



# *Operator's Manual*



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# Operator's Manual

with Schematics

*Patents are pending on several parts of the Primal Rage game*

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## C O N T E N T S

### **1 Set-Up**

|   |     |
|---|-----|
| How to Use This Manual . . . . .            | 1-1 |
| Operating the Game . . . . .                | 1-2 |
| Inspecting the Game . . . . .               | 1-2 |
| Control and Switch Locations . . . . .      | 1-2 |
| Power On/Off Switch. . . . .                | 1-2 |
| Volume Control . . . . .                    | 1-2 |
| Self-Test Switch . . . . .                  | 1-2 |
| Coin Counter. . . . .                       | 1-2 |
| Video Display Controls . . . . .            | 1-3 |
| Setting the Coin and Game Options . . . . . | 1-3 |
| Game Play . . . . .                         | 1-3 |
| Introduction . . . . .                      | 1-3 |
| Game Play. . . . .                          | 1-3 |
| One-Player Game . . . . .                   | 1-3 |
| Two-Player Game . . . . .                   | 1-4 |
| Hidden Features . . . . .                   | 1-4 |

### **2 Self-Test**

|  |     |
|--|-----|
| Introduction . . . . .                       | 2-1 |
| Entering and Exiting the Self-Test . . . . . | 2-2 |
| Select Test Menu . . . . .                   | 2-2 |
| Adjust Volume. . . . .                       | 2-2 |
| Statistics . . . . .                         | 2-3 |
| Statistics Screen . . . . .                  | 2-3 |
| More Statistics Screen . . . . .             | 2-3 |
| Histogram Screens . . . . .                  | 2-4 |
| Game Options . . . . .                       | 2-4 |
| Coin Options . . . . .                       | 2-5 |
| Controls Test . . . . .                      | 2-5 |
| Sound Test. . . . .                          | 2-6 |
| RAM (Memory) Tests . . . . .                 | 2-6 |
| ROM Test . . . . .                           | 2-6 |
| Video Tests . . . . .                        | 2-6 |
| Playfield Scrolling . . . . .                | 2-7 |
| MOB (Moving Object) Checksums . . . . .      | 2-7 |
| Alphanumerics. . . . .                       | 2-7 |
| Monitor Tests. . . . .                       | 2-7 |
| Color Test . . . . .                         | 2-7 |
| Purity Test . . . . .                        | 2-8 |
| Convergence Test . . . . .                   | 2-8 |

### **3 Troubleshooting and Maintenance**

|  |     |
|--|-----|
| Introduction. . . . .                            | 3-1 |
| Maintenance Procedures. . . . .                  | 3-2 |
| Introduction . . . . .                           | 3-2 |
| Cleaning Procedure for Coin Mechanisms . . . . . | 3-2 |
| Troubleshooting Procedures . . . . .             | 3-2 |
| Repair Procedures . . . . .                      | 3-2 |
| Introduction . . . . .                           | 3-2 |
| Speakers . . . . .                               | 3-3 |
| Attraction Panel Light Bulb . . . . .            | 3-3 |
| Pot Joysticks . . . . .                          | 3-3 |
| System Logic Assemblies . . . . .                | 3-3 |
| Video Display . . . . .                          | 3-6 |

### **4 Parts Illustrations**

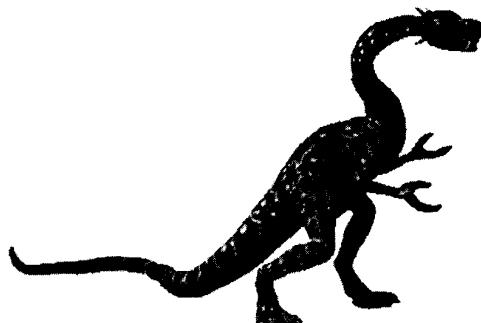
|  |     |
|--|-----|
| Part Ordering Information . . . . .                                      | 4-1 |
| For figure and page numbers, see the list of illustrations that follows. |     |

### **5 Schematics**

See the list of illustrations that follows.

### **Warranty**

Inside back cover



## ILLUSTRATIONS

|             |   |      |
|-------------|---|------|
| Figure 2-1  | Select Test Menu Screen.....                | 2-2  |
| Figure 2-2  | Adjust Volume Screen.....                   | 2-2  |
| Figure 2-3  | Statistics Screen.....                      | 2-3  |
| Figure 2-4  | More Statistics Screen .....                | 2-3  |
| Figure 2-5  | Histograms Screen .....                     | 2-4  |
| Figure 2-6  | Game Options Screen .....                   | 2-4  |
| Figure 2-7  | Coin Options Screen .....                   | 2-5  |
| Figure 2-8  | Controls Test Screen.....                   | 2-5  |
| Figure 2-9  | Sound Test Screen .....                     | 2-6  |
| Figure 2-10 | Memory Tests Screen.....                    | 2-6  |
| Figure 2-11 | Video Tests Screen .....                    | 2-7  |
| Figure 2-12 | Playfield Scrolling Screen .....            | 2-7  |
| Figure 2-13 | MOB Checksums Screen.....                   | 2-7  |
| Figure 2-14 | Alphanumerics Test Screen.....              | 2-7  |
| Figure 2-15 | Color Test Screen.....                      | 2-8  |
| Figure 2-16 | Purity Test Screen .....                    | 2-8  |
| Figure 2-17 | Convergence Test Screen .....               | 2-8  |
| Figure 4-1  | Cabinet Overview.....                       | 4-2  |
| Figure 4-2  | Power Supply Assembly.....                  | 4-3  |
| Figure 4-3  | Over/Under Coin Door Assembly .....         | 4-4  |
| Figure 4-4  | Board Stack Assembly .....                  | 4-6  |
| Figure 4-5  | Primal Rage Game (GT) PCB<br>Assembly ..... | 4-8  |
| Figure 4-6  | GT24M8 PCB Assembly.....                    | 4-15 |
| Figure 4-7  | JAMMA Filter PCB Assembly .....             | 4-17 |

|            |   |      |
|------------|---|------|
| Figure 5-1 | Primal Rage Game (GT) PCB<br>Assembly Schematic Diagram ..... | 5-2  |
| Figure 5-2 | Coin Door Wiring Diagram .....                                | 5-7  |
| Figure 5-3 | GT24M8 PCB Assembly Schematic<br>Diagram.....                 | 5-8  |
| Figure 5-4 | JAMMA Filter PCB Assembly<br>Schematic Diagram .....          | 5-14 |
| Figure 5-5 | Primal Rage Game Wiring Diagram...<br>5-16                    |      |
| Figure 5-6 | CH31_2 (CAGE™ Audio) Board Block<br>Diagram.....              | 5-18 |

## TABLES

|           |  |     |
|-----------|--|-----|
| Table 1-1 | Game Specifications .....              | 1-2 |
| Table 2-1 | Summary of All Self-Test Screens ..... | 2-2 |
| Table 2-2 | Game Option Settings .....             | 2-4 |
| Table 2-3 | Coin Option Settings .....             | 2-5 |
| Table 3-1 | General Troubleshooting .....          | 3-4 |
| Table 3-2 | ROMs and RAMs Troubleshooting.....     | 3-5 |
| Table 3-3 | Voltage Inputs and Test Points .....   | 3-6 |



# Set-Up

## How to Use This Manual

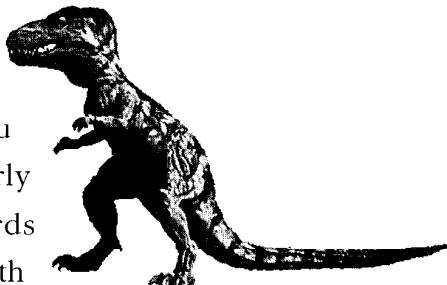
**T**HIS MANUAL IS written for operators and service personnel. It provides information for setting up, playing, testing, and maintaining your Primal Rage™ game.

Primal Rage is a one- or two-player head-to-head fighting game featuring fantasy creatures and state-of-the-art animation.

Chapter 1 of this manual contains set-up and game play information. ♦ Chapter 2 con-

tains a description of the self-test procedures and option settings. The self-test is important in the Primal Rage game. You can troubleshoot the printed-circuit boards (PCBs), main circuits, and controls using the screens in the

self-test. You should regularly test the boards and controls with the self-test to keep your game in peak condition and at top earnings. ♦ Chapter 3 contains several troubleshooting tables, plus maintenance and repair procedures for the game components. If you have problems with your game, use this chapter to troubleshoot and repair it. Be sure to perform the preventive maintenance tasks to keep your game in good condition. ♦ Chapter 4 contains the illustrations and PCB parts lists. ♦ Chapter 5 contains the schematics for all the PCBs and all the wiring diagrams.



# Operating the Game

To operate your game for maximum income, you should regularly run the self-test and check the controls with the Control Test and Sound Test in the self-test. By using the self-test regularly, you can find and fix problems immediately. This lets you keep your game in top condition.

# Inspecting the Game

## **WARNING**

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

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

Make note of the power consumption when you set up this game, so that you do not overload your electrical circuit. See Table 1-1 for the power consumption and the other important specifications of this game.

Inspect your Primal Rage game carefully to ensure that the game is complete and was delivered to you in good condition. Inspect the cabinet and seat as follows:

1. Examine the exterior of the cabinet for dents, chips, or broken parts.
2. Open the lower rear access panels. Unlock and open the coin doors. Inspect the interior of the cabinet as follows:
  - a. Check that all plug-in connectors on the cabinet harnesses are firmly plugged in. Do not force connectors together. The connectors are keyed so they fit only in the proper orientation. A reversed connector can damage a printed-circuit board (PCB). This will void your warranty.
  - b. Ensure that all plug-in integrated circuits on each PCB are firmly plugged into their sockets.
  - c. Inspect the power cord for any cuts or dents in the insulation.
  - d. Inspect the power supply. Make sure that the correct fuses are installed. Check that the harness is plugged in correctly. Check that the green ground wires are connected.

| Characteristic          | Specification               |
|-------------------------|-----------------------------|
| <b>Input Current</b>    | 3 Amps at 120 V             |
| <b>Line Fuse Rating</b> | 3 Amps at 250 V, slow blow  |
| <b>Line Voltage</b>     | 102 to 132 VAC              |
| <b>Temperature</b>      | 5° to 38° C (37° to 100° F) |
| <b>Humidity</b>         | Not to exceed 95% relative  |
| <b>Width</b>            | 25.25 inches (64 cm)        |
| <b>Depth</b>            | 33 inches (84 cm)           |
| <b>Height</b>           | 71.75 inches (182 cm)       |
| <b>Weight</b>           | 325 lbs. (148 kg)           |

**Table 1-1 Game Specifications**

- e. Inspect other sub-assemblies, such as the video displays, controls, printed-circuit boards, and speakers. Make sure that they are mounted securely and that the ground wires are connected.

# Control and Switch Locations

All of the controls are located on the back of the cabinet or behind the coin doors. The following describes the locations in more detail:

## **Power On/Off Switch**

The power on/off switch is located near the top of the cabinet lower rear panel.

## **Volume Control**

There is no volume adjustment knob on any PCB in this game. Instead, volume is adjusted in the self-test software. The attract-mode and game-play volumes can be adjusted separately. Refer to Chapter 2 of this manual for more information.

## **Self-Test Switch**

To perform the self test, open the upper coin door and activate the self-test switch mounted on a bracket located on the inside left panel of the game cabinet.

## **Coin Counter**

The coin counter is located below the coin box, inside the coin door.

## Video Display Controls

This game provides access to six of the most important video display controls — vertical and horizontal position, vertical hold, vertical size, black level, and contrast. To gain access to the video display controls, remove the rear panel. The control knobs are mounted on the inside of one of the side panels.



Primal Rage features a four-button control that allows "power" hits to be mapped onto both the top and bottom button pairs. To execute special moves, players must press and hold button combinations while moving the joystick at the same time, in a method that differs from standard fighting game controls. This allows for a diversity of regular hits while at the same time providing a new way of executing special moves. Because of this feature, Primal Rage controls allow for very fluid combination potential. Advanced players will be motivated to learn all of the moves to develop the best combinations, providing the driving force for high-level competitive action.

## Setting the Coin and Game Options

The Primal Rage coin and game options are set in the self-test. Refer to Chapter 2 for the recommended settings and the procedure for setting the options.

## Game Play

This section describes the features and play of the Primal Rage game.

### Introduction

Primal Rage is a head-to-head fighting game featuring state-of-the-art stop-motion animated characters. Players choose from seven different giant fantasy creatures in an attempt to dominate the new "Urth," using fighting moves, powerful "secret" moves, masterful combo hits and graphic finishing sequences to eliminate their opponent.

Primal Rage utilizes a proprietary new stop-motion animation technique that provides realistic and life-like character motion. In addition to state-of-the-art graphics, Primal Rage features the new CAGE "Total Immersion Audio" system, providing great stereo sound that punctuates high-impact game play.

Due to their great size and special powers, each of the seven available characters in Primal Rage is worshipped as a "god" by the surviving humans of Urth. As players go through the game, they amass additional followers with every victory. Followers can also be eaten to replenish strength, if needed, but this is really a matter of personal taste.



### Game Play

The game offers two basic types of play:

- One-player game. The player must defeat all seven opposing characters to get to the Bonus Round and Final Battle.
- Two-player game. Players battle each other for trophies, human followers, and World Domination. The winner is the player who captures the most "globes" and amasses the most followers.

### One-Player Game

The player must defeat all seven opposing characters, one at a time, in order to get to the Bonus Round and Final Battle. Each player and opponent character has a "health bar" at the top of the screen that is reduced whenever a damaging hit is made. If a player's health bar is reduced, human followers can be eaten for bonus health. Each opponent defeated will result in a new territory being awarded.

### Finishing Moves

When an opponent character has lost all its health and is standing there dizzy, the character is in its "death throes" and is about to die. The "finishing move" is a special button combination (different with each character) that can be used to "finish off" an opponent while it is in its death throes. Using a finishing move demonstrates technique and generates excitement, but, most importantly, affects the status of opponent characters when they return during the Final Battle. Players will be motivated to master all of the finishing moves in order to play a perfect game.

**Bonus Round and Final Battle**

After defeating all seven opponents, the player is awarded a Bonus Round, during which points and bonus health can be collected by snacking on human followers. After the Bonus Round, the player moves to the Final Battle, during which all of the player's foes must be quickly vanquished once again, only this time with a twist: the player has only one health bar plus bonus health, and each opponent character will return either as a normal character or as a ghost-like character. Any character that the player did not eliminate using a finishing move during the regular rounds will come back as a normally healthy character. Characters on which a player successfully executed finishing moves will return as ghosts that suffer more damage per hit inflicted.

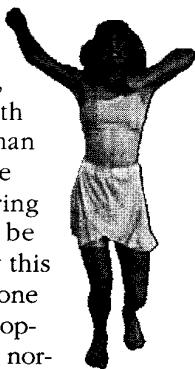
Any player who has won the Final Battle is rewarded with the story line for that character and a special graphic picture depicting that character's life after they have captured Urth. Players who lose all of their health during the Final Battle have the opportunity to continue the game by adding more coins.

**Challenge Game**

During a 1-player game, another player can challenge the current player by inserting coins in the unused side of the game. The original player now competes against the new challenger.

**Two-Player Game**

Players battle each other in a match decided by winning two out of three rounds. A trophy and human followers are awarded to the player who wins each round, and a new territory on the globe is awarded to the winner of the match.

**Human Followers**

Human followers are awarded for various accomplishments in the game. The number of followers awarded depends upon how well a player fights, including attack combinations, damage to the opponent, use of finishing moves, and fatalities.

**Sudden Death**

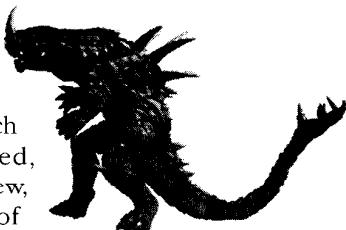
If the two players are tied at the end of the third round (same number of trophies and both players still alive), then a Sudden Death round is started. At the beginning of Sudden Death, the timer is reset to 20 and players receive full health bars. During play, each player's health bar will be reduced by time and hits. If Sudden Death ends without a victor, both players will die and the game will end in a tie.

**World Domination**

In order to achieve World Domination, a player must win all seven territories on the globe. When this is achieved, the player will be awarded a globe and more human followers. There is no limit to the number of globes awarded in a 2-player game. The winner is the player who captures the most globes and amasses the most human followers.

**Hidden Features**

Many hidden features are included in Primal Rage. Some of these features are activated by different joystick and button combinations. Some are skill-specific and some require cooperation between players. Many hidden features depend upon which character is being played, which background is in view, or which combination of moves is used.

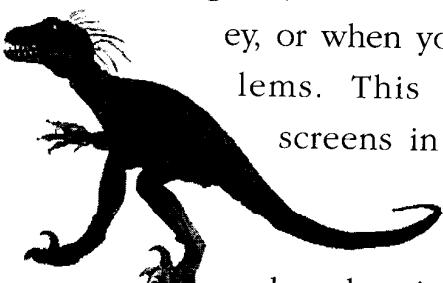


# Self-Test

## Introduction

USE THE PRIMAL RAGE™ self-test to check the condition of the game circuitry and controls.

You will see the self-test information on the video display and hear the sound test information through the speakers. You do not need any additional equipment to perform the self-test. Perform the self-test when you first set up the game, each time you collect the money, or when you suspect game problems. This chapter shows the screens in the self-test and explains each of the tests. The screens and explanations are arranged in the order they appear in the self-test. Table 2-1 lists all the self-test screens.



# Entering and Exiting the Self-Test

The game's self-test switch is located behind the coin door. Turning it on causes the screen to enter the self-test mode. Doing so displays the Select Test menu; see Figure 2-1. Exit the self-test by turning off the self-test switch at any time.

At the bottom of the self-test screen you may find that the MOS or OS versions shown in this manual are different from your game. Any version differences in the software are unimportant.

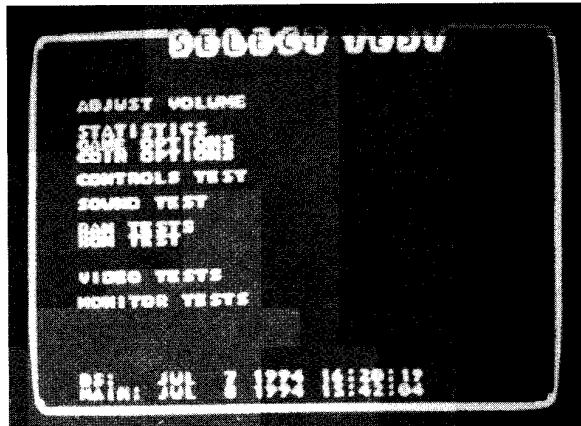
## Select Test Menu

Choose which test or screen you want to see from this menu, shown in Figure 2-1. Move up and down the menu by moving either joystick up or down (or by pressing the left player upper right button). Start the

| <b>Select Test Menu</b>        |  |
|--------------------------------|--|
| <i>Adjust Volume</i>           |  |
| <i>Statistics</i>              |  |
| Statistics                     |  |
| More Statistics                |  |
| Histograms                     |  |
| <i>Game Options</i>            |  |
| <i>Coin Options</i>            |  |
| <i>Controls Test</i>           |  |
| <i>Sound Test</i>              |  |
| <i>RAM (Memory) Tests</i>      |  |
| Video RAM                      |  |
| Video RAM (quick)              |  |
| Color RAM                      |  |
| Working RAM                    |  |
| Working RAM (quick)            |  |
| All RAM                        |  |
| <i>ROM Test</i>                |  |
| <i>Video Tests</i>             |  |
| Playfield Scrolling            |  |
| MOB (Moving Objects) Checksums |  |
| Alphanumerics                  |  |
| <i>Monitor Tests</i>           |  |
| Color Test                     |  |
| Purity Test                    |  |
| Convergence Test               |  |

**Table 2-1 Summary of All Self-Test Screens**

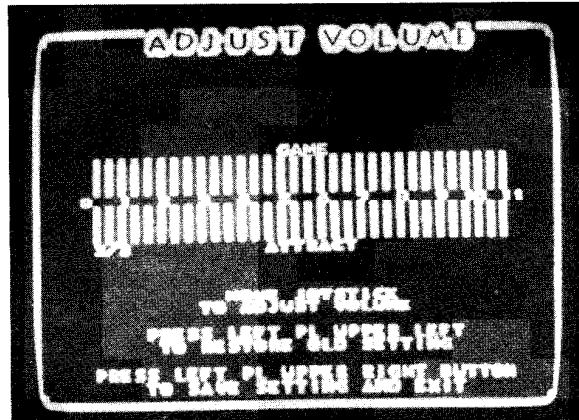
selected test by pressing the left player upper left button.



**Figure 2-1 Select Test Menu Screen**

## Adjust Volume

Adjust the volume of the game using this screen, shown in Figure 2-2. Follow the instructions at the bottom of the screen to restore the old volume level or to save the new volume and return to the select test menu.



**Figure 2-2 Adjust Volume Screen**

The software continuously plays music to allow you to adjust both the game and attract-mode volume levels. The word *GAME* or *ATTRACT* flashes to show which of the two volumes levels you are adjusting. Move either joystick up or down to select either one. The attract-mode volume level has four steps: mute, 1/3, 2/3 or full volume level (these are fractions of the game volume level).

# Statistics

Use the information shown in the statistics and histogram (bar graph) screens to keep track of your game use and maximize your profits.

The game statistics are collected from the last time the statistics were cleared. Follow the instructions at the bottom of the screen to clear the statistics or to advance to the next statistics or histogram screen.

## Statistics Screen

The Statistics screen (see Figure 2-3) lists the following information:

- Left Coins shows the number of coins counted in the left coin mechanism.
- Right Coins shows the number of coins counted in the right coin mechanism.
- Aux Coins shows the number of coins manually added by the operator. (not inserted into any mechanism).
- Idle Minutes shows the number of minutes that the game was idle and not being played.
- 1-Player Minutes/2-Player Minutes shows the number of minutes that the game was played by one or two players.
- New Game Minutes shows the number of minutes played after starting a new game.
- Continued Game Minutes shows the number of minutes played after continuing a game.
- EEPROM Error Count shows the number of errors counted in the erasable memory. If you have an error count, the statistics may be wrong. If you consistently have errors counted for several weeks, replace the EEPROM at 22H on the Primal Rage game PCB.

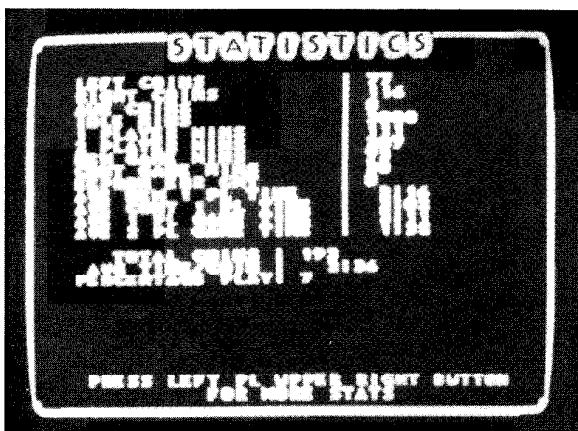


Figure 2-3 Statistics Screen

- Average New/Continued 1 Player Time shows an average of the number of minutes played by one player in a new or continued game.
- Average 1 Player/2 Player Game Time shows an average of the number of minutes played in one game by one or two players.
- Total Coins shows the number of coins counted in both left and right coin mechanisms.
- Average Time per Coin shows an average of the number of minutes played for every coin counted.
- Percentage Play shows the ratio of game playing time to total time the game has been turned on.

## More Statistics Screen

The More Statistics screen (see Figure 2-4) lists the following information:

- 1 Player/2 Player Games shows the number of games played by 1 or 2 players.
- 1 Player/2 Player Continues shows the number of games continued by 1 or 2 players.
- 1 Player Finishes shows the number of games finished in 1-player game mode.
- Challenge Games shows the number of 1-player games interrupted by a 2nd-player challenge.
- Sudden Deaths shows the number of tie games decided by sudden death.
- Final Battles shows the number of times a single player achieved a Final Battle.
- Final Continues shows the number of credits used during a Final Battle.

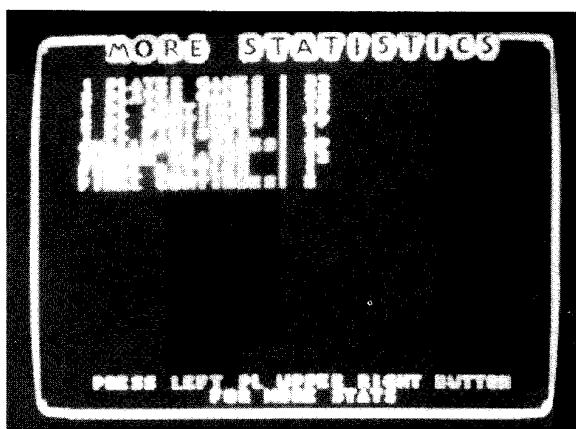


Figure 2-4 More Statistics Screen

## Histogram Screens

The Histograms screen is a menu that lets you display one of three screens (see Figure 2-5). These show various horizontal bar graphs for round time, match time, and selections per character.

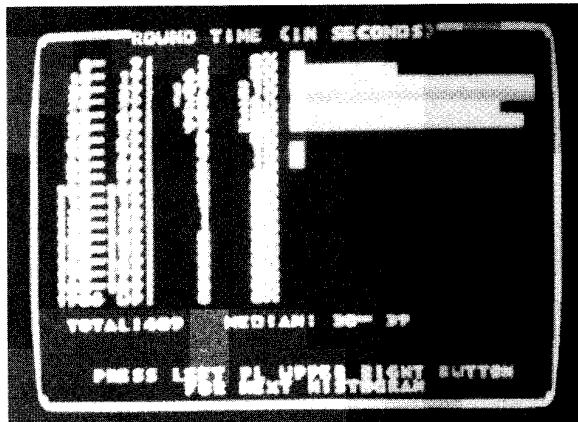


Figure 2-5 Histograms Screen

## Game Options

Check and select the game options on this screen, shown in Figure 2-6. The screen shows the factory default settings in green.

To move through the options, to change or save the settings, or to return to the select test menu, follow the

instructions shown at the bottom of the screen. The game options, with defaults, are shown and explained in Table 2-2.

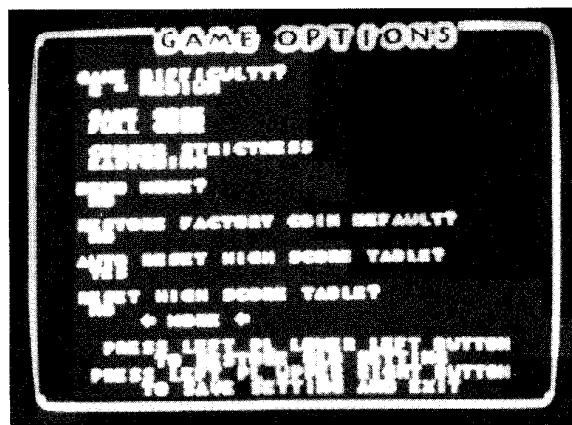


Figure 2-6 Game Options Screen

## Coin Options

Check and select the coin options on this screen, shown in Figure 2-7. The screen shows the factory default settings in green.

To move through the options, to change or save the settings, or to return to the select test menu, follow the instructions shown at the bottom of the screen. The coin option settings, with defaults, are shown and explained in Table 2-3.

| Game Option                         | Available Settings            |             | Explanation   |
|-------------------------------------|-------------------------------|-------------|---|
| <b>Game Difficulty</b>              | Easiest ...<br>Most Difficult | Medium ✓    | Provides a choice of sixteen levels of game difficulty.   |
| <b>Game Gore</b>                    | No Gore                       | Full Gore ✓ | Provides a choice of two levels of gory effects. No Gore disables all blood and finishing moves.                  |
| <b>Censor Strictness</b>            | Easygoing                     | Strict ✓    | Strict setting disallows certain vulgar letter combinations in the high score table and in the top score display. |
| <b>Demo Mode</b>                    | Yes                           | No ✓        | In demo mode, characters never die. This setting should be used for demonstrations only.                          |
| <b>Restore Factory Coin Default</b> | Yes                           | No ✓        | Returns coin settings to factory default.   |
| <b>Auto Reset High Score Table</b>  | Yes ✓                         | No          | Automatically clears the high score table periodically.   |
| <b>Reset High Score Table</b>       | Yes                           | No ✓        | Clears the high score table the next time you start a game (one time only).                                       |
| <b>Restore Factory Default</b>      | Yes                           | No ✓        | Returns all game settings to factory default.   |

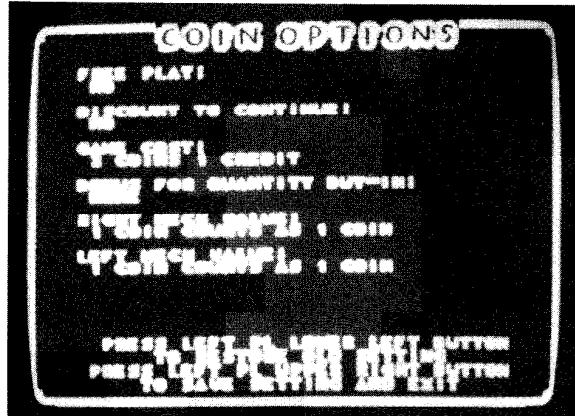
✓ Manufacturer's recommended settings

Table 2-2 Game Option Settings

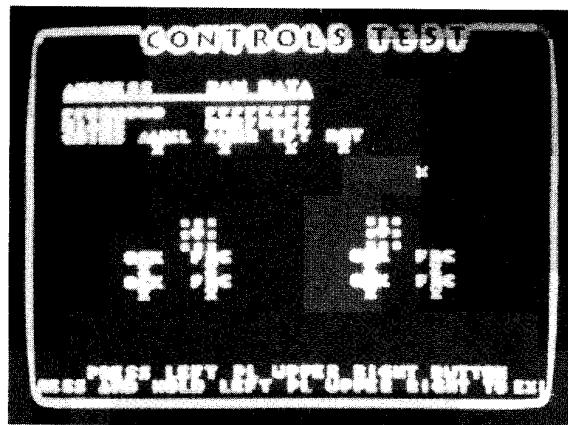
| Coin Option                      | Available Settings   | Explanation   |
|----------------------------------|--|---|
| <b>Free Play</b>                 | No ✓ Yes   | Lets you choose free play to demonstrate the game.  |
| <b>Discount to Continue</b>      | No ✓ Yes   | When set to Yes, this option reduces by 50% the player's cost to continue a game (always rounded up to the next full coin). |
| <b>Game Cost</b>                 | 1 coin 1 credit<br>2 coins 1 credit ✓<br>3 coins 1 credit<br>...<br>8 coins 1 credit                                 | The number of coins required for one credit.  |
| <b>Bonus for Quantity Buy-in</b> | None ✓<br>2 coins give 1<br>3 coins give 1<br>3 coins give 2<br>...<br>9 coins give 2<br>9 coins give 3              | Lets you choose from various kinds of bonuses or no bonus.  |
| <b>Right Mech Value</b>          | 1 coin counts as 1 coin ✓<br>1 coin counts as 2 coins<br>...<br>1 coin counts as 7 coins<br>1 coin counts as 8 coins | The number of coins each coin counts as in the right coin mechanism.  |
| <b>Left Mech Value</b>           | 1 coin counts as 1 coin ✓<br>1 coin counts as 2 coins<br>...<br>1 coin counts as 7 coins<br>1 coin counts as 8 coins | The number of coins each coin counts as in the left coin mechanism.   |

✓ Manufacturer's recommended settings

**Table 2-3 Coin Option Settings**



**Figure 2-7 Coin Options Screen**



**Figure 2-8 Controls Test Screen**

## Controls Test

The controls test screen is shown in Figure 2-8. This test checks all the pushbutton switches and the joystick potentiometers.

As you use each control, the numbers for the joystick pots increase or decrease, or the red Xs for switches become 0s. If the changes do not appear on the screen, check the controls and their wiring.

To reset the joystick pot limits, to change or save the settings, or to return to the select test menu, follow the instructions shown at the bottom of the screen.

Press and *hold* the left player upper right button to exit from the controls test.

## Sound Test

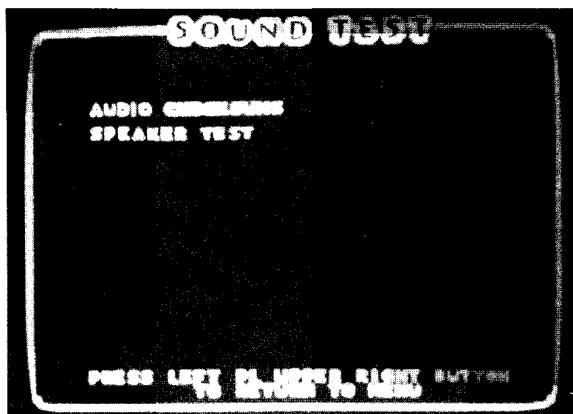
Use this selection screen, shown in Figure 2-9, to test the sound board.

### **NOTE**

*The audio boards must be installed and connected in the game to perform this test.*

To check the audio ROMs, run the Audio Checksums test. To determine if all three speakers are working properly, select the Speaker Test.

In the Audio Checksums test, verify that all the checksums are displayed in white. If any of them show red numbers, you have a problem with the circuitry or ROMs. If all ROMs are bad, suspect the circuitry. If a single checksum is bad, check for improper ROM seating.



**Figure 2-9 Sound Test Screen**

When you select the Speaker Test, you will hear a sequence of three sounds, with a different sound coming from each speaker: the left speaker will emit a frog sound, the right speaker will emit a woman's scream, and the sub-woofer will emit a booming footfall sound.

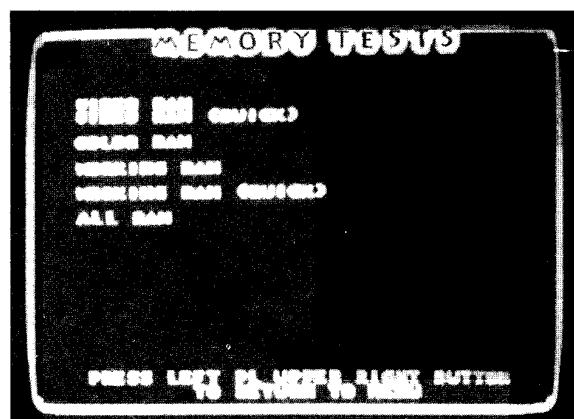
### **NOTE**

*The footfall sound coming from the sub-woofer will also be heard to a certain extent from the other two speakers.*

## RAM (Memory) Tests

Use this selection screen, shown in Figure 2-10, to run any of the five RAM tests. These tests check the RAM chips in various ways.

When you turn on the power, the game automatically runs through the random-access memory (RAM) tests. Refer to Chapter 3 of this manual for more details.



**Figure 2-10 Memory Tests Screen**

## ROM Test

This screen displays any ROM errors by showing a non-zero number after a particular item. A properly working board should cause your screen to display only 0s in the right column.

If a ROM fails, a message may be displayed. However, depending on how bad the ROM error is, you may not be able to enter the self-test.

If you have a ROM error, check the four ROMs labeled PGM\_LL, PGM\_LM, PGM\_UM, and PGM\_UU at 24L through 29L on the Primal Rage game PCB. Check these locations for bent pins or incorrectly inserted chips. Also see Table 3-2 for information about the locations of the ROMs and their functions.

## Video Tests

Use this selection screen, shown in Figure 2-11, to determine the condition of the video circuitry on the game PCB.

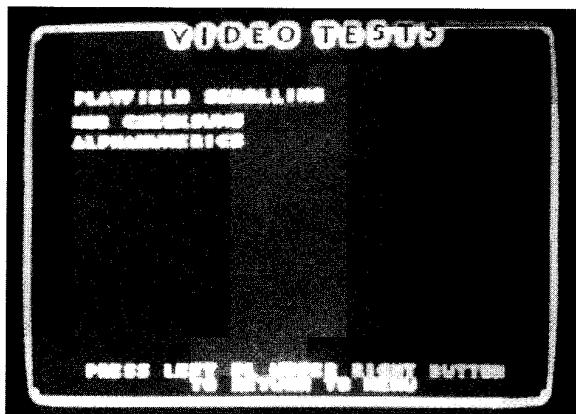


Figure 2-11 Video Tests Screen

### Playfield Scrolling

The playfield scrolling test is shown in Figure 2-12. To scroll the playfield continuously in a horizontal or vertical direction, move the joystick in the corresponding direction. Make sure that the playfield screen is clean and scrolls smoothly across the screen.

If the screen image does not move, or appears different from Figure 2-13, you have a problem in the playfield circuitry at locations 25N–28N on the Primal Rage game PCB. To return to the select test menu, follow the instructions shown at the bottom of the screen.

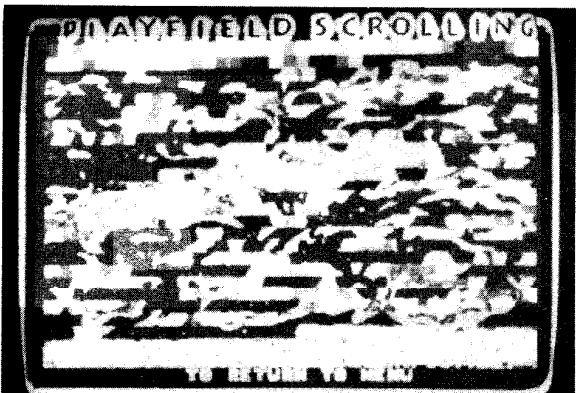


Figure 2-12 Playfield Scrolling Screen

### MOB (Moving Objects) Checksums

The first MOB test screen examines the checksums of the MOB ROMs. If the checksums match, you should see the white numbers displayed as shown in Figure 2-13. The twelve designations listed in the left column on the screen (MOH0/MOL0 through 1.3) are the labels on the chips, located on the Primal Rage PCB and the GT24M8 piggyback board. If the checksums do not match, either you have a defective EPROM/ROM or a chip may be installed incorrectly.

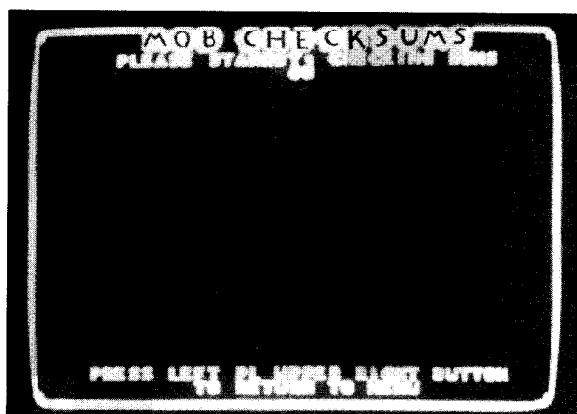


Figure 2-13 MOB Checksums Screen

### Alphanumerics

The alphanumerics test is shown in Figure 2-14. To page (scroll) the screen up/down, move the joystick accordingly. If the screen image does not move, or appears different from this figure, you have a problem in the alphanumeric circuitry at location 22P/R on the Primal Rage game PCB. To return to the select test menu, follow the instructions shown at the bottom of the screen.

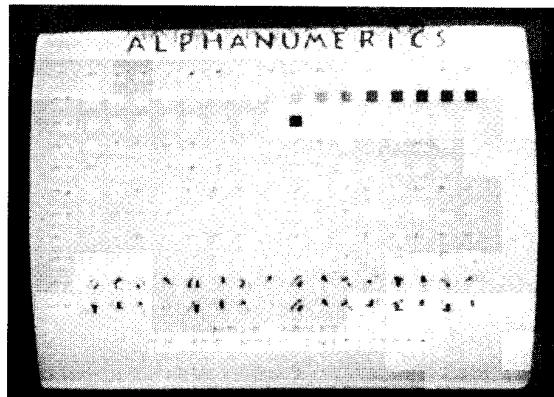


Figure 2-14 Alphanumerics Test Screen

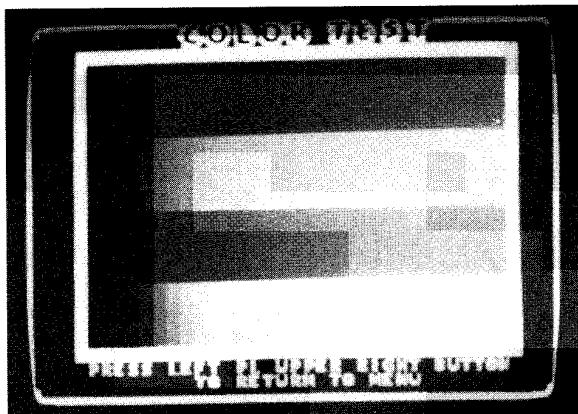
## Monitor Tests

The monitor test selection screen lets you select from three screens — color, purity, and convergence. Advance to each screen to completely test the monitor.

### Color Test

The color test (see Figure 2-15) indicates the dynamic range of the video display color circuitry. The screen should show three bands (red, green, and blue) in the left half, plus white in the right half, ranging from

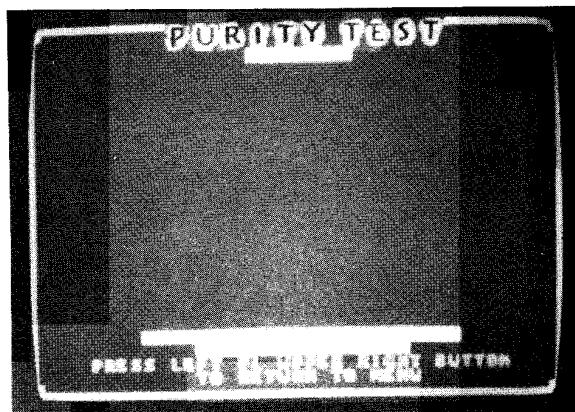
black to white, from left to right. The red, green, and blue bands are produced by only one color gun being turned on in each band.



**Figure 2-15 Color Test Screen**

### Purity Test

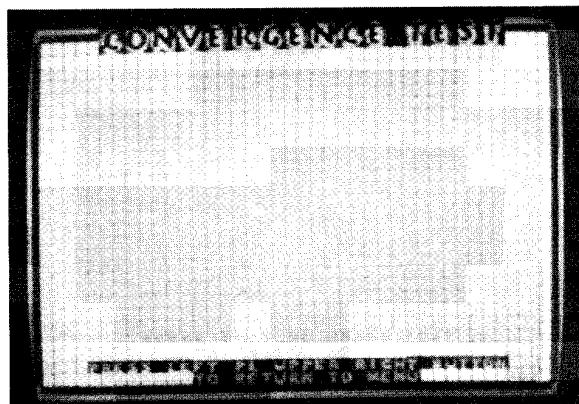
The next five screens are color purity tests. The entire screen will be red (see Figure 2-16), green, blue, white, and grey. Press the Left player upper Left button to change colors. Each screen should show no unevenness of color and no lines in the display.



**Figure 2-16 Purity Test Screen**

### Convergence Test

The convergence test has three screens — white, violet, and green backgrounds with grid lines. This sequence is then repeated but without any text on the screen. The green screen is shown in Figure 2-17. To see the remaining screens or return to the select test menu, follow the instructions shown at the bottom of the screen.



**Figure 2-17 Convergence Test Screen**

Check the following on the screens:

- The grid lines should be straight within 3.0 mm and the lines should not pincushion or barrel.
- The convergence of the lines on the violet and green screens should be within 2.0 mm.

If these screens do not meet these criteria, adjust the video display as described in the video display manual.

Return to the select test menu by pressing the thumb button.

Causes of errors could be problems with the cable, terminators installed incorrectly, harnesses, or connectors.



# Troubleshooting & Maintenance

## Introduction

**T**HIS CHAPTER contains maintenance, troubleshooting and repair procedures for your Primal Rage™ game. The maintenance section gives information on cleaning the parts. The troubleshooting section contains several tables to help determine the source of a problem and the steps necessary to repair it. The repair section contains the steps necessary to remove and install the serviceable parts. Together, these three sections provide a complete guide to servicing your Primal Rage™ game.



# Maintenance Procedures

## Introduction

This section describes the maintenance procedures for all of the major assemblies and components of the game. The maintenance procedures should be performed every 3–4 months on a regular basis.

### **WARNING**

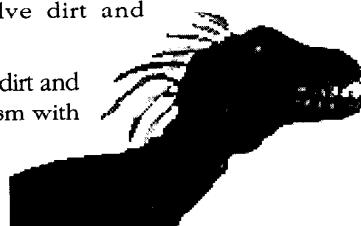
*Before performing any maintenance or repairs, please observe all of the following safety precautions:*

1. Turn the game's power off.
2. Unplug the power cord from the electrical socket.
3. Secure loose clothing such as ties and long sleeves that could get caught within the game.
4. Remove all metal jewelry such as watches and necklaces that could conduct electricity from the game's power sources.

## Cleaning Procedure for Coin Mechanisms

Regular use of the coin mechanisms may result in a build-up of residue and dirt. If this is the case, clean the coin mechanism by following the steps below (refer to Figure 4-6 for detailed part information on the coin door).

1. Open the upper coin door.
2. Open the gate on the door that covers the magnet. Use the blade of a screwdriver to scrape away any metal filings that have collected on the magnet.
3. Clean the loose dust and dirt from the coin mechanism with a lint-free rag or a soft brush.
4. Clean the dirt and residue from the coin path with a toothbrush. Hot, soapy water may be used to help dissolve dirt and residue.
5. Blow out all the loose dirt and dry the coin mechanism with compressed air.



6. Close the gate on the door that covers the magnet and close the upper coin door.

### **CAUTION**

*Never lubricate the coin mechanism with oil or grease.*

## Troubleshooting Procedures

This section is designed to help determine the source of a malfunction and detailed information on repairing the problem.

*Table 3-1 General Troubleshooting*, is divided into two columns. The left-hand column is broken down into the general nature of problems. The right-hand column lists suggested solutions to solve the problem.

*Table 3-2 ROMs and RAMs Troubleshooting*, is designed to help determine the specific ROMs and RAMs that are the source of a game logic malfunction. The left-hand column shows some problems that may result from malfunctioning ROMs and RAMs. The middle column shows the ROMs and RAMs that may be the source of the problem and their purposes. The right-hand column shows the PCB locations of the ROMs and RAMs that may be causing the problem.

*Table 3-3 Voltage Inputs and Test Points*, is divided into three columns. The left-hand column shows the correct voltages that should be measured. The middle column shows the physical locations of the test points or LEDs. The right-hand column shows the sources and purposes of the voltages.

## Repair Procedures

### Introduction

This section describes the repair procedures for all of the major assemblies and components of the game. Before performing any repairs, use the tables in the *Troubleshooting Procedures* section to help narrow the source of the problem. The *Maintenance Procedures* section may also provide a good starting point for fixing many game problems before beginning what might be unnecessary repairs.

## Speakers

Each game has three speakers: the two top speakers under the attract panel and a sub-woofer next to the coin door. The speakers provide the music and sounds for the game and self-tests. Failure of the speakers may result in distorted or no sound. If this is the case, replace the speakers by following the removal and installation steps below.

1. Remove the six screws securing the speaker grille; remove the speaker grille and set aside.
2. Remove the four speaker mounting screws.
3. Disconnect the harness from the speaker.
4. Replace and reinstall the speaker in reverse order.

## Attraction Panel Light Bulb

To replace the attraction panel light bulb, follow the removal and installation steps that follow.

1. Partially loosen the six screws securing the speaker grille.
2. Remove the three screws from the attraction panel retainer on top of the cabinet; remove the bracket and set aside.
3. Slide the plastic attraction panel upwards to remove it.
4. Remove the cardboard bulb retaining clips one at a time by pressing on the circular tab and pulling the clip toward you.
5. Rotate the bulb toward you while gently pulling on the bulb to remove it.

## Pot Joysticks

The pot joystick and its handle are shown in Figure 4-4. If you want to repair the joystick control, disassemble it by removing it from the pedestal. The hardware that secures the joystick assembly to the pedestal is also listed in that figure.

## System Logic Assemblies

This section describes the repair and maintenance procedures for the major assemblies and components that are related to the system's logic and electronics, including the printed-circuit boards (PCBs) and the power supply. These components are housed in a slide-out drawer underneath the front access panel.

### Primal Rage Game PCB Set

The Primal Rage game PCB set (board stack) is responsible for the display graphics and game play. Failure of the game PCB set may result in erratic or no game play. If this

is the case, repair or replace the game PCB set by following the removal and installation steps below.

1. Remove the two retaining screws securing the control panel.
2. Unlock the control panel and open the panel by pulling toward you.
3. Disconnect the harness connectors from the game PCB set. (There are 5 connectors in all.)
4. Slide the drawer that holds the PCB set toward you. Drawer movement may be hindered by the joystick and button harnesses. If this is the case, disconnect the harnesses.
5. Unfasten the screw and spacer that secures the game PCB set to the drawer. Remove the game PCB set and its attached cover (refer to Figure 4-7).

### CAUTION

*Before handling static-sensitive components, properly ground yourself to discharge buildup of static charges.*

6. Re-install the game PCB set by following the previous steps in the reverse order.

### Power Supply

The power supply is responsible for providing power to all of the game assemblies that require it. Failure of the power supply may result in erratic game play or no power at all. If this is the case, repair or replace the power supply assembly by following the steps below.

### WARNING

*The power supply can contain high voltages even after the power is turned off. To avoid injury, observe all of the safety precautions before working on the power supply. (Refer to the Introduction in the Maintenance Procedures section.)*

1. Unlock the rear door of the cabinet and remove it.
2. Disconnect the wiring harnesses from the power supply.
3. Unfasten the 2 screws that secure the power supply assembly to the cabinet, and remove the power supply assembly.
4. Re-install the power supply assembly by following the previous steps in the reverse order.

| Problem                            | Suggested Action   |
|------------------------------------|--|
| <b>Coin Mechanism Problem</b>      | <ol style="list-style-type: none"> <li>1. Check the wiring connections to the coin mechanism.</li> <li>2. Check the voltage to the + side of the mechanism.</li> <li>3. Test the coin mechanism with the Controls Test screen in the self-test.</li> <li>4. Check the power distribution board fuses.</li> </ol>   |
| <b>Joystick Problem</b>            | <ol style="list-style-type: none"> <li>1. Check the switches and potentiometers using the Controls Test in the self-test.</li> <li>2. Reset the limits on the joystick using the Controls Test in the self-test.</li> <li>3. Has the control been lubricated with the correct type of lubricant? If not, lubricate it as shown in Figure 4-4.</li> <li>4. Check the harnesses and connectors.</li> <li>5. If you took the control apart, have you reassembled it correctly?</li> <li>6. Make sure all the parts of the control are in good order. Repair or replace parts as needed.</li> </ol>  |
| <b>Sound Problem</b>               | <ol style="list-style-type: none"> <li>1. Check the speaker volume setting; make sure the volume isn't zero!</li> <li>2. Check both parts of the Sound Board Test in the self-test.</li> <li>3. Check the voltage on the JXPWR connector.</li> <li>4. Check the connections from the Quad Amp PCB to the speakers.</li> <li>5. Check the audio ROMs' checksums in the Sound Board Test of the self-test procedure.</li> <li>6. Check the resistance of the speakers for 8 Ohms on the 4-inch speakers and 4 Ohms on the 8-inch woofer next to the coin box.</li> </ol>   |
| <b>Video Display Problem</b>       |  |
| Screen is dark                     | <ol style="list-style-type: none"> <li>1. Check to see that the game is plugged in and powered on.</li> <li>2. Check the line fuse if no power is present.</li> <li>3. Check the display brightness.</li> <li>4. Check the solder connections on the line filter and the transformer.</li> <li>5. Check the edge connector to the PCB.</li> <li>6. Check the harnesses and connectors to the video display PCB.</li> <li>7. Check the voltage levels to the video display PCB.</li> <li>8. Run through the following checklist. If you answer <i>no</i> to any question, you have a problem with the video display, not with the game circuitry. In this case, refer to your video display service manual. <ul style="list-style-type: none"> <li>a. Do you have power to the video display?</li> <li>b. Are the video display's filaments lit?</li> <li>c. Do you have the correct voltage to the video display?</li> </ul> </li> </ol> |
| Only a colored screen appears      | <ol style="list-style-type: none"> <li>1. Attempt to run a complete RAM/ROM test in the self-test.</li> <li>2. Replace the RAM if a RAM failure is reported in the self-test.</li> </ol>   |
| Picture wavers or is too small     | <ol style="list-style-type: none"> <li>1. Check the voltage levels to the video display PCB.</li> <li>2. Check the B+ to the video display. (Refer to the video display manual.)</li> </ol>  |
| Attract panel does not light       | <ol style="list-style-type: none"> <li>1. Check the bulb in the attract panel.</li> <li>2. Check the Power Distribution Board fuses.</li> </ol>  |
| Picture is wavy                    | <ol style="list-style-type: none"> <li>1. Check the connection of the monitor ground wire to the monitor.</li> <li>2. Check the connections of the sync inputs.</li> </ol>   |
| Picture is upside down or reversed | <ol style="list-style-type: none"> <li>1. If you replaced the monitor recently, check the horizontal or vertical yoke wire connections to the video display. They may be switched.</li> </ol>  |

**Table 3-1 General Troubleshooting**

| Problem                               | Suggested Action   |
|---------------------------------------|--|
| Convergence, purity or color problems | 1. Use the self-test mode to digitally adjust the video display.<br>2. Use the adjustment procedures in your video display manual. |
| Picture is not centered               | 1. Use the centering procedures in your video display manual.  |

**Table 3-1 General Troubleshooting, Continued****ROMs/RAMs**

The ROMs and RAMs contain the programming routines used by the game PCB set to control game play. Refer to *Table 3-2 ROMs and RAMs Troubleshooting* to determine the ROMs or RAMs that are malfunctioning. Replace the damaged ROMs or RAMs by following the removal and installation steps below.

1. Remove the game PCB set according to the procedure in the *Primal Rage Game PCB Set* section.

**CAUTION**

*Before handling static-sensitive components, properly ground yourself to discharge buildup of static charges.*

2. Remove the damaged ROMs and RAMs from the game PCB set using a chip extraction tool.
3. Install the new ROMs and RAMs by plugging them in the game PCB set sockets.
4. Re-install the game PCB set by following the steps in the *Primal Rage Game PCB Set* section in the reverse order.

| Problem  | ROMs/RAMs Source and Purpose  | Location   |
|--|---|--|
| <b>ROMs</b>  |   |  |
| The program works, but the motion objects are incorrect or non-existent. | Motion Object ROMs and GALs (responsible for moving graphic objects)    | 1S, 11S–15S, 9T, 17P, 22U. Also, ROMs on rows V, W |
| Garbage appears on the screen or game play doesn't work correctly.       | Program ROMs (responsible for game control)                             | 24L–29L  |
| The text or numbers are incorrect or non-existent.                       | Alphanumeric ROM (responsible for controlling graphic text and numbers) | 22P/R  |
| The sound is incorrect or non-existent.                                  | Audio ROMs (responsible for controlling sound)                          | ROMs on Row 11 of Sound CH31 board.                |
| The moving backgrounds graphics are incorrect or non-existent.           | Playfield ROMs (responsible for controlling background graphics)        | 25N–28N  |
| <b>RAMs</b>  |   |  |
| The display color is yellow.   | Working RAM   |  |
| The display color is green.  | Video RAM   |  |
| The display color is white.  | Color RAM   |  |

**Table 3-2 ROMs and RAMs Troubleshooting**

| Voltage       | Test Point or LED Location | Voltage Source and Purpose                           |
|---------------|----------------------------|--|
| +5 ± 0.25 VDC | +5V Low, 5V High           | Logic power from the switching power supply.         |
| -5 V          | -VOP (pin 11 of LM324)     | -5 V from the switching power supply (if connected). |

**Table 3-3 Voltage Inputs and Test Points**

## Video Display

To repair, replace or make adjustments to the video display, follow the removal and installation steps below.

**WARNING****High Voltage**

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

**X-Radiation**

This video display is 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 (CRT) may implode if struck or dropped. The shattered glass from the tube may cause injury up to six feet away. Use care when handling the display and when removing it from the game cabinet. Also, wear gloves to protect your hands from the sheet-metal edges.

- Unfasten the 8 square drive screws that secure the monitor door to the cabinet and remove them.
- Discharge the high-voltage from the cathode-ray tube (CRT).

**NOTE**

The label on the video display assembly shows a circuit for discharging the high-voltage contained in the CRT to ground when the power is off.

- Secure one end of a solid 18-gauge wire to a well-insulated or wooden handle screwdriver.
- Secure the other end of the wire to an earth ground.

- Briefly touch the blade end of the screwdriver to the CRT anode by sliding it under the anode cap.
  - Wait 2 minutes and repeat the previous step.
- Disconnect all of the wire harnesses from the video display.
  - Unfasten the square-drive screws that secure the light housing assembly and remove it.
  - Unfasten the square-drive screws that secure the lower glass retainer. Remove the display shield and cardboard bezels.
  - Unfasten the 4 flat washers and nuts that secure the video display chassis to the cabinet monitor mounting brackets.
  - Remove the video display assembly from the cabinet.

**CAUTION**

*Do not attempt to remove the video display without its chassis.*

- Install the new video display by following the previous steps (excluding steps 2a.-2d.) in the reverse order.
- If necessary, adjust the new video display's brightness, size, centering, purity and convergence according to the video display service manual.

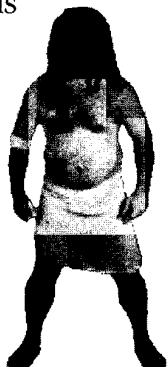
**CAUTION**

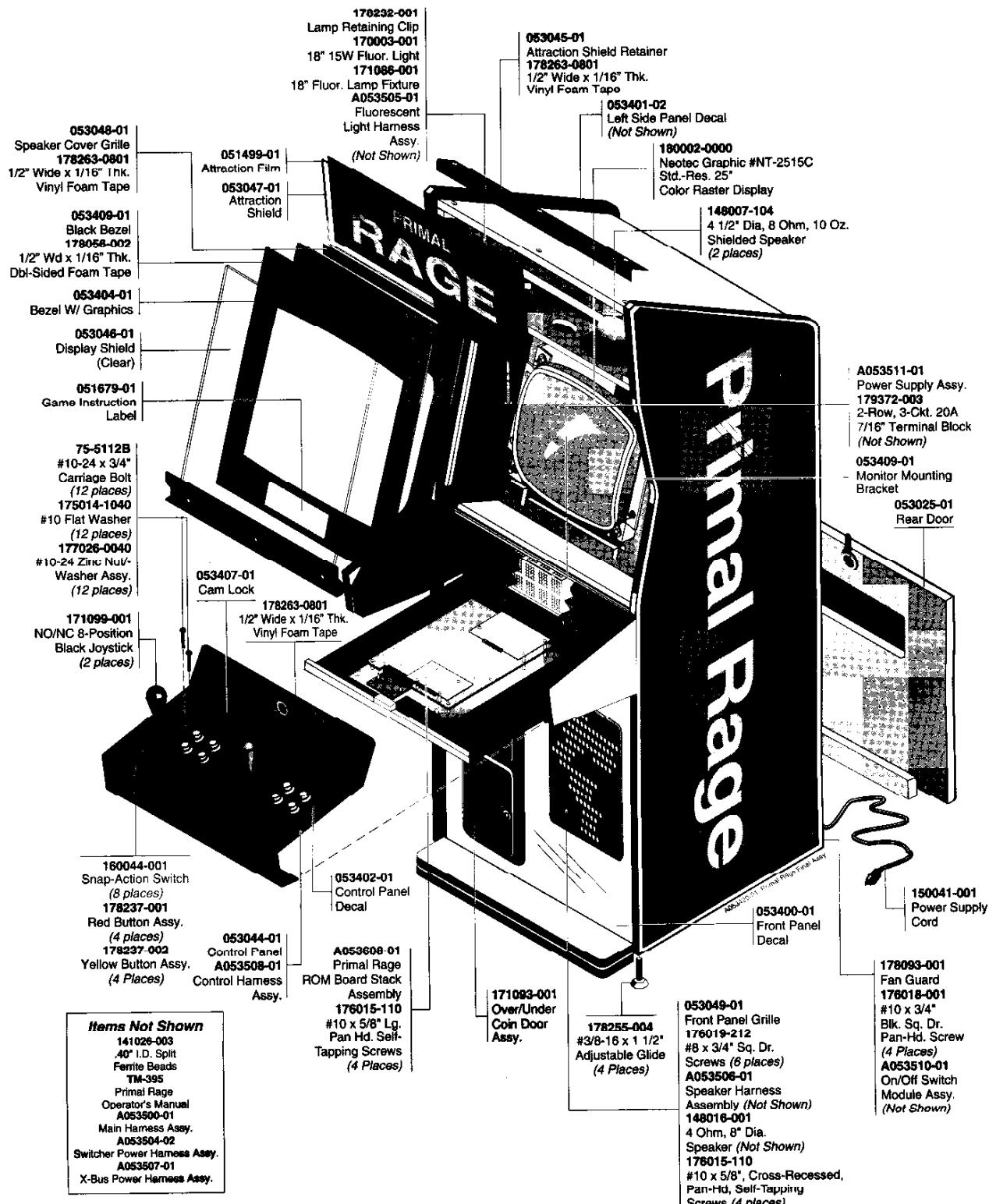
*The low-impedance (75Ω) Neotec NT-2515C monitor (used in the Atari Games standard upright cabinet) and high-impedance Hantarex Polo 33" monitor (used in the Showcase 33 cabinet) are **not** interchangeable. If you do plan to replace an existing monitor with the other type, you must change resistors in the video driver circuits on the Primal Rage game PCB. Refer to the game PCB schematic on page 5-6 for more details.*

# Parts Illustrations

## Part Ordering Information

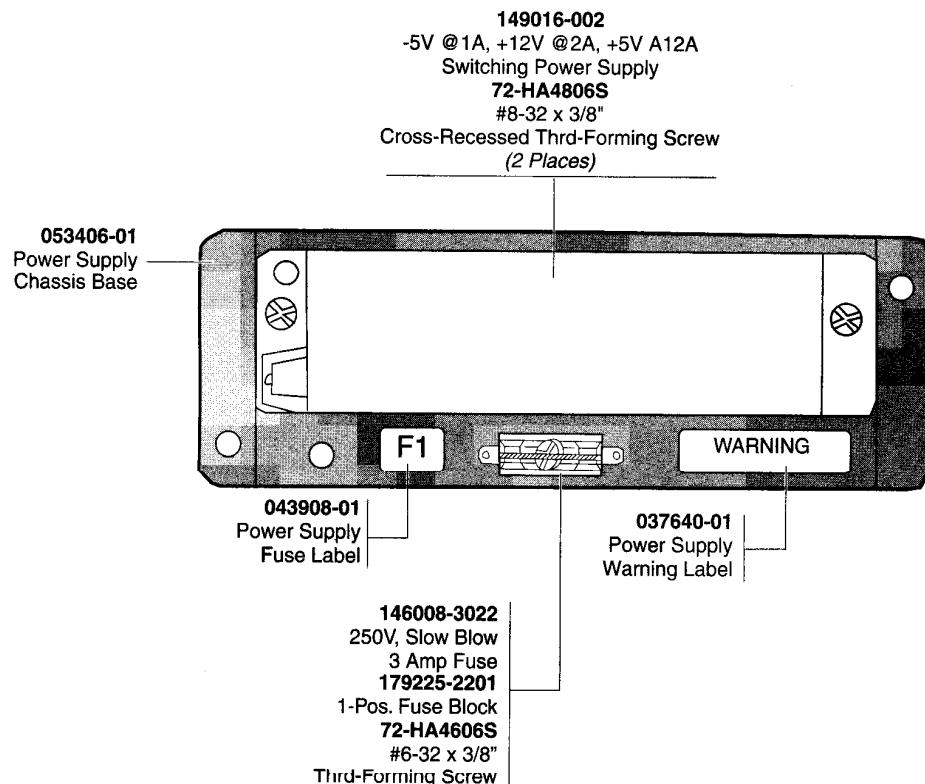
**T**HIS CHAPTER provides information you need to order parts for your game. The printed-circuit board (PCB) parts lists are arranged in alphabetical order by component. Within each section the parts are arranged numerically by part number. When you order parts, give the part number, part name, the number of this manual, and the serial number of your game. With this information, we can fill your order rapidly and correctly. We hope this will create less downtime and more profit from your games. Atari Games Customer Service phone numbers are listed on the inside front cover of this manual.



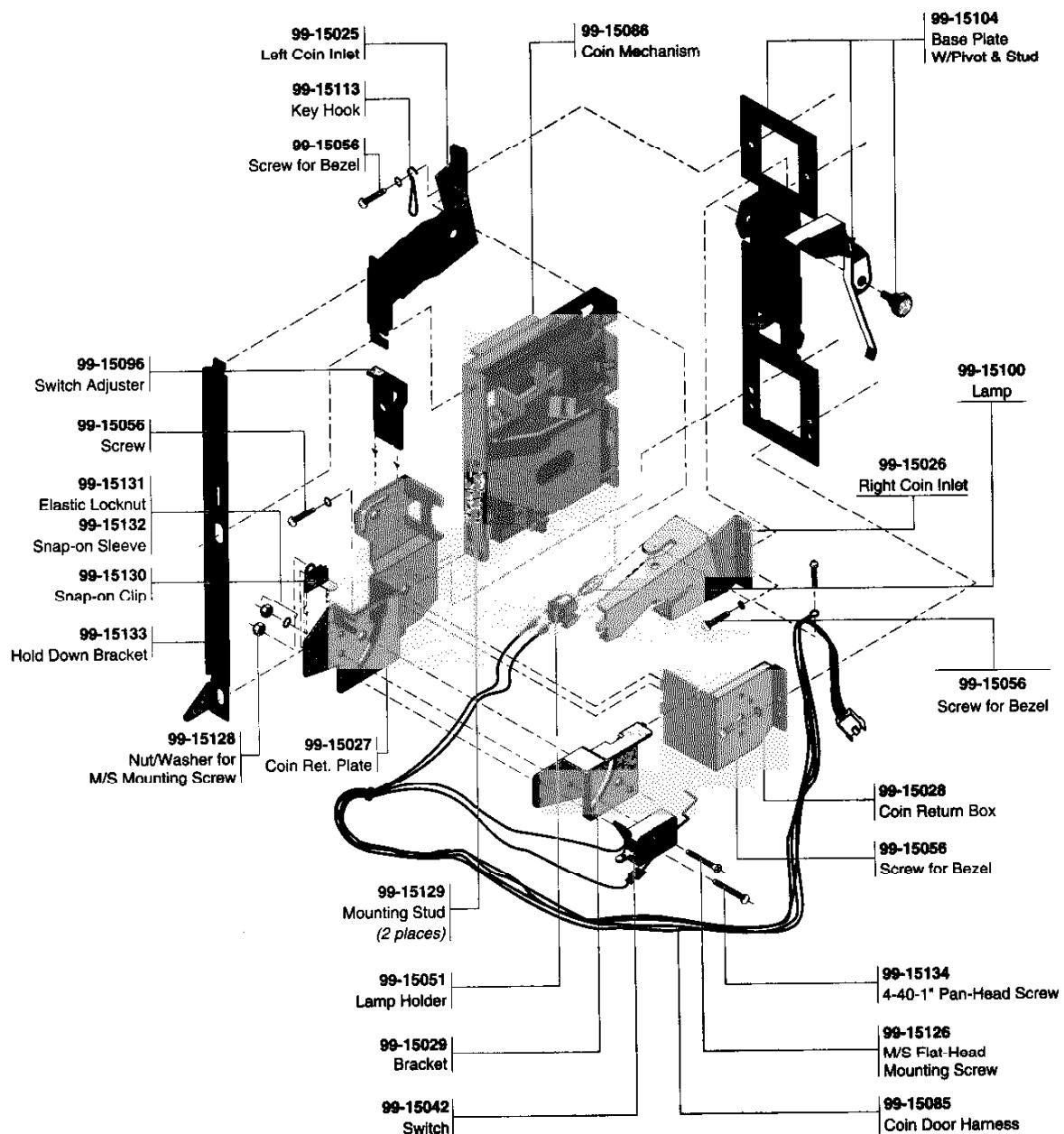


**Figure 4-1 Cabinet Overview**

A053420-01 A

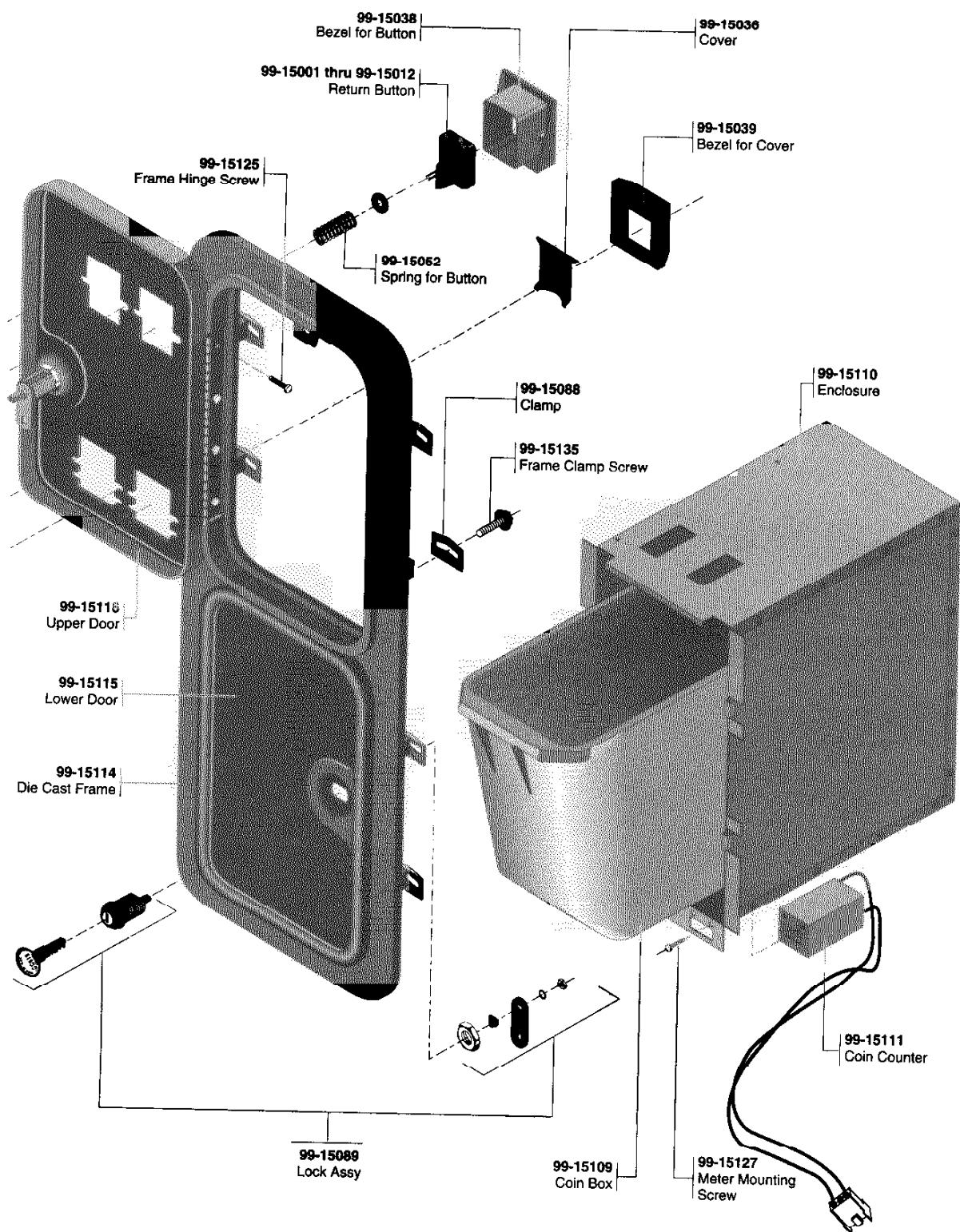
**Figure 4-2 Power Supply Assembly**

A053511-01



**Figure 4-3 Over/Under Coin Door Assembly**

171093-001

**Figure 4-3 Over/Under Coin Door Assembly**

171093-001

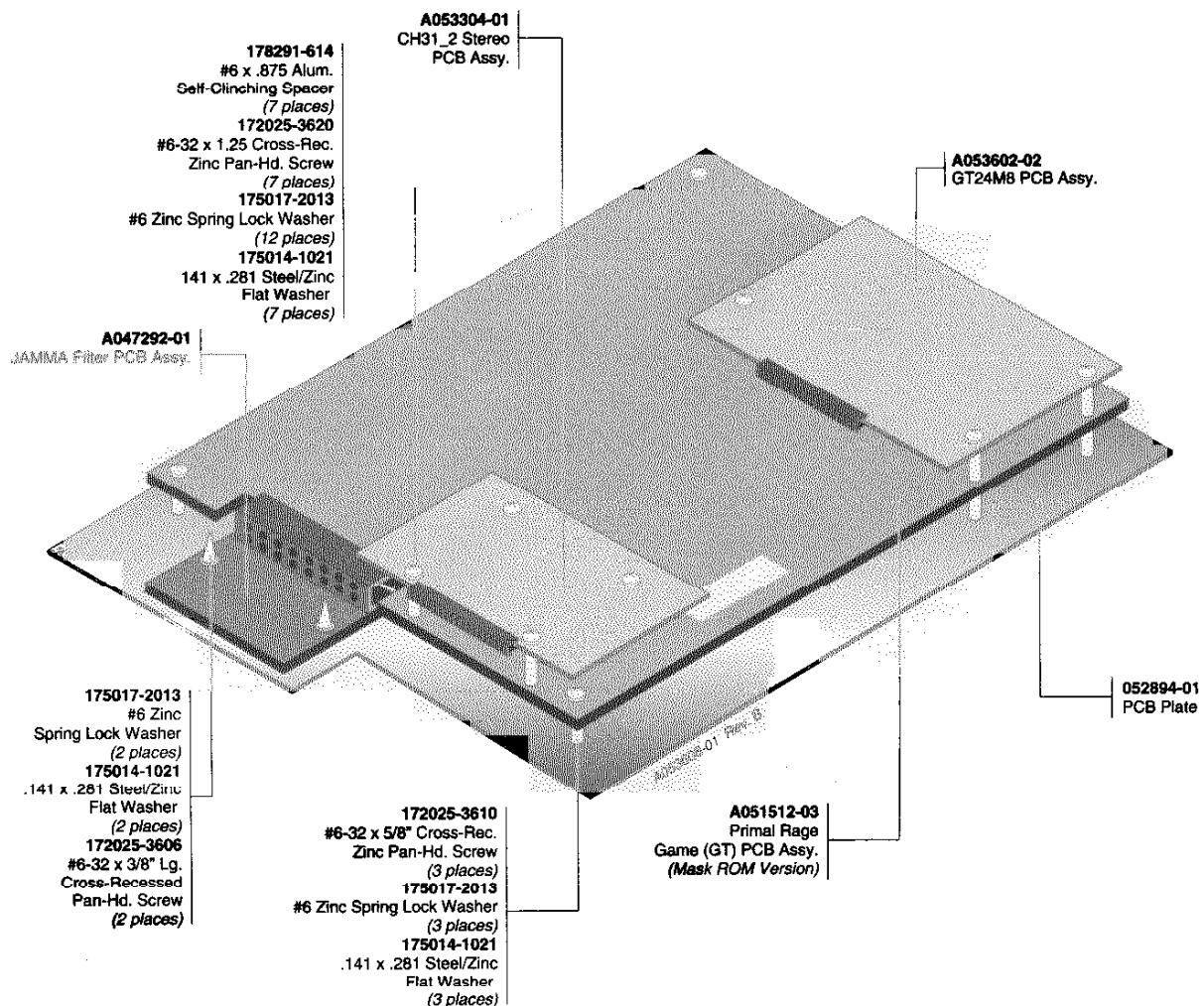
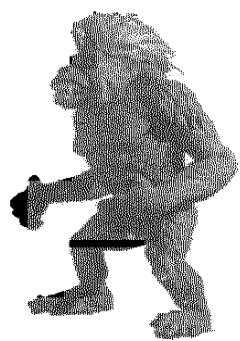
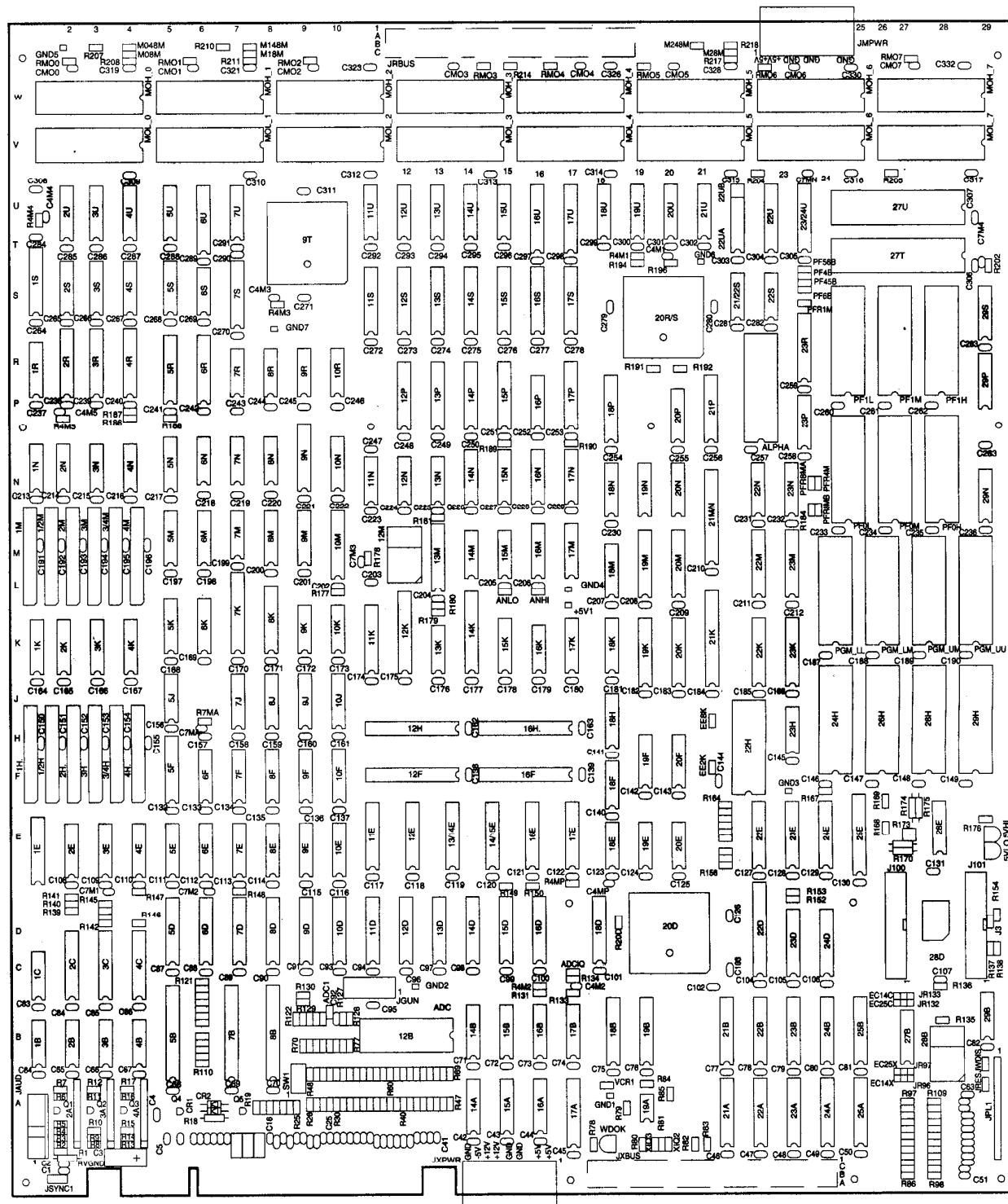


Figure 4-4 Board Stack Assembly

A053399-02 A

N O T E S





**NOTE:** For best display quality, use this game PCB (from an Atari Games standard upright cabinet) only with a Neotec monitor. Do not install this game PCB into a Showcase 33 Deluxe cabinet.

Figure 4-5 Primal Rage Game (GT) PCB Assembly

A051512-03 A

## Primal Rage Game PCB Assembly Parts List

| Designator                           | Description  | Part No.    | Designator | Description                               | Part No.    |
|--------------------------------------|--|-------------|------------|---|-------------|
| 1/2H, 1/2M,                          |  |             | 1          | Pr, EPROM, 512KX8, 100 ns, Pgm Uu<br>XXXX | 136102-0044 |
| 1H., 1M                              | Socket, Zip 28                                       | 179302-028  | 1          | Pr, EPROM, 512KX8, 100 ns, Moh 0 1C39     | 136102-0301 |
| 1S                                   | Socket, 20 Pin, .300, Dbl Wipe                       | 179356-0320 | 1          | Pr, EPROM, 512KX8, 100 ns, Mol 0 2C11     | 136102-0300 |
| 2H., 2M, 3/4H, 3/4M, 3H, 3M, 4H., 4M |  |             | 1          | Pr, EPROM, 512KX8, 150 ns, PF0M XXXX      | 136102-0051 |
|                                      | Socket, Zip 28                                       | 179302-028  | 1          | Pr, EPROM, 512KX8, 150 ns, PF0L XXXX      | 136102-0050 |
| 5B                                   | Socket, 28 Pin, .300, Dbl Wipe                       | 179356-0328 | 1          | Pr, EPROM, 512KX8, 150 ns, Pgm Ll<br>XXXX | 136102-0041 |
| 5F                                   | Socket, 20 Pin, .300, Dbl Wipe                       | 179356-0320 | 1          | Pr, EPROM, 512KX8, 100 ns, Pgm Um<br>XXXX | 136102-0043 |
| 5N                                   | Socket, 16 Pin, .300, Dbl Wipe                       | 179356-0316 | 1/2M       | Integrated Circuit, VRAM, 256KX4, 100 ns  | 137682-100  |
| 7B                                   | Socket, 28 Pin, .300, Dbl Wipe                       | 179356-0328 | 1B         | Integrated Circuit, 74LS11                | 137149-001  |
| 7K                                   | Socket, 24 Pin, .300, Dbl Wipe                       | 179356-0324 | 1C         | Integrated Circuit, 7406                  | 137052-001  |
| 8B                                   | Socket, 28 Pin, .300, Dbl Wipe                       | 179356-0328 | 1E         | Integrated Circuit, 74LS244               | 137038-001  |
| 8K, 9N                               | Socket, 20 Pin, .300, Dbl Wipe                       | 179356-0320 | 1K         | Integrated Circuit, 74F157                | 137494-001  |
| 9T                                   | Socket, 68 Pin, PGA for 68PLCC<br>Integrated Circuit | 179237-068  | 1M         | Integrated Circuit, VRAM, 256KX4, 100 ns  | 137682-100  |
| 10M,11K,11S                          | Socket, 20 Pin, .300, Dbl Wipe                       | 179356-0320 | 1N         | Integrated Circuit, 74F08                 | 137483-001  |
| 12B                                  | Socket, 28 Pin, .600, Dbl Wipe                       | 179356-0628 | 1R         | Integrated Circuit, 74F163                | 137345-001  |
| 12F, 12H                             | Socket, 28 Pin, .300, Dbl Wipe                       | 179356-0328 | 2A         | Res, R2R10, 1K/2K, SIP10                  | 118015-001  |
| 12K                                  | Socket, 24 Pin, .300, Dbl Wipe                       | 179356-0324 | 2B         | Integrated Circuit, 74LS27                | 137062-001  |
| 12S,13M,13S                          | Socket, 20 Pin, .300, Dbl Wipe                       | 179356-0320 | 2C         | Integrated Circuit, 74HCT273              | 137655-001  |
| 14K                                  | Socket, 24 Pin, .300, Dbl Wipe                       | 179356-0324 | 2E         | Integrated Circuit, 74LS157               | 137029-001  |
| 14S, 15S                             | Socket, 20 Pin, .300, Dbl Wipe                       | 179356-0320 | 2K         | Integrated Circuit, 74F157                | 137494-001  |
| 16F, 16H.                            | Socket, 28 Pin, .300, Dbl Wipe                       | 179356-0328 | 2M         | Integrated Circuit, VRAM, 256KX4, 100 ns  | 137682-100  |
| 17P, 17S                             | Socket, 20 Pin, .300, Dbl Wipe                       | 179356-0320 | 2N         | Integrated Circuit, 74F08                 | 137483-001  |
| 20D, 20R/S                           | Socket, 68 Pin, PGA for 68PLCC<br>Integrated Circuit | 179237-068  | 2R         | Integrated Circuit, 74LS377               | 137145-001  |
| 21K, 21M/N                           | Socket, 28 Pin, .300, Dbl Wipe                       | 179356-0328 | 2S         | Integrated Circuit, 74F378                | 137612-001  |
| 22A                                  | Socket, 20 Pin, .300, Dbl Wipe                       | 179356-0320 | 2U         | Integrated Circuit, 74F163                | 137345-001  |
| 22D                                  | Socket, 28 Pin, .300, Dbl Wipe                       | 179356-0328 | 3/4M       | Integrated Circuit, VRAM, 256KX4, 100 ns  | 137682-100  |
| 22E                                  | Socket, 20 Pin, .300, Dbl Wipe                       | 179356-0320 | 3A         | Integrated Circuit, 74HCT273              | 137655-001  |
| 22H                                  | Socket, 24 Pin, .600 Dbl Wipe                        | 179356-0624 | 3B         | Res, R2R10, 1K/2K, SIP10                  | 118015-001  |
| 22UB, 23E,                           |  |             | 3C         | Integrated Circuit, 74F157                | 137494-001  |
| 24E                                  | Socket, 20 Pin, .300, Dbl Wipe                       | 179356-0320 | 3E         | Integrated Circuit, 74LS27                | 137682-100  |
| 24H                                  | Socket, 32 Pin, .600, Dbl Wipe                       | 179356-0632 | 3K         | Integrated Circuit, 74F163                | 137029-001  |
| 25E                                  | Socket, 24 Pin, .300, Dbl Wipe                       | 179356-0324 | 3L         | Integrated Circuit, 74HCT273              | 137655-001  |
| 26H                                  | Socket, 32 Pin, .600, Dbl Wipe                       | 179356-0632 | 3R         | Integrated Circuit, 74LS157               | 137029-001  |
| 27I, 27U                             | Socket, 40 Pin, .600, Dbl Wipe                       | 179356-0640 | 3S         | Integrated Circuit, 74F157                | 137494-001  |
| 28H, 29H                             | Socket, 32 Pin, .600, Dbl Wipe                       | 179356-0632 | 3M         | Integrated Circuit, VRAM, 256KX4, 100 ns  | 137682-100  |
| JXBUS                                | Shroud, 96CKT DIN41621                               | 179369-0096 | 3N         | Integrated Circuit, 74F08                 | 137483-001  |
| ++1005V1                             | Test Point   | 179051-001  | 3R         | Integrated Circuit, 74F377                | 137622-001  |
| 1                                    | Pr, 1020-68PLCC Fpga, 20D XXXX                       | 136101-1005 | 3S         | Integrated Circuit, 74F157                | 137494-001  |
| 1                                    | Pr, EPROM, 128KX8, 100 ns, Alpha<br>XXXX             | 136102-0045 | 3U         | Integrated Circuit, 74F378                | 137612-001  |
| 1                                    | Pr, EPROM, 512KX8, 100 ns, Pgm Lm<br>XXXX            | 136102-0042 | 4A         | Res, R2R10, 1K/2K, SIP10                  | 118015-001  |
|                                      |  |             | 4B         | Integrated Circuit, 74LS27                | 137062-001  |

## T-MEK Game PCB Assembly, Continued

### Parts List

| <b>Designator</b> | <b>Description</b>                           | <b>Part No.</b> | <b>Designator</b> | <b>Description</b>                            | <b>Part No.</b> |
|-------------------|--|-----------------|-------------------|---|-----------------|
| 4C                | Integrated Circuit, 74HCT273                 | 137655-001      | 10D               | Integrated Circuit, 74F374                    | 137420-001      |
| 4E                | Integrated Circuit, 74LS157                  | 137029-001      | 10E               | Integrated Circuit, 74LS157                   | 137029-001      |
| 4K                | Integrated Circuit, 74F157                   | 137494-001      | 10F, 10J          | Integrated Circuit, 74F153                    | 137492-001      |
| 4M                | Integrated Circuit, VRAM, 256KX4, 100 ns     | 137682-100      | 10K               | Integrated Circuit, 74LS86                    | 137079-001      |
| 4N                | Integrated Circuit, 74F32                    | 137486-001      | 10N               | Integrated Circuit, 74LS163 A                 | 137114-001      |
| 4R                | Integrated Circuit, 74LS377                  | 137145-001      | 10R               | Integrated Circuit, 74F04                     | 137437-001      |
| 4S                | Integrated Circuit, 74F157                   | 137494-001      | 11D, 11E          | Integrated Circuit, 74F273                    | 137610-001      |
| 4U                | Integrated Circuit, 74F163                   | 137345-001      | 11N               | Integrated Circuit, 74F04                     | 137437-001      |
| 5D                | Integrated Circuit, 74LS245                  | 137134-001      | 11U               | Integrated Circuit, 74F163                    | 137345-001      |
| 5E                | Integrated Circuit, 74LS157                  | 137029-001      | 12D, 12E          | Integrated Circuit, 74F374                    | 137420-001      |
| 5J                | Integrated Circuit, 74F08                    | 137483-001      | 12H               | Integrated Circuit, SRAM, 32KX8,<br>25 ns, .3 | 137670-025      |
| 5K, 5M            | Integrated Circuit, 74F157                   | 137494-001      | 12M               | Crystal, 28.636 MHz, Osc. Module              | 144008-009      |
| 5R                | Integrated Circuit, 74LS244                  | 137038-001      | 12N               | Integrated Circuit, 74F74                     | 137436-001      |
| 5S, 5U            | Integrated Circuit, 74F169                   | 137496-001      | 12P               | Integrated Circuit, 74F273                    | 137610-001      |
| 5VHI, 5VLO        | LED, Red, T1-3/4, Diffused, .5MCD,<br>80-Deg | 138021-001      | 12U               | Integrated Circuit, 74F163                    | 137345-001      |
| 6D                | Integrated Circuit, 74F374                   | 137420-001      | 13/14E, 13D       | Integrated Circuit, 74LS245                   | 137134-001      |
| 6E                | Integrated Circuit, 74LS157                  | 137029-001      | 13K               | Integrated Circuit, 74F32                     | 137486-001      |
| 6F, 6K, 6M        | Integrated Circuit, 74F157                   | 137494-001      | 13N               | Integrated Circuit, 74F74                     | 137436-001      |
| 6N                | Integrated Circuit, 74F32                    | 137486-001      | 13P               | Integrated Circuit, 74F374                    | 137420-001      |
| 6R                | Integrated Circuit, 74LS244                  | 137038-001      | 13U               | Integrated Circuit, 74F163                    | 137345-001      |
| 6S                | Integrated Circuit, 74F260                   | 137570-001      | 14/15E            | Integrated Circuit, 74F273                    | 137610-001      |
| 6U                | Integrated Circuit, 74F377                   | 137622-001      | 14A, 14B          | Integrated Circuit, 74LS257                   | 137136-001      |
| 7D                | Integrated Circuit, 74LS245                  | 137134-001      | 14D               | Integrated Circuit, 74F273                    | 137610-001      |
| 7E                | Integrated Circuit, 74LS157                  | 137029-001      | 14M               | Integrated Circuit, 74F00                     | 137327-001      |
| 7F, 7J            | Integrated Circuit, 74F153                   | 137492-001      | 14N               | Integrated Circuit, 74F157                    | 137494-001      |
| 7M                | Integrated Circuit, 74LS74                   | 137023-001      | 14P               | Integrated Circuit, 74F374                    | 137420-001      |
| 7N                | Integrated Circuit, 74F32                    | 137486-001      | 14U               | Integrated Circuit, 74F163                    | 137345-001      |
| 7R                | Integrated Circuit, 74F08                    | 137483-001      | 15A, 15B          | Integrated Circuit, 74LS257                   | 137136-001      |
| 7S                | Integrated Circuit, 74F377                   | 137622-001      | 15D               | Integrated Circuit, 74F374                    | 137420-001      |
| 7U                | Integrated Circuit, 74F169                   | 137496-001      | 15K               | Integrated Circuit, 74F153                    | 137492-001      |
| 8D                | Integrated Circuit, 74F374                   | 137420-001      | 15M               | Integrated Circuit, 74F86                     | 137649-001      |
| 8E                | Integrated Circuit, 74LS157                  | 137029-001      | 15N               | Integrated Circuit, 74F153                    | 137492-001      |
| 8F, 8J            | Integrated Circuit, 74F153                   | 137492-001      | 15P               | Integrated Circuit, 74F374                    | 137420-001      |
| 8M                | Integrated Circuit, 74F174                   | 137531-001      | 15U               | Integrated Circuit, 74F163                    | 137345-001      |
| 8N                | Integrated Circuit, 74F08                    | 137483-001      | 16A, 16B          | Integrated Circuit, 74LS257                   | 137136-001      |
| 8R                | Integrated Circuit, 74F02                    | 137481-001      | 16D               | Integrated Circuit, 74LS245                   | 137134-001      |
| 9D                | Integrated Circuit, 74LS245                  | 137134-001      | 16E               | Integrated Circuit, 74F374                    | 137420-001      |
| 9E                | Integrated Circuit, 74LS157                  | 137029-001      | 16H               | Integrated Circuit, SRAM, 32KX8,<br>25 ns, .3 | 137670-025      |
| 9F, 9J            | Integrated Circuit, 74F153                   | 137492-001      | 16K               | Integrated Circuit, 74LS04                    | 137009-001      |
| 9K                | Integrated Circuit, 74F260                   | 137570-001      | 16M, 16N          | Integrated Circuit, 74F153                    | 137492-001      |
| 9M                | Integrated Circuit, 74F163                   | 137345-001      |                   |   |                 |
| 9R                | Integrated Circuit, 74F00                    | 137327-001      |                   |   |                 |

**Primal Rage Game PCB Assembly, Continued**  
**Parts List**

| Designator | Description                                | Part No.   | Designator | Description                                       | Part No.    |
|------------|--|------------|------------|---|-------------|
| 16P        | Integrated Circuit, 74F151                 | 137490-001 | 23A        | Integrated Circuit, 74LS244                       | 137038-001  |
| 16S        | Integrated Circuit, 74F374                 | 137420-001 | 23B        | Integrated Circuit, 74LS273                       | 137040-001  |
| 16U        | Integrated Circuit, 74F244                 | 137502-001 | 23D        | Integrated Circuit, 74LS245                       | 137134-001  |
| 17A        | Integrated Circuit, 74LS273                | 137040-001 | 23H        | Integrated Circuit, 74F32                         | 137486-001  |
| 17B        | Integrated Circuit, 74LS148                | 137417-001 | 23K, 23M   | Integrated Circuit, 74LS374                       | 137144-001  |
| 17E        | Integrated Circuit, 74LS245                | 137134-001 | 23N        | Integrated Circuit, 74LS378                       | 137305-001  |
| 17K        | Integrated Circuit, 74LS157                | 137029-001 | 23P        | Integrated Circuit, 74LS157                       | 137029-001  |
| 17M, 17N   | Integrated Circuit, 74F153                 | 137492-001 | 23R        | Integrated Circuit, 74LS377                       | 137145-001  |
| 17U        | Integrated Circuit, 74F244                 | 137502-001 | 24A        | Integrated Circuit, 74LS245                       | 137134-001  |
| 18B, 18D   | Integrated Circuit, 74LS245                | 137134-001 | 24B, 24D   | Integrated Circuit, 74F245                        | 137591-001  |
| 18E        | Integrated Circuit, 74F04                  | 137437-001 | 24H        | Integrated Circuit, SRAM, 32KX8, 70 ns, .6        | 137615-070  |
| 18F        | Integrated Circuit, 74LS74                 | 137023-001 | 25A        | Integrated Circuit, 74LS245                       | 137134-001  |
| 18H        | Integrated Circuit, 74F138                 | 137521-001 | 25B        | Integrated Circuit, 74F245                        | 137591-001  |
| 18K, 18M   | Integrated Circuit, 74F153                 | 137492-001 | 26H        | Integrated Circuit, SRAM, 32KX8, 70 ns, .6        | 137615-070  |
| 18N        | Integrated Circuit, 74LS163 A              | 137114-001 | 27B        | Integrated Circuit, 74F163                        | 137345-001  |
| 18U        | Integrated Circuit, 74F163                 | 137345-001 | 27T        | Integrated Circuit, SOS                           | 137550-001  |
| 19A        | Integrated Circuit, DS1232                 | 137762-001 | 27U        | Integrated Circuit, Pfhs                          | 137419-104  |
| 19B        | Integrated Circuit, 74LS273                | 137040-001 | 28B        | Crystal, 50.000 MHz, Osc. Module                  | 144008-005  |
| 19E        | Integrated Circuit, 74LS74                 | 137023-001 | 28D        | Integrated Circuit, CPU, 68EC020, 25 MHz, 100PQFP | 137691-025  |
| 19F        | Integrated Circuit, 74F138                 | 137521-001 | 28E        | Integrated Circuit, LM613                         | 137746-001  |
| 19K, 19M   | Integrated Circuit, 74LS245                | 137134-001 | 28H        | Integrated Circuit, SRAM, 32KX8, 70 ns, .6        | 137615-070  |
| 19N        | Integrated Circuit, 74LS163 A              | 137114-001 | 29B        | Integrated Circuit, 74F20                         | 137530-001  |
| 19U        | Integrated Circuit, 74F163                 | 137345-001 | 29H        | Integrated Circuit, SRAM, 32KX8, 70 ns, .6        | 137615-070  |
| 20E        | Integrated Circuit, 74F08                  | 137483-001 | 29N        | Integrated Circuit, 74LS298                       | 137201-001  |
| 20F        | Integrated Circuit, 74F138                 | 137521-001 | 29P        | Integrated Circuit, 74LS153                       | 137104-001  |
| 20K, 20M   | Integrated Circuit, 74LS374                | 137144-001 | 29S        | Integrated Circuit, 74LS298                       | 137201-001  |
| 20N        | Integrated Circuit, 74LS163 A              | 137114-001 | A          | Pr, Fpla, 20NS, 9T 446D                           | 136094-0004 |
| 20P        | Integrated Circuit, 74LS378                | 137305-001 | A          | Pr, GAL16V8, 25NS, 11K 72ED                       | 136101-0011 |
| 20R/S      | Integrated Circuit, CPU, PLCC              | 137658-101 | A          | Pr, GAL16V8, 10NS, 22UB 3863                      | 136101-1220 |
| 20U        | Integrated Circuit, 74F163                 | 137345-001 | A          | Pr, GAL16V8, 15NS, 22A 2A8 A                      | 136101-0021 |
| 21/22S     | Integrated Circuit, 74F04                  | 137437-001 | A          | Pr, GAL16V8, 15NS, 23F 75C3                       | 136101-0013 |
| 21B        | Integrated Circuit, 74LS245                | 137134-001 | A          | Pr, GAL16V8, 25NS, 12S 4A81                       | 136094-0014 |
| 21K,21M/N  | Integrated Circuit, SRAM, 32KX8, 25 ns, .3 | 137670-025 | A          | Pr, GAL16V8, 25NS, 9N 5AED                        | 136101-0012 |
| 21P        | Integrated Circuit, 74LS377                | 137145-001 | A          | Pr, GAL16V8, 25NS, 17S 3139                       | 136094-0007 |
| 21U        | Integrated Circuit, 74F163                 | 137345-001 | A          | Pr, GAL16V8, 25NS, 13M 5C94                       | 136101-1008 |
| 22B        | Integrated Circuit, 74LS245                | 137134-001 | A          | Pr, GAL16V8, 25NS, 17P 270 A                      | 136094-0015 |
| 22D        | Integrated Circuit, SRAM, 8KX8, 25 ns, .3  | 137667-025 | A          | Pr, GAL16V8, 25NS, 11S 25F2                       | 136094-0016 |
| 22H        | Integrated Circuit, 28C16-200, 200 ns      | 137648-200 | A          | Pr, GAL16V8, 25NS, 24E 477 A                      | 136101-0018 |
| 22K, 22M   | Integrated Circuit, 74LS245                | 137134-001 | A          | Pr, GAL16V8, 10NS, 1S B535                        | 136101-0006 |
| 22N        | Integrated Circuit, 74LS378                | 137305-001 |            |   |             |
| 22S        | Integrated Circuit, 74F04                  | 137437-001 |            |   |             |
| 22U,23/24U | Integrated Circuit, 74LS273                | 137040-001 |            |   |             |

## Primal Rage Game PCB Assembly, Continued

### Parts List

| <b>Designator</b>                                  | <b>Description</b>                           | <b>Part No.</b> | <b>Designator</b>  | <b>Description</b>                            | <b>Part No.</b> |
|--|--|-----------------|--|---|-----------------|
| A  | Pr, GAL16V8, 25NS, 10M 326F                  | 136101-0009     |  |   |                 |
| A  | Pr, GAL20V8, 25NS, 7K 9CA6                   | 136101-0019     |  |   |                 |
| A  | Pr, GAL22V10, 10NS, 25E D358                 | 136101-0017     |  |   |                 |
| A  | Pr, GAL22V10, 15NS, 12K 7553                 | 136101-1022     |  |   |                 |
| A  | Pr, PROM, 82S147, 13S 76B6                   | 136094-0001     | EC25C, EC25X, EE2K   | Resistor, 10 Ω, ±5%, 1/8 W                    | 110027-100      |
| A  | Pr, PROM, 82S147, 14S FD85                   | 136094-0002     | GND1-7   | Test Point                                    | 179051-001      |
| A  | Pr, PROM, 82S147, 15S 9B61                   | 136094-0003     | J3   | Connector, 2 Circuit, Header, .100 Ctr        | 179048-002      |
| ADC1   | Connector, 2 Circuit, Header, .100 Ctr       | 179048-002      | JAUD   | Connector, 6 Ckt, Header, .156 Ctr, Key 3     | 179213-006      |
| ALPHA  | Socket, 32 Pin, .600, Dbl-Wipe               | 179356-0632     | JMPWR  | Connector, 9 Ckt, Header, .156 Ctr, Rt, Key 3 | 179165-009      |
| ANLO   | Resistor, 10 Ω, ±5%, 1/8 W                   | 110027-100      | JPL1   | Connector, 15 Ckt, Header, .100 Ctr           | 179118-015      |
| B  | Pr, GAL16V8, 25NS, 22E B82E                  | 136101-1025     | JRBUS  | Connector, 96 Ckt, Rcpt, Pressfit, Long       | 179368-0096     |
| B  | Pr, GAL16V8, 25NS, 8K 5ADE                   | 136101-0010     | JRBUS)   | Shroud, 96CKT, DIN41621                       | 179369-0096     |
| C1, C2   | Capacitor, 100 pF, 100 V, ±5%, Ceramic       | 122016-101      | JRES   | Connector, 2 Circuit, Header, .100 Ctr        | 179048-002      |
| C3   | Capacitor, 100 μF, 16 V, Electrolytic, Axial | 124008-107      | JSYNC1   | Connector, 3 Ckt, Header, .100 Ctr            | 179048-003      |
| C4   | Capacitor, .1 μF, 50 V, +80%–20%, Cer.       | 122002-104      | JWDIS  | Connector, 2 Circuit, IIcadcr, .100 Ctr       | 179048-002      |
| C4M1-C4M5,   |  |                 | JXBUS  | Connector, 96 Ckt, Rcpt, Pressfit, Long       | 179368-0096     |
| C4MP   | Capacitor, 47 pF, 100 V, ±5%, Ceramic        | 122016-470      | JXPWR  | Connector, 9 Ckt, Header, .156 Ctr, Rt, Key 3 | 179165-009      |
| C5-C8  | Capacitor, .01 μF, 50 V, +80%–20%, Cer.      | 122002-103      | M28M, M48M, M148M, M248M                                     |   |                 |
| C7M1-C7M4, C7MA, C7MN                              | Capacitor, 47 pF, 100 V, ±5%, Ceramic        | 122016-470      | Resistor, 10 Ω, ±5%, 1/8 W                                   | 110027-100                                    |                 |
| C9-C12   | Capacitor, 1000 pF, 100 V, ±10%, Cer.        | 122015-102      | MOH_0-MOH_7, MOL_0-MOL_7, PF0H, PF0L, PF0M, PF1H, PF1L, PF1M |   |                 |
| C13-C15  | Capacitor, 270PFC, 50 V, EMI Filter          | 140006-271      | Socket, 32 Pin, .600, Dbl Wipe                               | 179356-0632                                   |                 |
| C16  | Capacitor, 100 pF, 100 V, ±5%, Ceramic       | 122016-101      | PGM_LL   | Socket, 32 Pin, .600, Dbl Wipe                | 179356-0632     |
| C17  | Capacitor, .1 μF, 50 V, ±80%–20%, Cer.       | 122002-104      | PGM_LM   | Socket, 32 Pin, .600, Dbl Wipe                | 179356-0632     |
| C18  | Capacitor, .01 μF, 50 V, ±80%–20%, Cer.      | 122002-103      | PGM_UM   | Socket, 32 Pin, .600, Dbl Wipe                | 179356-0632     |
| C19  | Capacitor, .1 μF, 50 V, ±80%–20%, Cer.       | 122002-104      | PGM_UU   | Socket, 32 Pin, .600, Dbl Wipe                | 179356-0632     |
| C20, C21   | Capacitor, .01 μF, 50 V, ±80%–20%, Cer.      | 122002-103      | Q1-Q3  | Transistor, 2N3904                            | 133041-001      |
| C22, C23   | Capacitor, .1 μF, 50 V, ±80%–20%, Cer.       | 122002-104      | Q4, Q5   | Transistor, 2N5306                            | 133033-001      |
| C24-C31  | Capacitor, .01 μF, 50 V, ±80%–20%, Cer.      | 122002-103      | PF6B, PF56B, PFR4M   |   |                 |
| C32-C37  | Capacitor, .1 μF, 50 V, ±80%–20%, Cer.       | 122002-104      | Resistor, 10 Ω, ±5%, 1/8 W                                   | 110027-100                                    |                 |
| C38-C41  | Capacitor, .01 μF, 50 V, ±80%–20%, Cer.      | 122002-103      | R1   | Resistor, 470 Ω, ±5%, 1/8 W                   | 110027-471      |
| C42-C50  | Capacitor, .1 μF, 50 V, ±80%–20%, Cer.       | 122002-104      | R2   | Resistor, 75 Ω, ±5%, 1/8 W                    | 110027-750      |
| C51, C52   | Capacitor, .01 μF, 50 V, ±80%–20%, Cer.      | 122002-103      | R3   | Resistor, 470 Ω, ±5%, 1/8 W                   | 110027-471      |
| C53-C60  | Capacitor, .1 μF, 50 V, ±80%–20%, Cer.       | 122002-104      | R4   | Resistor, 10 Ω, ±5%, 1/8 W                    | 110027-100      |
| C61, C62   | Capacitor, .01 μF, 50 V, ±80%–20%, Cer.      | 122002-103      | R4M1-R4M5, R4MP  |   |                 |
| C63-C317, C319, C321, C323, C326, C328, C330, C332 | Capacitor, .1 μF, 50 V, ±80%–20%, Cer.       | 122002-104      | Resistor, 47 Ω, ±5%, 1/8 W                                   | 110027-470                                    |                 |
| CMO0-7   | Capacitor, 47 pF, 100 V, ±5%, Ceramic        | 122016-470      | R5   | Resistor, 100 Ω, ±5%, 1/8 W                   | 110027-101      |
| CR1, CR2   | Diode, 1N4001                                | 131048-001      | R6   | Resistor, 1 K Ω, ±5%, 1/8 W                   | 110027-102      |
|  |  |                 | R7   | Resistor, 2.4 K Ω, ±5%, 1/8 W                 | 110027-242      |
|  |  |                 | R7MA   | Resistor, 47 Ω, ±5%, 1/8 W                    | 110027-470      |
|  |  |                 | R8   | Resistor, 75 Ω, ±5%, 1/8 W                    | 110027-750      |

## Primal Rage Game PCB Assembly, Continued

### Parts List

| <b>Designator</b> | <b>Description</b>            | <b>Part No.</b> | <b>Designator</b>                        | <b>Description</b>                        | <b>Part No.</b> |
|-------------------|-------------------------------|-----------------|--|---|-----------------|
| R9                | Resistor, 10 Ω, ±5%, 1/8 W    | 110027-100      | R153                                     | Resistor, 2.2 K Ω, ±5%, 1/8 W             | 110027-222      |
| R10               | Resistor, 100 Ω, ±5%, 1/8 W   | 110027-101      | R154                                     | Resistor, 10 K Ω, ±5%, 1/8 W              | 110027-103      |
| R11               | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | R156-R158                                | Resistor, 100 Ω, ±5%, 1/8 W               | 110027-101      |
| R12               | Resistor, 2.4 K Ω, ±5%, 1/8 W | 110027-242      | R159                                     | Resistor, 1 K Ω, ±5%, 1/8 W               | 110027-102      |
| R13               | Resistor, 75 Ω, ±5%, 1/8 W    | 110027-750      | R160                                     | Resistor, 10 Ω, ±5%, 1/8 W                | 110027-100      |
| R14               | Resistor, 10 Ω, ±5%, 1/8 W    | 110027-100      | R161, R162                               | Resistor, 1 K Ω, ±5%, 1/8 W               | 110027-102      |
| R15               | Resistor, 100 Ω, ±5%, 1/8 W   | 110027-101      | R163, R164                               | Resistor, 10 Ω, ±5%, 1/8 W                | 110027-100      |
| R16               | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | R167                                     | Resistor, 510 Ω, ±5%, 1/8 W               | 110027-510      |
| R17               | Resistor, 2.4 K Ω, ±5%, 1/8 W | 110027-242      | R168                                     | Resistor, 10 Ω, ±5%, 1/8 W                | 110027-100      |
| R18               | Resistor, 0 Ω, ±5%, 1/4 W     | 110005-001      | R169                                     | Resistor, 10 K Ω, ±5%, 1/8 W              | 110027-103      |
| R19, R20          | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | R170                                     | Resistor, 11.0 K Ω, ±1%, 1/4 W            | 110034-1102     |
| R20D              | Resistor, 10 Ω, ±5%, 1/8 W    | 110027-100      | R171                                     | Resistor, 10.5 K Ω, ±1%, 1/4 W            | 110034-1052     |
| R21               | Resistor, 470 Ω, ±5%, 1/8 W   | 110027-471      | R172                                     | Resistor, 1 K Ω, ±5%, 1/8 W               | 110027-102      |
| R22-R25           | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | R173                                     | Resistor, 39 K Ω, ±5%, 1/8 W              | 110027-393      |
| R26, R27          | Resistor, 470 Ω, ±5%, 1/8 W   | 110027-471      | R174, R175                               | Resistor, 39.2 K Ω, ±1%, 1/4 W            | 110034-3922     |
| R28-R35           | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | R176                                     | Resistor, 470 Ω, ±5%, 1/8 W               | 110027-471      |
| R36-R45           | Resistor, 470 Ω, ±5%, 1/8 W   | 110027-471      | R178                                     | Resistor, 47 Ω, ±5%, 1/8 W                | 110027-470      |
| R46               | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | R179, R180                               | Resistor, 10 K Ω, ±5%, 1/8 W              | 110027-103      |
| R47               | Resistor, 470 Ω, ±5%, 1/8 W   | 110027-471      | R181                                     | Resistor, 4.7 K Ω, ±5%, 1/8 W             | 110027-472      |
| R48, R49          | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | R184                                     | Resistor, 10 K Ω, ±5%, 1/8 W              | 110027-103      |
| R50-R57           | Resistor, 470 Ω, ±5%, 1/8 W   | 110027-471      | R186                                     | Resistor, 1 K Ω, ±5%, 1/8 W               | 110027-102      |
| R58-R68           | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | R188                                     | Resistor, 10 Ω, ±5%, 1/8 W                | 110027-100      |
| R69               | Resistor, 470 Ω, ±5%, 1/8 W   | 110027-471      | R189                                     | Resistor, 470 Ω, ±5%, 1/8 W               | 110027-471      |
| R70-R77           | Resistor, 10 K Ω, ±5%, 1/8 W  | 110027-103      | R190                                     | Resistor, 10 K Ω, ±5%, 1/8 W              | 110027-103      |
| R78-R83           | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | R191, R192                               | Resistor, 1 K Ω, ±5%, 1/8 W               | 110027-102      |
| R84               | Resistor, 4.7 K Ω, ±5%, 1/8 W | 110027-472      | R194                                     | Resistor, 470 Ω, ±5%, 1/8 W               | 110027-471      |
| R85-R97           | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | R196                                     | Resistor, 1 K Ω, ±5%, 1/8 W               | 110027-102      |
| R98-R109          | Resistor, 470 Ω, ±5%, 1/8 W   | 110027-471      | R202                                     | Resistor, 47 Ω, ±5%, 1/8 W                | 110027-470      |
| R110-R123         | Resistor, 10 Ω, ±5%, 1/8 W    | 110027-100      | R204                                     | Resistor, 4.7 K Ω, ±5%, 1/8 W             | 110027-472      |
| R124              | Resistor, 100 Ω, ±5%, 1/8 W   | 110027-101      | R205                                     | Resistor, 47 Ω, ±5%, 1/8 W                | 110027-470      |
| R125              | Resistor, 220 Ω, ±5%, 1/8 W   | 110027-221      | R207, R208, R210, R211, R214, R217, R218 | Resistor, 10 K Ω, ±5%, 1/8 W              | 110027-103      |
| R126, R127        | Resistor, 100 Ω, ±5%, 1/8 W   | 110027-101      | R208                                     | Resistor, 10 K Ω, ±5%, 1/8 W              | 110027-103      |
| R128              | Resistor, 10 K Ω, ±5%, 1/8 W  | 110027-103      | RMO0-RMO7                                |   |                 |
| R129, R130        | Resistor, 10 Ω, ±5%, 1/8 W    | 110027-100      | RVGND                                    | Resistor, 47 Ω, ±5%, 1/8 W                | 110027-470      |
| R131              | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      | SW1                                      | Switch, Slide, SPDT                       | 160040-001      |
| R133              | Resistor, 470 Ω, ±5%, 1/8 W   | 110027-471      | VCR1                                     | Connector, 2 Circuit, Header, .100 Ctr    | 179048-002      |
| R134              | Resistor, 4.7 K Ω, ±5%, 1/8 W | 110027-472      | WDOK                                     | LED, Red, T1-3/4, Diffused, .5MCD, 80-Deg | 138021-001      |
| R136              | Resistor, 10 K Ω, ±5%, 1/8 W  | 110027-103      | XIQ2                                     | Resistor, 10 Ω, ±5%, 1/8 W                | 110027-100      |
| R137, R138        | Resistor, 220 Ω, ±5%, 1/8 W   | 110027-221      |  |   |                 |
| R139-R146         | Resistor, 10 Ω, ±5%, 1/8 W    | 110027-100      |  |   |                 |
| R147, R148        | Resistor, 47 Ω, ±5%, 1/8 W    | 110027-470      |  |   |                 |
| R149, R152        | Resistor, 1 K Ω, ±5%, 1/8 W   | 110027-102      |  |   |                 |

N O T E S



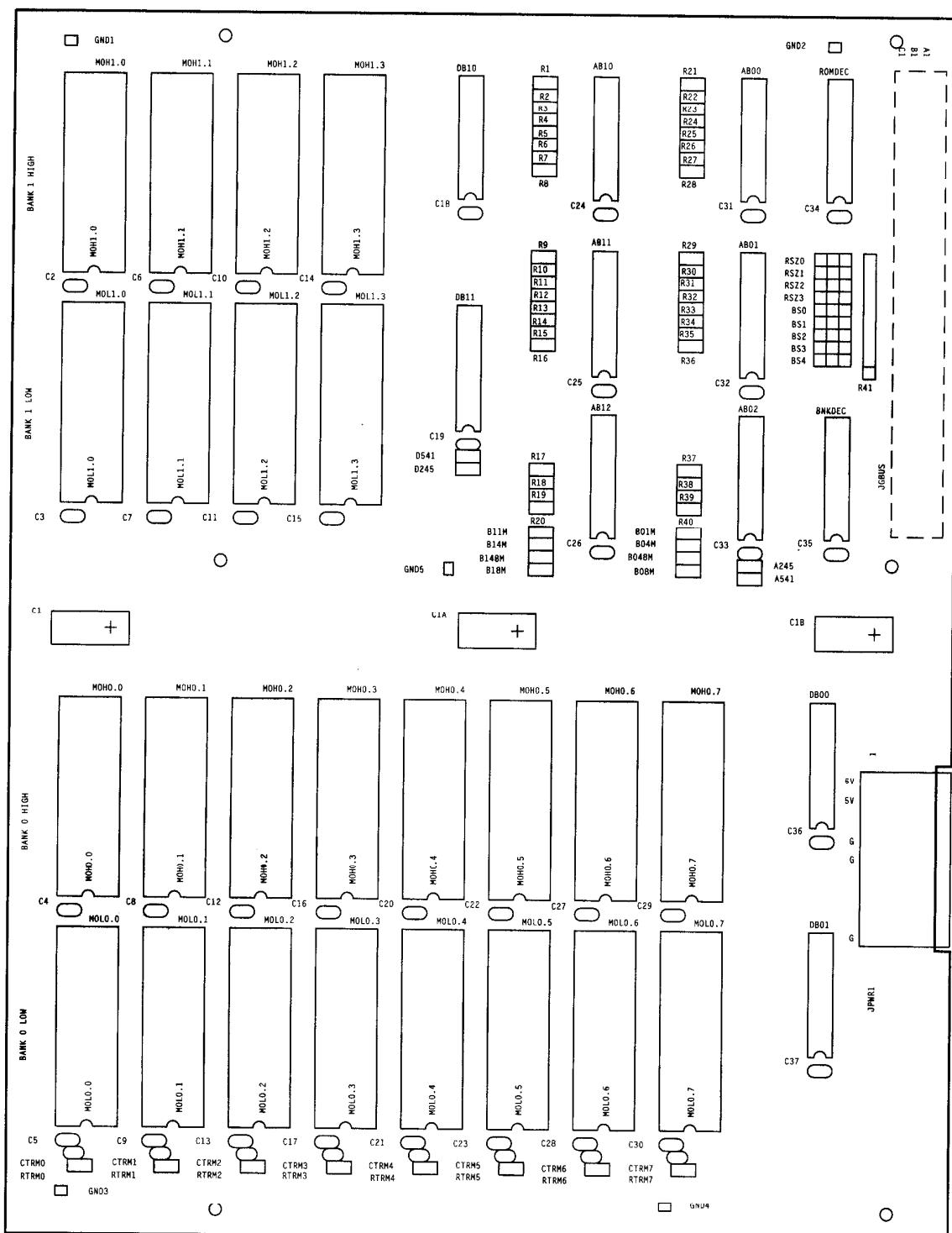


Figure 4-6 GT24M8 PCB Assembly

A053602-02 A

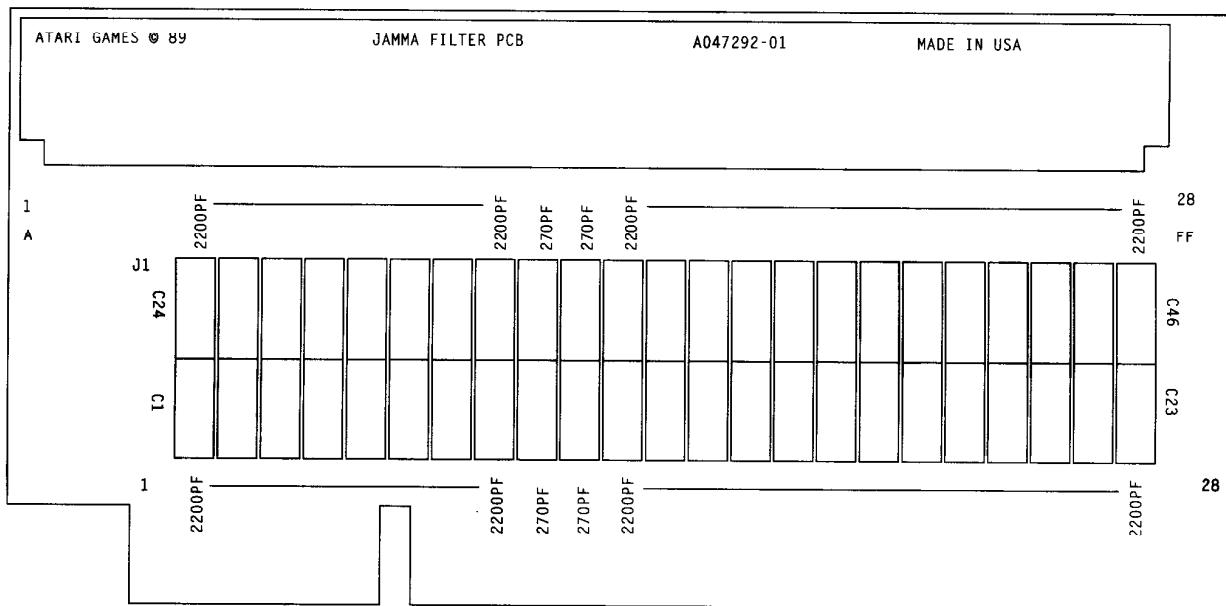
GT24M8 PCB Assy. A  
A053601-xx Rev. A

## GT24M8 PCB Assembly

### Parts List

| <b>Designator</b>  | <b>Description</b>                  | <b>Part No.</b> |
|--------------------|-------------------------------------|-----------------|
| (HS1-HS3)          | Screw, Pan, 4-40X3/8, X-Rec, Cad    | 172025-3206     |
| A                  | Pr, GAL16V8, 10NS, Romdec 50F8      | 136102-0260     |
| A                  | Pr, GAL16V8, 15NS, Bnkdec 1FD0      | 136102-0261     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL0.2 5FC8  | 136102-0320     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL0.6 96C1  | 136102-0328     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL0.4 90BD  | 136102-0324     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL1.0 9FB6  | 136102-0332     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH1.2 40E9  | 136102-0337     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH0.7 F538  | 136102-0331     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH0.1 89F0  | 136102 0319     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL0.0 B69E  | 136102-0316     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL0.7 82B5  | 136102-0330     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH0.5 9060  | 136102-0327     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL0.1 CF92  | 136102-0318     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH0.3 D5E7  | 136102-0323     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL1.2 0777  | 136102-0336     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH0.6 87C4  | 136102-0329     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL1.3 0E47  | 136102-0338     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL0.5 660E  | 136102-0326     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH0.0 9AB3  | 136102-0317     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH0.2 B2A6  | 136102-0321     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL0.3 D4DF  | 136102-0322     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH1.3 6AFB  | 136102-0339     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH1.1 E50C  | 136102-0335     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOL1.1 BA48  | 136102-0334     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH1.0 1D6 A | 136102-0333     |
| A                  | Pr, Mrom, 1MX8, 100NS, MOH0.4 F3EE  | 136102-0325     |
| A245               | Res, 10 Ω, ±5%, 1/8 W               | 110027-100      |
| AB0-AB2, AB10-AB12 | Integrated Circuit, 74F245          | 137591-001      |
| B1M, B4M           | Res, 10K Ω, ±5%, 1/8 W              | 110027-103      |
| B8M                | Res, 10 Ω, ±5%, 1/8 W               | 110027-100      |
| B11M,B14M          | Res, 10K Ω, ±5%, 1/8 W              | 110027-103      |

| <b>Designator</b>  | <b>Description</b>                           | <b>Part No.</b> |
|--|--|-----------------|
| B18M, B48M, B148M  | Res, 10 Ω, ±5%, 1/8 W                        | 110027-100      |
| BNKDEC   | Socket, 20 Pin, .300, Dbl Wipe               | 179356-0320     |
| BS1, BS2   | Res, 10 Ω, ±5%, 1/8 W                        | 110027-100      |
| C1,C1A,C1B   | Capacitor, 100 μF, 16 V, Electrolytic, Axial | 124008-107      |
| C2-C37   | Capacitor, .1 μF, 50 V, +80%-20%, Cer.       | 122002-104      |
| CTRM0-CTRM7  | Capacitor, 47 pF, 100 V, ±5%, Cer.           | 122016-470      |
| D245   | Res, 10 Ω, ±5%, 1/8 W                        | 110027-100      |
| DB0, DB1, DB10, DB11                                       | Integrated Circuit, 74F245                   | 137591-001      |
| GND1-GND5  | Test Point                                   | 179051-001      |
| JBS0, JBS3   | Connector, 2 Ckt, Header, .100 Ctr           | 179048-002      |
| JPWR1  | Connector, 9 Ckt, Header, .156, Key 3, Rt    | 179213-109      |
| JRSZ0  | Connector, 2 Ckt, Header, .100 Ctr           | 179048-002      |
| MOH0.0-MOH0.7, MOH1.0-MOH1.3, MOL0.0-MOL0.7, MOL1.0-MOL1.3 | Socket, 32 Pin, .600, Dbl Wipe               | 179356-0632     |
| R1-R40   | Resistor, 33 Ω, ±5%, 1/8 W                   | 110027-330      |
| R41  | Resistor, 4.7 ΩKx9, ±2%, 1/8 W               | 118010-472      |
| ROMDEC   | Socket, 20 Pin, .300, Dbl Wipe               | 179356-0320     |
| RSZ1-RSZ3  | Res, 10 Ω, ±5%, 1/8 W                        | 110027-100      |
| RTRM0-RTRM7  | Res, 47 Ω, ±5%, 1/8 W                        | 110027-470      |

**Figure 4-7 JAMMA Filter PCB Assembly**

A047292-01 B

### JAMMA Filter PCB Assembly Parts List

| Designator | Description                         | Part No.   | Designator | Description                         | Part No.   |
|------------|-------------------------------------|------------|------------|-------------------------------------|------------|
| C1-8       | 2200 pF, 50V, 3-Pin EMI Filter Cap. | 140006-222 | C32, C33   | 270 pF, 50V, 3-Pin EMI Filter Cap.  | 140006-271 |
| C9, C10    | 270 pF, 50V, 3-Pin EMI Filter Cap.  | 140006-271 | C34-46     | 2200 pF, 50V, 3-Pin EMI Filter Cap. | 140006-222 |
| C11-31     | 2200 pF, 50V, 3-Pin EMI Filter Cap. | 140006-222 | J1         | Connector, 56 Ckt., .156 Ctr, RT    | 179240-056 |

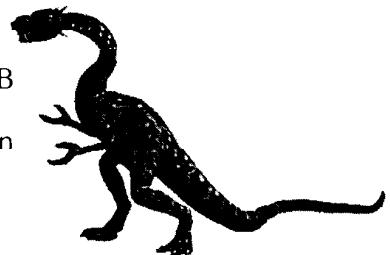
## N O T E S

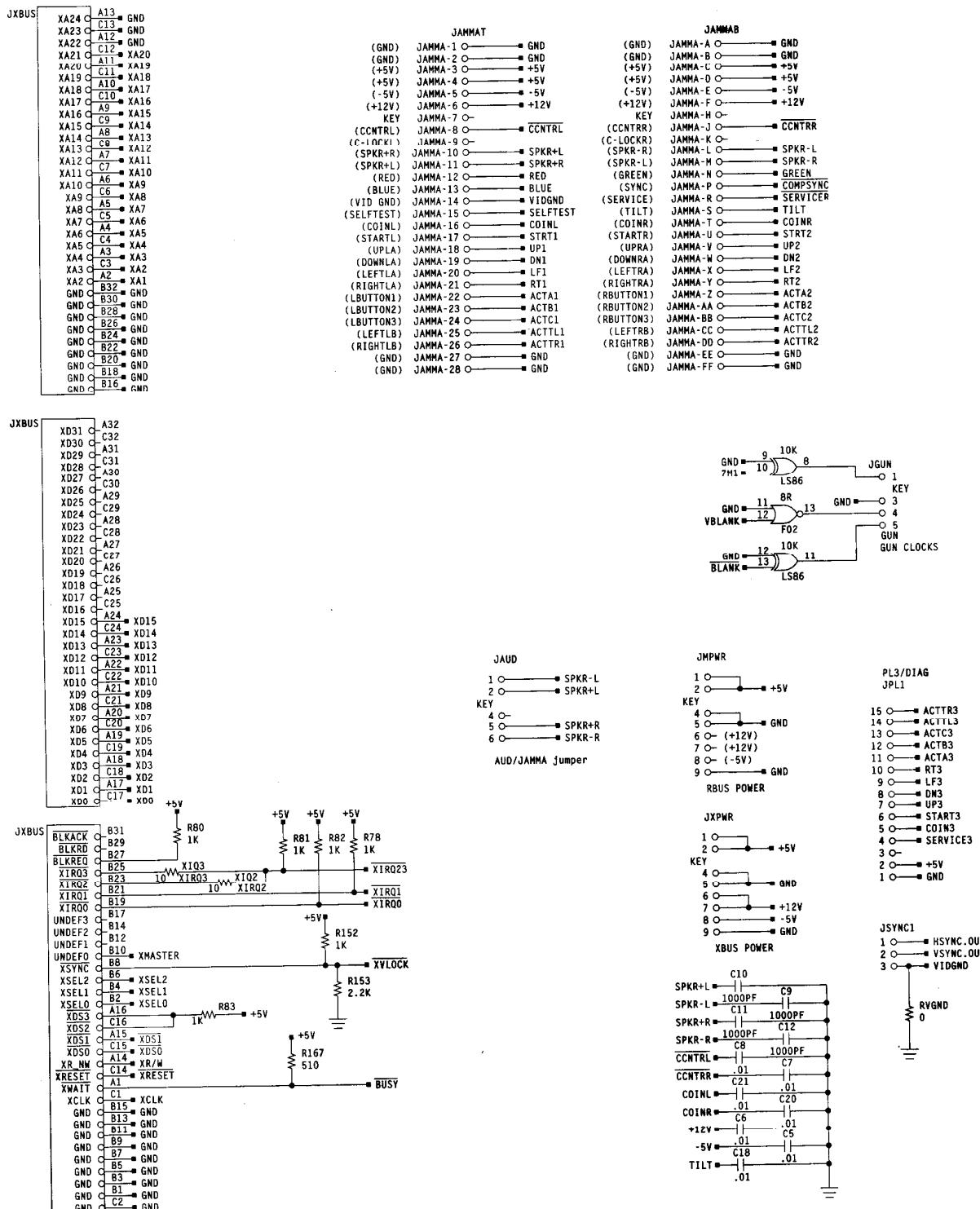


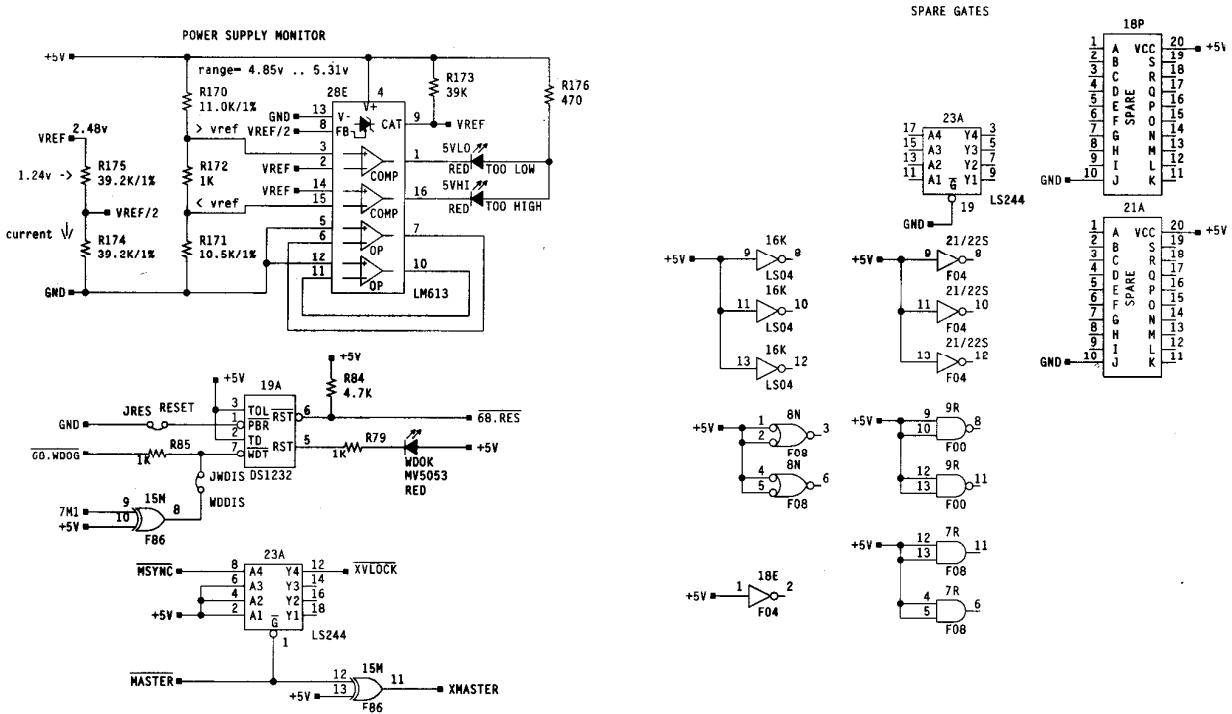
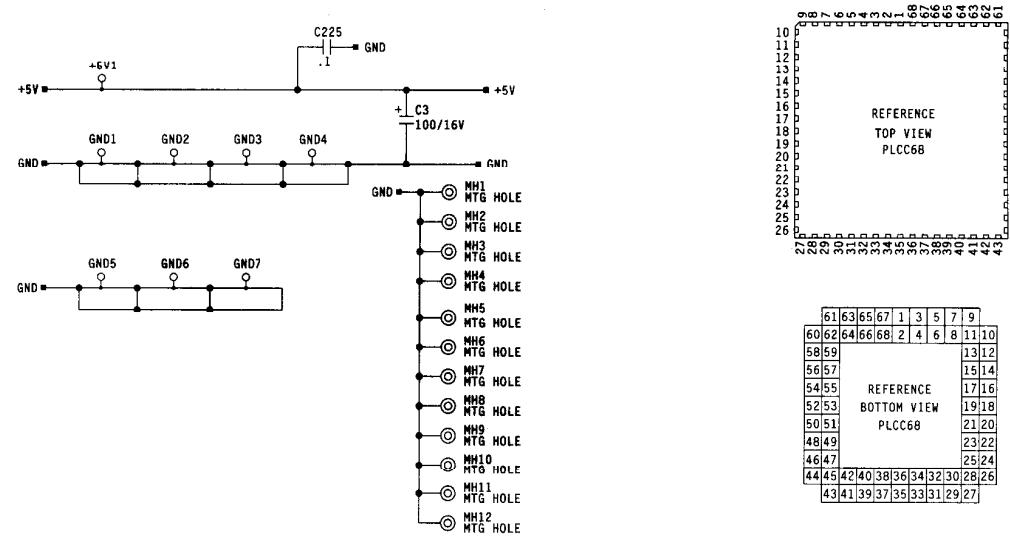
# Schematic Diagrams

## INTRODUCTION

**T**HIS CHAPTER contains the schematic diagrams for most of the Primal Rage™ game printed-circuit boards, including the game PCB (also called the GT board), the GT24M8 PCB, and the JAMMA Filter PCB. In addition, this chapter includes wiring diagrams for the entire game and the coin door, and a block diagram of the CH31 (CAGE Audio) PCB. The PCB *assembly drawings* are illustrated in Chapter 4, Parts Illustrations.







**Figure 5-1 Primal Rage Game (GT) PCB Schematic Diagram, Continued**

051511-01 Rev. D (Sheet 1)

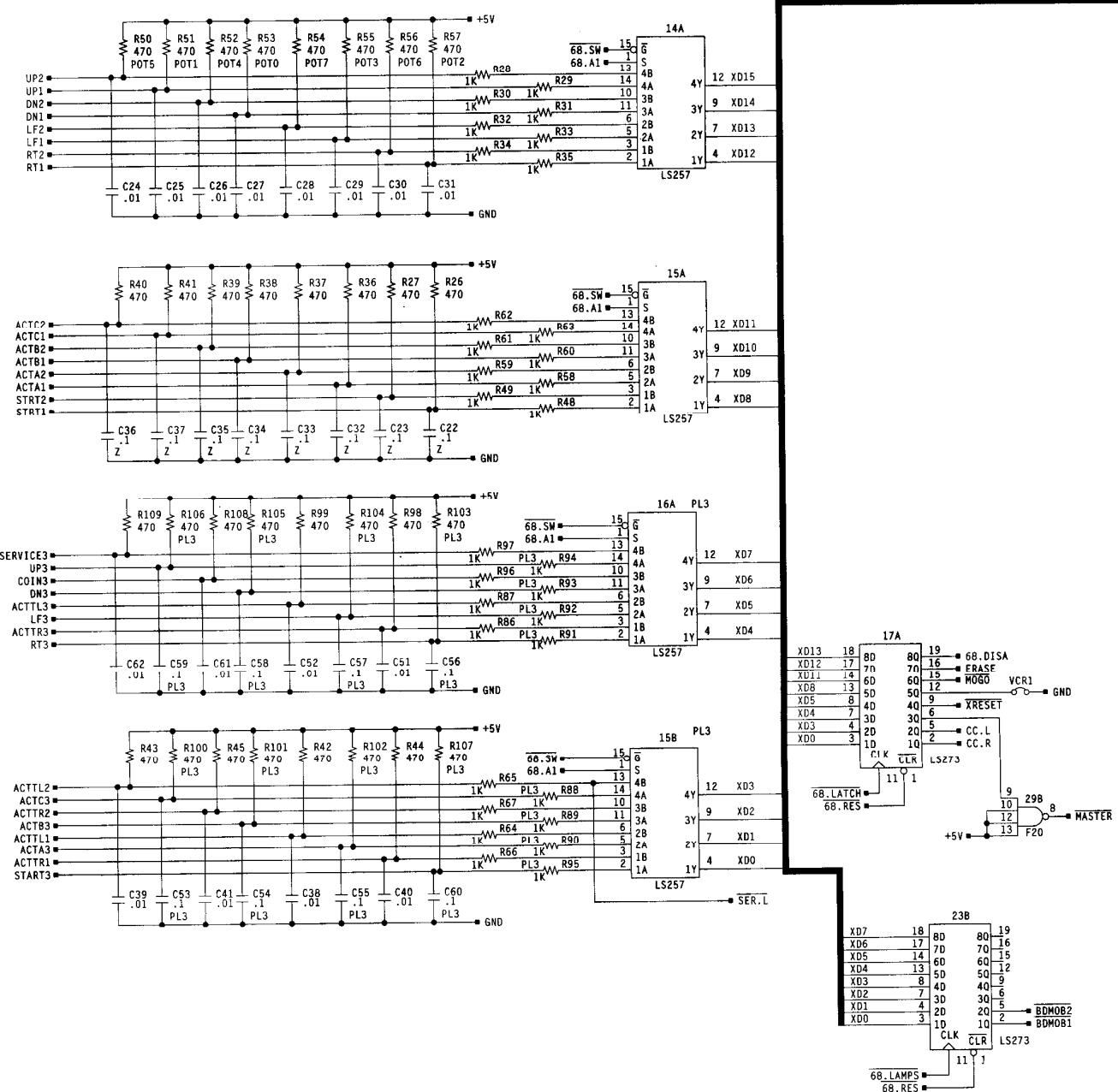


Figure 5-1 Primal Rage Game (GT) PCB Schematic Diagram

051511-01 Rev. D (Sheet 9)

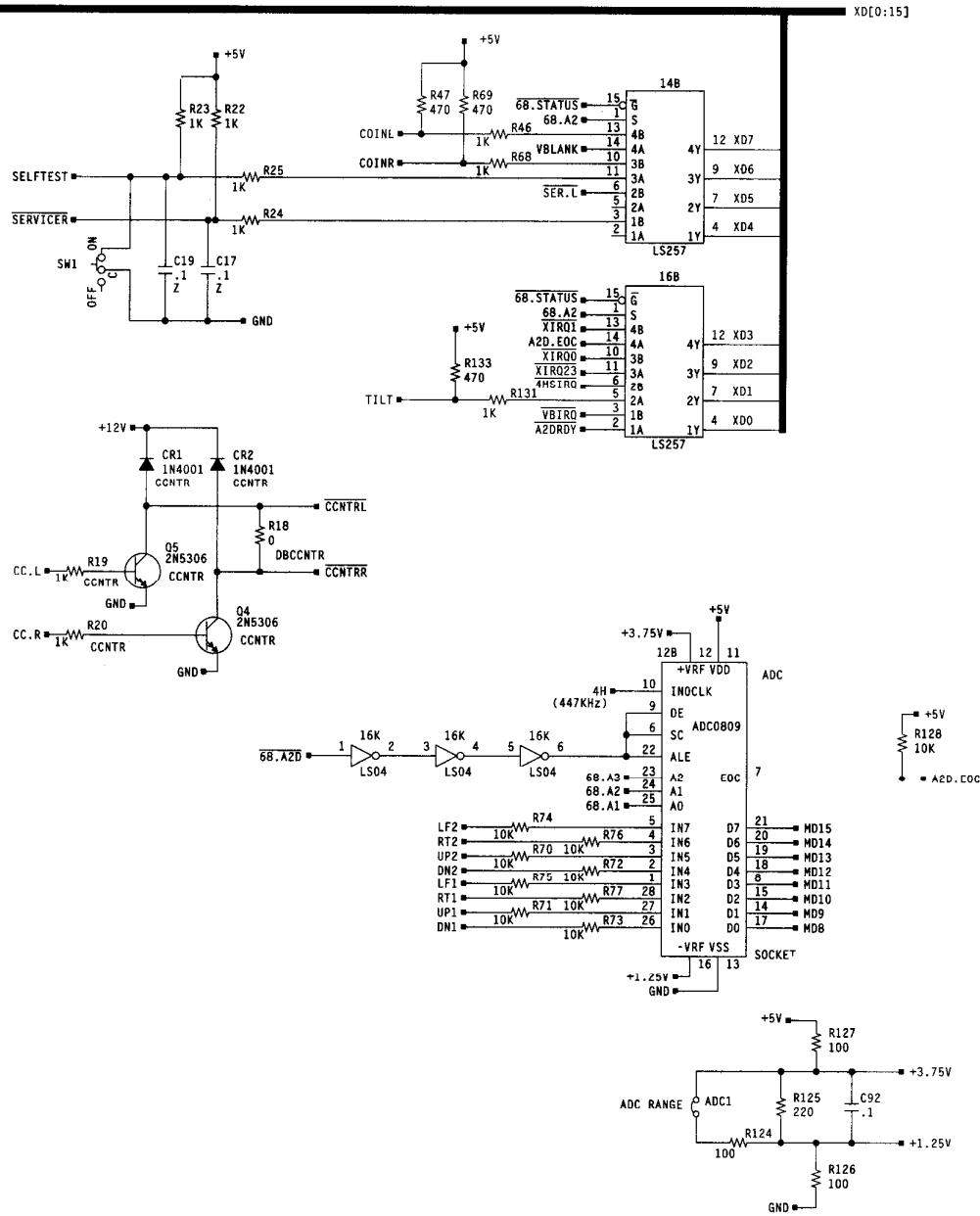


Figure 5-1 Primal Rage Game (GT) PCB Schematic Diagram, Continued

051511-01 Rev. D (Sheet 9)

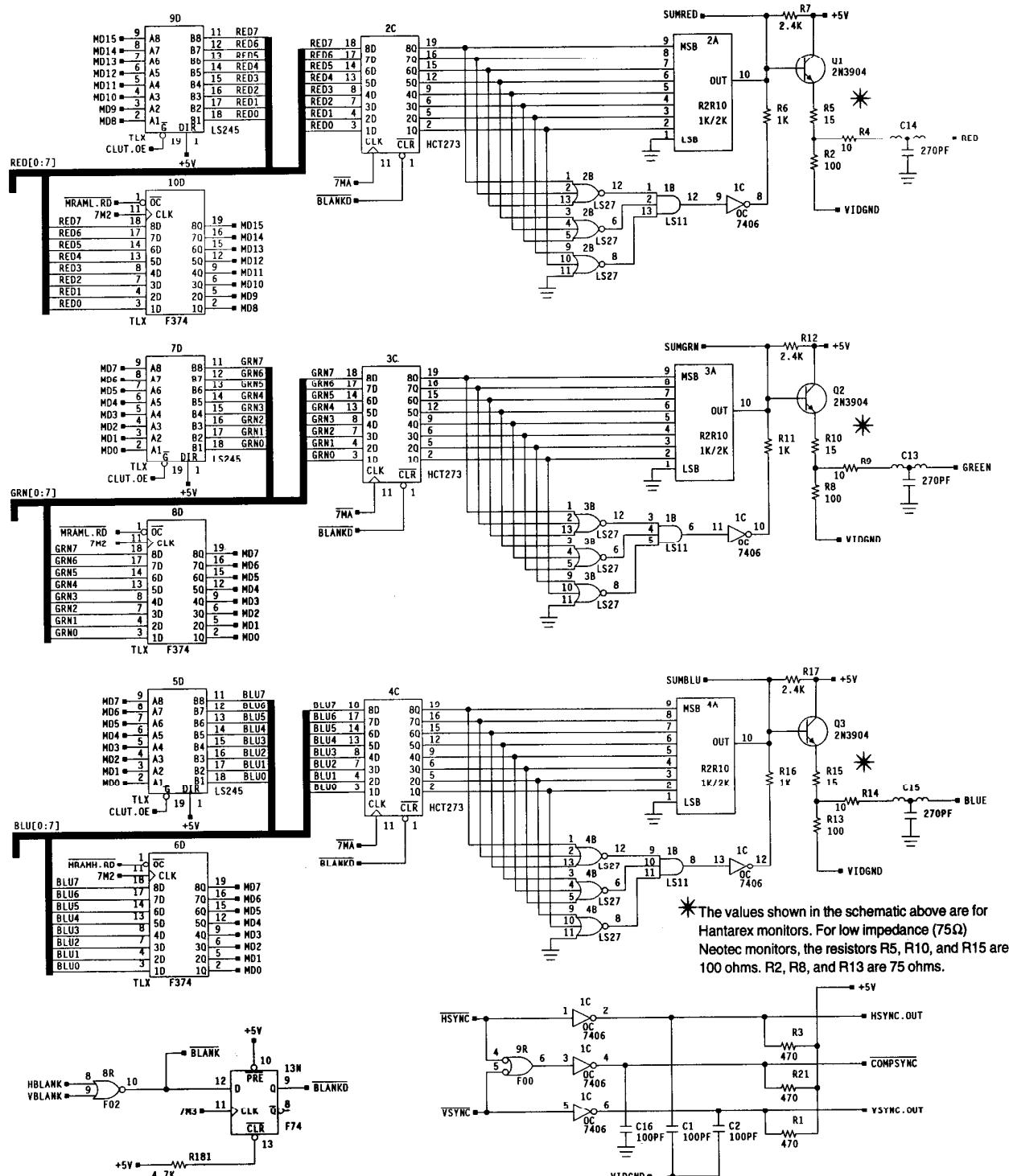
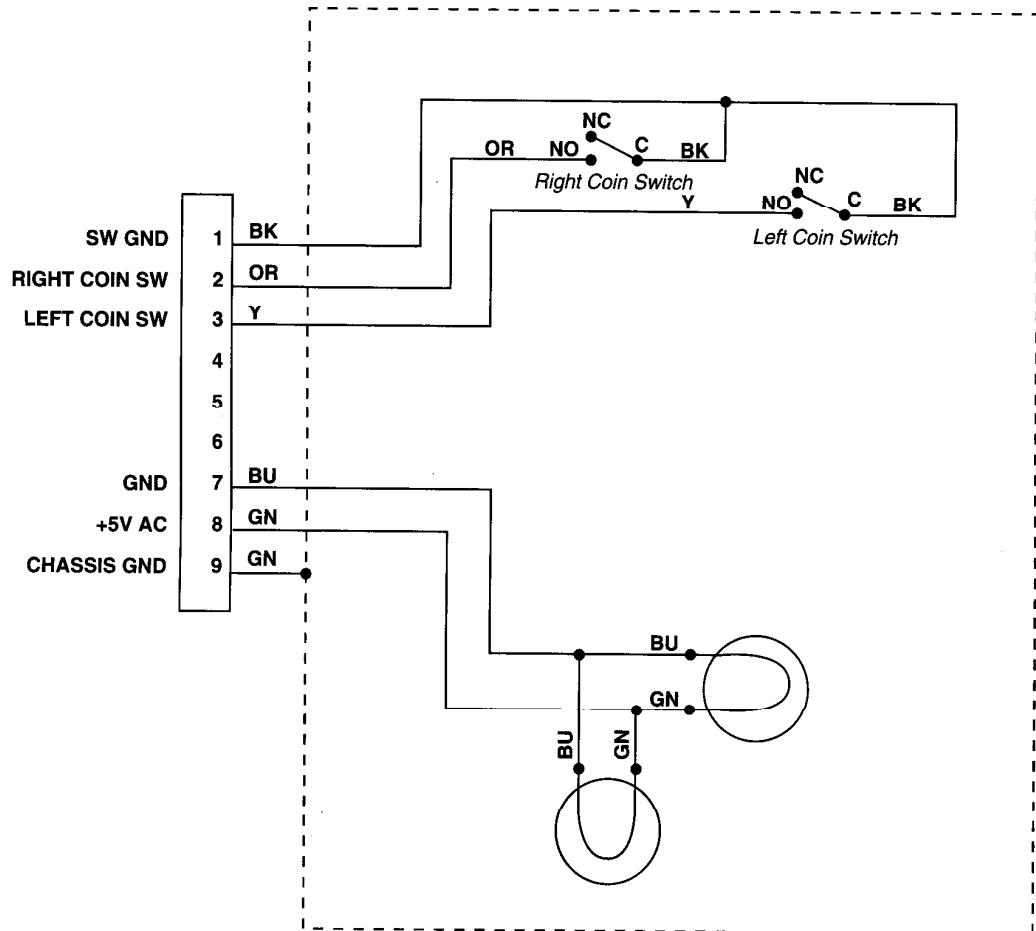


Figure 5-1 Primal Rage Game (GT) PCB Schematic Diagram

051511-01 Rev. D (Sheet 15)

**Figure 5-2 Coin Door Wiring Diagram**

049507-01 Rev. A

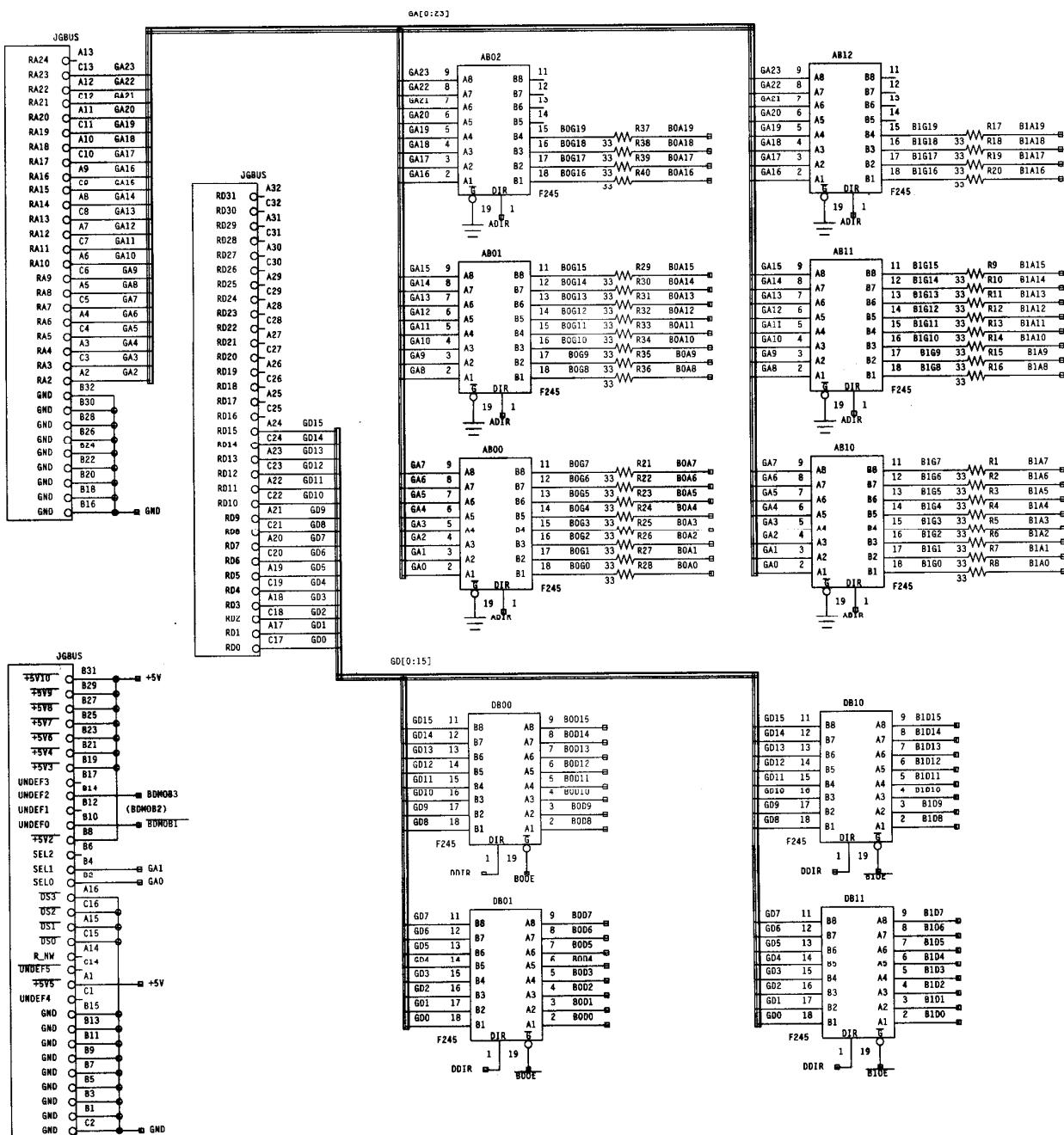


Figure 5-3 GT24M8 PCB Schematic Diagram

053601-xx Rev. B (Sheet 1)

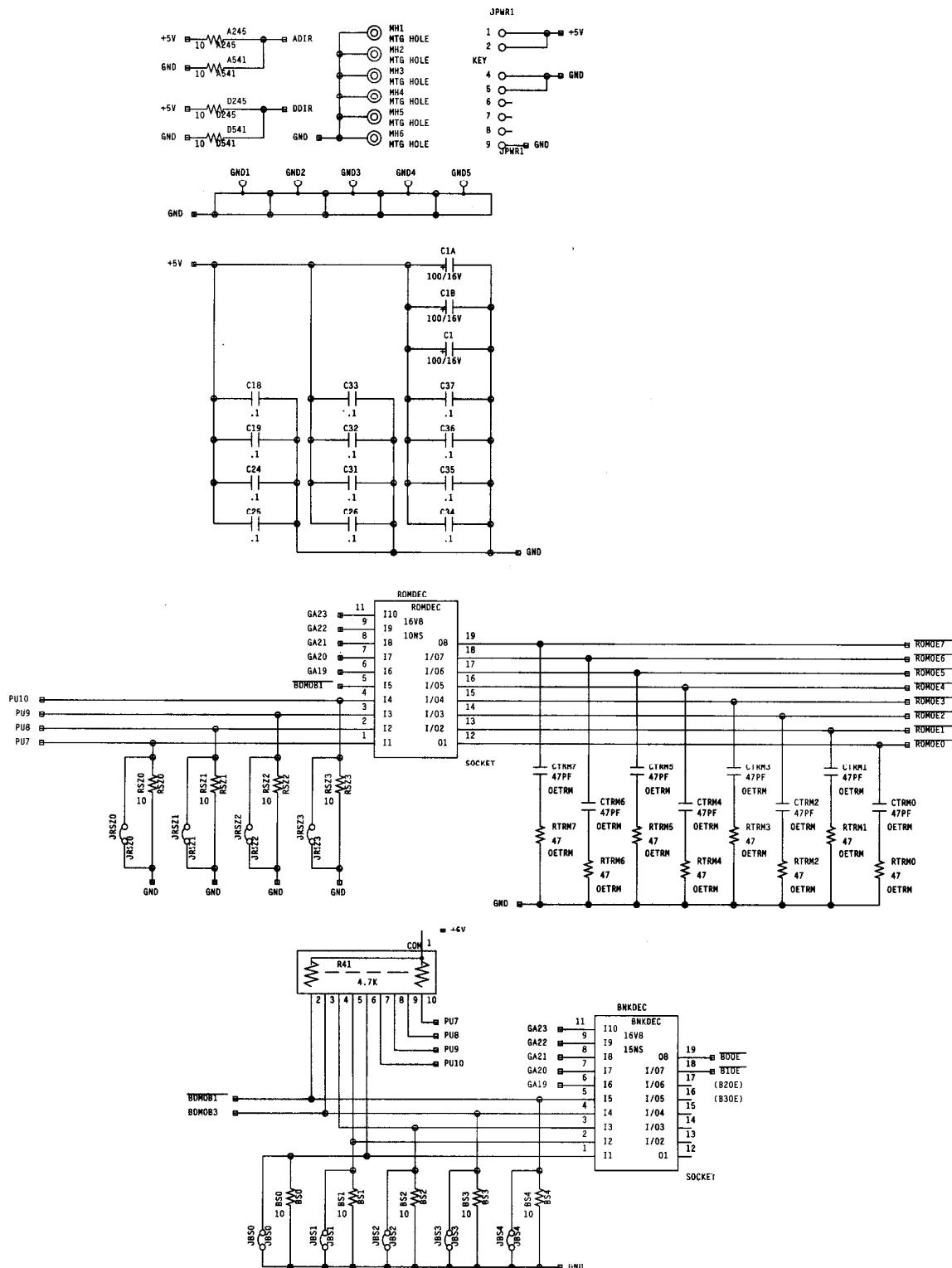
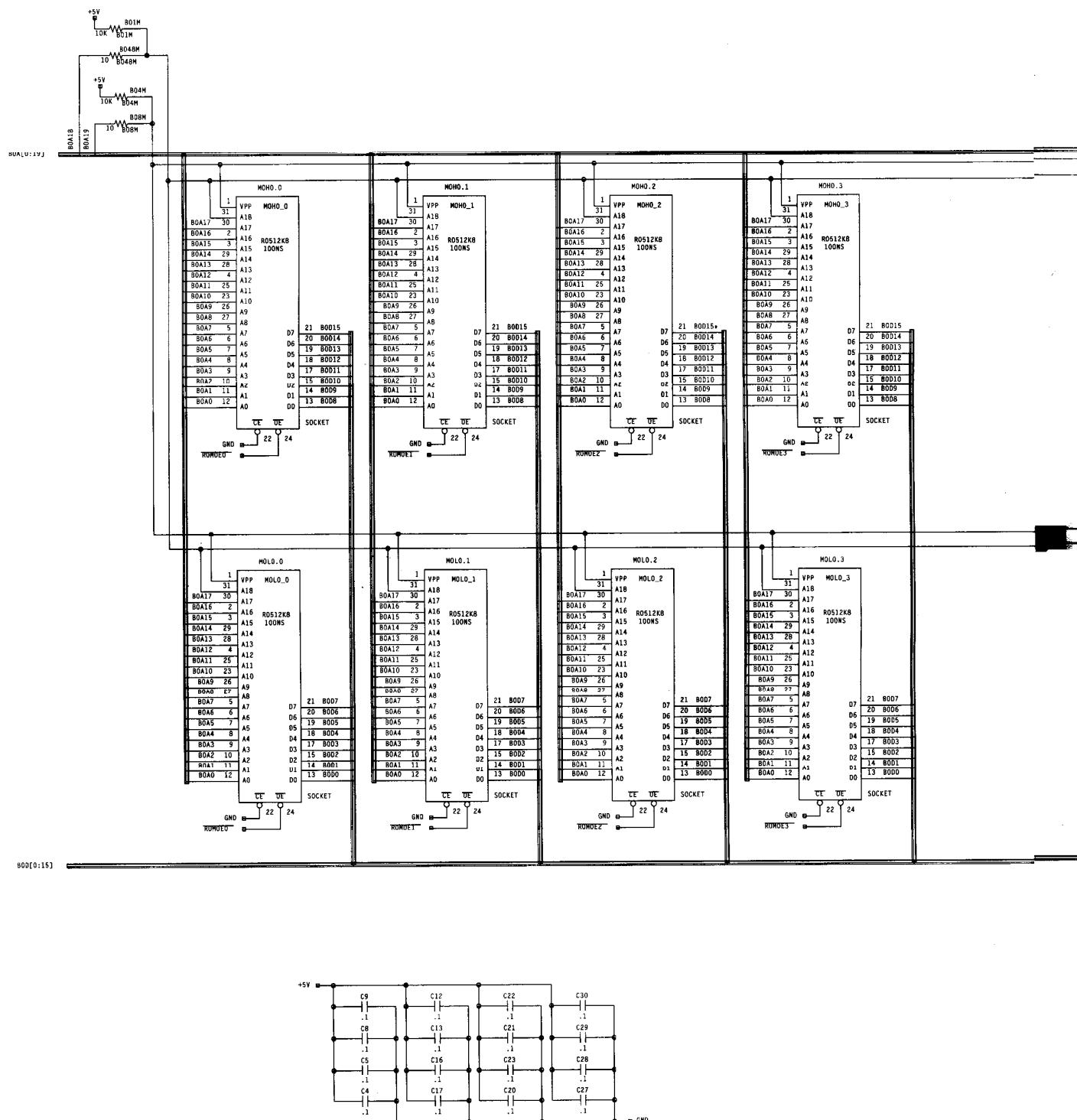


Figure 5-3 GT24M8 PCB Schematic Diagram, Continued

053601-xx Rev. B (Sheet 1)



**Figure 5-3 GT24M8 PCB Schematic Diagram**

053601-xx Rev. B (Sheet 2)

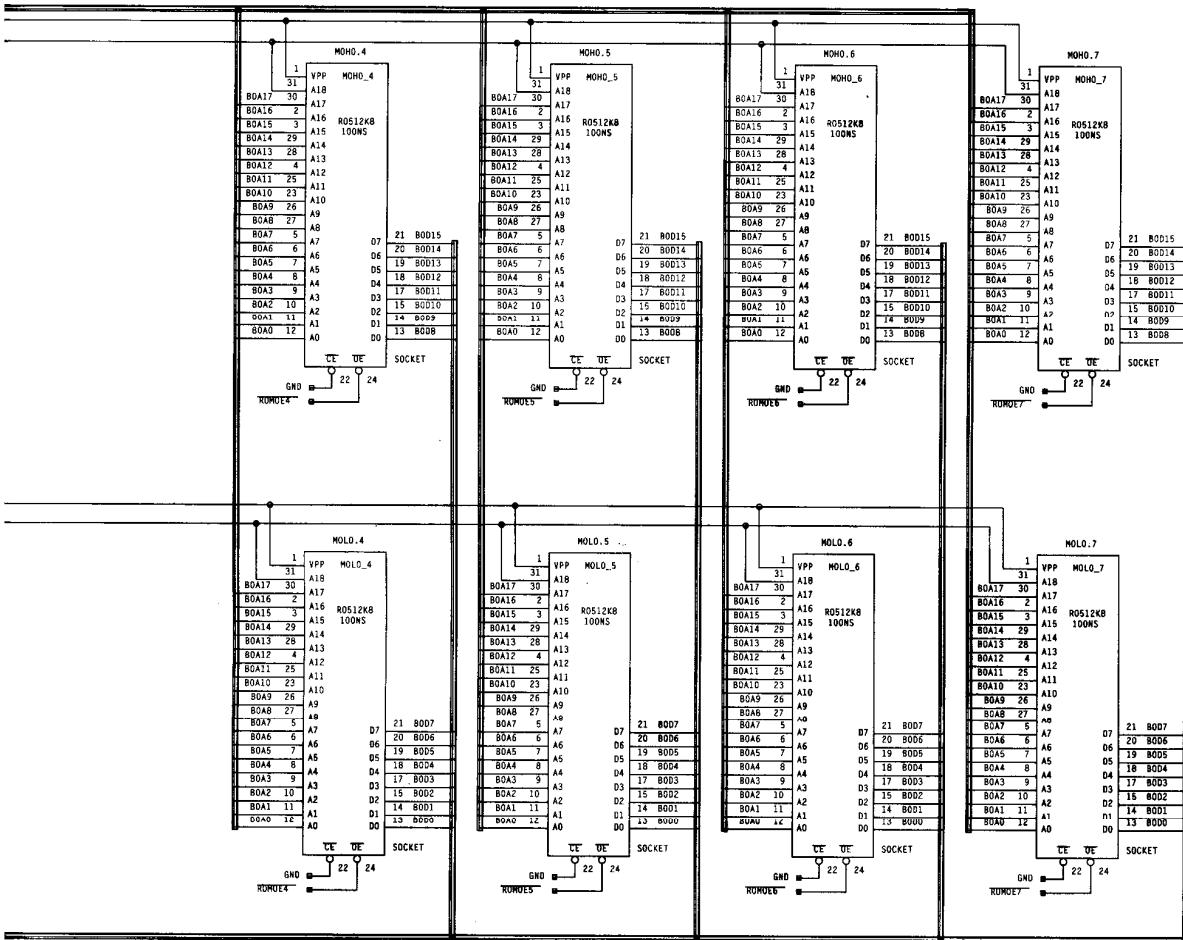


Figure 5-3 GT24M8 PCB Schematic Diagram, Continued

033601-xx Rev. B (Sheet 2)

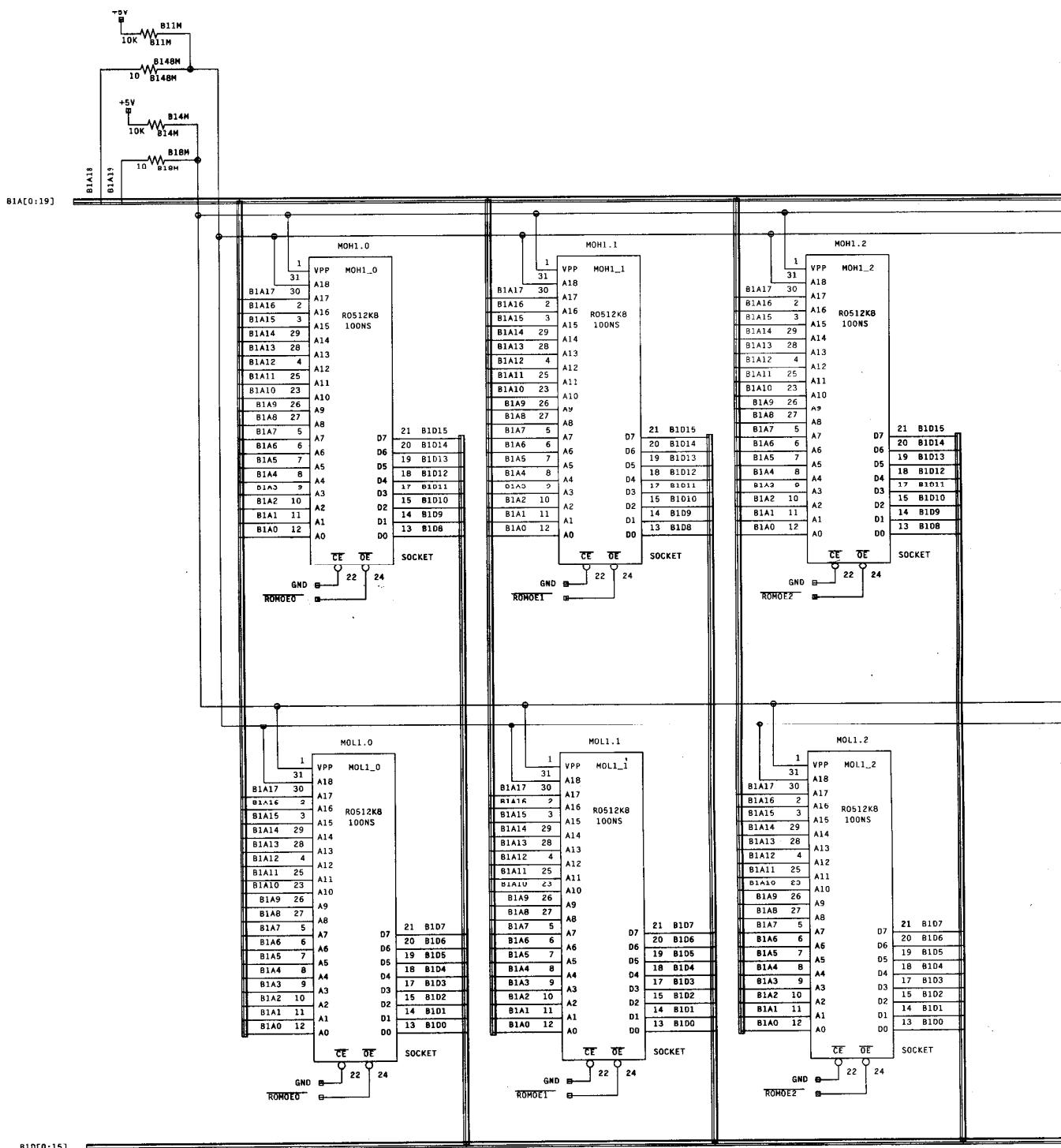


Figure 5-3 GT24M8 PCB Schematic Diagram

053601-XX Rev. B (Sheet 3)

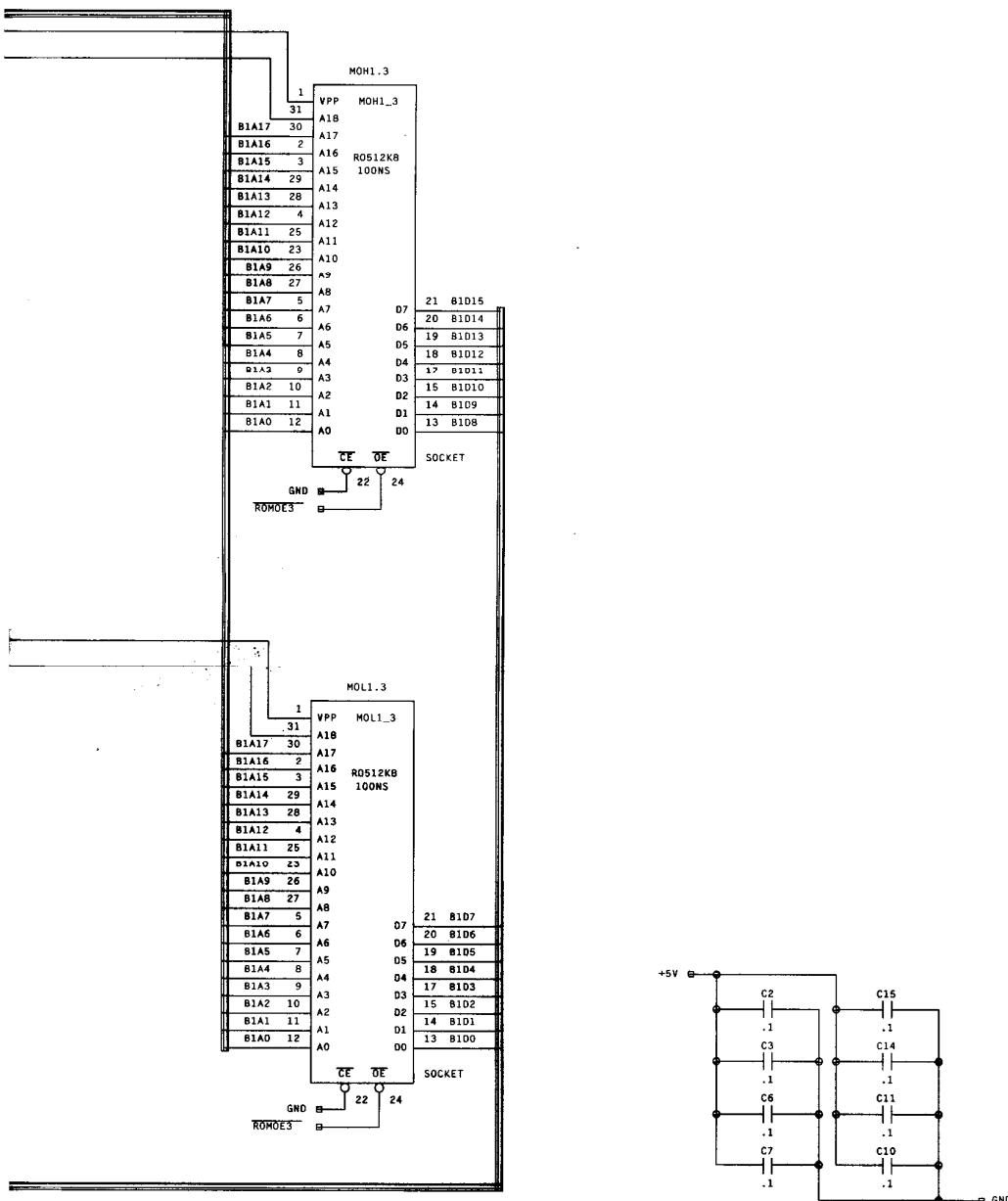


Figure 5-3 GT24M8 PCB Schematic Diagram, Continued

053601-XX Rev. B (Sheet 3)

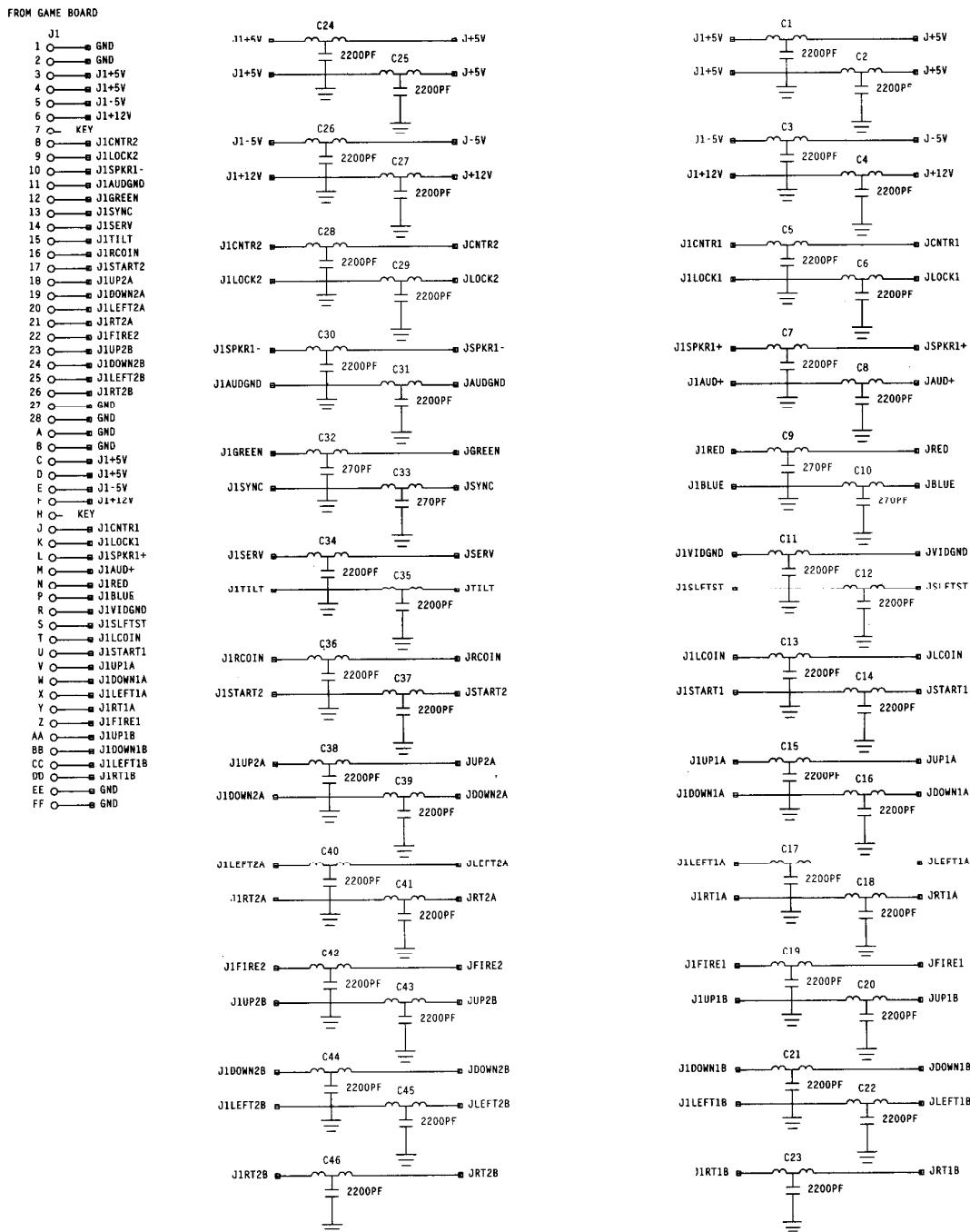
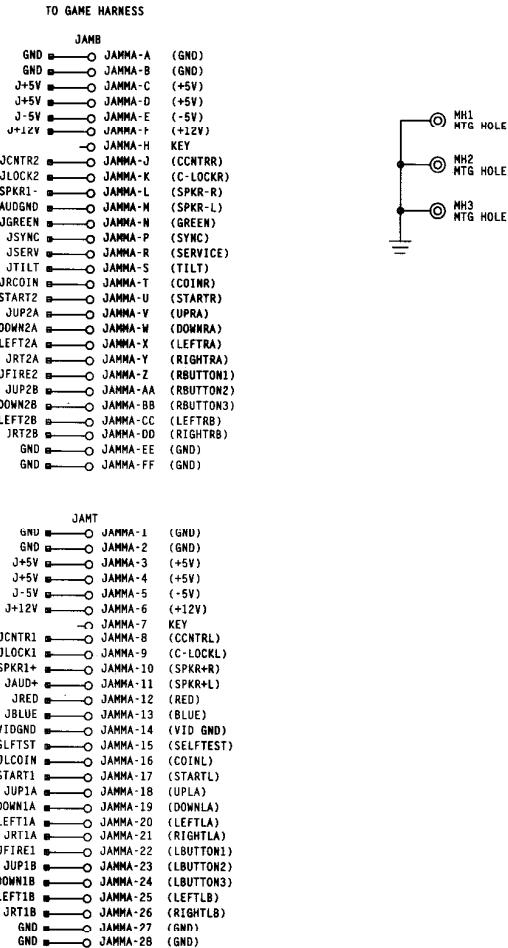


Figure 5-4 JAMMA Filter PCB Schematic Diagram

047292-01 B

**Figure 5-4 JAMMA Filter PCB Schematic Diagram**

047292-01 B

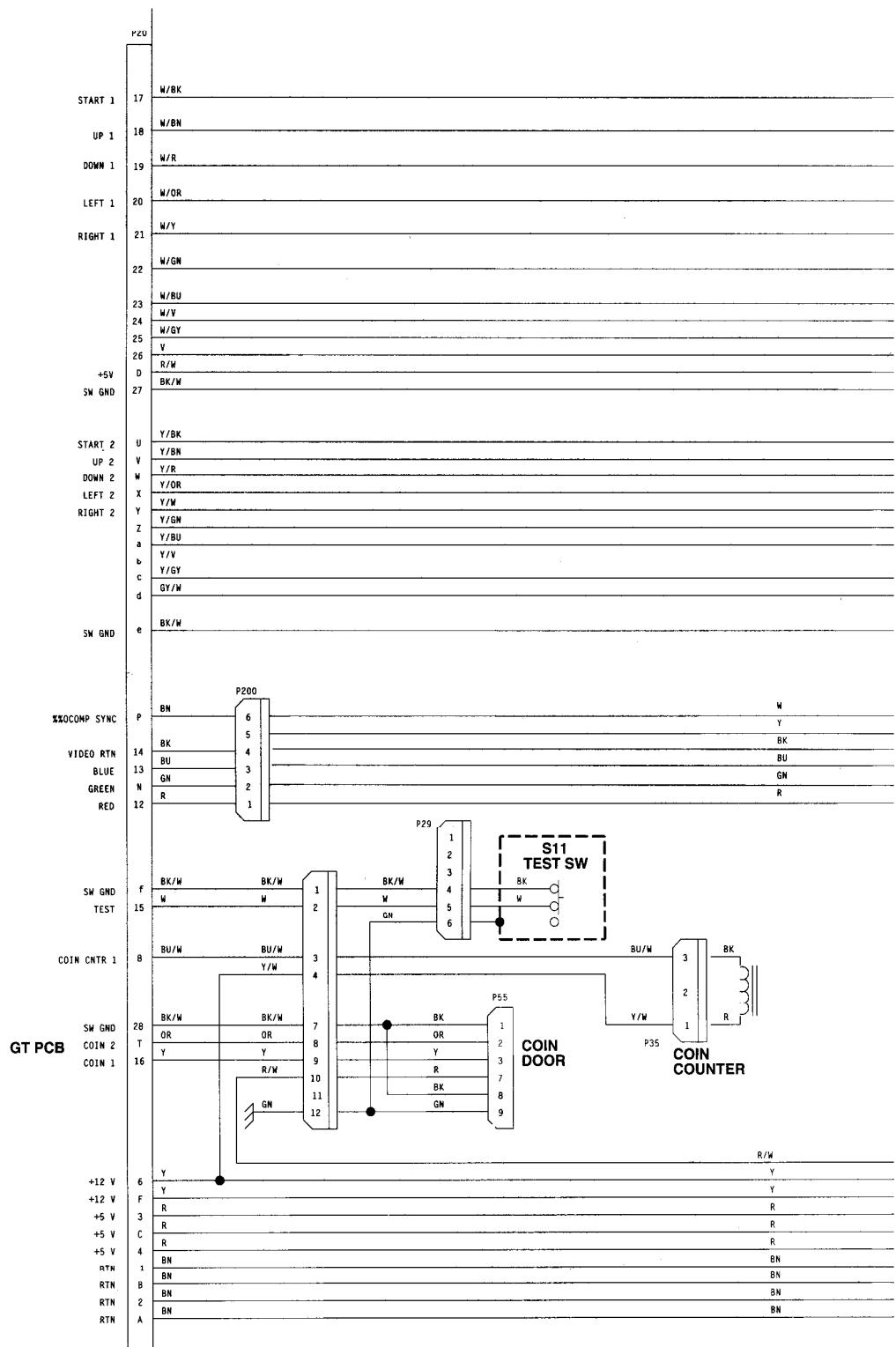


Figure 5-5 Primal Rage Game Wiring Diagram

053499-01 Rev. A

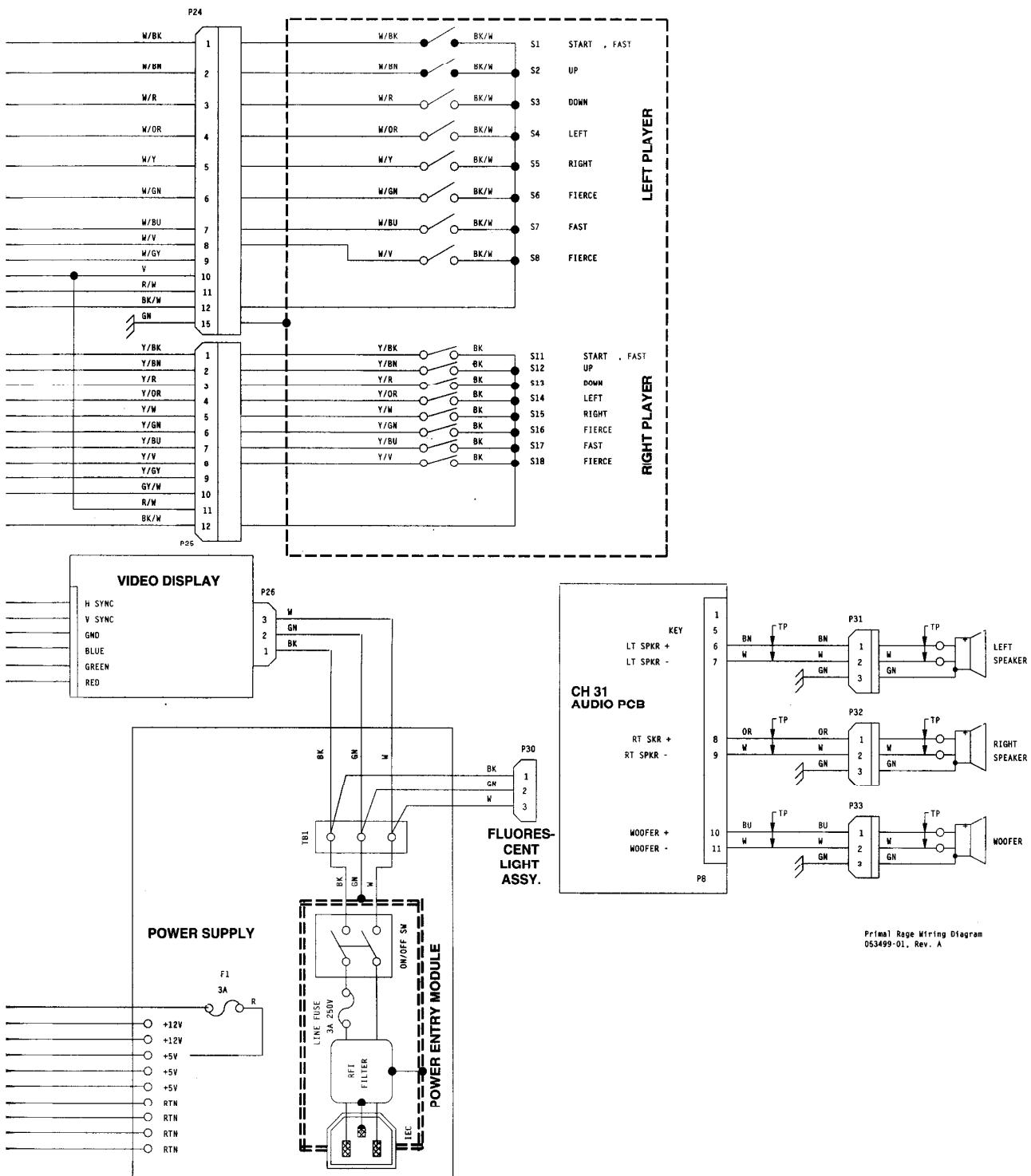


Figure 5-5 Primal Rage Game Wiring Diagram, Continued

053499-01 Rev. A

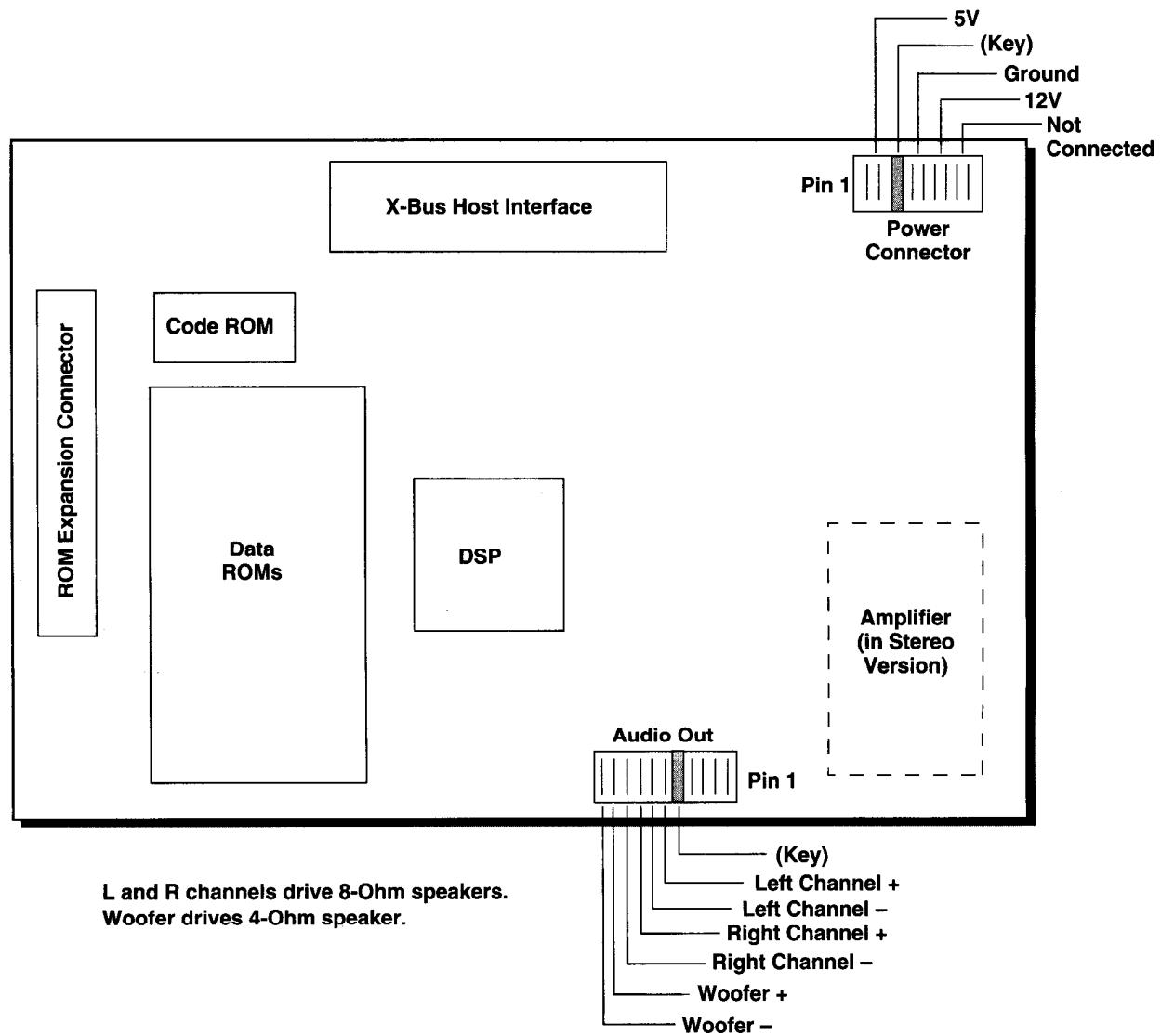


Figure 5-6 CH31\_2 (CAGE Audio) Board Block Diagram

# Warranty

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

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

- (a) Seller is promptly notified in writing upon discovery by Buyer that said products are defective;
- (b) Such products are returned prepaid to Seller's plant; and
- (c) Seller's examination of said products discloses to Seller's satisfaction that such alleged defects existed and were not caused by accident, misuse, neglect, alteration, improper repair, installation, or improper testing.

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

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

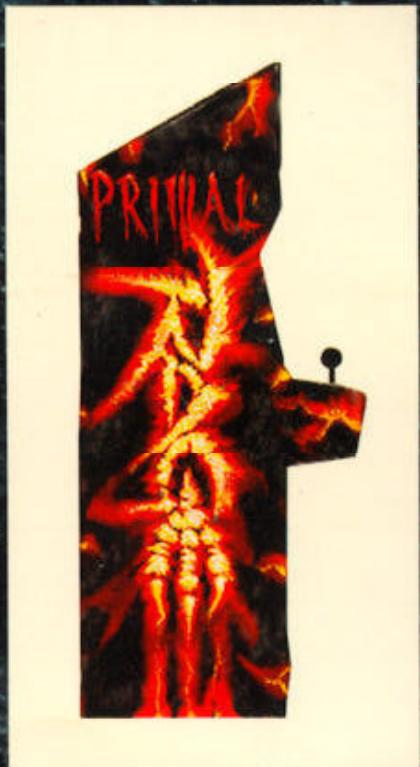
The use of any non-Atari parts may void your warranty, according to the terms of the warranty. The use of any non-Atari parts may also adversely affect the safety of your game and cause injury to you and others. Be very cautious in using non-Atari-supplied components with our games, in order to ensure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

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

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# Showcase Supplement for Primal Rage™

*Supplement to the Primal Rage Operator's Manual (TM-395)  
and the Showcase 33 Deluxe Service Manual (TM-393, 2nd printing)*

## Introduction

**T**HIS SUPPLEMENT describes the parts unique to your Showcase 33 cabinet version of Primal Rage™. Besides this supplement, you should have received with your game the *Showcase 33 Deluxe Service Manual* (TM-393, 2nd printing) and the *Primal Rage Operator's Manual* (TM-395). Those manuals, together with this supplement, provide the information you need for setting up, playing, testing, and maintaining your Primal Rage game.

## Parts Unique to the Primal Rage Showcase 33 Deluxe Cabinet

- Ground plane and two-part metal "hat" section over the board stack (see Figure 1 of this supplement). The board stack in this Showcase cabinet does not require a JAMMA Filter PCB. Therefore, ignore any references in the *Primal Rage Operator's Manual* to that printed-circuit board.
- Primal Rage control panel assembly (see Figure 2)
- Attraction decal (see Figure 2)
- Game wiring diagram for the Showcase cabinet (see Figure 3)

### CAUTION

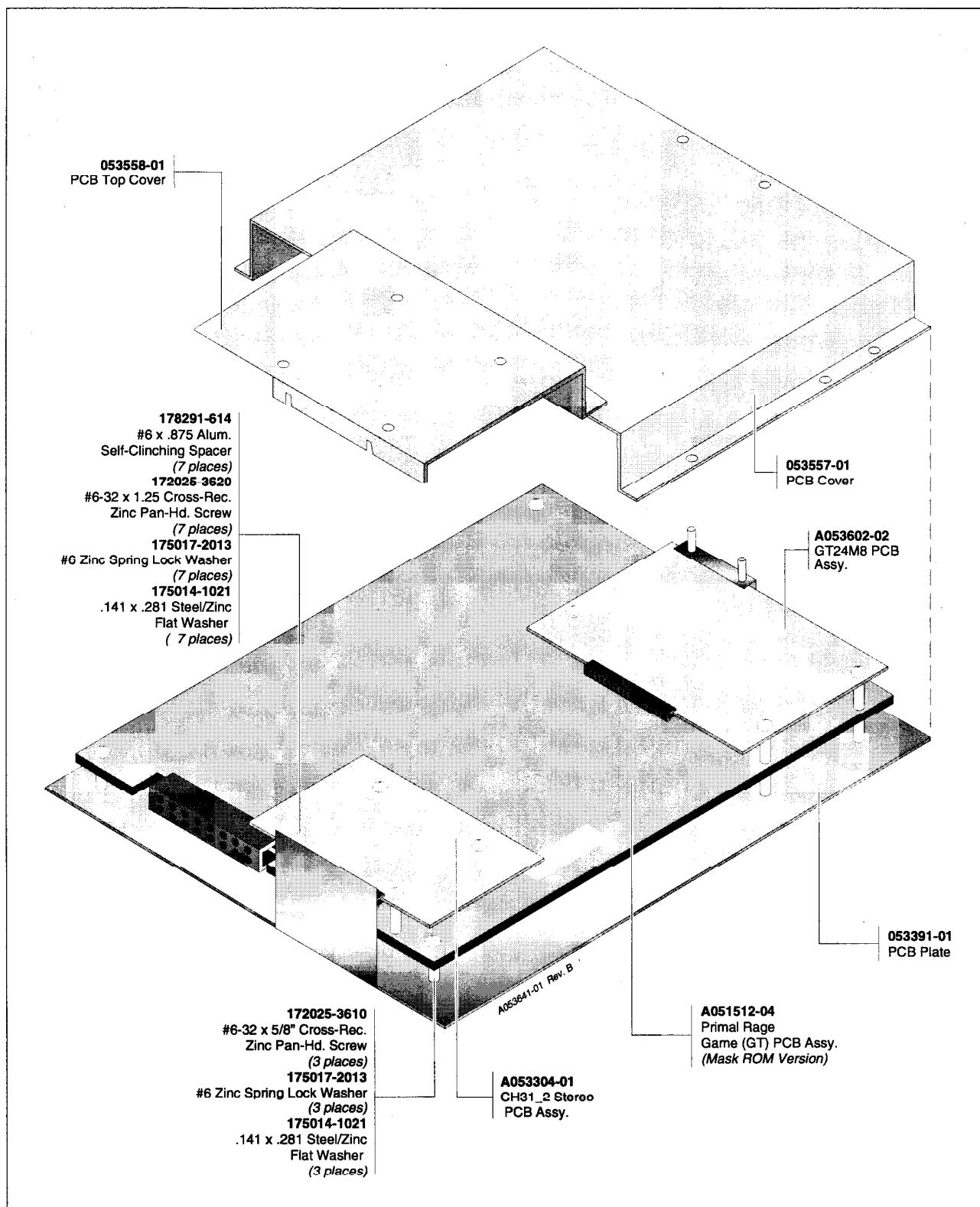
The low-impedance ( $75\Omega$ ) Neotec NT-2515C monitor (used in the Atari Games standard upright cabinet) and the high-impedance Hantarex Polo 33" monitor (used in the Showcase 33 cabinet) are **not** interchangeable. If you do plan to replace an existing monitor with the other type, you must change resistors in the video driver circuits on the Primal Rage game PCB. Refer to the game PCB schematic on page 5-6 of the Primal Rage Operator's Manual for more details.

If you need technical assistance, call your distributor or Atari Games Customer Service at one of the following locations:

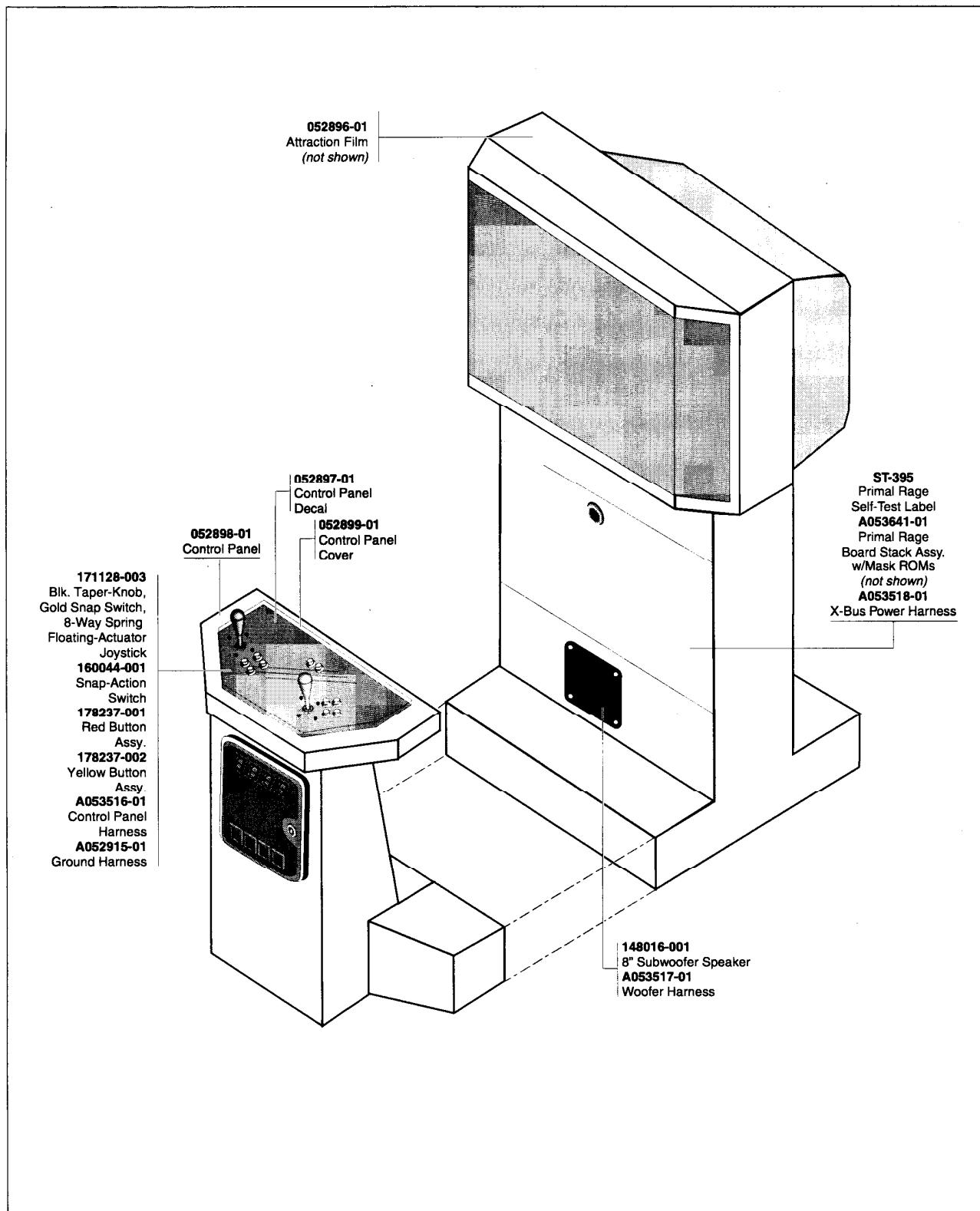
**United States:** (408) 434-3950  
Atari Games Corporation,  
737 Sycamore Drive, Milpitas, CA 95035  
(Monday-Friday, 7:30 a.m.- 4:00 p.m. Pacific time)

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Atari Games Ireland Limited,  
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**Figure 1 Primal Rage Board Stack Assembly  
(Showcase 33 Deluxe Cabinet Only)**



**Figure 2 Primal Rage Showcase 33 Deluxe Cabinet  
(Front View)**

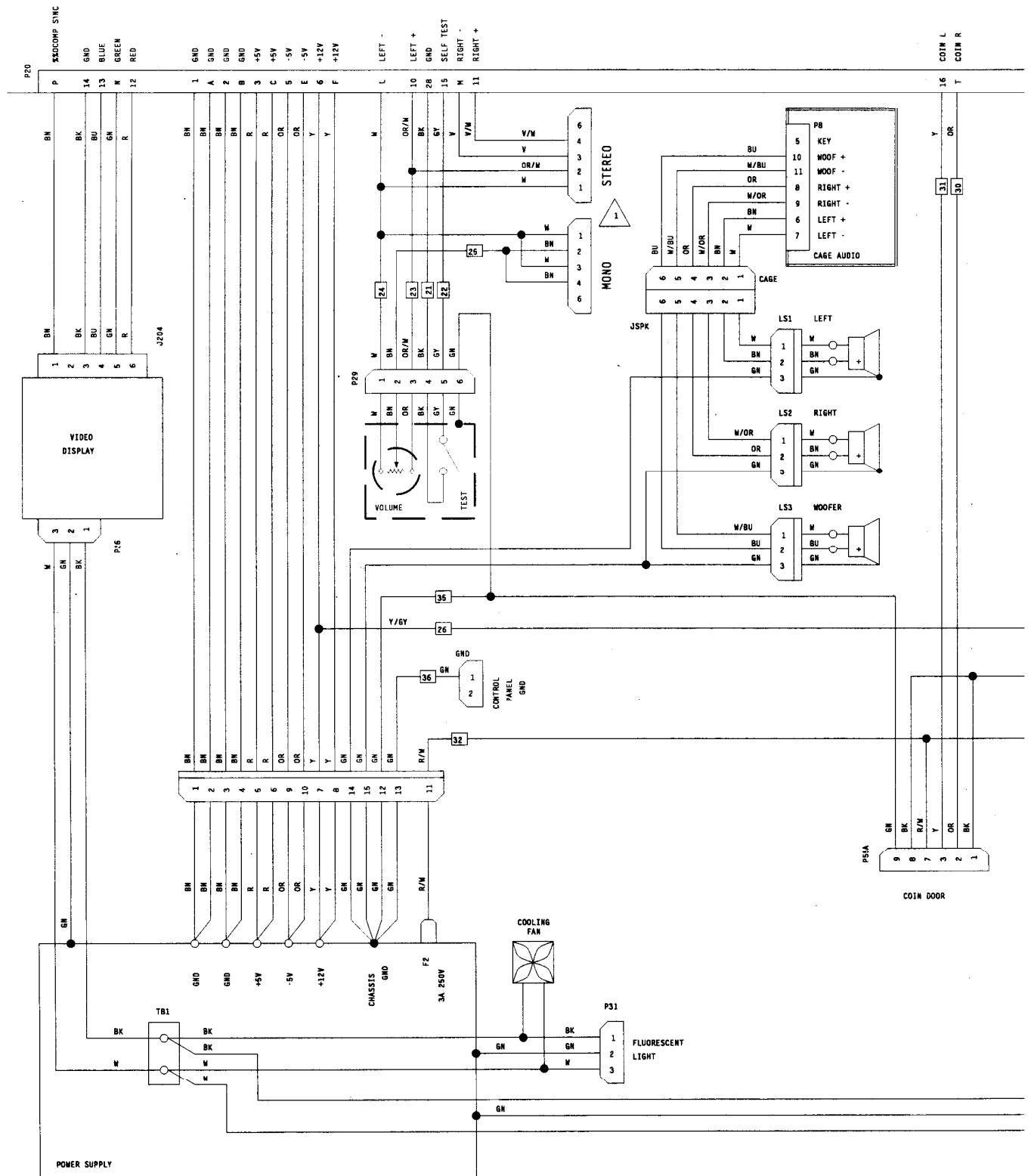


Figure 3 Primal Rage Game Wiring Diagram (Showcase Cabinet Version)

053515-01 Rev. A

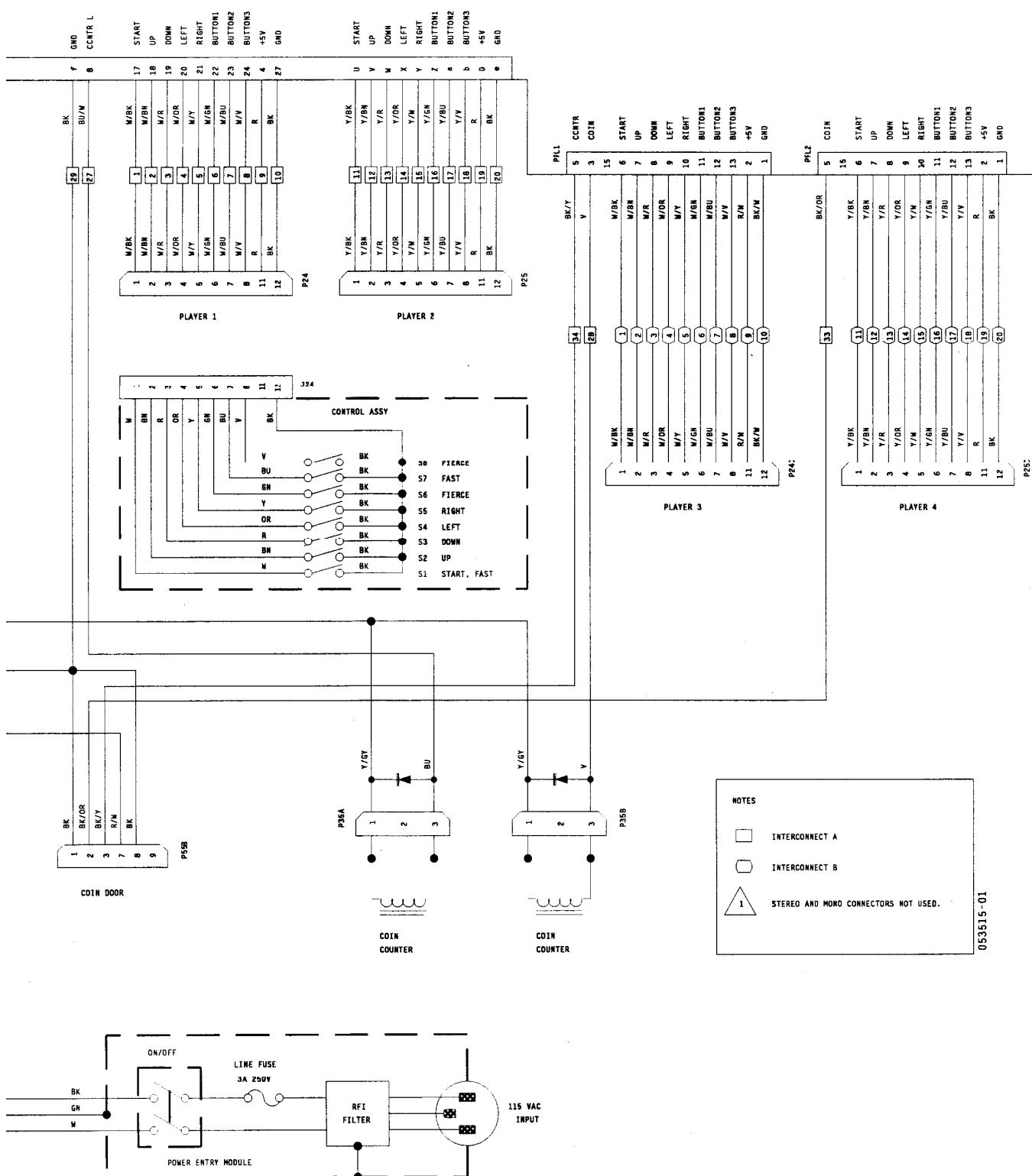


Figure 3 Primal Rage Game Wiring Diagram, Continued (Showcase Cabinet Version)

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