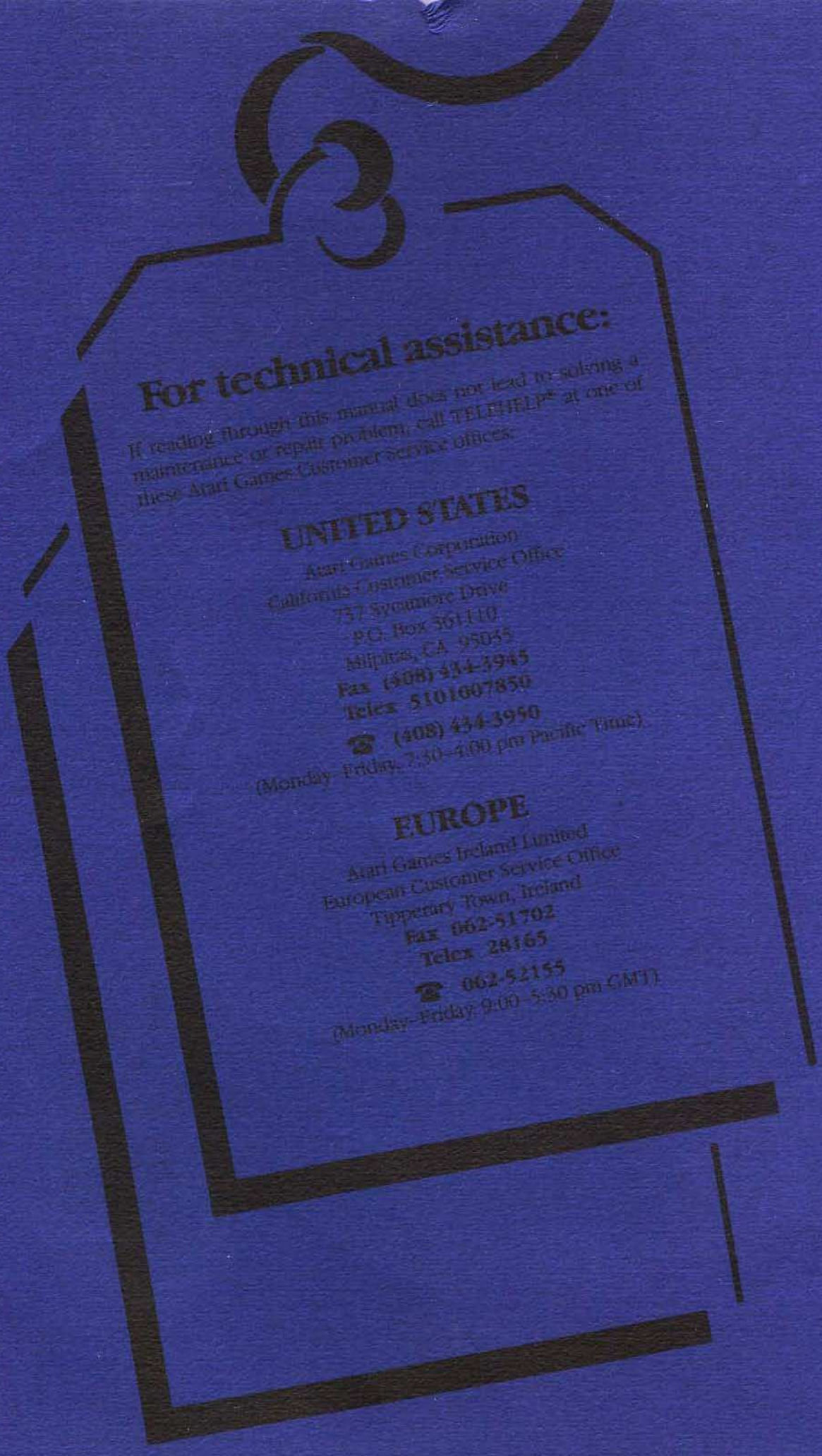
TM-308
1st Printing

Operators Manual

with Illustrated Parts Lists



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APB™ Operators Manual

with Illustrated Parts Lists

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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.
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- On games provided with an Electromagnetic Interference (EMI) ground plane, be sure the game printed-circuit boards (PCBs) are properly installed on the EMI Ground Plane. 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

How to Use This Manual 1-1
Inspecting the Game 1-2
Installing the Seat 1-2
Control and Switch Locations 1-3
Setting the Coin and Game Options 1-3
Game Play 1-4

2 Self-Test

Main Self-Test Screen 2-2
Power-On Restart Reset 2-2
High Scores Reset 2-2
Statistics Reset 2-3
Options Report 2-3
Statistics Report 2-3
Day Histogram Report 2-4
Sound Test 2-4
Controls Test 2-4
Color Bar Test 2-5
Program ROM Test 2-6
Motion Object ROM Test 2-6
Alphanumeric ROM Test 2-6
Playfield ROM Test 2-6
All RAM Test 2-7
Set Enhancements Demo 2-7
Can Player Die? Demo 2-7

3 Maintenance

Preventive Maintenance 3-2

Preventive-Maintenance Intervals 3-2
Removing the Control Panel 3-2
Cleaning the Push-Button Leaf Switches 3-2
Maintaining the Steering Wheel 3-2
Cleaning the Coin Mechanism 3-2
Cleaning the Interior Components 3-3

Corrective Maintenance 3-4

Removing the Video Display 3-5
Removing the Steering Wheel 3-6
Disassembling the Steering Wheel 3-6
Reassembling the Steering Wheel 3-6
Removing the Foot Pedal 3-6
Removing the Game PCBs 3-6
Removing the Incandescent Lights 3-8
Removing the Speakers 3-8

4 Troubleshooting

Troubleshooting Aids 4-2
Troubleshooting Techniques 4-2
Soldering Techniques 4-2
Troubleshooting Static-Sensitive Devices 4-3

5 Illustrated Parts Lists

See List of Illustrations that follows.

APB Coin Information and Game Statistics Sheet

See last page of this manual.

List of Illustrations

Figure 1-1	Control and Switch Locations	1-3
Figure 2-1	Main Self-Test Screen	2-2
Figure 2-2	Power-On Restart Reset Screen	2-2
Figure 2-3	High Scores Reset Screen	2-3
Figure 2-4	Statistics Reset Screen	2-3
Figure 2-5	Options Report Screen	2-3
Figure 2-6	Statistics Report Screen	2-4
Figure 2-7	Day Histogram Report Screen	2-4
Figure 2-8	Sound Test	2-4
Figure 2-9	Controls Test	2-5
Figure 2-10	Color Bar Test	2-5
Figure 2-11	Program ROM Test	2-6
Figure 2-12	Alphanumeric ROM Test	2-6
Figure 2-13	Motion Object ROM Test	2-6
Figure 2-14	Playfield ROM Test	2-7
Figure 3-1	Control Panel Removal	3-3
Figure 3-2	Maintaining the Steering Wheel	3-4
Figure 3-3	Video Display Removal	3-5
Figure 3-4	Game PCB Removal	3-7
Figure 4-1	Removing IC (Cut-Pin Method)	4-3
Figure 4-2	Removing IC Pins	4-3
Figure 4-3	Removing Solder from Plated-Through Holes	4-4
Figure 4-4	Removing Solder from Lead Connection Pads	4-4
Figure 5-1	Cabinet-Mounted Assemblies	5-2
Figure 5-2	Control Panel Assembly	5-5
Figure 5-3	Steering Wheel Assembly	5-6
Figure 5-4	Switching/Linear (SL) Power Supply Assembly	5-8
Figure 5-5	Foot Pedal Assembly	5-12
Figure 5-6	Coin Acceptors, Inc. Coin Door Assembly	5-14
Figure 5-7	Printed-Circuit Board Mounting Hardware	5-17
Figure 5-8	APB Central Processing Unit (CPU) PCB Assembly	5-18
Figure 5-9	APB Video PCB Assembly	5-22
Figure 5-10	Audio II PCB Assembly	5-28

List of Tables

Table 1-1	Game Specifications	1-2
Table 1-2	Coin and Credit Option Settings	1-4
Table 1-3	Game Option Settings	1-5

Safety Summary

The following safety precautions apply to all game operators and service personnel. Specific warnings and cautions will be found throughout this manual where 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 2-wire outlet, we recommend you hire a licensed electrician to install a grounded outlet. Players may receive an electrical shock if the control panel is not properly grounded! After servicing any parts on the control panel, check that the grounding wire is firmly secured to the inside of the control panel. Only then should you lock up the game.

AC Power Connection. Before connecting the game to the AC power source, verify that the game's power supply is properly configured for the line voltage in your location.

Disconnect Power During Repairs. To avoid electrical shock, disconnect the game from the AC power source before removing or repairing any part of the game. When removing or repairing the video display, extra precautions must be taken to avoid electical shock because high voltages may exist within the display circuitry and cathode-ray tube (CRT) even after power has been disconnected. Do not touch internal parts of the display with your hands or with metal objects! Always discharge the high voltage from the CRT before servicing this area of the game. To discharge the CRT: Attach one end of a large, well-insulated, 18-gauge jumper wire to ground. Momentarily touch the free end of the grounded jumper to the CRT anode by sliding it under the anode cap. Wait two minutes and discharge the anode again.

Use Only ATARI Parts. To maintain the safety integrity of your ATARI game, do not use non-ATARI parts when repairing the game. Use of non-ATARI parts or other modifications to the game circuitry may adversely affect the safety of your game, and injure you or your players.

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

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. Note that they are keyed to fit only one way. If they do not slip on easily, do not force them. A reversed connector may damage your game and void the warranty.

Ensure the Proper AC Line Frequency. Video games manufactured for operation on 60 Hz line power (i.e., United States) must not be operated in countries with 50 Hz line power (i.e., Europe). The fluorescent light ballast transformer will overheat, causing a potential fire hazard if 60 Hz games are operated on power lines using 50 Hz. Check the product identification label of your game for the line frequency required.

ABOUT NOTES, CAUTIONS, AND WARNINGS

In all 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 injured or killed if instructions are not followed. (The word *WARNING* is always surrounded by international warning symbols—triangles with exclamation marks inside of them.)

Chapter 1

Set-Up

How to Use This Manual

This manual is written for game operators and service personnel, and provides information for setting up, playing, testing, and maintaining your APB™ (All-Points Bulletin) game.

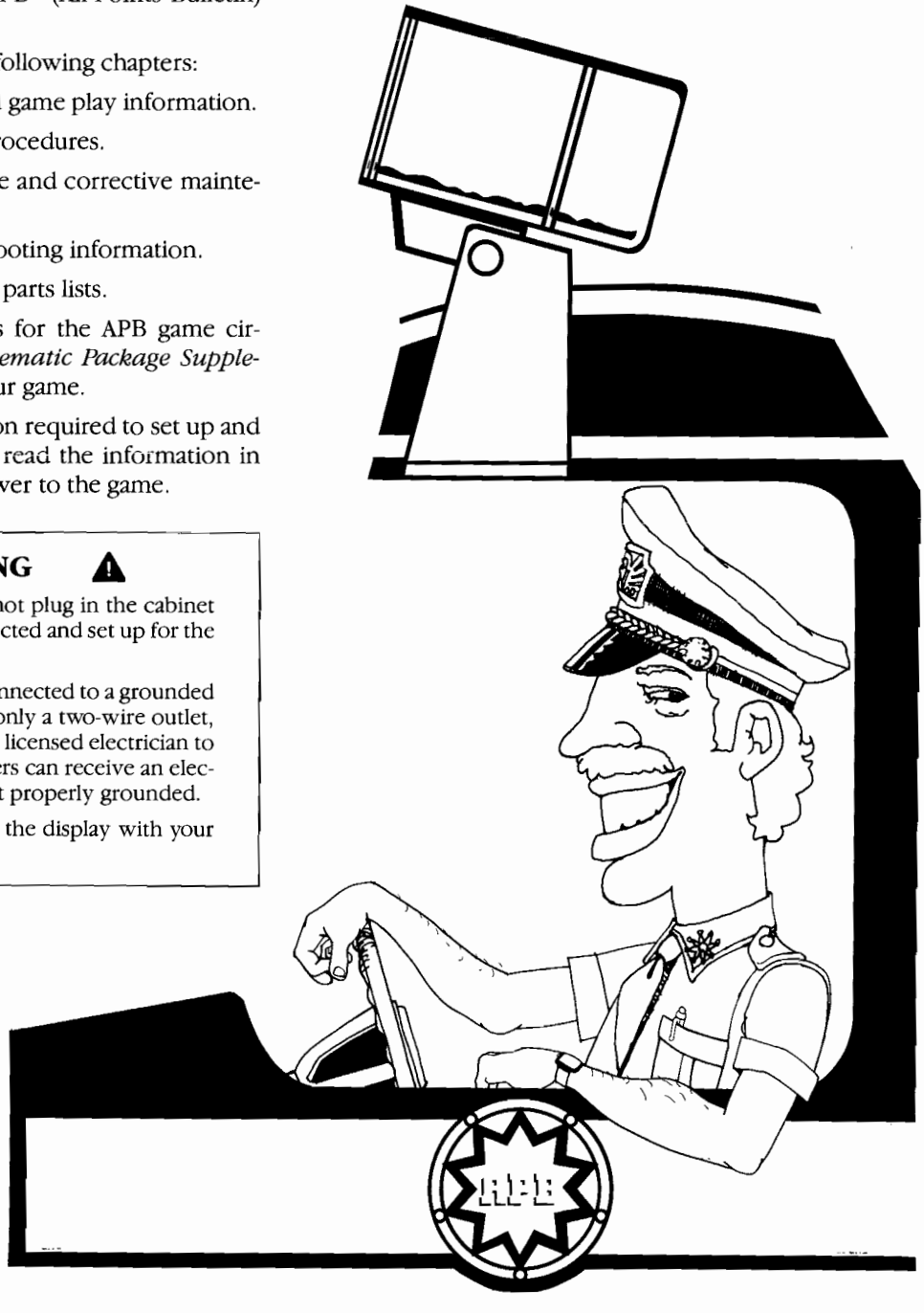
This manual is divided into the following chapters:

- Chapter 1 contains set-up and game play information.
- Chapter 2 contains self-test procedures.
- Chapter 3 contains preventive and corrective maintenance procedures.
- Chapter 4 contains troubleshooting information.
- Chapter 5 contains illustrated parts lists.

Wiring and schematic diagrams for the APB game circuitry are contained in the *Schematic Package Supplement* (SP-308) included with your game.

This chapter includes information required to set up and play your APB game. Carefully read the information in this chapter before applying power to the game.

> **⚠ 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 only be connected to a grounded three-wire outlet. If you have only a two-wire outlet, we recommend that you hire a licensed electrician to install a grounded outlet. Players can receive an electrical shock if the cabinet is not properly grounded.
>
> Do not touch internal parts of the display with your hands or with metal objects.



Inspecting the Game

> **⚠ WARNING ⚠**
> Do not plug in the game until you have completed the following inspection steps.

Please inspect your APB game carefully to ensure that the game is complete and delivered to you in good condition. Figure 5-1 shows the locations of the component parts of the game. Table 1-1 lists space, power, and environmental requirements.

Inspect the factory-assembled game as follows:

1. Examine the exterior of the cabinet for dents, chips, or broken parts.
2. Unlock and open the rear access panel. 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 only fit in the proper orientation. *A reversed edge 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), speakers, and the incandescent lights. Make sure they are mounted securely and that the green ground wires are connected.

Table 1-1 Game Specifications

Characteristic	Specification
Power Consumption	240 V-A, 167 W RMS
Temperature	+5° to +38° C (+37° to +100° F)
Humidity	Not to exceed 95% relative
Line Voltage	105 to 130 VAC
Width	25⅝ in. (64 cm)
Depth	34 in. (86 cm) cabinet only 56 in. (142 cm) with seat installed
Height	73¾ in. (187 cm)
Weight	323 lbs. (146 kg)

Installing the Seat

The seat must be positioned in front of the cabinet before playing your APB game. Perform the following procedure to install the seat.

1. Remove the seat and four nuts from the box packed inside the shipping container.
2. Remove the bolt, flat washer, and split-lock washer contained in the instruction manual bag. (An optional metal plate and four screws are also included in the bag. Use the plate and screws only if you permanently remove the seat frame from the game.)
3. Unlock and open the rear access panel if not already done.
4. From the rear of the cabinet, remove the bolt holding the seat frame to the cabinet floor.

> **NOTE**
> The seat can be placed in two different positions in front of your game, either 17 inches or 22 inches from the control panel.

5. From the front of the cabinet, pull out the seat frame to the desired distance from the control panel, until the screw holes in the frame are aligned with the screw holes in the seat bracket located on the cabinet floor.

> **NOTE**
> You may have to loosen the four bolts holding the bracket to the cabinet floor if the seat frame does not easily slide out of the bracket. Be sure to retighten them after properly positioning the frame.

6. Place the seat on top of the seat frame. Install and tighten the four nuts underneath the seat.
7. From the rear of the cabinet, place the two bolts and washers in the bracket and tighten.
8. To reposition the seat frame for moving or shipping the cabinet, reverse the order of steps 2 through 7. Be sure to keep the seat (if removed) and its hardware in a convenient place for future use.

> **NOTE**
> If you do not want to install the seat in front of your game, a metal plate can be placed over the seat frame opening. After removing the seat frame, place the plate over the opening and drill four holes. Then install the plate and screws.

Control and Switch Locations

Power On/Off Switch

The power on/off switch is located at the bottom rear of the cabinet. (See Figure 5-1.)

Volume Control

The volume control is located on the Audio II PCB behind the upper coin door. (See Figure 1-1.) The volume control adjusts the level of sound produced by the game.

Coin Counter

The coin counter is located on the shelf behind the upper coin door. The coin counter records the number of coins deposited.

Self-Test Switch

The self-test switch is located on the Audio II PCB behind the upper coin door. (See Figure 1-1.) The self-test switch selects the Self-Test Mode to check game operation. Refer to Chapter 2 for a complete description of self-test operation.

Setting the Coin and Game Options

The APB cabinet has two dual-in-line package (DIP) option switches located on the CPU printed circuit board (PCB). (See Figure 1-1.)

- The option switch at location 6/7A and switches 1 and 2 at location 5/6A are for selecting coin options.
- The option switches 3–7 at location 5/6A are for selecting game options.

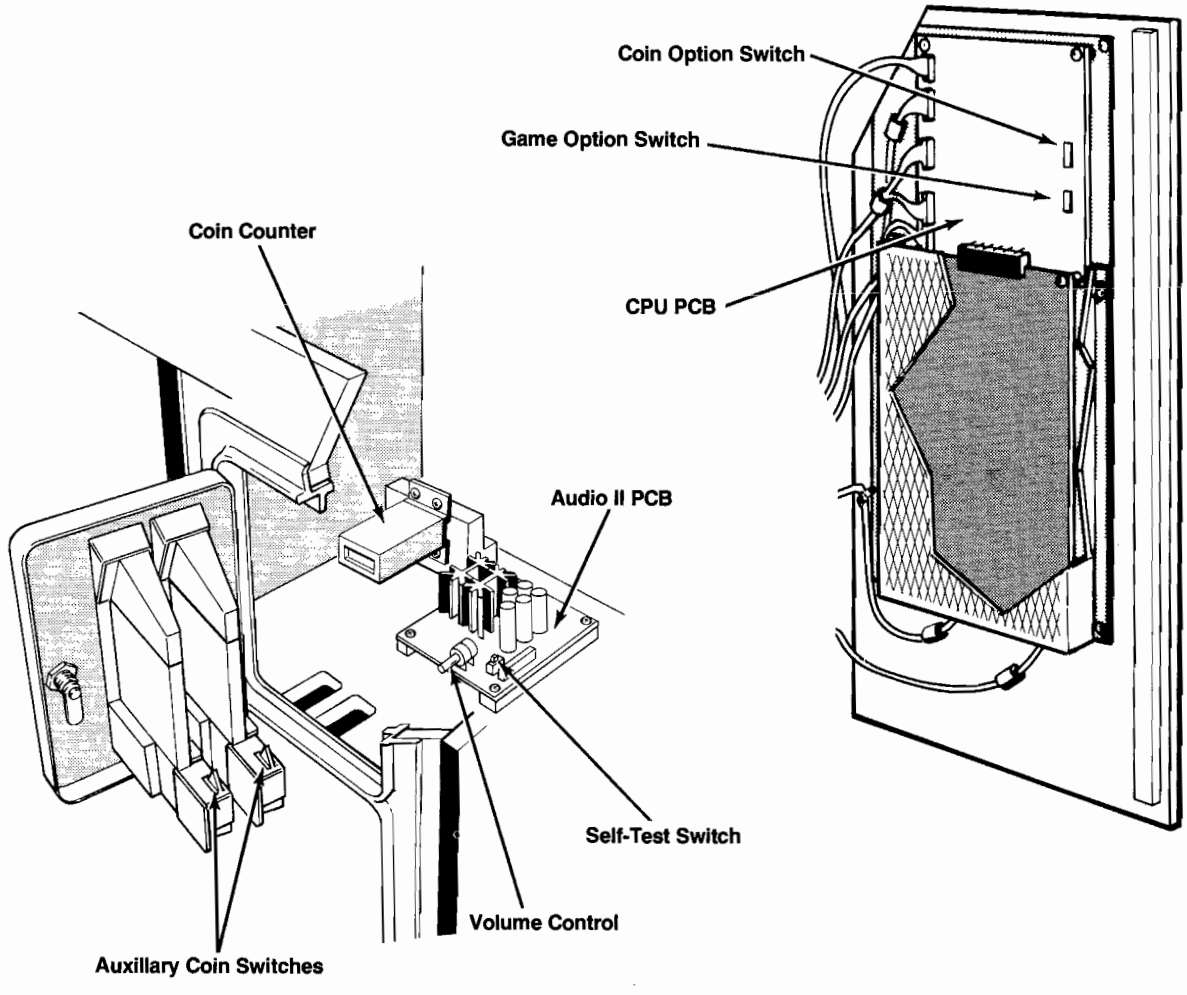


Figure 1-1 Control and Switch Locations

Set the coin and credit option settings by changing the settings of the DIP switches. Refer to Table 1-2 and Table 1-3 for the available options and default (recommended) settings.

To change the coin and credit settings, first remove the thin film of plastic covering the option switch. Use a pen or a sharp-pointed instrument to slide the appropriate small buttons to different settings. Right is the *on position*, and left is the *off position*. The steering wheel and the push buttons are *not* used to change these settings.

Game Play

This section of the manual describes the theme of the APB game, the operating modes, and the game play features.

Introduction

APB is a unique driving/shooting game where the player portrays Officer Bob in his action-packed pursuit of common law-breakers and hardened criminals. APB features a 360° steering wheel and multi-directional scrolling to allow players to explore the highways and byways of Bob's beat.

Attract Mode

The Attract Mode begins when the game is powered up or after exiting the Play or Self-Test Modes. The Attract Mode ends when coins or tokens are inserted and the start button is pressed. The Attract Mode continuously cycles through the following displays:

- High score table
- APB title screen
- Game play demonstration

Unique Features to Attract Players

- Numerous detailed animation sequences are included to add humor and enhance player enjoyment, as well as create player involvement with the many characters found in the game.
- Multi-directional scrolling allows players to drive in all directions on the screen. Players are encouraged to explore the streets and back roads of Bob's beat in their constant, action-packed pursuit of law-breakers.
- The unique upright cabinet configuration features a compact, operator-adjustable sitdown-style seat for player comfort along with a dynamic overhead attraction panel.

Play Mode

APB is the ultimate cops-and-robbers game in which players portray Officer Bob. The levels of game play are measured in days. In order to progress to the next level, play-

Table 1-2 Coin and Credit Option Settings

Settings of 8-Toggle Switch on APB CPU PCB (at 6/7A)								Option
1	2	3	4	5	6	7	8	
								Coins Per Credit
						Off	Off	1 Coin 1 Credit ◄
						Off	On	2 Coins 1 Credit
						On	Off	3 Coins 1 Credit
						On	On	4 Coins 1 Credit
								Right Coin Mechanism
				Off	Off			1 Coin Counts as 1 Coin ◄
				Off	On			1 Coin Counts as 4 Coins
				On	Off			1 Coin Counts as 5 Coins
				On	On			1 Coin Counts as 6 Coins
								Left Coin Mechanism
			Off					1 Coin Counts as 1 Coin◄
			On					1 Coin Counts as 2 Coins
								Bonus Adder
Off	Off	Off						No Bonus Adder ◄
Off	Off	On						2 Coins Give 1 Extra Coin
Off	On	Off						4 Coins Give 1 Extra Coin
Off	On	On						4 Coins Give 2 Extra Coins
On	Off	Off						5 Coins Give 1 Extra Coin
On	Off	On						3 Coins Give 1 Extra Coin
On	On	On						Free Play

◄ *Manufacturer's recommended settings*

Table 1-3 Game Option Settings

Settings of 8-Toggle Switch on APB CPU PCB (at 5/6A)								Option	How Setting Affects Game Play		
1	2	3	4	5	6	7	8		No. of Demerits Allowed	Bonus Increments Every __ Pts.	Perfect Day Bonus
							—	As of press time, this switch is not used and has no effect. However, refer to the Report Options screen in self-test to be sure.			
								Add-A-Coin Control			
					Off	On		Maximum of 3 Add-A-Coin Games			
					On	Off		Maximum of 10 Add-A-Coin Games			
					Off	Off		Maximum of 25 Add-A-Coin Games ◄			
					On	On		Unlimited Add-A-Coin Games			
								Game Difficulty			
		Off	On	On				Hardest	4	18,000	No
		Off	Off	On				Very Hard	5	15,000	No
		Off	On	Off				Hard	6	13,000	Yes
		On	Off	Off				Medium Hard	7	11,000	Yes
		Off	Off	Off				Medium Easy ◄	8	10,000	Yes
		On	Off	On				Easy	9	8,000	Yes
		On	On	Off				Very Easy	10	6,000	Yes
		On	On	On				Easiest	11	5,000	Yes
								Start Game/Add-A-Coin Ratio			
Off	On							1:1 (1 Credit to Start/1 Credit to Continue)			
Off	Off							2:1 (2 Credits to Start/1 Credit to Continue) ◄			
On	On							3:1 (3 Credits to Start/1 Credit to Continue)			
On	Off							3:2 (3 Credits to Start/2 Credits to Continue)			

◄ *Manufacturer's recommended settings*

ers must arrest a daily quota of law-breakers or arrest the APB criminal of the day and return to the police station.

There are multiple objectives to challenge both novice and experienced players:

1. Make the daily quota by arresting the offenders (litterbugs, drunks, dopers, honking taxis, hitchhikers, bikers, speeders and others);
2. Send APB criminals to jail (Sid Sniper, Juan Fingers, Freddy Freak, Hans Oop and many more);
3. Collect bonus time, extra fuel, and police car enhancements.

The game is over when the player obtains too many demerits. Demerits are given for not arresting the day's quota of criminals, for shooting innocent vehicles, crashing the police car, running out of gas, etc.

Controls consist of a 360° steering wheel, a siren button, a fire button, and a gas pedal. In order to make an arrest, players must press the siren button and tag the lawbreaker. The fire button can be used after the player has picked up the gun car enhancement from the speed shop.

By driving through the speed shop, players can select from several different enhancements for their police cars, including: faster acceleration, higher top speed, radar, armor, guns, and better brakes. Players can acquire many levels of these enhancements. The ability to build a more powerful police car is an added incentive for players to use the add-a-coin game continuation and maintain their vehicles.

Players continue to be challenged as they portray Officer Bob through an unlimited number of game play levels. Add-a-coin game continuation and level select features are included for increased earning power.

High Score Mode

Upon completing a game and if players are among the top 25 scorers recorded on the game, they have several seconds to enter their initials before the game returns to the attract mode. Players select their initials by moving the steering wheel and pressing the siren button when the proper initial is displayed.

To encourage high score competitiveness among players, you can periodically reset the high score table through the self-test. The top eight scores are kept in memory, while scores 9 through 25 are reset daily during power-up. Resetting the top eight scores in the self-test will give new players a chance to be recognized as top APB players.

Hints for Game Play

- To obtain higher scores, players should search off-road and collect bags of money and doughnuts.
- Players should try to complete the lowest car quota as soon as possible. (Another quota item may replace it.)
- For a chance at receiving hints toward the mystery APB, players should meet the quota and return the APB criminal to the police station.
- To have one demerit removed, players should strive to play a perfect day (except Day 1).

Game Difficulty Options

The game difficulty option settings for APB (see Table 1-3) represent a totally new approach for Atari Games. We believe this new style of option table will make it easier for operators to adjust APB to suit players of all skill levels.

By changing one setting, the operator adjusts several game variables at the same time:

- **Demerits Allowed:** Similar to the typical game concept of "lives", the game is over when the player gets more than the number of demerits allowed.
- **Bonus Increments:** One demerit is erased at the indicated score multiples.
- **Perfect Day Bonus:** One demerit is erased for completing a perfect day. A perfect day means catching the daily quota of criminals and not bumping the police car into any other obstacles. The player does *not* have to arrest the APB criminal of the day.

The game difficulty option setting also affects a few other, more subtle, game tuning elements. These elements are gas usage, day timer clock speed, and the collision speed necessary to make the player's car explode.

Game difficulty options should be changed by only one setting at a time. Changing from "medium easy" to "medium hard" will shorten the average game time by 10 to 20 seconds, depending upon the players in the location.

Maximizing Earnings

Operator options on this game have been kept very simple. Enter Self-Test and use the Report Statistics screen to evaluate game data. The Report Options screen can be used to make adjustments to game difficulty and coinage.

The key to maximum earnings is striking a midpoint on game times. Game times must be short enough so that player turnover is high. Conversely, game times must be long enough to give a player a good value and insure repeat play (repeat play is crucial to longevity). APB gives the operator flexibility to tune game difficulty and enough statistics to intelligently make adjustments.

If collections seem low or are dropping off, the most important thing to do is check all player controls and coin mechanisms for proper operation before making any other changes. As with all games, APB must be in proper working order to maximize earnings.

When evaluating the average game time, consider the price that the player is paying to play the game. In order to give players good value for their money, the average time for new games should be somewhat longer for APB games that are set for two coins to start (a minimum of 2:30 versus 1:30 for games set for one coin to start). The average game time for continued games will be shorter than that for new games, due to the increasing difficulty of the game.

> **NOTE**
>
> Average game times reported in APB are *not* on a per-coin basis as with some other Atari games.

If earnings seem low, the game is technically sound and the average game time is too short, try changing the game difficulty option to an easier setting. This change will give players more game time for their money.

If the average game time per quarter is too long, try changing the game difficulty to a harder setting. If the average game time per quarter is still too long after a few weeks, try an even harder setting.

After changing the game difficulty settings, it is a good idea to reset the game statistics. The histograms should be cleared by following the instructions in Self-Test (this resets the average game time statistics).

Game Sounds

Your APB game uses more effective audio than previous games, which results in more player involvement and enjoyment. The game uses advanced digital sound-generation techniques to create realistic musical instrument sounds (such as clarinets, harmonicas, drums, and violins). Although a player may not be consciously aware of the music, it has a direct effect on the excitement and emotional experience of the game.

The APB game creates ear-catching sound effects, which are designed to give feedback to make the player believe that the game is responding directly to his actions. To maximize the player's enjoyment of this enhanced audio and maximize your earnings, consider the following hints:

1. The game location should be a relatively dead acoustical environment. The goal is to minimize unnecessary sound reflection, so that the sounds from the APB game won't be drowned out by the accumulation of other sounds that bounce around the room. Carpets help eliminate sound reflections from the floor. Acoustical tile is also useful, especially if you have low ceilings.

2. If you use an environmental sound system or a stereo, consider lowering its volume or perhaps even turning it off. In the days when video games just made harsh beeps and boops, a central sound system helped make up for the lack of drive and excitement in a game's sounds. But your APB game is very musical, and a sound system interferes with the game's ability to interest players and draw bystanders.
3. Be concerned with the overall volume levels in arcade environments. The goal is to involve the players' emotions, not to damage their hearing. To a certain point, raising the game volume helps add to player excitement, but above that level it creates hearing fatigue and the high volume starts to drive players away. Rather than turning up the volume on the APB games to cut through the background sound level, try lowering the volume of any neighboring games that have sounds which are not an attractive or important element. Careful placement of games and attention to unnecessary noise sources can also help increase the player's sense of game involvement and interaction.

NOTES

Chapter 2

Self-Test

The APB™ game tests itself and provides visual and audible indications of the condition of the game circuitry and controls. Self-test information is displayed on the screen and through the sound system. No additional equipment is required.

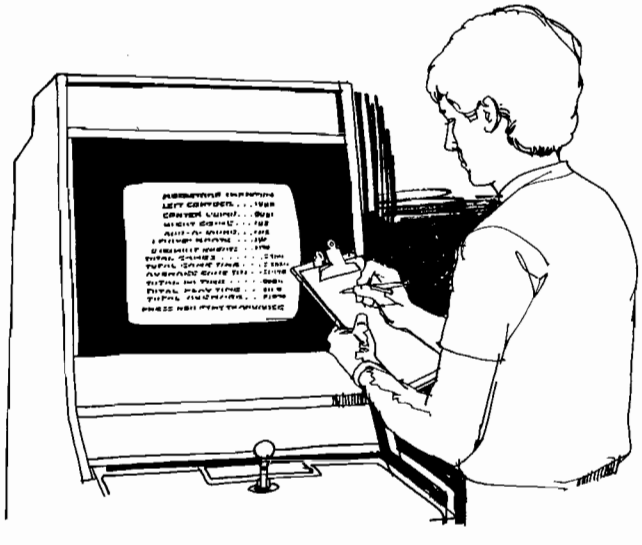
We suggest that you perform a self-test when you first set up the game, each time you collect the money, or when you suspect game failure.

When the self-test switch is turned on, the game enters the Self-Test Mode. The Main Self-Test screen is displayed and lists 16 self-tests that provide information pertaining to the game circuits and controls. Turning the self-test switch off at any time during the Self-Test Mode, except for the demo items, causes the game to return to the Attract Mode. Refer to Chapter 1 for the location of the self-test switch.

NOTE

During all of the self-tests, except the Controls Test, turning the steering wheel returns you to the Main Self-Test screen.

In the Controls Test, you must turn the wheel until the message *Hit siren to exit* is displayed. After pressing the Siren button, turning the wheel returns you to the Main Self-Test screen.



Main Self-Test Screen

The Main Self-Test screen is shown in Figure 2-1. This screen lists four categories of operator-selectable APB self-tests and game statistics: Reset, Report, Test, and Demo. They consist of: Power-On Restart Reset, High Scores Reset, Statistics Reset, Options Report, Statistics Report, Day Histogram Report, Sound Test, Controls Test, Color Bars Test, Program ROM Test, Alphanumeric ROM Test, Motion Object ROM Test, Playfield ROM Test, All RAM Test, Set Enhancements Demo, and Can Player Die? Demo.

> **NOTE**
>
> Four tests are for program development purposes only and cannot be selected. These include: PF Animation, Show MOB Data, PF Coco Editor, and Tile Editor.

Turning the steering wheel counterclockwise sequences down through the list of tests; turning the wheel clockwise sequences up through the list. Then pressing the Siren button selects the self-test and, if applicable, displays the self-test screen.

Power-On Restart Reset

The Power-On Restart Reset screen is shown in Figure 2-2. This option performs a power-on type reset of the game.

The RAM test checks the condition of the zero page RAM, motion object RAM, playfield RAM, and alphanumeric RAM. If this test fails, the message *BAD* is displayed in red and shows the code for the failed RAM. The ROM test checks all eight of the program ROMs on the CPU PCB for check sums. If this test fails, the message *BAD* is displayed in red and shows the code for the failed ROM.

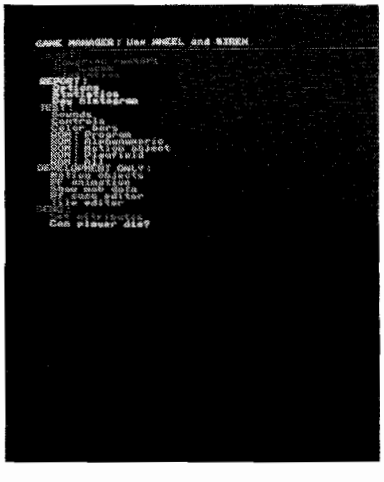


Figure 2-1 Main Self-Test Screen

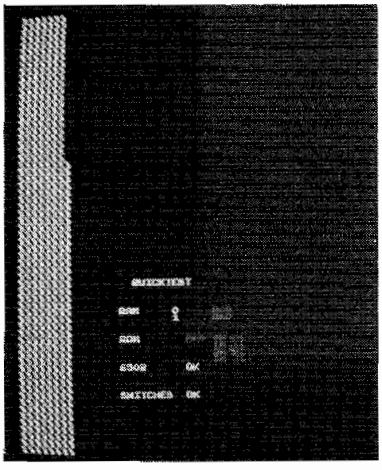


Figure 2-2 Power-On Restart Reset Screen

The 6502 Processor test indicates the condition of the 6502 sound microprocessor and associated circuitry. The 6502 test starts with a reset/communications check for proper response to start up protocol. The test then checks the communications ports (T-11 to 6502 and 6502 to T-11), the 6502 reset circuit, and the general condition of the 6502. If the 6502 circuitry does not respond properly to the reset, the system retries the reset procedure ten times. If the 6502 circuitry fails to reset through all ten attempts, the message *BAD* is displayed.

The Switch test checks the condition of the push-button leaf switches. If a leaf switch is stuck or is not functioning properly, the message *BAD* is displayed.

Select this option on the Main Self-Test screen by turning the steering wheel, then press the Siren button. The message *Are you SURE? Hit SIREN and FIRE if yes.* is displayed. Pressing the Siren and the Fire buttons simultaneously resets the game. After the test is completed, the message *GAME MANAGER: Use WHEEL and SIREN* is displayed at the top of the screen.

Turn the steering wheel to return to the Main Self-Test screen.

High Scores Reset

The High Scores Reset screen is shown in Figure 2-3. This option resets the high score table to the factory settings.

Select this option on the Main Self-Test screen by turning the steering wheel, then press the Siren button. The message *Are you SURE? Hit SIREN and FIRE if yes.* is displayed. Pressing the Siren and the Fire buttons simultaneously resets the high scores. The message *DONE* is then displayed on the screen.

Turn the steering wheel again to return to the Main Self-Test screen.

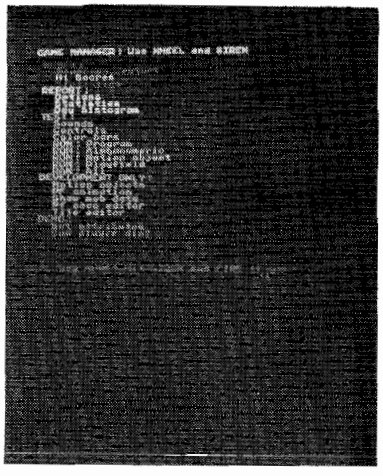


Figure 2-3 High Scores Reset Screen

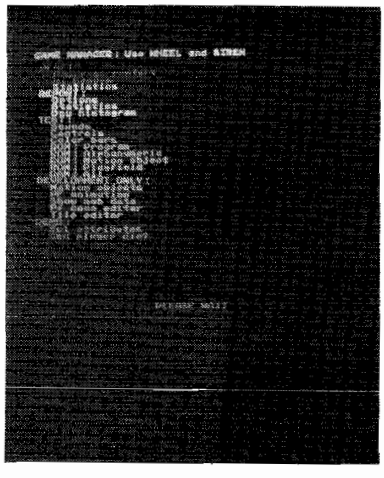


Figure 2-4 Statistics Reset Screen

Statistics Reset

The Statistics Reset screen is shown in Figure 2-4. This option resets the current game statistics. The statistics information is accumulated from the last time the statistics were reset.

Select this option on the Main Self-Test screen by turning the steering wheel, then press the Siren button. The message *Are you SURE? Hit SIREN and FIRE if yes.* is displayed. Pressing the Siren and the Fire buttons simultaneously resets the game statistics. The message *Please wait* is displayed on the screen. Then after several seconds, the message *SUCCESS* is displayed.

Turn the steering wheel to return to the Main Self-Test screen.

Options Report

The Options Report screen is shown in Figure 2-5. This screen indicates the current coin and game option settings of the two dual-in-line package (DIP) switches at locations 6/7A and 5/6A on the CPU PCB.

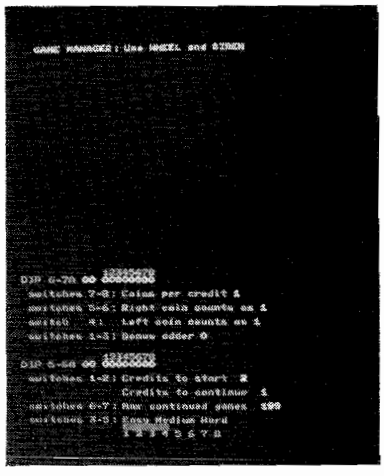


Figure 2-5 Options Report Screen

- The option switches at location 6/7A and switches 1 and 2 of the option switches at location 5/6A are used for selecting the coin and credit options.
- The option switches 3 through 7 at location 5/6A are for selecting game options.

Select this option on the Main Self-Test screen by turning the steering wheel, then press the Siren button.

Set the coin and game option settings by changing the settings of the DIP switches located on the CPU PCB. Refer to Tables 1-2 and 1-3 in this manual for the available options and default (recommended) settings.

To change these settings, first remove the thin film of plastic covering the option switch. Use a pen or a sharp-pointed instrument to slide the appropriate small buttons to different settings. With the PCB installed in the game, right is the *on position*, and left is the *off position*. The steering wheel and the push buttons are *not* used to change these settings. After changing the switch settings, press the Siren button to redisplay the settings.

Turn the steering wheel to return to the Main Self-Test screen.

Statistics Report

The Statistics Report screen is shown in Figure 2-6. This screen provides a visual check of the current game statistics, showing the distribution of times for starting games. These times are measured from game start to the first add-a-coin, or from game start to game end if no coin is added. The number of games in each category is indicated numerically and as a bar graph.

The statistics information is accumulated from the last time the statistics were reset. The green-highlighted reading indicates the number of new games. The red-highlighted reading indicates the number of continued games.

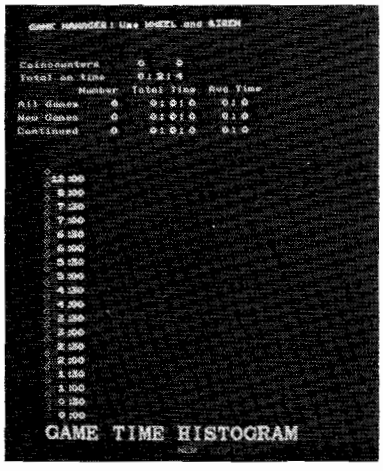


Figure 2-6 Statistics Report Screen

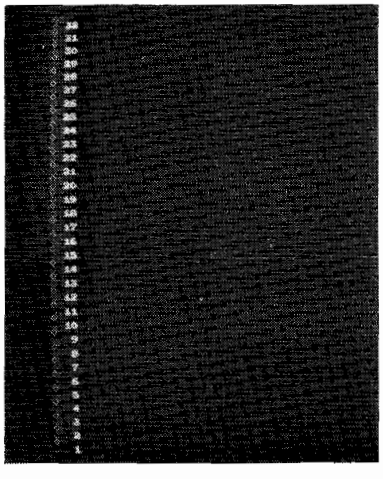


Figure 2-7 Day Histogram Report Screen

Select this option on the Main Self-Test screen by turning the steering wheel, then press the Siren button.

Turn the steering wheel to return to the Main Self-Test screen.

Day Histogram Report

The Day Histogram Report screen is shown in Figure 2-7 and gives a failure/success measure for each day. The number of games in each category is indicated numerically and as a bar graph. The green-highlighted reading indicates the number of times a day was started. The red-highlighted reading indicates the number of times a day was successfully completed.

Select this option on the Main Self-Test screen by turning the steering wheel, then press the Siren button.

Turn the steering wheel to return to the Main Self-Test screen.

Sound Test

The Sound Test screen is shown in Figure 2-8. This test indicates the condition of the sound-effects circuits, including the music (Yamaha) synthesizer, sound-effects generator (POKEY) sound outputs, and the speech chip.

Select this test on the Main Self-Test screen by turning the steering wheel, then press the Siren button. Next, turn the steering wheel clockwise to sequence forward through the sounds; turn the steering wheel counterclockwise to sequence backward. After selecting the desired sound, press the Siren button to start the sound. Select *STOP* to turn off the sound during the test.

> **NOTE**
>
> Four items *must* be checked during this test:
>
> - *POK1* consists of four tones in a major chord that come from the left sound channel.
> - *POK2* consists of four tones in a major chord that come from the right sound channel.
> - *YTST* consists of eight tones in a major scale that alternate between left and right sound channels (16 tones total).
> - *TALK* consists of a synthesized voice repeating the message "speech chip test."

To return to the Main Self-Test screen, turn the wheel to select *EXIT*, the last item displayed on the screen. Next, press the Siren button and then turn the steering wheel.

Controls Test

The Controls Test screen is shown in Figure 2-9. This test indicates the condition of the steering wheel, foot pedal, and push-button leaf switches.

The *PEDAL* message displays the low, high, range, raw, and normalized values of the foot pedal. These values

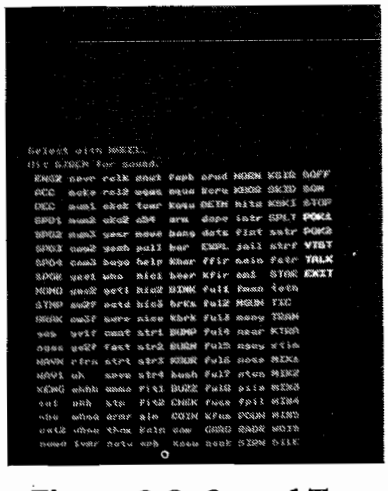


Figure 2-8 Sound Test

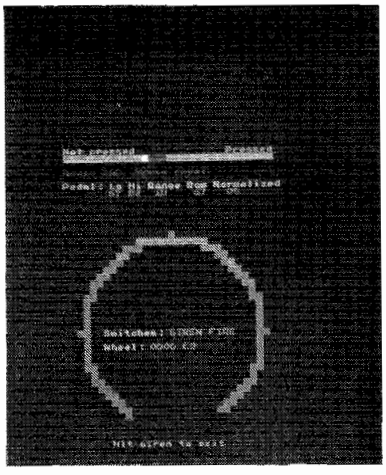


Figure 2-9 Controls Test

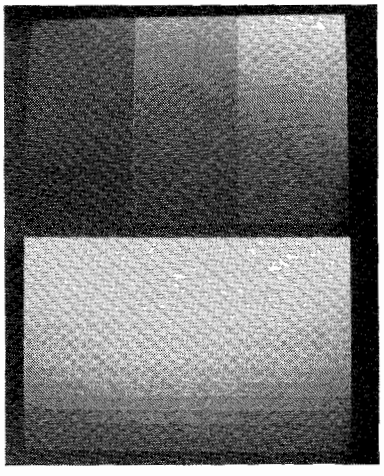


Figure 2-10 Color Bar Test

should increase as the pedal is pressed. The message *Range OK* is displayed if the pedal is functioning properly. The message *Range BAD. Press pedal.* is displayed if the pedal is malfunctioning.

The *SWITCH* message displays the two types of push-button switches: Siren, and Fire. Pressing the respective button should highlight the button name on the screen.

The *WHEEL* message displays hexadecimal values of instantaneous (left value) and accumulated (right value) readings. Look for consistent readings (within ± 2) when you turn the steering wheel to its left and right limits. As you turn the wheel clockwise, a green circle indicating a clockwise direction is drawn simultaneously on the screen; as you turn it counterclockwise, a blue circle is drawn simultaneously in a counterclockwise direction. Turn the wheel until the message *Hit siren to exit.* is displayed, then press the Siren button.

Turn the wheel to return to the Main Self-Test screen.

Color Bar Test

The Color Bar Test consists of several color display screens that indicate the condition of the video display color circuits. These screens are used to test for white tracking, color purity, and convergence. One of the screens is shown in Figure 2-10.

> **NOTE**
>
> During this test, pressing the Siren button sequences through each different color screen.

This test begins with a screen displaying fifteen horizontal color bars beginning with lavender, yellow, red, blue, and green. These same colors are then repeated in sequence except that each color is separated by a white horizontal bar. In the next screen display, vertical color bars of green, white, blue, white, red, white, yellow, white, lavender, and white are repeated across the screen.

Next follow five Color Bar screens that indicate the condition of the display color-purity circuits. These consist of individual color screens of red, green, blue, white, and grey. If the display characteristics are not correct, refer to the display manual included with your game for the color-gun adjustment procedure or to determine the possible cause of failure.

The four Convergence Test screens that follow indicate the condition of the display size, centering, linearity, and convergence. Initially, a white-dot convergence pattern is displayed followed by purple-, cyan- (blue-green), and yellow-dot screens. Convergence between any two colors should not exceed 0.7 mm in the middle of the screen and 1.2 mm in the corners.

This pattern can also be used to adjust screen size, centering, and brightness (black level). To obtain the proper screen size, adjust the pattern to be as large as the face of the CRT: all four pattern corners should be just at the corners of the CRT. After adjusting the screen size, check the game playfield: verify that the score information is on the screen.

For white tracking purposes, a screen showing sixteen vertical grey-scale bars and three groups of sixteen vertical bars with shades of red, green, or blue is displayed. Each group of red, green, or blue should be split in half horizontally to show two fade scales. Each upper fade scale is ranged by changes in overall color intensity (z) and each lower fade scale by individual color intensity (R, G, B). This test helps to determine if white tracking is set properly (grey-scale bars range from white to grey).

Select this test on the Main Self-Test screen by turning the steering wheel, then press the Siren button.

Turn the steering wheel to return to the Main Self-Test screen.

Program ROM Test

The Program ROM Test screen is shown in Figure 2-11. During this test the eight program ROMs on the CPU PCB are tested for check sums. If the ROM test fails, a red message *ERROR* with the location of the failed ROM is displayed. If the ROM test is good, a white message *OK* is displayed.

Select this test on the Main Self-Test screen by turning the steering wheel, then press the Siren button.

Turn the steering wheel to return to the Main Self-Test screen.

Motion Object ROM Test

The Motion Object ROM Test screen is shown in Figure 2-12. This test indicates the condition of the motion-object ROMs, horizontal and vertical display locations, and motion-object color palettes.

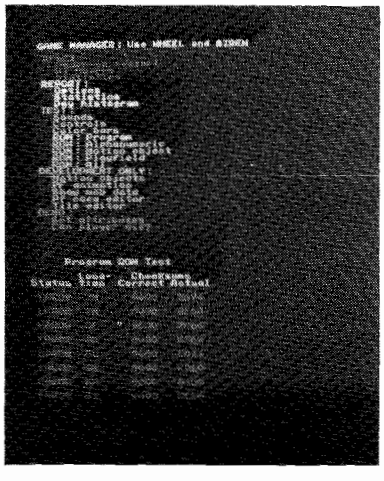


Figure 2-11 Program ROM Test

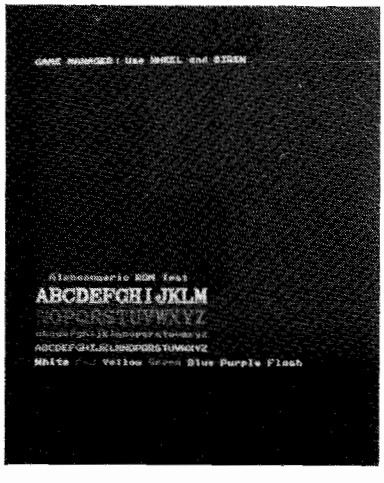


Figure 2-12 Alphanumeric ROM Test

Select this test on the Main Self-Test screen by turning the steering wheel, then press the Siren button. Next, turn the wheel and all game pictures are displayed one at a time. If a picture cannot be made the correct color by pressing the Siren button, then a ROM is bad.

Turn the steering wheel to return to the Main Self-Test screen.

Alphanumeric ROM Test

The Alphanumeric ROM Test screen is shown in Figure 2-13. This screen indicates the condition of the alphanumeric ROM, and color palettes. This screen shows five rows of alphanumeric characters under the title Alphanumeric ROM Test: the first row with white, uppercase characters followed by a second row with red, uppercase characters; the third row with green, lowercase characters; and the fourth row with yellow, uppercase characters. The fifth row tests the color palettes and displays eight "color" words: white, red, yellow, green, blue, purple, and "flashing" purple.

Select this test on the Main Self-Test screen by turning the steering wheel, then press the Siren button.

Turn the steering wheel to return to the Main Self-Test screen.

Playfield ROM Test

The Playfield ROM Test screen is shown in Figure 2-14. This screen indicates the condition of each playfield ROM, and the vertical and horizontal playfield scrolling registers.

For each of the four ROM pairs, the screen displays one picture and the ROM pair PCB location.

Select this option on the Main Self-Test screen by turning the steering wheel, then press the Siren button. Consec-

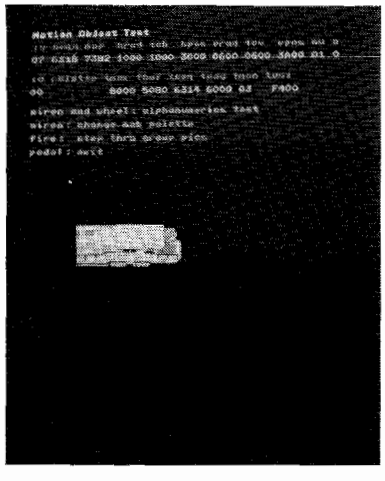


Figure 2-13 Motion Object ROM Test

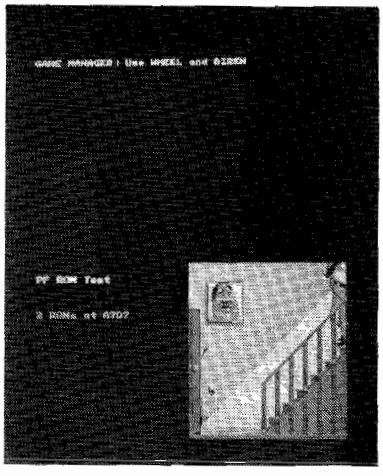


Figure 2-14 Playfield ROM Test

utive pressing of the Siren button sequences through the ROM locations and their corresponding game pictures.

Turn the steering wheel to return to the Main Self-Test screen.

All RAM Test

The All RAM Test instructs the operator to do a power-on restart to test the RAM.

Select this option on the Main Self-Test screen by turning the steering wheel, then press the Siren button. The message *To test all RAM do RESET power-on restart.* is displayed.

Select the Power-On Restart reset option on the Main Self-Test screen by turning the steering wheel, then press the Siren button. The message *Are you SURE? Hit SIREN and FIRE if yes.* is displayed. Pressing the Siren and the Fire buttons simultaneously resets the RAM. The message *GAME MANAGER: Use WHEEL and SIREN* is displayed after the test is completed.

Turn the steering wheel to return to the Main Self-Test screen.

Set Enhancements Demo

The Set Enhancements Demo screen is for demonstration purposes only, and sets the player enhancements to the maximum available for the day (level) being played.

Select this option on the Main Self-Test screen by turning the steering wheel, then press the Siren button. The message *DONE* is displayed.

Turn the steering wheel to make a different selection on the Main Self-Test screen.

Can Player Die? Demo

The Can Player Die? Demo is for demonstration purposes only, and prevents players from dying during the demo.

Select this option on the Main Self-Test screen by turning the steering wheel, then press the Siren button. The message *NO* is displayed. Pressing the Siren button again, displays the message *YES*.

Turn the steering wheel to make a different selection on the Main Self-Test screen.

NOTES

Chapter 3

Maintenance

This chapter includes preventive and corrective maintenance procedures for the APB™ game components that are subject to the most use. To assure maximum trouble-free operation from this game, we recommend that preventive maintenance be performed as described in this chapter.

Removal, disassembly, reassembly, and replacement procedures are provided for components that might require corrective maintenance. Appropriate references are provided to Chapter 5, Illustrated Parts Lists, to help locate the parts of this game that are mentioned, but not illustrated, in the maintenance procedures.

Preventive Maintenance

Preventive maintenance includes cleaning, lubricating, and tightening hardware. How often preventive maintenance is performed depends upon the game environment and frequency of play. However, for those components listed in Table 3-1 Preventive-Maintenance Intervals, we recommend that preventive maintenance be performed at the intervals specified.

Preventive-Maintenance Intervals

The preventive-maintenance intervals specified in Table 3-1 are the recommended minimum requirements for the components listed.

> **⚠ WARNING ⚠**
> To avoid possible electrical shock, turn off the game before performing any maintenance procedures.

Removing the Control Panel

Perform the following procedure to remove/replace the control panel. (See Figure 3-1.)

1. Unlock and open the rear access panel.
2. Carefully reach through the rear access panel opening and release the spring draw latches located under the control panel on both sides of the cabinet.
3. Use a 5/32-inch Allen wrench to remove the two screws and washers holding the front of the control panel to the cabinet.
4. Grasp the steering wheel control and gently lift until the bottom edge of the control panel clears the cabinet.
5. Disconnect the control panel harness connector and remove the control panel from the cabinet.

Table 3-1 Recommended Preventive-Maintenance Intervals

Steering Wheel	Inspect weekly, lubricate, and tighten hardware at least every three months.
Foot Pedal	Lubricate and tighten hardware at least every three months.
Coin Mechanism	Inspect whenever you collect coins. Clean at least every three months.

6. Replace the control panel in the reverse order of removal.

Cleaning the Push-Button Leaf Switches

Perform the following procedure to clean the leaf switch contacts and tighten the securing hardware.

1. Follow the procedure described in the preceding steps 1–5 for removing the control panel.
2. Use electrical contact cleaner to clean the contacts. Do not burnish them. When the push button is pressed, the wiping action of the cross-bar contacts provides a self-cleaning feature.
3. Using a $^{15}/_{16}$-inch open-end wrench, tighten the stamped nut securing the push-button leaf switches to the control panel.

Maintaining the Steering Wheel

Preventive maintenance on the steering wheel consists of:

- Inspecting the steering wheel housing for excessive wear or dirt.
- Inspecting the Optical Coupler PCB Assembly for damage.
- Lubricating the friction-producing surfaces of the white bearings.
- Replacing or tightening the securing hardware if necessary.

Perform the following procedure to lubricate and tighten the steering wheel control. (See Figure 3-2.)

1. Open the control panel as previously described.
2. Apply white grease (Atari part no. 107027-001) to the lubrication points shown in Figure 3-2.
3. Using a $^{5}/_{16}$-inch nut driver (or an appropriate tool), tighten the screws holding the steering wheel assembly to the control panel.

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.

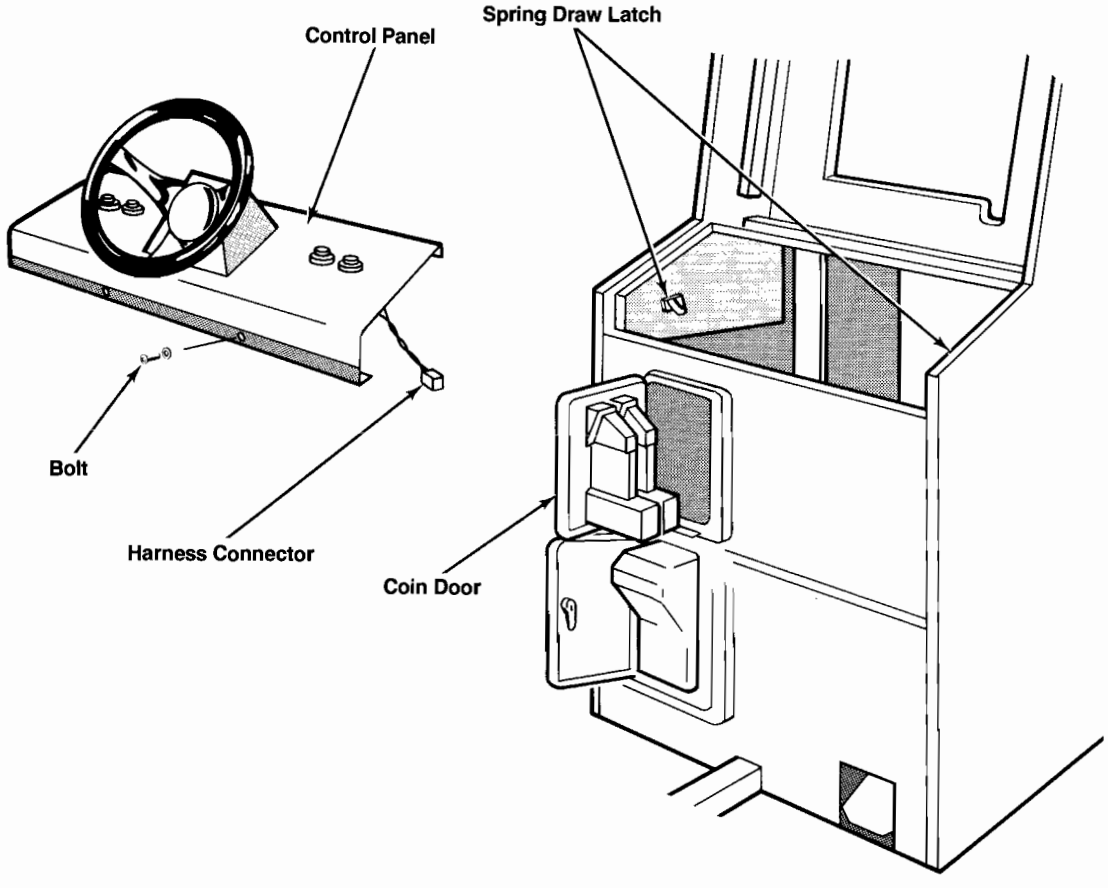


Figure 3-1 Control Panel Removal

Cleaning the Interior Components

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

> **⚠ WARNING ⚠**
>
> Turn off the game 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.

1. Unlock and open the rear access panel.
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 large, well-insulated, 18-gauge jumper wire to ground.
   b. Momentarily touch the free end of the grounded jumper to the CRT anode by sliding it under the anode cap.
   c. Wait two minutes and repeat part b.

> **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.

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 supplies, PCB assemblies, display, etc.).

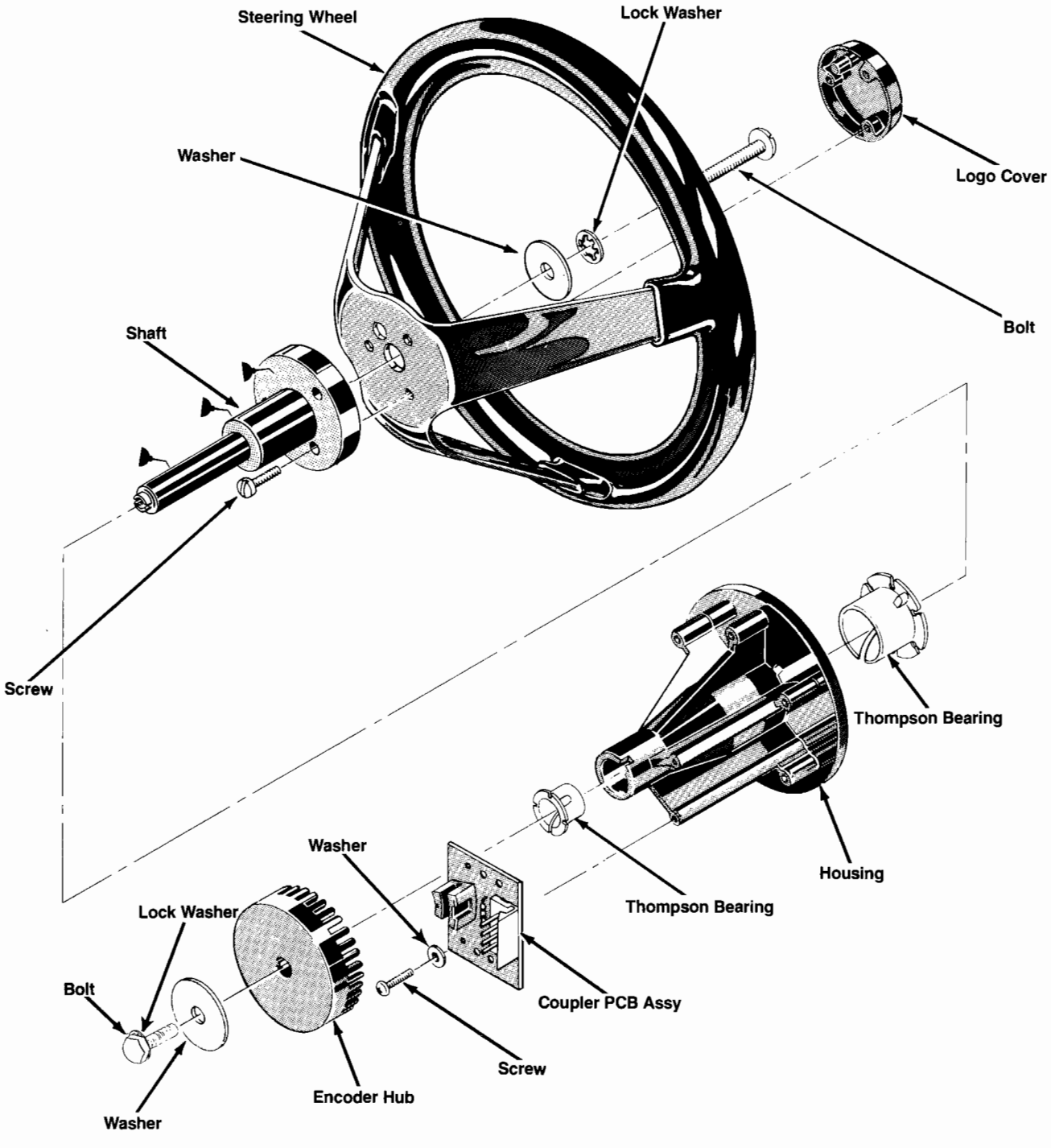


Figure 3-2 Maintaining the Steering Wheel

Corrective Maintenance

Corrective maintenance consists of removal, disassembly, reassembly, and replacement of game components. The following procedures are provided for components that may require corrective maintenance.

Removing the Video Display

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

1. Turn the game power off and wait two minutes. Unplug the power cord.
2. Remove the control panel as described in *Preventive Maintenance.*
3. Reach up through the panel slot underneath the bezel with your fingers and press forward on the display shield to pry it loose from the cabinet.
4. Grasp the display shield on the bottom edge and gently pull it out from the cabinet.
5. Use a flat-head screwdriver to remove the staples, if any, securing the bezel to the cabinet. Remove the bezel.
6. Unlock and open the rear access panel.

⚠ WARNING ⚠

High Voltage

The video display contains potentially 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.

7. 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 large, well-insulated, 18-gauge jumper wire to ground.
   b. Momentarily touch the free end of the grounded jumper to the CRT anode by sliding it under the anode cap.
   c. Wait two minutes and repeat part b.
8. Disconnect the video signal and the display power connectors.
9. Use a ⅜-inch nut driver to remove the four sets of nuts and washers from the corners of the video display chassis. Remove the two hex-head screws from the bottom corners of the chassis.
10. Carefully slide the display out through the front of the cabinet.
11. Replace the video display in the reverse order of removal.

NOTE

Whenever the cathode-ray tube is replaced, readjust the brightness, purity, and convergence as described in the display manual.

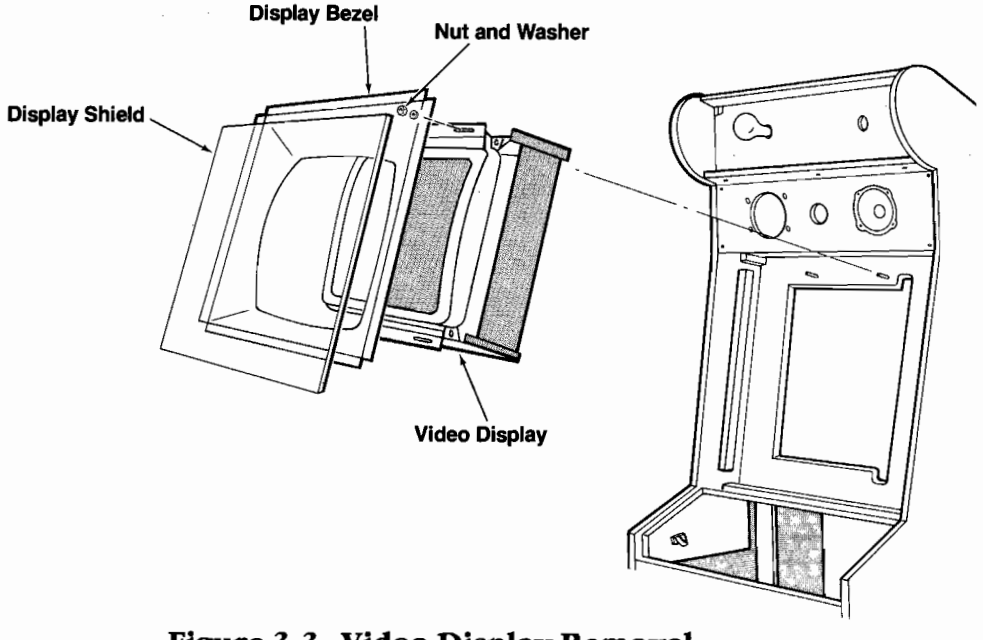


Figure 3-3 Video Display Removal

Removing the Steering Wheel

Perform the following procedure to remove/replace the steering wheel. (See Figure 3-2.)

1. Open the control panel as described under *Preventive Maintenance.*
2. Disconnect the harness connectors from the coupler PCB connector.
3. Using a 5/16-inch nut driver, remove the six screws holding the steering wheel assembly to the control panel.
4. Lift the steering wheel assembly out of the control panel.
5. Replace the steering wheel in the reverse order of removal. Reconnect the harness connectors to the coupler PCB connector.

Disassembling the Steering Wheel

Perform the following procedure to disassemble the steering wheel assembly. (See Figure 3-2.)

1. Using a 5/16-inch nut driver (or appropriate tool), remove the six screws holding the steering wheel assembly to the control panel.
2. Using a 7/16-inch nut driver (or appropriate tool), remove the bolt and washer from the bottom of the encoder hub.
3. Pull the shaft from the housing.
4. Remove the three screws holding the cover to the shaft.
5. Remove the 3/8-inch × 1-inch screw from the shaft.

Reassembling the Steering Wheel

Replace the steering wheel parts in the reverse order of removal. After reassembling the steering wheel, be sure that the hub can spin freely in the slot of the optical coupler on the PCB.

Removing the Foot Pedal

Perform the following procedure to remove/replace the foot pedal. (See Figure 5-6.)

1. Disconnect the foot pedal cable assembly from the main harness assembly located inside the rear of the cabinet.
2. Using a 5/16-inch hex driver (or appropriate tool), remove the two bolts and washers holding the foot pedal frame to the cabinet base. Remove the foot pedal.
3. Replace the foot pedal in the reverse order of removal.

Removing the Game PCBs

Perform the following procedure to remove/replace the game PCBs.

CAUTION

Do not attempt to remove the CPU and Video PCBs while they are connected together. If you are going to remove both of these PCBs, remove the Video PCB first to avoid damaging the PCBs or the edge connectors.

Video PCB

Perform the following procedure to remove/replace the Video PCB. (See Figure 3-4.)

1. Turn the game power off.
2. Unlock and open the rear access panel.
3. Remove the four thumb nuts holding the EMI cover to the ground plane.
4. Disconnect the harness connectors from the bottom of the Video PCB.
5. Remove *one* of the two thumb screws and spacers holding the top of the Video PCB (and the bottom of the CPU PCB) to the ground plane. Loosen, but do not remove, the other thumb screw.

NOTE

The brass thumb screws are easy to cross-thread. Use care when installing and tightening them.

6. Remove the two thumb screws holding the bottom of the Video PCB to the ground plane. Carefully hold the Video PCB in place to prevent the PCB from falling or causing excessive bending at the edge connector.
7. Remove the remaining thumb screw and spacer that was loosened in step 5. Gently disconnect the Video PCB from the CPU PCB.
8. Replace the Video PCB by first connecting the Video PCB to the CPU PCB edge connector. Carefully position both the Video and CPU PCBs so that the holes (in the bottom of the CPU PCB and at the top of the Video PCB) are aligned. Partially install one thumb screw and spacer through both of the PCBs and into the corresponding ground plane post.
9. Install and tighten the two thumb screws holding the bottom of the CPU PCB to the ground plane.
10. Install the remaining thumb screw holding the top of the Video PCB (and bottom of the CPU PCB) to the ground plane.

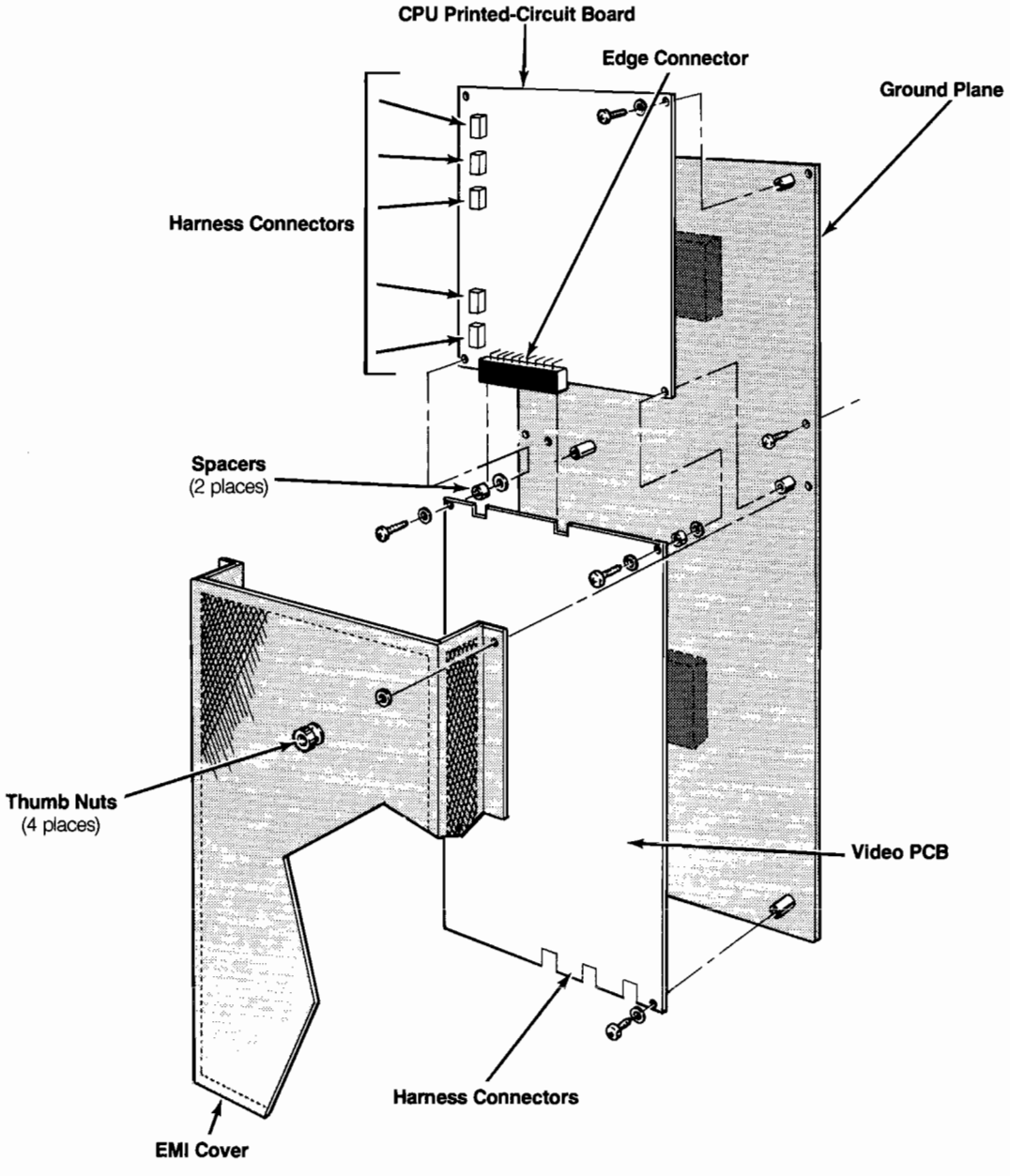


Figure 3-4 Game PCB Removal

11. Finger-tighten both thumb screws holding the top of the Video PCB (and bottom of the CPU PCB) to the ground plane.
12. Connect the harness connector to the bottom of the Video PCB.

NOTE

To comply with emission requirements, the Federal Communications Commission requires that the Video PCB Assembly be housed in the EMI cover. *Do not operate* this game without properly installing the EMI cover, metal spacers, and thumb nuts.

CPU PCB

Perform the following procedure to remove/replace the Central Processing Unit (CPU) PCB. (See Figure 3-4.)

NOTE

If the Video PCB has already been removed, disconnect the harness connectors from the left edge of the CPU PCB, then remove the two thumb screws holding the top of the CPU PCB to the ground plane. Remove the CPU PCB.

1. Turn the game power off.
2. Unlock and open the rear access panel.
3. Remove the four thumb nuts holding the EMI cover to the ground plane.
4. Disconnect the harness connectors from the left edge of the CPU PCB.
5. Remove the four thumb screws holding the CPU PCB (and the top of the Video PCB) to the ground plane.
6. Gently disconnect the CPU PCB from the Video PCB.
7. Replace the CPU PCB by first connecting the CPU PCB to the Video PCB edge connector. Carefully position both the CPU and the Video PCBs so that the holes (in the bottom of the CPU PCB and at the top of the Video PCB) are aligned. Partially install one thumb screw and spacer through both of the PCBs and into the corresponding ground plane post.
8. Install and tighten the two thumb screws holding the top of the Video PCB to the ground plane.
9. Install the remaining thumb screw holding the bottom of the CPU PCB (and the top of the Video PCB) to the ground plane.
10. Finger-tighten both thumb screws holding the bottom of the CPU PCB (and the top of the Video PCB) to the ground plane.
11. Connect the harness connectors to the left edge of the CPU PCB. (See Figure 3-4 for the proper connector locations.)

Removing the Incandescent Lights

Perform the following procedure to remove/replace the incandescent lights.

1. Turn the game power off.
2. From the front of the cabinet, use a ⅛-inch hex driver to remove the six screws and washers holding the curved attraction shield to the top of the cabinet.

⚠ WARNING ⚠

When working near the light bulbs, be sure that you do not touch them until they have cooled—or about five minutes.

3. Unscrew each light bulb and remove them from the sockets.
4. To remove the entire light fixture, use a Phillips screwdriver to remove the two screws holding the lightboard panel to the cabinet.
5. Then disconnect the light harness connector in the rear of the cabinet. Using a screwdriver, remove the two screws holding the light base and lift the base out of the front of the cabinet. Replace the light fixture in the reverse order of removal.

Removing the Speakers

Perform the following procedure to remove/replace the speakers.

1. Turn the game power off.
2. From the front of the cabinet, use a ⅛-inch hex driver to remove the four screws holding the speaker cover grille to the cabinet.
3. Use a Phillips screwdriver to remove the six screws holding the front of the speaker panel to the cabinet.
4. Disconnect the speaker harness assembly.
5. Remove the speaker panel.

CAUTION

Do not touch the speaker cones when handling the speakers. The cone material is fragile and can be easily damaged.

6. Use a Phillips screwdriver to remove the four screws holding the speaker to the cabinet. Do not let the speaker fall.
7. Lower the speaker just far enough to disconnect the two speaker wires. Be sure that you hook up the wires correctly. Otherwise, the game will produce less than the desired volume because the speakers will be out of phase.

   The signal wire on each speaker should be attached to the speaker tab marked with color, a + sign, or a round dot. (The signal wires are shown on the game wiring diagram; refer to the Schematic Package included with the game.)
8. Replace the speaker in the reverse order of removal.

Chapter 4

Troubleshooting

The information in this chapter discusses troubleshooting aids and techniques to assist the service technician when trouble is suspected in a game. Most troubles can be located quickly by following the information in this chapter. However, if problems persist, contact your local distributor or your Atari Games Corporation Customer Service Office, listed on the inside front cover of this manual, for assistance.

NOTE

We recommend that troubleshooting and repair procedures be performed by a qualified service technician.

Troubleshooting Aids

Troubleshooting aids are provided throughout this manual and the schematic package supplement. The following information is intended to acquaint the service technician with the portions of these documents that contain useful troubleshooting and repair information.

Assembly and Component Locations

The parts lists in Chapter 5 of this manual illustrate the locations of assemblies and components. Printed-circuit board (PCB) illustrations aid in rapidly locating components shown on the corresponding schematic diagram(s).

Diagrams

The schematic package supplement for this manual contains schematic diagrams with component locations, active component type numbers, and electrical values.

Troubleshooting Techniques

⚠ WARNING ⚠

To avoid electrical shock, turn off the game power before attempting to troubleshoot this game.

The following troubleshooting steps are arranged in a sequence recommended for locating a defective component. The procedure begins with a check of the simple trouble possibilities and progresses to more extensive procedures for localizing the problem to an assembly or major circuit, and then to a defective component.

Check Fuses

Check for open fuses. Refer to the power supply parts list in Chapter 5 and to the display manual for the location and rating of each fuse used in this game. Make sure that replacement fuses are the proper type and rating.

Check Power-Supply Voltages

Improper operation of all circuits usually indicates a power supply problem. Be sure that the proper line voltage is available to the power supply. Refer to the label on the power supply for its voltage rating.

Localize Trouble

Determine the trouble symptom. Use the wiring diagrams in the schematic package supplement to determine which assemblies or major circuits could cause the trouble. Perform the self-test procedure provided in Chapter 2 of this manual.

Visual Check

Visually check for obvious problems in the portion of the game where the trouble is suspected. For example, check for loose or defective solder connections, integrated circuits loose in their sockets, loose cable connections, broken wires, and damaged PCBs or components.

Check Individual Components

Check soldered-in passive components (e.g., resistors, capacitors, diodes) by disconnecting one end to isolate the measurement from the effects of the surrounding circuitry. Often, direct substitution is the most practical way to determine if a component is faulty. However, eliminate the possibility of some other circuit problem that could damage the substitute component.

Repair the Assembly

CAUTION

Soldered-in transistors and integrated circuits are difficult to remove without damaging the printed-circuit board or component. Refer to the information in this chapter pertaining to soldering and replacing integrated circuits and transistors.

Repair or replace the defective part. Refer to Chapter 3 and information in this chapter for special removal and replacement procedures. Check for proper operation of the repaired circuit.

Soldering Techniques

Observe the following recommendations when removing or replacing components soldered to a PCB. Poor soldering practices can damage a PCB or heat-sensitive electrical components.

Choosing the proper soldering iron is essential before attempting to remove or replace soldered-in components. Excessive heat is a common cause of damage to a component or PCB. However, transient voltages from solder guns or improperly grounded soldering irons can also damage certain voltage-sensitive semiconductor devices. Refer to *Troubleshooting Static-Sensitive Devices* for more specific information.

A 15- to 27-watt pencil-tip soldering iron is recommended to avoid separating the etched circuit wiring from the board material and to avoid damaging active components. A temperature-controlled soldering station rated at 700°F with a fine cone or a very fine chisel tip can also be used.

CAUTION

Solder guns are *not* recommended for removing or replacing soldered-in components on a printed-circuit board. Solder guns can overheat a device, and their large transient voltage can damage a voltage-sensitive device.

The following additional equipment is recommended for removing and replacing soldered-in components:

- Solder Sucker—Hand-operated vacuum tool used to remove liquified solder from the PCB. We recommend the top-of-the-line Soldapullt® brand.
- Solder Wick—Resin-soaked copper braid used for removing excess solder from the lead connections on the PCB. See *Removing Integrated Circuits* for precautions relating to the use of a solder wick on a multilayer PCB with plated-through holes.
- Flux Remover—Non-corrosive chemical used to clean foreign material from the PCB before soldering and to remove any flux residue where components have been replaced. Also used to clean any foreign material from the PCB during preventive maintenance. Isopropyl alcohol is recommended.
- Acid Brush—Small stiff-bristled paint or toothbrush used with flux remover to clean flux and other foreign material from the PCB.

Removing Integrated Circuits

The easiest and safest method for removing soldered-in integrated circuits (IC) from a PCB is to cut off each pin as close to the IC case as possible with a tip dyke (diagonal cutter) as shown in Figure 4-1.

Use the proper soldering iron as previously described under *Soldering Techniques*. Then, to avoid excessive heat buildup in one area of the PCB, apply heat directly to each pin in a random order. Remove the loosened pin with the tip of the soldering iron or a needle-nose pliers as shown in Figure 4-2. Allow a moment for the PCB to cool before proceeding to the next pin. Apply just enough heat to remove any stubborn pins.

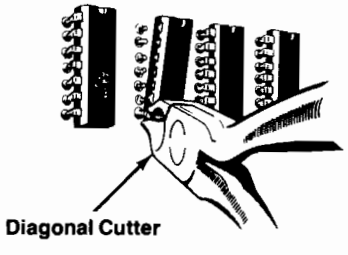


Figure 4-1 Removing IC (Cut-Pin Method)

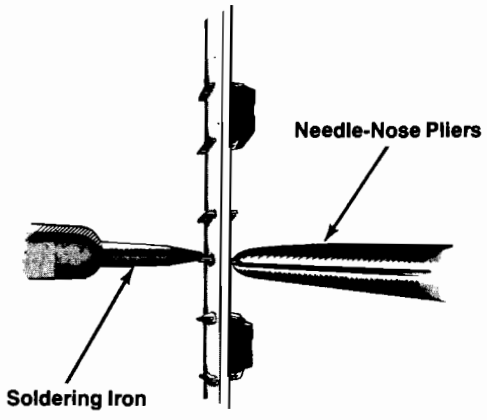


Figure 4-2 Removing IC Pins

For a multi-layer PCB with plated-through holes, use a solder sucker to remove the remaining solder from inside each hole as shown in Figure 4-3. If possible, suck the solder from the opposite side of the PCB from where the heat is applied.

Use a solder wick to remove excess solder from around the lead connection pads on the top and/or bottom surface of the PCB as shown in Figure 4-4.

CAUTION

Do not use a solder wick to remove solder from inside plated-through holes. The heat required for the solder wick to remove the solder from inside the hole could damage the PCB.

Use an integrated-circuit (IC) pulling tool to remove socketed ICs. Do not pry up on one end of the ICs, because the pins could be bent or broken.

Troubleshooting Static-Sensitive Devices

Certain precautions must be taken when working with static-sensitive devices, e.g., 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 buildup in a person's body or leakage from an improperly grounded soldering iron can cause static-sensitive device failure.

Before handling 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. A bare wire wrapped around your wrist and attached to an earth ground is effective when working extensively with static-sensitive de-

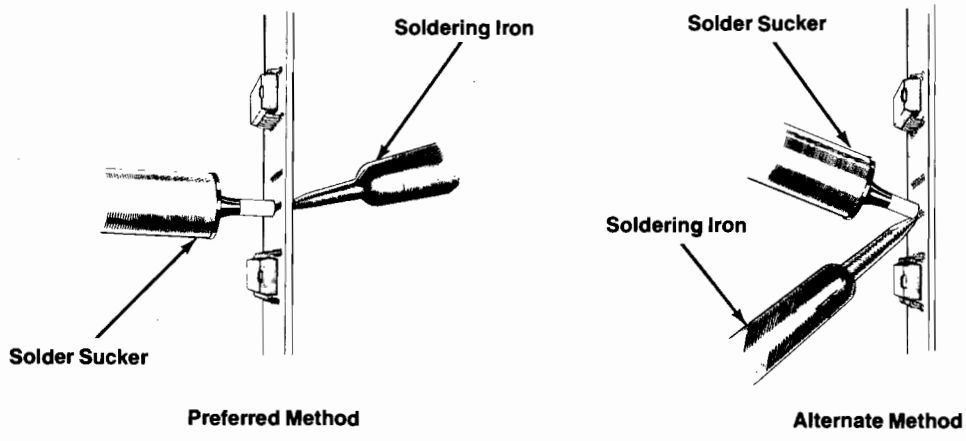


Figure 4-3 Removing Solder from Plated-Through Holes

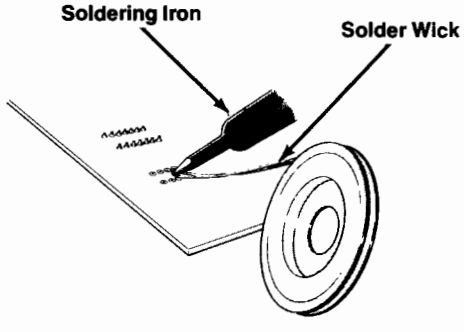


Figure 4-4 Removing Solder from Lead Connection Pads

vices. When soldering a static-sensitive device, use a soldering iron with a properly grounded three-wire cord. (Refer to *Soldering Techniques* for a discussion of recommended soldering irons and procedures.)

A static-sensitive device can appear defective due to leakage on a PCB. Observe the precautions for grounding static voltages described in the preceding paragraph and clean both sides of the PCB with flux remover or an eraser before replacing what can be a good static-sensitive device. For discrete FETs, clean thoroughly between the gate, drain, and source leads.

Static-sensitive devices can be packaged in conductive foam or 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.

Chapter 5

Illustrated Parts Lists

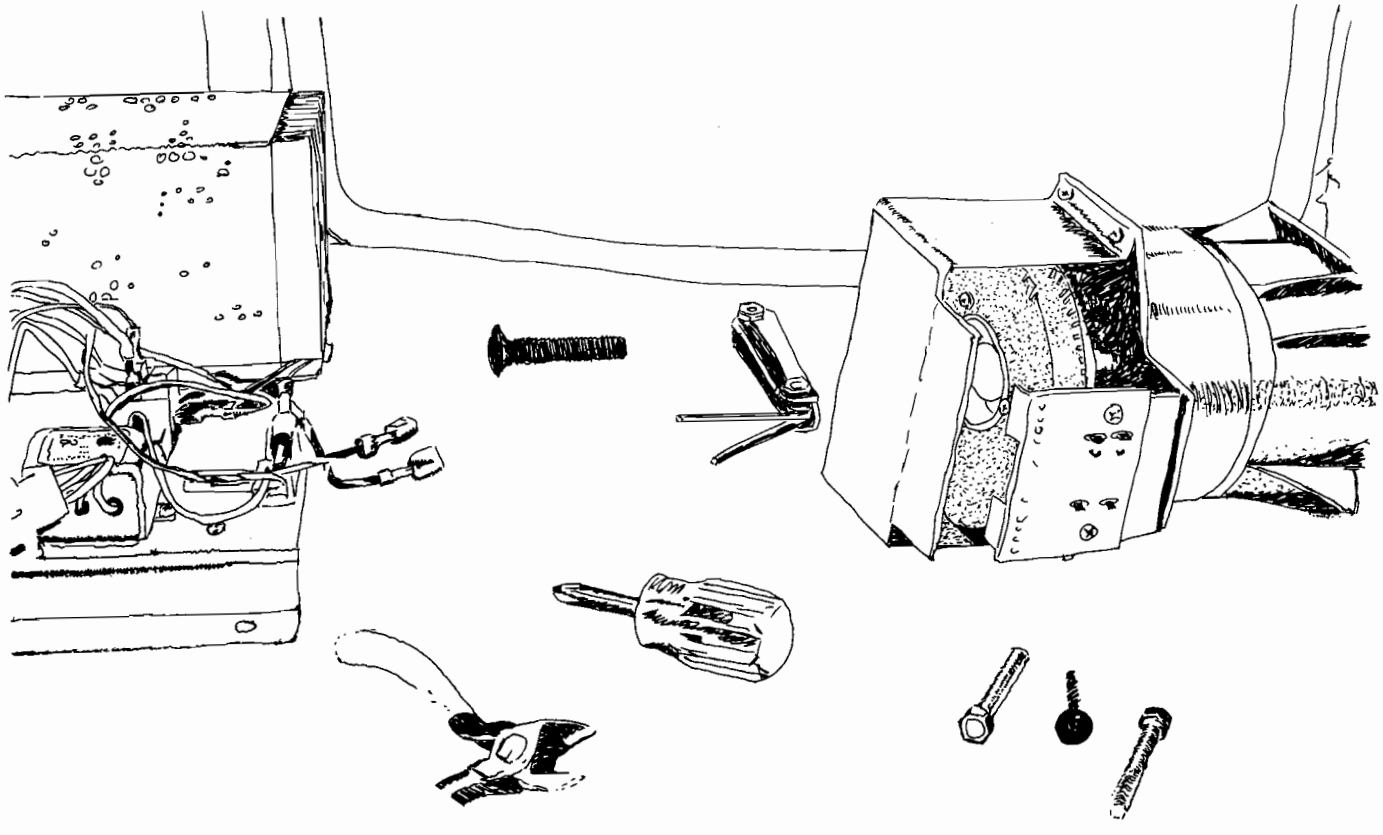
This chapter provides information you need to order parts for your game. Common hardware (screws, nuts, washers, etc.) has been deleted from most of the parts lists.

The PCB parts lists are arranged in alphabetical order by component. Each component subsection is arranged alphanumerically by reference designator.

Other parts lists are arranged alphanumerically by Atari part number. In these parts lists, all A-prefix numbers come first. Following these are numbers in sequence evaluated up to the hyphen, namely 00- through 99-, then 000598- through approximately 201000-.

When ordering parts, please give the part number, part name, number of this manual, and serial number of your game. This will help us fill your order rapidly and correctly. We hope the results will be less downtime and more profit from your game.

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



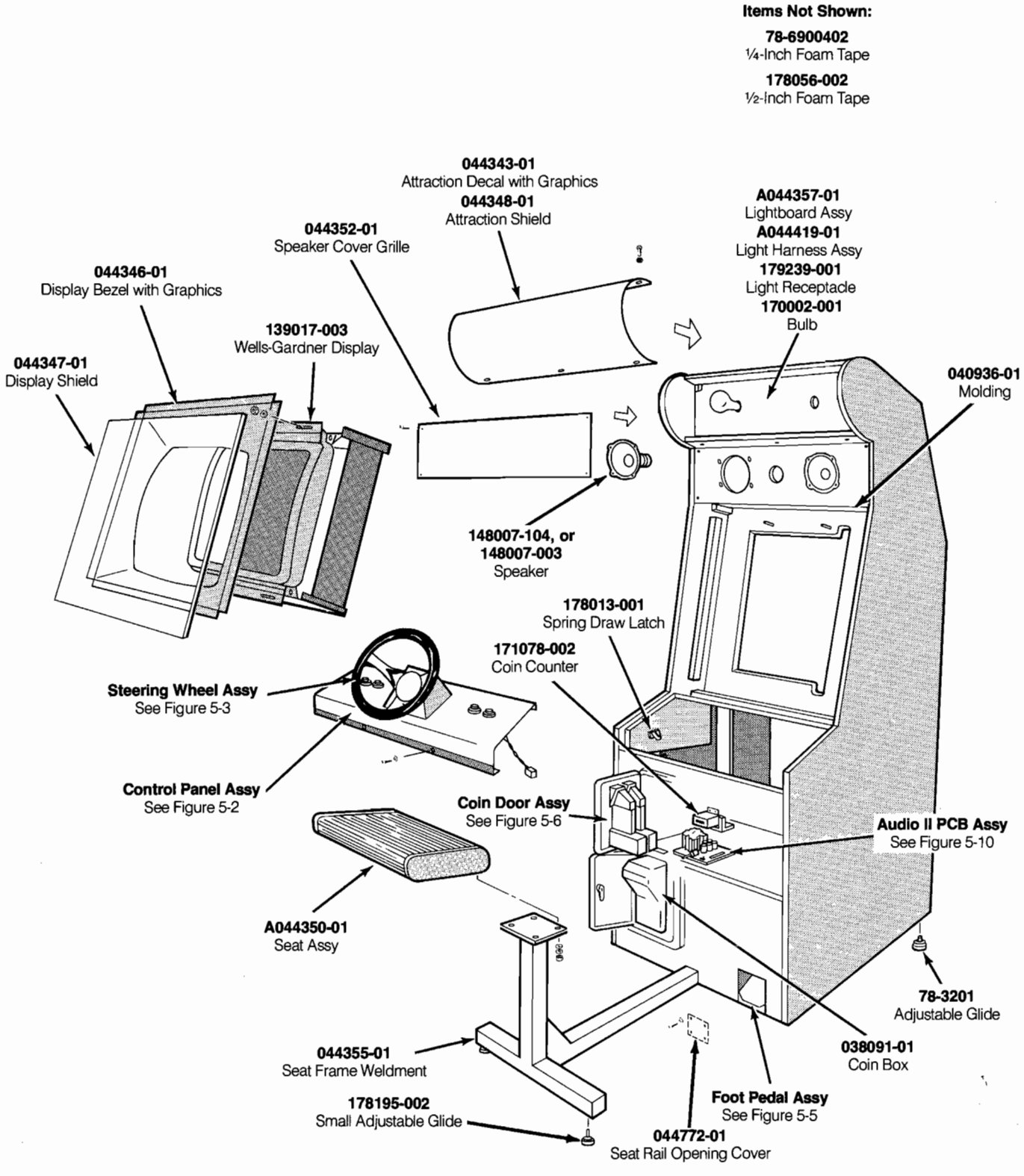


Figure 5-1 Cabinet-Mounted Assemblies
A044340-01 C

NOTE

To comply with emission requirements, the Federal Communications Commission requires that the Video PCB Assembly be housed in the EMI cover. *Do not operate this game* without properly installing the EMI cover, metal spacers, and thumb nuts.

Also, do not operate this game without the Filter Board Assembly installed at the bottom of the Video PCB.

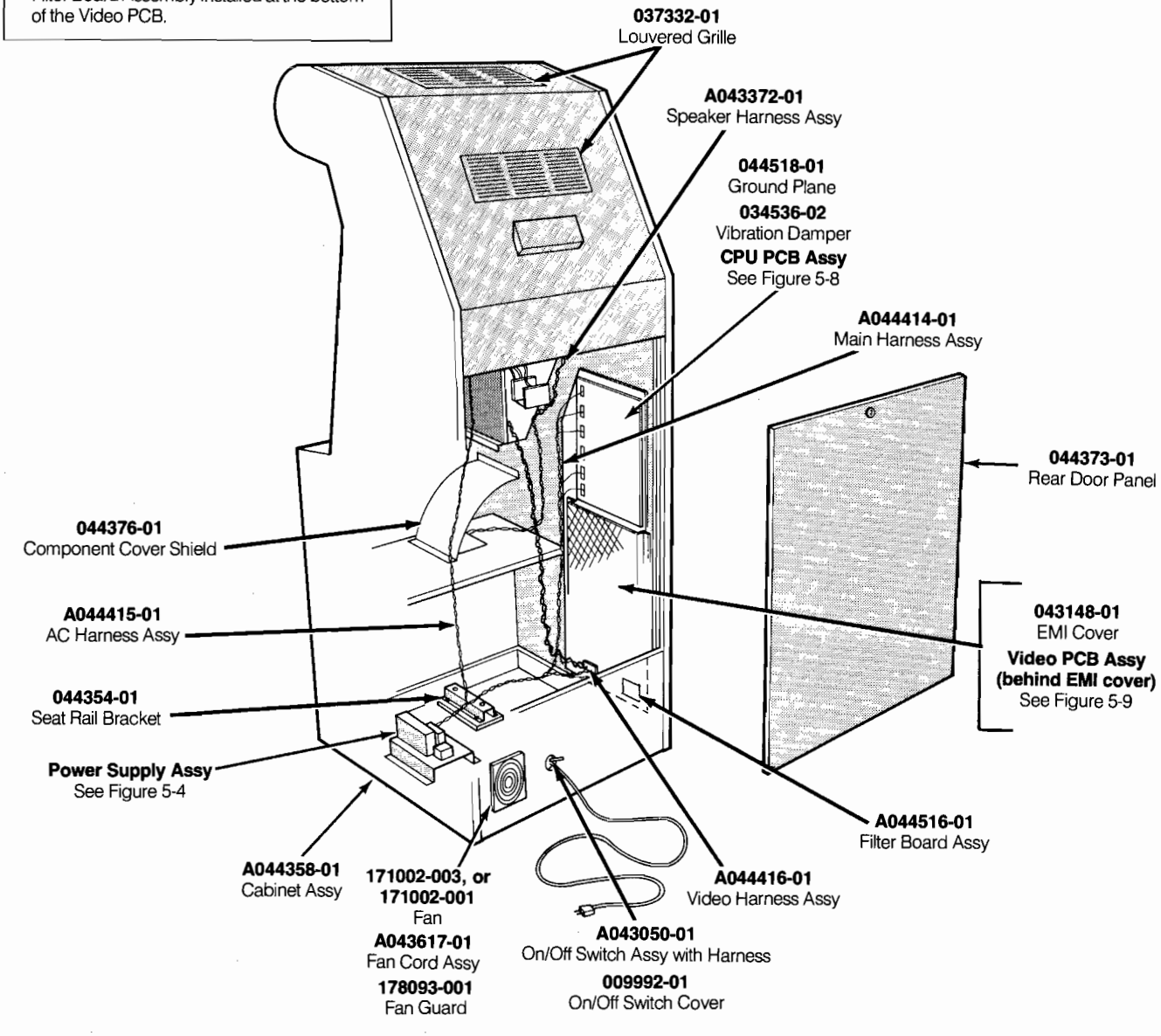


Figure 5-1 Cabinet-Mounted Assemblies, Continued
A044340-01 C

Cabinet-Mounted Assemblies
Parts List

Part No.	Description
A043050-01	On/Off Switch Assembly with Harness
A043372-01	Speaker Harness Assembly
A043617-01	Fan Cord Assembly
A044350-01	Seat Assembly
A044357-01	Lightboard Assembly
A044358-01	Cabinet Assembly
A044414-01	Main Harness Assembly
A044415-01	AC Harness Assembly
A044416-01	Video Harness Assembly
A044516-01	Filter Board Assembly
78-3201	Adjustable Glide
78-6900402	¼-Inch × ⅛-Inch Thick Foam Tape (24 inches required; used on front edge of control panel facing display shield)
009992-01	On/Off Switch Cover
034536-02	½-Inch Thick Vibration Damper
037332-01	Louvered Grille
038091-01	Coin Box
043148-01	EMI Cover
044343-01	Attraction Decal with Graphics
044346-01	Display Bezel with Graphics
044347-01	Display Shield
044348-01	Attraction Shield
044352-01	Speaker Cover Grille
044354-01	Seat Rail Bracket
044355-01	Seat Frame Weldment
044373-01	Rear Door Panel
044376-01	Component Cover Shield
044518-01	Ground Plane
044772-01	Seat Rail Opening Cover
139017-003	Wells-Gardner 19-Inch Medium-Resolution Color Raster Display, Model 19K7915
148007-104	4½-Inch, 8 Ω, 10 W, Shielded Speaker (Acceptable substitute is part no. 148007-003)
170002-001	60 W 120 V Soft White Bulb
171002-003	110 V, 110 CFM Exhaust Fan (Acceptable substitute is 110 V, 70 CFM Exhaust Fan, part no. 171002-001)
171078-002	12 VDC Non-Resettable Coin Counter
178013-001	Spring Draw Latch
178056-002	½-Inch × 1/16-Inch Thick Foam Tape (4 inches required; two inches used underneath each side of bezel)
178093-001	Fan Guard
178195-002	#¼-20 × 1-Inch Long Adjustable Glide (on underside corners of seat frame)
	The following are technical information supplements for this game:
TM-308	APB Operators Manual
SP-308	APB Schematic Package
ST-308	APB Self-Test Label
TM-297	Wells-Gardner Model 19K7915 Video Display Service Manual

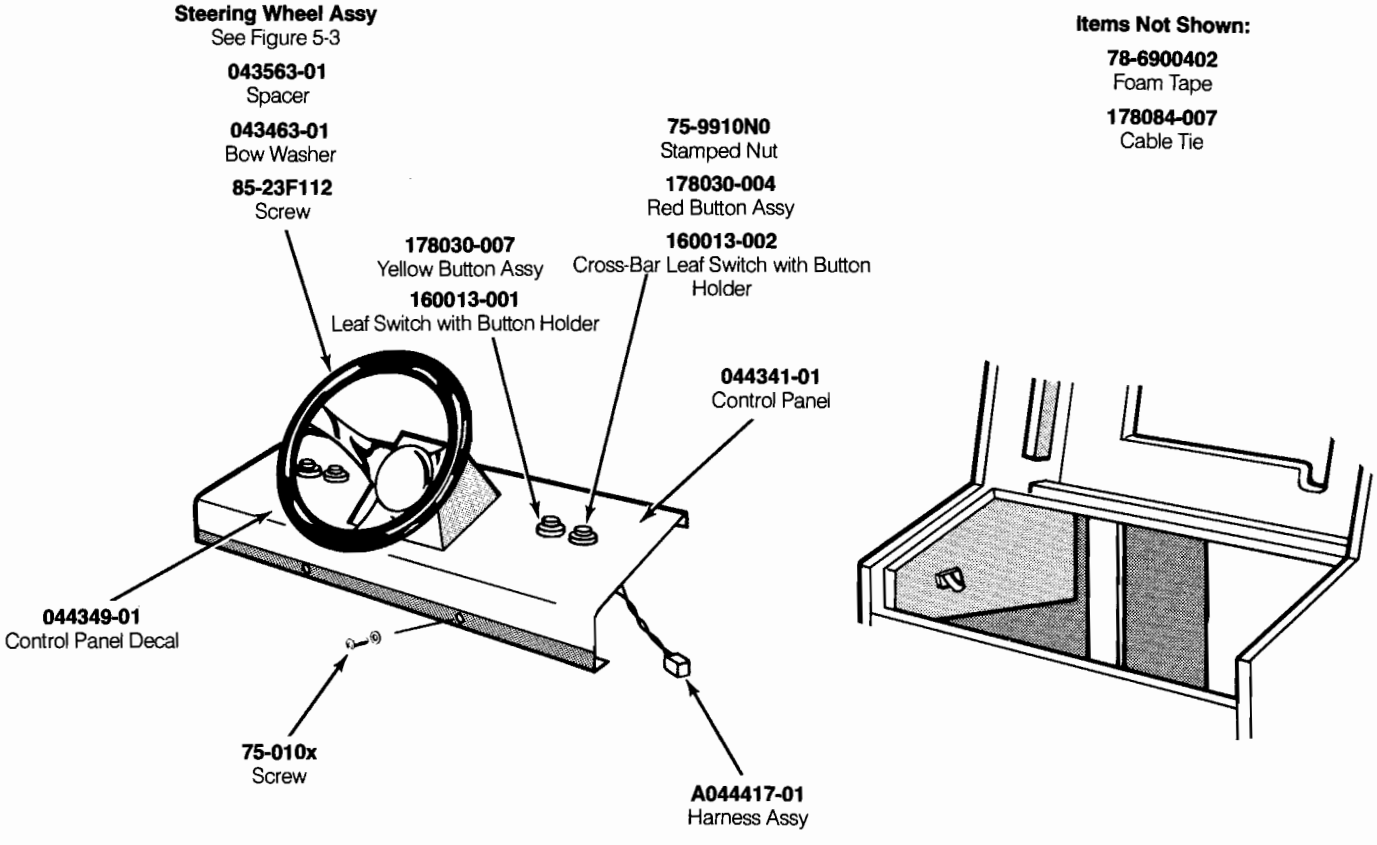


Figure 5-2 Control Panel Assembly A044342-01 A

Control Panel Assembly Parts List

Part No.	Description
A000598-10	Steering Wheel Assembly
A044417-01	Control Harness Assembly
75-010x	#10 Flat Washer
75-9910NO	#11 ⅝-Inch Stamped Nut
85-23F112	#10¾-Inch Type F Hex Washer-Head Screw
043463-01	Bow Washer
043563-01	Plastic Spacer
044341-01	Control Panel
044349-01	Control Panel Decal
160013-001	Leaf Switch with Button Holder
160013-002	Cross-Bar Leaf Switch with Button Holder
178030-004	Red Button Assembly
178030-007	Yellow Button Assembly
178084-007	Twist-Lock Cable Tie

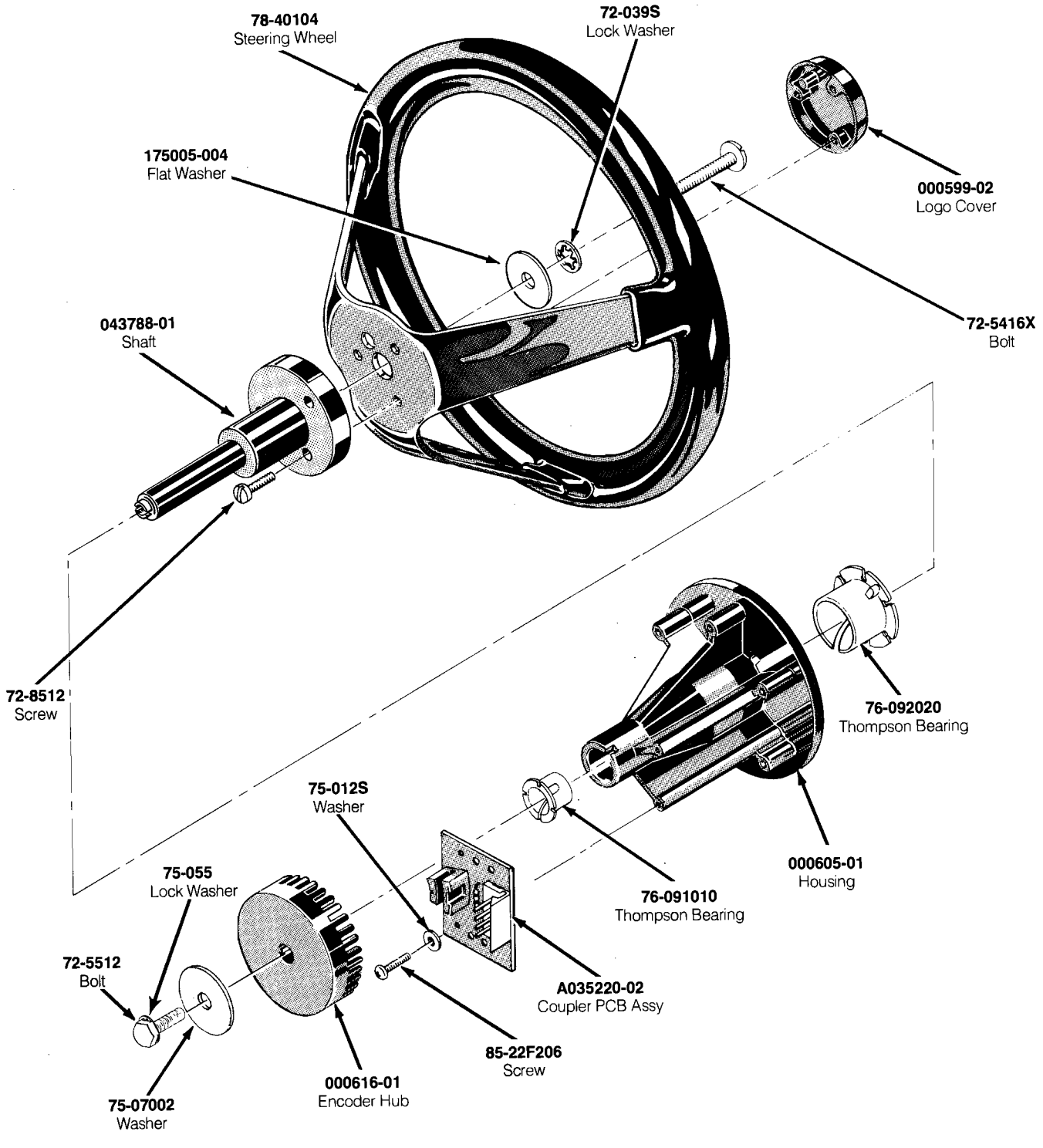


Figure 5-3 Steering Wheel Assembly
A000598-10 AC

Steering Wheel Assembly
Parts List

Part No.	Description
A035220-02	Coupler PCB Assembly
72-039S	⅜-Inch External Steel/Zinc Lock Washer
72-5416X	⅜-16 x 1-Inch Steel/Zinc Hex-Head Bolt
72-5512	¼-20 x ¾-Inch Steel/Zinc Hex-Head Bolt
72-8512	¼-20 x ¾-Inch Socket Head Cap Screw
75-012S	#2 Flat Plain Washer
75-055	¼-Inch Internal Tooth Lock Washer
75-07002	¼-Inch Special Flat Washer
76-091010	Type-10L10-FK Thompson Bearing
76-092020	Type-20L20-FK Thompson Bearing
78-40104	10-Inch Steering Wheel
85-22F206	#2-56 x ⅜-Inch Cross-Recessed Pan-Head Machine Screw
000599-02	Atari Logo Cover
000605-01	Housing
000616-01	Encoder Hub
043788-01	Shaft
107027-001	Multi-Use Lithium-Base Lubricant
175005-004	.406 I.D., 1.25 O.D., 16-Gauge Thick Steel/Zinc Flat Washer

⚠ WARNING ⚠

This 5-volt switching power supply may not have a shield as illustrated below. The power supply has high voltages on it when power is turned on. Therefore, be sure you *do not touch this power supply* unless you have turned off the power to the game.

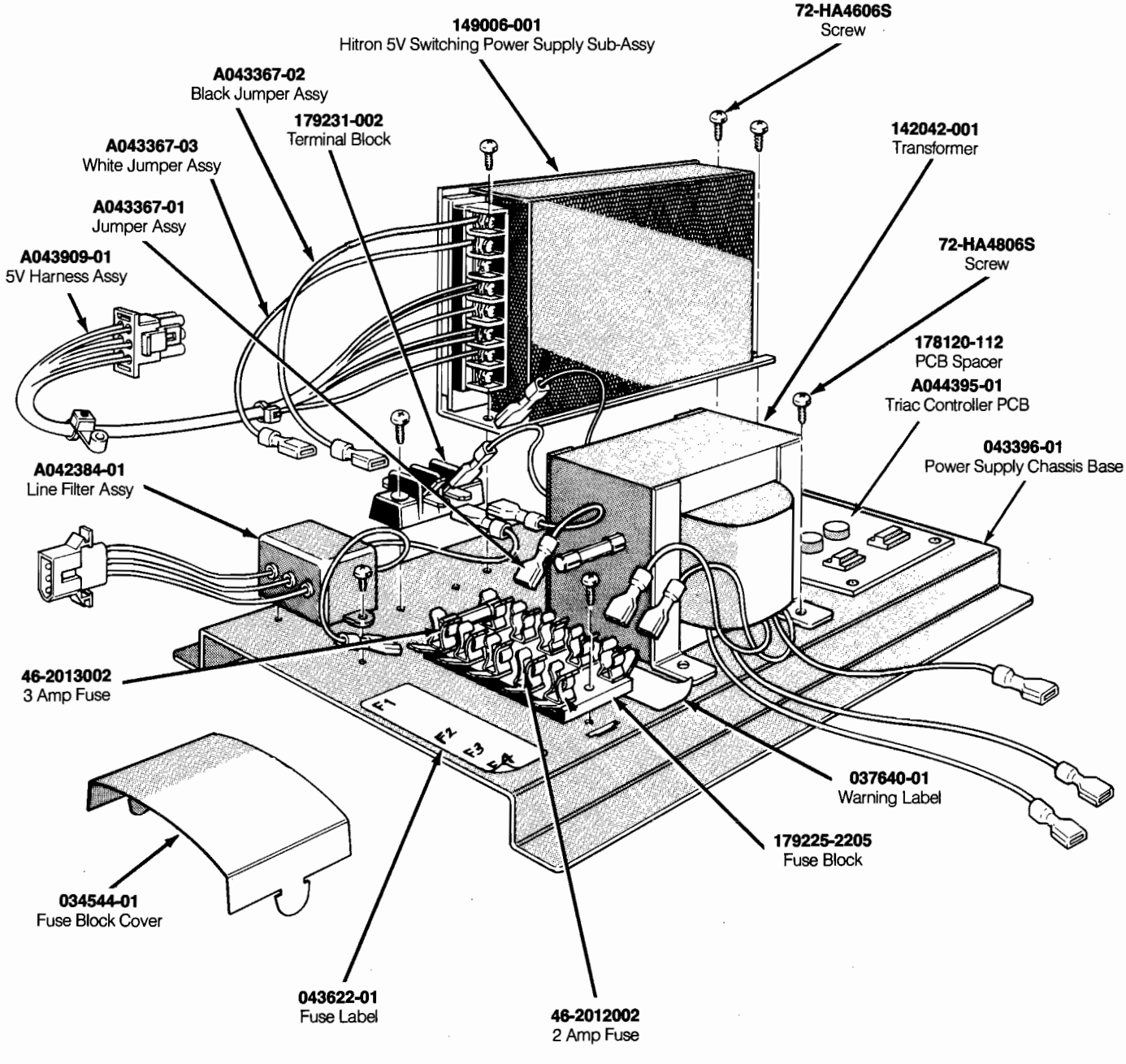


Figure 5-4 Switching/Linear (SL) Power Supply Assembly A044547-01 A

Switching/Linear (SL) Power Supply Assembly Parts List

Part No.	Description
A042384-01	Line Filter Assembly
A043367-01	Jumper Assembly
A043367-02	6-Inch, Black Jumper Assembly
A043367-03	6-Inch, White Jumper Assembly
A043909-01	5 V Harness Assembly
A044395-01	Triac Controller PCB
46-2012002	250 V Slow-Blow 2 A Fuse
46-2013002	250 V Slow-Blow 3 A Fuse
72-HA4606S	#6-32 x ⅜-Inch Cross-Recessed Pan-Head Thread-Forming Screw
72-HA4806S	#8-32 x ⅜-Inch Cross-Recessed Pan-Head Thread-Forming Screw
034544-01	Fuse Block Cover
037640-01	Power Supply Warning Label
043396-01	Power Supply Chassis Base
043622-01	Power Supply Fuse Label
142042-001	Transformer
149006-001	Hitron 5 V 13 A Switching Power Supply Sub-Assembly; see below.
178120-112	¾-Inch PCB Spacer
179225-2205	5-Position Fuse Block (Acceptable substitute is part no. 79-3206)
179231-002	2-Position Terminal Block

Hitron 5-Volt Power Supply Sub-Assembly Parts List

Designator	Description	Part No.
	Capacitors	
C1	Capacitor, Metal Film, 0.047 µF, 250 V	99-211036
C2	Capacitor, Metal Film, 0.1 µF, 400 V	99-211038
C3, C4	Capacitor, Ceramic, 4700 µF, 400 V	99-211049
C5, C6	Capacitor, Electrolytic, 100 µF, 200 V	99-211046
C7	Capacitor, Metal Film, 0.1 µF, 400 V	99-211038
C8	Capacitor, Ceramic, 0.001 µF, 2 kV	99-211042
C9	Capacitor, Ceramic, 0.01 µF, 1 kV, Z5U	99-211041
C10	Capacitor, Electrolytic, 220 µF, 25 V	99-211045
C11	Capacitor, Metal Film, 0.22 µF, 100 V	99-211037
C12	Capacitor, Metal Film, 0.022 µF, 100 V	99-211039
C13	Capacitor, Metal Film, 0.22 µF, 100 V	99-211037
C14	Capacitor, Ceramic, 1800 PF, 2 kV, Z5V	99-211040
C15–C18	Capacitor, Electrolytic, 2200 µF, 16 V	99-211069
C19	Capacitor, Ceramic, 470 PF, 1 kV, Z5P	99-211043
C20	Capacitor, Electrolytic, 2200 µF, 16 V	99-211069
C21	Capacitor, Ceramic, 220 µF, 25 V	99-211070
	Diodes	
D1, D2	Diode, Fast Recovery, RPG10K	99-211064
D3	Diode, Fast Recovery, RPG15B	99-211011
D4	Diode, Fast Recovery, RPG10B	99-211009
D5–D7	Diode, Switching, 1N4148	99-211012

Hitron 5-Volt Power Supply Sub-Assembly Parts List, Continued

Designator	Description	Part No.
D8, D9	Diode, Schottky, S15SC4M	99-211064
D11, D12	Diode, Schottky, S10SC4M	99-211005
D13–D16	Diode, Rectifier, 1N4006	99-211008
	Inductors	
L1	Inductor, 15 mH	99-211052
L2	Inductor, 9.8 μH	99-211071
L6, L7	Inductor, 7 μH (Acceptable substitute is part no. 99-211051)	99-211050
L4	Inductor, 2.2 μH	99-211054
L5	Inductor, 1.5 mH	99-211053
	Resistors	
R1, R2	Resistor, Carbon Film, 180 kΩ, ±5%, 1 W	99-211034
R3	Resistor, Wirewound, 120 Ω, ±5%, 2 W	99-211019
R4	Resistor, Wirewound, 0.47 Ω, ±5%, 2 W	99-211018
R5	Resistor, Wirewound, 27 Ω, ±5%, 2 W	99-211065
R6, R7	Resistor, Carbon Film, 5.6 Ω, ±5%, ¼ W	99-211027
R8	Resistor, Wirewound, 0.47 Ω, ±5%, 2 W	99-211018
R9	Resistor, Carbon Film, 10 Ω, ±5%, ¼ W	99-211029
R10	Resistor, Carbon Film, 1 kΩ, ±5%, ¼ W	99-211032
R11	Resistor, Carbon Film, 47 Ω, ±5%, ¼ W	99-211025
R12	Resistor, Carbon Film, 5.6 Ω, ±5%, ¼ W	99-211027
R13	Resistor, Carbon Film, 330 Ω, ±5%, ¼ W	99-211026
R14	Resistor, Carbon Film, 270 Ω, ±5%, ½ W	99-211023
R15	Resistor, Carbon Film, 330 Ω, ±5%, ½ W	99-211022
R16	Resistor, Carbon Film, 8.2 Ω, ±5%, ¼ W	99-211028
R17, R18	Resistor, Carbon Film, 56 Ω, ±5%, ¼ W	99-211031
R19	Resistor, Carbon Film, 39 Ω, ±5%, ¼ W	99-211030
R20	Resistor, Carbon Film, 2 kΩ, ±5%, ¼ W	99-211035
R21	Resistor, Carbon Film, 470 Ω, ±5%, ¼ W	99-211024
R22	Resistor, 2.2 kΩ, ±2%, ¼ W	99-211021
R23	Resistor, Metal Film, 2 kΩ, ±2%, ¼ W	99-211033
R25	Resistor, Carbon Film, 10 Ω, ±5%, ¼ W	99-211029
R26	Resistor, Carbon Film, 6.8 Ω, ±5%, ½ W	99-211066
R27	Resistor, Carbon Film, 12 Ω, ±5%, ¼ W	99-211067
R28	Resistor, Carbon Film, 2.4 Ω, ±5%, ½ W	99-211068
R31	Resistor, Wirewound, 150 Ω, ±5%, 2 W	99-211016
	Transistors	
Q1	Transistor, NPN, 2SD725	99-211062
Q2	Transistor, NPN, PE8050B	99-211003
Q3	Transistor, PNP, PE8550B	99-211063
	Miscellaneous	
F1	Fuse, 2 A, 125 V, Semko	99-211058
IC1	Regulator, UA431AWC	99-211001
SCR1	Thyristor, SCR	99-211013
T1	Transformer	99-211055
T2	Transformer	99-211075
TR1	Thermistor, 0.5 Ω, ±5%, 5 W	99-211020
VR1	Potentiometer, Trimming, 3 kΩ	99-211014
ZD1	Diode, Zener, 1N752A	99-211007
	Fuse, 2 A, 250 V	99-211056
	Fuse Holder	99-211060
	Terminal Block, 8 Ckt.	99-211057
	Heat Sink	99-211059
	Heat Sink, 1.5 mm	99-211061

N O T E S

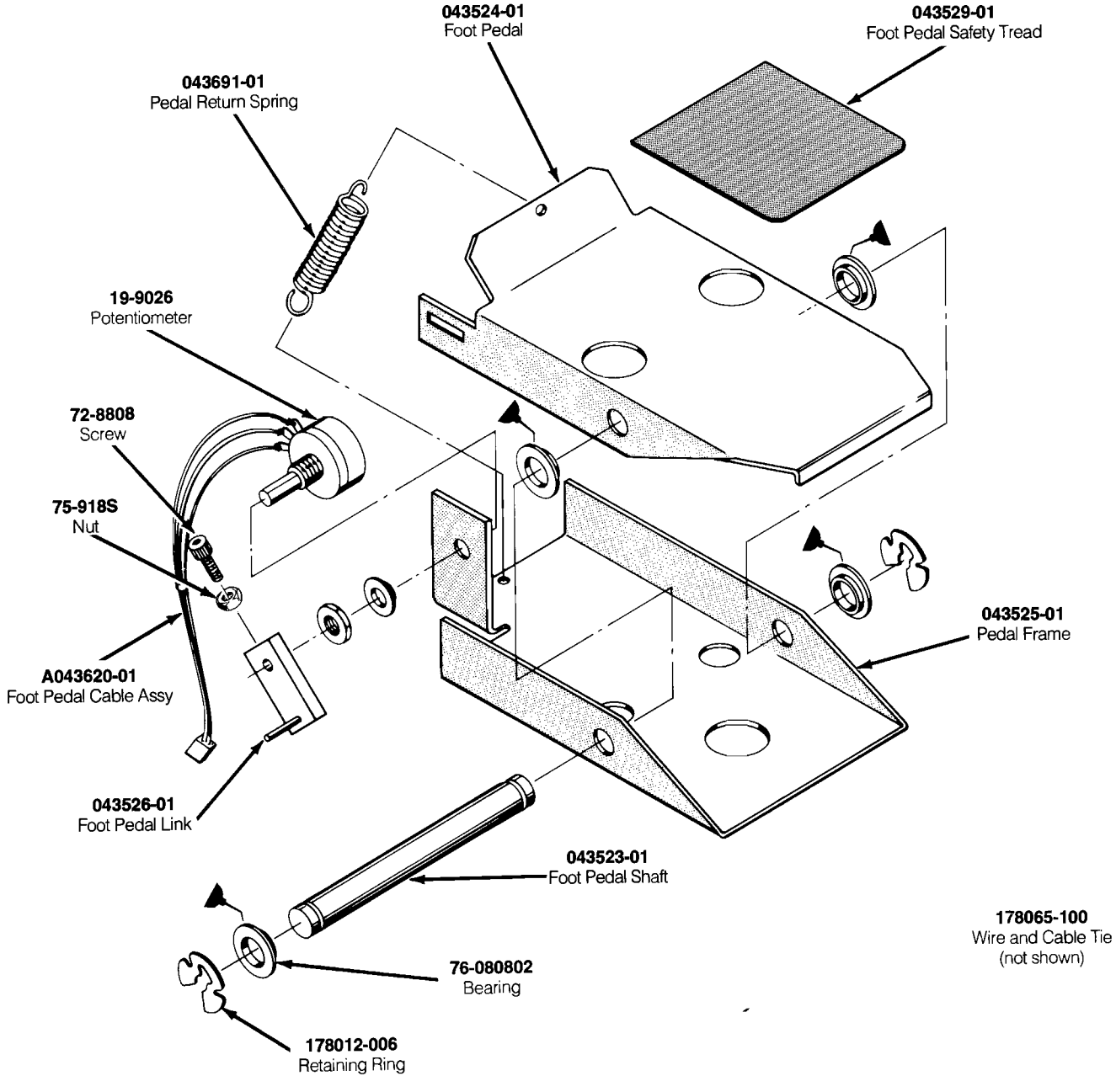
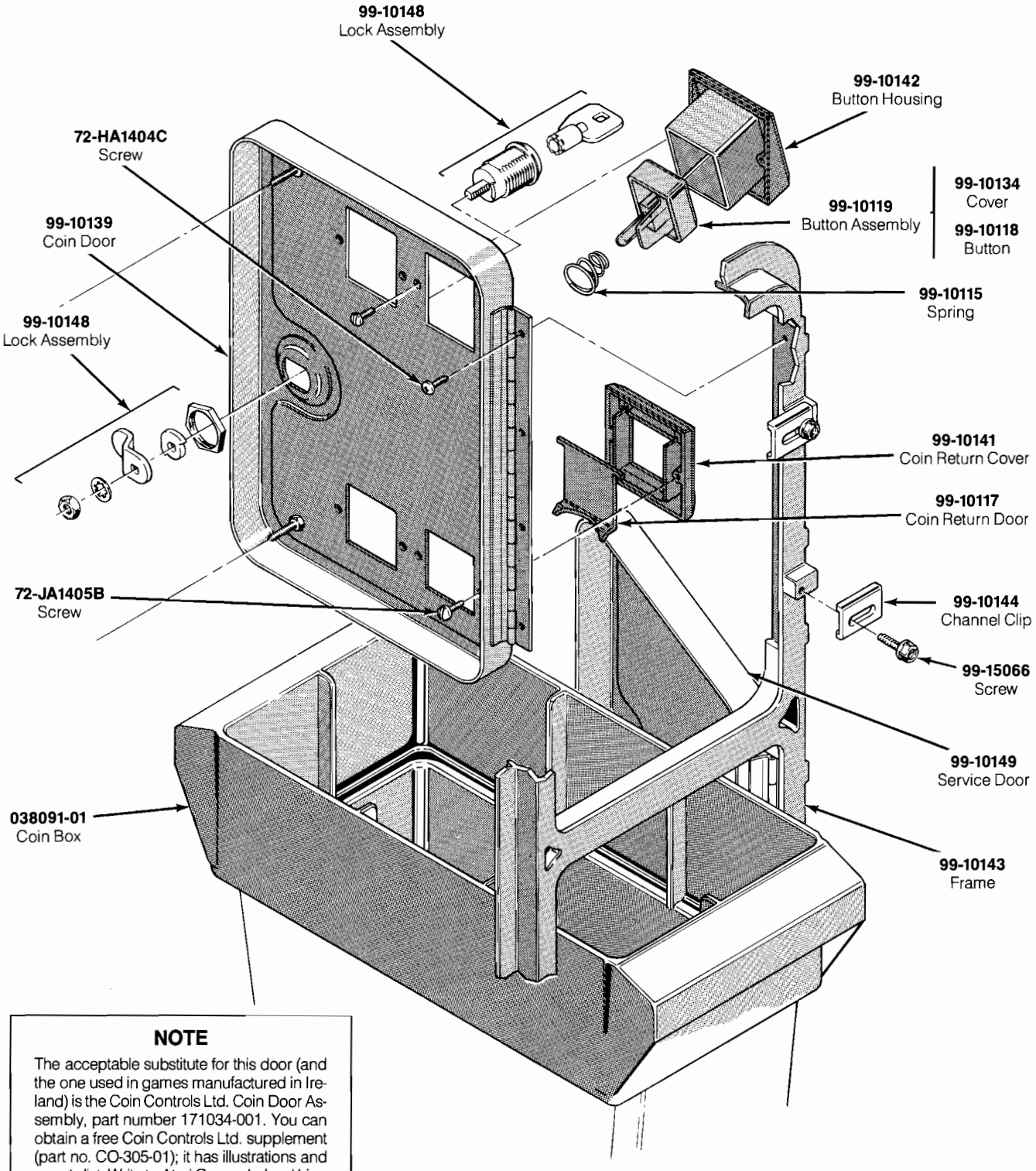


Figure 5-5 Foot Pedal Assembly
A043527-01 B

Foot Pedal Assembly
Parts List

Part No.	Description
A043620-01	Foot Pedal Cable Assembly
19-9026	5 kΩ Potentiometer with Hex Nut and Lock Washer
72-8808	#8-32 × ½-Inch Hex Socket-Head Cap Screw
75-918S	#8-32 Steel Cadmium Hex Machine Nut
76-080802	½-Inch I.D. × ⅛-Inch Bearing (Nyliner)
043523-01	Foot Pedal Shaft
043524-01	Foot Pedal
043525-01	Pedal Frame
043526-01	Foot Pedal Link
043529-01	Foot Pedal Safety Tread
043691-01	Pedal Return Spring
107027-001	Multi-Use Lithium-Base Lubricant
178012-006	½-Inch Diagonal Shaft Retaining Ring
178065-100	4-Inch Loose Wire and Cable Tie



NOTE

The acceptable substitute for this door (and the one used in games manufactured in Ireland) is the Coin Controls Ltd. Coin Door Assembly, part number 171034-001. You can obtain a free Coin Controls Ltd. supplement (part no. CO-305-01); it has illustrations and a parts list. Write to Atari Games Ireland Limited, Tipperary Town, Ireland. Telephone 062-52155.

Figure 5-6 Coin Acceptors, Inc. Coin Door Assembly 171027-001 A

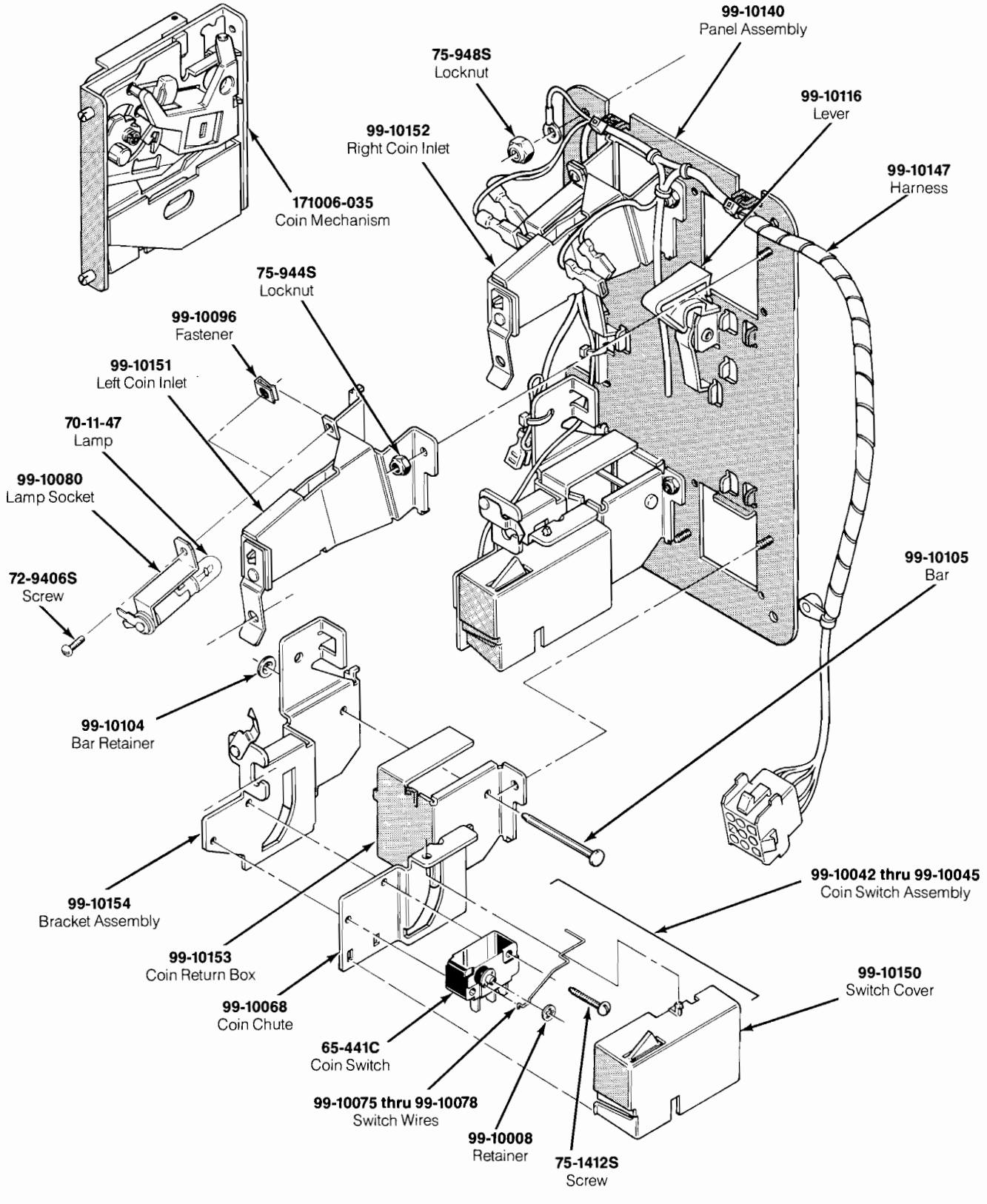
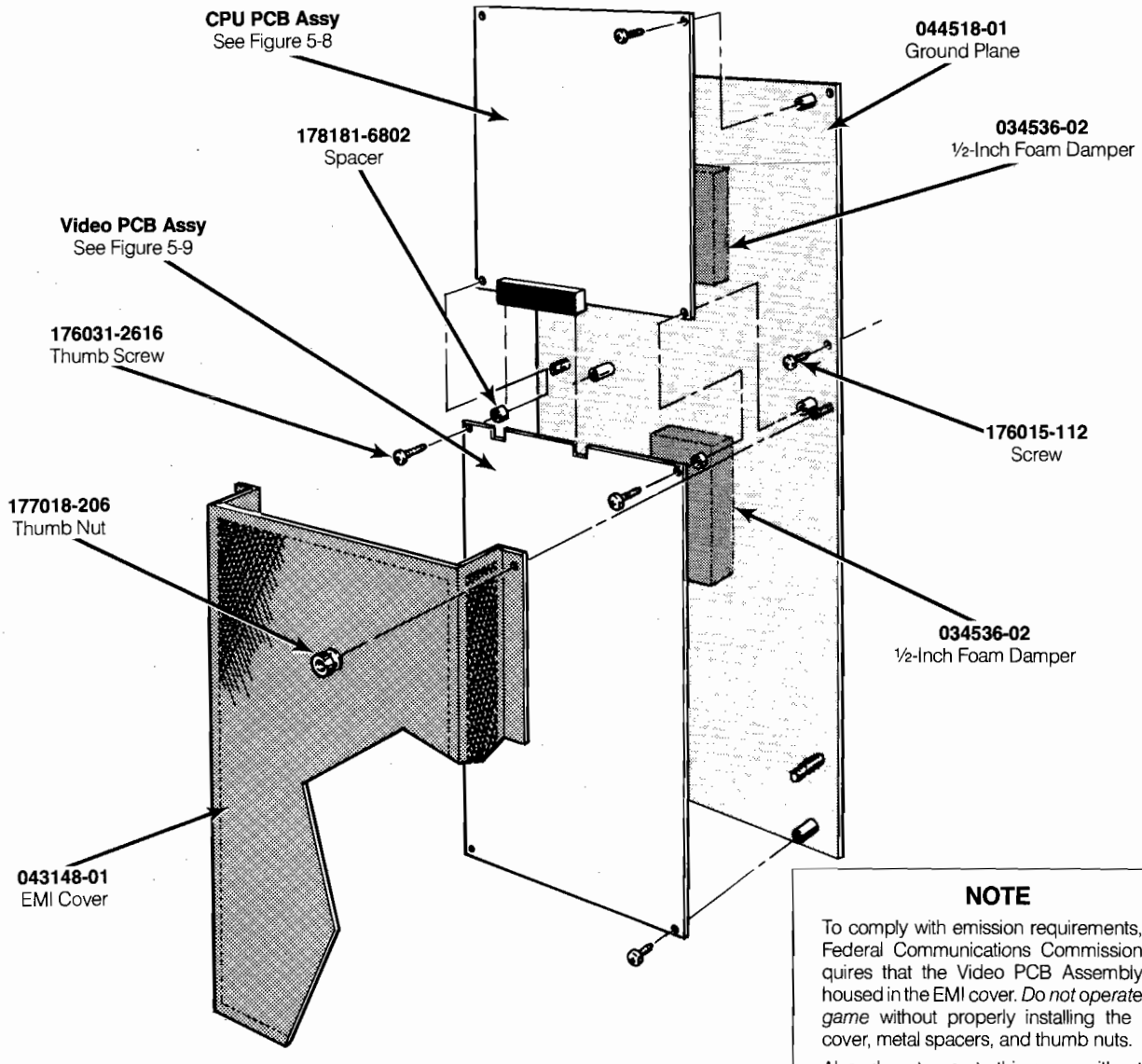


Figure 5-6 Coin Acceptors, Inc. Coin Door Assembly, Continued
171027-001 A

Coin Acceptors, Inc. Coin Door Assembly Parts List

Part No.	Description
65-441C	Coin Switch
70-11-47	Miniature Bayonet Lamp
72-9406S	#4-40 × ⅜-Inch Truss-Head Screw
72-HA1404C	#4-40 × ¼-Inch Pan-Head Screw
72-JA1405B	#4-40 × 0.31-Inch Pan-Head Screw
75-1412S	#4-40 × ¾-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
99-10118	Amber Coin Return Button
99-10119	Amber Coin Button for U.S. 25¢
99-10134	Coin Button Cover
99-10139	Coin Door
99-10140	Coin Door Inner-Panel Assembly
99-10141	Die-Cast Coin Return Cover
99-10142	Die-Cast Button Housing
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
99-15066	Screw for Clamp
171006-035	Metal Coin Mechanism for U.S. 25¢



NOTE

To comply with emission requirements, the Federal Communications Commission requires that the Video PCB Assembly be housed in the EMI cover. *Do not operate this game* without properly installing the EMI cover, metal spacers, and thumb nuts.

Also, do not operate this game without the Filter Board Assembly installed at the bottom of the Video PCB.

Figure 5-7 PCB Mounting Hardware

PCB Mounting Hardware Parts List

Part No.	Description
A044519-01	Video PCB Assembly
A044520-01	CPU PCB Assembly
034536-02	½-Inch Foam Vibration Damper
043148-01	EMI Cover
044518-01	Ground Plane
176015-112	10 × ¾-Inch Cross-Recessed Pan-Head Deep-Thread Screw
176031-2616	#6-32 × ½-Inch Knurled Thumb Screw
177018-206	#6-32 Knurled Thumb Nut
178181-6802	.250 O.D × .171 I.D. × .125-Long Round Spacer

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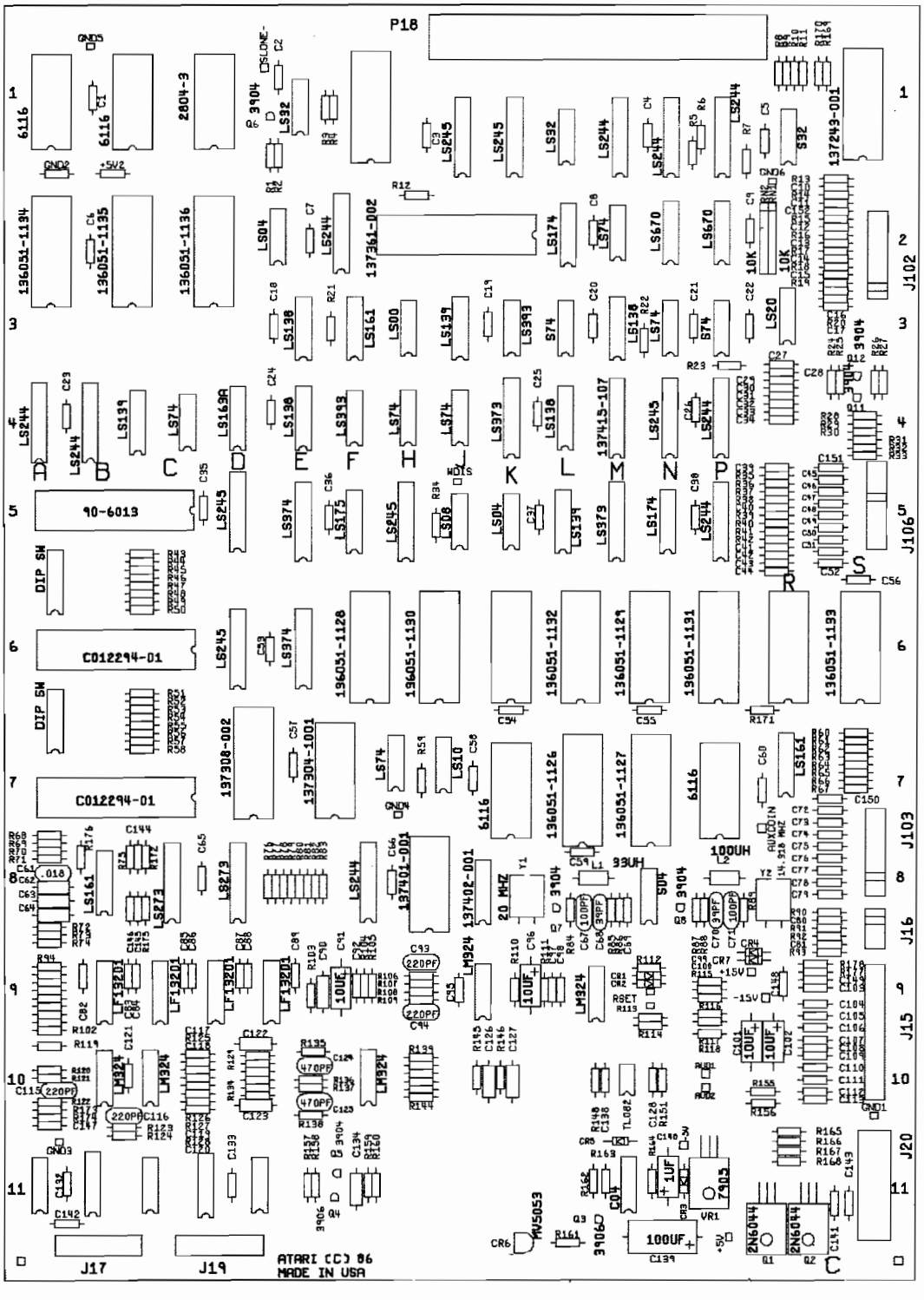

Figure 5-8 APB Central Processing Unit (CPU) PCB Assembly A044520-01 A

APB Central Processing Unit (CPU) PCB Assembly Parts List

Designator	Description	Part No.
	Integrated Circuits	
1A	Integrated Circuit, Type-6116	137211-001
1B/C	Integrated Circuit, Type-6116	137211-001
1D	Integrated Circuit, Type-2804-3 EEPROM	137329-300
1E	Integrated Circuit, Type-74LS32	37-74LS32
1J	Integrated Circuit, Type-74LS245	37-74LS245
1K	Integrated Circuit, Type-74LS245	37-74LS245
1L	Integrated Circuit, Type-74LS32	37-74LS32
1M	Integrated Circuit, Type-74LS244	37-74LS244
1N	Integrated Circuit, Type-74LS244	37-74LS244
1P	Integrated Circuit, Type-74LS244	37-74LS244
1R	Integrated Circuit, Type-74S32	37-74S32
1S	Integrated Circuit, Type-ADC0809	137243-001
2A	Integrated Circuit, EPROM, Type-27512, 200 ns	136051-x134
2B	Integrated Circuit, EPROM, Type-27512, 200 ns	136051-x135
2C/D	Integrated Circuit, EPROM, Type-27512, 200 ns	136051-x136
2F	Integrated Circuit, Type-74LS244	37-74LS244
2J	Integrated Circuit, Type-T11 (DCT11-XA)	137361-002
2L	Integrated Circuit, Type-74LS174	37-74LS174
2M	Integrated Circuit, Type-74LS74	37-74LS74
2N	Integrated Circuit, Type-74LS670	37-74LS670
2P	Integrated Circuit, Type-74LS670	37-74LS670
3E	Integrated Circuit, Type-74LS138	137177-001
3F	Integrated Circuit, Type-74LS161	37-74LS161
3H	Integrated Circuit, Type-74LS00	37-74LS00
3J	Integrated Circuit, Type-74LS139	37-74LS139
3K	Integrated Circuit, Type-74LS393	37-74LS393
3L	Integrated Circuit, Type-74S74	37-74S74
3M	Integrated Circuit, Type-74LS138	137177-001
3N	Integrated Circuit, Type-74LS74	37-74LS74
3P	Integrated Circuit, Type-74S74	37-74S74
3R	Integrated Circuit, Type-74LS20	37-74LS20
4A	Integrated Circuit, Type-74LS244	37-74LS244
4A/B	Integrated Circuit, Type-74LS244	37-74LS244
4B/C	Integrated Circuit, Type-74LS139	37-74LS139
4C/D	Integrated Circuit, Type-74LS74	37-74LS74
4D	Integrated Circuit, Type-74LS163A	37-74LS163A
4E	Integrated Circuit, Type-74LS138	137177-001
4F	Integrated Circuit, Type-74LS393	37-74LS393
4H	Integrated Circuit, Type-74LS74	37-74LS74
4J	Integrated Circuit, Type-74LS74	37-74LS74
4K	Integrated Circuit, Type-74LS373	37-74LS373
4L	Integrated Circuit, Type-74LS138	137177-001
4M	Integrated Circuit, SLAPSTIC	137412-107
4N	Integrated Circuit, Type-74LS245	37-74LS245
4P	Integrated Circuit, Type-74LS244	37-74LS244
5B	Integrated Circuit, Type-6502A	90-6013
5D	Integrated Circuit, Type-74LS245	37-74LS245
5E	Integrated Circuit, Type-74LS374	37-74LS374
5F	Integrated Circuit, Type-74LS175	37-74LS175
5H	Integrated Circuit, Type-74LS245	37-74LS245
5J	Integrated Circuit, Type-74LS08	37-74LS08
5K	Integrated Circuit, Type-74LS04	37-74LS04
5L	Integrated Circuit, Type-74LS139	37-74LS139
5M	Integrated Circuit, Type-74LS373	37-74LS373
5N	Integrated Circuit, Type-74LS174	37-74LS174
5P	Integrated Circuit, Type-74LS244	37-74LS244
6B	Integrated Circuit, POKEY	C012294-01
6D	Integrated Circuit, Type-74LS245	37-74LS245
6E	Integrated Circuit, Type-74LS374	37-74LS374
6F	Integrated Circuit, EPROM, Type-27512, 200 ns	136051-x128
6J	Integrated Circuit, EPROM, Type-27512, 200 ns	136051-x130
6L	Integrated Circuit, EPROM, Type-27512, 200 ns	136051-x132
6N	Integrated Circuit, EPROM, Type-27512, 200 ns	136051-x129
6P	Integrated Circuit, EPROM, Type-27512, 200 ns	136051-x131
6S	Integrated Circuit, EPROM, Type-27512, 200 ns	136051-x133
7B	Integrated Circuit, POKEY	C012294-01
7D	Integrated Circuit, Type-TMS5220C	137308-002
7F	Integrated Circuit, Leta	137304-1001
7H	Integrated Circuit, Type-74LS74	37-74LS74
7J	Integrated Circuit, Type-74LS10	37-74LS10
7K	Integrated Circuit, Type-6116	137211-001
7L	Integrated Circuit, EPROM, Type-27128, 300 ns	136051-x126
7N	Integrated Circuit, EPROM, Type-27128, 300 ns	136051-x127
7P	Integrated Circuit, Type-6116	137211-001
7R	Integrated Circuit, Type-74LS161	37-74LS161
8B	Integrated Circuit, Type-74LS161	37-74LS161
8C	Integrated Circuit, Type-74LS273	37-74LS273
8D	Integrated Circuit, Type-74LS273	37-74LS273
8F	Integrated Circuit, Type-74LS244	37-74LS244
8H/J	Integrated Circuit, Type-Y2151	137401-001
8J/K	Integrated Circuit, Type-YM3012	137402-001
8N	Integrated Circuit, Type-74S04	37-74S04
9B	Integrated Circuit, Type-LF13201	137352-001
9C	Integrated Circuit, Type-LF13201	137352-001
9D	Integrated Circuit, Type-LF13201	137352-001
9D/E	Integrated Circuit, Type-LF13201	137352-001
9J/K	Integrated Circuit, Type-LM324	37-LM324
9L/M	Integrated Circuit, Type-LM324	37-LM324

APB Central Processing Unit (CPU) PCB Assembly Parts List, Continued

Designator	Description	Part No.
10B	Integrated Circuit, Type-LM324	37-LM324
10C	Integrated Circuit, Type-LM324	37-LM324
10F	Integrated Circuit, Type-LM324	37-LM324
10L/M	Integrated Circuit, Type-TLO82CP	37-TLO82CP
11M	Integrated Circuit, Type-74C04	137309-001
	Sockets	
	16-Pin Medium-Insertion-Force Socket	79-42C16
	20-Pin Medium-Insertion-Force Socket	79-42C20
	24-Pin Medium-Insertion-Force Socket	79-42C24
	28-Pin Medium-Insertion-Force Socket	79-42C28
	40-Pin Medium-Insertion-Force Socket	79-42C40
	Capacitors	
C1–C60	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C31–C60	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C61	Capacitor, Ceramic, .018 μF, 50 V	122015-183
C62–C64	Capacitor, Ceramic, .22 μF, 25 V	122004-224
C65	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C66	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C67	Capacitor, Mica, 100 pF, 100 V	128002-101
C68	Capacitor, Mica, 39 pF, 100 V	128002-390
C69	Capacitor, Ceramic, .1μF, 50 V	122002-104
C70	Capacitor, Mica, 39 pF, 100 V	128002-390
C71	Capacitor, Mica, 100 pF, 100 V	128002-101
C72–C79	Capacitor, Ceramic, .01 μF, 25 V	122005-103
C80	Capacitor, Ceramic, .001 μF, 50 V	122002-102
C81	Capacitor, Ceramic, .001 μF, 50 V	122002-102
C82–C89	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C90	Capacitor, Ceramic, .22, 25 V	122004-224
C91	Capacitor, Tantalum, 10 μF, 20 V	29-046
C92	Capacitor, Ceramic, .01 μF, 25 V	122005-103
C93	Capacitor, Mica, 220 pF, 100 V	128002-221
C94	Capacitor, Mica, 220 pF, 100 V	128002-221
C95	Capacitor, Ceramic, .0027 μF, 50 V	122015-272
C96	Capacitor, Tantalum, 10 μF, 20 V	29-046
C97	Capacitor, Ceramic, .0027 μF, 50 V	122015-272
C98–C100	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C101	Capacitor, Aluminum, 10 μF, 35 V	24-350106
C102	Capacitor, Aluminum, 10 μF, 35 V	24-350106
C103–C109	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C110	Capacitor, Ceramic, .01 μF, 25 V	122005-103
C111	Capacitor, Ceramic, .01 μF, 25 V	122005-103
C112	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C113	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C115	Capacitor, Mica, 220 pF, 100 V	128002-221
C116	Capacitor, Mica, 220 pF, 100 V	128002-221
C117	Capacitor, Ceramic, .01 μF, 25 V	122005-103
C118	Capacitor, Ceramic, .001 μF, 50 V	122002-102
C119	Capacitor, Ceramic, .001 μF, 50 V	122002-102
C120	Capacitor, Ceramic, .01 μF, 25 V	122005-103
C121	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C122	Capacitor, Ceramic, .22 μF, 25 V	122004-224
C123	Capacitor, Ceramic, .22 μF, 25 V	122004-224
C124	Capacitor, Mica, 470 pF, 100 V	128002-471
C125	Capacitor, Mica, 470 pF, 100 V	128002-471
C126	Capacitor, Ceramic, .22 μF, 25 V	122004-224
C127	Capacitor, Ceramic, .22 μF, 25 V	122004-224
C128	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C132	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C133	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C134	Capacitor, Ceramic, .22 μF, 25 V	122004-224
C135	Capacitor, Aluminum, 470 μF, 25 V	24-250477
C136	Capacitor, Aluminum, 470 μF, 25 V	24-250477
C138	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C139	Capacitor, Aluminum, 100 μF, 35 V	24-350107
C140	Capacitor, Aluminum, 1 μF, 50 V	24-500105
C141	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C143	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C144	Capacitor, Ceramic, .0027 μF, 50 V	122015-272
C145	Capacitor, Ceramic, .0012 μF, 50 V	122015-122
C146	Capacitor, Ceramic, .0039 μF, 50 V	122015-392
C147	Capacitor, Ceramic, .0068 μF, 50 V	122015-682
C148	Capacitor, Ceramic, .1 μF, 50 V	122002-104
C149–C152	Capacitor, Ceramic, .1 μF, 50 V	122002-104
	Diodes	
CR1–CR3	Diode, Type-1N100	31-1N100
CR4	Diode, Type-1N4001	31-1N4001
CR5	Diode, Type-1N4001	31-1N4001
CR6	Diode, Light-Emitting, Type-MV5053	38-MV5053
CR7	Diode, Type-1N4001	31-1N4001
	Connectors and Fasteners	
J15	Connector, Header, 17-Circuit, .100 ctr	179118-017
J16	Connector, Header, 5-Circuit, .100 ctr	179118-005
J20	Connector, Header, 9-Circuit, .156 ctr, pol	179014-009
J103	Connector, Header, 11-Circuit, .100 ctr	179118-011
J106	Connector, Header, 11-Circuit, .100 ctr	179118-011
P18	Connector, Card Edge, 80-Circuit (40 x 2)	179221-180
Q1, Q2	Fastener, Nylon, Snap-in	81-4302
Q9, Q10	Fastener, Nylon, Snap-in	81-4302
VR1	Fastener, Nylon, Snap-In	81-4302
	Terminal, Fast-On Tab (Acceptable substitute is part number 020670-01)	179051-002
	Inductors	
L1	Inductor, 33 μH	141016-007
L2	Inductor, 100 μH	141002-001

"x" in the part number denotes the revision level

APB Central Processing Unit (CPU) PCB Assembly Parts List, Continued

Designator	Description	Part No.
	Transistors	
Q1, Q2	Transistor, 2N6044	34-2N6044
Q3, Q4	Transistor, 2N3906	33-2N3906
Q5–Q8	Transistor, 2N3904	34-2N3904
Q11, Q12	Transistor, 2N3904	34-2N3904
	Resistors	
R1, R2	Resistor, ¼ W, 10K Ω, ±5%	110000-103
R3, R4	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R5–R7	Resistor, ¼ W, 220 Ω, ±5%	110000-221
R8–R11	Resistor, ¼ W, 4.7K Ω, ±5%	110000-472
R12	Resistor, ¼ W, 470 Ω, ±5%	110000-471
R13–R20	Resistor, ¼ W, 100 Ω, ±5%	110000-101
R21–R23	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R24–R27	Resistor, ¼ W, 4.7K Ω, ±5%	110000-472
R28–R33	Resistor, ¼ W, 470 Ω, ±5%	110000-471
R34	Resistor, ¼ W, 10K Ω, ±5%	110000-103
R35	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R36	Resistor, ¼ W, 220 Ω, ±5%	110000-221
R37	Resistor, ¼ W, 220 Ω, ±5%	110000-221
R38–R42	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R43–R58	Resistor, ¼ W, 10K Ω, ±5%	110000-103
R59	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R60–R67	Resistor, ¼ W, 3.3K Ω, ±5%	110000-332
R68	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R69	Resistor, ¼ W, 1.8K Ω, ±5%	110000-182
R70	Resistor, ¼ W, 10K Ω, ±5%	110000-103
R71	Resistor, ¼ W, 5.6K Ω, ±5%	110000-562
R72–R74	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R75	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R76–R85	Resistor, ¼ W, 10K Ω, ±5%	110000-103
R86	Resistor, ¼ W, 220 Ω, ±5%	110000-221
R87	Resistor, ¼ W, 220 Ω, ±5%	110000-221
R88, R89	Resistor, ¼ W, 10K Ω, ±5%	110000-103
R90	Resistor, ¼ W, 100 Ω, ±5%	110000-101
R91	Resistor, ¼ W, 4.7K Ω, ±5%	110000-472
R92	Resistor, ¼ W, 100 Ω, ±5%	110000-101
R93	Resistor, ¼ W, 4.7K Ω, ±5%	110000-472
R94	Resistor, ¼ W, 22K Ω, ±5%	110000-223
R95	Resistor, ¼ W, 47K Ω, ±5%	110000-473
R96	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R97	Resistor, ¼ W, 22K Ω, ±5%	110000-223
R98	Resistor, ¼ W, 47K Ω, ±5%	110000-473
R99	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R100	Resistor, ¼ W, 22K Ω, ±5%	110000-223
R101	Resistor, ¼ W, 47K Ω, ±5%	110000-473
R102	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R103	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R104, R105	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R106	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R107, R108	Resistor, ¼ W, 18K Ω, ±5%	110000-183
R109	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R110	Resistor, ¼ W, 390 Ω, ±5%	110000-391
R111	Resistor, ¼ W, 560 Ω, ±5%	110000-561
R112	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R113	Resistor, ¼ W, 5.6K Ω, ±5%	110000-562
R114	Resistor, ¼ W, 10K Ω, ±5%	110000-103
R115, R116	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R117	Resistor, ¼ W, 470 Ω, ±5%	110000-471
R118	Resistor, ¼ W, 470 Ω, ±5%	110000-471
R119	Resistor, ¼ W, 470K Ω, ±5%	110000-474
R120–R124	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R125	Resistor, ¼ W, 2.2K Ω, ±5%	110000-222
R126, R127	Resistor, ¼ W, 4.7K Ω, ±5%	110000-472
R128	Resistor, ¼ W, 2.2K Ω, ±5%	110000-222
R129	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R130	Resistor, ¼ W, 47K Ω, ±5%	110000-473
R131–R133	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R134	Resistor, ¼ W, 47K Ω, ±5%	110000-473
R135–R138	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R139	Resistor, ¼ W, 47K Ω, ±5%	110000-473
R140	Resistor, ¼ W, 68K Ω, ±5%	110000-683
R141, R142	Resistor, ¼ W, 47K Ω, ±5%	110000-473
R143	Resistor, ¼ W, 68K Ω, ±5%	110000-683
R144	Resistor, ¼ W, 47K Ω, ±5%	110000-473
R148, R151	Resistor, ¼ W, 100K Ω, ±5%	110000-104
R155, R156	Resistor, ¼ W, 470 Ω, ±5%	110000-471
R157	Resistor, ¼ W, 10K Ω, ±5%	110000-103
R158, R159	Resistor, ¼ W, 3.3K Ω, ±5%	110000-332
R160	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R161	Resistor, ¼ W, 150 Ω, ±5%	110000-151
R162	Resistor, ¼ W, 10K Ω, ±5%	110000-103
R163	Resistor, ¼ W, 3.3K Ω, ±5%	110000-332
R164, R166	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R168	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R169, R170	Resistor, ¼ W, 4.7K Ω, ±5%	110000-472
R171	Resistor, ¼ W, 270 Ω, ±5%	110000-271
R172	Resistor, ¼ W, 12 Ω, ±5%	110000-123
R173	Resistor, ¼ W, 56 Ω, ±5%	110000-563
R174	Resistor, ¼ W, 10K Ω, ±5%	110000-103
R175	Resistor, ¼ W, 8.2 Ω, ±5%	110000-822
R176	Resistor, ¼ W, 3.9K Ω, ±5%	110000-392
R177	Resistor, ¼ W, 470 Ω, ±5%	110000-471
R178	Resistor, ¼ W, 1K Ω, ±5%	110000-102
R179	Resistor, ¼ W, 0 Ω, ±5%	110005-001
RN1, RN2	Resistor Network, SIP, 10K × 8, 1/8 W	118002-103
	Miscellaneous	
VR1	Voltage Regulator, Type-7905	37-7905
Y1	Crystal, 20 MHz	144000-003
Y2	Crystal, 14.318 MHz	90-101
5/6A	Switch, 8-Position, DIP	160031-008
6/7A	Switch, 8-Position, DIP	160031-008

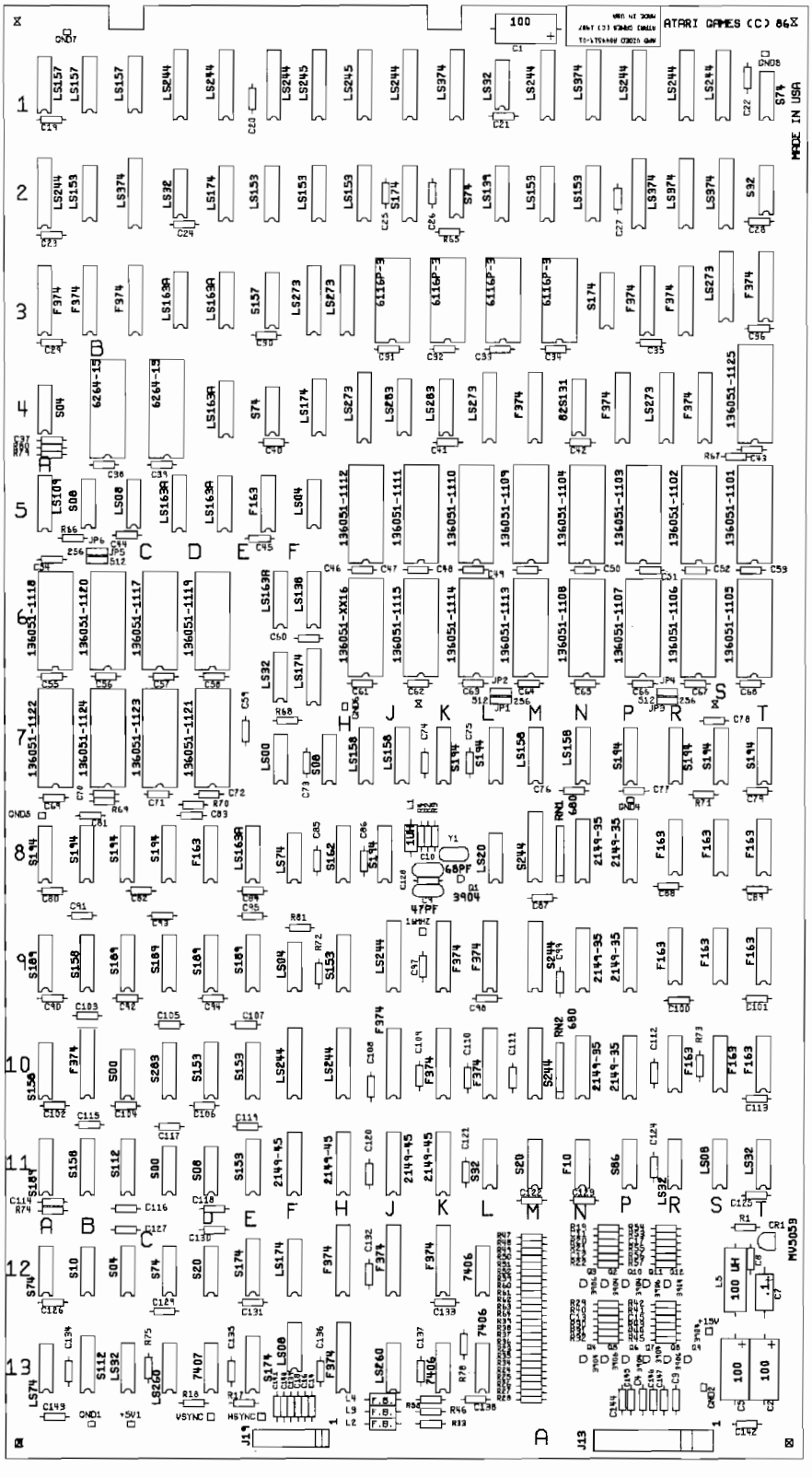

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Figure 5-9 APB Video PCB Assembly A044519-01 A

APB Video PCB Assembly Parts List

Designator	Description	Part No.
	Integrated Circuits	
1A	Type-74LS157 Integrated Circuit	37-74LS157
1B	Type-74LS157 Integrated Circuit	37-74LS157
1B/C	Type-74LS157 Integrated Circuit	37-74LS157
1C/D	Type-74LS244 Integrated Circuit	37-74LS244
1D/E	Type-74LS244 Integrated Circuit	37-74LS244
1E/F	Type-74LS244 Integrated Circuit	37-74LS244
1F/H	Type-74LS245 Integrated Circuit	37-74LS245
1H	Type-74LS245 Integrated Circuit	37-74LS245
1J	Type-74LS244 Integrated Circuit	37-74LS244
1K	Type-74LS374 Integrated Circuit	37-74LS374
1L	Type-74LS32 Integrated Circuit	37-74LS32
1M	Type-74LS244 Integrated Circuit	37-74LS244
1N	Type-74LS374 Integrated Circuit	37-74LS374
1P	Type-74LS244 Integrated Circuit	37-74LS244
1R	Type-74LS244 Integrated Circuit	37-74LS244
1S	Type-74LS244 Integrated Circuit	37-74LS244
1T	Type-74S74 Integrated Circuit	37-74S74
2A	Type-74LS244 Integrated Circuit	37-74LS244
2B	Type-74LS153 Integrated Circuit	37-74LS153
2B/C	Type-74LS374 Integrated Circuit	37-74LS374
2C/D	Type-74LS32 Integrated Circuit	37-74LS32
2D/E	Type-74LS174 Integrated Circuit	37-74LS174
2E/F	Type-74LS153 Integrated Circuit	37-74LS153
2F/H	Type-74LS153 Integrated Circuit	37-74LS153
2H	Type-74LS153 Integrated Circuit	37-74LS153
2J	Type-74S174 Integrated Circuit	137209-001
2K	Type-74S74 Integrated Circuit	37-74S74
2L	Type-74LS139 Integrated Circuit	37-74LS139
2M	Type-74LS153 Integrated Circuit	37-74LS153
2N	Type-74LS153 Integrated Circuit	37-74LS153
2P	Type-74LS374 Integrated Circuit	37-74LS374
2R	Type-74LS374 Integrated Circuit	37-74LS374
2S	Type-74LS374 Integrated Circuit	37-74LS374
2T	Type-74S32 Integrated Circuit	37-74S32
3A	Type-74F374 Integrated Circuit†	137420-001
3B	Type-74F374 Integrated Circuit†	137420-001
3B/C	Type-74F374 Integrated Circuit†	137420-001
3C/D	Type-74LS163A Integrated Circuit	37-74LS163A
3D/E	Type-74LS163A Integrated Circuit	37-74LS163A
3E/F	Type-74S157 Integrated Circuit	37-74S157
3F/H	Type-74LS273 Integrated Circuit	37-74LS273
3H	Type-74LS273 Integrated Circuit	37-74LS273
3H/J	Type-6116P-3, 150 ns RAM Integrated Circuit	137211-001
3K	Type-6116P-3, 150 ns RAM Integrated Circuit	137211-001
3L	Type-6116P-3, 150 ns RAM Integrated Circuit	137211-001
3M	Type-6116P-3, 150 ns RAM Integrated Circuit	137211-001
3N	Type-74S174 Integrated Circuit	137209-001
3P	Type-74F374 Integrated Circuit†	137420-001
3R	Type-74F374 Integrated Circuit†	137420-001
3S	Type-74LS273 Integrated Circuit	37-74LS273
3T	Type-74F374 Integrated Circuit†	137420-001
4A	Type-74S04 Integrated Circuit	37-74S04
4B/C	Type 6264-15 RAM Integrated Circuit	137441-001
4C/D	Type 6264-15 RAM Integrated Circuit	137441-001
4D/E	Type-74LS163A Integrated Circuit	37-74LS163A
4E/F	Type-74S74 Integrated Circuit	37-74S74
4F/H	Type-74LS174 Integrated Circuit	37-74LS174
4H	Type-74LS273 Integrated Circuit	37-74LS273
4J	Type-74LS283 Integrated Circuit	137204-001
4K	Type-74LS283 Integrated Circuit	137204-001
4K/L	Type-74LS273 Integrated Circuit	37-74LS273
4M	Type-74F374 Integrated Circuit†	137420-001
4M/N	Type-82S131 Programmable PROM Integrated Circuit	136034-131
4N/P	Type-74F374 Integrated Circuit†	137420-001
4P/R	Type-74LS273 Integrated Circuit	37-74LS273
4R/S	Type-74F374 Integrated Circuit†	137420-001
4T	Type-27128, EPROM, Integrated Circuit	136051-x125
5A	Type-74LS109 Integrated Circuit	37-74LS109
5B	Type-74S08 Integrated Circuit	37-74S08
5B/C	Type-74LS08 Integrated Circuit	37-74LS08
5C/D	Type-74LS163A Integrated Circuit	37-74LS163A
5D/E	Type-74LS163A Integrated Circuit	37-74LS163A
5E/F	Type-74F163 Integrated Circuit*	137345-001
5F/H	Type-74LS04 Integrated Circuit	37-74LS04
5H	Type-27512, EPROM, Integrated Circuit	136051-x112
5J/K	Type-27512, EPROM, Integrated Circuit	136051-x111
5K/L	Type-27512, EPROM, Integrated Circuit	136051-x110
5M	Type-27512, EPROM, Integrated Circuit	136051-x109
5N	Type-27512, EPROM, Integrated Circuit	136051-x104
5P/R	Type-27512, EPROM, Integrated Circuit	136051-x103
5R/S	Type-27512, EPROM, Integrated Circuit	136051-x102
5T	Type-27512, EPROM, Integrated Circuit	136051-x101
6A	Type-27512, EPROM, Integrated Circuit	136051-x118
6B/C	Type-27512, EPROM, Integrated Circuit	136051-x120
6C/D	Type-27256, EPROM, Integrated Circuit	136051-x117
6D/E	Type-27512, EPROM, Integrated Circuit	136051-x119
6/7E/F	Type-74LS32 Integrated Circuit	37-74LS32
6/7F/H	Type-74LS174 Integrated Circuit	37-74LS174

"x" in the part number denotes the revision level
**Acceptable substitute is Type-74AS163N Integrated Circuit, part no. 137421-001*
†*Acceptable substitute is Type-74AS374N Integrated Circuit, part no. 137422-001*

APB Video PCB Assembly
Parts List, Continued

Designator	Description	Part No.
6E/F	Type-74LS163A Integrated Circuit	37-74LS163A
6F/H	Type-74LS138 Integrated Circuit	137177-001
6H	Type-27512, EPROM, Integrated Circuit	136051-x116
6J/K	Type-27512, EPROM, Integrated Circuit	136051-x115
6K/L	Type-27512, EPROM, Integrated Circuit	136051-x114
6M	Type-27512, EPROM, Integrated Circuit	136051-x113
6N	Type-27512, EPROM, Integrated Circuit	136051-x108
6P/R	Type-27512, EPROM, Integrated Circuit	136051-x107
6R/S	Type-27512, EPROM, Integrated Circuit	136051-x106
6T	Type-27512, EPROM, Integrated Circuit	136051-x105
7A	Type-27512, EPROM, Integrated Circuit	136051-x122
7B/C	Type-27256, EPROM, Integrated Circuit	136051-x124
7C/D	Type-27512, EPROM, Integrated Circuit	136051-x123
7D/E	Type-27512, EPROM, Integrated Circuit	136051-x121
7E/F	Type-74LS00 Integrated Circuit	37-74LS00
7F/H	Type-74S08 Integrated Circuit	37-74S08
7H/J	Type-74LS158 Integrated Circuit	137203-001
7J	Type-74LS158 Integrated Circuit	137203-001
7K	Type-74S194 Integrated Circuit	137424-001
7L	Type-74S194 Integrated Circuit	137424-001
7M	Type-74LS158 Integrated Circuit	137203-001
7N	Type-74LS158 Integrated Circuit	137203-001
7P	Type-74S194 Integrated Circuit	137424-001
7R	Type-74S194 Integrated Circuit	137424-001
7S	Type-74S194 Integrated Circuit	137424-001
7T	Type-74S194 Integrated Circuit	137424-001
8A	Type-74S194 Integrated Circuit	137424-001
8B	Type-74S194 Integrated Circuit	137424-001
8B/C	Type-74S194 Integrated Circuit	137424-001
8C/D	Type-74S194 Integrated Circuit	137424-001
8D	Type-74F163 Integrated Circuit*	137345-001
8E	Type-74LS163A Integrated Circuit	37-74LS163A
8F	Type-74LS74 Integrated Circuit	37-74LS74
8H	Type-74S162 Integrated Circuit	137342-001
8J	Type-74S194 Integrated Circuit	137424-001
8L	Type-74LS20 Integrated Circuit	37-74LS20
8M	Type-74S244 Integrated Circuit	137333-001
8N	Type-2149, 35 ns Static RAM Integrated Circuit	137199-003
8P	Type-2149, 35 ns Static RAM Integrated Circuit	137199-003
8R	Type-74F163 Integrated Circuit*	137345-001
8S	Type-74F163 Integrated Circuit*	137345-001
8T	Type-74F163 Integrated Circuit*	137345-001
9A	Type-74S189 Integrated Circuit	37-74S189
9B	Type-74S158 Integrated Circuit	137312-001
9B/C	Type-74S189 Integrated Circuit	37-74S189
9C/D	Type-74S189 Integrated Circuit	37-74S189
9D	Type-74S189 Integrated Circuit	37-74S189
9E	Type-74S189 Integrated Circuit	37-74S189
9F	Type-74LS04 Integrated Circuit	37-74LS04
9H	Type-74S153 Integrated Circuit	137207-001
9J	Type-74LS244 Integrated Circuit	37-74LS244
9K	Type-74F374 Integrated Circuit†	137420-001
9L	Type-74F374 Integrated Circuit†	137420-001
9M	Type-74S244 Integrated Circuit	137333-001
9N	Type-2149, 35 ns Static RAM Integrated Circuit	137199-003
9P	Type-2149, 35 ns Static RAM Integrated Circuit	137199-003
9R	Type-74F163 Integrated Circuit*	137345-001
9S	Type-74F163 Integrated Circuit*	137345-001
9T	Type-74F163 Integrated Circuit*	137345-001
10A	Type-74S158 Integrated Circuit	137312-001
10B	Type-74F374 Integrated Circuit†	137420-001
10B/C	Type-74S00 Integrated Circuit	37-74S00
10C/D	Type-74S283 Integrated Circuit	137241-001
10D	Type-74S153 Integrated Circuit	137207-001
10E	Type-74S153 Integrated Circuit	137207-001
10F	Type-74LS244 Integrated Circuit	37-74LS244
10H	Type-74LS244 Integrated Circuit	37-74LS244
10J	Type-74F374 Integrated Circuit†	137420-001
10K	Type-74F374 Integrated Circuit†	137420-001
10L	Type-74F374 Integrated Circuit†	137420-001
10M	Type-74S244 Integrated Circuit	137333-001
10N	Type-2149, 35 ns Static RAM Integrated Circuit	137199-003
10P	Type-2149, 35 ns Static RAM Integrated Circuit	137199-003
10R	Type-74F163 Integrated Circuit*	137345-001
10S	Type-74F163 Integrated Circuit*	137345-001
10T	Type-74F163 Integrated Circuit*	137345-001
11A	Type-74S189 Integrated Circuit	37-74S189
11B	Type-74S158 Integrated Circuit	137312-001
11B/C	Type-74S112 Integrated Circuit	137334-001
11C/D	Type-74S00 Integrated Circuit	37-74S00
11D	Type-74S08 Integrated Circuit	37-74S08
11E	Type-74S153 Integrated Circuit	137207-001
11F	Type-2149, 45 ns Static RAM Integrated Circuit	137199-002
11H	Type-2149, 45 ns Static RAM Integrated Circuit	137199-002

"x" in the part number denotes the revision level
**Acceptable substitute is Type-74AS163N Integrated Circuit, part no. 137421-001*
†Acceptable substitute is Type-74AS374N Integrated Circuit, part no. 137422-001

APB Video PCB Assembly Parts List, Continued

Designator	Description	Part No.
11J	Type-2149, 45 ns Static RAM Integrated Circuit	137199-002
11K	Type-2149, 45 ns Static RAM Integrated Circuit	137199-002
11L	Type-74S32 Integrated Circuit	37-74S32
11M	Type-74S20 Integrated Circuit	137423-001
11N	Type-74F10 Integrated Circuit	137428-001
11P	Type-74S86 Integrated Circuit	137002-001
11R	Type-74LS32 Integrated Circuit	37-74LS32
11S	Type-74LS08 Integrated Circuit	37-74LS08
11T	Type-74LS32 Integrated Circuit	37-74LS32
12A	Type-74S74 Integrated Circuit	37-74S74
12B	Type-74S10 Integrated Circuit	137236-001
12B/C	Type-74S04 Integrated Circuit	37-74S04
12C/D	Type-74S74 Integrated Circuit	37-74S74
12D	Type-74S20 Integrated Circuit	137423-001
12E	Type-74S174 Integrated Circuit	137209-001
12F	Type-74LS174 Integrated Circuit	37-74LS174
12H	Type-74F374 Integrated Circuit†	137420-001
12J	Type-74F374 Integrated Circuit†	137420-001
12K	Type-74F374 Integrated Circuit†	137420-001
12L	Type-7406 Integrated Circuit	37-7406
13A	Type-74LS74 Integrated Circuit	37-74LS74
13B	Type-74S112 Integrated Circuit	137334-001
13B/C	Type-74LS32 Integrated Circuit	37-74LS32
13C/D	Type-74LS260 Integrated Circuit	137332-001
13D	Type-7407 Integrated Circuit	37-7407
13E	Type-74S174 Integrated Circuit	137209-001
13F	Type-74LS08 Integrated Circuit	37-74LS08
13H	Type-74F374 Integrated Circuit†	137420-001
13J	Type-74LS260 Integrated Circuit	137332-001
13K	Type-7406 Integrated Circuit	37-7406
13L	Type-7406 Integrated Circuit	37-7406
	Sockets	
	28-Contact, Medium-Insertion-Force IC Socket	79-42C28
	Capacitors	
C1, C2	Capacitor, Aluminum, 100 µF, 35 V	24-350107
C3, C4	Capacitor, Ceramic, .1 µF, 50 V	122002-104
C5	Capacitor, Aluminum, 100 µF, 35 V	24-350107
C7	Capacitor, Electrolytic, 1 µF, 50 V	24-500105
C8	Capacitor, Ceramic, .1 µF, 50 V	122002-104
C9	Capacitor, Mica, 47 pF, 100 V	128002-470
C10	Capacitor, Mica, 68 pF, 100 V	128002-680
C11–C13	Capacitor, Ceramic, .1 µF, 50 V	122002-104
C14	Capacitor, Ceramic, 100 pF, 100 V	122016-101
C15	Capacitor, Ceramic, .1 µF, 50 V	122002-104
C16	Capacitor, Ceramic, 100 pF, 100 V	122016-101
C17	Capacitor, Ceramic, .1 µF, 50 V	122002-104
C18	Capacitor, Ceramic, 100 pF, 100 V	122016-101
C19–C138	Capacitor, Ceramic, .1 µF, 50 V	122002-104
C139–C141	Capacitor, Ceramic, .001 µF 50 V	122002-102
C144–C147	Capacitor, Ceramic, .1 µF, 50 V	122002-104
	Connectors	
J13	Connector, Header, 11-Circuit .156 Ctr., Pol	179014-011
J19	Connector, Header, Sq. Pin, 11-Circuit, .100 Ctr.	179118-011
JP1–JP6	Connector, Header, 6 Ckt. (2 rows × 3 Ckt.), .100 Ctr.	179177-006
JP1–JP6	Connector, Receptacle, 2 Ckt.	179178-002
	Ferrite Beads and Inductors	
L1	Inductor, 1 µH	141007-001
L2–L4	Ferrite Bead	141003-005
L5	Inductor, 100 µH	141019-001
	Transistors	
Q1, Q2	Type-2N3904 Transistor	34-2N3904
Q3	Type-2N3906 Transistor	33-2N3906
Q4	Type-2N3904 Transistor	34-2N3904
Q5	Type-2N3906 Transistor	33-2N3906
Q6, Q7	Type-2N3904 Transistor	34-2N3904
Q8	Type-2N3906 Transistor	33-2N3906
Q9, Q10	Type-2N3904 Transistor	34-2N3904
Q11	Type-2N3906 Transistor	33-2N3906
Q12	Type-2N3904 Transistor	34-2N3904
	Resistors	
R1	150 Ω, ±5%, ¼ W Resistor	110000-151
R2	10K Ω, ±5%, ¼ W Resistor	110000-103
R4	68 Ω, ±5%, ¼ W Resistor	110000-680
R17, R18	220 Ω, ±5%, ¼ W Resistor	110000-221
R19	1K Ω, ±5%, ¼ W Resistor	110000-102
R20	120 Ω, ±5%, ¼ W Resistor	110000-121
R21, R22	180 Ω, ±5%, ¼ W Resistor	110000-181
R23	220 Ω, ±5%, ¼ W Resistor	110000-221
R24	470 Ω, ±5%, ¼ W Resistor	110000-471
R25	1K Ω, ±5%, ¼ W Resistor	110000-102
R26	2K Ω, ±5%, ¼ W Resistor	110000-202
R27	150 Ω, ±5%, ¼ W Resistor	110000-151
R28	3.9K Ω, ±5%, ¼ W Resistor	110000-392
R29	390 Ω, ±5%, ¼ W Resistor	110000-391
R30	68 Ω, ±5%, ¼ W Resistor	110000-680
R31	470 Ω, ±5%, ¼ W Resistor	110000-471

"x" in the part number denotes the revision level
**Acceptable substitute is Type-74AS163N Integrated Circuit, part no. 137421-001*
†*Acceptable substitute is Type-74AS374N Integrated Circuit, part no. 137422-001*

APB Video PCB Assembly
Parts List, Continued

Designator	Description	Part No.
R32	68 Ω, ±5%, ¼ W Resistor	110000-680
R33	10 Ω, ±5%, ¼ W Resistor	110000-100
R34	620 Ω, ±5%, ¼ W Resistor	110000-621
R35	1.2K Ω, ±5%, ¼ W Resistor	110000-122
R36	2.4K Ω, ±5%, ¼ W Resistor	110000-242
R37	5.1K Ω, ±5%, ¼ W Resistor	110000-512
R38	820 Ω, ±5%, ¼ W Resistor	110000-821
R39	10K Ω, ±5%, ¼ W Resistor	110000-103
R40, R41	160 Ω, ±5%, ¼ W Resistor	110000-161
R42	390 Ω, ±5%, ¼ W Resistor	110000-391
R43	68 Ω, ±5%, ¼ W Resistor	110000-680
R44	470 Ω, ±5%, ¼ W Resistor	110000-471
R45	68 Ω, ±5%, ¼ W Resistor	110000-680
R46	10 Ω, ±5%, ¼ W Resistor	110000-100
R47	620 Ω, ±5%, ¼ W Resistor	110000-621
R48	1.2K Ω, ±5%, ¼ W Resistor	110000-122
R49	2.4K Ω, ±5%, ¼ W Resistor	110000-242
R50	5.1K Ω, ±5%, ¼ W Resistor	110000-512
R51	820 Ω, ±5%, ¼ W Resistor	110000-821
R52	10K Ω, ±5%, ¼ W Resistor	110000-103
R53	160 Ω, ±5%, ¼ W Resistor	110000-161
R54	390 Ω, ±5%, ¼ W Resistor	110000-391
R55	68 Ω, ±5%, ¼ W Resistor	110000-680
R56	470 Ω, ±5%, ¼ W Resistor	110000-471
R57	68 Ω, ±5%, ¼ W Resistor	110000-680
R58	10 Ω, ±5%, ¼ W Resistor	110000-100
R59	620 Ω, ±5%, ¼ W Resistor	110000-621
R60	1.2K Ω, ±5%, ¼ W Resistor	110000-122
R61	2.4K Ω, ±5%, ¼ W Resistor	110000-242
R62	5.1K Ω, ±5%, ¼ W Resistor	110000-512
R63	820 Ω, ±5%, ¼ W Resistor	110000-821
R64	10K Ω, ±5%, ¼ W Resistor	110000-103
R65–R75	K Ω, ±5%, ¼ W Resistor	110000-102
R78	220 Ω, ±5%, ¼ W Resistor	11000-221
R79–R81	470 Ω, ±5%, ¼ W Resistor	110000-471
RN1, RN2	Resistor Network, SIP, 680 Ω × 7	118007-681
	Miscellaneous	
C142	Filter, Feed-Thru, 2000 pF, 15A	140002-001
CR1	Diode, Light-Emitting, Type-MV5053	38-MV5053
TAB	Terminal, Fast-On (Acceptable substitute is Test Point, part no. 020670-001	179051-002
Y1	Crystal, 32 MHz	144003-002
	Terminal, Ring Lug, #8, Solder Tab	179005-002

"x" in the part number denotes the revision level
**Acceptable substitute is Type-74AS163N Integrated Circuit, part no. 137421-001*
†*Acceptable substitute is Type-74AS374N Integrated Circuit, part no. 137422-001*

N O T E S

NOTE: This illustration shows *all* parts required for every version of this PCB assembly. Refer to the parts list on the opposite page for actual parts used.

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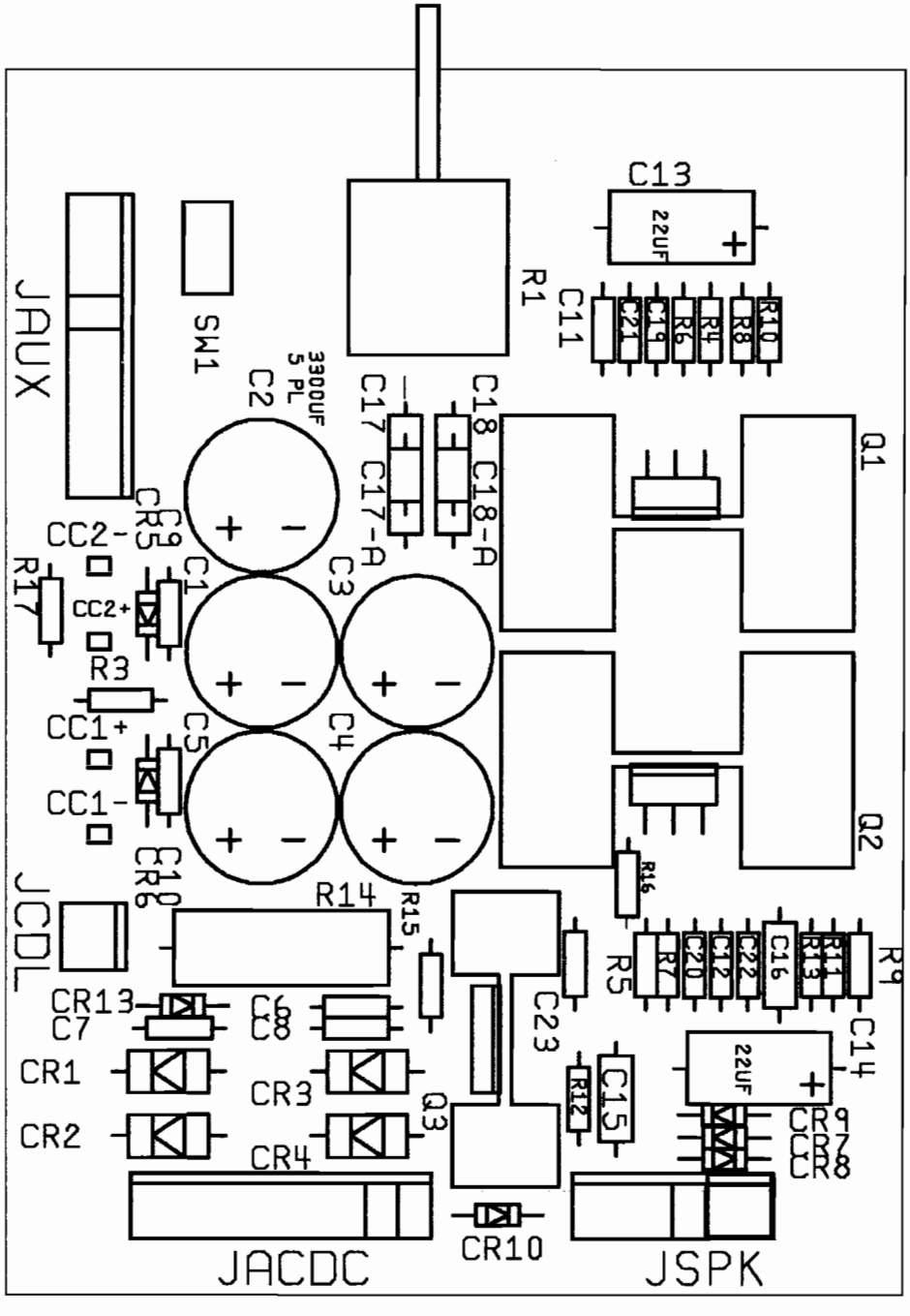

Figure 5-10 Audio II PCB Assembly
A043661-01 D

Audio II PCB Assembly
Parts List

Designator	Description	Part No.
	Capacitors	
C1–C5	3300 μF, 25 V Radial Electrolytic Capacitor	123003-338
C6–C12	.1 μF, 50 V Ceramic Capacitor	122002-104
C13–C14	22 μF, 35 V Electrolytic Capacitor	24-350226
C15–C18	.22 μF, 25 V Ceramic Capacitor	122006-224
C19–C20	.001 μF, 50 V Ceramic Capacitor	122002-102
C21–C23	.1 μF, 50 V Ceramic Capacitor	122002-104
	Diodes	
CR1–CR4	Type-1N5401 Diode	31-1N5401
CR5–CR10	Type-1N4001 Diode	31-1N4001
CR13	Type-1N4002 Diode	31-1N4002
	Connectors	
JACDC	Key 2, 9 Ckt., .156-Inch Ctr. Header Connector	179213-009
JAUX	Key 6, 9 Ckt., .156-Inch Ctr. Header Connector	179213-009
JCDL	2 Ckt., .156-Inch Ctr. Header Connector	179213-002
JSPK	Key 3, 6 Ckt., .156-Inch Ctr. Header Connector	179213-006
	Integrated Circuits	
Q1–Q2	Type-TDA-2030 Amplifier	137301-001
Q3	Standup Type-7815 Integrated Circuit	37-7815
	Resistors	
R1	10 kΩ, Dual Horizontal Pot Resistor	119011-103
R3	10 Ω, ±5%, ¼ W Resistor	110000-100
R4–R7	22 kΩ, ±5%, ¼ W Resistor	110000-223
R8–R9	10 kΩ, ±5%, ¼ W Resistor	110000-103
R10–R11	1 kΩ, ±5%, ¼ W Resistor	110000-102
R12–R13	1 Ω, ±5%, ¼ W Resistor	110000-010
R14, R17	0 Ω, ±5%, ¼ W Resistor	110005-001
	Miscellaneous	
SW1	SPDT Miniature Slide Self-Test Switch	69-004
TP28–TP29	#6-32 × 3/8-Inch Cross-Recessed Pan-Head Screw	72-1606S
TP28–TP29	#6-32 Nut/Washer Assembly	75-99516
TP28–TP29	Thermal Compound	78-16001
TP28–TP29	Type-TDA-230 Heat Sink	178190-032
TP101	#4-40 × 3/8-Inch Cross-Recessed Pan-Head Screw	72-1406S
TP101	#4-40 Nut/Washer Assembly	75-99514
TP101	Thermal Compound	78-16001
TP101	Type-7815 Heat Sink	178190-124
	Hot Melt Adhesive	106006-001
	Test Point	179051-001

NOTES

Glossary

AC
Alternating current; from zero it rises to a maximum positive level, then passes through zero again to a maximum negative level.

ACTIVE STATE
The true state of a signal. For example: The active state for $\overline{\text{START}}$ is low.

ADDRESS
A value that identifies a specific location of data in memory; normally expressed in hexadecimal notation.

ANALOG
Measurable in an absolute quantity (as opposed to on or off). Analog devices are volume controls, light dimmers, stereo amplifiers, etc.

ANODE
The positive (arrow) end of a diode.

AMPLIFIER
A device used to increase the strength of an applied signal.

AMPLITUDE
The maximum instantaneous value of a waveform pulse from zero.

ASTABLE
Having no normal state. An astable device will free-run or oscillate as long as operating voltage is applied. The oscillation frequency is usually controlled by external circuitry.

AUXILIARY COIN SWITCH
A momentary-contact pushbutton switch with a black cap located on the utility panel. The auxiliary coin switch adds credits to the game without activating a coin counter.

BEZEL
A cut, formed, or machined retention device, such as the conical device used to mount a pushbutton switch to a control panel, or the formed device used to frame the video display screen.

BIDIRECTIONAL
Able to send or receive data on the same line (e.g., the data bus of a microprocessor).

BINARY
A number system that expresses all values by using two digits (0 and 1).

BIT
A binary digit; expressed as 1 or 0.

BLANKING
Turning off the beam on a cathode-ray tube during retrace.

BLOCK DIAGRAM
A drawing in which functional circuitry units are represented by blocks. Very useful during initial troubleshooting.

BUFFER
1. An isolating circuit designed to eliminate the reaction of a driven circuit on the circuits driving it (e.g., a buffer amplifier).
2. A device used to supply additional drive capability.

BUS
An electrical path over which information is transferred from any of several sources to any of several destinations.

CAPACITOR
A device capable of storing electrical energy. A capacitor blocks the flow of DC current while allowing AC current to pass.

CATHODE
The negative end of a diode.

CHIP
An integrated circuit comprising many circuits on a single wafer slice.

CLOCK
A repetitive timing signal for synchronizing system functions.

COINCIDENCE
Occurring at the same time.

COIN COUNTER
A 6-digit electromechanical device that counts the coins inserted in the coin mechanism(s).

COIN MECHANISM
A device on the inside of the coin door that inspects the coin to determine if the correct coin has been inserted.

COMPLEMENTARY
Having opposite states, such as the outputs of a flip-flop.

COMPOSITE SYNC
Horizontal and vertical synchronization pulses that are bused together into a single signal. This signal provides the timing necessary to keep the display in synchronization with the game circuitry.

COMPOSITE VIDEO
Complete video signal from the game system to drive the display circuitry, usually comprising H SYNC, V SYNC, and the video.

CREDIT
One play for one person based on the game switch settings.

CRT
Cathode-ray tube.

DATA
General term for the numbers, letters, and symbols that serve as input for device processing.

DARLINGTON
A two-transistor amplifier that provides extremely high gain.

DC
Direct current, meaning current flowing in one direction and of a fixed value.

DEFLECTION YOKE
Electromagnetic coils around the neck of a cathode-ray tube. One set of coils deflects the electron beam horizontally and the other set deflects the beam vertically.

DIAGNOSTICS
A programmed routine for checking circuitry. For example: the self-test is a diagnostic routine.

DIODE
A semiconductor device that conducts in only one direction.

DISCRETE
Non-integrated components, such as resistors, capacitors, and transistors.

DMA
Direct memory access. DMA is a process of accessing memory that bypasses the microprocessor logic. DMA is normally used for transferring data between the input/output ports and memory.

DOWN TIME
The period during which a game is malfunctioning or not operating correctly due to machine failure.

EAROM
Electrically alterable read-only memory (see ROM). The EAROM is a memory that can be changed by applying high voltage.

EPROM
Erasable programmable read-only memory (see ROM).

FLYBACK
A step-up transformer used in a display to provide the high voltage.

GATE

1. A circuit with one output that responds only when a certain combination of pulses is present at the inputs.

2. A circuit in which one signal switches another signal on and off.

3. To control the passage of a pulse or signal.

HARNESS

A prefabricated assembly of insulated wires and terminals ready to be attached to a piece of equipment.

HEXADECIMAL

A number system using the equivalent of the decimal number 16 as a base. The symbols 0–9 and A–F are usually used.

HISTOGRAM

A special type of bar graph that shows how quantities are distributed. Histograms are included in the self-test of most Atari games, and typically show how long players play that game.

IC

Integrated circuit. An electronic circuit in which all elements and the connections are made in or on a single semiconductor substrate. See also *chip*.

IMPLODE

To burst inward; the inward collapse of a vacuum tube.

I/O

Input/Output.

IRQ

Interrupt request. IRQ is a control signal to the microprocessor that is generated by external logic. This signal tells the microprocessor that external logic needs attention. Depending on the program, the processor may or may not respond.

LED

The abbreviation for a light-emitting diode.

LOCKOUT COIL

Directs coins into the coin return box when there is no power to the game.

LOGIC STATE

The binary (1 or 0) value at the node of a logic element or integrated circuit during a particular time. Also called the logic level. The list below shows the voltage levels corresponding to the logic states (levels) in a TTL system.

Logic 0, Low = 0 VDC to +0.8 VDC
Grey Area (Tri-State Level) = +0.8 VDC to +2.4 VDC
Logic 1, High = +2.4 VDC to +5 VDC

MULTIPLEXER

A device that takes several low-speed inputs and combines them into one high-speed data stream for simultaneous transmission on a single line.

NMI

Non-maskable interrupt. NMI is a request for service by the microprocessor from external logic. The microprocessor cannot ignore this interrupt request.

PAGE

A subsection of memory. A read-only memory device (see ROM) is broken into discrete blocks of data. These blocks are called pages. Each block has X number of bytes.

PCB

The abbreviation for a printed-circuit board.

PHOTOTRANSISTOR

A transistor that is activated by an external light source.

POTENTIOMETER

1. A resistor that has a continuously moving contact which is generally mounted on a moving shaft. Used chiefly as a voltage divider. Also called a *pot* (slang).

2. An instrument for measuring a voltage by balancing it against a known voltage.

RAM

Random-access memory. A device for the temporary storage of data.

RASTER-SCAN DISPLAY

A display system whereby images are displayed by continuously scanning the cathode-ray tube horizontally and vertically with an electron beam. The display system controls the intensity of the electron beam.

RETRACE

In a raster-scan display, retrace is the time during which the cathode-ray tube electron beam is resetting either from right to left or from bottom to top.

RESISTOR

A device designed to have a definite amount of resistance. Used in circuits to limit current flow or to provide a voltage drop.

ROM

Read-only memory. A device for the permanent storage of data.

SIGNATURE ANALYSIS

A process of isolating digital logic faults at the component level by means of special test equipment called signature analyzers. Basically, signature analyzers (e.g., the ATARI® CAT Box) convert lengthy bit streams into four-digit hexadecimal signatures. The signature read by the analyzer at each circuit node is then compared with the known good signature for that node. This process continues until a fault is located.

TROUBLESHOOT

The process of locating and repairing a fault.

VECTOR

A line segment drawn between specific X and Y coordinates on a cathode-ray tube.

WATCHDOG

A counter circuit designed to protect the microprocessor from self-destruction if a program malfunction occurs. If a malfunction does occur, the counter applies continuous pulses to the reset line of the microprocessor, which causes the microprocessor to keep resetting.

X-Y DISPLAY

A display system whereby images are displayed with vectors.

ZENER DIODE

A special diode used as a regulator. Its main characteristic is breaking down at a specified reverse-bias (Zener) voltage.

APB™ Statistics

Date: _____ **Location:** _____

Coin Information and Game Times

Coin counters	L: _____ R: _____	Number of coins deposited in the left and right coin mechanisms, respectively
Total on time	_____ : _____ : _____	Total time (in hours : minutes : seconds) that the game has been turned on

	Number	Total Time	Avg. Time
All Games	_____	_____ : _____ : _____	_____ : _____
New Games	_____	_____ : _____ : _____	_____ : _____
Continued	_____	_____ : _____ : _____	_____ : _____

Histograms of Game Times*

_____ 12:00	_____ 4:00
_____ 8:00	_____ 3:30
_____ 7:30	_____ 3:00
_____ 7:00	_____ 2:30
_____ 6:30	_____ 2:00
_____ 6:00	_____ 1:30
_____ 5:30	_____ 1:00
_____ 5:00	_____ 0:30
_____ 4:30	_____ 0:00

**The green-highlighted reading indicates the number of new games. The red-highlighted reading indicates the number of continued games.*

(Continued on back)

Day Histogram* *

	32		16
	31		15
	30		14
	29		13
	28		12
	27		11
	26		10
	25		9
	24		8
	23		7
	22		6
	21		5
	20		4
	19		3
	18		2
	17		1

* **The green-highlighted reading indicates the number of times a day was started. The red-highlighted reading indicates the number of times a day was successfully completed.*

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.

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