Universal Kit
Installation Instructions
For technical assistance:
If reading through this manual does not lead to
solving your game maintenance or repair
problem, call TELE-HELP® at one of these
Atari Games Customer Service offices:

UNITED STATES
Atari Games Corporation
California Customer Service Office
757 Sycamore Drive
P.O. Box 361110
Milpitas, CA 95035
FAX (408) 434-3945
Telex 5101007850
⑦ (408) 454-3950
(Monday–Friday, 7:30 a.m.–4:00 p.m. Pacific time)

EUROPE
Atari Games Ireland Limited
European Customer Service Office
Tipperary Town, Ireland
Fax 062-51702
Telex 70665
⑦ 062-52155
(Monday–Friday, 9:00 a.m.–5:30 p.m. GMT)

Skull & Crossbones™
Universal Kit
Installation Instructions
with Parts Illustrations and Schematic Diagrams
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 lots or parts not supplied by Atari Games Corporation.

**Note**

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of Federal Communications Commission (FCC) Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area or modification to this equipment is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference. If you suspect interference from an Atari game at your location, check the following:
- All ground wires in the game are properly connected as shown in the game wiring diagram.
- The power cord is properly plugged into a grounded three wire outlet.
- On games provided with an Electromagnetic Interference (EMI) ground cage, be sure that the printed circuit boards (PCBs) are properly installed on the EMI ground cage and that the end board is securely installed with all screws in place and tightened.

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

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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 explode! 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 connector 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 thereof, 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
Installation

How to Use This Manual

This manual provides information for installing, testing, and troubleshooting the Skull & Crossbones universal kit. The manual is divided into the following chapters: Chapter 1 describes the installation procedure and the Skull & Crossbones game play. Chapter 2 contains self-test procedures. Chapter 3 contains troubleshooting procedures. Chapter 4 contains illustrated parts lists. Chapter 5 contains the schematics for the game PCB and the JSA Audio II PCB. Also bound into Chapter 1 of this manual is the template for drilling the holes into the Skull & Crossbones control panel.
**Tools Required**

- Two C-clamps
- Drill with 1/4 inch drill bit, a 1 3/16-inch hole cutter (or 1 3/16-inch chassi punch), and a 1 3/4-inch hole cutter
- Phillips screwdriver
- Flat-blade screwdriver
- Socket set
- Wire cutters and strippers
- Straightedge
- Squeegee
- X-ACTO™ knife
- Fast-ons (if you are installing a new JAMMA harness)

**Preventing Existing Game for Conversion**

1. Turn off power to the game.
2. Remove the old game PCB(s). Remove the game harness if it is not Japan Amusement Machinery Manufacturers Association (JAMMA)-compatible.
3. Remove all the control panel decals, labels, and controls.
4. Remove any side decals from the cabinet. If your cabinet has wood grain or laminate sides, remove the old graphics and adhesive. If the sides are damaged, repair them before putting on the new decals.
5. Remove and clean the video display plexiglass, display bezel, attraction shield, and marquee, if any.
6. Paint the cabinet, if required.
7. Wipe down and vacuum the cabinet as necessary, including the face of the display.

**Inspecting the Kit**

Check to see that you have all the parts listed in the kit parts list in Table 1-2. If any part is missing or damaged, please contact your distributor with the Skull & Crossbones kit serial number, part number and description of any missing or damaged parts, and date received.
### Table 1-2 Kit Contents Checklist

<table>
<thead>
<tr>
<th>Received Item</th>
<th>Item</th>
</tr>
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<tr>
<td>🟫 Skull &amp; Crossbones Game Board Set (consists of the Game PCB and JSA Audio II PCB Assemblies)</td>
<td>🟫 JAMMA Harness Assy</td>
</tr>
<tr>
<td>🟫 Display Board</td>
<td>🟫 Attraction Film with Graphics</td>
</tr>
<tr>
<td>🟫 Attraction Shield</td>
<td>🟫 Control Panel Decal</td>
</tr>
<tr>
<td>🟫 Set of Control Functions Labels</td>
<td>🟫 Control Panel Cover</td>
</tr>
<tr>
<td>🟫 Two Side Panel Decals</td>
<td>🟫 Left Coinage Decal</td>
</tr>
<tr>
<td>🟫 Right Coinage Decal</td>
<td>🟫 Product Identification Label</td>
</tr>
<tr>
<td>🟫 FCC Label</td>
<td>🟫 Skull &amp; Crossbones Universal Kit Installation Instructions</td>
</tr>
<tr>
<td>🟫 Two 8-Position Microswitch Joysticks</td>
<td>🟫 Three Red Button Assemblies</td>
</tr>
<tr>
<td>🟫 Three Blue Button Assemblies</td>
<td>🟫 Six Snap-Action Switches</td>
</tr>
<tr>
<td>🟫 Four Nylon Standoffs</td>
<td>🟫 Four Type All #6 Screws</td>
</tr>
<tr>
<td>🟫 Twelve Black #10 Carriage Bolts</td>
<td>🟫 Twelve #10 Poly Locknuts</td>
</tr>
</tbody>
</table>

Packaging materials are not included in the list.

### Control Panel

Unpack the Skull & Crossbones Game control panel cover (part no. 067290-01) and control panel decal (part no. 067453-01). Measure your control panel to find out what size the decal and cover should be. Cut the control panel decal and cover to fit.

#### Drilling Holes in the Control Panel Cover

1. Clamp the control panel cover to the control panel.
2. Drill four corner holes through the control panel and the control panel cover. Use a 1/4-inch drill bit.
3. Install four carriage bolts and locknuts through the holes to hold the cover and the control panel together.
4. Cut the control panel template out of the manual (see the end of this chapter). Make an actual-size copy of it.
5. Tape the two templates next to each other on the control panel cover. See Figure 1-2 for the controls arrangement.
6. Cut the holes in the cover and panel as shown by the templates using a 1 3/16-inch hole cutter for the button holes and a 1 3/4-inch hole cutter for the joystick knob holes. Use a 1/4-inch drill bit to drill the mounting holes for the joysticks.

### Installing the Control Panel Decal and Labels

1. Disassemble the control panel and the control panel cover. Deburr the holes in the cover and the panel.
2. Install the control panel decal on the control panel. Using a sharp knife, cut out the holes for the controls in the decal.
3. Put the control labels on the control panel. (See Figure 1-2.)
4. Install the cover on the control panel with four carriage bolts and locknuts.

### Installing the Controls

1. Install the black player control buttons on the left player and the white player control buttons on the right. (See Figure 1-2.)

**NOTE**

After the buttons are tightened on the control panel, you can put a small amount of clear RTV silicon on two or three areas of the locknut to prevent the buttons from being unscrewed from the top.

### Figures

![Figure 1-2 Assembling the Control Panel and Cover](image)

2. Mount each joystick assembly on the control panel with four carriage bolts and locknuts. Install the joystick so to the Azan Games logos are upright. See Figure 1-2.
3. Install the joystick harnesses on each joystick.

### General Harness Installation

1. If your game does not already have a JAMMA harness, find the JAMMA harness (part no. AA46501-01) in the kit and install it.
2. Using Table 1-3, JAMMA Pin and Wire Connections, for wiring information, connect the JAMMA harness to existing component harnessing. You can do this using crimp splices or by butt soldering.

**WARNING**

Do not simply tie the wires together. If you do, you could cause intermittent problems, loose connections, oxidation, or even a fire.

### Connecting Power Wires

1. Connect the wires on the JAMMA harness to the power supply. You need +5V, -5V, and +12V for the Skull & Crossbones Game. This kit may not require all of the voltages used in your original game. Tie off any unused wires on the power supply.
2. You will notice that there is more than one wire for each voltage. You must use more than one wire, as called out in the footnotes of Table 1-3. Using more than one wire for each voltage ensures that you do not overload the edge connector and cause it to burn.

### Connecting Video Display Wires

Connect the wires designated for the RED, GREEN, and BLUE video guns along with the sync and ground wires.

**NOTE**

The JAMMA harness provides only negative composite sync. However, if your video display requires separate positive sync, see Chapter 3 for alternative wiring.

### Connecting Coin Door Wires

1. Connect the wires on the JAMMA harness to the coin switches and meter.
2. Connect one side of the door lamps to one of the BU/W wires. Connect the other side of the door lamps to the R wire supplying +5V to the joysticks.

**NOTE**

Do not use -5V for the coin door lamps. +5V is required for audio.

(Some games have separate power supply outputs for the coin door lamps. If you choose to use these outputs, make sure you connect both sides of the lamps to the terminals on the power supply.)

3. Be sure to clean the coin mechanisms; however, do not lubricate the coin mechanisms.

### Connecting the Control Wires

Connect the joystick wires to the JAMMA harness according to the information in Table 1-3. The test screen is in the game self-test, explained in Chapter 2.

### Grounding the Cabinet

**WARNING**

Consult a licensed electrician if you're not clear about the following grounding procedure. An improperly connected power cord is hazardous and can cause fatal injuries to players and/or technicians.

Find the ground lead (green) of the 115V input power line. Connect this lead in a Daisy Chain fashion to a bare metal part of the coin door, control panel, video display, and power supply. This is a safety requirement for the players' protection. This AC ground must be of #18 AWG wire or larger.

### Checking the Cabinet Systems

Before plugging in the game PCB, turn on the power to the game, and check +5 Volts on pins 3, 4, C, and D of the JAMMA connector; +12 Volts on pins F and H; and -5 Volts on pins E and F. Check that the video display and the attraction lamp have power.

The above voltages should be measured, using a volt-meter, with respect to pin 1 (BN wire) and ground. Now turn off the power to the game.

**WARNING**

Always power down before installing or removing the game or JSA Audio II board. Components on these PCBs are very sensitive to power spikes. Removal or installation while the power is on can damage your game board.
### Table 1-3 JAMMA Pin and Wire Connections

<table>
<thead>
<tr>
<th>Signal</th>
<th>Wire Color</th>
<th>Pin</th>
<th>Wire Color</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5V</td>
<td>B</td>
<td>1</td>
<td>B</td>
<td>1</td>
<td>+5V</td>
</tr>
<tr>
<td>+12V</td>
<td>Y</td>
<td>4</td>
<td>Y</td>
<td>4</td>
<td>+12V</td>
</tr>
<tr>
<td>-5V</td>
<td>OR</td>
<td>3</td>
<td>R</td>
<td>2</td>
<td>-5V</td>
</tr>
<tr>
<td>SPKR+</td>
<td>K</td>
<td>9</td>
<td>BU</td>
<td>5</td>
<td>COINCTR</td>
</tr>
<tr>
<td>AUDIO GND</td>
<td>N</td>
<td>11</td>
<td>R</td>
<td>6</td>
<td>RED</td>
</tr>
<tr>
<td>SERVICE SW</td>
<td>GY</td>
<td>14</td>
<td>BU</td>
<td>6</td>
<td>BLUE</td>
</tr>
<tr>
<td>Right Player</td>
<td></td>
<td></td>
<td>BK</td>
<td>6</td>
<td>VIDEO RIN</td>
</tr>
<tr>
<td>Left Player</td>
<td></td>
<td></td>
<td>NOT USED</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Notes
- NC means no connection required for Skull & Crossbones. TP means twisted pair.
- Connect four of the large BN wires to the 5V RTN (GND) terminal on the power supply unless the power supply has a 12V RTN. If there is a 12V RTN, connect one of the wires to the 12V RTN (GND) terminal.
- The wires to the +5V terminal of the power supply, the power supply has a +SENSE terminal, connect one of these four wires to the +SENSE instead of the +5V.
- Connect both wires to the -5V terminal of the power supply.
- Connect both wires to the +12V terminal of the power supply. If your count(0) requests 12V, you can use one of these two wires for the + side of the coin counter(0).
- Connect to the negative side of the coin counter(s). If your count(s) require 5V, you will need to spiee into the end wire that supplies +5V. See Note 2 above. Note: Do not use shadow figures of the Executioner, the Ninja Master, and the Medusa before they can fight face-to-face with the evil Wizard. If they make it to the throne room and overcome the Wizard, players are rewarded with a room full of treasure.
- Players use a joystick and sword button in a combination of defensive and offensive maneuvers to battle the various enemies. Players can learn the lance and backslash, two skilled sword-fighting moves that are the most effective.
- In order to increase the long-term appeal of the game, players can select various difficulty levels of easy, medium, and hard to vary their paths through the game. By selecting the longer hard path, players are rewarded with more food, drink, and booby along the way.

### Setting the Coin and Game Options
- The Skull & Crossbones coin and game options are set during the self-test. See Chapter 2 for information about the option settings.

### Game Play
This section of the manual describes the theme of the Skull & Crossbones game and the game play features.

#### Introduction
Skull & Crossbones is a swashbuckling adventure in which players portray two pirates competing for food, drink, booty, and revenge. Players use a joystick and button to control the unique swordfighting mechanism.

#### Playing the Game
The game begins with an encounter with the evil Wizard, who robs our heroes of all of their booty. The pirates swear revenge and set off on a quest to destroy the Wizard and recover their treasure.

The adventure takes them around the world. The pirates battle the fierce captains and crews of opponents. They encounter the somber guards and the merciless Executioner in the Spanish castle. In the ninja camp they fight the Ninja Master and his followers. On the beach the heroes encounter the dreaded Medusa and a horde of wicked skeletons that rise from the dead. Finally, the pirates reach the Wizard’s Island, where they must again battle against the
Chapter 2

Self-Test

The Skull & Crossbones™ 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 the self-test when you first set up the game, each time you collect the money, or when you suspect game failure. The self-test screens provide information about the game circuits and controls. To enter the self-test, turn on the self-test switch located at the front of the JS Audio II board. To leave the Self-Test, turn off the self-test switch only while displaying the Select Test menu.

Use a copy of this template for the second set of player controls.
Table 2-1 Summary of All Self-Test Screens

<table>
<thead>
<tr>
<th>Screen</th>
<th>Use or Purpose</th>
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<tr>
<td>Statistics Screen</td>
<td>Displays game statistics.</td>
</tr>
<tr>
<td>Histogram Screen 1</td>
<td>Displays the histogram for all new games.</td>
</tr>
<tr>
<td>Histogram Screen 2</td>
<td>Displays the histogram for all continued games.</td>
</tr>
<tr>
<td>Histogram Screen 3</td>
<td>Displays the histogram for the level at which players quit.</td>
</tr>
<tr>
<td>Histogram Screen 4</td>
<td>Histograms on this screen are not usable for operations.</td>
</tr>
<tr>
<td>Histogram Screen 5</td>
<td>Histograms on this screen are not usable for operations.</td>
</tr>
<tr>
<td>Game Options Screen</td>
<td>Use to set and check the game options settings.</td>
</tr>
<tr>
<td>Coin Options Screen</td>
<td>Use to set and check the coin options settings.</td>
</tr>
<tr>
<td>Sound Test Screen</td>
<td>Use to check the audio PCB circuits, RAM, and ROM. Also use to check the coin mechanism operation.</td>
</tr>
<tr>
<td>Complete RAM Test Screen</td>
<td>Use to test RAM.</td>
</tr>
<tr>
<td>Complete ROM Test Screen</td>
<td>Use to test program ROM.</td>
</tr>
<tr>
<td>Playfield Test Screen</td>
<td>Use to test the game sounding circuits.</td>
</tr>
<tr>
<td>Motion Object Screen</td>
<td>Use to test the movement and color of game objects.</td>
</tr>
<tr>
<td>Alpha Test Screen</td>
<td>Use to check the alphanumeric display.</td>
</tr>
<tr>
<td>Color Test Screen</td>
<td>Use to check the video display colors.</td>
</tr>
<tr>
<td>Red Color Purity Screen</td>
<td>Use to check the red color purity in the video display.</td>
</tr>
<tr>
<td>Green Color Purity Screen</td>
<td>Use to check the green color purity in the video display.</td>
</tr>
<tr>
<td>White Color Purity Screen</td>
<td>Use to check the blue color purity in the video display.</td>
</tr>
<tr>
<td>Blue Color Purity Screen</td>
<td>Use to check the blue color purity in the video display.</td>
</tr>
<tr>
<td>Grey Color Purity Screen</td>
<td>Use to check the grey color in the video display.</td>
</tr>
<tr>
<td>White Convergence Screen</td>
<td>Use to check and adjust video display convergence of red, blue, and green.</td>
</tr>
<tr>
<td>Green Convergence Screen</td>
<td>Use to check and adjust video display convergence of red, blue, and green.</td>
</tr>
</tbody>
</table>

Self-Test Selection

The 13 tests in the self-test procedure are listed in a menu, which is displayed immediately after you enter the self-test. To select any of the tests, move the left joystick up or down (you can also press the left Turn button). To start the selected test, press the left player sword button. To leave the self-test, turn off the self-test switch when the menu is displayed. The 13 tests are:

- Statistics and Histograms
- Game Options Test
- Coin Options
- Sound Board Test
- Switch Test
- Complete RAM Test
- Complete ROM Test
- Playfield Test
- Motion Object Test
- Alphanumeric
- Padd Test
- Color Test
- Purity Test
- Convergence Test

Statistics and Histograms Screen

Use the information shown on the statistics screen and on the histogram screens to keep track of your game use. Record the information on the Skull & Crossbones statistics page in the back of this manual.

The information shown on the Statistics Screen (Figure 2-1) is accumulated from the last time the statistics were reset. Simultaneously press the RED DOG SWORD and TURN buttons to reset the statistics.

At the bottom of the statistic screen are two times and dates. These are the program version dates. If you are having problems with your game, you may need to give Atari Games Customer Service this information.

The statistics screen shows the following statistics:

- Left Coins: number of coins deposited into the left coin mechanism.
- Right Coins: number of coins deposited into the right coin mechanism.
- New Players: number of players beginning a new game.

Histogram 1

Time to the First Start Health in Seconds

0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95
1.00

Press ONE EYE SWORD Button
Reset High Score Table clears the high score table, if set to yes.

Histogram 2

Histogram 2 shows the time in seconds of all additional coins deposited.

Histogram 3 shows at which waves the players did not continue.

Histograms 4, 5, and 6 are for development use only, and contain no operator-adjustable information.

If you read the screens infrequently, the number of games will always be correct proportionally, but may be incorrect numerically.

Game Options

To move through the game options, including the ones before the word MORE, press the left joystick up or down. You can change the highlighted game option. The factory default settings are shown in green. To change an option setting, move the left joystick right or left.

NOTE
Not all of the options are shown when you enter this screen. The word MORE shows at the top or bottom of the screen to indicate more options. Use the left joystick to scroll through the options.

Sounds in Attract (Model) plays the Skull & Crossbones game music, if set to yes.

Reset High Score Table clears the high score table, if set to yes.
Game Difficulty adjusts the speed of the enemies that players must fight during each wave.

Health at Start controls the amount of health given at the start of the game.

Health for Additional Coins controls the amount of health given for inserting additional coins.

Bonus Health (for) Coins Added Before Start controls whether you give progressively larger amounts of health to players who insert additional coins before entering the game.

The Lose Health Warning option is a type of censor to eliminate the blood spurt warning to players that their health is about to run out.

**GAME OPTIONS**

- Sounds in Attract? No
- Reset High Score Table? No
- Game Difficulty? Moderate
- Health at Start? 20
- Health for Additional coins? 20
- Bonus Health Coins added before Start? Yes

**MORE**

- Move ONE-EYE JOYSTICK to any position
- Press ONE-EYE TURN Button to reset options
- Press ONE-EYE SWORD Button to save this setting and exit

**COIN OPTIONS**

- Coins to Start a New Player
- Turn Coins Multiplier
- Bonus Adder
- Free Play

- Move ONE-EYE JOYSTICK to any position
- Press ONE-EYE TURN Button
- Press ONE-EYE SWORD Button to save this setting and exit

**Figure 2-3 Game Options Screen**

- Coins Meld? can allow all the coins to be pooled, and players must then assign the coins to each other by pressing one of the two auxiliary coin switches. Refer to Chapter 1 for more information.

- Restore Factory Default? allows you to set all the game options to the factory-recommended options by choosing yes. If you want to use your own settings, be sure to set this to no.

The Game Option Screen can be seen in Figure 2-3 above.

**Coin Options**

To move through the coin options, push the left joystick up or down. You can change the highlighted coin option. The factory default settings are shown in green. To change an option setting, move the left joystick right or left.

- Coins to Start a New Player is the number of coins required for a new player to enter the game.

**Figure 2-4 Coin Options Screen**

**Sound Board Test**

The sound test indicates the condition of the microprocessor and sound effects circuits on the ISA Audio II Board. The sound test screen is shown in Figure 2-5. The sound microprocessor resets at the beginning of the test. You will hear the first sound three seconds after the test starts.

After the microprocessor is reset and you hear the first sound, the number of the game sound and the sound CPU status appear information. If the CPU is good, the word "Good" appears. If you get an error message at any point in the sound test, see Table 2-3 for more information.

The test cycles through the following tests:

- Music Chip Test
- ADPCM Test
- SCOM Reset Test

**Switch Test**

The switch test is shown in Figure 2-6. Use this test to check the controls. As you press the buttons and move the joystick, the proper lines should light up.

**Figure 2-6 Switch Test Screen**

- If the highlighting does not appear, follow the maintenance and repair procedures for the controls in Chapter 3 of this manual. Press the left player SWORD and TURN buttons together to move to the next screen.

**Complete RAM Test**

While this test is checking the RAMs, you see a white screen. If the game successfully completes the RAM test, the menu will reappear in less than 15 seconds. If the game has a bad RAM, you may see a message (see Figure 2-7 for an example) or, if the problem is severe, you may only see a colored screen.

**Figure 2-7 RAM Error Message**

**Table 2-2 Game Option Settings**

<table>
<thead>
<tr>
<th>Option</th>
<th>Available Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sounds in Attract</td>
<td>Yes *</td>
</tr>
<tr>
<td>Reset High Score Table</td>
<td>No *</td>
</tr>
<tr>
<td>Game Difficulty</td>
<td>Easy *</td>
</tr>
<tr>
<td>Health at Start</td>
<td>25, 50 *</td>
</tr>
<tr>
<td>Health for Addl Coins</td>
<td>10, 20, 30, 40, 50*</td>
</tr>
<tr>
<td>Bonus Health for Coins</td>
<td>None</td>
</tr>
<tr>
<td>Added Before Start</td>
<td></td>
</tr>
<tr>
<td>Low Health Warning</td>
<td>Nothing</td>
</tr>
<tr>
<td>Coin Melds?</td>
<td>Separate mels *</td>
</tr>
<tr>
<td>Restore Factory Default</td>
<td>Yes *</td>
</tr>
<tr>
<td>Manufacturer’s recommended settings</td>
<td></td>
</tr>
</tbody>
</table>
Playfield Test

This test indicates the condition of some of the graphics ROMs, the vertical and horizontal scroll registers, and the joystick control. Use the left joystick to move left, right, up, and down. Press the left TURN button to see all the playfield palettes, numbered 0 to 15. The screen is shown in Figure 2-9. Exit the screen by pressing the left sword button.

Motion Object Test

The motion object test screen is shown in Figure 2-10. This tests the movement and color of various game objects.

<table>
<thead>
<tr>
<th>Error Message</th>
<th>Location on JSA Audio II PCB</th>
<th>Cause or Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music Chip Time Out</td>
<td>5A</td>
<td>If you see this when you enter the sound test, the sound processor cannot proceed any further. Press any right player button to exit the test.</td>
</tr>
<tr>
<td>Sound CPU Interrupt Error</td>
<td>5F, 5E, 4F</td>
<td>Causes the number of errors caused by the JSA II PCB or Game PCB.</td>
</tr>
<tr>
<td>Sound CPU RAM</td>
<td>1B</td>
<td>This means that the SC40 chip (part no. 17728-001) on one of these boards is bad.</td>
</tr>
<tr>
<td>Communications Error #1</td>
<td>3D</td>
<td>Probably a JSA Audio II PCB is disconnected from the Game PCB, or the chip at 1D is not inserted into its socket.</td>
</tr>
<tr>
<td>Communications Error #2</td>
<td>Sound Processor Not Responding</td>
<td>A major problem with the JSA Audio II PCB. If you cannot enter the self-test, check that the connector between the JSA Audio II PCB and the Game PCB is plugged in properly.</td>
</tr>
</tbody>
</table>

Color Test

This test indicates the condition of the video display color circuits. The screen is shown in Figure 2-12. The left side of the screen should be black and change to light colors on the right. From top to bottom the screen should appear white, red, green, and blue. If the screen does not fit this description, refer to the manual for your video display. Exit the screen by pressing the left sword button.

Convergence Test

The convergence test is shown in Figure 2-14. This test has three screens. The first is white, the second is purple, and the last is green. Check the following on the screens:
- The grid lines should be straight within 3.0 mm and the lines should not be wavy or barreled.
- The convergence of the lines on the violet and white screens should be within 2.0 mm.

Color Purity Test

The color purity test has five screens. The first screen is shown in Figure 2-13. These screens show the condition of the color purity circuit in the video display. Each screen should display a rectangle of color, with no curving at the corners.
Chapter 3

Maintenance and Troubleshooting

This chapter contains regular maintenance information, troubleshooting tables, and repair procedures for your Skull & Crossbones game. This chapter contains the regular preventive maintenance schedule and information on maintaining the joystick. The next part contains three troubleshooting tables. One table has general troubleshooting information, the second contains the voltage levels and test points on the PCBs, and the last is a table of ROM-caused problems with specific ROMs to check and replace.

The last part of the chapter contains repair procedures and removal instructions for the joystick, video display, and speakers of the Skull & Crossbones game. If a part is mentioned, but not illustrated, see Chapter 4, Illustrated Parts Lists, for information.
Preventive Maintenance

Preventive maintenance includes inspecting, cleaning, lubricating, and tightening hardware. Perform the preventive maintenance regularly so you can keep the game in top condition, avoid problems, and maximize your earnings. Preventive maintenance tasks and intervals are shown in Table 3-1. For the best performance from your Skull & Crossbones game, you should check and maintain your game according to the times shown in Table 3-1. The preventive maintenance procedures for the joystick and coin mechanism are in this section.

**WARNING**
Always unplug the game before you perform any repairs.

Maintaining the Joystick

Maintain the joystick by inspecting the pivot ball, actuator half-ball, and the shaft and by lubricating the joystick with lithium grease.

1. Turn off the power to the game.
2. Open the control panel and disconnect the harness connector.
3. Remove the joystick from the control panel. Use a 3/8-inch wrench to remove the nuts and washers that hold the joystick on the control panel.
4. Remove the four long screws that hold the joystick together. See Figure 3-1.
5. Take off the 8-position plate, the actuator, and the lower housing.
6. Check the actuator half-ball, the pivot ball, and the shaft for dirt and wear.
7. Lubricate the actuator half-ball on the end of the joystick shaft, the pivot ball below the upper housing, and the spring inside the upper housing. Use lithium grease.
8. Put the joystick assembly back together. Fit the pin into the pivot ball into the slot in the lower housing.

9. Replace the long screws and tighten them. Do not overtighten the screws. The joystick handle must return to center easily.

**NOTE**
Do not overtighten the long screw. Over-tightening can cause difficulty in moving the handle and frustration for players.

10. Replace the joystick assembly on the control panel.
11. Use the self-test to make sure you have reassembled the joystick correctly. Dust and dirt out with compressed air.

Troubleshooting

The tables in this section (3-2, 3-3, and 3-4) can help you troubleshoot problems in your game. The troubleshooting table lists possible sources of problems of various parts of the game. The voltage inputs and test points can help you troubleshoot PCB problems. The ROM problems table can help determine exactly which ROM might be causing game play problems.

Repairs

This section includes the procedure for repairing the joystick assembly.

Disassembling the Joystick

Perform the following procedure to disassemble the joystick (see Figure 3-1).

1. Take off the control panel and disconnect the harness connectors.
2. Remove the joystick from the control panel. Use a 3/8-inch wrench to remove the four locknuts and washers holding the joystick onto the control panel.
3. Remove the four screws holding the 8-position plate on the bottom of the assembly.
4. Remove the white plastic actuator and the lower housing that the four switches are attached to.
5. Remove the small roll pin holding the actuator half-ball on the bottom of the shaft by pushing the roll pin all the way through the shaft. Slide the actuator half-ball off the end of the shaft.
6. Remove the large roll pin holding the large pivot ball on the shaft below the upper housing. Push the pin through the ball and the shaft. The pin will not be easy to remove because of the pressure on the pivot ball from the spring above it. After you push the pin all the way through the ball, slide the pivot ball off the shaft.
7. Slide the upper housing off the shaft.
8. Slide the plunger and the spring off the shaft.
9. Slide the disc off the shaft.

Reassembling the Joystick

1. Install the disc on the shaft.
2. Slide the spring on the shaft. Push the large end of the plunger onto the shaft and over part of the spring (see Figure 3-1).

**NOTE**
Lubricate the plunger, ball, and housing at this point in the reassembly procedure.

3. Slide the upper housing onto the shaft.
4. Before you put the pivot ball on the shaft, insert the large roll pin partway into the pivot ball. The roll pin should not interfere with sliding the pivot ball onto the shaft. Slide the ball onto the shaft, and line up the roll pin with the hole in the shaft. Now push the pin through the shaft.
5. You will have to hold the pivot ball against the pressure of the spring. Make sure the ends of the roll pin extend out the same amount on both sides.

6. Fit the lower housing over the shaft so that the ends of the large roll pin fit into the slots on the inside of the housing. Turn the lower housing so that the screw casings align with the holes in the upper housing.
7. Put on the white plastic actuator so that the black cushion ring is opposite the switches.
8. Now install the 8-position plate below the actuator so that you can reinsert the long screws.
9. Put the long Phillips head screws through the 8-position plate and up through the housings. Do not overtighten the screws, or the joystick will be too hard to move.

10. Reinstall the joystick on the control panel.

Table 3-2 Voltage Inputs and Test Points on the PCBs

<table>
<thead>
<tr>
<th>PCB</th>
<th>Voltage</th>
<th>Test Point or LED</th>
<th>Source and Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main</td>
<td>+5 ± 0.25 VDC</td>
<td>VCCI</td>
<td>Logic power from the switching power supply.</td>
</tr>
<tr>
<td>Main</td>
<td>CR1 LED</td>
<td></td>
<td>Lights when 5 V is applied to the main PCB and the reset (RST) jumper is open.</td>
</tr>
<tr>
<td>Audio</td>
<td>CR2 LED</td>
<td></td>
<td>Lights when +5 V supply is good.</td>
</tr>
<tr>
<td>Audio</td>
<td>CR3 LED</td>
<td></td>
<td>Lights when the +5 V supply is good.</td>
</tr>
<tr>
<td>Audio</td>
<td>CR4 LED</td>
<td></td>
<td>Lights when the +12 V supply is good (but only if the audio PCB has a 12 V resistor at Q3 on it).</td>
</tr>
</tbody>
</table>

Table 3-1 Maintenance and Inspection Items

<table>
<thead>
<tr>
<th>Part</th>
<th>When to Check</th>
<th>What to Check and Maintain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coin Mechanism</td>
<td>Every 6 months</td>
<td>Clean.</td>
</tr>
<tr>
<td>Interior Components</td>
<td>Every 3 months</td>
<td>Clean.</td>
</tr>
<tr>
<td>Joystick</td>
<td>Every 3 months</td>
<td>Lubricate. Make sure nuts holding the joystick on the control panel are tight.</td>
</tr>
<tr>
<td>Pushbuttons</td>
<td>Every 6 months</td>
<td>Make sure the pushbuttons are tight on the control panel.</td>
</tr>
</tbody>
</table>
Table 3-3 Troubleshooting Table

<table>
<thead>
<tr>
<th>Problem</th>
<th>Suggested Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coin Mechanism Problems</td>
<td>Test the coin mechanisms with the sound test screen in the self-test.</td>
</tr>
<tr>
<td></td>
<td>1. Check the harness and connectors.</td>
</tr>
<tr>
<td></td>
<td>2. Perform the self-test.</td>
</tr>
<tr>
<td>Game Play Problems</td>
<td>A screen character does not move or moves intermittently.</td>
</tr>
<tr>
<td></td>
<td>1. Check the connections.</td>
</tr>
<tr>
<td></td>
<td>2. Check the harness and connectors.</td>
</tr>
<tr>
<td></td>
<td>3. If you took the joystick apart, have you reassembled it correctly?</td>
</tr>
<tr>
<td></td>
<td>4. Make sure all the parts on the joystick are in good repair. Repair or replace parts.</td>
</tr>
<tr>
<td>Joystick Problems</td>
<td>1. Has the joystick been lubricated with white lithium grease? If not, lubricate it.</td>
</tr>
<tr>
<td></td>
<td>2. Check the harness and connectors.</td>
</tr>
<tr>
<td></td>
<td>3. If you took the joystick apart, have you reassembled it correctly?</td>
</tr>
<tr>
<td></td>
<td>4. Make sure all the parts on the joystick are in good repair. Repair or replace parts.</td>
</tr>
<tr>
<td>The handle does not immediately return to center.</td>
<td>1. Make sure the actuator is installed correctly.</td>
</tr>
<tr>
<td></td>
<td>2. Lubricate the joystick.</td>
</tr>
<tr>
<td>A joystick handle sticks.</td>
<td>1. Check if the screws holding the joystick assembly together are too tight.</td>
</tr>
<tr>
<td></td>
<td>2. Lubricate the assembly.</td>
</tr>
<tr>
<td>Sound Problems</td>
<td>1. Is the speaker volume turned up?</td>
</tr>
<tr>
<td></td>
<td>2. Check the audio ROM and RAM in the self-test on the Sound Test screen. See Table 2-4, Bad Sound RAM and ROM Locations.</td>
</tr>
<tr>
<td></td>
<td>3. Check the voltage level to the audio PCB. See Table 2-2, Voltage Inputs and Test Points.</td>
</tr>
<tr>
<td></td>
<td>4. Check the wiring from the audio PCB to the speaker.</td>
</tr>
<tr>
<td></td>
<td>5. Replace the speaker.</td>
</tr>
<tr>
<td>Video Display Problems</td>
<td>Screen is dark</td>
</tr>
<tr>
<td></td>
<td>1. Is the game plugged in?</td>
</tr>
<tr>
<td></td>
<td>2. Is the game turned on?</td>
</tr>
<tr>
<td></td>
<td>3. Are the connections good?</td>
</tr>
<tr>
<td></td>
<td>4. Check all of the items below. If you can answer no to any question, you have a problem with the video display. See your video display service manual.</td>
</tr>
<tr>
<td>Display area waviers or is too small</td>
<td>a. Do you have power to the video display?</td>
</tr>
<tr>
<td></td>
<td>b. Are the video displays filamented?</td>
</tr>
<tr>
<td></td>
<td>c. Do you have high voltage to the video display?</td>
</tr>
<tr>
<td></td>
<td>5. Is the voltage level to the video display PCB correct?</td>
</tr>
<tr>
<td></td>
<td>(Power voltage is 100 VAC or 110 VAC, depending on the type of video display.</td>
</tr>
<tr>
<td></td>
<td>Video signal voltage is 0.5 to 3.5 Volts.)</td>
</tr>
<tr>
<td></td>
<td>6. If the level is not correct, check the connectors and the harness.</td>
</tr>
<tr>
<td></td>
<td>7. Check the +12 V and the +15 V circuit on game PCB.</td>
</tr>
<tr>
<td>Display area waviers or is too small</td>
<td>1. Check the voltage to the video display PCB.</td>
</tr>
<tr>
<td></td>
<td>2. Do you have high voltage to the video display?</td>
</tr>
<tr>
<td>Convergence, purity or color problems</td>
<td>Use the screens in the self-test to adjust the video display.</td>
</tr>
<tr>
<td>Game is stuck in self-test</td>
<td>Make sure both self-test switches are switched off. If one or both are switched on, then the game will be in self-test.</td>
</tr>
</tbody>
</table>

Figure 3-1 Maintaining the Joystick
Table 3-4 What ROM Problems Look Like

<table>
<thead>
<tr>
<th>Problem</th>
<th>ROM Causing Problem</th>
<th>Check the ROM(0) at</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program works, motion objects look OK, but the playfield is wrong. Garbage on screen, program doesn’t work. Game program is erratic. No sound or erratic sound.</td>
<td>Playfield Video processor Video program ROM 6, 1, 2, 3, 4, 5, 6, 7 Audio ROM</td>
<td>245A, B, C, D, 228A, 228C, 213A, 213C, 2004, 2006, 2165A, 195C</td>
</tr>
</tbody>
</table>

Chapter 4

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 usually are not listed in the parts lists. The parts lists (except for the PCB parts lists) are arranged alphabetically by Atari part number. All “A” prefix numbers, which are assemblies, come first. Next are part numbers with six numbers followed by a hyphen (000598- through 201000-). Ending the list are part numbers with a two-number designation followed by a hyphen (00- through 99-). The PCB parts lists are arranged in alphabetical order by component. Within each section the parts are arranged numerically by part number. When you order parts, give the part number, part name, the number of this manual, and the serial number of your kit. With this information, we can fill your order rapidly and correctly. We hope this will create less downtime and more profit from your games. Atari Games Customer Service phone numbers are listed on the inside front cover of this manual.

Figure 4-1 Skull & Crossbones Kit Assembly A047450-01 B

Parts List

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>047592-01</td>
<td>Left Coin Decal</td>
<td>177010-240</td>
<td>#10-24 Poly Locknut</td>
</tr>
<tr>
<td>047592-02</td>
<td>Right Coin Decal</td>
<td>178237-001</td>
<td>Red Button Assembly</td>
</tr>
<tr>
<td>047593-01</td>
<td>Side Panel Decal</td>
<td>178237-005</td>
<td>Blue Button Assembly</td>
</tr>
<tr>
<td>047205-01</td>
<td>Attraction Shield</td>
<td>178265-001</td>
<td>1-style Nylon Standoff</td>
</tr>
<tr>
<td></td>
<td>Control Panel Cover</td>
<td>72-66125</td>
<td>#6 x 3/4-Inch Long, Type AB, Cross-Recessed Screw</td>
</tr>
<tr>
<td>047209-01</td>
<td>Display Bezel with Graphics</td>
<td>75-51168</td>
<td>#10-24 x 1-Inch Long Black Carriage Bolt</td>
</tr>
<tr>
<td>047451-01</td>
<td>Attraction Film with Graphics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>047452-01</td>
<td>Control Panel Decal</td>
<td>A040953-03</td>
<td>8-Position Microswitch Joystick</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A046501-01</td>
<td>JAMMA Harness Assembly</td>
</tr>
<tr>
<td>047453-01</td>
<td>Control Panel Decal</td>
<td>A046963-01</td>
<td>Skull &amp; Crossbones Game PCB Assembly</td>
</tr>
<tr>
<td>047454-01</td>
<td>Set of Control Function Labels</td>
<td>A047184-02</td>
<td>JSA Audio II PCB Assembly</td>
</tr>
<tr>
<td>160044-001</td>
<td>Snap-Action Microswitch with Gold</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contacts</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 4-2 Microswitch Joystick Assembly
A040933-03 B

Figure 4-3 Skull & Crossbones Game PCB Assembly
A046903-01 F

NOTES:

⚠️ SEE PARTS LIST FOR ACCEPTABLE SUBSTITUTE.
Chapter 5

Schematic Diagrams

About this Chapter...

This chapter contains the schematics and wiring diagrams for your Skull & Crossbones™ game. These are arranged in the following order: Skull & Crossbones Game PCB, JSA Audio II PCB, the Skull & Crossbones memory map, and the faulty RAM/ROM tables. (The PCB assembly drawings are illustrated in Chapter 4, Illustrated Parts Lists.)
Figure 5-1 Skull & Crossbones Game PCB Assembly Schematic Diagram,
Sheet 1 of 10
04090401 D
Figure 5.1 Skull & Crossbones Game PCB Assembly Schematic Diagram,
Sheet 3 of 10
Figure 5-1 Skull & Crossbones Game PCB Assembly Schematic Diagram, Sheet 10 of 10
Table 1 RAM Error Locations

<table>
<thead>
<tr>
<th>Error Message</th>
<th>Display</th>
<th>Location on Game PCB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video RAM bad</td>
<td>Red with black background</td>
<td>250H, 255H</td>
</tr>
<tr>
<td>Color RAM bad</td>
<td>Multicolor horizontal stripes</td>
<td>408, 508</td>
</tr>
</tbody>
</table>

Table 2 ROM Error Locations

<table>
<thead>
<tr>
<th>Error Address</th>
<th>Location on Game PCB</th>
</tr>
</thead>
<tbody>
<tr>
<td>000000</td>
<td>23840(20)</td>
</tr>
<tr>
<td>020000</td>
<td>21900(1C)</td>
</tr>
<tr>
<td>040000</td>
<td>20600(1D)</td>
</tr>
<tr>
<td>070000</td>
<td>18500(3E)</td>
</tr>
</tbody>
</table>

Figure 5-3 Skull & Crossbones Faulty RAM/ROM Tables & Memory Map
Skull & Crossbones® Statistics Sheet

Statistics Screen:

- Left (Mechanism) Coins
- Right (Mechanism) Coins
- New Players
- Bonus Coins
- 0-Player Minutes
- 1-Player Minutes
- 2-Player Minutes
- Left-Player Minutes
- Right-Player Minutes
- Sessions
- Error Count

- Total Coins
  - 1-Player Coins
  - 2-Player Coins
  - Average Time/Coin
  - Average 1-Player Time/Coin
  - Average 2-Player Time/Coin
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 coinental 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 used 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 R SYNC, Y SYNC, and the video.

CREDIT
One play for each 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 VORTE
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. 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.

GL-1
FM BACK
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 condition of input is present at the inputs.
2. A circuit in which one signal switches another 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 15 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 current into the coil 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
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.

PHOTO TRANSISTOR
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 (dial). 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.

RAS TER-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 recharging or from bottom to top.

RESE T OR
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 decoding 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. These signature is read by the analyzer at each circuit node and is 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 stop 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.

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

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