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# VINDICATORS™

## Operators Manual with Illustrated Parts Lists



ATARI  
GAMES

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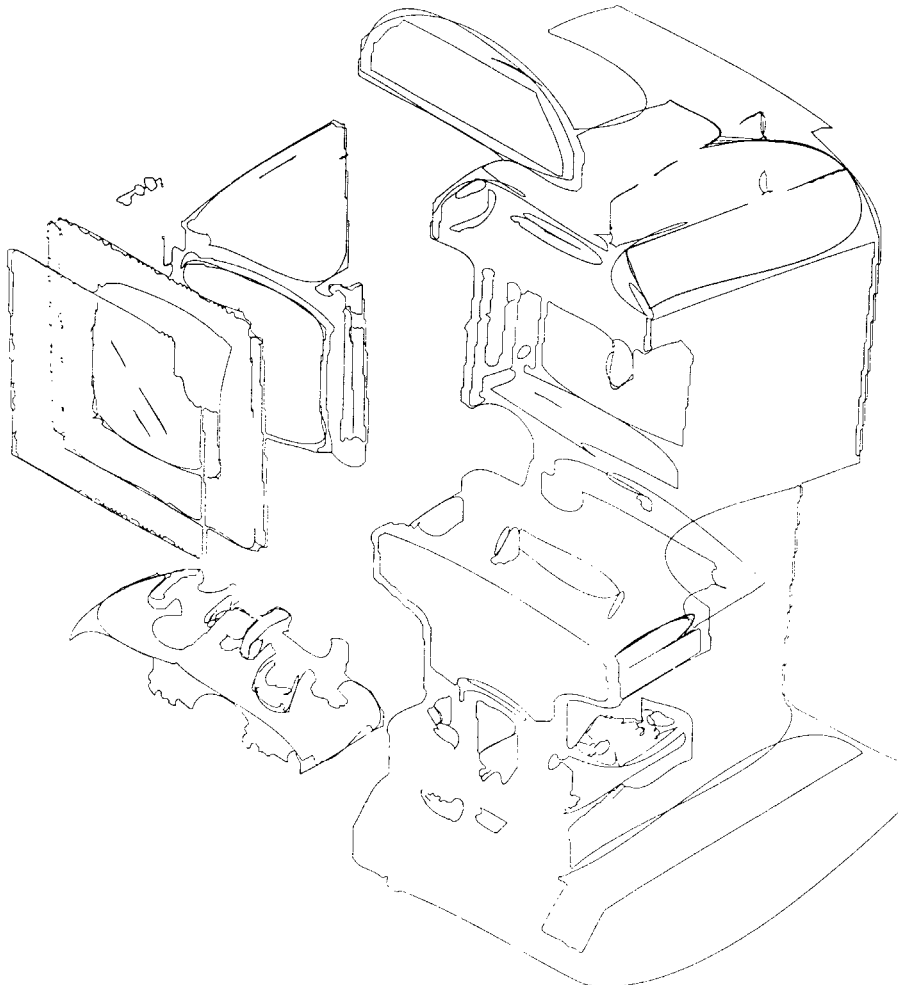
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# Vindicators™ Operators Manual

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.
- The power cord is properly plugged into a grounded three wire outlet.
- 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.

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# Safety Summary

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

## WARNING

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

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

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

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

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

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

## CAUTION

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

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

## ABOUT NOTES, CAUTIONS, AND WARNINGS

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

**NOTE**—A highlighted piece of information.

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

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



# Chapter 1

# Set-Up

## How to Use This Manual

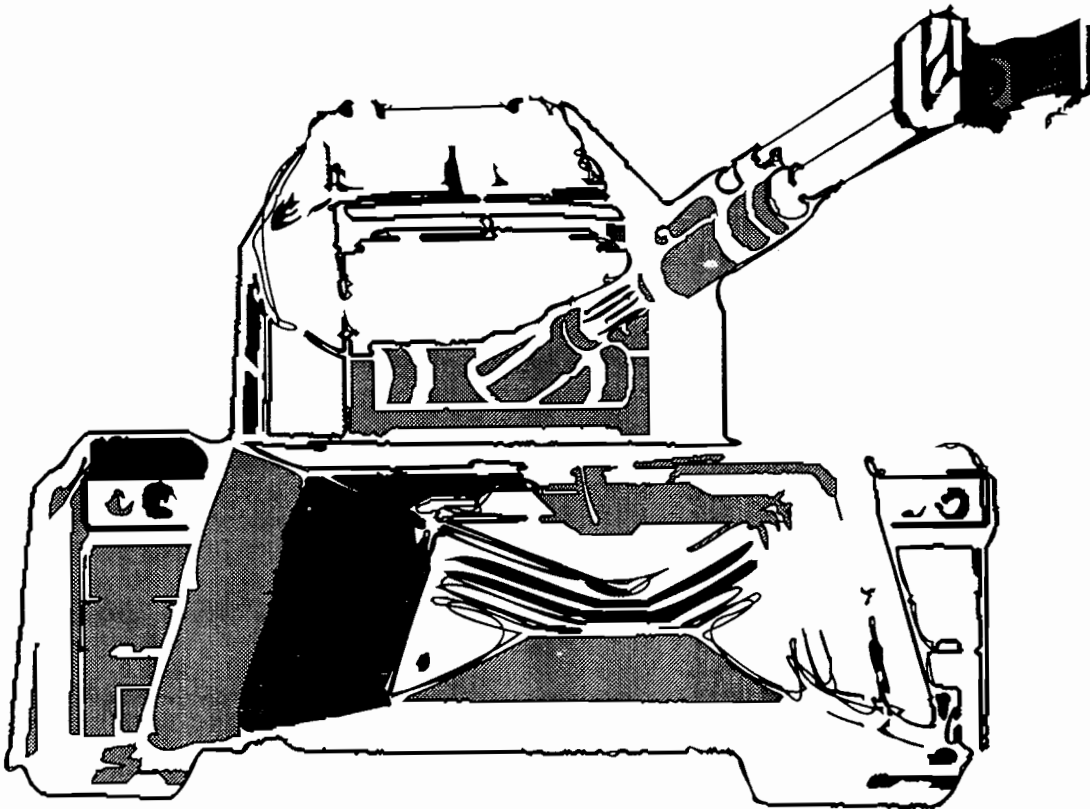
This manual is written for game operators and service personnel, and provides information for setting up, playing, testing, and maintaining your Vindicators™ game.

The 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 part lists.

Wiring and schematic diagrams for the Vindicators game circuitry are contained in the Schematic Package Supplement (SP-313) included with your game.

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



**WARNING**

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

This cabinet should be connected to a grounded three-wire outlet only. If you have only 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.

- b. Ensure that all plug-in integrated circuits on each PCB are firmly plugged into their sockets.
- c. Inspect the power cord for any cuts or dents in the insulation.
- d. Inspect the power supply. Make sure that the correct fuses are installed. Check that the harness is plugged in correctly and that the fuse block cover is mounted in place. Check that the green ground wires are connected.
- e. Inspect other major sub-assemblies, such as the video display, printed-circuit boards (PCBs), and speakers. Make sure that they are mounted securely and that the ground wires are connected.

## Inspecting the Game

**WARNING**

Do not plug in the game until you have completed the following inspection steps.

Please inspect your Vindicators game carefully to ensure that the game is complete and was 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 fit only in the proper orientation. *A reversed edge connector can damage a printed-circuit board (PCB) and will void your warranty.*

**Table 1-1 Game Specifications**

Characteristic	Specification
Power Consumption	150 V-A, 120 W RMS
Temperature	+5° to +50° C (+37° to +122° F)
Humidity	Not to exceed 95% relative
Line Voltage	102 to 132 VAC (U.S. games)
Width	27 in. (69 cm)
Depth	39 in. (99 cm)
Height	71 in. (180 cm)
Weight	302 lbs. (137 kg)

## 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 PCB behind the upper coin door. (See Figure 1-1.) The volume control adjusts the level of sound produced by the game.

### Self-Test Switch

The self-test switch is located to the left of the volume control on the Audio 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.

### Coin Counter

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

## Setting the Coin and Game Options

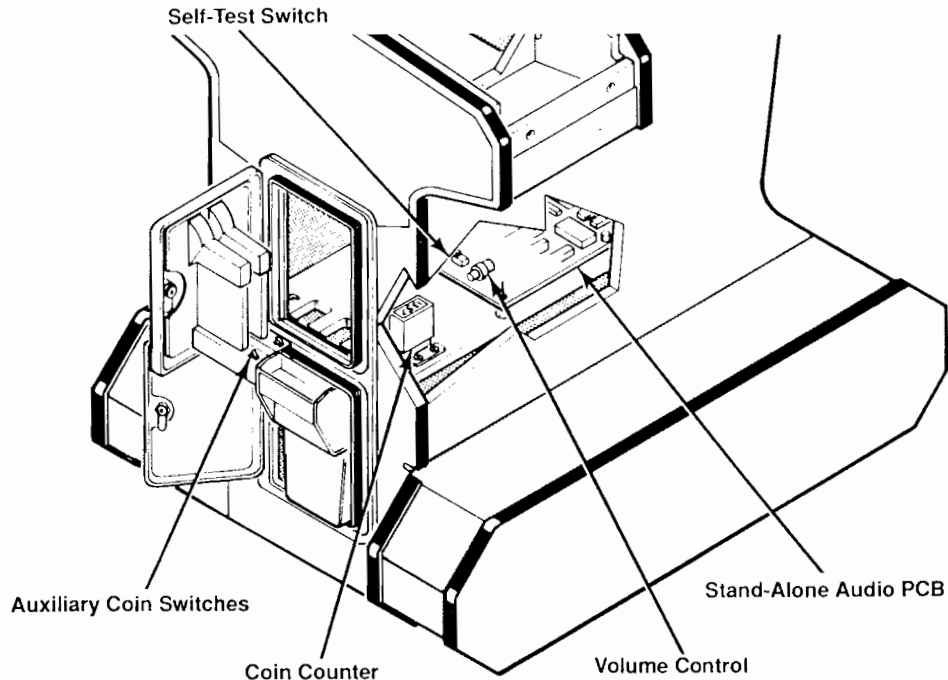
The Vindicators coin and game options are set in the Self-Test Mode. Refer to Chapter 2 for the recommended settings and the procedure for setting the options.

## Game Play

This section of the manual describes the theme of the Vindicators game and the game play features.

### Introduction

Vindicators is a one- or two-player tank game with a continuous buy-in feature, allowing players to join in



**Figure 1-1 Control and Switch Locations**

at any time. A color-coded control panel (left player/blue and right player/red) and game character allow for instant identification by players. Each player has a special tank controller with thumb and trigger buttons. The tank controller is used to steer and command an arsenal of weapons. Players pick up fuel to stay alive and stars to customize their tanks. With these stars, an arsenal of weapons and super powers can be purchased. Players can also select their starting points and are rewarded with a cache of stars for accepting a greater challenge.

### Play Mode

Vindicators takes place in the year 2525 outside Galaxy TR15. The mission is to intercept and destroy the invading forces from the evil Tangent Empire. The goal is to proceed through multi-level stations, securing each by demolishing its control center. The weapon is the SR-88 Strategic Battle Tank.

As team commanders of these SR-88 Strategic Battle Tanks, the players must face the invading forces from the Tangent Empire. The invaders have 14 space stations equipped with turrets and highly mobile armored tanks that constantly patrol the Tangent's fortifications.

The SR-88 battle tanks are powerful, but their fuel supply is very volatile. The players must constantly replenish their fuel supply by picking up fuel canisters at the many levels of the stations. Battle stars are also found along the way which provide enhancements such as:

- increased shot range
- increased shot power

- increased shot speed
- force shields
- smart shots
- bomb cannons
- tank armor.

### Maximizing Earnings

Operator options on this game have been kept very simple. You should thoroughly read Chapter 2, Self-Test, for information on the Coin Options, Game Options, Histogram, and Statistics screens so that you can effectively use the available options. Use the Self-Test screens showing Statistics and Histogram to evaluate game data, and the Game Options screen to make adjustments. (Refer also to the Self-Test chapter for more information on setting options.)

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 players a good value and ensure repeat play. (Repeat play is crucial to longevity.) The Vindicators software gives the operator the flexibility to tune game difficulty and enough statistics to intelligently make adjustments.

If collections seem low or are dropping off, check all player controls and coin mechanisms for proper operation.

If earnings seem low, the game is technically sound, and the average game time per quarter is under 150 seconds, 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 over 270 seconds, first try changing the game difficulty to a harder setting. If the average game time per quarter is still over 270 seconds after a few weeks, try an even harder setting.

**NOTE**

Be sure to keep the factory default at "no" if you wish to try other than factory-recommended settings.

After changing the game-difficulty settings, it is a good idea to reset the game statistics. The coin information and game statistics should be cleared in self-test by

pressing the Player 1 right Fire button; this resets the average game time statistic. In addition, the histogram should be cleared by pressing the Player 1 right Fire button while displaying the Histogram screen.

**Special Contest Feature**

Vindicators includes a special contest feature that offers players the opportunity to win a free Vindicators T-shirt. After successfully completing the contest round, players will be asked to input their name, age, and birth date. A five-character code will be given to players to send to Atari Games for verification. T-shirts are limited to quantities on hand, and the contest is void where prohibited by law. All entries must be postmarked no later than October 1, 1988, to be valid.

## Chapter 2

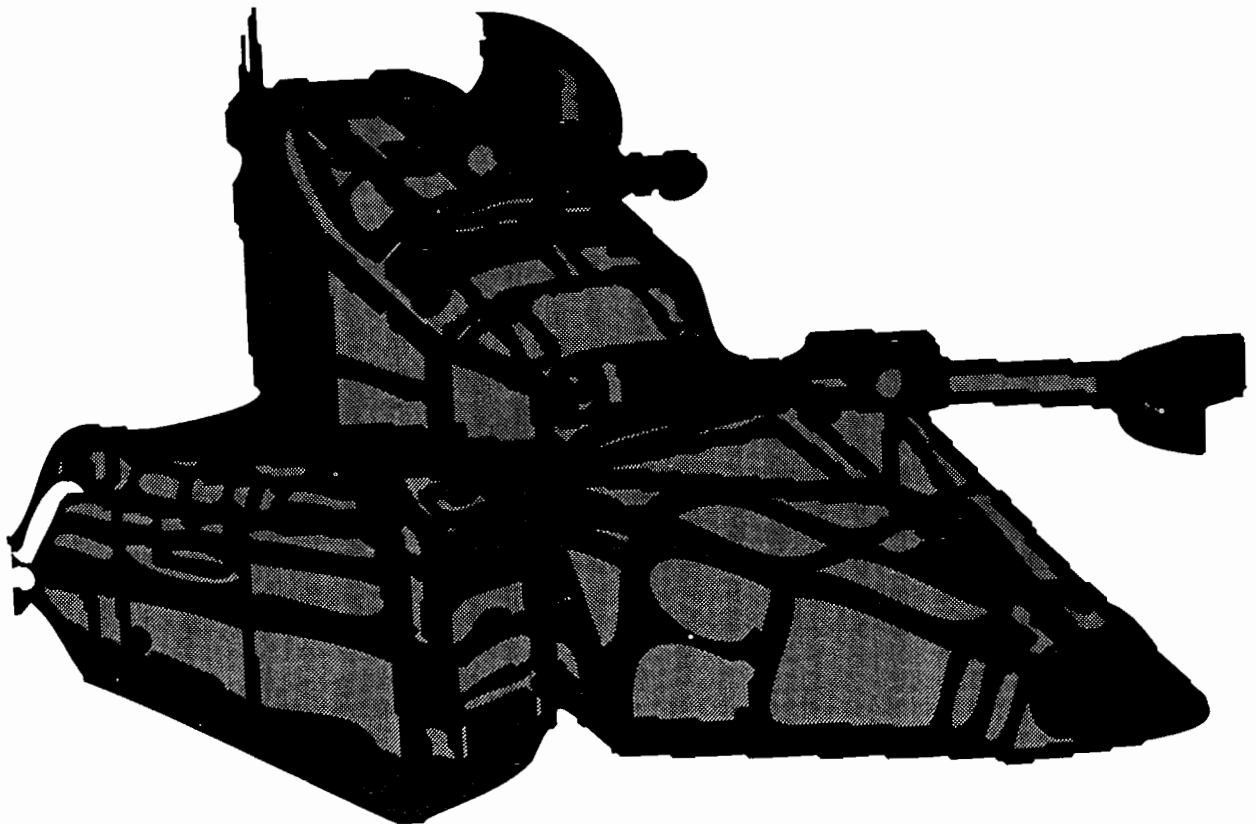
# Self-Test

The Vindicators™ 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.

Thirteen self-test screens provide information pertaining to the game circuits and controls. The game enters the Self-Test Mode after the self-test switch is turned on. The following self-test screens are arranged in the sequence in which they occur when the self-test switch is turned on. After the Sound Test, the sequence starts over with the Switch Test. Turning the self-test switch off at any time during the Self-Test Mode causes the game to return to the Attract Mode.

Refer to Chapter 1 for the self-test switch location.



# RAM/ROM Test

The RAM/ROM Test screens are shown in Figures 2-1 and 2-2.

This test provides a visual check of the game RAM, ROM, and associated circuitry. If the RAM and ROM Test passes, the display advances to the Switch Test.

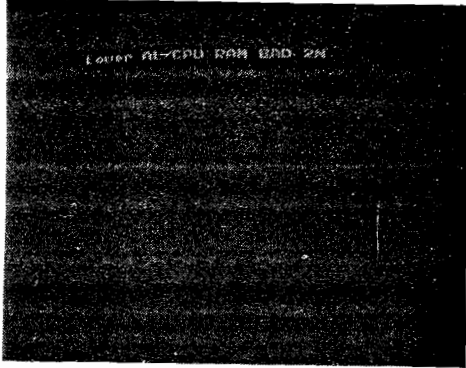


Figure 2-1 RAM Test Fails

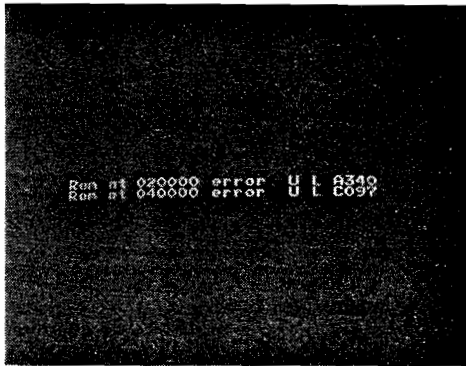


Figure 2-2 ROM Test Fails

The RAM/ROM Test is divided into two sections. The RAM Test is performed first. If the RAM Test passes after a six-second delay, the self-test skips to the ROM Test without displaying any message. If the RAM fails, a message will be displayed in the upper left of the screen as shown in Table 2-1. The RAM Test will continue to run until it passes. If the Player 1 left Fire button is pressed and released, the RAM Test will advance to the next RAM or ROM Test.

The ROM Test will display no messages and advance to the Switch Test if no errors occur. If a ROM fails, a message is displayed. Table 2-2 shows the location of the failing ROM. If the Player 1 left Fire button is pressed and released, the ROM Test will advance to the next test.

**Table 2-2 Faulty Upper or Lower Main ROM Locations**

Error Address	Location on Game PCB	
00000	U=1D	L=3D
20000	U=1F	L=3F
40000	U=1K	L=3K

**Table 2-1 Faulty RAM Locations**

RAM Type	Location	Video Display Characteristic on Game PCB
Upper PF/MO	2M	Background color is dark green and foreground is bright blue.
Lower PF/MO	1N	Background color is dark green and foreground is bright blue.
Upper AL/CPU	1M	Background color is dark brown and foreground is light blue.
Lower AL/CPU	2N	Background color is dark brown and foreground is light blue.
Upper Color RAM	18K	Reddish or brightly colored.
Lower Color RAM	16K	Blues and greens will be the prevalent colors.

# Switch Test

The Switch Test is shown in Figure 2-3. This test checks the condition of the player controls. The tank controller movement and the buttons that are checked include:

- |                     |                      |
|---------------------|----------------------|
| <b>Left Player:</b> | <b>Right Player:</b> |
| L Fire              | L Fire               |
| R Fire              | R Fire               |
| L Thumb             | L Thumb              |
| R Thumb             | R Thumb              |
| L Up                | L Up                 |
| R Up                | R Up                 |
| L Down              | L Down               |
| R Down              | R Down               |
|                     | Left Player Start    |
|                     | Right Player Start   |
|                     | Spare 1              |
|                     | Spare 2              |
|                     | Spare 3              |
|                     | Spare 4              |
|                     | Spare 5              |
|                     | Spare 6              |

Press the Player 1 left Fire button for the next screen.

Operate the tank controller and pushbuttons for the right player first, and then the left player. Check that the screen highlights in grey the appropriate tank controller movement or button that was pressed. If any *Spare* message is highlighted, you may have a hardware problem and the game play may not work correctly.



**Figure 2-3 Switch Test**

Press the Player 1 left Fire button to obtain the next screen.

## Coin Options

The Coin Options screen is shown in Figure 2-4. The Coin Options screen indicates the current coin option settings and is used to change those settings.

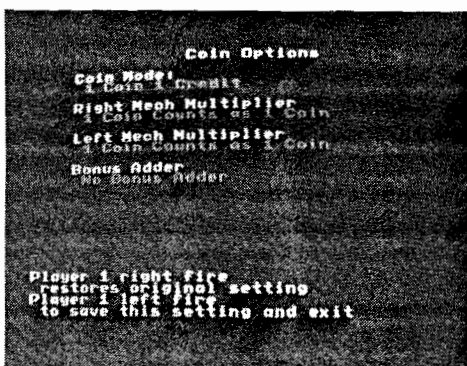
*COIN MODE* should have a red box around it. Move the player 1 right control up or down to cycle through four game price selections as follows:

- One Coin (Default)
- Two Coins
- Three Coins
- Four Coins

Select the desired value. Note that the default (recommended) setting of One Coin is highlighted in green.

Move the player 1 left control down to move the red box to *RIGHT MECH MULTIPLIER*. Then move the player 1 right control up or down to cycle through four multiplier selections as follows:

- 1 Coin Counts as 1 Coin (Default)
- 1 Coin Counts as 4 Coins
- 1 Coin Counts as 5 Coin
- 1 Coin Counts as 6 Coins



**Figure 2-4 Coin Options**

Select the desired value. Note that the default (recommended) setting of 1 Coin Counts as 1 Coin is highlighted in green.

Move the Player 1 left control down to move the red box to *LEFT MECH MULTIPLIER*. Then move the Player 1 right control up or down to cycle through two multiplier selections as follows:

- 1 Coin counts as 1 Coin (Default)
- 1 Coin counts as 2 Coins

Select the desired value. Note that the default (recommended) setting of 1 Coin counts as 1 coin is highlighted in green.

Move the Player 1 left control down to move the red box to *BONUS ADDER*. Move the Player 1 right control up or down to cycle through seven bonus adder selections as follows:

- No Bonus Adder (Default)
- 2 Coins Give 1 Extra Coin
- 4 Coins Give 1 Extra Coin
- 4 Coins Give 2 Extra Coins
- 5 Coins Give 1 Extra Coin
- 3 Coins Give 1 Extra Coin
- Free Play

Select the desired value. Note that the default (recommended) setting of No Bonus Adder is highlighted in green.

If you replace the EEROM at location 1C or if a hardware problem occurs, the coin options will switch to the default (green) settings.

If you want to cancel the coin option changes and restore the original settings, press the Player 1 right Fire button.

Press the Player 1 left Fire button to set the game for the options selected and obtain the next screen. Exiting from the Coin Options screen by turning off the self-test switch will not set the game for the selected coin options.

## Game Options

The Game Options screen is shown in Figure 2-5. This screen indicates the current game-option settings, and is used to reset the high score table and change the game-option settings. Refer to Table 2-3 for the available options and the default (recommended) settings. Note that the default settings are highlighted in green.

Move the Player 1 right control up or down and note that the settings in the red box change. Select the desired value. Move the Player 1 left control up or down to move the red box to the desired option.

Move the Player 1 right control up or down to cycle through all the available game option settings and se-

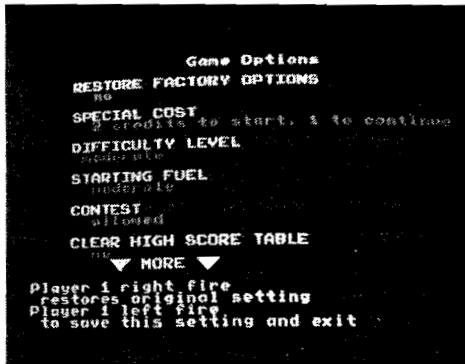


Figure 2-5 Game Options

Option Name	Available Settings	
Restore Factory Options	No ♦	Yes
Special Cost	No Special Cost Two Credits to Start; One to Continue ♦	
Difficulty Level	Easy	Moderate ♦
	Hard	Hardest
Starting Fuel	Easy	Moderate ♦
	Hard	Hardest
Contest	Allowed ♦	Disabled
Clear High Score Table	Yes	No ♦
Music in Attract Mode	Yes ♦	No
Auto High-Score-Table Reset	Yes ♦	No

♦ *Manufacturer's recommended settings*

lect the desired value. Repeat this procedure for the remaining options.

**Restore Factory Options**—Restores game options to default settings.

**Special Cost**—Requires 2 credits to start and 1 to continue action.

**Difficulty Level**—Controls overall difficulty level of game.

**Starting Fuel**—Controls the quantity of starting fuel at beginning of game.

**Contest**—Determines whether the contest is available.

**Clear High Score Table**—The high score table is not reset unless you select Yes.

**Music in Attract**—Determines if music is played in Attract Mode.

**Auto High-Score-Table Reset**—Automatically resets the high-score table after 2000 games if no player has achieved a high score in the last 200 games.

If you want to cancel the option changes and restore the original settings, press the Player 1 right Fire button.

Press the Player 1 left Fire button to set the game for the options selected and obtain the next screen. Exiting the Game Options screen by turning off the self-test switch will not set the game for the selected options.

## Statistics

The Statistics screen appears as shown in Figure 2-6. This screen provides a visual check of the current game statistics. The statistics information is accumulated either from the first time the game was turned on or from the last time the statistics were reset. To reset



Figure 2-6 Statistics

the statistics information, press the Player 1 right Fire button.

The following information appears on the Statistics screen:

- Left Coins shows the number of coins deposited in the left coin mechanism.
- Right Coins shows the number of coins deposited in the right coin mechanism.
- 0 Plyr Mins shows the minutes of idle time.
- 1 Plyr Mins shows the minutes played as a 1-player game.
- 2 Plyr Mins shows the minutes played as a 2-player game.
- Easy Games shows the number of players who started at the easy level.
- Medium Games shows the number of players who started at the medium level.
- Hard Games shows the number of players who started at the hard level.
- Joined Games shows the number of players who joined while a game was in progress.

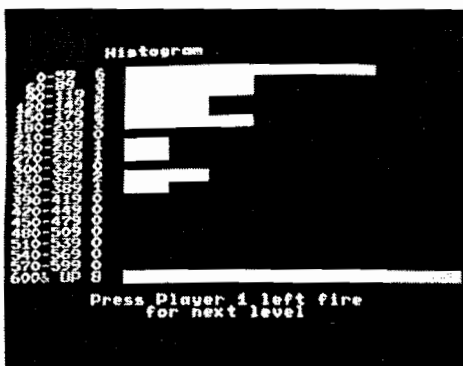


- Total Games shows the total number of games played. One “game” is the time between a player starting and that player dying, regardless of time or number of coins inserted.
- Error Count shows the number of EEROM errors that were detected. Replace the EEROM at location 1C on the Game PCB if the errors detected exceed approximately 75 per week.
- Total Coins shows the total number of coins deposited in all the coin mechanisms.
- Avg Time/Coin shows the average game time per coin, in seconds, for all players.

Press the Player 1 left Fire button to obtain the next screen.

## Histogram

The Histogram screen is shown in Figure 2-7. The histogram shows the average game time from 0 to 600 or more seconds. The Histogram also provides a corresponding bar graph.



**Figure 2-7 Histograms**

The game times information is accumulated either from the first time the game was turned on or from the last time the game times were reset. To reset the Histogram, press the player 1 right Fire button when in the Histogram screen.

Press the Player 1 left Fire button to obtain the next screen.

## Playfield Test

The Playfield Test is shown in Figure 2-8. Under the title *PLAYFIELD TEST* bank number is indicated. Each bank refers to a graphics block in hardware. There are six banks. By pressing the Player 1 left Thumb button, each bank is sequentially accessed. The Player 1 right Thumb button cycles through the bank backwards. The valid banks are 0 through 5. Other banks will not give a cohesive picture and should be ignored.

By moving the Player 1 left tank controller up and

down, vertical scrolling is achieved. Moving the Player 1 right tank controller up and down gives horizontal scrolling.

Playfield banks 0, 1, 2, and 3 refer to EPROM locations 8/9R, 12/13R, 8/9P, and 12/13P.



**Figure 2-8 Playfield Test**

Playfield banks 4 and 5 refer to EPROM locations 7R, 14R, 7P, and 14P.

Press the Player 1 left Fire button to obtain the next screen.

## Motion Object Test

The Motion Object Test appears as shown in Figure 2-9. The Motion Object Test indicates the condition of the motion-object buffer circuit. There are seven objects placed in one row at the top of the screen. The following information is provided at the bottom of the screen:

- OBJECT indicates the number of the motion object selected.
- PICTURE indicates the stamp number in ROM.
- HORIZONTAL indicates the horizontal position of the object.



**Figure 2-9 Motion Object Test**

- VERTICAL indicates the vertical position of the object.
- SIZE indicate the number of stamps high and wide.
- COLOR PALETTE indicates the palette number for colors.

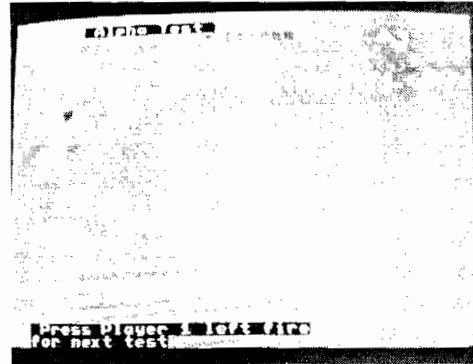
Perform the test procedure as described in Table 2-4.

Press the Player 1 left Fire button to obtain the next screen.

## Alphanumeric Test

The Alphanumeric Test is shown in Figure 2-10. This test indicates the condition of the alphanumeric circuit. Check that there are no errors on the screen. If there are errors, check the EPROM at N16 or its circuitry.

Press the Player 1 left Fire button to obtain the next screen.



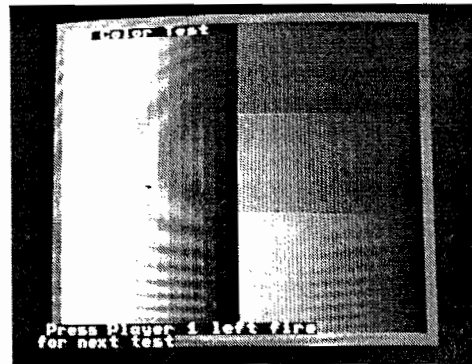
**Figure 2-10 Alphanumeric Test**

## Color Test

The Color Test is shown in Figure 2-11. This test indicates the condition of the display color circuits.

The screen should show 16 vertical gray-scale bars and three blocks of red, green and blue, each containing 16 vertical bars. The brightest bars should be on the left and darkest (black) on the right, with a grey frame around the screen. This frame will help to identify the darkest color band. If the display characteristics are not correct, refer to the display manual for the color-gun adjustment procedure or to determine the possible cause of failure. To adjust the brightness, find the darkest column (not black) with the red, green, and blue colors. This column should be just barely visible.

Press the Player 1 left Fire button to obtain the next screen.



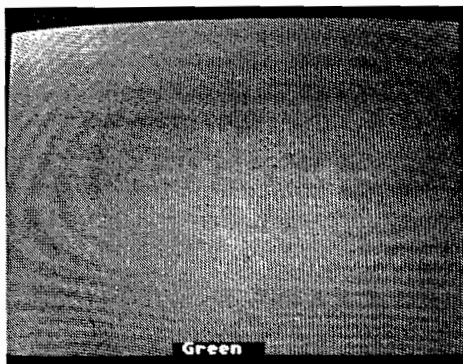
**Figure 2-11 Color Test**

Table 2-4 Motion Object Test Description	
Control/Movement	Function
Player 2 Left Fire Button (increment by 1)	Displays a different set of pictures. (See PICTURE.) Press this button to view the pictures from 0 to 5FFF. If there are errors, inspect:  <i>Picture</i> <i>EPROM location on Game PCB Board</i>
Player 2 Right Fire Button (decrement by 1)	0-3FFF      8/9R 12/13R 8/9P 12/13P
	4000-5FFF    7R 14R 7P 14P
Player 2 Left Thumb Button	Increments picture by size
Player 2 Right Thumb Button	Decrements picture by size
Player 1 Left Tank Controller	Moves the vertical position of object
Player 1 Right Tank Controller	Moves the horizontal position of object
Player 1 Left Thumb Button	Decreases the selected object number
Player 1 Right Thumb Button	Increases the selected object number
Player 1 Right Fire Button	Increases the palette of the selected object
Player 1 Start Button	Increases the vertical size of the selected object
Player 2 Start Button	Increases the horizontal size of the selected object

## Color Purity Test

The Color Purity Test consists of five color displays that indicate the condition of the display color-purity circuits. The first display to appear should be a red screen with the word RED displayed at the bottom of the screen.

Press the Player 1 right Fire button, and the next display to appear should be green with the word *GREEN* displayed at the bottom of the screen (see Figure 2-12). Press the Player 1 right Fire button to obtain a blue, white, and finally a gray screen. After the gray screen, the display will repeat the red, green, blue, white and gray sequence again.



**Figure 2-12 Color Purity Test**

If the display characteristics are not correct, refer to the display manual for the color-purity adjustment procedure or the possible cause of failure.

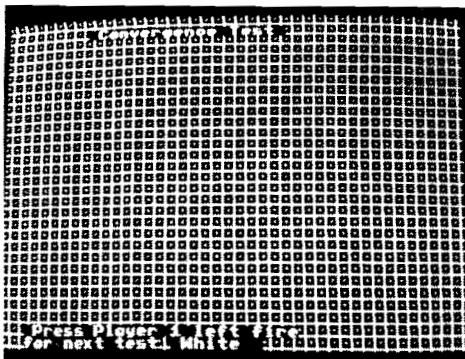
Press the Player 1 left Fire button to obtain the next screen.

## Convergence Test

The Convergence Test is shown in Figure 2-13. This test indicates the condition of the display size, centering, linearity, and convergence. The grid pattern should be white.

Press the Player 1 right Fire button and the grid pattern should turn violet. Pressing the Player 1 right Fire button again should cause the grid pattern to turn green. Check the grid pattern for the following characteristics (the violet and white patterns are used to adjust the display convergence):

- The four corners of the frame around the grid pat-



**Figure 2-13 Convergence Test**

tern should touch all four corners of the screen.

- Grid lines should show no pincushioning or barreling, and the lines should be straight within 3.0 mm.
- Violet and white pattern convergence should be within 2.0 mm.

If the display characteristics are not within these limits, refer to the display manual for the linearity and convergence adjustment procedures or to determine the possible cause of failure.

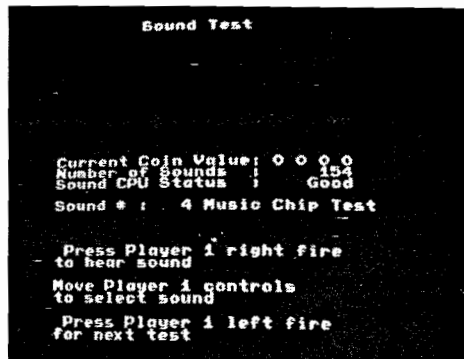
Press the Player 1 left Fire button to obtain the next screen.

## Sound Test

The Sound Test is shown in Figure 2-14. This test indicates the condition of the coin mechanisms and the music, speech, and sound-effects circuits.

The sound microprocessor is reset at the beginning of this test. The game may take up to three seconds to produce the first sound. If the sound-microprocessor reset fails, the message *SOUND PROCESSOR NOT RESPONDING* should blink near the top of the screen. If the sound microprocessor is good, check the coin mechanisms and the sound microprocessor circuits by observing the following messages:

- *CURRENT COIN VALUE* consists of four zeroes. The third and fourth zeroes correspond to the left and right coin mechanisms, respectively. These zeroes should change to ones when the coin switch is held down, and back to zeroes when it is released.
- *NUMBER OF SOUNDS* indicates of the number of sounds used in the Vindicators game.
- *SOUND CPU STATUS* indicates the condition of the sound microprocessor. If the sound microprocessor is good, the word *GOOD* should appear. If the sound microprocessor or associated circuitry is faulty, a number will appear (to indicate sound status) in addition to an error message located at the top of the screen. Refer to Table 2-5 for the error



**Figure 2-14 Sound Test**

messages and faulty sound RAM and ROM locations on the Stand-Alone Audio PCB.

- SOUND # indicates the sound selected by moving the Player 1 right tank controller up (increments the sound number) or down (decrements the sound number). To hear the sound, press the Player 1 right Fire button one or more times. Moving the Player 1 left control up or down or pressing the Player 1 right Thumb button silences the sound.
- Sound 4 (Music Chip Test) consists of eight tones in a major scale that alternate between sound channels (16 tones in all).
- Sound 5 (Effects Chip Test) consists of four tones in a major chord that come from both sound channels simultaneously.
- SCOM (serial communications) Reset Test checks that the Game PCB can reset the Stand-Alone Audio PCB.

Press the Player 1 left Fire button to return to the Switch Test.

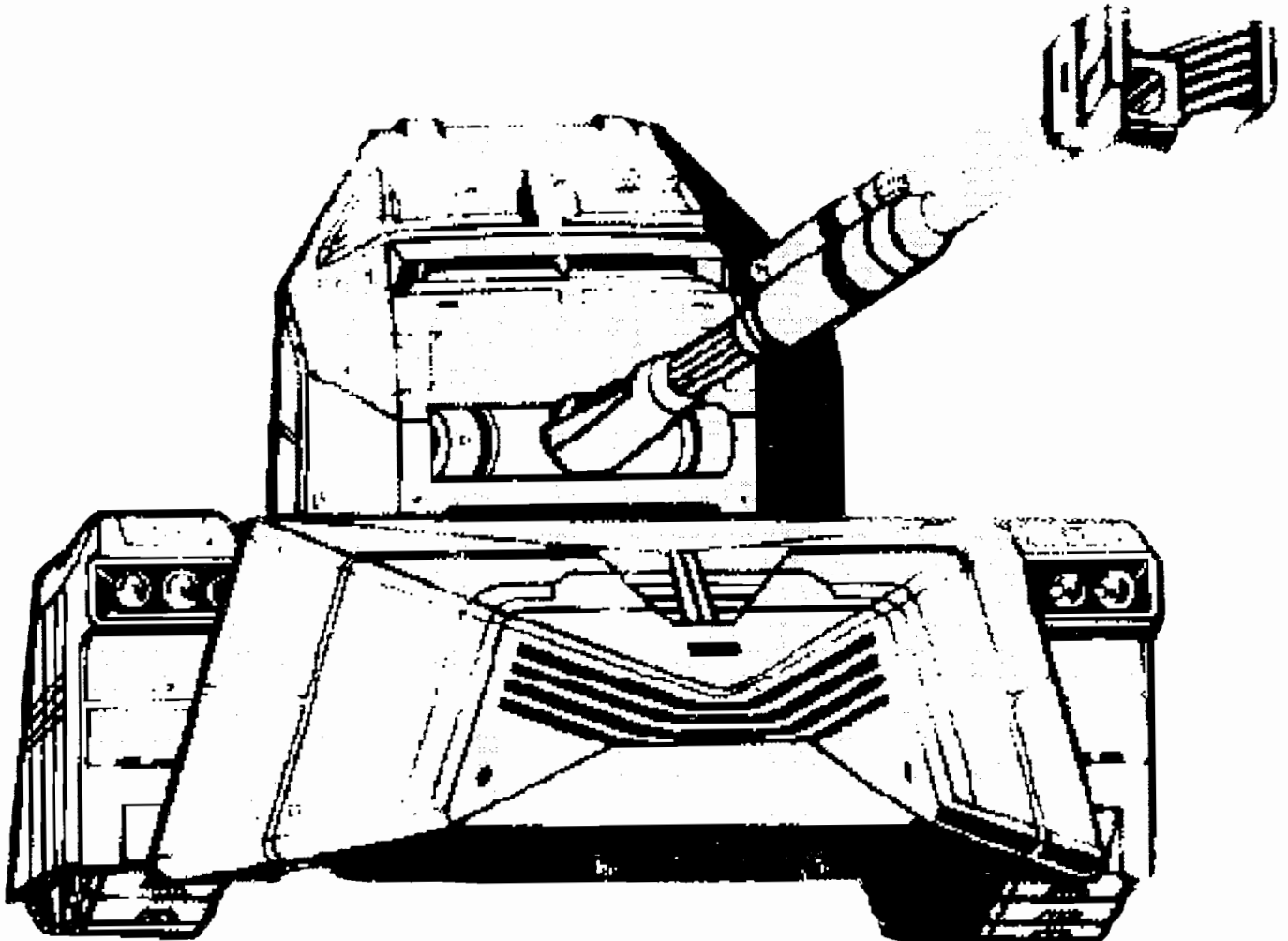
**Table 2-5 Faulty Sound RAM and ROM Locations**

Error Message	Location on Stand-Alone Audio PCB/Cause
Music Chip Time Out	2F
Sound CPU Interrupt Error	2F, 5K, Transistor Q8
Sound CPU RAM 1 Error	2H
Sound CPU ROM 1 Error	2K
Communications Error #1	If displayed when entering test, then sound processor cannot run further. Press Fire button to obtain next test.  1M Will count number of errors caused by either the Stand-Alone Audio PCB or Game PCB. This error message usually means that the chip no. 137526-001 on either of these two boards is bad or is loose in its socket.
Communications Error #2	A probable disconnection of the Stand-Alone Audio PCB from the Game PCB, or the chip at 1M is not inserted into its socket.
Sound Processor Not Responding	A major problem with the Stand-Alone Audio PCB. If you cannot enter the self-test, the cause may be a harness disconnection between the Stand-Alone Audio and Game PCBs.

# Maintenance

This chapter includes preventive and corrective maintenance procedures for the Vindicators™ 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, re-assembly, 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

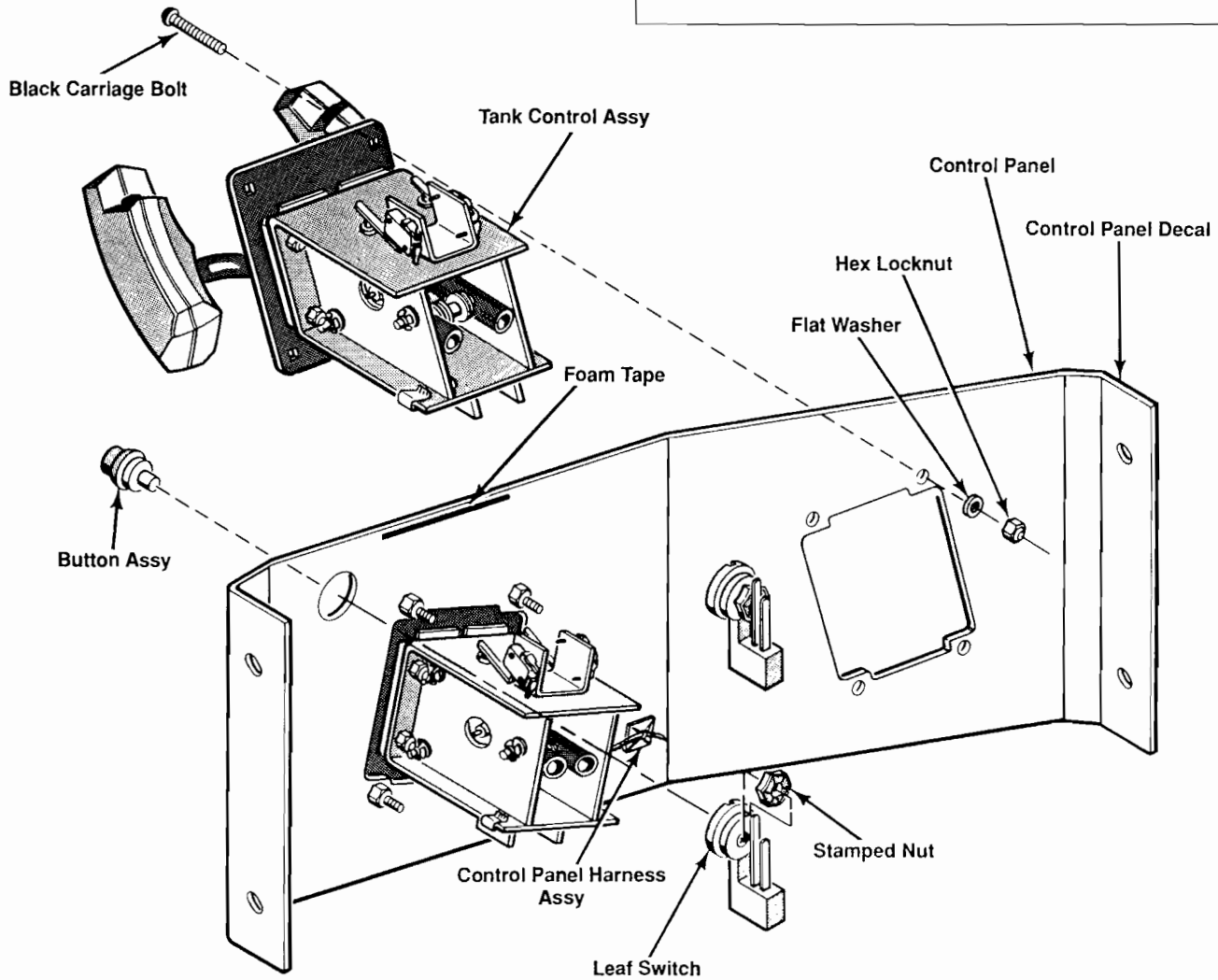
The preventive-maintenance intervals specified in Table 3-1 are the recommended minimum requirements for the components listed.

### WARNING

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

**Table 3-1 Recommended Preventive-Maintenance Intervals**

<b>Tank Controller</b>	Inspect weekly, lubricate, and tighten hardware at least every three months.
<b>Coin Mechanism</b>	Inspect whenever you collect coins. Clean at least every three months.



**Figure 3-1 Leaf Switch and Tank Controller Removal**

## Removing the Control Panel

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

1. Use the tamper-proof hex-key wrench (included in the operators manual bag) to remove the four tamper-proof screws and washers holding the control panel to the cabinet.

### NOTE

A hole is provided on the cabinet shelf inside the upper coin door to conveniently store the hex-key wrench when not being used. This hole is located to the left of the coin slots.

2. Grasp the tank controller and gently lift until the bottom edge of the control panel clears the cabinet.
3. Disconnect the three control panel harness connectors and remove the control panel from the cabinet.
4. 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. (See Figure 3-1.)

1. Remove the control panel as previously described in this chapter.
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. Then use the Self-Test to verify proper switch contact.
3. Use a 15/16-inch open-end wrench to tighten the stamped nut holding the push-button leaf switches to the control panel.
4. Replace the control panel in the cabinet in the reverse order of removal.

## Tank Controller

Preventive maintenance on the tank controller consists of:

- Inspection of each snap-action switch to assure that the actuators are not bent or deformed.
- Lubrication of each spacer, shaft, and pivot shaft.

## Lubricating the Tank Controller

Perform the following procedure to lubricate each tank controller. (See Figure 3-1.)

1. Remove the control panel as previously described in this chapter.
2. Use a 3/8" wrench to remove the four nuts holding the tank controller to the control panel.
3. Apply a small amount of lithium grease (Atari part no. 178027-001) between each spacer and tube handle. Repeat this procedure for each of the four spacers.
4. Apply a small amount of lithium grease to the pivot shaft.
5. Replace the tank controller and 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.

## 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 and display service 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.).

## Corrective Maintenance

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

### Removing the Tank Controller

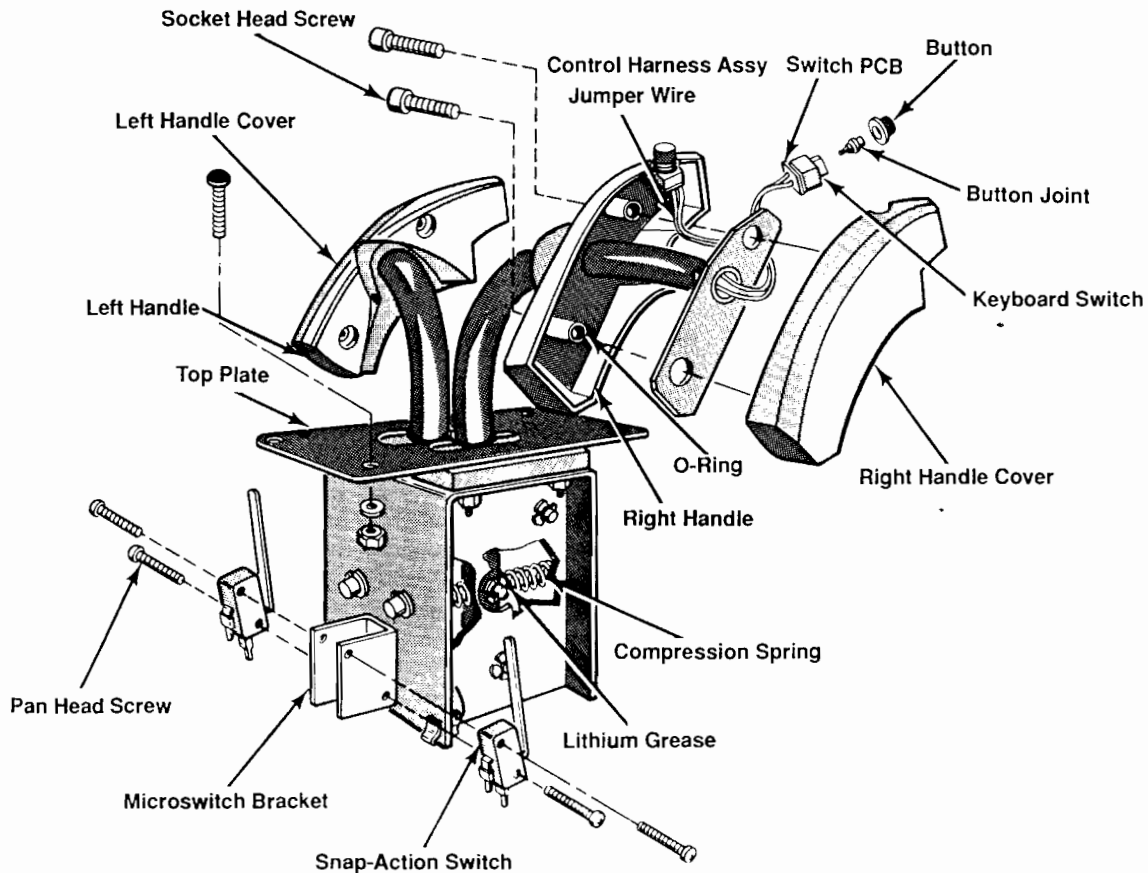
Perform the following procedure to remove/replace the tank controller (See Figure 3-1.)

1. Remove the control panel as described under Preventive Maintenance.

2. Use a 3/8-inch hex driver to remove the four nuts holding the tank controller to the control panel.
3. Carefully lift the tank controller out of the control panel.
4. Replace the tank controller in the reverse order of removal.

### Disassembling the Tank Controller

Perform the following procedure to disassemble the tank controller. (See Figure 3-2.)



**Figure 3-2 Tank Controller Disassembly and Lubrication**



1. Remove the covers from the handles using a 4mm socket wrench to remove the four M4 x 18mm socket head cap screws.
2. Remove the button joint and button from the switches.
3. Unsolder the harness from the PCB and switches, and slip the harness through the handle, as shown in Figure 3-2.
4. Remove the retaining ring from the end of the pivot shaft. Remove the washers from the shaft, and remove the shaft from the tube and the frame.
5. Remove the retaining ring attached to the translator shaft that protrudes beyond the handle tube. Remove the flat washer and retaining ring from the other side of the translator shaft. Remove the actuator shaft, including the washer and spring, through the handle tube. Remove the slip washer and slip spring from the actuator shaft, and remove the actuator shaft from the frame.
6. Repeat the procedure in Step 5 above for the other handle tube.
7. Remove the handles and tubes from the slides and spacer frame. Note the orientation of the handles for subsequent re-assembly.
8. Remove the handles from the tubes.
9. Remove the slides from the spacer frame.
10. Remove the spacer and the top plate from the frame by removing the #10 nut and lock washer.
11. Remove the retaining rings from the shaft, slip the bumper stop off the shaft and slip shaft from the frame.
12. Repeat this procedure for the other bumper stop.

## Reassembling the Tank Controller

Perform the following procedure to reassemble the tank controller. (See Figure 3-2.)

1. Slip the bumper stop shaft partially through the frame. Then slip the bumper stop over the shaft. Push the shaft through the other side of the frame. Install the retaining rings.
2. Repeat Step 1 for the other bumper stop shaft.
3. Mount the frame spacer, nylon washer, and top plate on the frame. Secure using four #10 lock washers and nuts.
4. Slip the slide handle in the spacer frame as shown in Figure 3-2.
5. Slip the left and right side handles over the left and right side tubes, respectively.
6. Slip the handle/tube assemblies through the slide

handle and spacer frame. Note the proper orientation of the handles.

7. Place the switch actuator shaft partially through the frame. Place the actuator shaft spacer over the switch actuator shaft, and push the switch actuator shaft through the handle/tube assemblies. Place the washer and spring on the actuator shaft, and push the shaft until it protrudes on the other side of the frame. Install the translator shaft through the actuator shaft as shown. Mount the flat washer and retaining ring on the translator shaft protruding handle/tube. Apply a small amount of lithium grease to the parts.
8. Repeat Step 7 for the other handle/tube assembly.
9. Insert the pivot shaft through the frame and the tube, slip the nylon washers over the shaft, and continue pushing the shaft until it protrudes on the other side of the frame. Install four retaining rings to secure the pivot shaft.
10. Place the wiring harness through the handle tubes as shown, and solder to the switches and PCB.
11. Mount the button joint and button on the keyboard switches.
12. Install covers on the right and left handles using four M4 x 18mm socket head cap screws.

## 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. Use a 1/8-inch hex driver to remove the five screws holding the speaker grille to the cabinet. Remove the speaker grille.

### **WARNING**

#### ***High Voltage***

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

#### ***X-Radiation***

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

#### ***Implosion Hazard***

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

3. Remove the video display shield.
4. Carefully remove the bezel from the protective foam tape.
5. Use a 1/8-inch hex driver to remove the four screws holding the upper rear door. Remove the door.
6. Be sure that the game power is turned off before discharging the high voltage from the cathode-ray tube (CRT). The display assembly contains a circuit for discharging the high voltage to ground when power is removed. However, to make certain, always discharge the display as follows:
  - 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.
7. From the rear of the cabinet, disconnect the display harness connectors from the display.

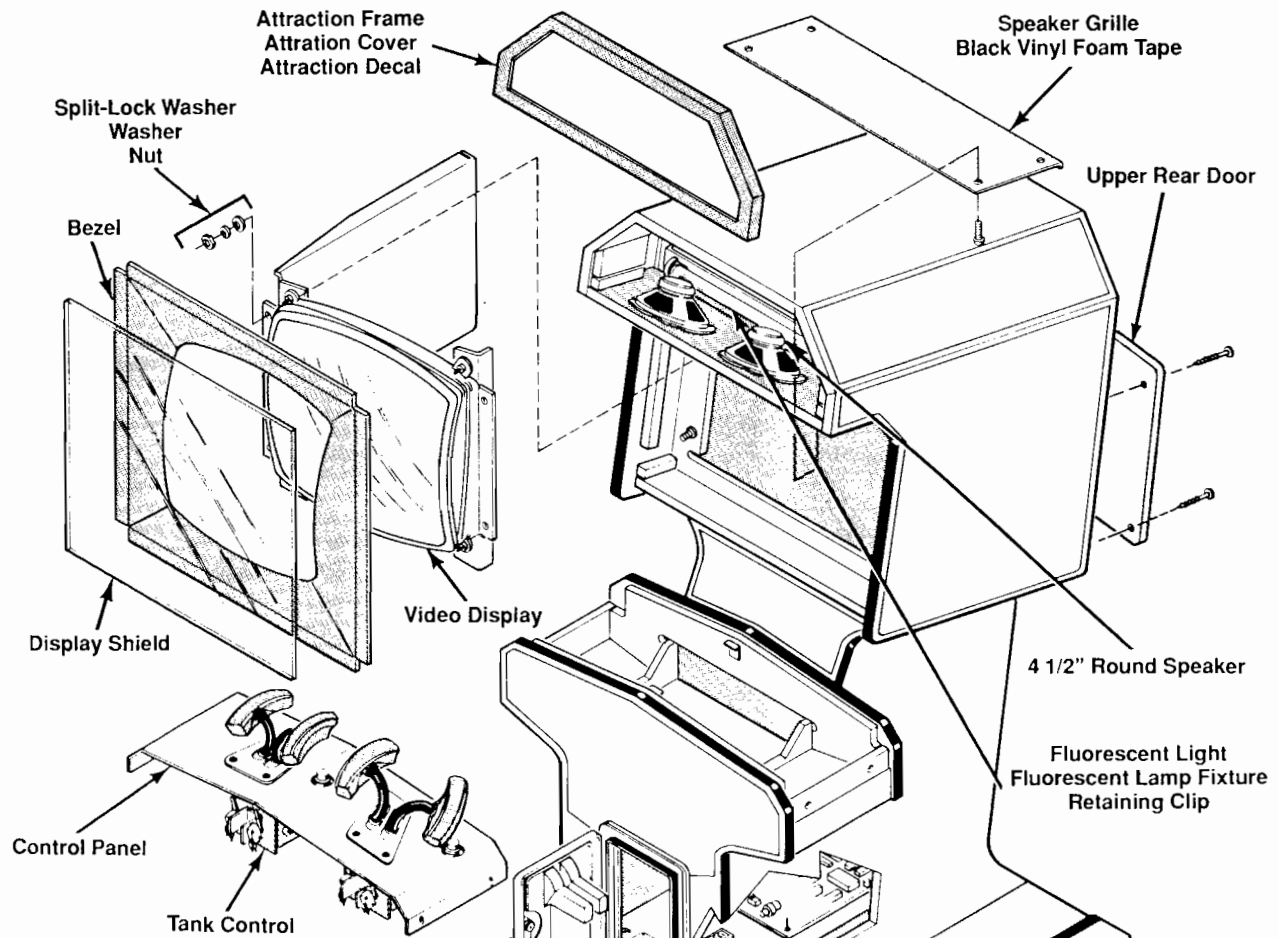
**WARNING**

To avoid dropping the video display, use extreme care when removing the display from the cabinet. We recommend that no one weighing less than 150 pounds should attempt to remove the display. In addition, we recommend that you wear gloves to protect your hands from the sheet-metal edges.

8. Use a 7/16-inch nut driver to remove the four nuts holding the display to the cabinet.
9. Carefully lift the display out through the front of the cabinet.

**NOTE**

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



**Figure 3-3 Control Panel, Video Display, and Speaker Removal**

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

## Replacing the Video Display

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

1. Carefully lift the video display through the front of the cabinet.
2. Position the display so that the four holes in the video display mounting brackets align with the four studs in the cabinet.
3. Tighten the four mounting nuts and washers holding the mounting brackets to the cabinet studs.
4. Use a 7/16-inch nut driver to tighten the nuts with washers securing the display to the cabinet. Be sure that the display is centered horizontally.
5. Connect the display harnesses to the display.
6. Replace the bezel, display shield, and speaker grille.

## Removing the Game PCB

Perform the following procedure to remove/replace the Game PCB.

1. Turn the game power off.
2. Unlock and remove the rear access panel from the cabinet.
3. Disconnect the harness connectors from the Game PCB.
4. Use a Phillips screwdriver to remove the two screws and washers holding the Game PCB to the cabinet.
5. Grasp the edge of the Game PCB and gently lift it out of the slotted guide.
6. Replace the Game PCB in the reverse order of removal.

## Removing the Fluorescent Light

Perform the following procedure to remove/replace the fluorescent light. (See Figure 3-3.)

1. Turn the game power off.
2. Use a 1/8-inch hex driver to remove the eight screws holding the attraction frame to the top of the cabinet. Remove the frame.

3. Remove the light box plastic shield.
4. Remove the fluorescent light from the light fixture.
5. To remove the entire light fixture, use a 1/8-inch hex driver to remove the four screws holding the upper rear door at the rear of the cabinet. Remove the door.
6. Disconnect the light harness connector in the rear of the cabinet.
7. Use a Phillips screwdriver to remove the two screws holding the light fixture. Remove the light fixture.
8. Replace the fluorescent light and/or light fixture in the reverse order of removal.

## Removing the Speakers

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

1. Turn the game power off.
2. Use a 1/8-inch hex driver to remove the five screws holding the speaker grille to the cabinet. Remove the grille.
3. Use a 1/8-inch hex driver to remove the eight screws holding the attraction frame to the cabinet. Remove the frame.

### CAUTION

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

4. Use a Phillips screwdriver to remove the four screws holding the speaker to the cabinet. Do not let the speaker fall.
5. Lower the speaker just far enough to disconnect the two speaker wires.
6. Replace the speaker in the reverse order of removal. 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.)

# N O T E S

# 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 in this manual and in the schematic package supplement. The most useful of these are:

### Assembly and Component Locations

The locations of assemblies and components are in the parts lists in Chapter 5 of this manual. The Printed-circuit board (PCB) illustrations can 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 schematic package supplement 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

If all circuits are operating improperly, this 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.

### Locate the Trouble

Decide what the symptom is. Perform the self-test procedure provided in Chapter 2 of this manual. Use the wiring diagrams in the schematic package supplement to determine which assemblies or major circuits may be causing the trouble.

### 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, the most practical way to determine if a component is faulty is to substitute a new component. Before you do this, make sure that you do not have some other circuit problem that could damage the new 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 4 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. You can damage a PCB or heat-sensitive electrical components with poor soldering practices.

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

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

**CAUTION**

Do not use a solder gun to remove or replace soldered-in components on a printed circuit board. A solder gun can overheat a device, and its large transient voltage can damage a voltage-sensitive device.

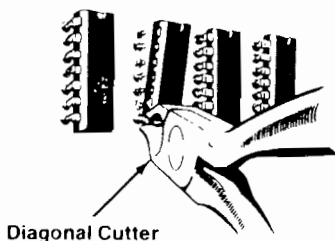
You will also need the following additional equipment for removing and replacing soldered-in components:

- **Solder Sucker**—Hand-operated vacuum tool to remove liquified solder from the PCB. We recommend the top-of-the-line Soldapull® brand.
- **Solder Wick**—Resin-soaked copper braid to remove 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 multi-layer PCB with plated-through holes.
- **Flux Remover**—Non-corrosive chemical to clean foreign material from the PCB before soldering and to remove any flux residue where components have been replaced. Also use it 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.

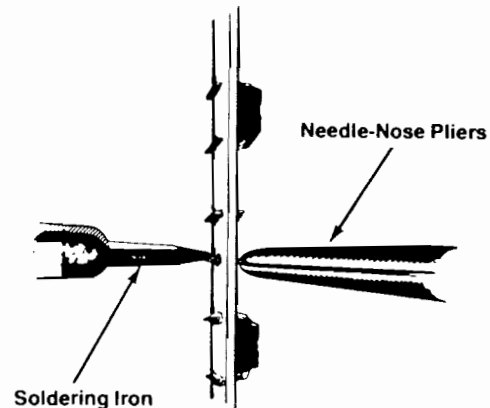
**Removing Integrated Circuits**

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**

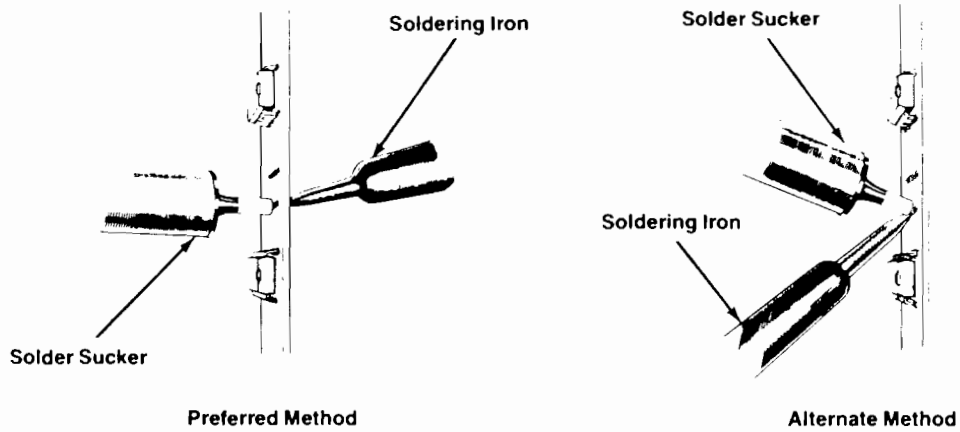
Do not use a solder wick to remove solder from inside plated-through holes. The heat required for the solder wick to remove the solder from inside the hole could damage the PCB.

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.

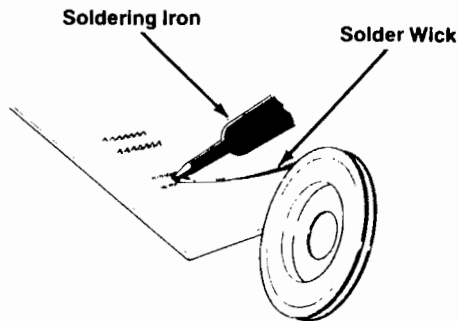
**Troubleshooting Static-Sensitive Devices**

Certain precautions must be taken when working with static-sensitive devices, such as 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 to fail.

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 devices. When soldering a static-sensi-



**Figure 4-3 Removing Solder from Plated-Through Holes**



**Figure 4-4 Removing Solder from Lead Connection Pads**

tive 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.)

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

New static-sensitive devices can be packaged in conductive foam or can 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.



# Illustrated Parts Lists

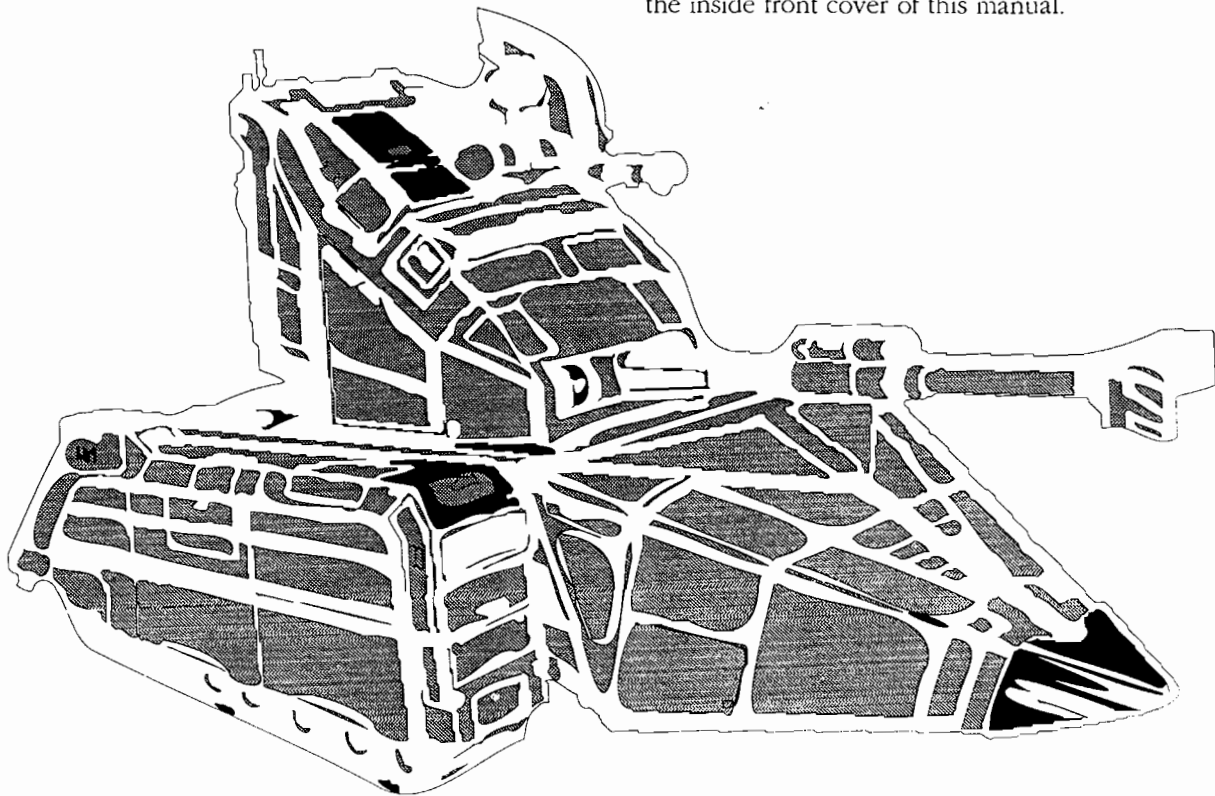
This chapter provides information you need to order parts for your game. Common hardware parts, such as screws, nuts, washers, and so on, are not in the parts lists.

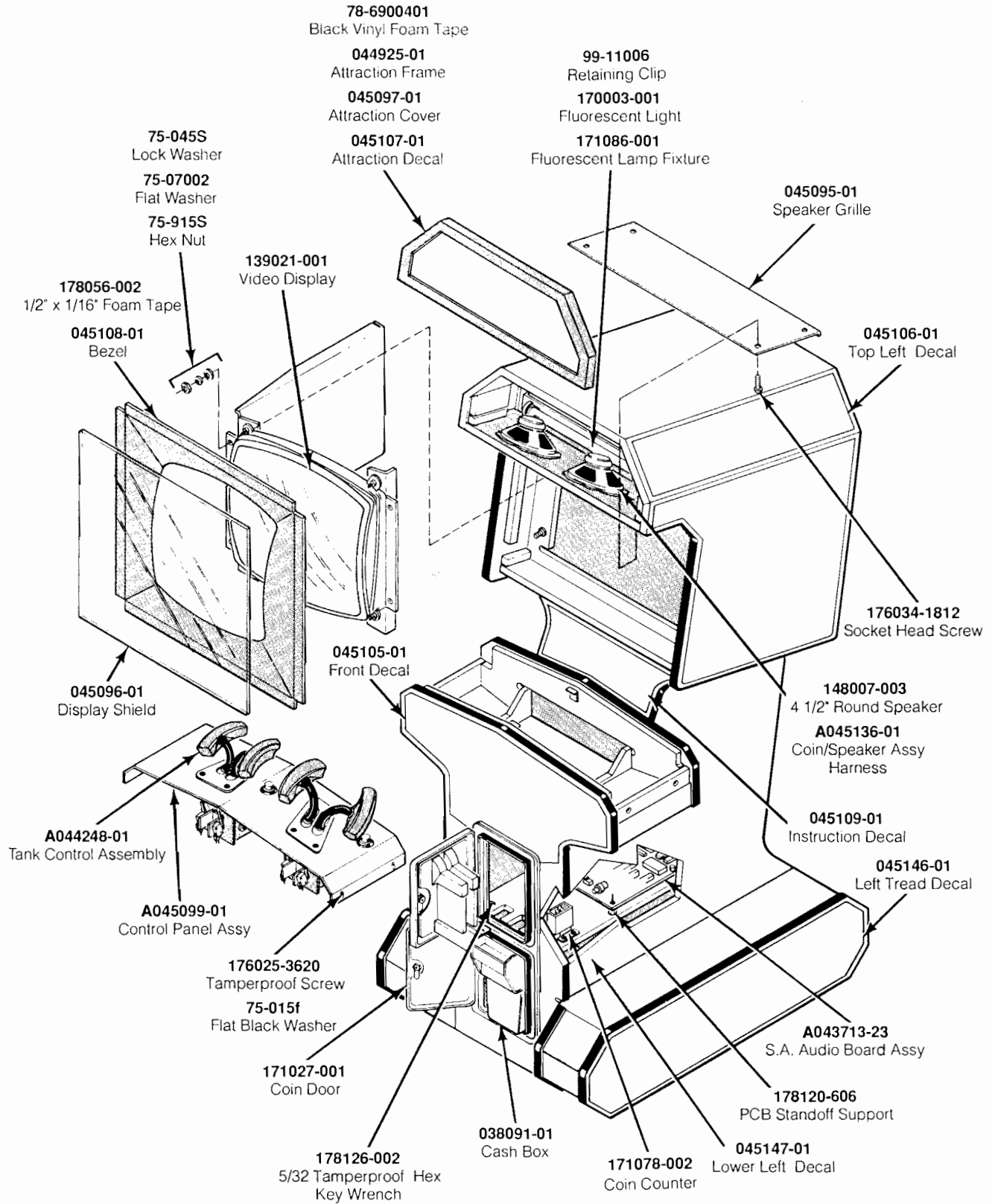
The PCB parts lists are arranged in alphabetical order by component. Each component section is arranged alphanumerically by reference designator.

Other parts lists are arranged alphanumerically by Atari part number. In these parts lists, all A-prefix numbers come first. Next come part numbers with a two number designation followed by a hyphen (00-through 99-). Ending the list are part numbers with six numbers followed by a hyphen (000598- through 201000-).

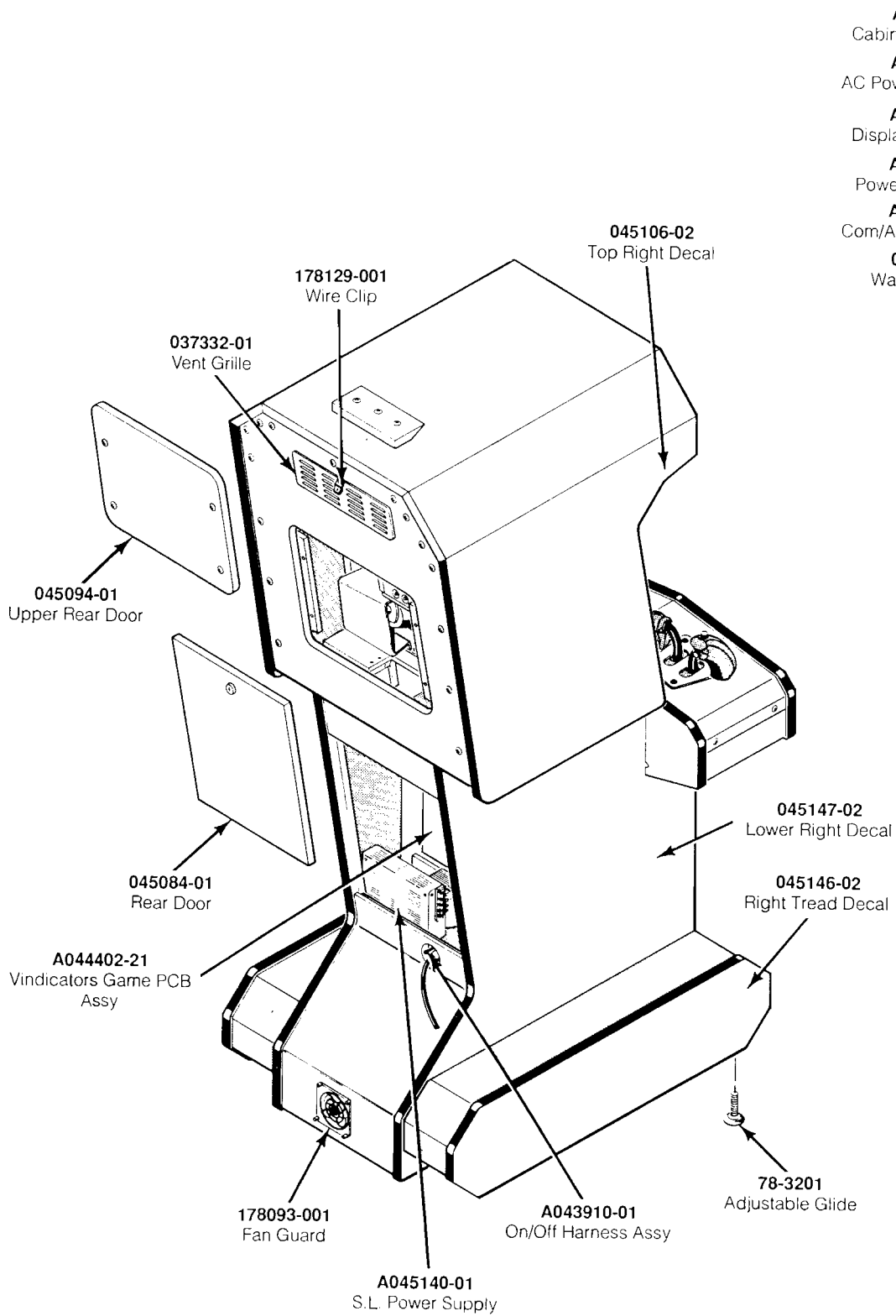
When you order parts, give the part number, part name, the number of this manual, and the serial number of your game. With this information, we can fill your order rapidly and correctly. We hope this will create less downtime and more profit from your games.

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





**Figure 5-1 Cabinet Mounted Assemblies  
A045101-01 A**



- A045135-01**  
Cabinet Assy Harness
- A044875-01**  
AC Power Assy Harness
- A045045-01**  
Display Assy Harness
- A045134-01**  
Power Assy Harness
- A045133-01**  
Com/Aud Assy Harness
- 045108-02**  
Water Deflector

**Figure 5-1 Cabinet-Mounted Assemblies, Continued**

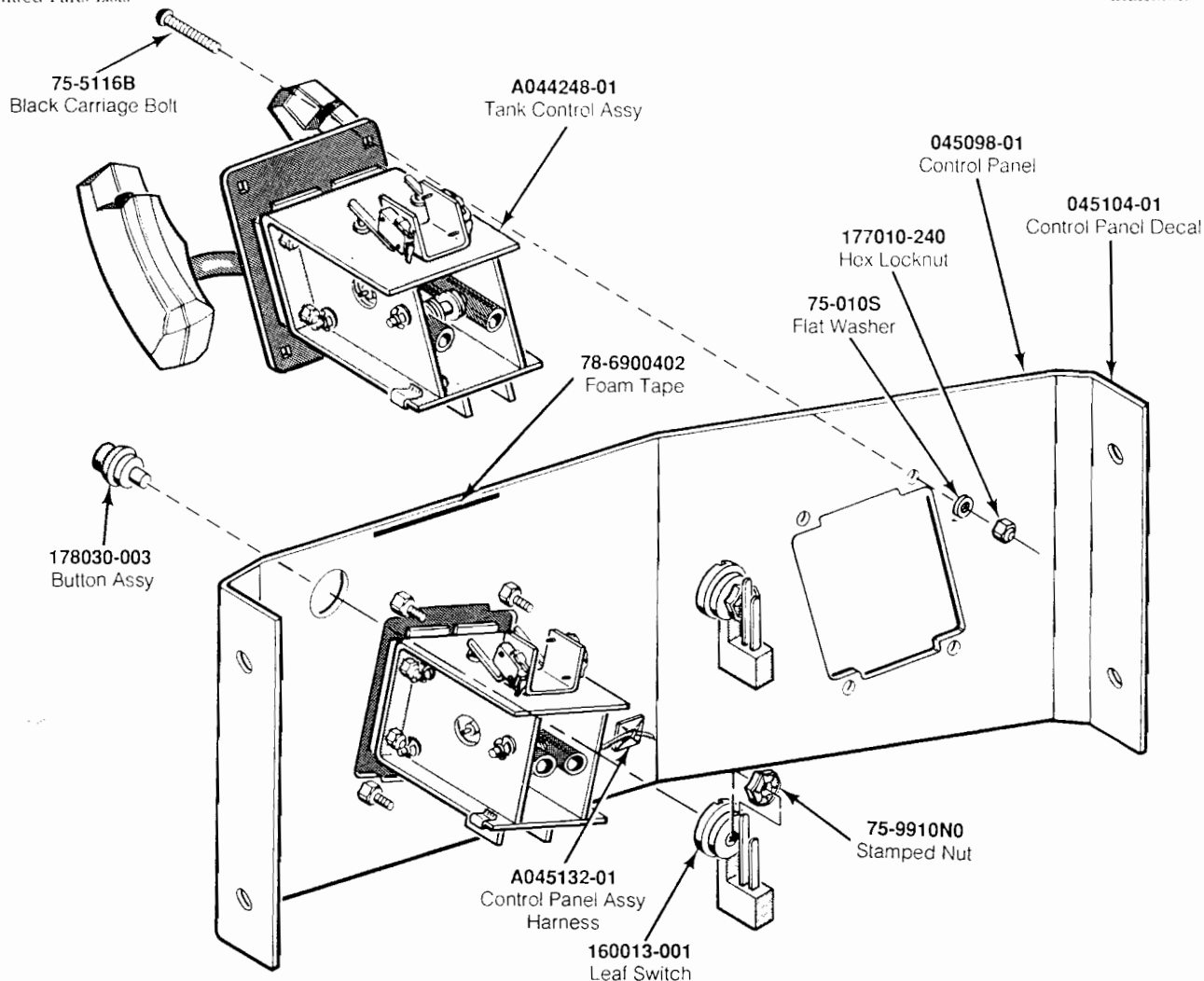
## Cabinet-Mounted Assemblies Parts List

Part No.	Description
038091-01	Cash Box
044925-01	Attraction Frame
045084-01	Rear Door
045094-01	Upper Rear Door
045095-01	Speaker Grille
045096-01	Display Shield
045097-01	Attraction Decal Cover
045105-01	Lower Front Decal
045107-01	Attraction Decal
045108-01	Bezel
045108-02	Water Deflector
045109-01	Instruction Decal
045106-01	Top Left Side Decal
045106-02	Top Right Side Decal
045146-01	Left Tread Decal
045146-02	Right Tread Decal
045147-01	Lower Left Side Decal
045147-02	Lower Right Side Decal
139021-001	19-inch Color Raster Video Display
148007-003	4 1/2-Inch Round Unshielded Speaker
170003-001	18-inch 15 Watt Fluorescent Light
171027-001	25¢/25¢ U.S.A.Over/Under Coin Door
171078-002	12 V DC Non-Resettable Terminated Coin Counter
171086-001	18-inch Fluorescent Lamp Fixture
176025-3620	Button Head Tamperproof Screw
178056-002	1/2-Inch x 1/16-Inch Foam Tape
178120-606	0.375-Inch PCB Standoff Support
178126-002	5/32-Inch Hex Tamperproof Driver Key
75-015F	1/4-Inch, Black Flat Washer
78-6900401	1/4-Inch x 1/16-Inch Black Vinyl Foam Tape
99-11006	Fluorescent Lamp Retaining Clip
A043713-23	Stand Alone Audio Board Assembly
A043910-01	On/Off Harness Assembly
A044402-21	Vindicators Game PCB Assembly
A044875-01	AC Power Assembly Harness
A045045-01	Display Assembly Harness
A045099-01	Control Panel Assembly
A045100-01	Cabinet Assembly
A045133-01	Com/Aud Assembly Harness
A045134-01	Power Assembly Harness
A045135-01	Cabinet Assembly Harness
A045136-01	Coin/Speaker Assembly Harness
A045140-01	SL Power Supply Assembly

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<b>Part No.</b>	<b>Description</b>
<i>The following items are the technical information supplements for this game:</i>	
SP-317	Schematic Package
ST-317	Self-Test Label
TM-304	Sharp Color Video Display Service Manual
TM-317	Operators Manual

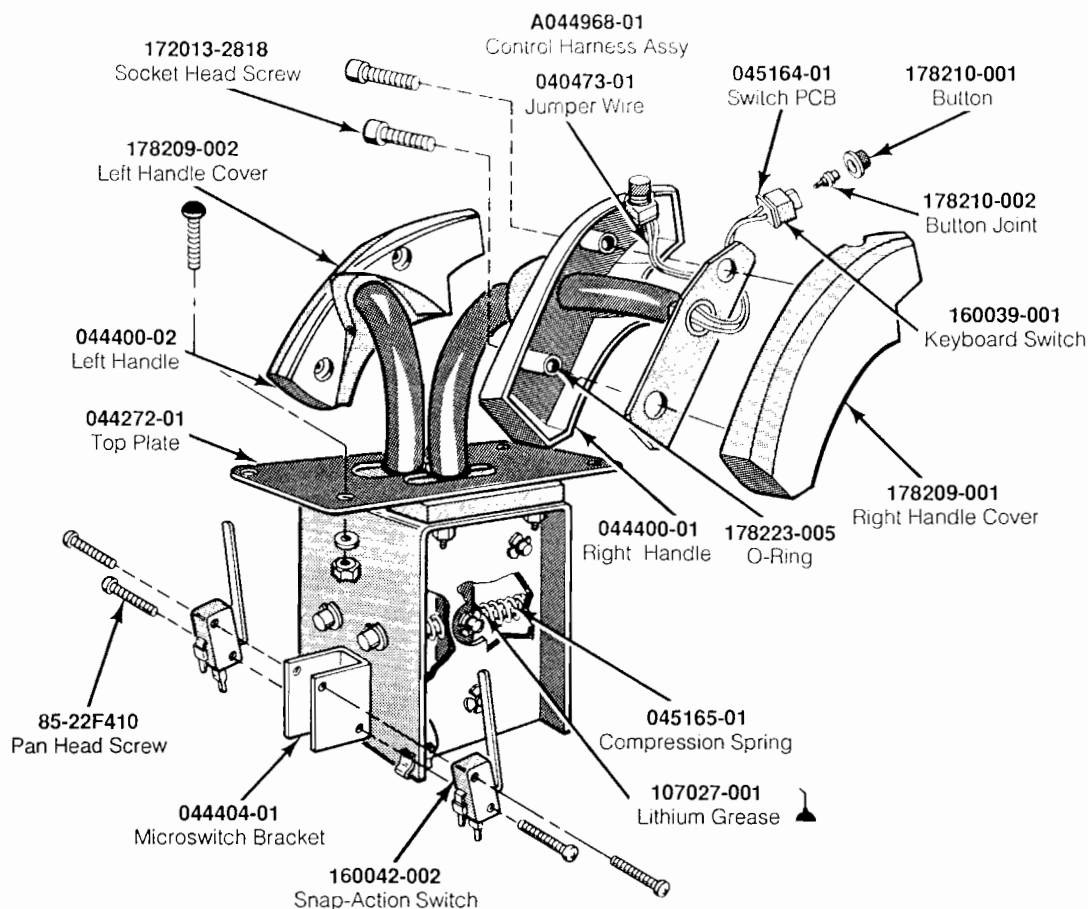
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**Figure 5-2 Control Panel Assembly  
A045099-01 A**

**Control Panel Assembly  
Parts List**

Part No.	Description
045098-01	Control Panel
045104-01	Control Panel Decal
160013-001	Leaf Switch with Embossed Button Holder
177010-240	Polymer #10-24 Hex Locknut
178030-003	Black Button Assembly
75-010S	#10 Flat Washer
75-5116B	#10-24 Black Carriage Bolt
75-9910N0	5/8"-11 Stamped Nut
78-6900402	1/4-Inch x 1/8-Inch Thick Foam Tape
A044248-01	Tank Controller Assembly
A045132-01	Control Panel Assembly Harness

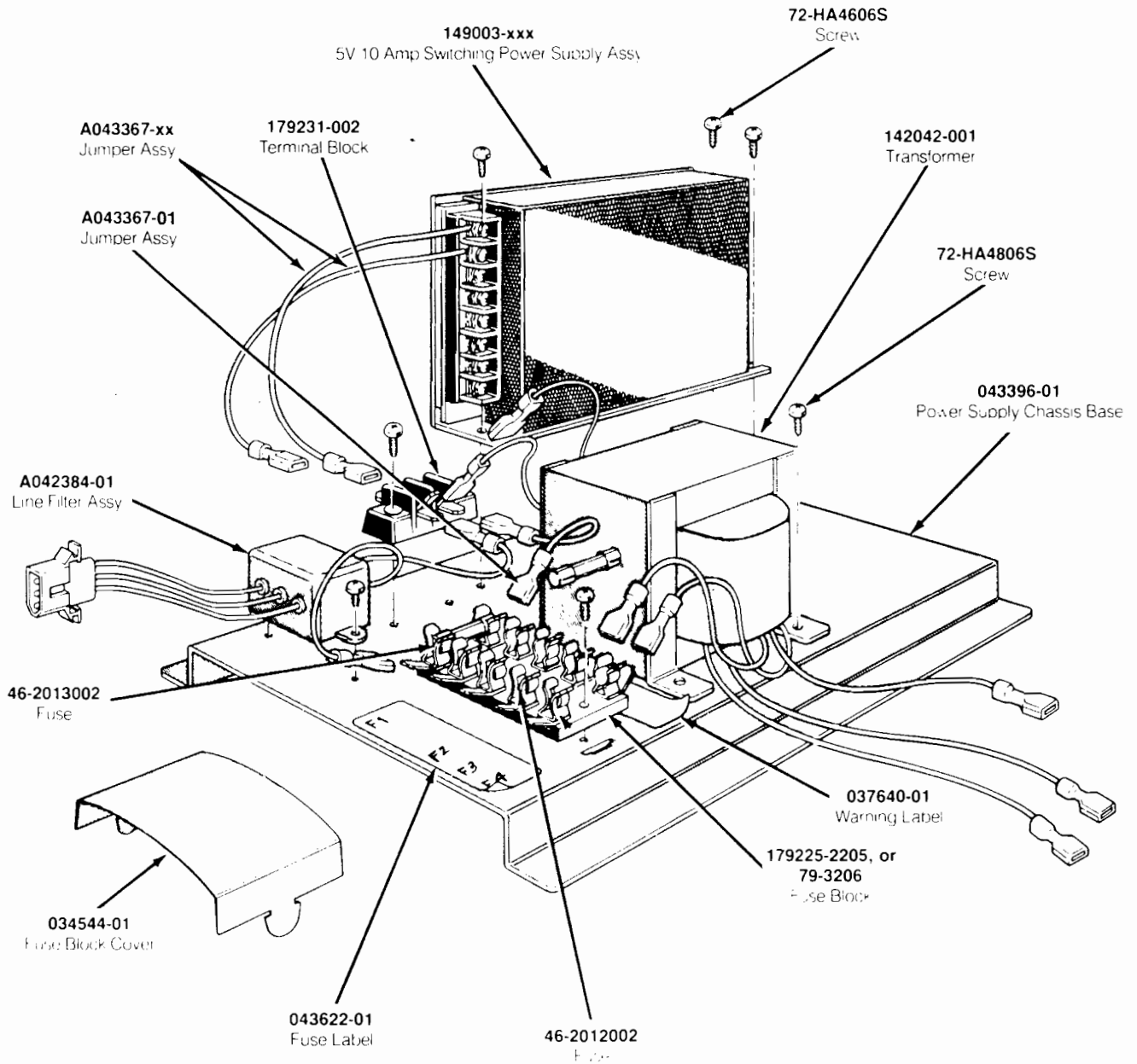


**Figure 5-3 Tank Controller Assembly  
A044248-01 C**

**Tank Controller Assembly  
Parts List**

Part No.	Description
A044968-01	Control Harness Assembly
040473-01	Jumper Wire
044272-01	Top Plate
044400-01	Right Handle
044400-02	Left Handle
044404-01	Microswitch Bracket
045164-01	Switch PCB
045165-01	Compression Spring
107027-001	Lithium Grease
160039-001	Keyboard Switch
160042-002	Snap-Action Switch
172013-2818	M4 Socket Cap Head Black Screw
178209-001	Right Handle Cover
178209-002	Left Handle Cover
178210-001	Button
178210-002	Button Joint
178223-005	.364 I.D. x .070" Wide O-Ring

**WARNING**  
The switching 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  
A045140-01 A**



**Switching/Linear 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
46-2012002	2 Amp 250 V Slow Blow Fuse
46-2013002	3 Amp 250 V Slow Blow Fuse
72-HA4606s	#6-32 Thread-Forming Screw
72-HA4806s	#8-32 Thread-Forming Screw
034544-01	Fuse Block Cover
037640-01	Power Supply Warning Label
043396-01	Power Supply Base Chassis
043622-01	Power Supply Fuse Label
142048-001	Transformer
149003-003	Hitron 5V 10A Switching Power Supply
179225-2205	5 Position Fuse Block (Acceptable substitute is part no. 79-3206)
179231-002	2 Position Terminal Block

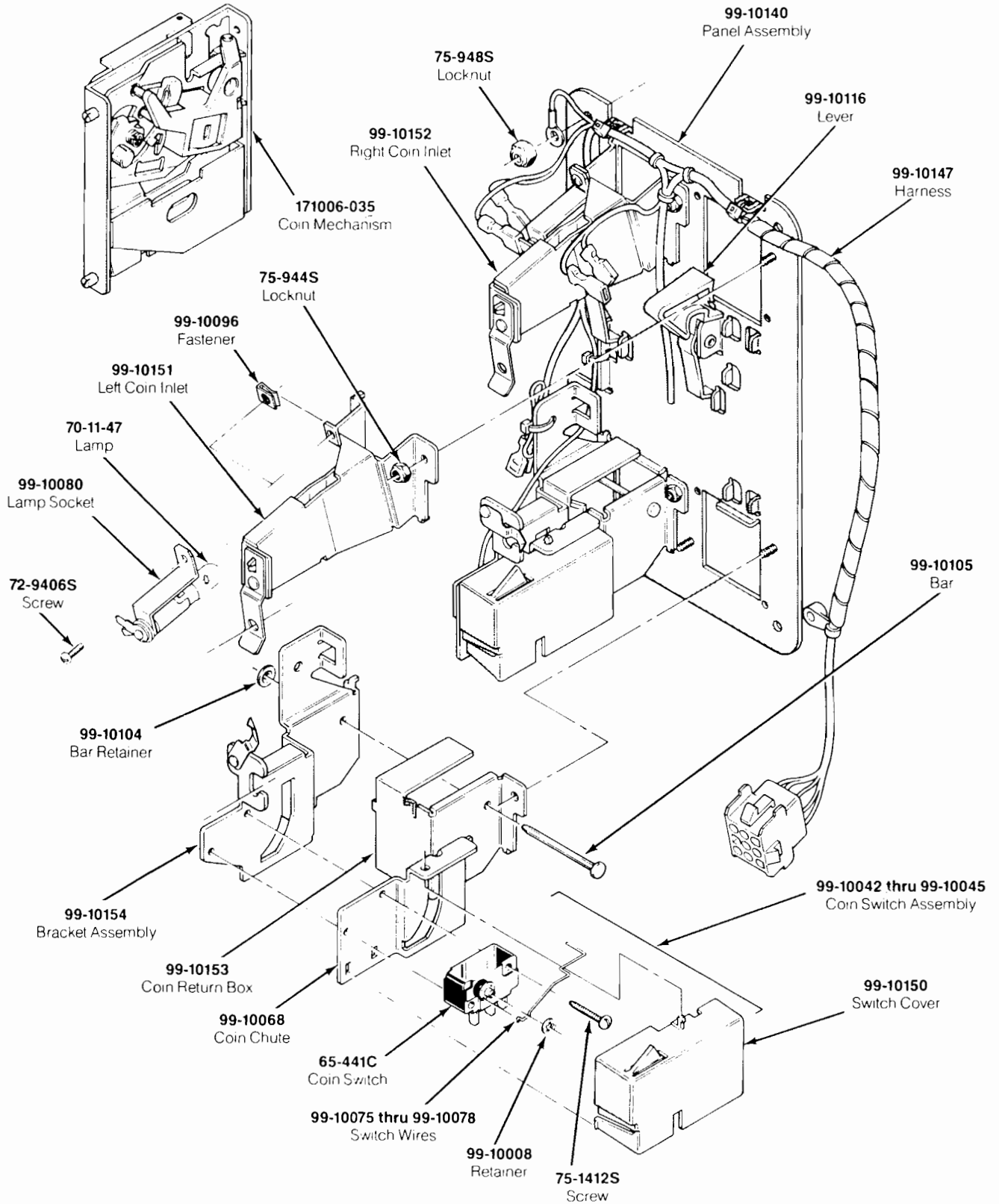
**Hitron 5-Volt Power Supply Sub-Assembly  
Model HSA-122B(S) Parts List**

Designator	Description	Part No.
<b>Capacitors</b>		
C1	Capacitor, Metal Film, 0.047 $\mu$ F, 250 V	99-211036
C2	Capacitor, Metal Film, 0.1 $\mu$ F, 400 V	99-211038
C3, C4	Capacitor, Ceramic, 4700 $\mu$ F, 400 V	99-211049
C5, C6	Capacitor, Electrolytic, 100 $\mu$ F, 200 V	99-211046
C7	Capacitor, Metal Film, 0.1 $\mu$ F, 400 V	99-211038
C8	Capacitor, Ceramic, 0.001 $\mu$ F, 2 kV	99-211042
C9	Capacitor, Ceramic, 0.01 $\mu$ F, 1 kV, Z5U	99-211041
C10	Capacitor, Electrolytic, 220 $\mu$ F, 25 V	99-211045
C11	Capacitor, Metal Film, 0.22 $\mu$ F, 100 V	99-211037
C12	Capacitor, Metal Film, 0.022 $\mu$ F, 100 V	99-211039
C13	Capacitor, Metal Film, 0.22 $\mu$ F, 100 V	99-211037
C14	Capacitor, Ceramic, 1800 PF, 2 kV, Z5 V	99-211040
C17	Capacitor, Electrolytic, 470 $\mu$ F, 25 V	99-211044
C19	Capacitor, Electrolytic, 2200 $\mu$ F, 16 V	99-211048
C20	Capacitor, Electrolytic, 1000 $\mu$ F, 25 V	99-211047
C21	Capacitor, Ceramic, 470 PF, 1 kV, Z5P	99-211043
C22	Capacitor, Electrolytic, 2200 $\mu$ F, 16 V	99-211048
C23	Capacitor, Electrolytic, 1000 $\mu$ F, 25 V	99-211047
C24	Capacitor, Electrolytic, 2200 $\mu$ F, 16 V	99-211048
<b>Diodes</b>		
D1, D2	Diode, Fast Recovery, RPG10K	99-211010
D3	Diode, Fast Recovery, RPG15B	99-211011
D4	Diode, Fast Recovery, RPG10B	99-211009
D5-D7	Diode, Switching, 1N4148	99-211012

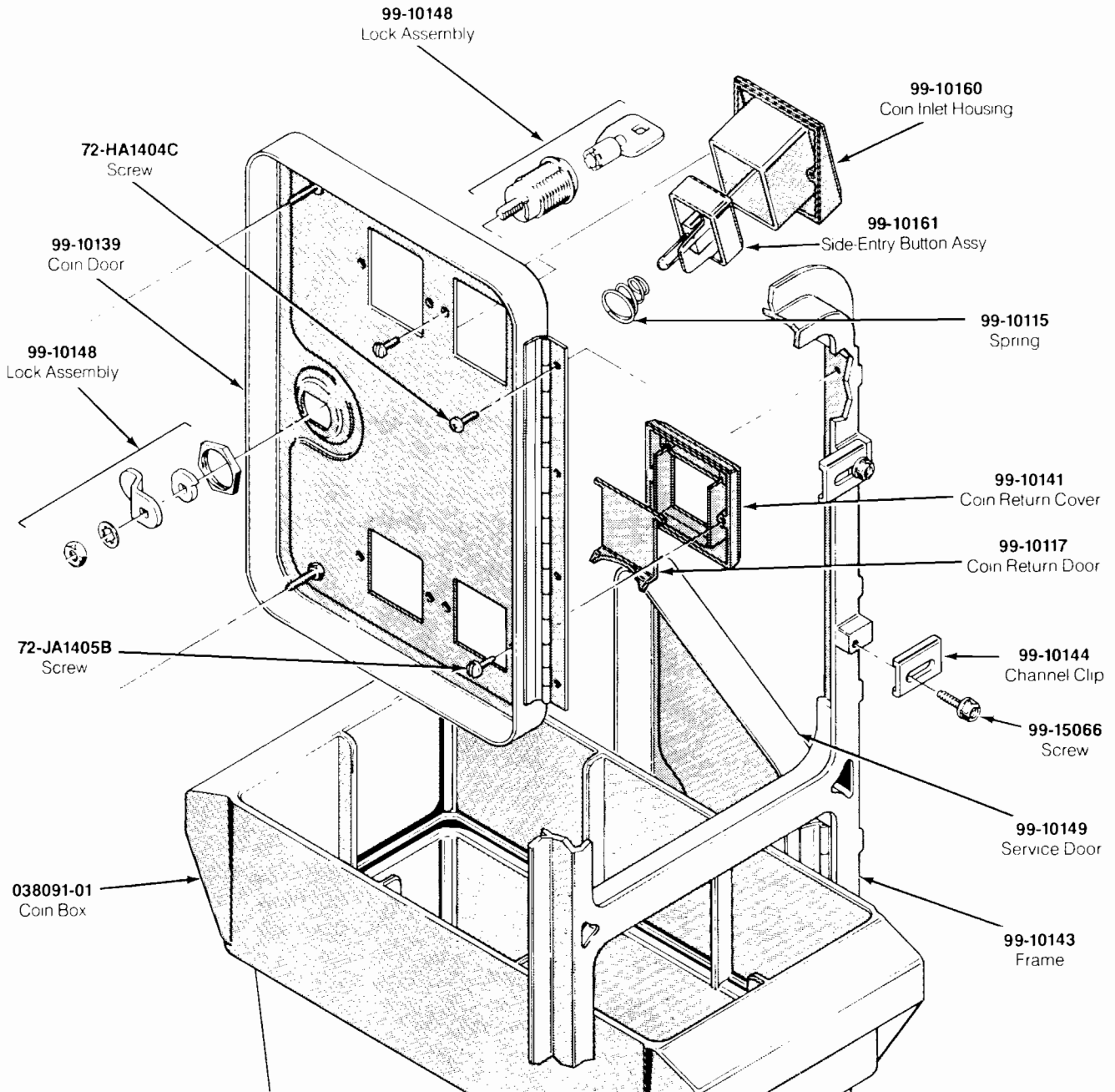
**Hitron 5-Volt Power Supply Sub-Assembly  
Model HSA-122B(S) Parts List, Continued**

<b>Designator</b>	<b>Description</b>	<b>Part No.</b>
D9	Diode, Fast Recovery, 30DF1	99-211006
D11, D12	Diode, Schottky, S10SC4M	99-211005
D13-D16	Diode, Rectifier, 1N4006	99-211008
<b>Inductors</b>		
L1	Inductor, 15 mH	99-211052
L3	Inductor, 7 $\mu$ H (Acceptable substitute is part no. 99-211051)	99-211050
L4	Inductor, 2.2 $\mu$ H	99-211054
L5	Inductor, 1.5 mH	99-211053
<b>Resistors</b>		
R1, R2	Resistor, Carbon Film, 180 k , $\pm 5\%$ , 1 W	99-211034
R3	Resistor, Wirewound, 120 , $\pm 5\%$ , 2 W	99-211019
R4	Resistor, Wirewound, 0.47 , $\pm 5\%$ , 2 W	99-211018
R5	Resistor, Wirewound, 33 , $\pm 5\%$ , 2 W	99-211017
R6, R7	Resistor, Carbon Film, 5.6 , $\pm 5\%$ , 1/4 W	99-211027
R8	Resistor, Wirewound, 0.47 , $\pm 5\%$ , 2 W	99-211018
R9	Resistor, Carbon Film, 10 , $\pm 5\%$ , 1/4 W	99-211029
R10	Resistor, Carbon Film, 1 k , $\pm 5\%$ , 1/4 W	99-211032
R11	Resistor, Carbon Film, 47 , $\pm 5\%$ , 1/4 W	99-211025
R12	Resistor, Carbon Film, 5.6 , $\pm 5\%$ , 1/4 W	99-211027
R13	Resistor, Carbon Film, 330 , $\pm 5\%$ , 1/4 W	99-211026
R14	Resistor, Carbon Film, 270 , $\pm 5\%$ , 1/2 W	99-211023
R15	Resistor, Carbon Film, 330 , $\pm 5\%$ , 1/2 W	99-211022
R16	Resistor, Carbon Film, 8.2 , $\pm 5\%$ , 1/4 W	99-211028
R17, R18	Resistor, Carbon Film, 56 , $\pm 5\%$ , 1/4 W	99-211031
R19	Resistor, Carbon Film, 39 , $\pm 5\%$ , 1/4 W	99-211030
R20	Resistor, Carbon Film, 2 k , $\pm 5\%$ , 1/4 W	99-211035
R21	Resistor, Carbon Film, 470 , $\pm 5\%$ , 1/4 W	99-211024
R22	Resistor, 2.2 k , $\pm 2\%$ , 1/4 W	99-211021
R23	Resistor, Metal Film, 2 k , $\pm 2\%$ , 1/4 W	99-211033
R25	Resistor, Carbon Film, 10 , $\pm 5\%$ , 1/4 W	99-211029
R26	Resistor, Wirewound, 50 , $\pm 5\%$ , 2 W	99-211015
R27	Resistor, Carbon Film, 47 , $\pm 5\%$ , 1/4 W	99-211025
R31	Resistor, Wirewound, 150 , $\pm 5\%$ , 2 W	99-211016
<b>Transistors</b>		
Q1	Transistor, NPN, 2SC1413A	99-211002
Q3	Transistor, NPN, PE8050B	99-211003
Q3	Transistor, PNP, PE8550B	99-211004
<b>Miscellaneous</b>		
F1	Fuse, 2 A, 250 V, SEMKO	99-211058
IC1	Regulator, UA431AWC	99-211001
SCR1	Thyristor, SCR	99-211013
T1	Transformer	99-211055
TR1	Thermistor, 0.5 Ohm, $\pm 5\%$ , 5 W	99-211020
VR1	Potentiometer, Trimming, 3 kOhm	99-211014
ZD1	Diode, Zener, 1N752A	99-211007
	Fuse, 2 A, 250 V	99-211056
	Fuse Holder, 6.35 mm	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 Coin Acceptors, Inc. Coin Door Assembly  
171027-001 A**



**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) that has illustrations and a parts list. Write to Atari Games Ireland Limited, Tipperary Town, Ireland. Telephone 062-52155.

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

## Coin Acceptors, Inc. Coin Door Assembly Parts List

Part No.	Description
65-411C	Coin Switch
70-11-47	Miniature Bayonet Lamp
72-9406S	=4-40 x 3/8-Inch Truss-Head Screw
72-HA1404C	=4-40 x 1/4-Inch Pan-Head Screw
72-JA1405B	=4-40 x .31-Inch Pan-Head Screw
75-1412S	=4-40 x 3/4-Inch Pan-Head Screw
75-994S	=4-40 Locknut
99-10008	Retainer
99-10042	Coin Switch Assembly for Belgian 5 Fr and U.S. 25¢
99-10043	Coin Switch Assembly for German 1 DM, Japanese 100 Yen, Swiss 1 Fr
99-10044	Coin Switch Assembly for German 2 DM, Italian 100 L, U.S. \$1.00
99-10045	Coin Switch Assembly for Australian \$.20, German 5 DM, British 10 P
99-10068	Coin Return Chute
99-10075	Switch Wire (included in coin switch assembly 99-10043)
99-10076	Switch Wire (included in coin switch assembly 99-10042)
99-10077	Switch Wire (included in coin switch assembly 99-10044)
99-10078	Switch Wire (included in coin switch assembly 99-10045)
99-10080	Lamp Socket
99-10081	Key Holder
99-10096	Fastener
99-10104	Bar Retainer
99-10105	Bar
99-10115	Spring
99-10116	Plastic Coin Return Lever
99-10117	Steel Coin Return Door
99-10139	Coin Door
99-10140	Coin Door Inner-Panel Assembly
99-10141	Die-Cast Coin Return Cover
99-10143	Coin Door Frame
99-10144	Channel Clip
99-10147	Harness
99-10148	Lock Assembly
99-10149	Service Door
99-10150	Switch Cover
99-10151	Left Coin Inlet
99-10152	Right Coin Inlet
99-10153	Coin Return Box
99-10154	Bracket Assembly
99-10160	1-Inch Wide Die-Cast Coin Inlet Housing
99-10161	25¢ Amber Side-Entry Coin Button Assembly
99-15066	Screw for Clamp
171006-035	Metal Coin Mechanism for U.S. 25¢

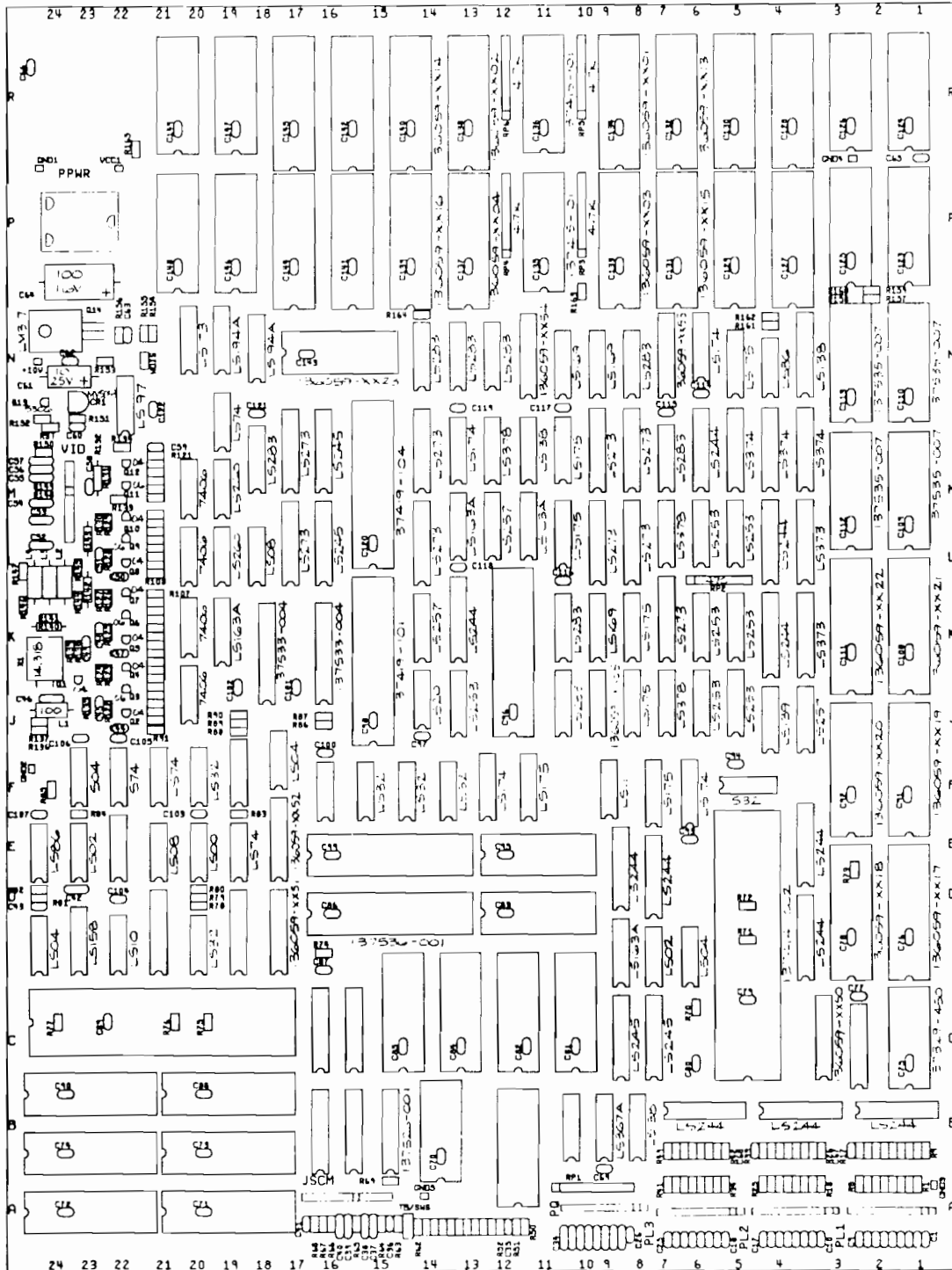


Figure 5-6 Vindicators Game PCB Assembly  
A044402-21 A

## Vindicators Game PCB Assembly Parts List

Designator	Description	Part No.
<b>Integrated Circuits</b>		
1/2B	Integrated Circuit, 74LS244	37-74LS244
1C	Integrated Circuit, 2804 A-45, 450 nsec	137329-450
1D	Integrated Circuit, EPROM, 27512-3, PRG 0-H	136059-1117
1F	Integrated Circuit, EPROM, 27512-3, PRG 1-H	136059-1119
1K	Integrated Circuit, EPROM, 27512-3, PRG 2-H	136059-1121
1M, 1N	Integrated Circuit, RAM, 8Kx8, 80 nsec (Acceptable substitutes are part nos. 137535-xxx of equal or faster speed.)	137535-007
2D	Integrated Circuit, EPROM, 27512-3, PRG 0-L	136059-1118
2F	Integrated Circuit, EPROM, 27512-3, PRG 1-L	136059-1120
2K	Integrated Circuit, EPROM, 27512-3, PRG 2-L	136059-1122
2M, 2N	Integrated Circuit, RAM, 8Kx8, 80 nsec (Acceptable substitutes are part nos. 137535-xxx of equal or faster speed.)	137535-007
3B	Integrated Circuit, 74LS244	37-74LS244
3C	Integrated Circuit, PAL, 16L8 A, Main Aclr	136059-1150
3D, 3E	Integrated Circuit, 74LS244	37-74LS244
3J	Integrated Circuit, 74LS257	37-74LS257
3K, 3L	Integrated Circuit, 74LS373	37-74LS373
3M	Integrated Circuit, 74LS374	37-74LS374
3N	Integrated Circuit, 74LS138	137177-001
4J	Integrated Circuit, 74LS139	37-74LS139
4K, 4L	Integrated Circuit, 74LS244	37-74LS244
4M	Integrated Circuit, 74LS374	37-74LS374
4N	Integrated Circuit, 74LS86	37-74LS86
5D	Integrated Circuit, 68010	137414-002
5F	Integrated Circuit, 74S32	37-74S32
5J, 5K, 5L	Integrated Circuit, 74LS253	37-74LS253
5M	Integrated Circuit, 74LS374	37-74LS374
5N	Integrated Circuit, 74LS175	37-74LS175
6B	Integrated Circuit, 74LS244	37-74LS244
6D	Integrated Circuit, 74LS04	37-74LS04
6F	Integrated Circuit, 74LS174	37-74LS174
6J, 6K, 6L	Integrated Circuit, 74LS253	37-74LS253
6M	Integrated Circuit, 74LS244	37-74LS244
6N	Integrated Circuit, 74LS174	37-74LS174
7/8B	Integrated Circuit, 74LS138	137177-001
7C	Integrated Circuit, 74LS245	37-74LS245
7D	Integrated Circuit, 74LS02	37-74LS02
7E	Integrated Circuit, 74LS244	37-74LS244
7F	Integrated Circuit, 74LS175	37-74LS175
7J	Integrated Circuit, 74LS378	137305-001
7K	Integrated Circuit, 74LS273	37-74LS273
7L	Integrated Circuit, 74LS378	137305-001
7M	Integrated Circuit, 74LS283	137204-001
7N	Integrated Circuit, PAL, 16R6 A, M.O-Control	136059-1153



### Vindicators Game PCB Assembly Parts List, Continued

Designator	Description	Part No.
7P	Integrated Circuit, EPROM, 27512-3, GRAF 1-2	136059-1115
7R	Integrated Circuit, EPROM, 27512-3, GRAF 1-0	136059-1113
8C	Integrated Circuit, 74LS245	37-74LS245
8D	Integrated Circuit, 74LS163 A	37-74LS163A
8E	Integrated Circuit, 74LS244	37-74LS244
8J, 8K	Integrated Circuit, 74LS175	37-74LS175
8L, 8M	Integrated Circuit, 74LS273	37-74LS273
8N	Integrated Circuit, 74LS283	137204-001
8P	Integrated Circuit, ROM, GRAF 0-2	136059-1103
8R	Integrated Circuit, ROM, GRAF 0-0	136059-1101
9B	Integrated Circuit, 74LS367 A	37-74LS367
9F	Integrated Circuit, 74LS11	137149-001
9J	Integrated Circuit, 82S129, Programmed	136059-1155
9K	Integrated Circuit, 74LS169	137109-001
9L, 9M	Integrated Circuit, 74LS273	37-74LS273
9N	Integrated Circuit, 74LS169	137109-001
10/11P, 10/11R	Integrated Circuit, Slags	137415-101
10J, 10K	Integrated Circuit, 74LS283	137204-001
10L, 10M	Integrated Circuit, 74LS175	37-74LS175
10N	Integrated Circuit, 74LS169	137109-001
11F	Integrated Circuit, 74LS175	37-74LS175
11L	Integrated Circuit, 74LS163 A	37-74LS163A
11M	Integrated Circuit, 74LS138	137177-001
11N	Integrated Circuit, 82S147, Programmed	136059-1154
12F	Integrated Circuit, 74LS174	37-74LS174
12L	Integrated Circuit, 74LS257	37-74LS257
12M	Integrated Circuit, 74LS378	137305-001
12N	Integrated Circuit, 74LS283	137204-001
13F	Integrated Circuit, 74LS32	37-74LS32
13J	Integrated Circuit, 74LS253	37-74LS253
13K	Integrated Circuit, 74LS244	37-74LS244
13L	Integrated Circuit, 74LS163 A	37-74LS163A
13M	Integrated Circuit, 74LS174	37-74LS174
13N	Integrated Circuit, 74LS283	137204-001
13P	Integrated Circuit, ROM, GRAF 0-3	136059-1104
13R	Integrated Circuit, ROM, GRAF 0-1	136059-1102
14/15B	Integrated Circuit, SCOM	137526-001
14D	Integrated Circuit, LB	137536-001
14F	Integrated Circuit, 74LS32	37-74LS32
14J	Integrated Circuit, 74LS20	37-74LS20
14K	Integrated Circuit, 74LS257	37-74LS257
14L, 14M	Integrated Circuit, 74LS273	37-74LS273
14N	Integrated Circuit, 74LS283	137204-001
14P	Integrated Circuit, EPROM, 27512-3, GRAF 1-3	136059-1116
14R	Integrated Circuit, EPROM, 27512-3, GRAF 1-1	136059-1114
15/16N	Integrated Circuit, EPROM, 27128-3, Alpha	136059-1123

### Vindicators Game PCB Assembly Parts List, Continued

Designator	Description	Part No.
15F	Integrated Circuit, 74LS32	37-74LS32
15J/K	Integrated Circuit, GPC	137419-101
15L/M	Integrated Circuit, PFHS	137419-104
16K	Integrated Circuit, RAM, 2Kx8, 70 nsec (Acceptable substitutes are part no. 137533-xxx or 137534-xxx of equal or faster speed.)	137533-004
16L, 16M	Integrated Circuit, 74LS245	37-74LS245
17D	Integrated Circuit, PAL, 16L8 A, Priority	136059-1151
17E	Integrated Circuit, PAL, 16L8 A, LB-Control	136059-1152
17F	Integrated Circuit, 74LS04	37-74LS04
17L, 17M	Integrated Circuit, 74LS273	37-74LS273
18E	Integrated Circuit, 74LS74	37-74LS74
18K	Integrated Circuit, RAM, 2Kx8, 70 nsec (Acceptable substitutes are part nos. 137533-xxx or 137534-xxx of equal or faster speed.)	137533-004
18L	Integrated Circuit, 74LS08	37-74LS08
18M	Integrated Circuit, 74LS283	137204-001
18N	Integrated Circuit, 74LS194 A	37-74LS194
19K	Integrated Circuit, 74LS163 A	37-74LS163A
19L, 19M	Integrated Circuit, 74LS260	137332-001
19M/N	Integrated Circuit, 74LS74	37-74LS74
19N	Integrated Circuit, 74LS194 A	37-74LS194
20D	Integrated Circuit, 74LS32	37-74LS32
20E	Integrated Circuit, 74LS00	37-74LS00
20F	Integrated Circuit, 74LS32	37-74LS32
20J, 20K, 20L, 20M	Integrated Circuit, 7406	37-7406
20N	Integrated Circuit, 74LS173	137529-001
21E	Integrated Circuit, 74LS08	37-74LS08
21F	Integrated Circuit, 74LS74	37-74LS74
22D	Integrated Circuit, 74LS10	37-74LS10
22F	Integrated Circuit, 74S74	37-74S74
22M/N	Integrated Circuit, 74LS197	137240-001
23D	Integrated Circuit, 74LS158	137203-001
23E	Integrated Circuit, 74LS02	37-74LS02
23F	Integrated Circuit, 74S04	37-74S04
24D	Integrated Circuit, 74LS04	37-74LS04
24E	Integrated Circuit, 74LS86	37-74LS86
<b>Capacitors</b>		
C1-C26, C36	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C37-C40	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C41, C43, C44	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C45	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C46	Capacitor, 39 pF, 100 V, Ceramic	122016-390
C47	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C48, C49	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C50	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C51	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C52-C54	Capacitor, 470 pF, 50 V, Ceramic	122013-471
C55-C57	Capacitor, .001 $\mu$ F, 50 V, Ceramic	122002-102
C58-C60	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104

## Vindicators Game PCB Assembly Parts List, Continued

Designator	Description	Part No.
C61	Capacitor, 10 $\mu$ F, 25 V, Electrolytic	24-250106
C62, C63	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C64	Capacitor, 100 $\mu$ F, 16 V, Electrolytic	24-160107
C65-C149	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
<b>Diodes</b>		
CR1	Diode, MV5053, Light Emitting	38-MV5053
<b>Inductors</b>		
L1	Inductor, 100 $\mu$ H	41-3003
L2-L4	Inductor, Ferrite Bead, N12N	141003-005
<b>Transistors</b>		
Q1, Q2	Transistor, 2N3904	34-2N3904
Q3	Transistor, 2N3906	33-2N3906
Q4, Q5	Transistor, 2N3904	34-2N3904
Q6	Transistor, 2N3906	33-2N3906
Q7, Q8	Transistor, 2N3904	34-2N3904
Q9	Transistor, 2N3906	33-2N3906
Q10	Transistor, 2N3904	34-2N3904
Q11	Transistor, 2N3906	33-2N3906
Q12	Transistor, 2N3904	34-2N3904
Q13	Transistor, 2N5306	133033-001
Q14	Integrated Circuit, LM317	137233-001
<b>Resistors</b>		
R1-R8	Resistor, 470 Ohm, $\pm$ 5%, 1/8 W	110027-471
R9-R15	Resistor, 1 K Ohm, $\pm$ 5%, 1/8 W	110027-102
R16	Resistor, 470 $\Omega$ , $\pm$ 5%, 1/8 W	110027-471
R17	Resistor, 1 K Ohm, $\pm$ 5%, 1/8 W	110027-102
R18-R25	Resistor, 470 Ohm, $\pm$ 5%, 1/8 W	110027-471
R26-R33	Resistor, 1 K Ohm, $\pm$ 5%, 1/8 W	110027-102
R34-R41	Resistor, 470 Ohm, $\pm$ 5%, 1/8 W	110027-471
R42-R49, R63	Resistor, 1 K Ohm, $\pm$ 5%, 1/8 W	110027-102
R64-R67	Resistor, 470 Ohm, $\pm$ 5%, 1/8 W	110027-471
R68, R70-R74	Resistor, 1 K Ohm, $\pm$ 5%, 1/8 W	110027-102
R78	Resistor, 470 Ohm, $\pm$ 5%, 1/8 W	110027-471
R80, R83-R85	Resistor, 1 K Ohm, $\pm$ 5%, 1/8 W	110027-102
R86	Resistor, 10 Ohm, $\pm$ 5%, 1/8 W	110027-100
R87-R90	Resistor, 1 K Ohm, $\pm$ 5%, 1/8 W	110027-102
R91	Resistor, 2.2 K Ohm, $\pm$ 5%, 1/8 W	110027-222
R92	Resistor, 4.7 K Ohm, $\pm$ 5%, 1/8 W	110027-472
R93	Resistor, 2.4 K Ohm, $\pm$ 5%, 1/8 W	110027-242
R94	Resistor, 120 Ohm, $\pm$ 5%, 1/8 W	110027-121
R95	Resistor, 620 Ohm, $\pm$ 5%, 1/8 W	110027-621
R96	Resistor, 470 Ohm, $\pm$ 5%, 1/8 W	110027-471
R97	Resistor, 3 K Ohm, $\pm$ 5%, 1/8 W	110027-302
R98	Resistor, 10 K Ohm, $\pm$ 5%, 1/8 W	110027-103
R99	Resistor, 470 Ohm, $\pm$ 5%, 1/8 W	110027-471
R100	Resistor, 4.7 K Ohm, $\pm$ 5%, 1/8 W	110027-472

### Vindicators Game PCB Assembly Parts List, Continued

Designator	Description	Part No.
R101	Resistor, 2.4 K Ohm, ±5%, 1/8 W	110027-242
R102	Resistor, 120 Ohm, ±5%, 1/8 W	110027-121
R103	Resistor, 620 Ohm, ±5%, 1/8 W	110027-621
R104	Resistor, 470 Ohm, ±5%, 1/8 W	110027-471
R105	Resistor, 3 K Ohm, ±5%, 1/8 W	110027-302
R106	Resistor, 10 K Ohm, ±5%, 1/8 W	110027-103
R107	Resistor, 470 Ohm, ±5%, 1/8 W	110027-471
R108	Resistor, 4.7 K Ohm, ±5%, 1/8 W	110027-472
R109	Resistor, 2.4 K Ohm, ±5%, 1/8 W	110027-242
R110	Resistor, 120 Ohm, ±5%, 1/8 W	110027-121
R111	Resistor, 620 Ohm, ±5%, 1/8 W	110027-621
R112	Resistor, 470 Ohm, ±5%, 1/8 W	110027-471
R113	Resistor, 3 K Ohm, ±5%, 1/8 W	110027-302
R114	Resistor, 10 K Ohm, ±5%, 1/8 W	110027-103
R115	Resistor, 470 Ohm, ±5%, 1/8 W	110027-471
R116	Resistor, 1 K Ohm, ±5%, 1/8 W	110027-102
R117	Resistor, 470 Ohm, ±5%, 1/8 W	110027-471
R118	Resistor, 240 Ohm, ±5%, 1/8 W	110027-241
R119	Resistor, 120 Ohm, ±5%, 1/8 W	110027-121
R120	Resistor, 1 K Ohm, ±5%, 1/8 W	110027-102
R121	Resistor, 240 Ohm, ±5%, 1/8 W	110027-241
R122	Resistor, 330 Ohm, ±5%, 1/8 W	110027-331
R123	Resistor, 390 Ohm, ±5%, 1/8 W	110027-391
R124	Resistor, 470 Ohm, ±5%, 1/8 W	110027-471
R125	Resistor, 330 Ohm, ±5%, 1/8 W	110027-331
R126	Resistor, 390 Ohm, ±5%, 1/8 W	110027-391
R127	Resistor, 470 Ohm, ±5%, 1/8 W	110027-471
R128	Resistor, 330 Ohm, ±5%, 1/8 W	110027-331
R129	Resistor, 390 Ohm, ±5%, 1/8 W	110027-391
R130, R131	Resistor, 470 Ohm, ±5%, 1/8 W	110027-471
R132	Resistor, 68 Ohm, ±5%, 1/4 W	110000-680
R133	Resistor, 470 Ohm, ±5%, 1/8 W	110027-471
R134	Resistor, 1 K Ohm, ±5%, 1/8 W	110027-102
R135	Resistor, 68 Ohm, ±5%, 1/8 W	110027-680
R136	Resistor, 2.2 K Ohm, ±5%, 1/8 W	110027-222
R137	Resistor, 240 Ohm, ±5%, 1/8 W	110027-241
R138, R139	Resistor, 10 K Ohm, ±5%, 1/8 W	110027-103
R140	Resistor, 68 Ohm, ±5%, 1/4 W	110000-680
R141	Resistor, 10 Ohm, ±5%, 1/8 W	110027-100
R142, R143	Resistor, 68 Ohm, ±5%, 1/4 W	110000-680
R144, R145	Resistor, 10 Ohm, ±5%, 1/8 W	110027-100
R147	Resistor, 2.2 K Ohm, ±5%, 1/8 W	110027-222
R148-R150	Resistor, 470 Ohm, ±5%, 1/8 W	110027-471
R151	Resistor, 240 Ohm, ±5%, 1/8 W	110027-241
R152	Resistor, 100 K Ohm, ±5%, 1/8 W	110027-104
R153	Resistor, 240 Ohm, ±5%, 1/8 W	110027-241
R154, R155	Resistor, 1 K Ohm, ±5%, 1/8 W	110027-102
R156	Resistor, 1.8 K Ohm, ±5%, 1/8 W	110027-182

### Vindicators Game PCB Assembly Parts List, Continued

Designator	Description	Part No.
R158	Resistor, 1 K Ohm, $\pm 5\%$ , 1/8 W	110027-102
R160	Resistor, 10 Ohm, $\pm 5\%$ , 1/8 W	110027-100
R161	Resistor, 1 K Ohm, $\pm 5\%$ , 1/8 W	110027-102
R162	Resistor, 10 Ohm, $\pm 5\%$ , 1/8 W	110027-100
R163-R165	Resistor, 1 K Ohm, $\pm 5\%$ , 1/8 W	110027-102
RP2	Resistor, 470x7, $\pm 5\%$ , 1/8 W, SIP (8-Pin)	118007-471
RP3-RP6	Resistor, 4.7Kx9, $\pm 5\%$ , 1/8 W, SIP (10-Pin)	118010-472
<b>Connectors</b>		
JSCM	Connector, 11-Circuit, Header, .100" Ctr	179118-011
RST, WDIS	Connector, 2-Circuit, Header, .100" Ctr	179048-002
VID	Connector, 11-Circuit, Header, .100" Ctr	179118-011
PL1-PL3	Connector, 11-Circuit, Header, .100" Ctr	179118-011
PPWR	Connector, 12-Circuit, Hdr. .250" Ctr	179069-012
<b>Miscellaneous</b>		
X1	Crystal, 14.318 MHz	144000-004
	Socket, 20-Pin	179259-020
	Socket, 24-Pin	179257-024
	Socket, 28-Pin	179257-028
	Socket, 40-Pin	179257-040
	Socket, 64-Pin	179256-064
	Test Point	179051-001

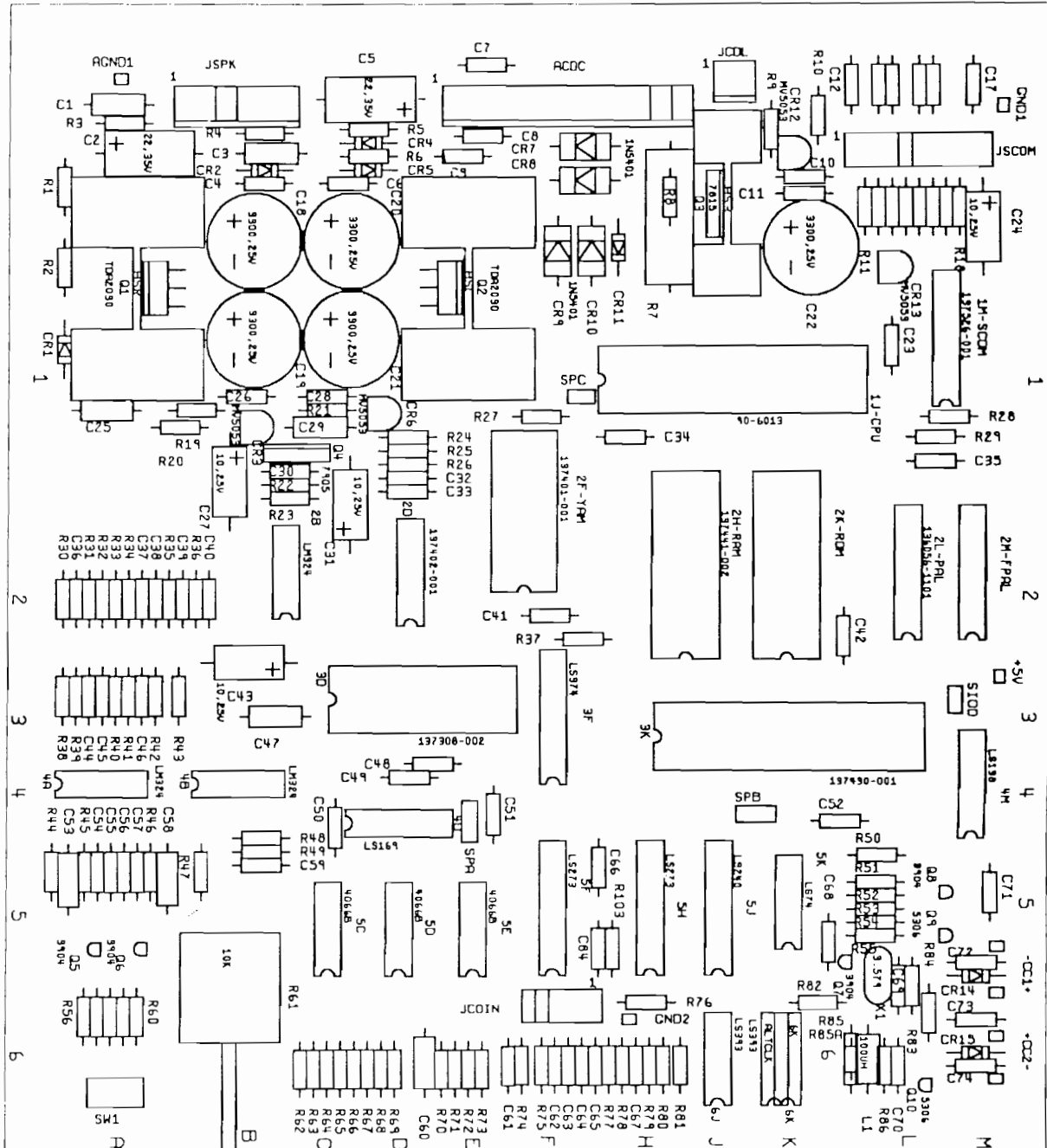


Figure 5-7 Stand-Alone Audio PCB Assembly  
A043713-23 A

## Stand-Alone Audio PCB Assembly Parts List

Location	Description	Part No.
<b>Integrated Circuits</b>		
1J-CPU	Integrated Circuit, 6502 A	90-6013
1M-SCOM	Integrated Circuit, SCOM	137526-001
2B	Integrated Circuit, LM324	37-LM324
2D	Integrated Circuit, YM3012	137402-001
2F-YAM	Integrated Circuit, YM2151	137401-001
2H-RAM	Integrated Circuit, 6264-15, 150 nsec	137441-002
2K-ROM	Integrated Circuit, 27512, 300 nsec	136059-1124
2L-PAL	Integrated Circuit, Programmed PAL16L8 A, 25 ns	136056-2101
3F	Integrated Circuit, 74LS374	37-74LS374
3K	Integrated Circuit, Pokey	137430-001
4A, 4B	Integrated Circuit, LM324	37-LM324
4M	Integrated Circuit, 74LS138	137177-001
5C, 5D, 5E	Integrated Circuit, 4066B	37-4066
5F, 5H	Integrated Circuit, 74LS273	37-74LS273
5J	Integrated Circuit, 74LS240	137251-001
5K	Integrated Circuit, 74LS74	37-74LS74
6J	Integrated Circuit, 74LS393	37-74LS393
ALTCLK	Integrated Circuit, 74LS393	37-74LS393
<b>Capacitors</b>		
C1	Capacitor, .22 $\mu$ F, 50 V, Ceramic	122015-224
C2	Capacitor, 22 $\mu$ F, 35 V, Electrolytic	24-350226
C3	Capacitor, .22 $\mu$ F, 50 V, Ceramic	122015-224
C4	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C5	Capacitor, 22 $\mu$ F, 35 V, Electrolytic	24-350226
C6-C9, C12	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C13-C16	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C17	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C18-C21	Capacitor, 3300 $\mu$ F, 25 V, Electrolytic, Radial	123003-338
C23	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C24	Capacitor, 10 $\mu$ F, 25 V, Electrolytic	24-250106
C25	Capacitor, .22 $\mu$ F, 50 V, Ceramic	122015-224
C26	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C27	Capacitor, 10 $\mu$ F, 25 V, Electrolytic	24-250106
C28	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C29	Capacitor, .22 $\mu$ F, 50 V, Ceramic	122015-224
C30	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C31	Capacitor, 10 $\mu$ F, 25 V, Electrolytic	24-250106
C32, C33	Capacitor, .001 $\mu$ F, 50 V, Ceramic	122002-102
C34, C35	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C37	Capacitor, .047 $\mu$ F, 100 V, Ceramic	122015-173
C38, C39	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C40	Capacitor, .001 $\mu$ F, 50 V, Ceramic	122002-102
C41, C42	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C43	Capacitor, 10 $\mu$ F, 25 V, Electrolytic	24-250106
C47	Capacitor, .22 $\mu$ F, 50 V, Ceramic	122015-224

## Stand-Alone Audio PCB Assembly Parts List, Continued

Location	Description	Part No.
C48-C52	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C53	Capacitor, .0022 $\mu$ F, 50 V, Axial Ceramic	122015-222
C54	Capacitor, .0027 $\mu$ F, 50 V, Ceramic	122015-272
C55	Capacitor, .001 $\mu$ F, 50 V, Ceramic	122002-102
C56	Capacitor, .0027 $\mu$ F, 50 V, Ceramic	122015-272
C57	Capacitor, .001 $\mu$ F, 50 V, Ceramic	122002-102
C58	Capacitor, .0022 $\mu$ F, 50 V, Axial Ceramic	122015-222
C61-C68	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
C69	Capacitor, 39 pF, 100 V, Ceramic	122016-390
C70	Capacitor, 100 pF, 100 V, Ceramic	122016-101
C71-C74, C84	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
<b>Diodes</b>		
CR1, CR2	Diode, 1N4001	31-1N4001
CR3	Diode, MV5053, Light-Emitting	38-MV5053
CR4, CR5	Diode, 1N4001	31-1N4001
CR6	Diode, MV5053, Light-Emitting	38-MV5053
CR7-CR10	Diode, 1N5401	31-1N5401
CR13	Diode, MV5053, Light-Emitting	38-MV5053
CR14, CR15	Diode, 1N4001	31-1N4001
<b>Inductor</b>		
L1	Inductor, 100 $\mu$ H	41-3003
<b>Transistors</b>		
Q1, Q2	Integrated Circuit, TDA2030	137301-001
Q4	Integrated Circuit, 7905, Standup	37-7905
Q5-Q8	Transistor, 2N3904	34-2N3904
Q9, Q10	Transistor, 2N5306	133033-001
<b>Resistors</b>		
R1	Resistor, 1 K Ohm, $\pm$ 5%, 1/4 W	110000-102
R2	Resistor, 10 K Ohm, $\pm$ 5%, 1/4 W	110000-103
R3, R4	Resistor, 1 Ohm, $\pm$ 5%, 1/4 W	110000-010
R5	Resistor, 1 K Ohm, $\pm$ 5%, 1/4 W	110000-102
R6	Resistor, 10 K Ohm, $\pm$ 5%, 1/4 W	110000-103
R10	Resistor, 0 Ohm, 1/4 W	110005-001
R11	Resistor, 1 K Ohm, $\pm$ 5%, 1/4 W	110000-102
R12	Resistor, 470 Ohm, $\pm$ 5%, 1/4 W	110000-471
R13	Resistor, 1 K Ohm, $\pm$ 5%, 1/4 W	110000-102
R14	Resistor, 470 Ohm, $\pm$ 5%, 1/4 W	110000-471
R15	Resistor, 1 K Ohm, $\pm$ 5%, 1/4 W	110000-102
R16	Resistor, 470 Ohm, $\pm$ 5%, 1/4 W	110000-471
R17, R18	Resistor, 10 K Ohm, $\pm$ 5%, 1/4 W	110000-103
R19	Resistor, 22 K Ohm, $\pm$ 5%, 1/4 W	110000-223
R20	Resistor, 1 K Ohm, $\pm$ 5%, 1/4 W	110000-102
R21	Resistor, 22 K Ohm, $\pm$ 5%, 1/4 W	110000-223
R22	Resistor, 10 Ohm, $\pm$ 5%, 1/4 W	110000-100
R23	Resistor, 560 Ohm, $\pm$ 5%, 1/4 W	110000-561
R24	Resistor, 1 K Ohm, $\pm$ 5%, 1/4 W	110000-102
R26, R27	Resistor, 10 Ohm, $\pm$ 5%, 1/4 W	110000-100



### Stand-Alone Audio PCB Assembly Parts List, Continued

Location	Description	Part No.
R28	Resistor, 10 K Ohm, $\pm 5\%$ , 1/4 W	110000-103
R29	Resistor, 1 K Ohm, $\pm 5\%$ , 1/4 W	110000-102
R33, R34	Resistor, 470 Ohm, $\pm 5\%$ , 1/4 W	110000-471
R35	Resistor, 75 K Ohm, $\pm 5\%$ , 1/4 W	110000-753
R36, R37	Resistor, 10 K Ohm, $\pm 5\%$ , 1/4 W	110000-103
R38	Resistor, 47 K Ohm, $\pm 5\%$ , 1/4 W	110000-473
R43-R48	Resistor, 12 K Ohm, $\pm 5\%$ , 1/4 W	110000-123
R49	Resistor, 10 K Ohm, $\pm 5\%$ , 1/4 W	110000-103
R50	Resistor, 1 K Ohm, $\pm 5\%$ , 1/4 W	110000-102
R51, R52	Resistor, 10 K Ohm, $\pm 5\%$ , 1/4 W	110000-103
R53, R54	Resistor, 1 K Ohm, $\pm 5\%$ , 1/4 W	110000-102
R55, R56	Resistor, 150 K Ohm, $\pm 5\%$ , 1/4 W	110000-154
R58	Resistor, 1 K Ohm, $\pm 5\%$ , 1/4 W	110000-102
R59	Resistor, 150 K Ohm, $\pm 5\%$ , 1/4 W	110000-154
R60	Resistor, 1 K Ohm, $\pm 5\%$ , 1/4 W	110000-102
R61	Potentiometer, 10 K Ohm, Horiz., Dual	119011-103
R62	Resistor, 7.5 K Ohm, $\pm 5\%$ , 1/4 W	110000-752
R63	Resistor, 30 K Ohm, $\pm 5\%$ , 1/4 W	110000-303
R64	Resistor, 15 K Ohm, $\pm 5\%$ , 1/4 W	110000-153
R65, R66	Resistor, 12 K Ohm, $\pm 5\%$ , 1/4 W	110000-123
R67	Resistor, 15 K Ohm, $\pm 5\%$ , 1/4 W	110000-153
R68	Resistor, 30 K Ohm, $\pm 5\%$ , 1/4 W	110000-303
R69	Resistor, 7.5 K Ohm, $\pm 5\%$ , 1/4 W	110000-752
R70	Resistor, 75 K Ohm, $\pm 5\%$ , 1/4 W	110000-753
R71	Resistor, 150 K Ohm, $\pm 5\%$ , 1/4 W	110000-154
R74-R81	Resistor, 1 K Ohm, $\pm 5\%$ , 1/4 W	110000-102
R82	Resistor, 470 Ohm, $\pm 5\%$ , 1/4 W	110000-471
R83	Resistor, 150 K Ohm, $\pm 5\%$ , 1/4 W	110000-154
R84	Resistor, 0 Ohm, 1/4 W	110005-001
R85A	Resistor, 470 Ohm, $\pm 5\%$ , 1/4 W	110000-471
R86	Resistor, 220 Ohm, $\pm 5\%$ , 1/4 W	110000-221
R103	Resistor, 150 K Ohm, $\pm 5\%$ , 1/4 W	110000-154
<b>Connectors</b>		
JACDC	Connector, 12 Circuit, Header, .156 Ctr, Key 11	179213-012
JCDL	Connector, 2 Circuit, Header, .156 Ctr	179213-002
JCOIN	Connector, 6 Circuit, Header, .100 Ctr, Key 2	179118-006
JSCOM	Connector, 11 Circuit, Header, .100 Ctr, Key 5	179118-011
JSPK	Connector, 6 Circuit, Header, .156 Ctr, Key 3	179213-006
<b>Miscellaneous</b>		
SW1	Switch, Slide, SPDT	69-004
1J-CPU	Socket, 40 Pin	79-42C40
2D	Socket, 16 Pin	79-42C16
2F-YAM	Socket, 24 Pin	79-42C24
2H-RAM, 2K-ROM	Socket, 28 Pin	79-42C28
3K	Socket, 40 Pin	79-42C40
HSL, HSR	Test Point Heat Sink, TDA2030	179051-001 178190-032
Q2	Nut/Washer Assy, #6-32	75-99516
Q2	Pan Head Screw, #6-32	72-1606S

# N O T E S

# Vindicators™

Date \_\_\_\_\_

## Coin Information and Game Statistics

Left Coins	_____	Number of coins deposited in left coin mechanism.
Right Coins	_____	Number of coins deposited in right coin mechanism
0 Plyr Mins	_____	Minutes of idle time
1 Plyr Mins	_____	Minutes played as a 1-player game
2 Plyr Mins	_____	Minutes played as a 2-player game
Easy Games	_____	Number of players who started at the easy level
Medium Games	_____	Number of players who started at the medium level
Hard Games	_____	Number of players who started at the hard level
Joined Games	_____	Number of players who joined while a game was in progress
Total Games	_____	Total number of unique games played*
Error Count	_____	EEROM errors
Total Coins	_____	Total number of coins deposited in both coin mechanisms
Avg Time/Coin**	_____	Average game time per coin in seconds (including add-a-coin continuation games)

## Histogram Information

Length of Game in Seconds	Number of Games	Length of Game in Seconds	Number of Games
0-59	_____	330-359	_____
60-89	_____	360-389	_____
90-119	_____	390-419	_____
120-149	_____	420-449	_____
150-179	_____	450-479	_____
180-209	_____	480-509	_____
210-239	_____	510-539	_____
240-269	_____	540-569	_____
270-299	_____	570-599	_____
300-329	_____	600 & Up	_____

\*One "game" is the time between a player starting and that player dying, regardless of time, number of coins inserted, or how many have played Vindicators.

\*\*It is important to note that "Avg Time/Coin" is in seconds, and this number cannot simply be doubled to compute Avg. Time/Game for a 2-credit-start, 1-credit-to-continue game (manufacturer's recommended setting). At this setting, the following formula can be used to calculate average seconds per game or average playtime in seconds:

1. Total coins ÷ total games = X
2. X - 1.00 = Y
3. X × Avg. Time/Coin = Z
4. Z ÷ Y = Avg. Seconds per Game



# 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 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 the application of high voltage.

**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.

**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**

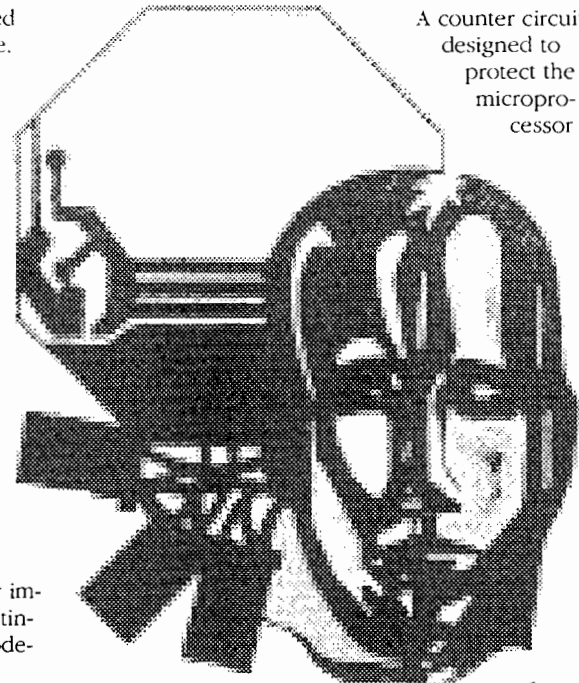
The process of locating and repairing a fault.

**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.

# 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.

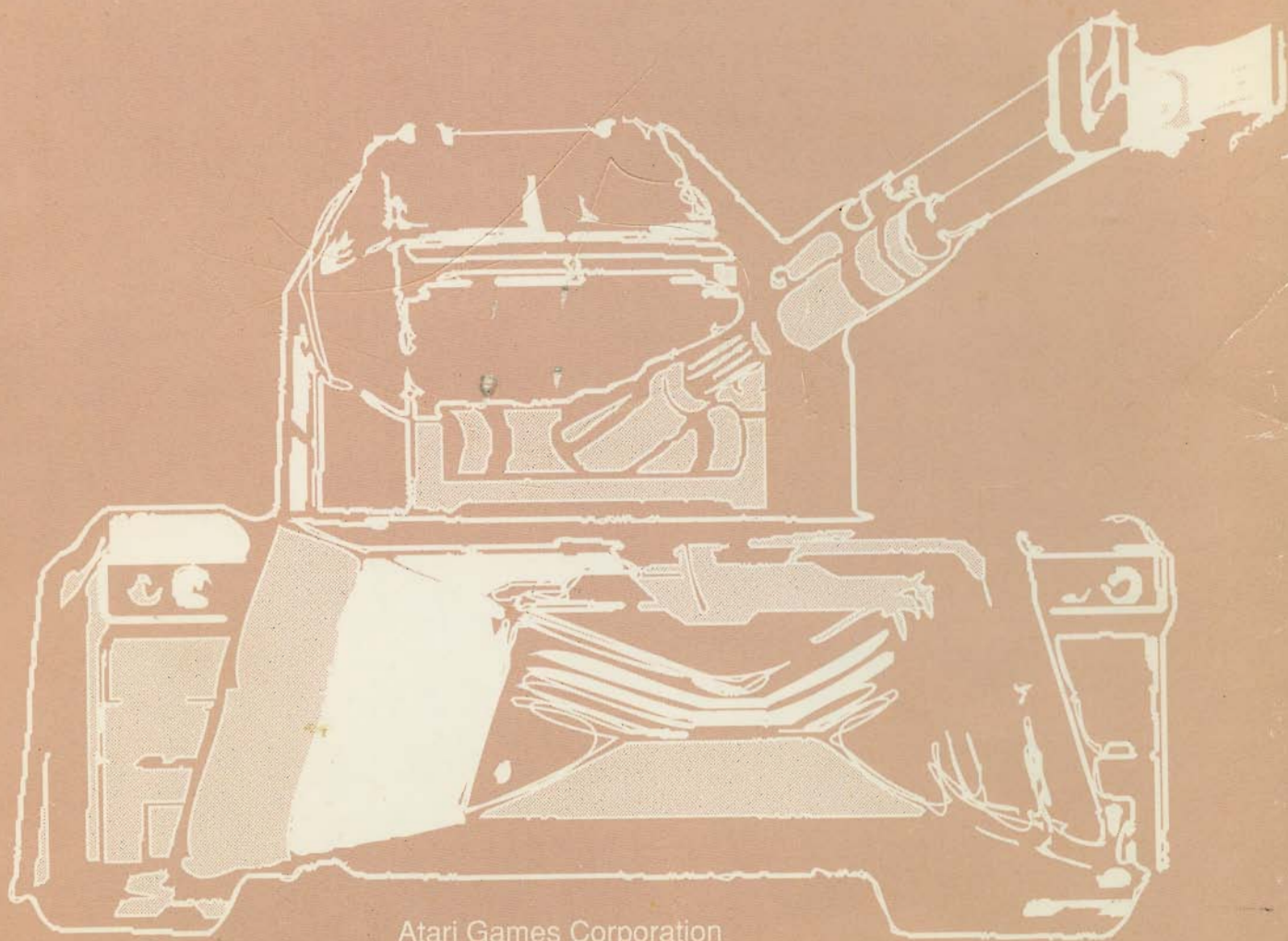
In no event shall Seller be liable for loss of profits, loss of use, incidental or consequential damages.

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