ATARI
GAMES

PIT-FIGHTER™

Operator's Manual
with Schematics

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Notice Regarding Non-Atari® Parts

NOTE

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

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

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

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1 Set-Up

2 Self-Test

3 Maintenance and Troubleshooting

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See the list of illustrations that follows.

5 Schematics

See the list of illustrations that follows.

Pit-Fighter Statistics Sheet

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Safety Summary

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

WARNING

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

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

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

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

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

Use the Proper Fuses. To avoid electrical shock, use replacement fuses which are specified in the parts list for this game. Replacement fuses must match those re-

placed in fuse type, voltage rating, and current rating. In addition, the fuse cover must be in place during game operation.

CAUTION

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

Ensure the Proper AC Line Frequency. Video games manufactured for operation on 60 Hz line power (used in the United States) must not be operated in countries with 50

Hz line power (used in Europe).

If a 60 Hz machine operates on 50 Hz line power, the fluorescent line ballast transformer will overheat and cause a potential fire hazard. Check the product identification label on your machine for the line frequency required.

ABOUT NOTES, CAUTIONS, AND WARNINGS

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

NOTE — A highlighted piece of information.

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

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

Set-Up

How to Use This Manual

This manual is written for operators and service personnel. It provides information for setting up, playing, testing, and maintaining your Pit-Fighter™ game. The manual is divided into the following chapters: ■ Chapter 1 contains set-up and game playing information. ■ Chapter 2 describes the self-test and how to use the self-test screens. ■ Chapter 3 contains maintenance, repair, and troubleshooting procedures. Be sure to perform the preventive maintenance tasks to keep the game in good condition. ■ Chapter 4 contains the illustrated parts lists. ■ Chapter 5 contains the schematics for the Pit-Fighter game PCB and JSA Audio II PCB and the game wiring diagram.
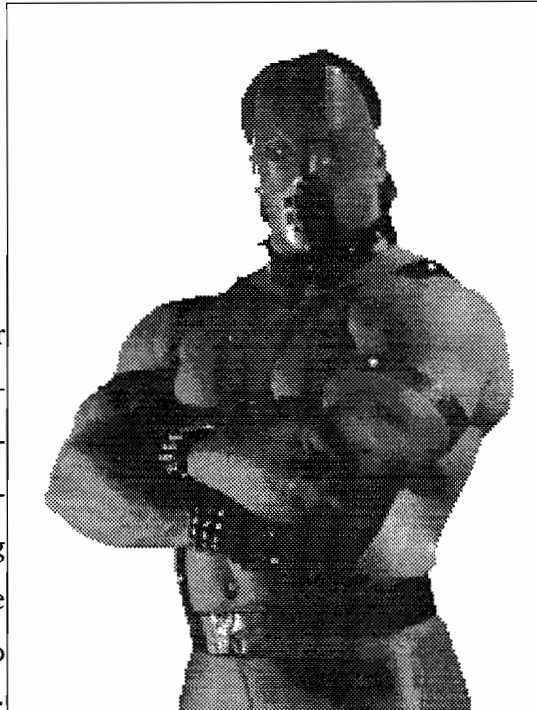
Inspecting the Game

WARNING

To avoid electrically shocking yourself and damaging the game electronics, do not plug in the game until it has been inspected and set up for your line voltage.

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.

Inspect your Pit-Fighter game carefully to ensure that the game is complete and was delivered to you in good condition.

Inspect the cabinet as follows:

1. Examine the exterior of the cabinet for dents, chips, or broken parts.

2. Open the service door. 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 and that the fuse block cover is mounted in place. Check that the green ground wire are connected.

Table 1-1 Game Specifications

Characteristic	Specification
Power Consumption	127 W maximum
Line Fuse Rating	2 Amps
Line Voltage	102 to 132 VAC
Temperature	5° to 38° C (37° to 100° F)
Humidity	Not to exceed 95% relative
Width	33.25 inches (84 cm)
Depth	38.25 inches (97 cm)
Height	71.75 inches (182 cm)
Weight	325 lbs. (148 kg)

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

Control and Switch Locations

Most of the controls are located inside the drawer, behind the control panel (see Figure 1-1). The only exception is the power on/off switch.

Power On/Off Switch

The power on/off switch is located at the top left of the cabinet (behind the peak).

Volume Control

The volume control is located on the JSA Audio II PCB, which is in the drawer behind the control panel.

Self-Test Switch

The self-test switch is also located on the JSA Audio II PCB, in the drawer behind the control panel.

Coin Counter

The coin counter is located on the bottom of the coin box, inside the lower coin door.

Installing the Control Panel

Make sure the game power is turned off. To install the separately packaged control panel, you need the following tools:

- Hex driver or wrench

- Four flat washers (provided with game)

- Four nut-washer assemblies (provided with game)

1. Reach in through the openings on the front of the drawer, and open the spring draw latch on each side. Pull the drawer out partly. (See Figure 1-1.)

2. Hold the control panel up to the front of the drawer, and match up the four threaded studs with the four small holes (one in each corner).

3. Install one flat washer and nut/washer assembly onto each threaded stud.

4. Plug the two control panel harness connectors into the game harness inside the drawer. These connectors are interchangeable, so be sure to match wire colors. Plug the third harness connector into the game PCB connector located near capacitors C42–C44. Plug the fourth (ground) wires together at the Fast-on connectors. **This step is very important, since these wires ground the control panel.**

5. Close the drawer and snap shut both latches.

Figure 1-1 Control and Switch Locations

6. Turn on the game power. Check that the video display and the attraction lamp have power.

Setting the Coin and Game Options

The Pit-Fighter 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 of the manual describes the theme of the Pit-Fighter game and the game play features.

Introduction

This is Pit-Fighter, the new underground sport! There's no shortage of action in this no-holds-barred street fight. Players control one of three skilled masters as they challenge street-tough fighters like "The Executioner", "Chainman Eddie", "Angel", and the "Masked Warrior"—the Ultimate Champion.

Pit-Fighter is made entirely of *digitally processed graphics* for the ultimate in realism. It even includes a camera zoom and side-to-side pan for a cinematic look.

Up to three can play, and players can join in at any time. Each player uses an 8-way joystick and three buttons to control his fighter. Using different button combinations, players command their fighters to punch, kick and jump. Using other control combinations generates a variety of other moves.

The total number of fighters on the screen at any one time is determined by the number of paying players.

In this free-for-all brawl, players can hit any fighter, even any of the good guys.

Play Mode

In Pit-Fighter, no rules exist. In this crude, unregulated form of prize fighting, anything goes. Fighters are in it for the money and glory of beating the champion.

Players begin by selecting one of three characters. Each are unique in appearance and fighting style.

Buzz — Former pro wrestler & bodybuilder. He specializes in brute-strength moves.

Ty — Champion kickboxer & Pit-Fight veteran. He has powerful kicks & killer instinct.

Kato — Master of the Flying Dragon style of Karate. He has incredible hand speed and agility.

Each player has a lethal "Super Move" that is unleashed when all three buttons are pressed. This explosive move is much more damaging to a fighter than regular moves. Their special Super Moves are:

Buzz — Killer Body Slam

Ty — Flying Deadly Double Kick

Kato — Lethal Dragon Punch

In Pit-Fighter, players fight numerous challengers as they battle their way to the top. To keep players on
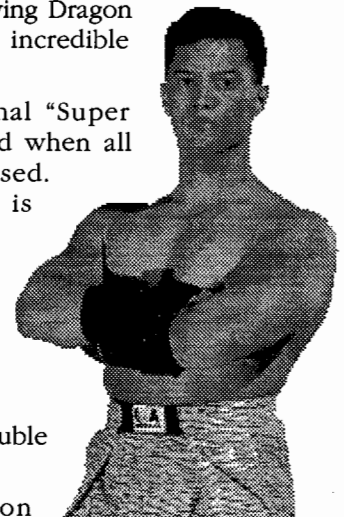
their toes, all the challengers have unique fighting skills and attack in a different way. Players must also be aware of a hostile crowd that will push and shove when fighters come too close. Some people will emerge from the crowd and stab fighters with knives. At the end of each match, players are awarded bonuses for Knockouts, Brutality, and a Fight Purse.

Every third match is a Grudge Match. Here, players fight head-to-head with other paying players in a multi-player game, or a computer twin of themselves in a one-player game. The winner is the last man standing in a three-knockdown fight. The last Grudge Match is an Elimination Match to decide who will challenge the Masked Warrior, the Ultimate Champion. After defeating the champion, a new one is crowned.

Self-Test

Use the Pit-Fighter 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

To enter the self-test, turn on the self-test switch on the JSA Audio II PCB (next to the volume control). Doing so displays the select test menu (entitled "Self Test"); see Figure 2-1. Exit the self-test by turning off the self-test switch at any time.

Table 2-1 Summary of the Self-Test Screens

Self Test (Select Test Menu)
Switch Test
Sound Test
Coin Options
Game Options
Game Statistics
Alpha(numeric) Test
Motion Object Test
Playfield Test
Color Test
    First Color Test
    Second Color Test
    Red Color Purity
    Green Color Purity
    Blue Color Purity
    White Color Purity
    Grey Color Purity
Convergence Test
    White Convergence
    Violet Convergence
    Blue Convergence
    Yellow Convergence

Table 2-2 Bad RAM Location by Error Address

Error Address	RAM Location High	Low
FE8000 (Color RAM)	45D	45C
FF0000 (Video RAM)	35J	25J

Table 2-3 Bad ROM Location by Error Address

Error Address	ROM Location High	Low
000000	5D	5B
020000	30D	30B

RAM and ROM Test

When you turn on the power, the game automatically runs through the random-access memory (RAM) and read-only memory (ROM) test. This test is *not* part of the self-test procedure. Regardless of whether or not the game has a problem, it will always advance to the attract mode. The game will stop only if you power it up and the self-test switch has been previously turned on.

Game RAM Test

No message appears while the test is checking the RAMs. If more than 30 seconds elapse and the self-test menu doesn't appear, the game has a problem. See Table 2-2 for the locations of bad RAMs. If the test finds no RAM errors, no message appears and the program goes to the ROM test after 15-20 seconds.

Game ROM Test

If the test finds no ROM errors, no message appears and the program goes to the title screen in the attract mode. If a ROM fails, a message is displayed. Furthermore, if the failed ROM is a program ROM, then the error number with checksums is shown in the center of the screen. The ROM error test takes a few seconds. See Table 2-3 for the location of bad ROMs.

If you think you have a ROM error, but the screen shows no messages, see Table 3-3 for information about the locations of various ROM functions.

Depending on how bad the ROM error is, you may not be able to enter the self-test.

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 using any of the three joysticks. Start the select-
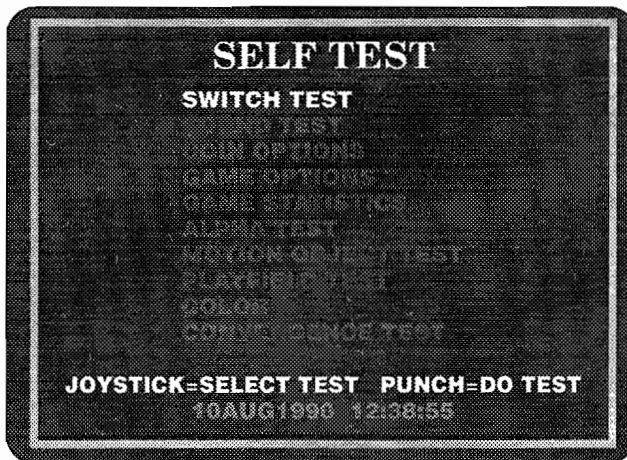
Figure 2-1 Select Test Menu Screen

ed test by pressing any of the punch buttons.

Switch Test

The switch test screen is shown in Figure 2-2. Test the joysticks and pushbutton switches. As you use each control, the pink *X*s for the pushbuttons change to *O*s, or the joystick switch markers (small yellow dots) are highlighted. If the changes do not appear on the screen, check the switch wiring and the switches.

NOTE

The coin mechanisms are checked in the Sound test. See the next section below.

Press the left Kick and Punch buttons simultaneously to return to the menu screen.
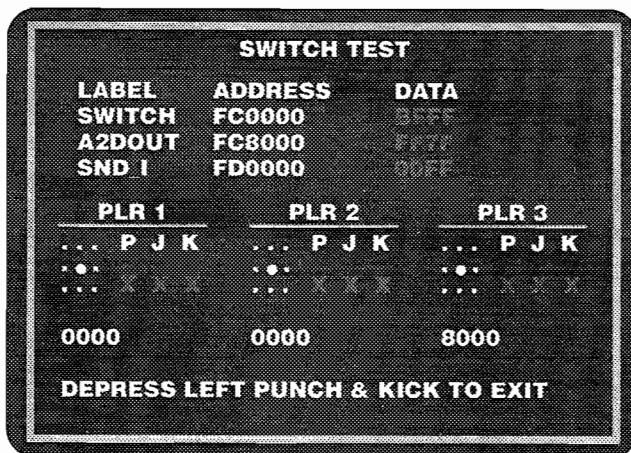
Figure 2-2 Switch Test Screen

Sound Test

The sound test indicates the condition of the sound effects circuit on the game PCB. The sound test screen appears in Figure 2-3.

Use one of the joysticks to select from the sounds; press one of the jump buttons to listen to it. (You can have numerous sounds playing simultaneously, or you can have silence, depending on which ones you select.) Pressing any punch button returns you to the menu screen.

Coin Options

Check and select the coin options on this screen, shown in Figure 2-4. 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
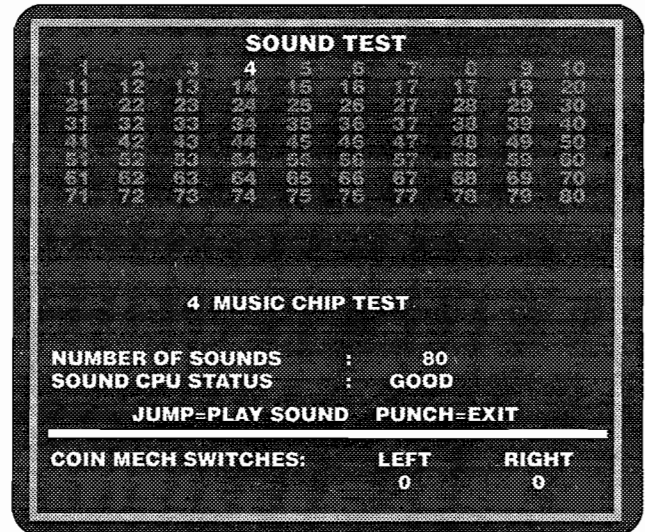
Figure 2-3 Sound Test Screen
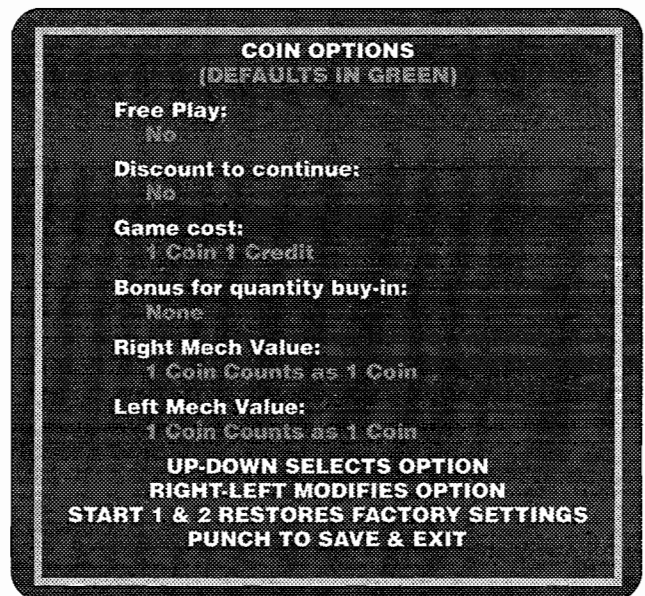
Figure 2-4 Coin Options Screen

instructions shown at the bottom of the screen. The coin option settings, with defaults, are shown and explained in Table 2-4.

Game Options

Check and select the game options on this screen, shown in Figure 2-5. 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

Table 2-4 Coin Option Settings

Option	Available Settings	Explanation
Free Play	No ✦ Yes	Lets you choose free play to demonstrate the game.
Discount to Continue	No ✦ Yes	If set to *Yes*, this option reduces by 50% the player's cost to continue a game (always rounded up to the next full coin).
Game Cost	1 coin 1 credit ✦ 2 coins 1 credit ... 8 coins 1 credit	The number of coins required for one credit.
Bonus for Quantity Buy-in	None ✦ 2 coins give 1 3 coins give 1 3 coins give 2 4 coins give 1 ... 9 coins give 2 9 coins give 3	Lets you choose from various kinds of bonuses or no bonus.
Right Mech Value	1 coin counts as 1 coin ✦ 1 coin counts as 2 coins ... 1 coin counts as 7 coins 1 coin counts as 8 coins	The number of coins each coin counts as in the right coin mechanism.
Left Mech Value	1 coin counts as 1 coin ✦ 1 coin counts as 2 coins ... 1 coin counts as 7 coins 1 coin counts as 8 coins	The number of coins each coin counts as in the left coin mechanism.

✦ *Manufacturer's recommended settings*

```
           GAME OPTIONS

        (DEFAULTS IN GREEN)

 DIFFICULTY LEVEL:
        MEDIUM
 MUSIC IN ATTRACT:
        YES
 AUTO CLEAR HIGH SCORES:
        YES
 CLEAR HIGH SCORES NOW:
        NO
 DISPLAY FBI SCREEN:
        YES

       UP-DOWN SELECTS OPTION
      RIGHT-LEFT MODIFIES OPTION
  START 1 & 2 RESTORES FACTORY SETTINGS
         PUNCH TO SAVE & EXIT
```
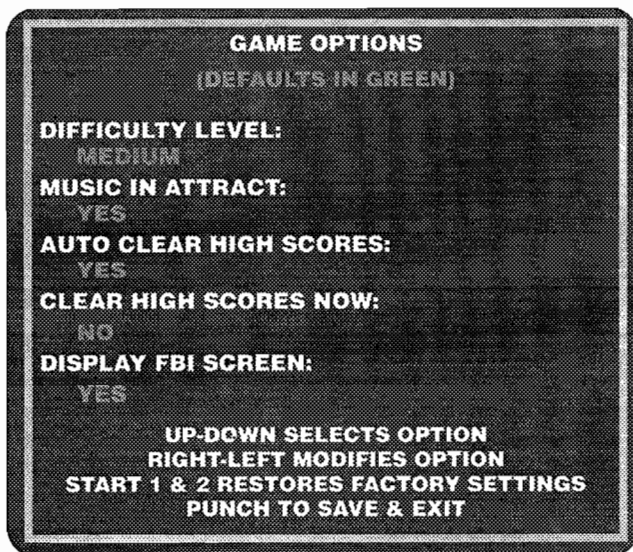
Figure 2-5 Game Options Screen

game options, with defaults, are shown and explained in Table 2-5.

Game Statistics

Use the information shown in the four statistics and histogram (bar graph) screens to keep track of your game use and maximize your profits. Record the information on the Pit-Fighter statistics page in the back of this manual. The first of the four screens is shown in Figure 2-6.

The game statistics are collected from the last time the statistics were cleared. You can clear the statistics by simultaneously pressing the Start 1 and 2 buttons (the left and center ones). Press the left Punch button to advance to the next statistics or histogram screen, or to go back to the Select Test menu.

Statistics Screen

The first statistics screen 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.

■ *0 Plyr Mins* shows the number of minutes that the game was idle.

■ *1 Plyr Mins* shows the number of minutes that the

Table 2-5 Game Option Settings

Option	Available Settings		Explanation
Difficulty Level	Easiest, Way Easy, Very Easy, Medium Easy, Medium ✦, Medium Hard, Very Hard, Hardest		Sets the game difficulty.
Music in Attract (Mode)	Yes ✦	No	Lets you turn the sound on or off in the attract mode.
Auto Clear High Scores	Yes ✦	No	Automatically clears the high-score table periodically.
Clear High Scores Now	Yes	No ✦	Immediately clears the high score table in the self-test.
Display FBI Screen	Yes ✦	No	Periodically displays the FBI emblem and the message "Winners Don't Use Drugs" in the attract mode. If this game is used outside of the U.S., we recommend you set this option to *No*.

✦ *Manufacturer's recommended settings*


```
                STATISTICS

        LEFT COINS:
        RIGHT COINS:
        0 PLYR MINS:
        1 PLYR MINS:
        2 PLYR MINS:
        3 PLYR MINS:
        SESSIONS:
        NEW GAMES:
        CONT GAMES:
        NEW MINS:
        CONT MINS:
        ERROR COUNT:

        TOTAL CREDITS:     26
        AVG TIME/CREDIT:   78 SEC
        AVG TIME/NEW GAME: 60 SEC
        AVG TIME/CONT GAME: 90 SEC

    OS CREATION DATE: 05AUG1990 03:28:15
    PG CREATION DATE: 05AUG1990 06:56:04

        START 1 & 2 TO CLEAR STATS
            LEFT PUNCH TO EXIT
```
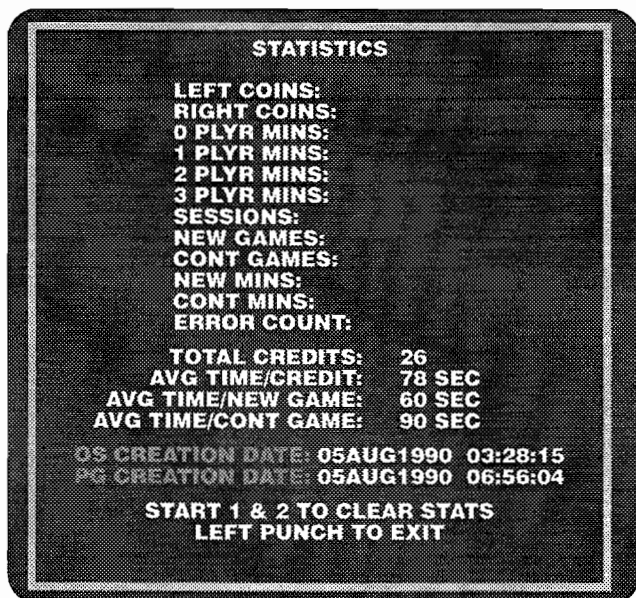
Figure 2-6 Statistics Screen

game was played by one person only.

- *2 Plyr Mins* shows the number of minutes that the game was played by two people.

- *3 Plyr Mins* shows the number of minutes that the game was played by three people.

- *Session* is measured from when the first player starts a game until the *Game Over* message appears.

- *New Games* shows the number of unique games played. A unique game is counted every time a player starts a new game (not a continued game).

- *Cont Games* shows the number of games that players continued.

- *New Mins* shows the number of minutes that the

game was played as new games.

- *Cont Mins* shows the number of minutes that the game was played as continued games.

- *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 EEROM at 30E on the Pit-Fighter game PCB.

- *Total Credits* is the number of credits accumulated by the game.

- *Average Time per Credit* is displayed in seconds. This item is tabulated for all games played since the statistics were cleared. If there are no credits, this line will not be displayed.

- *Average Time per New Game* is also displayed in seconds.

- *Average Time per Continued Game* is also displayed in seconds.

Histogram 1 Screen
The first histogram screen lists the length of time for all new games, grouped in 20-second increments (except for the shortest games lasting 0–39 seconds).

Histogram 2 Screen
The second histogram screen lists the same information as Histogram 1, except for continued games.

Histogram 3 Screen
The third histogram screen lists the length in minutes for all game sessions.

Alphanumeric Test

The alphanumeric test, shown in Figure 2-7, checks the condition of the alphanumerics in the game. If you see an error on the screen, check the EPROM at 15L.
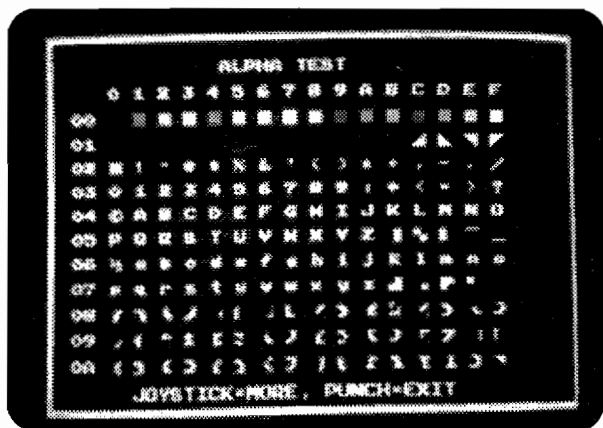
Figure 2-7 Alphanumeric Test Screen

Moving any of the joysticks up or down scrolls the screen up and down. Press any Punch button to go to the menu screen.

Motion Object Test

The motion object test screen, shown in Figure 2-8, tests the movement and color of various game objects. The most important part of this screen is the ROM status squares on the right side. The squares should all be green (indicating good motion object ROMs); red squares indicate bad ROMs.

Choose an object and move it or change it as follows:

Control:	This action results:
Left joystick	Left/right and up/down moves the object around on the screen.
Center joystick	Up/down enlarges/shrinks the object.
Left Jump, Kick	Selects one of the three motion objects (called 0, 1, and 2).

Center Jump, Kick	Selects a picture that will be displayed and manipulated as the motion object.

Press the left Punch button to go to the select test menu.

Playfield Test

The playfield test screen, shown in Figure 2-9, tests the movement of the playfield.

Move the left joystick up, down, left, and right to check whether the whole picture moves accordingly. Press the left Punch button to go to the menu screen.
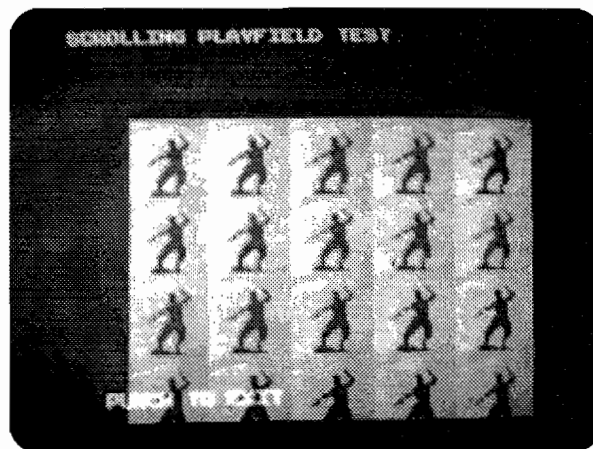
Figure 2-9 Playfield Test Screen

Color Test

This test has seven screens, the first of which is shown in Figure 2-10. Advance to each screen by pressing the Kick or Jump button.

- The first color test indicates the dynamic range of

Figure 2-8 Motion Object Test Screen
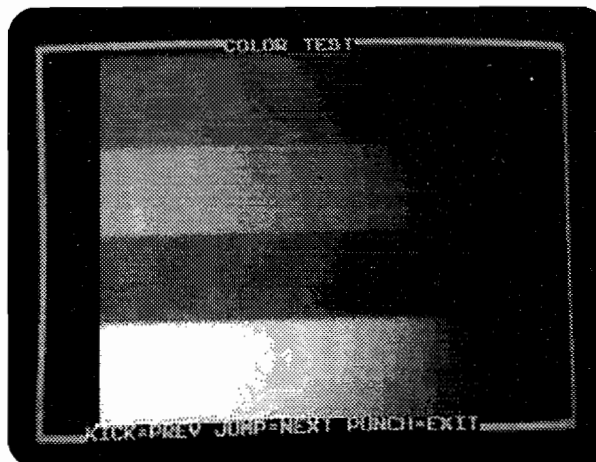
Figure 2-10 Color Test Screen

the video display color circuit. The screen should show four bands (red, green, blue, and white, from top to bottom), ranging from bright to dark, left to right. The red, green, and blue bands are produced by only one color gun being turned on in each band. At the bottom is a white band, in which all three color guns are turned on.

■ The second color test shows the same as the first color test, but with two color guns being turned on in three bands—a yellow band (red and green guns), cyan band (blue and green guns), and magenta band (blue and red guns). At the bottom is a white band.

■ The remaining five screens are color purity tests. The rectangles of color shown are red, green, blue, white, and grey.
Each screen should display a straight rectangle of color, with no curving at the corners, no unevenness of color, and no lines in the display.

If any of these screens are not correct, adjust the video display as described in the video display manual. Return to the menu screen by pressing any Punch button.

Convergence Test

The convergence test has four screens—white, violet, blue, and yellow grid lines. The white screen is shown in Figure 2-11. To see the remaining screens, press any
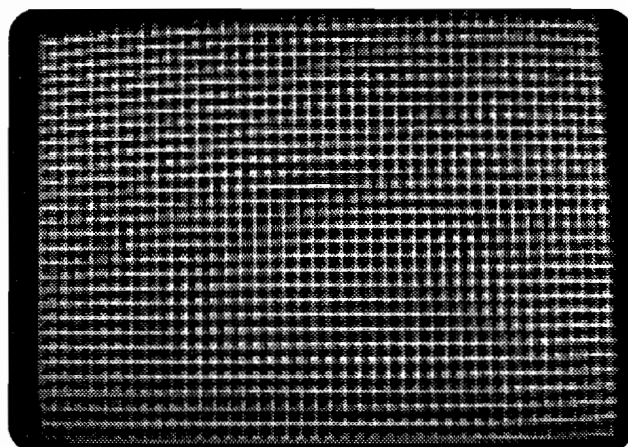
Figure 2-11 Convergence Test Screen

Kick or Jump button. Press any Punch button to go to the menu 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 black 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.

N O T E S

Troubleshooting and Maintenance

This chapter contains troubleshooting tables and repair procedures for your Pit-Fighter™ game. The chapter contains three troubleshooting tables. The first table has general troubleshooting information, the second table contains the voltage levels and test points on the game printed-circuit board, and the last table describes ROM-caused problems with specific ROMs to check and replace. The chapter also has instructions for removing and replacing the video display, in addition to repair information for the joystick control.
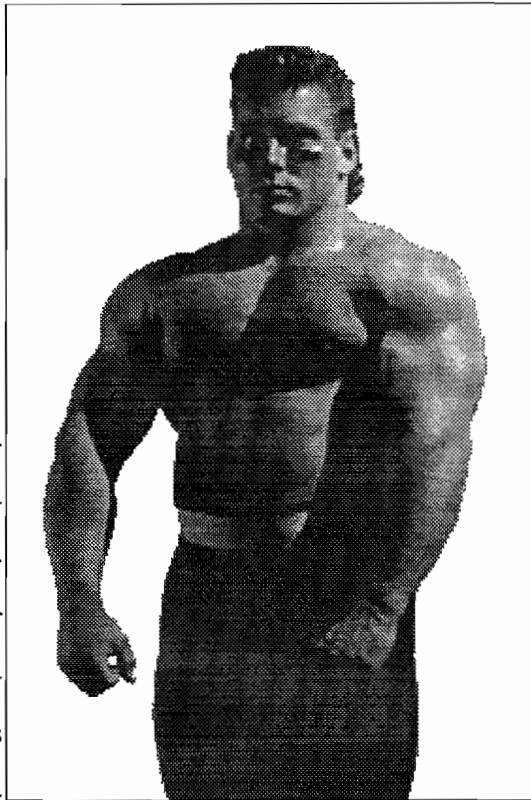
Table 3-1 Troubleshooting Table

Problem	Suggested Action
Coin Switch Problem	1. Check the wiring to the coin switch. 2. Check the voltage to the + side of the coin switch. 3. Test the coin switches with the sound test screen in the self-test.
Game Play Problem	1. Check the harness and connectors. 2. Perform the self-test. 3. Check the voltage levels on the PCB. See Table 3-2, *Voltage Inputs and Test Points*. 4. Check *What ROM Problems Look Like*, Table 3-3, for specific ROM problems. See Figure 4-5 for ROM locations.
Joystick or Switch Problem	1. Have the joysticks been lubricated with the correct type of lubricant? If not, lubricate them as shown in Figure 4-2. 2. Check the harnesses and connectors. 3. Check the switches on the joystick control or on the control panel. 4. If you took the joystick control apart, have you reassembled it correctly? 5. Make sure all the parts on the joystick are in good repair. Repair or replace parts.
Sound Problem	1. Is the speaker volume turned up? 2. Check the voltage on the JAMMA connector. 3. Check the wiring from the PCB to the speaker. 4. Check the voltage level to the PCB. See Table 3-2, *Voltage Inputs and Test Points*. 5. Replace the speaker.
Video Display Problem	

Screen is dark.	1. Is the game plugged in?
	2. Is the game turned on?
	3. Are the connections good?
	4. Is the line fuse good?
	5. Is the display brightness turned up?
	6. Are the connections on the line filter and transformer good?
	7. Are the connectors on the PCB tightly connected?
	8. Check all of the items below. If you answer *no* to any question, you have a problem with the video display, not with the game circuitry. See your video display service manual.
	  a. Do you have power to the video display?
	  b. Are the video display's filaments lit?
	  c. Do you have high voltage to the video display?
	9. Is the voltage level to the video display PCB correct? (Power voltage is 100 VAC or 110 VAC, depending on the type of video display. Video signal voltage is 0.5 to 3.5 Volts.)
	10. If the level is not correct, check the connectors and the harness.

Only a colored screen appears.	You probably have a serious RAM problem. See Table 3-5, *Colored Screens Indicating Bad RAMs*.
Display area wavers or is too small.	1. Do you have voltage to the video display PCB? 2. Do you have high voltage to the video display?
Picture is wavy.	1. Is the monitor ground connected to the monitor? 2. Are the sync inputs connected properly? Does your monitor need a separate positive sync?
Picture is upside down.	Switch the horizontal or vertical yoke wires on the display.
Convergence, purity or color problems.	Use the screens in the self-test to adjust the video display.
Picture is not centered.	Use the centering procedures in your video display manual.

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

Voltage	Test Point or LED	Source and Purpose
+5 ± 0.25 VDC	+5V1	Logic power from the switching power supply.
	CR1 LED	Lights when 5 V is applied to the Game PCB and the reset (RST) jumper is open.
	CR5 LED	Lights when the +12 V supply on the JSA Audio II PCB is good.
	CR4 LED	Lights when the –5 V supply on the JSA Audio II PCB is good.
+12V	+VOP (pin 4 of LM324)	+12 V from the switching power supply. Positive supply for the analog circuitry.
–5V	–VOP (pin 11 of LM324)	–5V from the switching power supply (if connected). Negative supply for the analog circuitry.

Maintaining the Coin Mechanism

The coin mechanism should be cleaned every three months. For detailed parts information on the coin door, see Figure 4-3. To maintain the coin mechanism:

1. Turn off the power to the game. Open the upper coin door.

2. Open the gate on the door covering the magnet. Use the blade of a screwdriver to scrape away any metal filings collected on the magnet.

3. For a thorough cleaning, wash the coin mechanism in hot soapy water. Use a toothbrush to remove any stubborn build-up of residue in the coin path.

4. Dry the coin mechanism with compressed air.

5. If you do not want to use water, brush the loose dust off with a soft brush and scrub the residue in the coin path with a toothbrush. Blow out all the loose dust and dirt with compressed air.

NOTE
Never lubricate the coin mechanism with oil or grease.

Repairing the Video Display

The video display frame in this game is designed to be used with both horizontal- and vertical-mounting displays, as well as 19- and 25-inch displays.

Removing the Video Display

If you have a problem with the video display, first run the self-test procedure to narrow down the cause. To make adjustments to the video display, unlock the service door on the rear of the cabinet.

If you want to repair the video display, remove it from the game by following this procedure:

1. Turn the game power off and wait two minutes. Unplug the power cord for safety.

2. While you wait, unlock the top service door on the rear of the cabinet.

3. Remove the three screws that attach the attraction shield retainer, and remove retainer, shield, and attraction film. Then remove the display shield, cardboard bezels, and cleats in front of the display.

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.

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4. Remove the four nuts and washers that secure the video display.

5. Discharge the high voltage from the cathode-ray tube (CRT). The display assembly contains a circuit for discharging the high voltage to ground when power is removed. However, to make certain, always discharge the display as follows:

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

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

Table 3-3 What ROM Problems Look Like

Problem	ROM Causing the Problem	Check the ROM at:
Program works, but the motion objects or playfield are wrong.	Graphics	Playfield: 45M–130M. Motion Object High: 65N–130N. Motion Object Low: 65R–130R. Alphanumerics: 15L.
Garbage on screen; program doesn't work.	Processor Program ROM 0	10H 5D, 5B
Game program is erratic. No sound or erratic sound.	Program ROM 1 Audio ROM:	15D, 15B
	Audio Program Audio ADPCM	1B 7K, 7J, 7E, 7D

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

d. Wait two minutes and repeat part c.

6. Disconnect the harness connectors from the video display.

7. Pull the video display assembly out of the cabinet. Be extremely careful.

Replacing the Video Display

Perform the following procedure to replace the video display in the cabinet.

1. Carefully lift the video display into the cabinet.

2. Install the nuts that hold the video display assembly.

3. Connect the power and signal harnesses to the video display.

   If you replace the CRT and yoke together, adjust the brightness, size, and centering as described in the video display service manual. Check the purity and convergence according to that manual, but adjust both only if required.

4. Install the video display shield, bezel, and cleats. Replace the attraction film, shield, and retainer.

5. Lock the rear service door on the cabinet.

Removing and Replacing the Joystick Control

The joystick control is shown in Figure 3-1. If you want to repair the joystick control, disassemble it by removing it from the control panel. To repair the joystick, disassemble it by removing the retaining ring at the bottom of the shaft. To replace any of the four switches, remove the two screws that secure each switch.

ROMs and RAMs

If you think you have bad ROMs or RAMs, run the self-test. If you see only a colored screen and cannot enter the self-test, see Table 3-3. Also refer to Table 3-4 if you think you have a RAM problem.

Table 3-4 Screen Colors Indicating Bad RAMs

Screen Color	RAM Error Location
Red	Working RAM
Green	Playfield RAM
Blue	Motion Object RAM

99-080040
Black Joystick Assy.

99-080041
2" Washer

Top Plate

Flat Washer

Bellows

Steel Washer

99-080030
Compression Spring

99-080039
Base Assy.
W/Gold Switch

Screw

Switch

99-080042
Microswitch Actuator

99-080043
3/8" Retaining Ring
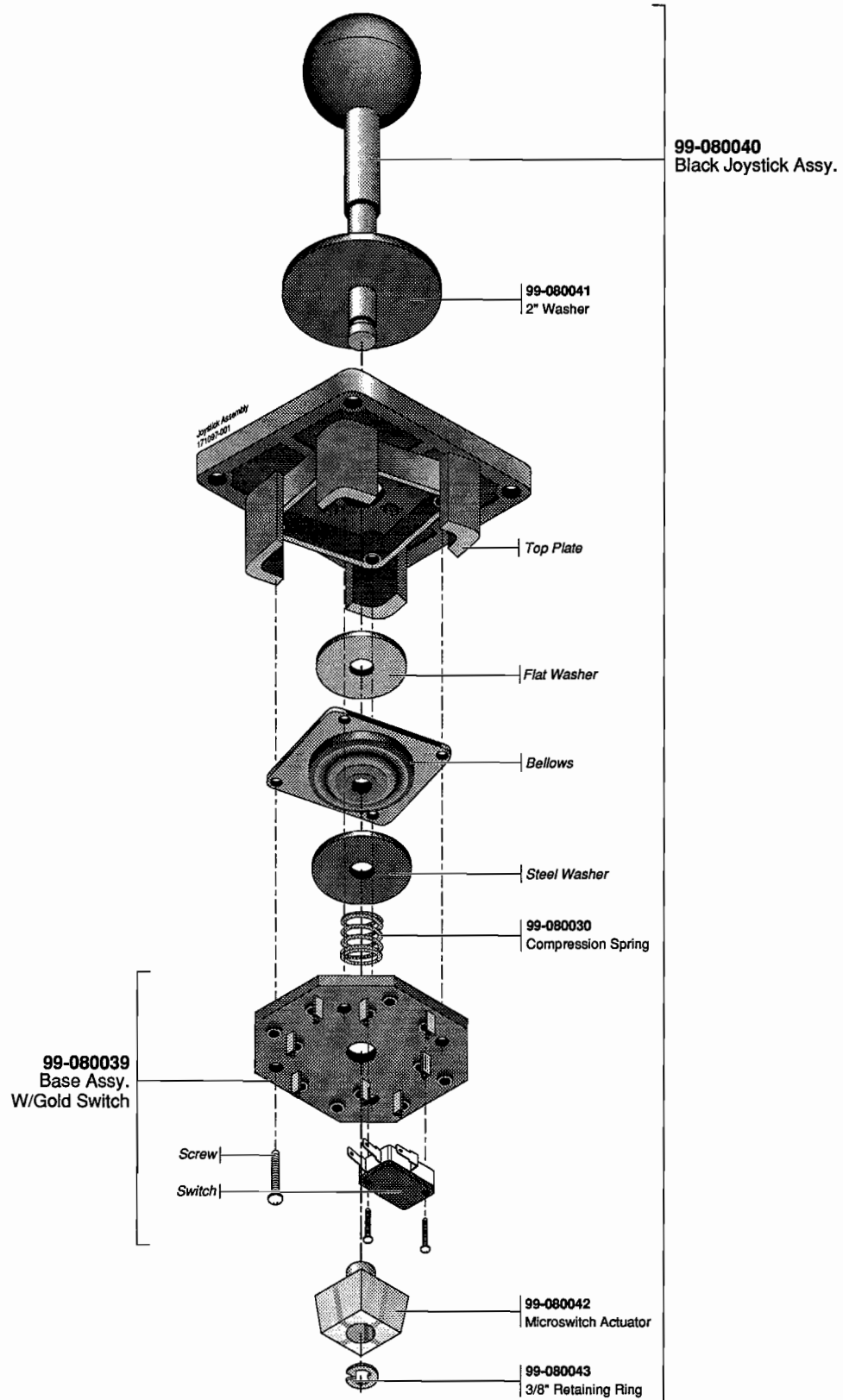
Figure 3-1 Maintaining the Joystick Control

N O T E S

Parts Illustrations
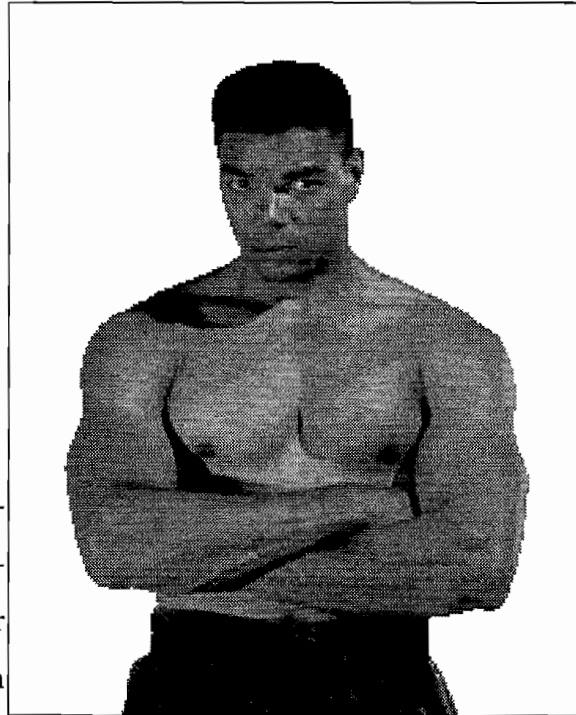
This chapter provides information you need to order replacement parts for your game. Common hardware, such as screws, nuts, washers, are included in these parts illustrations. When you order parts, give the part number, part name, the number of this manual, and the serial number of your game. With this 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.

046929-01
Glass Retainer
75-3816D
#8-32 x 1"
Flt Screw
(3 places)

178263-1202
3/4" x 1/8"
Vinyl Foam Tape

048425-02
Bezel W/
Graphics
178263-0801
1/2" x 1/16"
Foam Tape
(4")

048073-01
Black Bezel

046925-01
Lower Retainer
176019-212
#8 x 3/4" Sq. Dr.
LPW Screw

046926-01
Upper Retainer
176019-212
#8 x 3/4" Sq. Dr.
LPW Screw

170003-001
18", 15W Flourescent Light
171086-001
Flourescent Lamp Fixture
176015-110
#10 x 5/8" Pan-Hd. Screw
(2 places)
178232-001
Lamp Retaining Clip
(2 places)

046928-01
Attraction Shield

048423-02
Attraction Film

A047011-01
Speaker Panel Assy.
176019-220
#8 x 1 1/4" Sq. Dr. Screw
(4 places)

139022-401
25" Color Display
72-5516
1/4-20 x 1" Hex Screw
(4 places)
72-035C
1/4" Lock Washer
(4 places)
75-07002
Flat Washer
(4 places)
75-99515
#1/4-20 Nut/Washer Assy.
(4 places)

046927-01
Display Shield

048442-01
Ctl Panel
Backup

178056-002
1/2" W.,
1 1/16" Foam Tape

176019-212
#8-3/4" Sq. Dr. Screw
(7 Places)

A048440-01
Control Panel
Assy.

047974-01
Cleat
(2 Places)
176019-220
#8 x 1 1/4" Sq.
Dr. Screw
(6 Places)

047952-01
Mounting Frame
75-5520B
1/4-20 x 1 1/4" Sq.
Neck Carr. Bolt
(8 Places)
75-99515
1/4-20 Nut/
Washer Assy.
(8 Places)
176015-110
#10 x 5/8"
Pan-Hd. Screw
(12 Places)

A047896-03
Pit-Fighter Game
PCB Assy.
A047184-05
JSA Audio II
PCB Assy.
178278-616
#6 PCB Standoff
(3 places)
177000-536
#6-32 Nylon Nut
(3 places)

178013-001
Drawer Latch
(2 places)
176015-110
#10 x 5/8"
Pan-Hd. Screw
(8 places)

A048447-01
Drawer Assy.
A048446-01
Wood Drawer

75-0702
1/4" Wide Pattern Washer
(4 places)
75-07002
Flat Washer
(4 places)
75-045S
#1/4 Split Lock Washer
(4 places)
72-5532
#1/4-20 x 2" Hex Hd. Bolt
(4 places)

A048444-01
Control Pod Assy.

ST-357
Self-Test Label

045057-01
Ctl. Mounting Bracket
(4 places)
176015-110
#10 x 5/8" Pan-Hd. Screw
(8 places)

171093-001
25 Cent Coin Door Assy.
176015-110
#10 x 5/8" Pan-Hd. Screw

A047606-02
Power Supply Assy.

Figure 4-1 Cabinet-Mounted Assemblies, Front View
A048450-01 F

Items Not Shown:

A047073-01
Main Harness Assy.
A047607-01
Video Harness Assy.
A048099-01
Ground Jumper Assy.

009992-01
ON/OFF Switch Enclosure
176015-112
#10 x 3/4" Pan-Hd. Screw
(2 places)
A047711-01
Power Switch Assy.
176015-110
#10 x 5/8" Pan-Hd. Screw
(2 places)

A048448-01
Cabinet Assy.

047985-01
Cover
176019-212
#8 x 3/4" LPW Screw
(16 Places)

048422-01
Side Panel Decal
(2 places)

A047606-02
Pwr. Supply Assy.
176015-112
#10 x 3/4"
Pan-Hd. Screw
(4 Places)
75-99518
#8-32 Nut/
Washer Assy.

047976-01
Rear Door
176020-220
#8 x 1 1/4"LPW Screw
(4 places)
047985-01
Cover
176019-212
#8 x 3/4" Sq.
Drive Screw
(16 places)

043939-01
Leg Leveler Plate
176015-112
#10 x 3/4" Pan-Hd. Screw
(16 places)
178255-004
3/8-16 x 1 1/2"
Adjustable Glide
(4 places)

Figure 4-1 Cabinet-Mounted Assemblies, Rear View
A048450-01 F

99-080040
Black Joystick Assy.

99-080041
2" Washer

Joystick Assembly
171097-001

Top Plate

Flat Washer

Bellows

Steel Washer

99-080030
Compression Spring

99-080039
Base Assy.
W/Gold Switch

Screw

Switch

99-080042
Microswitch Actuator

99-080043
3/8" Retaining Ring

Figure 4-2 Joystick Assembly
171097-001

N O T E S

99-15025
Coin Inlet. Left

99-15113
Key Hook

99-15056
Screw for Bezel

99-15086
Coin Mechanism

99-15104
Base Plate
W/Pivot & Stud

99-15096
Sw. Adjuster

99-15056
Screw

99-15131
Elastic Locknut

99-15132
Snap-on Sleeve

99-15130
Snap-on Clip

99-15133
Hold Down Bracket

99-15100
Lamp

99-15026
Right Coin Inlet

99-15056
Screw for Bezel

99-15128
Nut/Washer for
M/S Mounting Screw

99-15027
Coin Ret. Plate

99-15028
Coin Ret. Box

99-15056
Screw for Bezel

99-15129
Mounting Stud
(2 places)

99-15051
Lamp Holder

99-15029
Bracket

99-15042
Switch

99-15134
4-40-1" Pan-Head Screw

99-15126
M/S Flat-Head
Mounting Screw

99-15085
Coin Door Harness

Figure 4-3 Coin Controls, Inc. Coin Door Assembly
171093-001

99-15038
Bezel for Button

99-15036
Cover

99-15001 thru 99-15012
Return Button

99-15039
Bezel for Cover

99-15125
Frame Hinge Screw

99-15052
Spring for Button

99-15088
Clamp

99-15110
Enclosure

99-15135
Frame Clamp Screw

99-15116
Upper Door

99-15115
Lower Door

99-15114
Die Cast Frame

99-15111
Coin Counter

99-15089
Lock Assy

99-15109
Coin Box

99-15127
Meter Mounting
Screw

Figure 4-3 Coin Controls, Inc. Coin Door Assembly
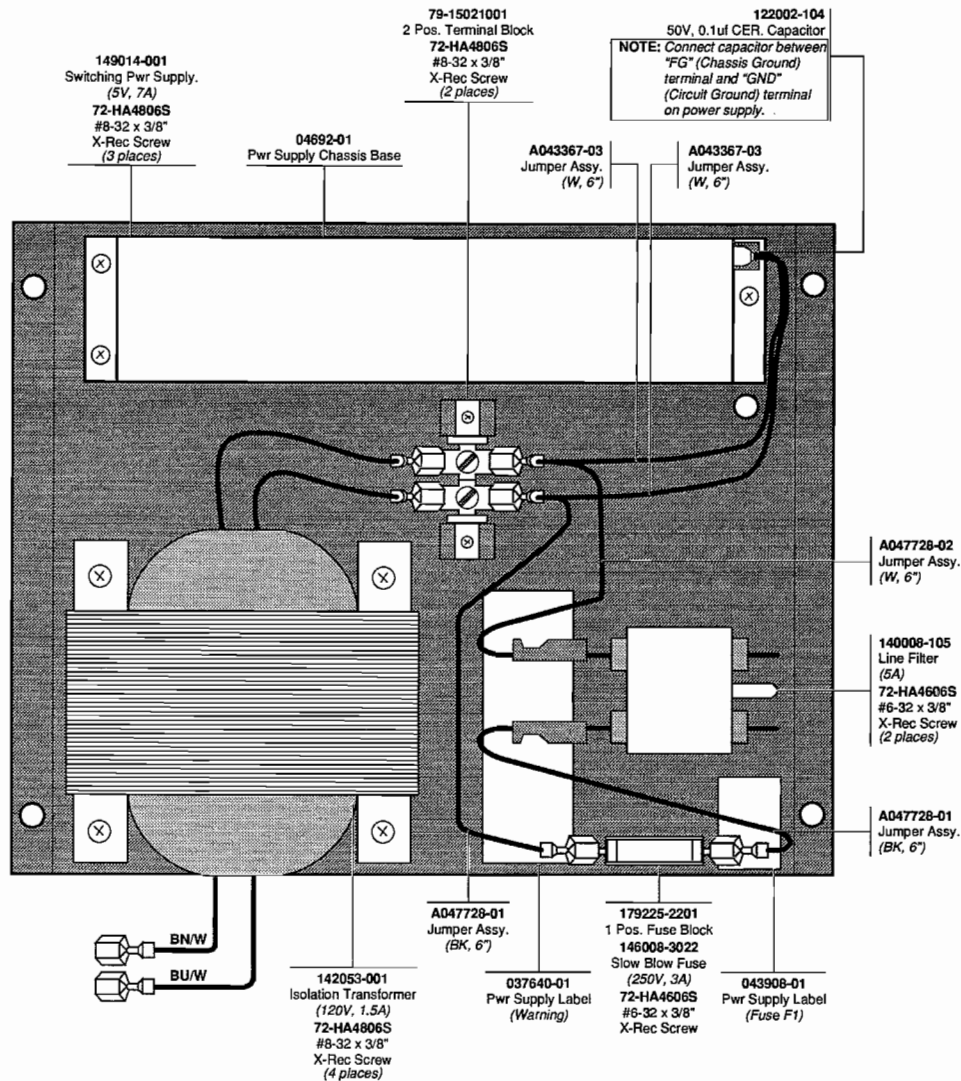**171093-001**

N O T E S

Figure 4-4 Power Supply Assembly (+5/–5/+12V)
A047606-02 D

Power Supply Assembly
Parts List

Part No.	Description	Part No.	Description
046924-01	Power Supply Chassis Base	A043367-02	Jumper Assy. (Black, 6")
149014-001	5 Volt 7 Amp Switching Power Supply	A043367-03	Jumper Assy. (White, 6")
140008-105	5 Amp Line Filter	043908-01	Power Supply Fuse Label (F1)
A047728-02	Assy., Jumper (White, 6")	122002-104	50V, 0.1uf CER Capacitor
142053-001	Transformer, Isolation (120 Volt, 1.5 Amp)	72-HA4606S	Screw, Thread-Rolling, Cross-Recessed,
79-15021001	Terminal Block, 2-Position		#6-32 x 3/8"
179225-2201	Fuse Block, 1-Position	72-HA4806S	Screw, Thread-Rolling, Cross-Recessed,
146008-3022	Fuse, 3 Amp, Slow-Blow, 250 Volt		#8-32 x 3/8"
		A047728-01	Assy., Jumper (Black, 6")

**Figure 4-5 Pit-Fighter Game PCB Assembly
A047896-03 J   (4-MB PROM Version)**

Pit-Fighter Game PCB Assembly (4-MB PROM Version)
Parts List

Designator	Description	Part No.	Designator	Description	Part No.
	Sockets		10M	Integrated Circuit, 7497	137090-001
5B, 5D	Socket, 32 Pin, .600-Inch	179257-032	10P	Integrated Circuit	136079-1053
10A1	Socket, 28 Pin, .600-Inch	179257-028			
10A2	Socket, 20 Pin, .300-Inch	179259-020	15B	Integrated Circuit, EPROM	136081-1031
10H, 10P	Socket, 64 Pin, .900-Inch	179256-064	15D	Integrated Circuit, EPROM	136081-1030
			15E	Integrated Circuit, GAL16V8	136081-1043
15B, 15D	Socket, 32 Pin, .600-Inch	179257-032	15F	Integrated Circuit, 74F244	137502-001
15E	Socket, 20 Pin, .300-Inch	179259-020			
15L, 20B, 20D	Socket, 32 Pin, .600-Inch	179257-032	15H	Integrated Circuit, 74LS377	137145-001
20E, 20S	Socket, 20 Pin, .300-Inch	179259-020	15J	Integrated Circuit, 74LS378	137305-001
			15L	Integrated Circuit, EPROM	136081-1027
25J	Socket, 28 Pin, .600-Inch	179257-028	15M	Integrated Circuit, 74LS378	137305-001
25S, 30A	Socket, 20 Pin, .300-Inch	179259-020			
30B, 30D	Socket, 32 Pin, .600-Inch	179257-032	15N	Integrated Circuit, 74F86	137649-001
30E	Socket, 24 Pin, .600-Inch	179257-024	15P, 15S	Integrated Circuit, 74F163	137345-001
			20E	Integrated Circuit, SLAPSTIC II	137412-112
30N, 30S	Socket, 20 Pin, .300-Inch	179259-020	20M	Integrated Circuit, 74LS151	137101-001
35J	Socket, 28 Pin, .600-Inch	179257-028			
40P, 40S	Socket, 20 Pin, .300-Inch	179259-020	20P	Integrated Circuit, 74F163	137345-001
45C, 45D	Socket, 24 Pin, .300-Inch	179259-024	20S	Integrated Circuit, PROM	136081-1042
			25F	Integrated Circuit, 74F00	137327-001
45M, 55M	Socket, 28 Pin, .600-Inch	179257-028	25H	Integrated Circuit, 74LS245	137134-001
60H	Socket, 40 Pin, .600-Inch	179257-040			
65D	Socket, 20 Pin, .300-Inch	179259-020	25J	Integrated Circuit, RAM, 32K x 8, 70 nsec	137615-070
65H	Socket, 24 Pin, .400-Inch	179258-024	25L	Integrated Circuit, 74LS377	137145-001
			25M	Integrated Circuit, 74LS166	137118-001
65M	Socket, 28 Pin, .600-Inch	179257-028	25N	Integrated Circuit, 74F08	137483-001
65N, 65R	Socket, 32 Pin, .600-Inch	179257-032			
70C	Socket, 20 Pin, .300-Inch	179259-020	25P	Integrated Circuit, 74LS378	137305-001
70H	Socket, 24 Pin, .400-Inch	179258-024	25S	Integrated Circuit, PROM	136081-1041
			30E	Integrated Circuit, 28C16-200, 200 nsec	137648-200
70M	Socket, 28 Pin, .600-Inch	179257-028	30F	Integrated Circuit, 74F245	137591-001
70N, 70R	Socket, 32 Pin, .600-Inch	179257-032			
75H	Socket, 24 Pin, .400-Inch	179258-024	30H	Integrated Circuit, 74LS245	137134-001
75M	Socket, 28 Pin, .600-Inch	179257-028	30L	Integrated Circuit, 74LS157	137029-001
			30M	Integrated Circuit, 74LS158	137203-001
85H	Socket, 24 Pin, .400-Inch	179258-024	30N	Integrated Circuit, GAL16V8	136079-1052
90M, 100M	Socket, 28 Pin, .600-Inch	179257-028			
105F	Socket, 20 Pin, .300-Inch	179259-020	30P	Integrated Circuit, 74F169	137496-001
110J	Socket, 40 Pin, .600-Inch	179257-040	30S	Integrated Circuit, PROM	136081-1040
			35A	Integrated Circuit, 74LS244	137038-001
115F	Socket, 20 Pin, .300-Inch	179259-020	35J	Integrated Circuit, RAM, 32K x 8, 70 nsec	137615-070
115M	Socket, 28 Pin, .600-Inch	179257-028			
120F	Socket, 20 Pin, .300-Inch	179259-020	40B	Integrated Circuit, 74F00	137327-001
120J	Socket, 40 Pin, .600-Inch	179257-040	40C	Integrated Circuit, 74F374	137420-001
			40D	Integrated Circuit, 74LS244	137038-001
120M	Socket, 28 Pin, .600-Inch	179257-028	40E	Integrated Circuit, SCOM	137526-001
125F	Socket, 20 Pin, .300-Inch	179259-020			
130M	Socket, 28 Pin, .600-Inch	179257-028	40F	Integrated Circuit, 74F245	137591-001
			40H	Integrated Circuit, 74LS245	137134-001
	Integrated Circuits		40L	Integrated Circuit, 74LS163 A	137114-001
5B	Integrated Circuit, EPROM	136081-1029	40M	Integrated Circuit, 74LS158	137203-001
5D	Integrated Circuit, EPROM	136081-1028			
5E	Integrated Circuit, 74F244	137502-001	40N	Integrated Circuit, 74F138	137521-001
5L	Integrated Circuit, 74LS379	137374-001	40P	Integrated Circuit, GAL16V8	136079-1045
			40S	Integrated Circuit, GAL16V8	136079-1047
5M	Integrated Circuit, 74F169	137496-001	45B	Integrated Circuit, 74F260	137570-001
10A2	Integrated Circuit, 74LS244	137038-001			
10E	Integrated Circuit, 74F244	137502-001	45C, 45D	Integrated Circuit, RAM, 2K x 8, 35 nsec, .3	137534-001
10H	Integrated Circuit, MC68HC000P12F	137669-0001	45E	Integrated Circuit, 74F153	137492-001
			45F	Integrated Circuit, 74F169	137496-001
10K	Integrated Circuit, 74F20	137530-001	45H	Integrated Circuit, 74LS245	137134-001
10L	Integrated Circuit, 74LS379	137374-001			

Pit-Fighter Game PCB Assembly (4-MB PROM Version)
Parts List, Continued

Designator	Description	Part No.	Designator	Description	Part No.
45J	Integrated Circuit, 74LS163 A	137114-001	85C	Integrated Circuit, 74F74	137436-001
45K	Integrated Circuit, 74F377	137622-001			
45M	Integrated Circuit, EPROM	136081-1025	85D	Integrated Circuit, 74LS378	137305-001
45N	Integrated Circuit, 7497	137090-001	85E	Integrated Circuit, 74F169	137496-001
			85F	Integrated Circuit, 74LS157	137029-001
45P	Integrated Circuit, 74LS377	137145-001	85H	Integrated Circuit, VRAM, 64K x 4, 150 nsec	137553-001
45S	Integrated Circuit, 74LS157	137029-001			
50C, 50D	Integrated Circuit, 74HC273	137556-001	90J	Integrated Circuit, 74LS157	137029-001
50E	Integrated Circuit, 74F153	137492-001	90K	Integrated Circuit, 74F153	137492-001
			90M	Integrated Circuit, EPROM	136081-1021
50F	Integrated Circuit, 74LS378	137305-001	95C	Integrated Circuit, 74F08	137483-001
50H	Integrated Circuit, 74LS377	137145-001			
50J	Integrated Circuit, 74LS163 A	137114-001	95D	Integrated Circuit, 74F163	137345-001
50K	Integrated Circuit, 74F377	137622-001	95E	Integrated Circuit, 74F169	137496-001
			95F	Integrated Circuit, 74LS157	137029-001
50N	Integrated Circuit, 74LS157	137029-001	95H, 100J	Integrated Circuit, 74F04	137437-001
50P	Integrated Circuit, 74LS377	137145-001			
50S	Integrated Circuit, 74F169	137496-001	100K	Integrated Circuit, 74F153	137492-001
55B	Integrated Circuit, 7406	137052-001	105B	Integrated Circuit, 74LS379	137374-001
			105C	Integrated Circuit, 74F74	137436-001
55N	Integrated Circuit, 74F169	137496-001	105E	Integrated Circuit, 74F32	137486-001
55P, 55S	Integrated Circuit, 74LS244	137038-001			
60C	Integrated Circuit, 74F374	137420-001	105F	Integrated Circuit, GAL16V8	136081-1051
60D	Integrated Circuit, 74LS377	137145-001	105H	Integrated Circuit, 74F175	137498-001
			110B	Integrated Circuit, 74F04	137437-001
60E	Integrated Circuit, 74F153	137492-001	110J	Integrated Circuit, SOS	137550-001
60H	Integrated Circuit, PFHS	137419-104			
60K	Integrated Circuit, 74F153	137492-001	115C	Integrated Circuit, 74F32	137486-001
65B	Integrated Circuit, 74F260	137570-001	115D, 115E	Integrated Circuit, 74F02	137481-001
			115F	Integrated Circuit, GAL16V8	136081-1050
65C	Integrated Circuit, 74LS244	137038-001	115H	Integrated Circuit, 74LS157	137029-001
65D	Integrated Circuit, GAL16V8	136079-1046			
65E	Integrated Circuit, 74F153	137492-001	120B	Integrated Circuit, 74F32	137486-001
65F	Integrated Circuit, 74F260	137570-001	120C	Integrated Circuit, 74F138	137521-001
			120D	Integrated Circuit, 74F74	137436-001
65H	Integrated Circuit, VRAM, 64K x 4, 150 nsec	137553-001	120E	Integrated Circuit, 74LS08	137012-001
65K	Integrated Circuit, 74F153	137492-001			
65N	Integrated Circuit, ROM, 27C4M	136081-1066	120F	Integrated Circuit, GAL16V8	136079-1049
65R	Integrated Circuit, ROM, 27C4M	136081-1065	120H	Integrated Circuit, 74F139	137488-001
			120J	Integrated Circuit, SOS	137550-001
70B	Integrated Circuit, 74LS244	137038-001	120M	Integrated Circuit, EPROM	136081-1018
70D	Integrated Circuit, 74F153	137492-001			
70E	Integrated Circuit, 74LS244	137038-001	125B	Integrated Circuit, 74F20	137530-001
70F	Integrated Circuit, 74LS157	137029-001	125C	Integrated Circuit, 74F138	137521-001
			125D	Integrated Circuit, 74LS197	137240-001
70H	Integrated Circuit, VRAM, 64K x 4, 150 nsec	137553-001	125E	Integrated Circuit, 74F04	137437-001
70J	Integrated Circuit, 74LS157	137029-001			
70K	Integrated Circuit, 74F153	137492-001	125F	Integrated Circuit, GAL16V8	136079-1048
70N	Integrated Circuit, ROM, 27C4M	136081-1068	125H, 125J	Integrated Circuit, 74F169	137496-001
			130B	Integrated Circuit, 74F32	137486-001
70R	Integrated Circuit, ROM, 27C4M	136081-1067	130D	Integrated Circuit, 74F08	137483-001
75B	Integrated Circuit, 74LS244	137038-001			
75C, 75D	Integrated Circuit, 74F32	137486-001	130E	Integrated Circuit, 74F169	137496-001
75E	Integrated Circuit, 74LS378	137305-001	130F	Integrated Circuit, 74LS379	137374-001
			130H	Integrated Circuit, 74F169	137496-001
75F, 75F	Integrated Circuit, 74LS157	137029-001	130M	Integrated Circuit, EPROM	136081-1017
75H	Integrated Circuit, VRAM, 64K x 4, 150 nsec	137553-001			
75J	Integrated Circuit, 74LS157	137029-001		**Capacitors**	
75K	Integrated Circuit, 74F153	137492-001	C1-C4	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104
			C5	Capacitor, 100 pF, 100 V, ±5%, Ceramic	122016-101
75M	Integrated Circuit, EPROM	136081-1022	C7	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104
80J	Integrated Circuit, 74LS157	137029-001	C8	Capacitor, .01 µF, 50 V, +80% −20%, Ceramic	122002-103
80K	Integrated Circuit, 74F153	137492-001			

Pit-Fighter Game PCB Assembly (4-MB PROM Version)
Parts List, Continued

Designator	Description	Part No.	Designator	Description	Part No.
C9	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R44-R46	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C10	Capacitor, .01 µF, 50 V, +80% −20%, Ceramic	122002-103	R47	Resistor, 47 Ω, ±5%, 1/8 W	110027-470
C11	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R48	Resistor, 2.2 KΩ, ±5%, 1/8 W	110027-222
C12	Capacitor, .01 µF, 50 V, +80% −20%, Ceramic	122002-103	R49	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C13	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R50	Resistor, 47 Ω, ±5%, 1/8 W	110027-470
C14	Capacitor, .01 µF, 50 V, +80% −20%, Ceramic	122002-103	R51	Resistor, 2.2 KΩ, ±5%, 1/8 W	110027-222
C15	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R52	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C16	Capacitor, .01 µF, 50 V, +80% −20%, Ceramic	122002-103	R53	Resistor, 47 Ω, ±5%, 1/8 W	110027-470
C17	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R54	Resistor, 2.2 KΩ, ±5%, 1/8 W	110027-222
C18	Capacitor, .01 µF, 50 V, +80% −20%, Ceramic	122002-103	R55-R57	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C19	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R58	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C20	Capacitor, .01 µF, 50 V, +80% −20%, Ceramic	122002-103	R59-R69	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C21	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R70	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C22	Capacitor, .01 µF, 50 V, +80% −20%, Ceramic	122002-103	R71	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C23-C27	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R72	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C28-C32	Capacitor, 100 pF, 100 V, ±5%, Ceramic	122016-101	R73, R74	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C33-C46	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R75, R76	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C47, C48	Capacitor, 100 pF, 100 V, ±5%, Ceramic	122016-101	R77	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C49	Capacitor, 47 µF, 25 V, Electrolytic	124009-476	R78	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C50-C66	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R79	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C67, C68	Capacitor, 100 pF, 100 V, ±5%, Ceramic	122016-101	R80	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C69-C95, C97-C135	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R81	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C136	Capacitor, 100 pF, 100 V, ±5%, Ceramic	122016-101	R82	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C137-C148	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R83	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103
C149	Capacitor, 100 pF, 100 V, ±5%, Ceramic	122016-101	R85	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C150-C192	Capacitor, .1 µF, 50 V, +80% −20%, Ceramic	122002-104	R87	Resistor, 10 Ω, ±5%, 1/8 W	110027-100
			R88	Resistor, 100 KΩ, ±5%, 1/8 W	110027-104
	Transistors		R89	Resistor, 220 Ω, ±5%, 1/8 W	110027-221
Q1-Q3	Transistor, 2N3904	133041-001			
Q4, Q5	Transistor, 2N5306	133033-001	R90	Resistor, 10 Ω, ±5%, 1/8 W	110027-100
Q6	Transistor, 2N3904	133041-001	R91	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
			R92	Resistor, 10 Ω, ±5%, 1/8 W	110027-100
	Resistors		R94-R96	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
R1-R4	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103			
R5	Resistor, 470 Ω, ±5%, 1/8 W	110027-471	R97, R98	Resistor, 100 Ω, ±5%, 1/8 W	110027-101
R6	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103	R99, R100	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103
R7	Resistor, 470 Ω, ±5%, 1/8 W	110027-471	R101	Resistor, 10 Ω, ±5%, 1/8 W	110027-100
			R103-R105	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
R8, R9	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103			
R10	Resistor, 470 Ω, ±5%, 1/8 W	110027-471	R106	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
R11	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103	R107, R108	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
R12	Resistor, 470 Ω, ±5%, 1/8 W	110027-471	R109, R111, R112	Resistor, 10 Ω, ±5%, 1/8 W	110027-100
			RN1-RN3	Resistor Network, R2R	118016-001
R13-R16	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102			
R17, R18	Resistor, 100 Ω, ±5%, 1/8 W	110027-101		**Miscellaneous**	
R19	Resistor, 220 Ω, ±5%, 1/8 W	110027-221	AUD(J1)	Connector, 40 Ckt, .1 x .1 Header	179291-040
R20	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103	CR1	Diode, MV5053, Light-Emitting	131027-002
			GND1, GND3	Test Point	179051-001
R21	Resistor, 100 Ω, ±5%, 1/8 W	110027-101	JL	Connector, 6 Ckt, Header, .100 Ctr, Key 4	179118-006
R22	Resistor, 47 Ω, ±5%, 1/8 W	110027-470	JT	Connector, 11 Ckt, Header, .100 Ctr, Key 2	179118-011
R23	Resistor, 100 Ω, ±5%, 1/8 W	110027-101	L1	Inductor, 100 µH	141024-001
R24, R25	Resistor, 47 Ω, ±5%, 1/8 W	110027-470			
			RESET	Connector, 2 Ckt, Header, .100 Ctr	179048-002
R26	Resistor, 100 Ω, ±5%, 1/8 W	110027-101	VID	Connector, 11 Ckt, Header, .100 Ctr, Key 3	179118-011
R27-R29	Resistor, 220 Ω, ±5%, 1/8 W	110027-221	WDDIS	Connector, 2 Ckt, Header, .100 Ctr	179048-002
R30-R34, R36-R38, R40	Resistor, 470 Ω, ±5%, 1/8 W	110027-471	X1	Crystal, 14.318 MHz	144000-004
R42, R43	Resistor, 10 Ω, ±5%, 1/8 W	110027-100	+5V1	Test Point	179051-001
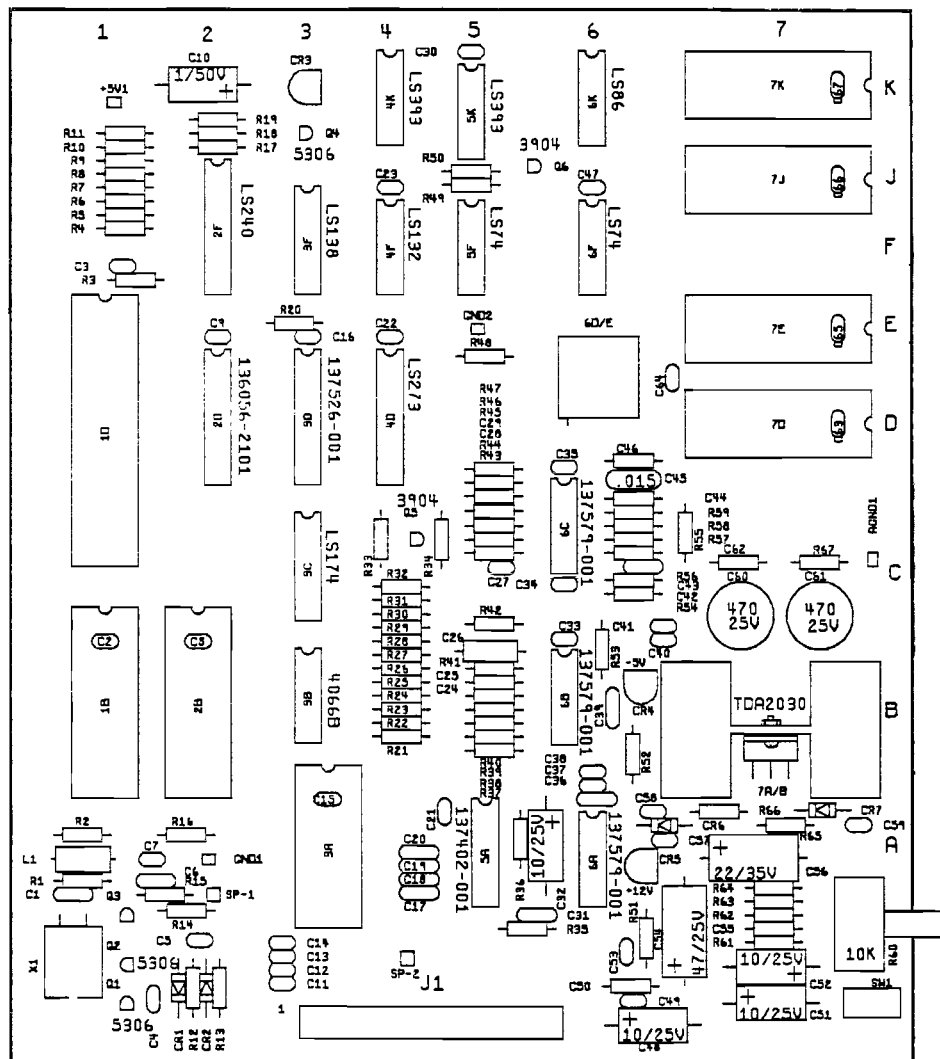
NOTE

The Pit-Fighter Board Set Assembly consists of: A047896-03, Pit-Fighter Game PCB Assy.; A047184-05, JSA Audio II PCB Assy. (this illustration); 178278-616, #6 Threaded PCB Support Standoffs; and 177000-536, #6-32 Nylon Nut.

Also note that the following components are not stuffed: R1, R2, R15, R16, R41, R55, R67, C1, C6, C7, C44, C46, C62, L1, X1, and Q3.
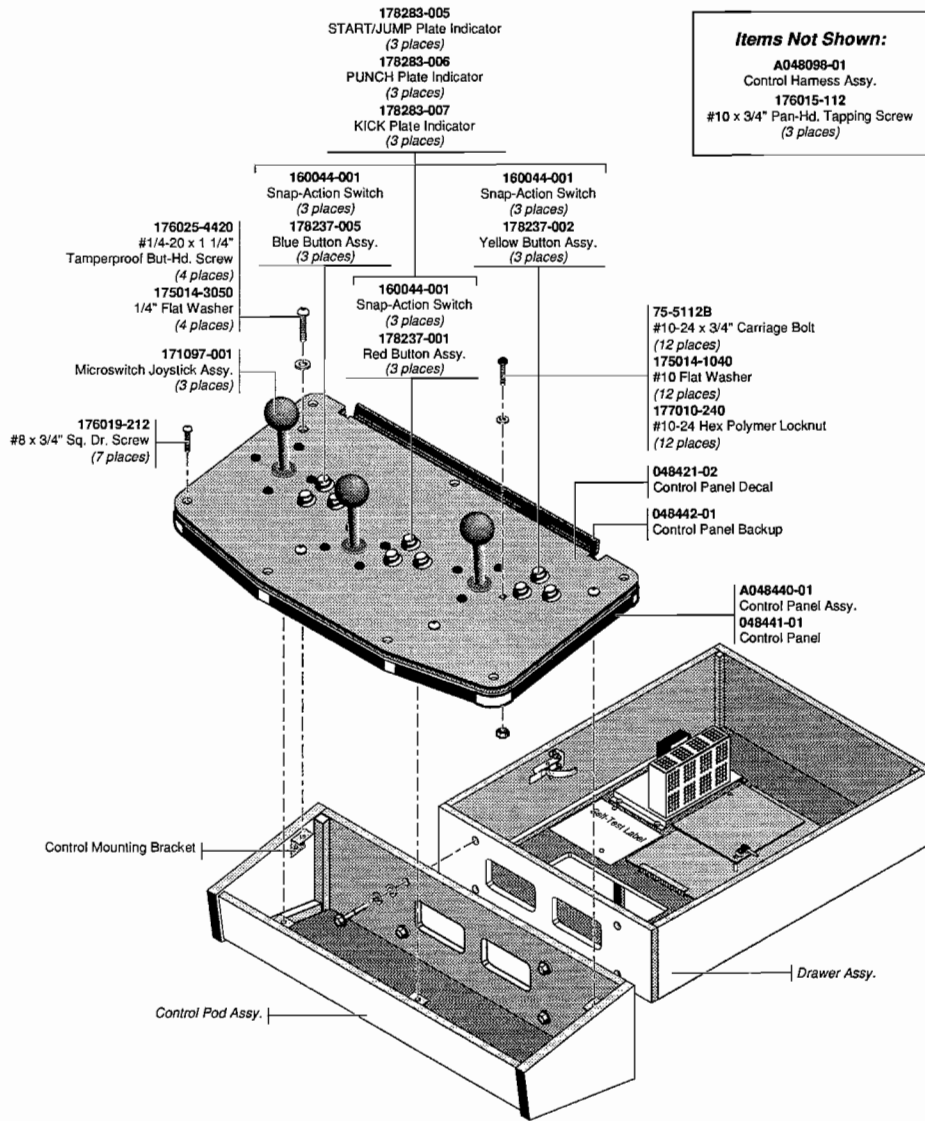
Figure 4-6 JSA Audio II PCB Assembly caption region (board layout diagram)

Figure 4-6 JSA Audio II PCB Assembly
A047184-05 F

Parts List

Designator	Description	Part No.	Designator	Description	Part No.
	Sockets			**Integrated Circuits**	
1B	Socket, 28 Pin, .600-Inch	179257-028	1B	Integrated Circuit, EPROM, 200nsec	136081-1060
1D	Socket, 40 Pin, .600-Inch	179257-040	1D	Integrated Circuit, 6502 A	137577-001
2B	Socket, 28 Pin, .600-Inch	179257-028	2B	Integrated Circuit, RAM, 8Kx8, 100 nsec	137535-004
3A	Socket, 24 Pin, .600-Inch	179257-024	2D	Integrated Circuit, PAL16L8	136056-2101
7D, 7E, 7J, 7K	Socket, 28 Pin, .600-Inch	179257-028			
			2F	Integrated Circuit, 74LS240	137251-001
	Miscellaneous		3A	Integrated Circuit, YM2151	137401-001
J1	Connector, 40-Ckt, .1 x .1	179292-040	3B	Integrated Circuit, 4066B	137580-001
7A/B	Nut/Washer Assy, #6-32	75-99516	3C	Integrated Circuit, 74LS174	137122-001
7A/B	Screw, Pan Hd, X-Rec, #6-32 x 3/8" L	72-1606S			
++1005V1	Test Point	179051-001	3D	Integrated Circuit, SCUM	137526-001
			3F	Integrated Circuit, 74LS138	137177-001
AGND1	Test Point	179051-001	4D	Integrated Circuit, 74LS273	137040-001
GND1, GND2	Test Point	179051-001	4F	Integrated Circuit, 74LS132	137096-001
HS1	Heat Sink, TDA2030	178190-016			
SW1	Switch, Slide, SPDT	160040-001	4K	Integrated Circuit, 74LS393	137146-001
7A/B	Thermal Compound	78-16001	5A	Integrated Circuit, YM3012	137402-001
			5F	Integrated Circuit, 74LS74	137023-001

JSA Audio II PCB Assembly
Parts List, Continued

Designator	Description	Part No.	Designator	Description	Part No.
5K	Integrated Circuit, 74LS393	137146-001	CR6, CR7	Diode, 1N4001	131048-001
				Transistors	
6A, 6B, 6C	Integrated Circuit	137579-001			
6D/E	Integrated Circuit (Surface Mount)	137607-001	Q1, Q2, Q4	Transistor, 2N5306	133033-001
6F	Integrated Circuit, 74LS74	137023-001	Q5, Q6	Transistor, 2N3904	133041-001
6K	Integrated Circuit, 74LS86	137079-001			
				Resistors	
7A/B	Integrated Circuit, TDA2030	137301-001	R3	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103
7D	Integrated Circuit, OTP, 200 nsec	136081-1064	R4-R12	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
7E	Integrated Circuit, OTP, 200 nsec	136081-1063	R13	Resistor, 0 Ω, ±5%, 1/4 W	110005-001
7J	Integrated Circuit, OTP, 200 nsec	136081-1062	R14, R17	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
7K	Integrated Circuit, OTP, 200 nsec	136081-1061			
			R18	Resistor, 100 KΩ, ±5%, 1/8 W	110027-104
	Capacitors		R19	Resistor, 240 Ω, ±5%, 1/8 W	110027-241
C2-C5, C8, C9	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R20	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103
C10	Capacitor, 1 µF, 50 V, Electrolytic	124001-105	R21	Resistor, 7.5 KΩ, ±5%, 1/8 W	110027-752
C11-C16	Capacitor, .1 µF, 50 V, Ceramic	122002-104			
C17-C20	Capacitor, 100 pF, 100 V, Ceramic	122016-101	R22	Resistor, 15 KΩ, ±5%, 1/8 W	110027-153
			R23	Resistor, 7.5 KΩ, ±5%, 1/8 W	110027-752
C21-C23	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R24, R25	Resistor, 30 KΩ, ±5%, 1/8 W	110027-303
C24	Capacitor, .22 µF, 50 V, Ceramic	122017-224	R26, R27	Resistor, 15 KΩ, ±5%, 1/8 W	110027-153
C25	Capacitor, 3300 pF, 50 V	122015-332			
C26	Capacitor, .0022 µF, 100 V, Axial	125006-222	R28	Resistor, 7.5 KΩ, ±5%, 1/8 W	110027-752
			R29, R30	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C27	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R31-R33	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C28	Capacitor, .0068 µF, 50 V, Ceramic	122015-682	R34	Resistor, 150 KΩ, ±5%, 1/8 W	110027-154
C29	Capacitor, .22 µF, 50 V, Ceramic	122017-224			
C30	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R35	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
			R36	Resistor, 560 Ω, ±5%, 1/8 W	110027-561
C31	Capacitor, .001 µF, 50 V, Ceramic	122002-102	R37	Resistor, 3.3 KΩ, ±5%, 1/8 W	110027-332
C32	Capacitor, 10 µF, 25 V, Electrolytic	124009-106	R38, R39	Resistor, 12 KΩ, ±5%, 1/8 W	110027-123
C33-C35	Capacitor, .1 µF, 50 V, Ceramic	122002-104			
C36	Capacitor, .001 µF, 50 V, Ceramic	122002-102	R40	Resistor, 20 KΩ, ±5%, 1/8 W	110027-203
			R42	Resistor, 100 KΩ, ±5%, 1/8 W	110027-104
C37, C38	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R43	Resistor, 2 KΩ, ±5%, 1/8 W	110027-202
C39	Capacitor, .001 µF, 50 V, Ceramic	122002-102	R44	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103
C40, C41	Capacitor, .1 µF, 50 V, Ceramic	122002-104			
C42	Capacitor, .0068 µF, 50 V, Ceramic	122015-682	R45	Resistor, 68 KΩ, ±5%, 1/8 W	110027-683
			R46	Resistor, 15 KΩ, ±5%, 1/8 W	110027-153
C43	Capacitor, .001 µF, 50 V, Ceramic	122002-102	R47	Resistor, 33 KΩ, ±5%, 1/8 W	110027-333
C45	Capacitor, .015 µF, 100 V, ±5%, Poly, Radial	126009-153	R48	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
C47	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R49, R50	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103
C48	Capacitor, 10 µF, 25 V, Electrolytic	124009-106	R51	Resistor, 1.2 KΩ, ±5%, 1/8 W	110027-122
			R52	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C49	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R53	Resistor, 100 KΩ, ±5%, 1/8 W	110027-104
C50	Capacitor, .22 µF, 50 V, Ceramic	122017-224			
C51, C52	Capacitor, 10 µF, 25 V, Electrolytic	124009-106	R54	Resistor, 6.8 KΩ, ±5%, 1/8 W	110027-682
C53	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R56	Resistor, 20 KΩ, ±5%, 1/8 W	110027-203
			R57	Resistor, 10 KΩ, ±5%, 1/8 W	110027-103
C54	Capacitor, 47 µF, 25 V, Electrolytic	124009-476	R58	Resistor, 6.8 KΩ, ±5%, 1/8 W	110027-682
C55	Capacitor, .22 µF, 50 V, Ceramic	122017-224			
C56	Capacitor, 22 µF, 35 V, Electrolytic	124000-226	R59	Resistor, 16 KΩ, ±5%, 1/8 W	110027-163
C57-C59	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R60	Potentiometer, 10 KΩ, Horizontal	119022-103
			R61	Resistor, 15 KΩ, ±5%, 1/8 W	110027-153
C60, C61	Capacitor, 470 µF, 25 V, Electrolytic, Radial	123003-477	R62, R63	Resistor, 47 KΩ, ±5%, 1/8 W	110027-473
C63-C67	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R64	Resistor, 68 KΩ, ±5%, 1/8 W	110027-683
			R65	Resistor, 33 KΩ, ±5%, 1/8 W	110027-333
	Diodes		R66	Resistor, 1 KΩ, ±5%, 1/8 W	110027-102
CR1, CR2	Diode, 1N4001	131048-001			
CR3-CR5	Diode, MV5053, Light-Emitting	131027-002			

178283-005
START/JUMP Plate Indicator
(3 places)
178283-006
PUNCH Plate Indicator
(3 places)
178283-007
KICK Plate Indicator
(3 places)

Items Not Shown:
A048098-01
Control Harness Assy.
176015-112
#10 x 3/4" Pan-Hd. Tapping Screw
(3 places)

160044-001
Snap-Action Switch
(3 places)
178237-005
Blue Button Assy.
(3 places)

160044-001
Snap-Action Switch
(3 places)
178237-002
Yellow Button Assy.
(3 places)

176025-4420
#1/4-20 x 1 1/4"
Tamperproof But-Hd. Screw
(4 places)
175014-3050
1/4" Flat Washer
(4 places)

160044-001
Snap-Action Switch
(3 places)
178237-001
Red Button Assy.
(3 places)

75-5112B
#10-24 x 3/4" Carriage Bolt
(12 places)
175014-1040
#10 Flat Washer
(12 places)
177010-240
#10-24 Hex Polymer Locknut
(12 places)

171097-001
Microswitch Joystick Assy.
(3 places)

176019-212
#8 x 3/4" Sq. Dr. Screw
(7 places)

048421-02
Control Panel Decal

048442-01
Control Panel Backup

A048440-01
Control Panel Assy.
048441-01
Control Panel

Control Mounting Bracket

Self-Test Label

Drawer Assy.

Control Pod Assy.

Figure 4-7 Control Panel Assembly
A048440-01 B

Parts List

Part No.	Description	Part No.	Description
A048098-01	Control Harness Assembly	176019-212	#8 x 3/4" Black Square-Drive LPW Screw
75-5112B	#10-24 x 3/4" Long Black Carriage Bolt	177010-240	#10-24 Polymer Hex Locknut
048421-02	Control Panel Decal	178034-026	13/16" Wide Black T-Molding
048441-01	Control Panel	178283-005	"Start/Jump" Indicator Plate
048442-02	Control Backup Panel	178283-006	"Punch" Indicator Plate
160044-001	Snap-Action Switch	178283-007	"Kick" Indicator Plate
171097-001	Wico 8-Position Microswitch Joystick (see Figure 4-2)	178237-001	Red Button Assembly
		178237-002	Yellow Button Assembly
175014-1040	#10 Flat Washer	178237-005	Blue Button Assembly
176015-112	#10 x 3/4" Long Cross-Recessed Pan-Head Self-Tapping Screw		

Schematic Diagrams
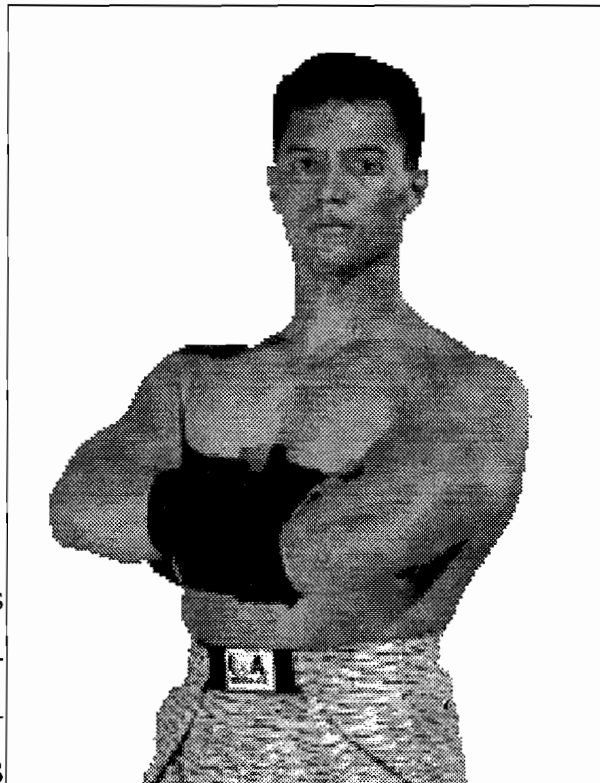
This chapter contains the schematics diagrams for your Pit-Fighter™ game PCB and the JSA Audio II PCB. The game wiring diagram is also included. The two PCB assembly drawings are illustrated in Chapter 4 of this manual.
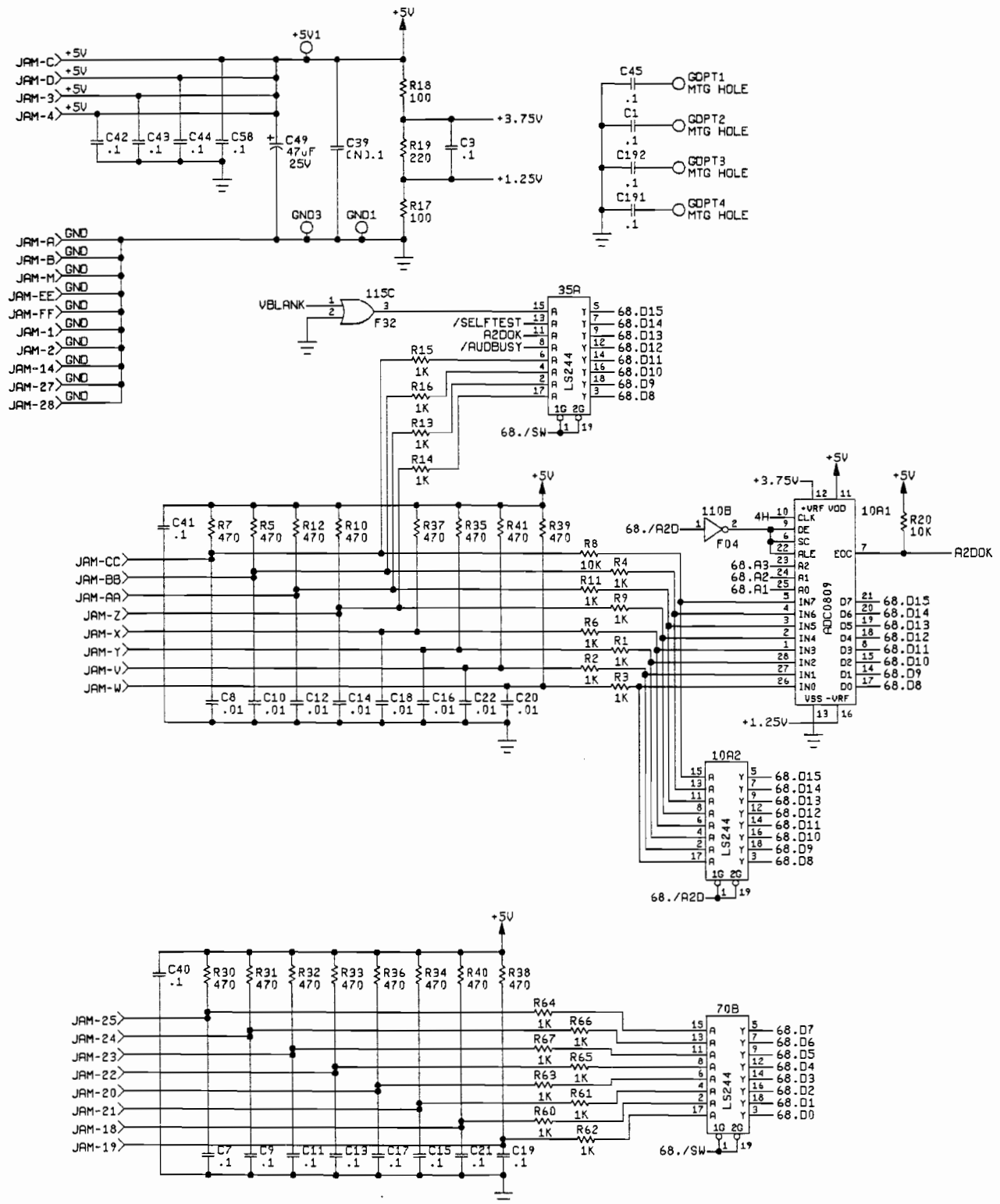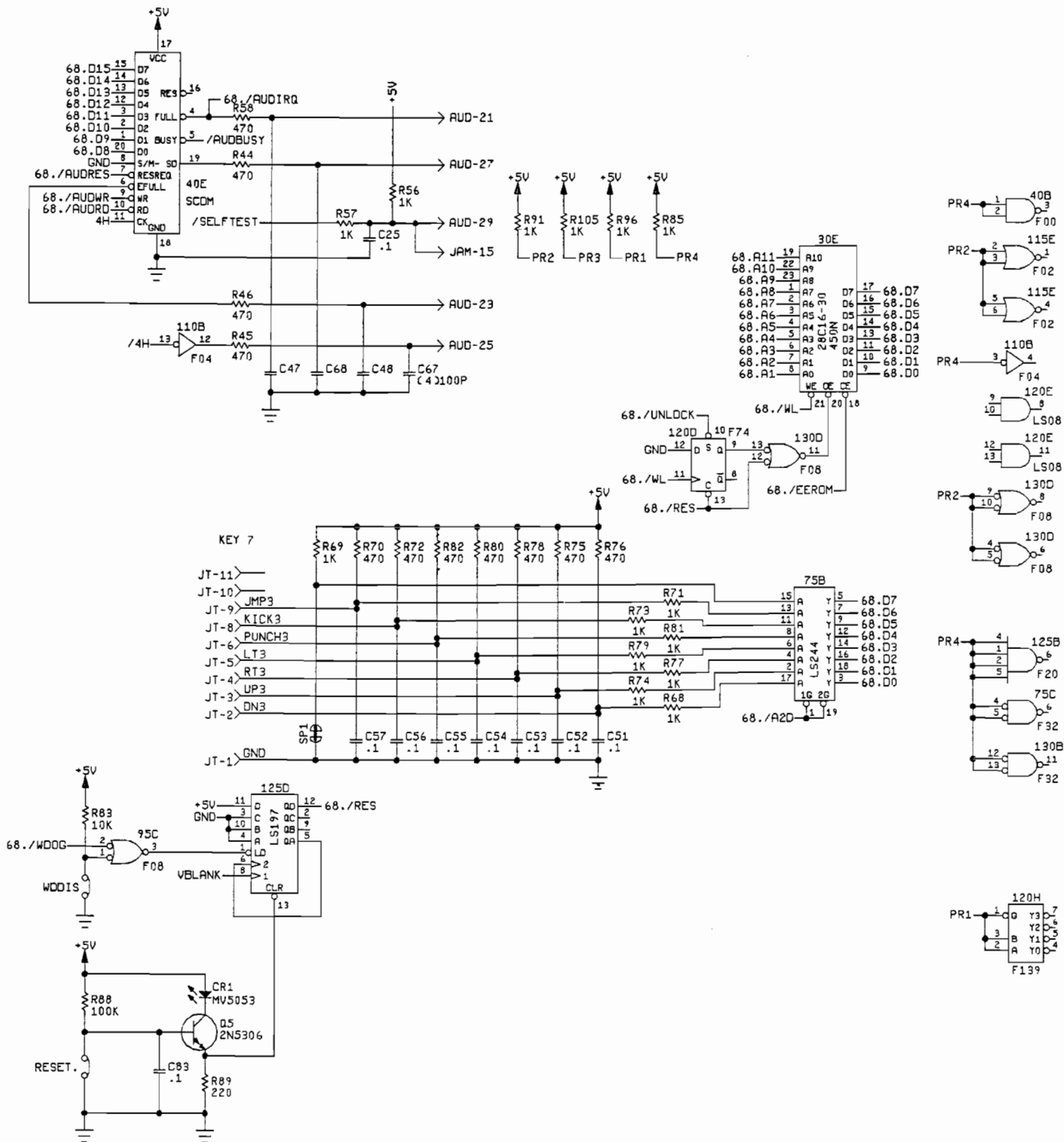
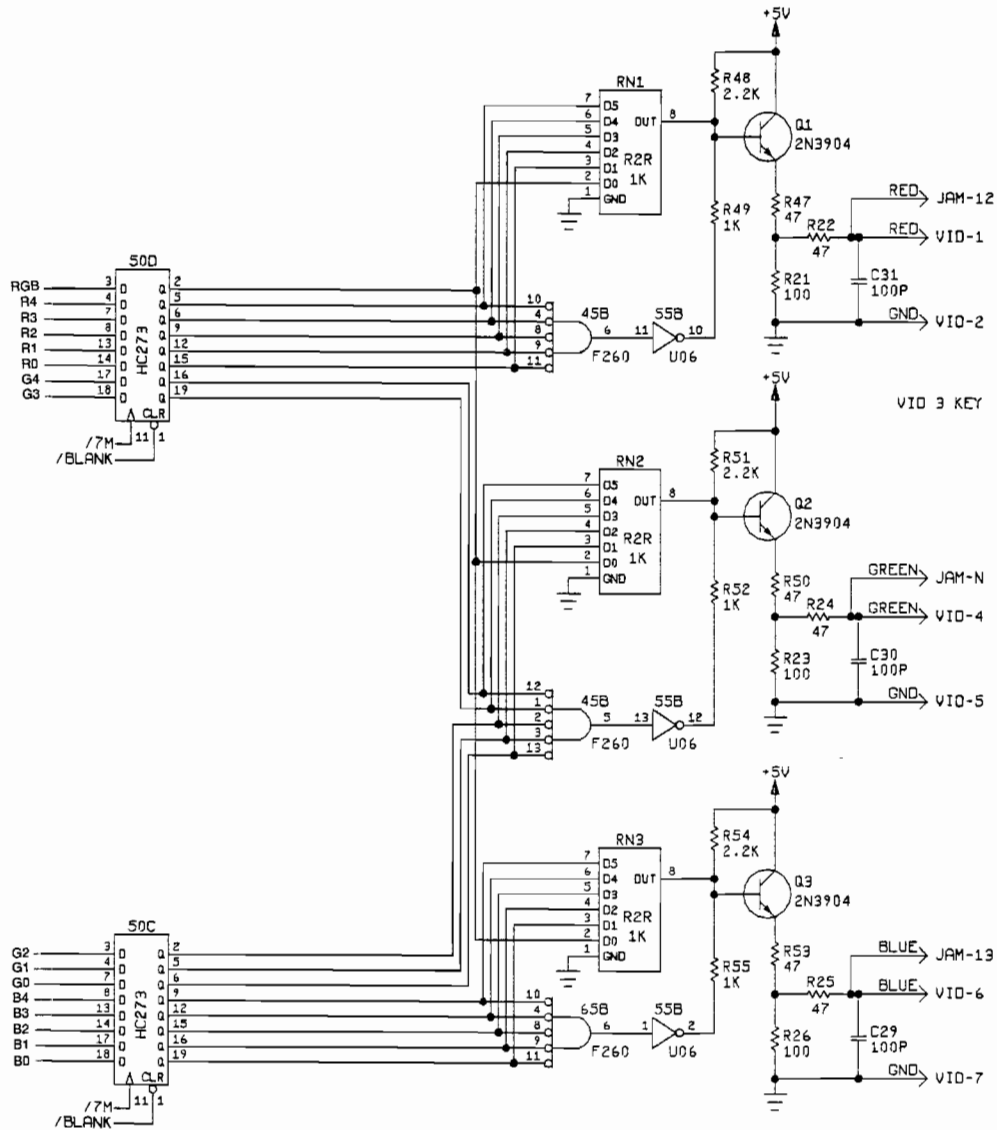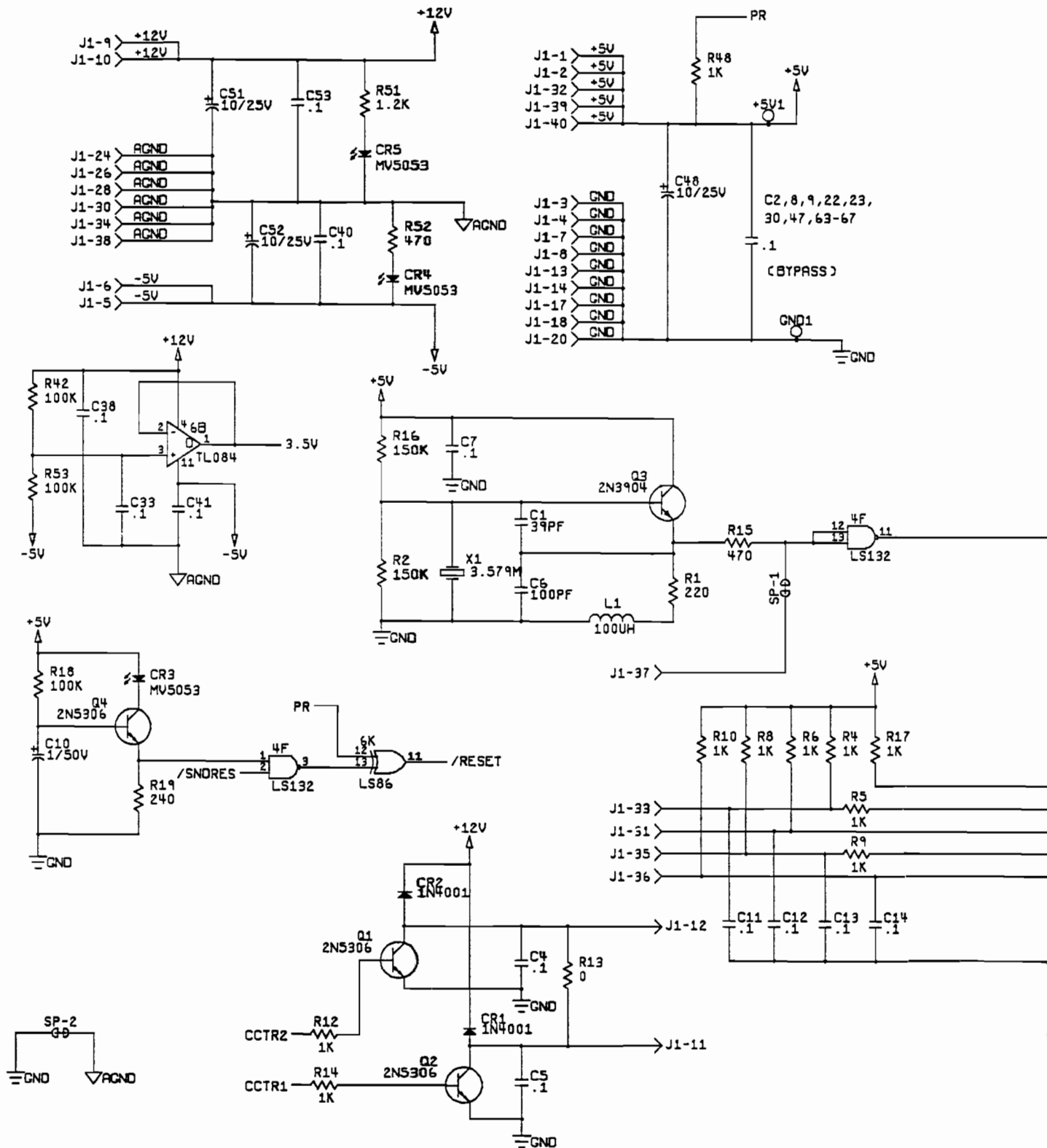**Figure 5-1 Pit-Fighter Game PCB Assembly Schematic Diagram**
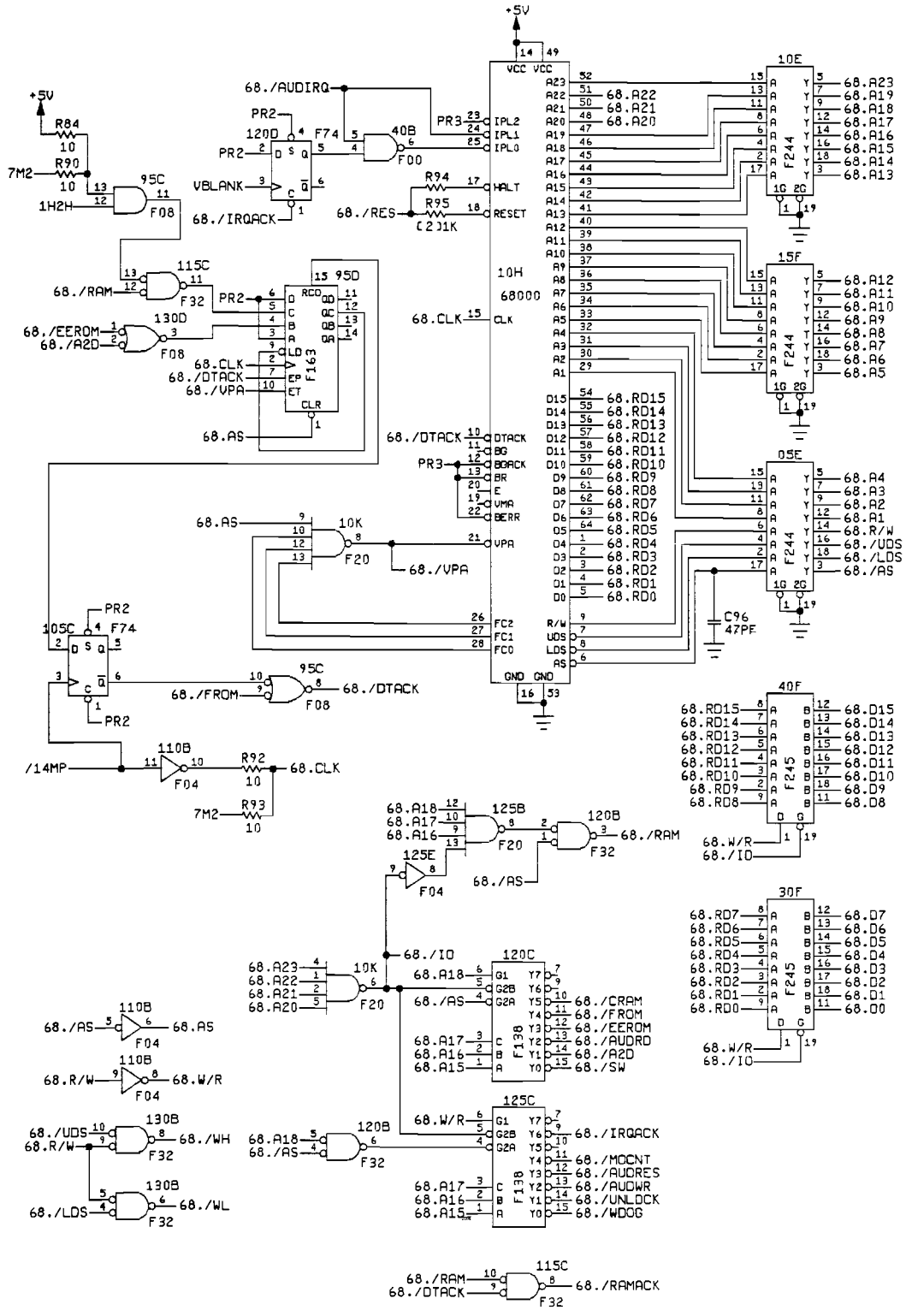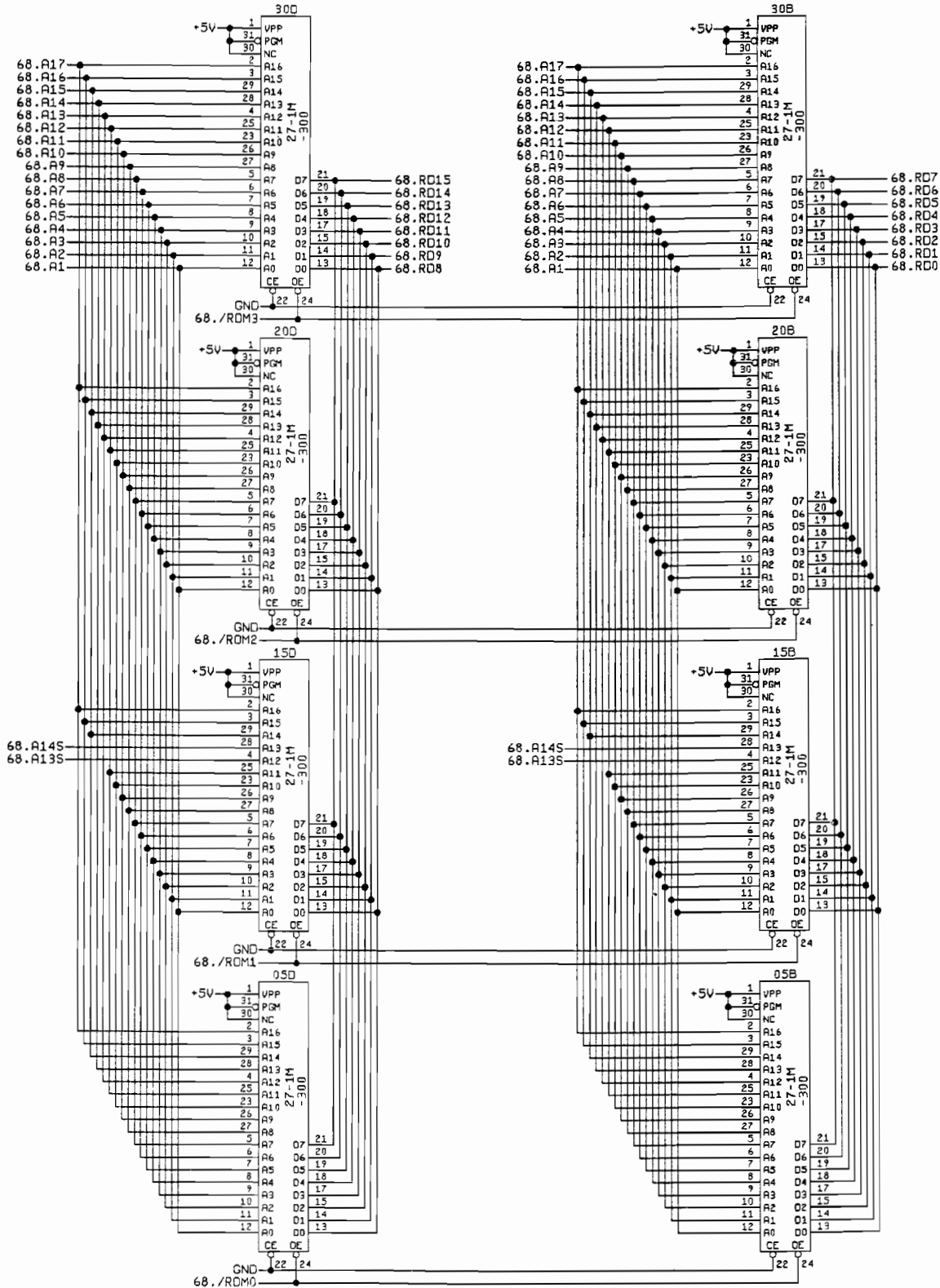
045977-01 J

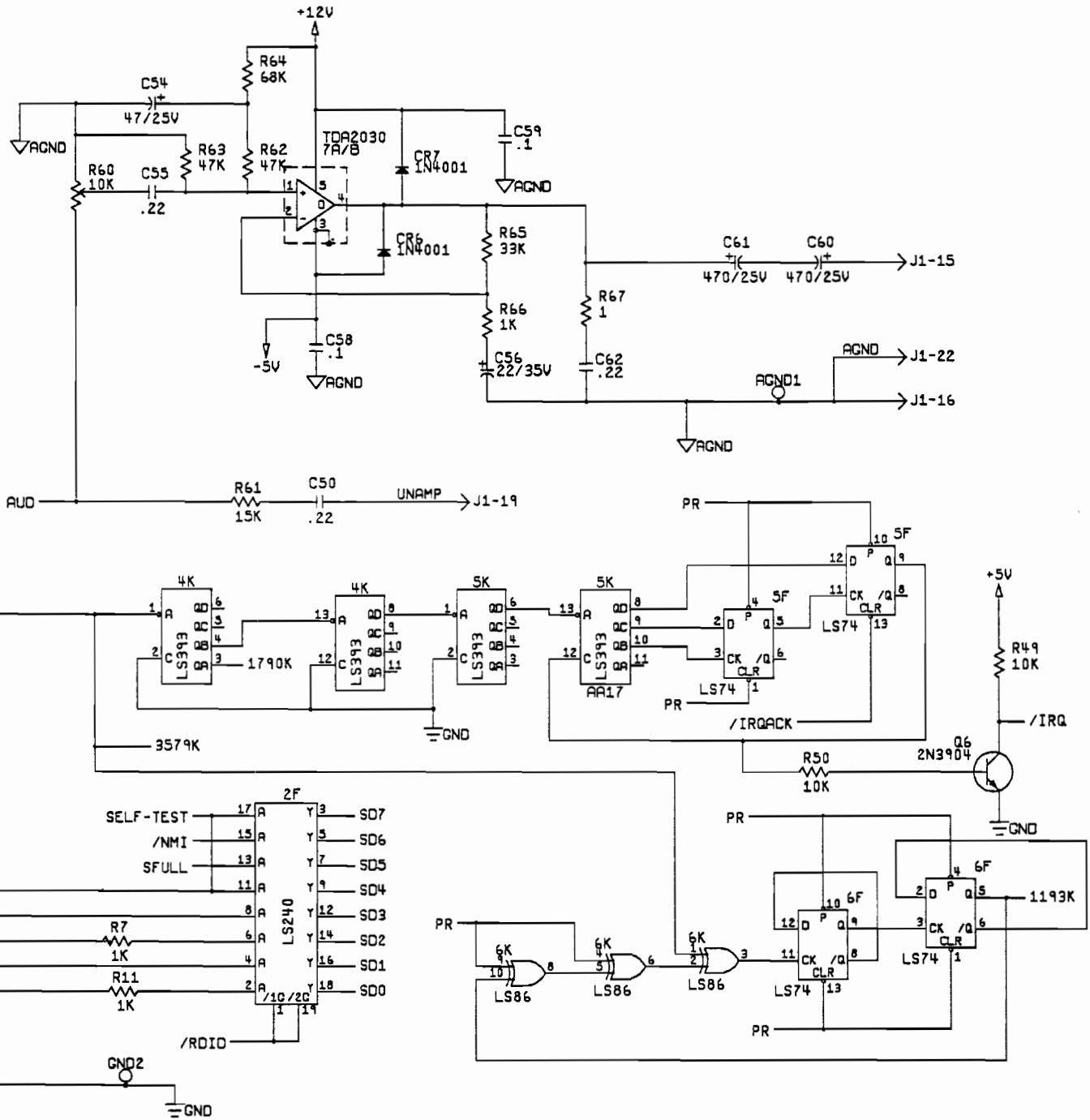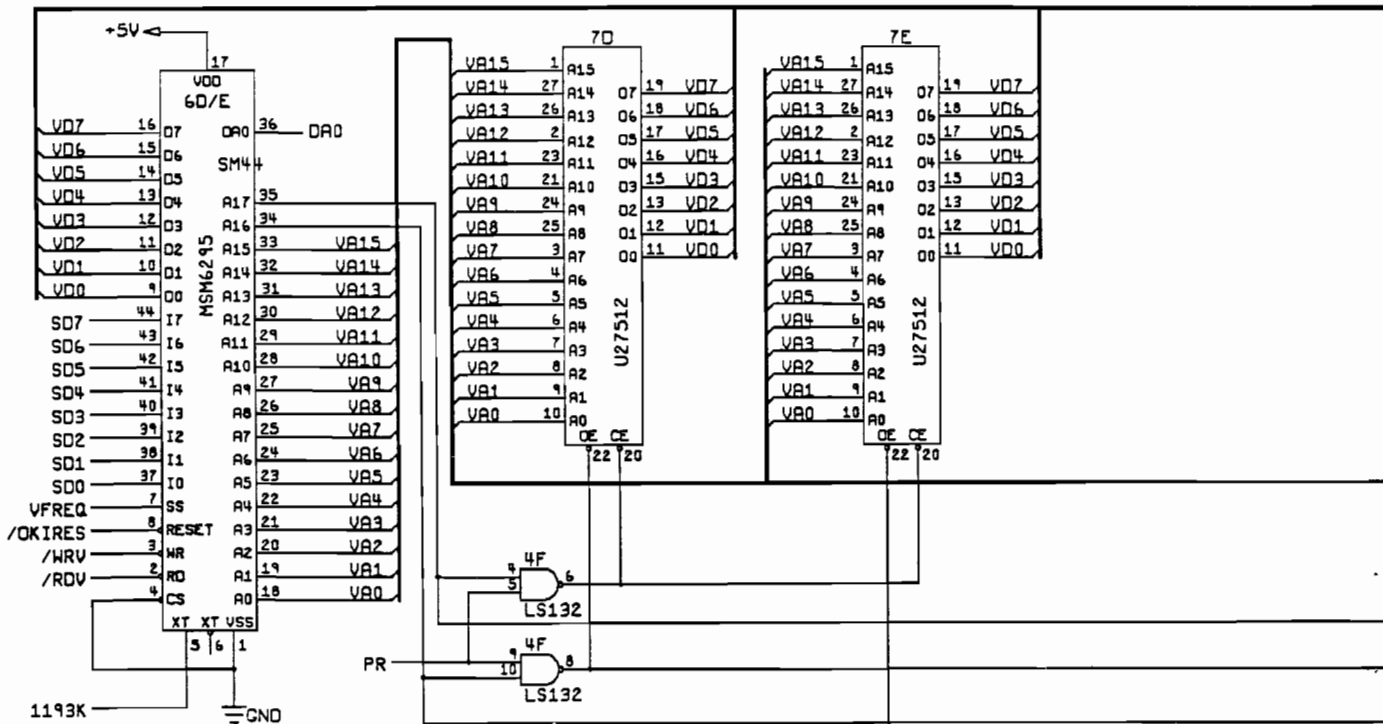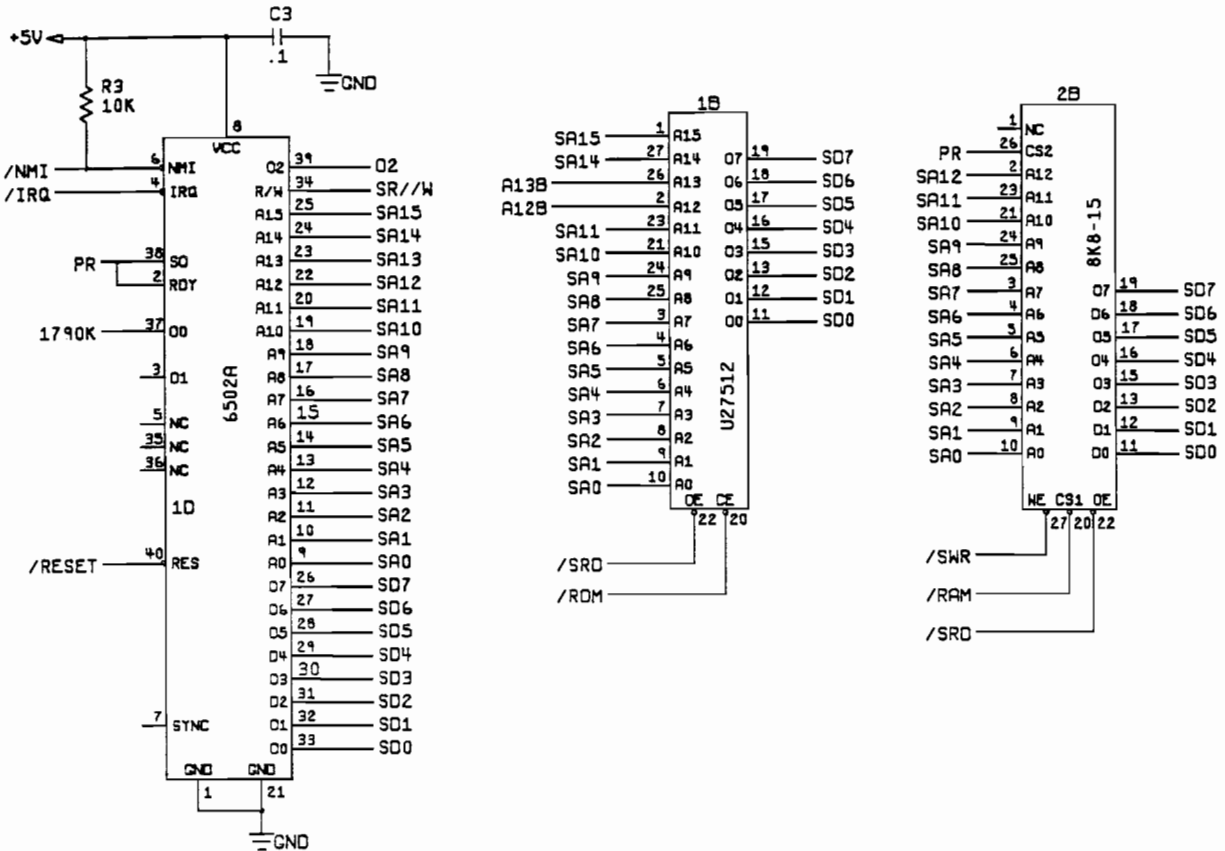**Figure 5-1 Pit-Fighter Game PCB Assembly Schematic Diagram**
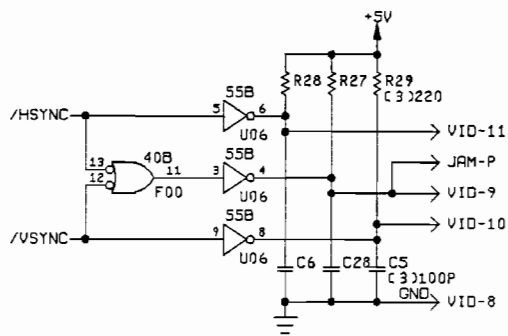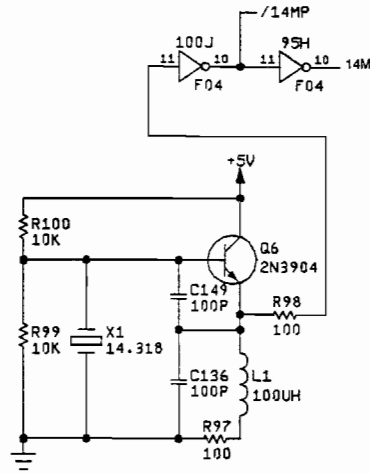
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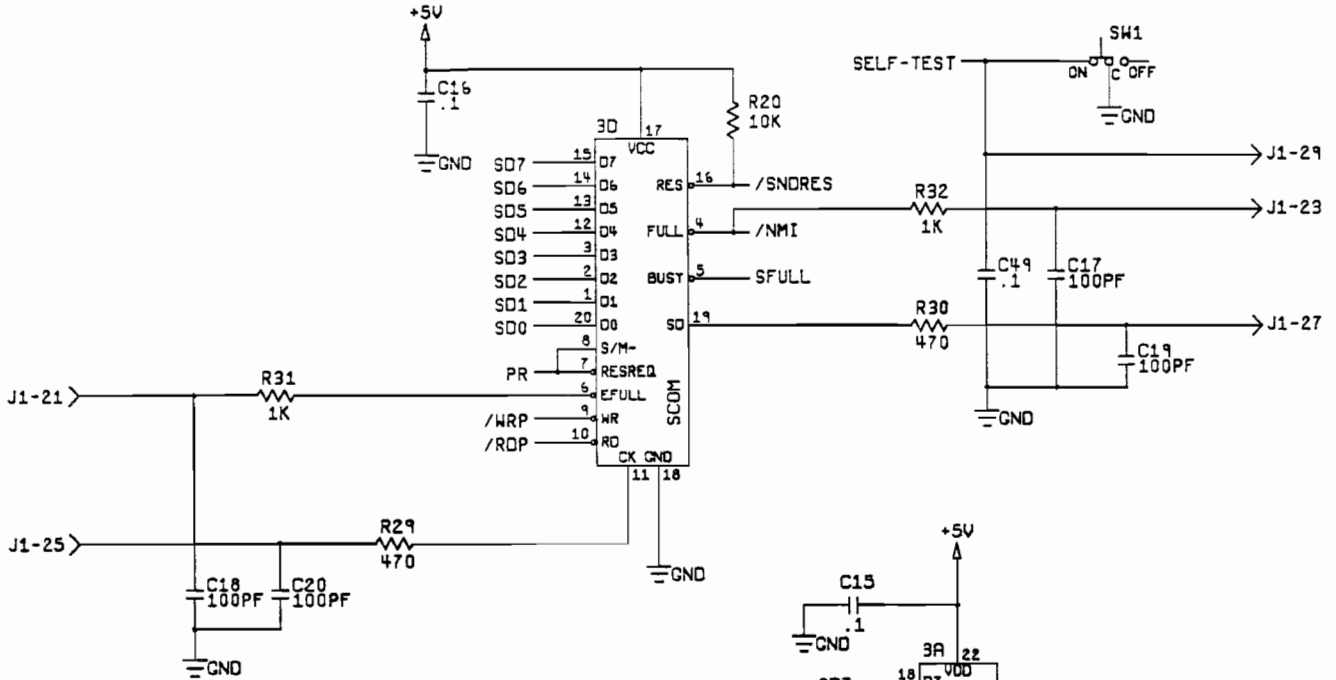**Figure 5-1 Pit-Fighter Game PCB Assembly Schematic Diagram**
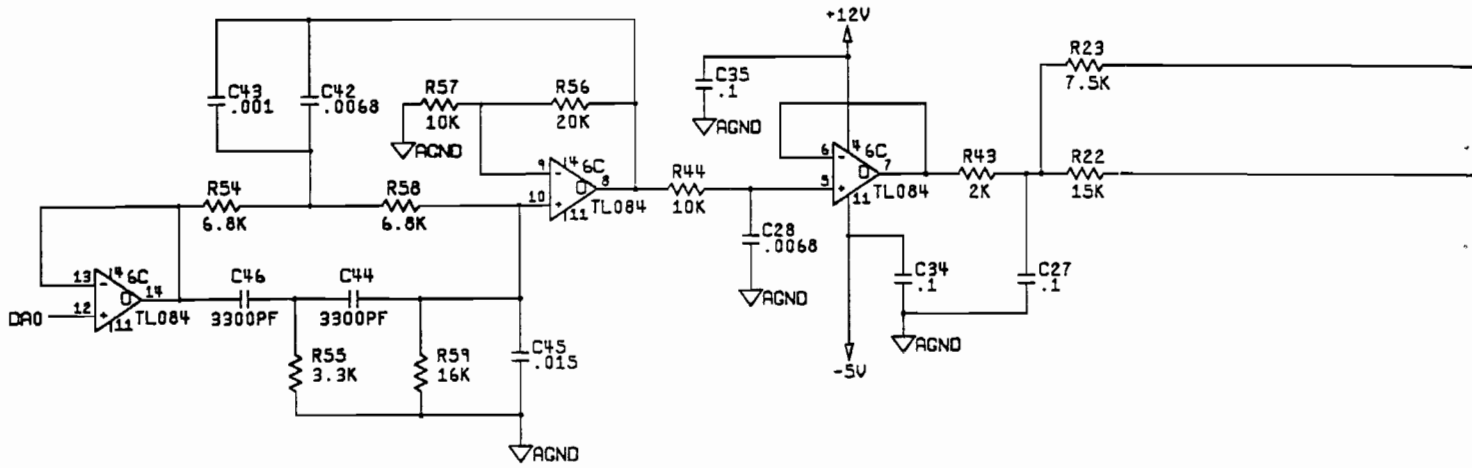
045977-01 J

Figure 5-2 JSA Audio II PCB Assembly Schematic Diagram
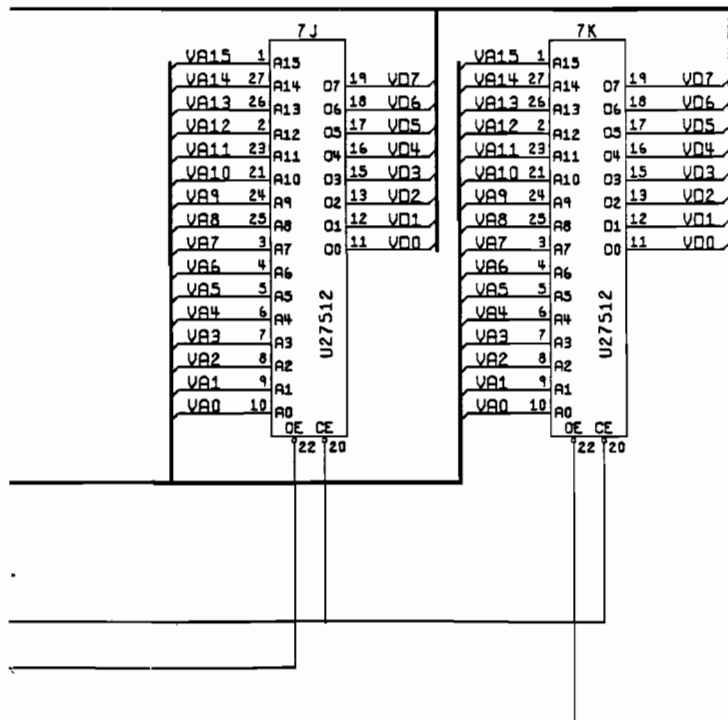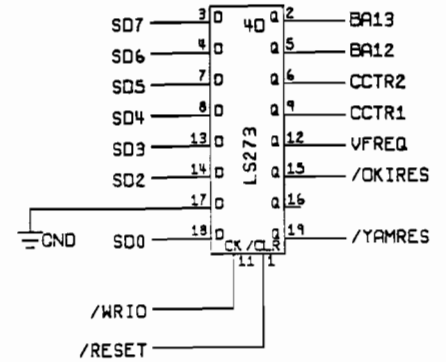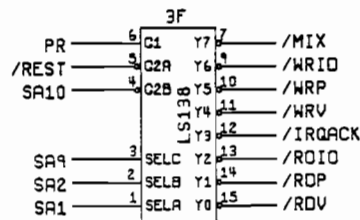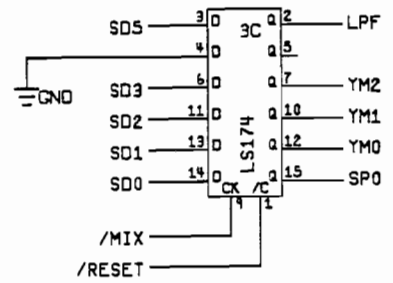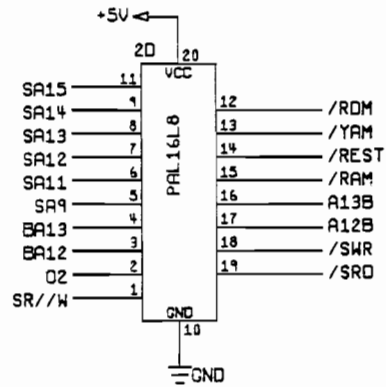
046487-01 E

Figure 5-2 JSA Audio II PCB Assembly Schematic Diagram
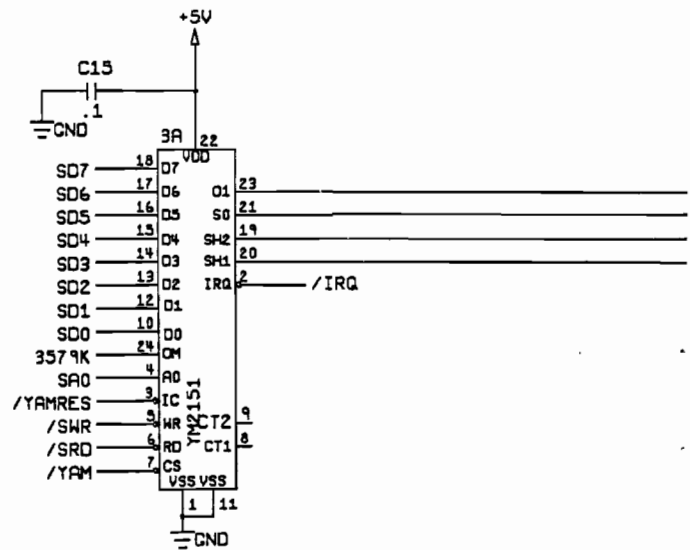
046487-01 E

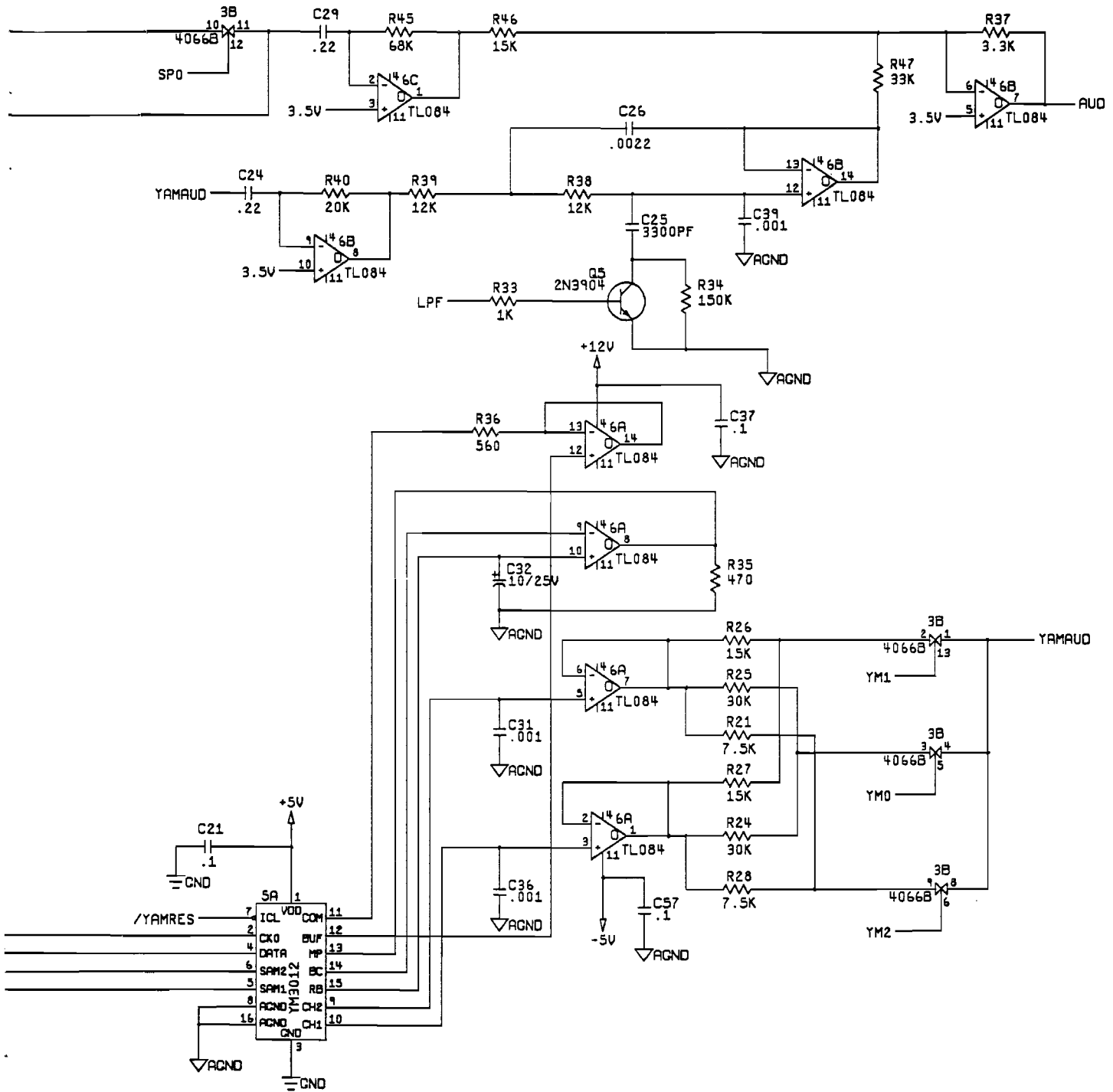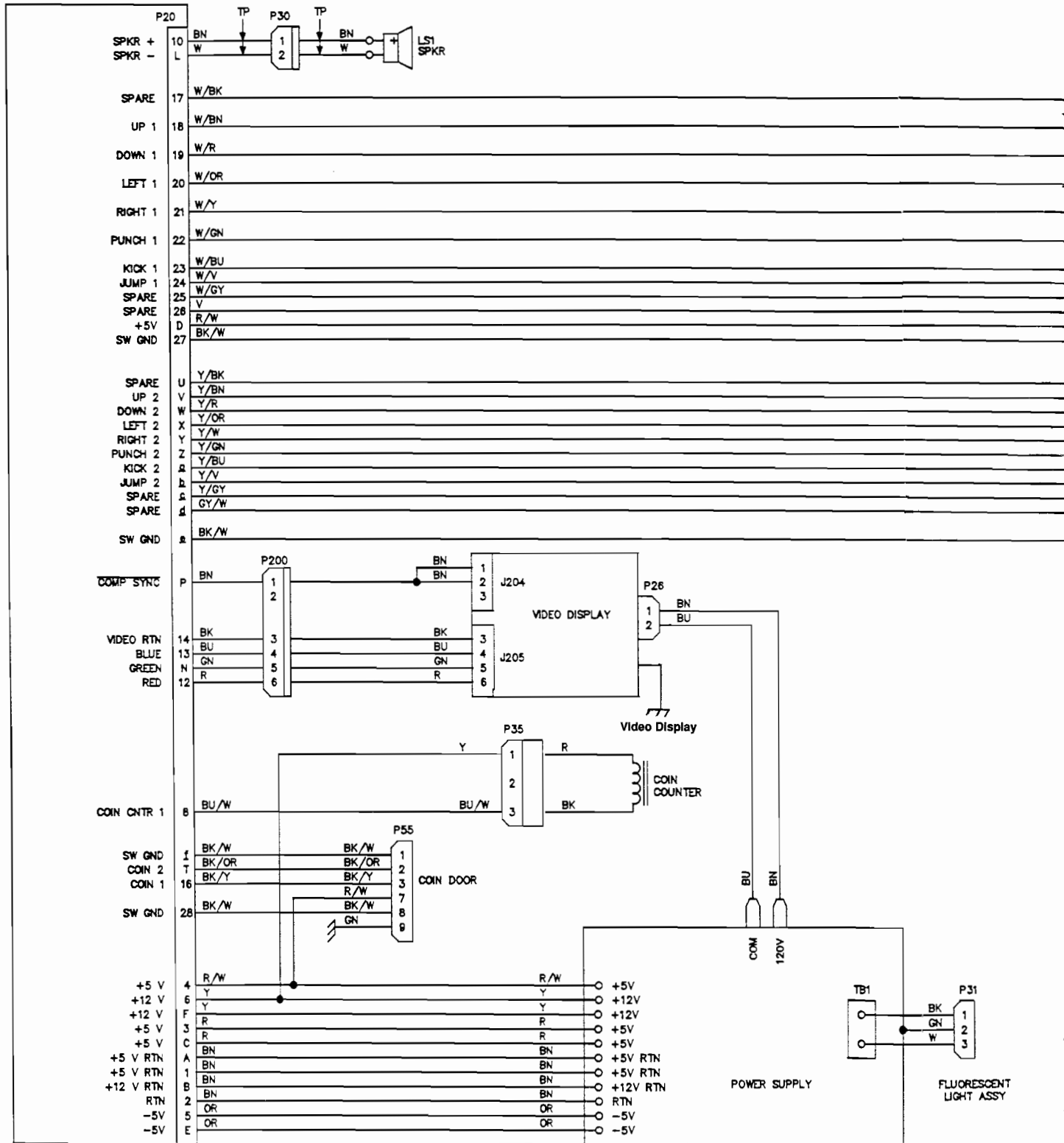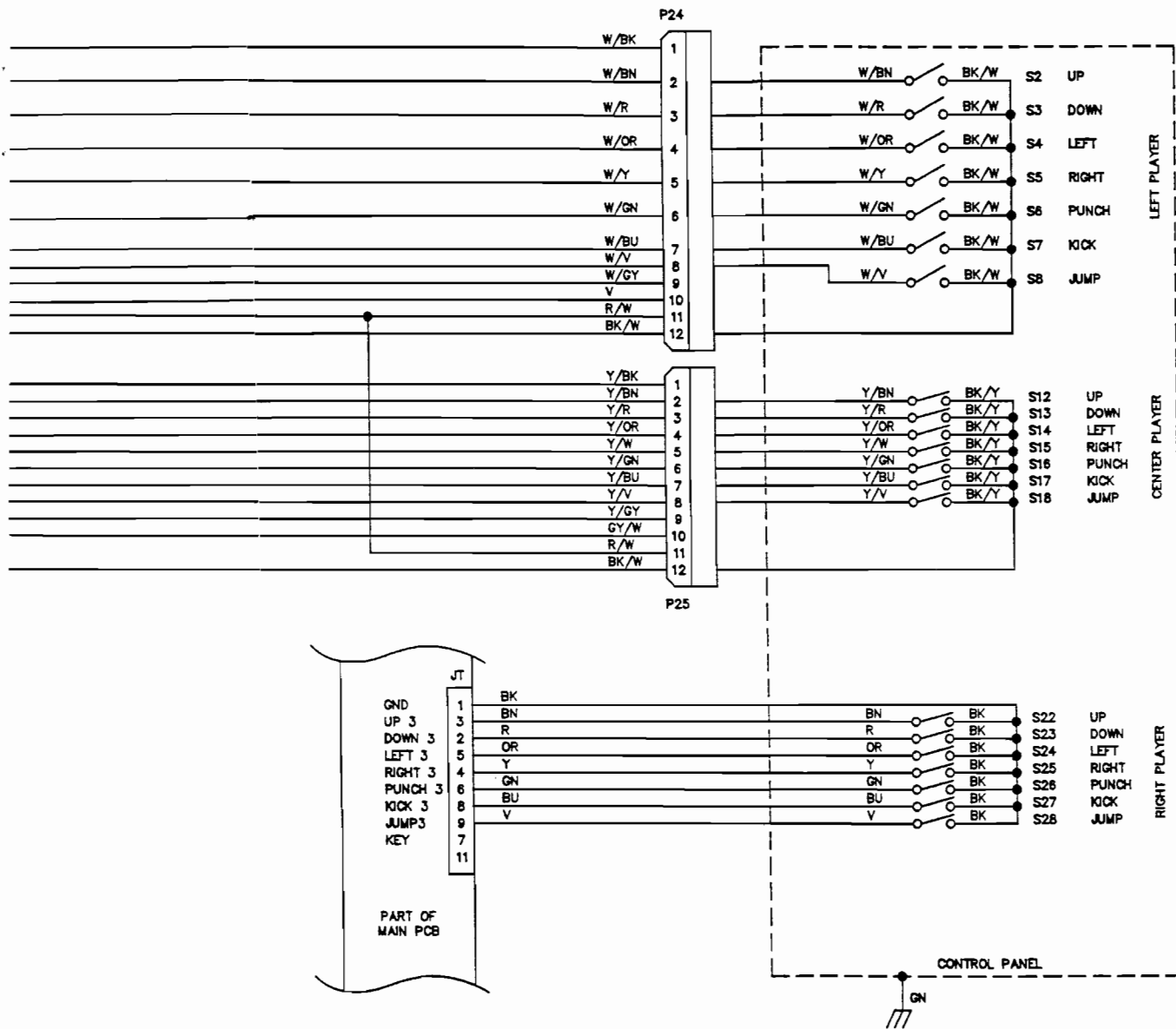**Figure 5-2 JSA Audio II PCB Assembly Schematic Diagram**
046487-01 E

Figure 5-3 Game Wiring Diagram

048097-01 A

N O T E S

ATARI
GAMES

Pit-Fighter Statistics Sheet

Date: _____   Location: _____

Statistics Screen

Left Coins: _____
Right Coins: _____
0 Player Minutes: _____
1 Player Minutes: _____
2 Player Minutes: _____
3 Player Minutes: _____
Sessions: _____
New Games: _____
Continued Games: _____
New (Game) Mins: _____
Cont. (Game) Mins: _____
Error Count: _____

Total Credits: _____
Avg Time/Credit: _____ sec
Avg Time/New Game: _____ sec
Avg. Time/Cont. Game: _____ sec

Histogram Screens

Histogram 1: New Games in Seconds		Histogram 2: Continuations in Seconds		Histogram 3: Sessions in Minutes	
0–39	_____	0–39	_____	0–2	_____
40–59	_____	40–59	_____	3–5	_____
60–79	_____	60–79	_____	6–8	_____
80–99	_____	80–99	_____	9–11	_____
100–119	_____	100–119	_____	12–14	_____
120–139	_____	120–139	_____	15–17	_____
140–159	_____	140–159	_____	18–20	_____
160–179	_____	160–179	_____	21–23	_____
180–199	_____	180–199	_____	24–26	_____
200–219	_____	200–219	_____	27–29	_____
220–239	_____	220–239	_____	30–32	_____
240–259	_____	240–259	_____	33–35	_____
260–279	_____	260–279	_____	36–38	_____
280–299	_____	280–299	_____	39–41	_____
300–319	_____	300–319	_____	42–44	_____
320–339	_____	320–339	_____	45–47	_____
340–359	_____	340–359	_____	48–50	_____
360–379	_____	360–379	_____	51–53	_____
380–399	_____	380–399	_____	54–56	_____
400 & up	_____	400 & up	_____	57 & up	_____

NOTES