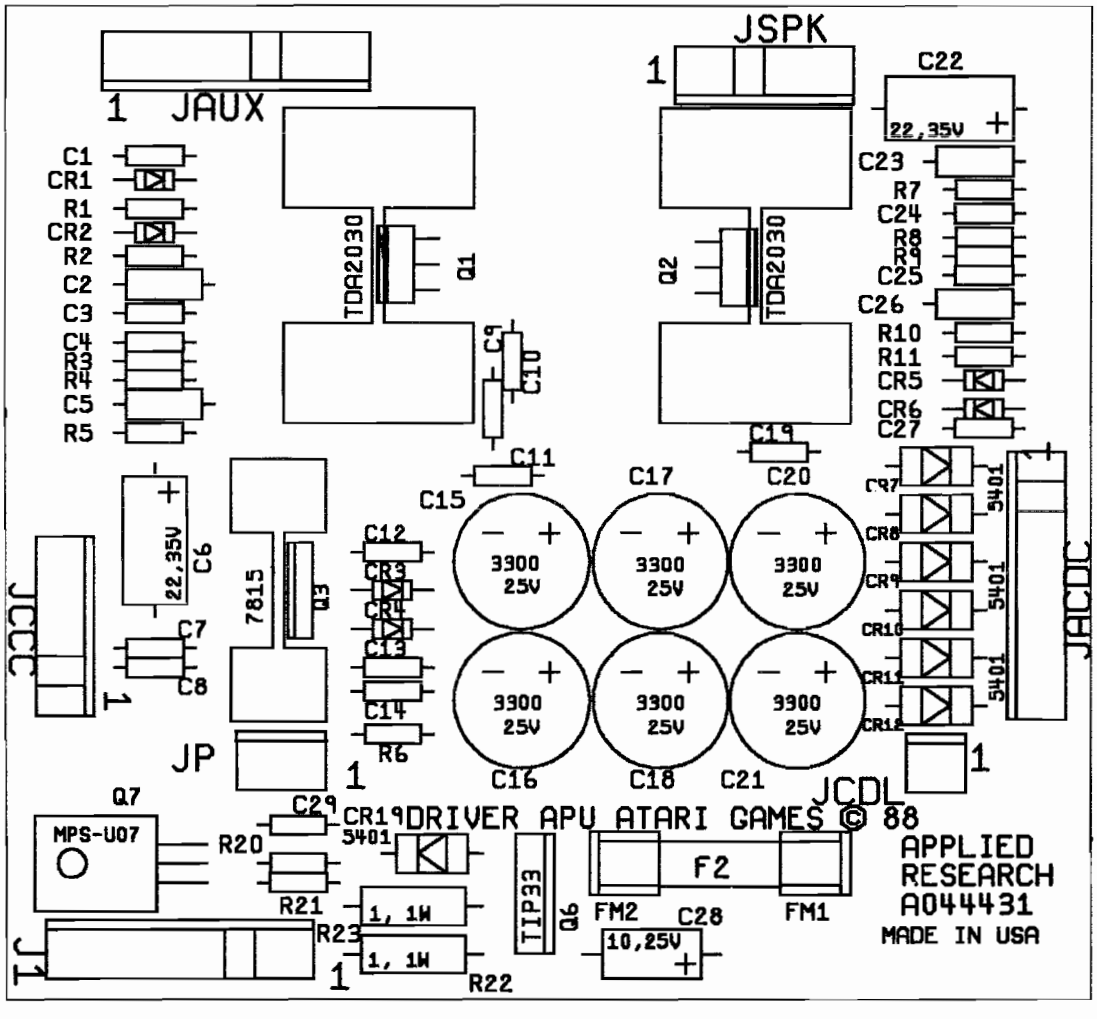


Figure 4-12 APU PCB Assembly
A044431-01 B

Shifter PCB Assembly
Parts List

Designator	Description	Part No.
	Capacitors	
C1	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C2	Capacitor, .22 µF, 50 V, Ceramic	122015-224
C3	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C4	Capacitor, .001 µF, 50 V, Ceramic	122002-102
C5	Capacitor, .22 µF, 50 V, Ceramic	122015-224
C6	Capacitor, 22 µF, 35 V, Electrolytic	124000-226
C7-C14	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C15-C18	Capacitor, 3300 µF, 25 V, Electrolytic, Radial	123003-338
C19	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C20, C21	Capacitor, 3300 µF, 25 V, Electrolytic, Radial	123003-338
C22	Capacitor, 22 µF, 35 V, Electrolytic	124000-226
C23	Capacitor, .22 µF, 50 V, Ceramic	122015-224
C24	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C25	Capacitor, .001 µF, 50 V, Ceramic	122002-102
C26	Capacitor, .22 µF, 50 V, Ceramic	122015-224
C27	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C28	Capacitor, 10 µF, 25 V, Electrolytic	124009-106
C29	Capacitor, .1 µF, 50 V, Ceramic	122002-104
	Diodes	
CR1-CR6	Diode, 1N4001	131048-001
CR7-CR12	Diode, 1N5401	131051-002
CR19	Diode, 1N5401	131051-002
	Fuse	
FU2	Fuse, 3 Amp, 250 V, Norm	146007-3022

Designator	Description	Part No.
	Transistors	
Q1, Q2	Integrated Circuit, TDA2030	137301-001
Q3	Integrated Circuit, 7815, Standup	137598-001
Q6	Transistor, TIP33, 40 V, 80 W	133044-001
Q7	Transistor, Mps-U07, 100 V, 2 A	133003-001
	Resistor	
R1	Resistor, 10 K Ω, ±5%, 1/4 W	110000-103
R2	Resistor, 1 Ω, ±5%, 1/4 W	110000-010
R3, R4	Resistor, 22 K Ω, ±5%, 1/4 W	110000-223
R5	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R6	Resistor, 10 Ω, ±5%, 1/4 W	110000-100
R7	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R8, R9	Resistor, 22 K Ω, ±5%, 1/4 W	110000-223
R10	Resistor, 1 Ω, ±5%, 1/4 W	110000-010
R11	Resistor, 10 K Ω, ±5%, 1/4 W	110000-103
R20	Resistor, 47 Ω, ±5%, 1/4 W	110000-470
R21	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R22, R23	Resistor, 1Ω, ±5%, 1 W, Carbon Film	110030-010
	Miscellaneous	
FM1, FM2	Fuseclip	179050-002
HS1, HS2	Heatsink, TDA2030	178190-032
HS3	Heatsink, 7815	178190-124
	Connector, 2 Ckt, Header, .156 Ctr	179213-002
	Connector, 9 Circuit, Header, .156 Ctr	179213-009
	Connector, 3 Ckt, Header, .156 Ctr	179213-003
	Connector, 6 Ckt, Header, .156 Ctr	179213-006
	Connector, 9 Circuit, Header, .156 Ctr	179213-009

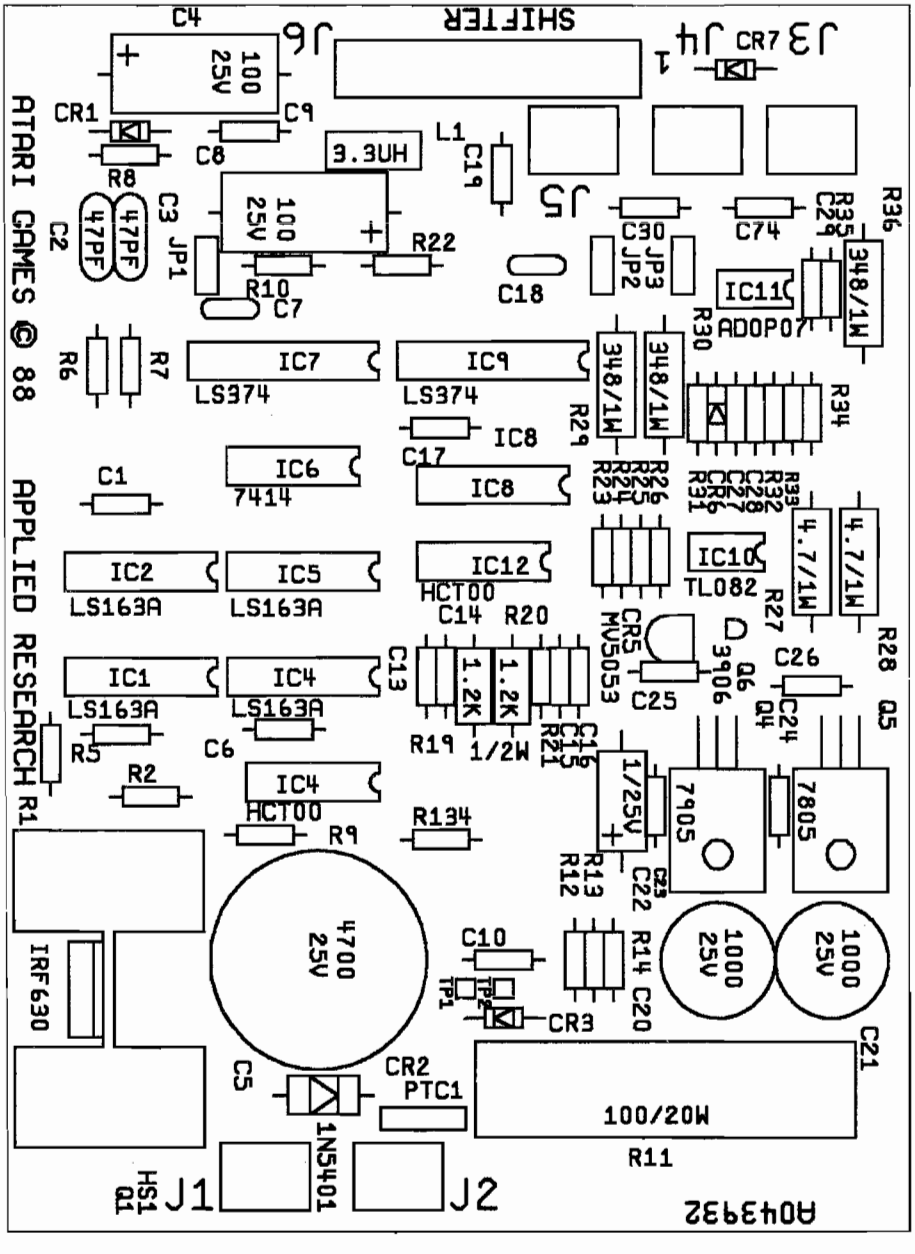


Figure 4-13 Shifter PCB Assembly
A043932-01 C

Shifter PCB Assembly
Parts List

Designator	Description	Part No.
	Capacitors	
C1	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C2, C3	Capacitor, 47 pF, 100 V, Mica	128002-470
C4	Capacitor, 100 µF, 25 V, Electrolytic	124010-107
C5	Capacitor, 4700 µF, 25 V, Electrolytic, Radial	123021-478
C6	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C7	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C8	Capacitor, 100 µF, 25 V, Electrolytic	124010-107
C9, C10	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C13-C17	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C19	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C18	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C20, C21	Capacitor, 1000 µF, 25 V, Electrolytic, Radial	123003-102
C22	Capacitor, 1 µF, 50 V, Electrolytic	124001-105
C23-C30, C74	Capacitor, .1 µF, 50 V, Ceramic	122002-104
	Diodes	
CR1	Diode, 1N4001	131048-001
CR2	Diode, 1N5401	131051-002
CR3	Diode, 1N4005	131048-005
CR5	Diode, MV5053, Light Emitting	131027-002
CR6	Diode, 1N100	131053-001
CR7	Diode, 1N4001	131048-001
	Integrated Circuits	
IC1, IC2	Integrated Circuit, 74LS163 A	137114-001
IC3	Integrated Circuit, 74HCT00	137606-001
IC4, IC5	Integrated Circuit, 74LS163 A	137114-001
IC6	Integrated Circuit, 7414	137017-001
IC7	Integrated Circuit, 74LS374	137144-001
IC8	Integrated Circuit, DAC-08	137159-001
IC9	Integrated Circuit, 74LS374	137144-001
IC10	Integrated Circuit, TL082CP	137584-001
IC11	Integrated Circuit, ADOP07CN	137523-001
IC12	Integrated Circuit, 74HCT00	137606-001
L1	Inductor, 3.3 µH	141023-001
	Fuse	
PTC1	Fuse, Current, PTC, .9 A, 50 V	146011-090

Designator	Description	Part No.
	Transistors	
Q1	Transistor, FET, IRF630	133039-001
Q4	Integrated Circuit, 7905	137581-001
Q5	Integrated Circuit, 7805	137596-001
Q6	Transistor, 2N3906	133040-001
	Resistors	
R1	Resistor, 100 K Ω, ±5%. 1/4 W	110000-104
R2	Resistor, 270 Ω, ±5%, 1/4 W	110000-271
R5	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R6, R7	Resistor, 510 Ω, ±5%, 1/4 W	110000-511
R8	Resistor, 10 K Ω, ±5%, 1/4 W	110000-103
R9	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R10	Resistor, 2.2 K Ω, ±5%, 1/4 W	110000-222
R11	Resistor, 100 Ω, ±5%, 20 W (Acceptable Substitute is part no. 116027-101)	116025-101
R12	Resistor, 68 K Ω, ±5%, 1/4 W	110000-683
R13, R14	Resistor, 10 K Ω, ±5%, 1/4 W	110000-103
R19, R20	Resistor, 1.2 K Ω, ±5%, 1/2 W	110001-122
R21	Resistor, 22 K Ω, ±5%, 1/4 W	110000-223
R22	Resistor, 2.2 K Ω, ±5%, 1/4 W	110000-222
R23	Resistor, 4.7 K Ω, ±5%, 1/4 W	110000-472
R24, R25	Resistor, 3 K Ω, ±5%, 1/4 W	110000-302
R26	Resistor, 330 Ω, ±5%, 1/4 W	110000-331
R27, R28	Resistor, 4.7 Ω, 1 W	110030-047
R29, R30	Resistor, 348 Ω, 1 W	110029-3480
R31	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R32	Resistor, 47 K Ω, ±5%, 1/4 W	110000-473
R33	Resistor, 100 Ω, ±5%, 1/4 W	110000-101
R34	Resistor, 39 K Ω, ±5%, 1/4 W	110000-393
R35	Resistor, 2.2 Ω, ±5%, 1/4 W	110000-022
R36	Resistor, 348 Ω, 1 W	110029-3480
R134	Resistor, 0 Ω, ±5%, 1/4 W	110005-001
	Miscellaneous	
HS1	Heatsink, TDA2030	178190-032
JP1-3	Connector, Rcpt, 2 Ckt	179178-002
J1-J5	Connector, 3 Circuit, Header, .156 Ctr	179213-003
J6	Connector, 26 Circuit, Header, .1 X . 1 Dual	179261-026
JP1-JP3	Connector, 3 Ckt, Header, .100 Ctr	179048-003

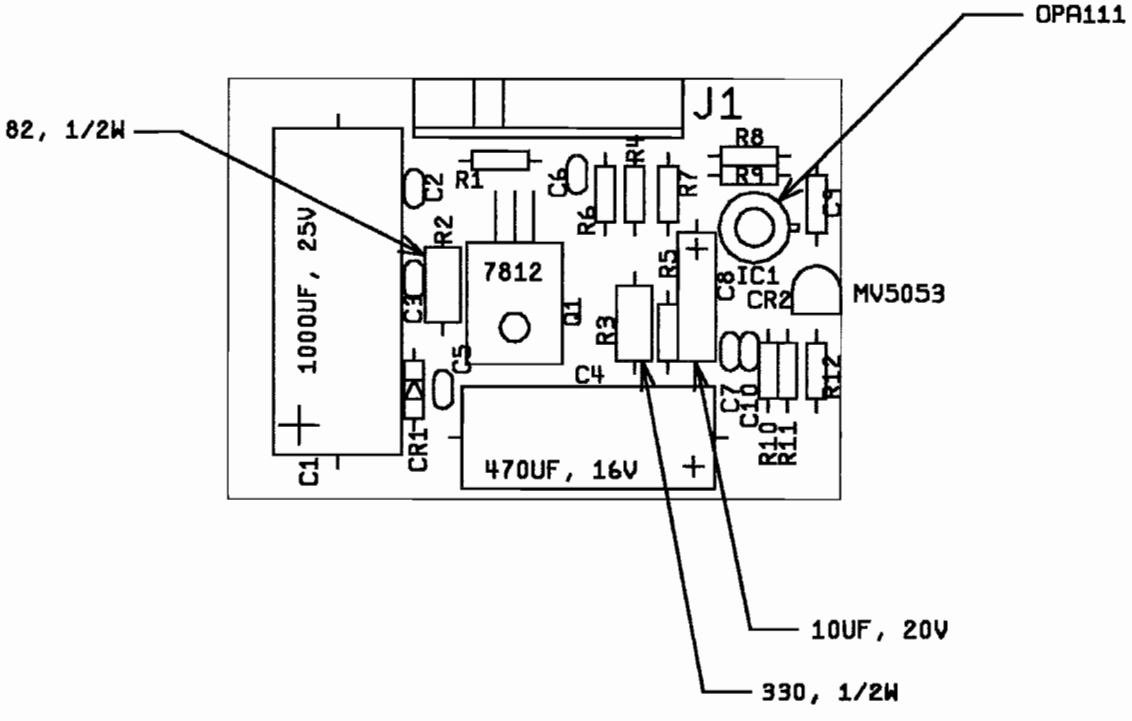


Figure 4-14 Brake PCB Assembly
A044817-01 B

Brake PCB Assembly
Parts List

Designator	Description	Part No.
	Capacitors	
C1	Capacitor, 1000 µF, 25 V, Electrolytic	123012-108
C2, C3	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C4	Capacitor, 470 µF, 16 V, Electrolytic	123004-471
C5-C7	Capacitor, .1 µF, 50 V, Ceramic	122002-104
C8	Capacitor, 10 µF, 20 V, Tant	127001-106
C9	Capacitor, .001 µF, 50 V, ±10%	122015-102
C10	Capacitor, .1 µF, 50 V, Ceramic	122002-104
	Diodes	
CR1	Diode, 1N4740, 10 V, Zener	131009-113
CR2	Diode, MV5053, Light Emitting	131027-002
	Integrated Circuit	
IC1	Integrated Circuit, OPA111	137576-001
	Transistor	
Q1	Integrated Circuit, 7812	137597-001

Designator	Description	Part No.
	Resistors	
R1	Resistor, 10, ±5%, 1/4 W	110000-100
R3	Resistor, 330 Ω, ±5%, 1/2 W	110001-331
R4	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R5	Resistor, 2.2 M Ω, ±5%, 1/4 W	110000-225
R6	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R7	Resistor, 10 K Ω, ±5%, 1/4 W	110000-103
R8	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
R9	Resistor, 270 K Ω, ±5%, 1/4 W	110000-274
R10-R12	Resistor, 1 K Ω, ±5%, 1/4 W	110000-102
	Miscellaneous	
J1	Connector, 9 Circuit, Header, .156 Ctr, Key 3	179213-009

N O T E S

Hard Drivin' Statistics Sheet

Statistics Information

Left Coins: ____
Right Coins: ____
Idle Mins: ____
Active Mins: ____

Xtnded Plays: ____
1-X Games: ____
2-X Games: ____
N-X Games: ____

Auto Games: ____
Error Count: ____
Total Games: ____

Laps by Track: ____ ____ ____
Xtended Games by Track: ____ ____ ____
No X Games by Track: ____ ____ ____

Champ Laps ____
Champ Wins ____

Inst Rpls: ____
Rpl Aborts: ____
Rpl Sec: ____

Total Credits: ____
Avg Time/Credit: ____

Histogram Information

0-99	____	280-299	____
100-119	____	300-319	____
120-139	____	320-339	____
140-159	____	340-359	____
160-179	____	360-379	____
180-199	____	380-399	____
200-219	____	400-419	____
220-239	____	420-439	____
240-259	____	440-459	____
260-279	____	460-UP	____

Games Played by Day and Hour

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
8:00 AM	____	____	____	____	____	____	____
9:00 AM	____	____	____	____	____	____	____
10:00 AM	____	____	____	____	____	____	____
11:00 AM	____	____	____	____	____	____	____
Noon	____	____	____	____	____	____	____
1:00 PM	____	____	____	____	____	____	____
2:00 PM	____	____	____	____	____	____	____
3:00 PM	____	____	____	____	____	____	____
4:00 PM	____	____	____	____	____	____	____
5:00 PM	____	____	____	____	____	____	____
6:00 PM	____	____	____	____	____	____	____
7:00 PM	____	____	____	____	____	____	____
8:00 PM	____	____	____	____	____	____	____
9:00 PM	____	____	____	____	____	____	____
10:00 PM	____	____	____	____	____	____	____
11:00 PM	____	____	____	____	____	____	____
Midnight	____	____	____	____	____	____	____
1:00 AM	____	____	____	____	____	____	____
2:00 AM	____	____	____	____	____	____	____
3:00 AM	____	____	____	____	____	____	____
4:00 AM	____	____	____	____	____	____	____
5:00 AM	____	____	____	____	____	____	____
6:00 AM	____	____	____	____	____	____	____
7:00 AM	____	____	____	____	____	____	____

Warranty

Seller warrants that its printed-circuit boards and parts thereon are free from defects in material and workmanship under normal use and service for a period of ninety (90) days from date of shipment. Seller warrants that its video displays and laser-video disc players (in games supplied with displays and video-disc players) are free from defects in material and workmanship under normal use and service for a period of thirty (30) days from date of shipment. None of the Seller's other products or parts thereof are warranted.

If the products described in this manual fail to conform to this warranty, Seller's sole liability shall be, at its option, to repair, replace, or credit Buyer's account for such products which are returned to Seller during said warranty period, provided:

(a) Seller is promptly notified in writing upon discovery by Buyer that said products are defective;

(b) Such products are returned prepaid to Seller's plant; and

(c) Seller's examination of said products discloses to Seller's satisfaction that such alleged defects existed and were not caused by accident, misuse, neglect, alteration, improper repair, installation, or improper testing.

In no event shall Seller be liable for loss of profits, loss of use, incidental or consequential damages.

Except for any express warranty set forth in a written contract between Seller and Buyer which contract supersedes the terms herein, this warranty is expressed in lieu of all other warranties expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose, and of all other obligations or liabilities on the Seller's part, and it neither assumes nor authorizes any other person to assume for the Seller any other liabilities in connection with the sale of products by Seller.

The use of any non-Atari parts may void your warranty, according to the terms of the warranty. The use of any non-Atari parts may also adversely affect the safety of your game and cause injury to you and others. Be very cautious in using non-Atari-supplied components with our games, in order to ensure your safety.

Atari distributors are independent, being privately owned and operated. In their judgment they may sell parts or accessories other than Atari parts or accessories. Atari Games Corporation cannot be responsible for the quality, suitability or safety of any non-Atari part or any modification including labor which is performed by such distributor.

ATARI®
GAMES

Atari Games Corporation
675 Sycamore Drive
P.O. Box 361110
Milpitas, CA 95035