ATARI
GAMES
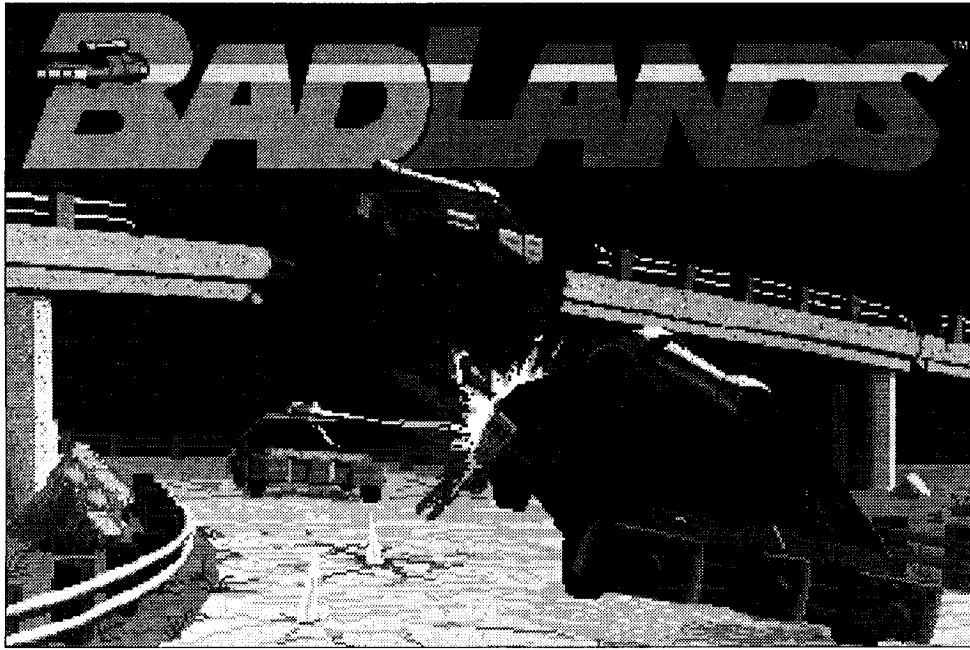
RADLANDS™

Universal Kit
Installation Instructions

KIT INSTALLATION INSTRUCTIONS

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Notice Regarding Non-Atari* Parts

WARNING

Use of non-Atari parts or modifications of any Atari game circuitry may adversely affect the safety of your game, and may cause injury to you and your players.

You may void the game warranty (printed on the inside back cover of this manual) if you do any of the following:

- Substitute non-Atari parts in the game.
- Modify or alter any circuits in the game by using kits or parts *not* supplied by Atari Games Corporation.

NOTE

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

- All ground wires in the game are properly connected as shown in the game wiring diagram.
- The power cord is properly plugged into a grounded three-wire outlet.
- On games provided with an Electromagnetic Interference (EMI) ground 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.

Contents

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

CAUTION

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

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

ABOUT WARNINGS, CAUTIONS, AND NOTES

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

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

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.

NOTE — A highlighted piece of information.

Chapter 1

Installation

How to Use This Manual
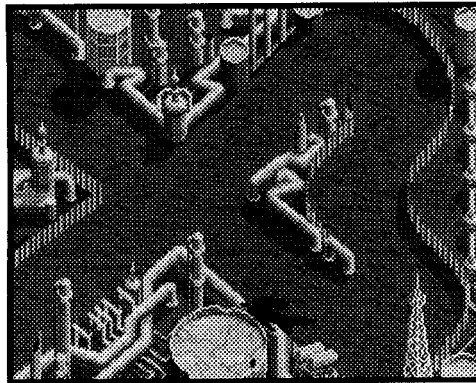
This manual provides information for installing, testing, and trouble-shooting the Badlands™ kit. The manual is divided into the following chapters: ■ Chapter 1 describes the installation procedure and the Badlands game play. ■ Chapter 2 contains self-test procedures. ■ Chapter 3 contains troubleshooting and maintenance procedures. ■ Chapter 4 contains illustrated parts lists. ■ Chapter 5 contains the schematics for the Badlands game PCB and steering PCB. Also, at the end of Chapter 1, is the template for installing the pedals on the cabinet.

WARNING
To avoid electrical shock, unplug the cabinet while installing the kit. After installation, plug the game only into a grounded 3-wire outlet.

Equipment Requirements

Table 1-1 lists the equipment required in the cabinet into which you are installing the Badlands kit.

Table 1-1 Equipment Requirements

Equipment	Specification
Video Display	Color RGB monitor
	Separate positive horizontal and vertical sync or negative composite sync
	Horizontal mounting
	Horizontal frequency: 15.750 KHz
	Vertical frequency: 60 Hz
	Video input: 1V to 3V peak-to-peak positive polarity
Control Panel	Metal only
Speaker	8 Ohms 10 Watts
Coin Mechanism	+5 VDC or +12 VDC
Power Cord	Three-conductor with ground
Power Supply	+5 VDC ± 0.25V @ 5.0 amps
	+12 VDC ± 0.5V @ 1.0 amp
	-5 VDC ± 0.5V @ 1.0 amp (Optional)

CAUTION
Do not unplug or plug in the Badlands game printed-circuit board (PCB) edge connector while the power is on. You could seriously damage the PCB.

Tools Required

■ Three C-clamps

■ Drill with 5/16-inch drill bit, 3/16-inch drill bit, and a 1 3/16-inch hole cutter (or a 1 3/16-inch chassis punch)

■ Phillips screwdriver

■ Flat-blade screwdriver

■ Socket set and ratchet

■ 1/4-20 hex wrench

■ Wire cutters and strippers

■ Straight edge

■ Squeegee

■ X-ACTO™ knife

■ Fast-ons (if you are installing a new JAMMA harness)

Inspecting the Kit

Check to see that you have all the parts listed in the kit parts list in Table 1-2. If any part is missing or damaged, contact your distributor with the Badlands kit

Table 1-2 Kit Contents List

Amount	Description	Part No.
1	JAMMA Harness Assy	A046501-01
1	Badlands Game PCB Assy	A047193-01
1	Steering Assy (assembled with JS Harness Assy, part no. A047138-01)	A047502-01
2	Pedal Assy	A047507-02
1	Badlands Poster	047106-02
1	Black Metal Control Panel Cover Plate	047461-01
2	Reinforcing Plate for Steering Assy	047512-01
2	Pedal Mounting Bracket	047509-01
1	Attraction Shield	047205-01
1	Attraction Film	047464-01
1	19" Display Bezel	047463-01
1	Control Panel Decal	047462-01
2	Side Panel Decal	047106-01
1	Product I.D. Label	038158-01
1	FCC Compliance Label	039450-01
2	Ferrite Split Bead	141026-001
4	Snap-Action Switch	160044-001
14	#10-24 Polymer Hex Lock Nut	177010-240
16	#1/4-20 Polymer Hex Lock Nut	177010-244
1	Tie Wrap	178032-002
1	5/32 Tamper-proof Hex Key	178126-002
2	Red Button Assy	178237-001
2	Blue Button Assy	178237-005
4	Nylon PCB Standoff	178265-001
4	Start/Fire Identification Collar	178283-001
4	#6 x 3/4-Inch-Long Pan-Head Screw	72-6612S
8	#10-24 x 1/2-Inch-Long Pan-Head Screw	72-1108F
6	#10 Flat Washer	175014-1040
16	1/4 Flat Washer	175014-1050
8	#10 Internal Lock Washer	75-050
6	#10-24 x 1-Inch-Long Black Carriage Bolt	75-5116B
8	1/4-20 x 1 1/4-Inch-Long Black Carriage Bolt	75-5520B
1	Badlands Universal Kit Installation Manual	TM-344

serial number, part number and description of the missing or damaged parts, and date received.

Preparing the Cabinet for the Kit Installation

1. Turn off power to the game.

2. Remove the following from the cabinet:

   ■ Old PCB(s).

   ■ Game harness if it is not Japan Amusement Machinery Manufacturers Association (JAMMA)-compatible.

   ■ Control panel decals,labels, and controls.

   ■ Side decals, graphics and adhesive. If the cabinet sides are damaged, repair them before putting on the new decals.

   ■ Video display shield, display bezel, attraction shield, and marquee.

3. Wipe down and vacuum the cabinet. Paint the cabinet, if required.

Installing the Kit Parts

The kit parts are shown installed on a cabinet in Figure 1-4.

Installing the Pedal

To install the pedals, you need a copy of the pedal installation template at the end of this chapter and the following parts from the kit:

■ The pedals and pedal brackets

■ Eight #10-24 x 1/2-inch-long pan-head screws, internal lock washers, and lock nuts

■ Eight 1/4-20 x 1 1/2-inch-long carriage bolts, flat washers and lock nuts.

1. Take a pedal apart by removing the set screws on the sides of the hinge. Take out the hinge pin. Take the pedal top off.

2. Use the #10-24 pan-head screws to attach pedal bottom to the bracket. (See Figure 1-1.) Install the lock washers and lock nuts. Put the ground wire lug between a lock washer and a lock nut on one of these screws.

3. Put a drop of oil on the hinge pin. Reassemble the pedal.

4. Put the other pedal on its bracket.

5. Cut the copy of the pedal installation template apart. Put the pieces on the the cabinet according to the dimensions shown in Figure 1-2 and on the template.

Drill the holes in the cabinet with a 5/16-inch drill bit.

NOTE

If you have a cabinet with a recessed base, put the pedal template higher so you will not drill into the gussets in the corners.

You will also have to drill two more holes through the cabinet floor to feed the pedal wires into the cabinet.

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7. Feed the pedal harnesses through the center holes. Insert the 1 1/2-inch-long carriage bolts from the outside. Install the flat washers and lock nuts.

Installing the Control Panel

To set up the Badlands control panel you need the following parts from the kit:

■ Black metal cover plate

■ Control panel decal

■ Two red and two blue buttons

■ Four start/fire button collars

■ Two steering assemblies

■ Two steering assembly mounting plates

■ Six #10-24 x 1-inch-long carriage bolts, flat washers, and lock nuts

■ Six #1/4 flat washers and lock nuts.

1. Lay the black metal cover plate over the bare control panel. Line up the two center button holes on the metal cover plate with the two center button holes on the control panel. Screw two buttons in the two center holes. See Figure 1-3. (If your control panel does not have the two center button holes in the correct position, just center the metal cover plate on the control panel.)

2. Clamp the cover plate to the control panel with three C-clamps.

3. Drill six mounting holes for the cover plate through the control panel using a 3/16-inch drill bit.

4. Install enough of the carriage bolts and lock nuts in the mounting holes to hold the cover plate in place.

5. Using the cover plate as a template, cut the holes for the outer buttons with the 1 3/16-inch hole cutter. Drill three mounting holes for each steering assembly using a 5/16-inch drill bit. You may also need to drill holes for the steering harnesses.

6. Take the metal cover plate off the control panel. With the cover plate off, install the control panel

Set Screw
(2 places)

Pedal Top

Hinge Pin

#10 Lock Nut
(4 places)

#10 Lock Washer
(4 places)

NOTE
This shows the installation of the harness ground lug.

Pedal Buttom

Flat Washer
(4 places)

1/4"-20 Lock Nut
(4 places)

1/4"-20 Carriage Bolt
(4 places)

#10-24 Pan-Hd Screw
(4 places)

Pedal Bracket
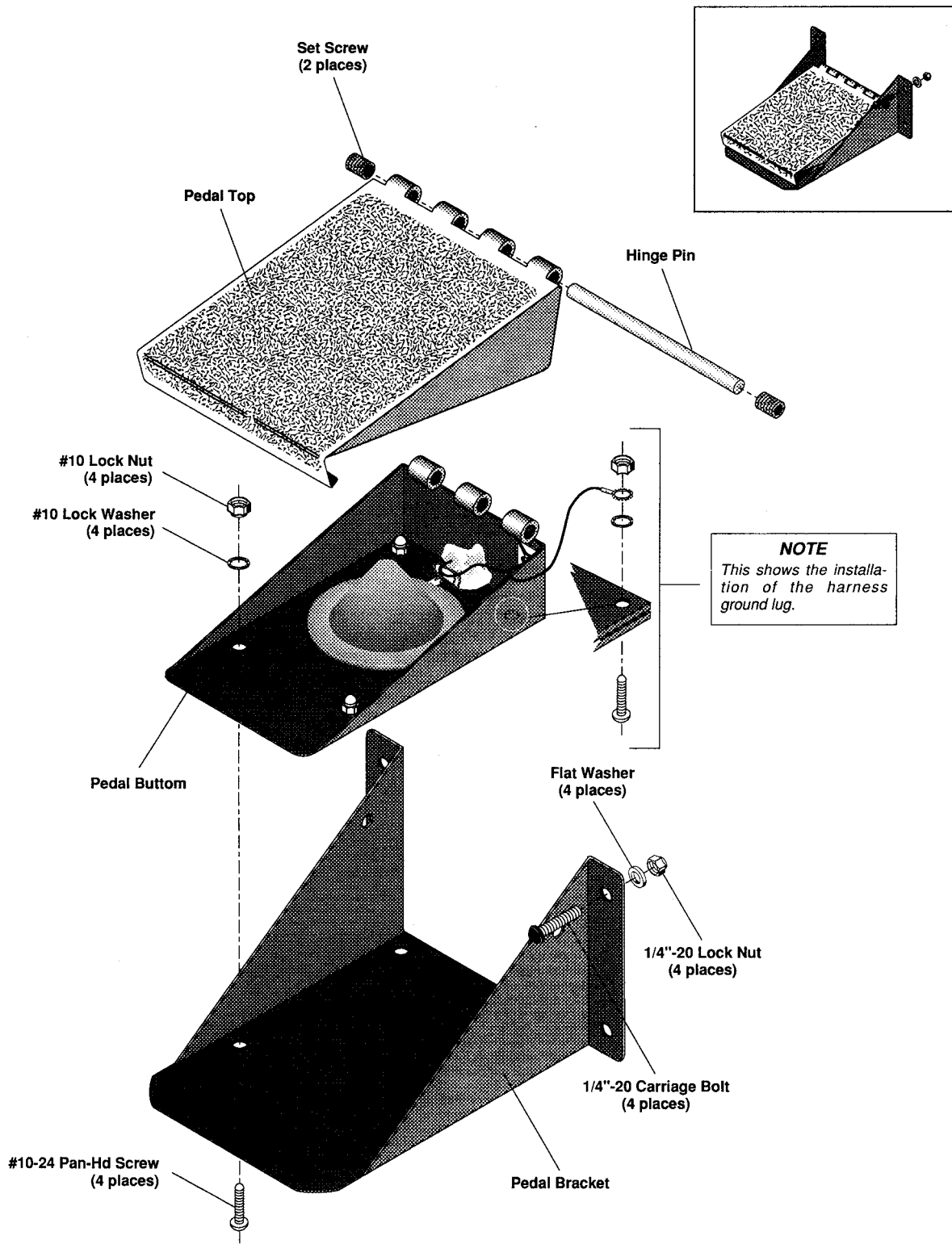
Figure 1-1 Assembling the Pedal
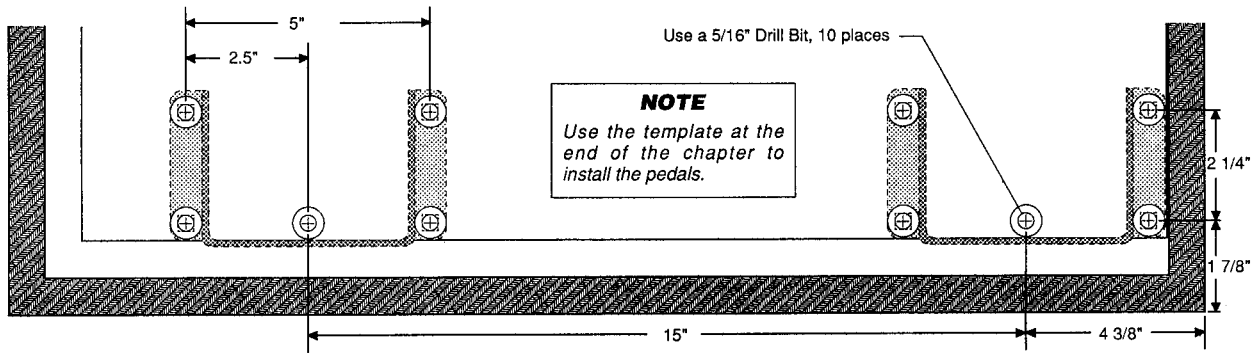
Figure 1-2 Installing the Pedals on the Game

decal on the control panel. *Do not put the decal over the black cover plate.*

8. Now install the black cover plate on the control panel with the carriage bolts, flat washers, and lock nuts.

9. Install each steering assembly with a mounting plate on the underside of the control panel. Install the mounting plate so the steering assembly cannot be torn off the control panel.

10. Put the 1/4-20 lock nuts and flat washers on the studs. **Do not use a ratchet or an air gun to tighten the nuts.**

CAUTION

Tighten the nuts on the steering assembly studs to 40 inch-pounds maximum. If you tighten the nuts too much, you can damage the assembly.

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11. Install the buttons with a plastic "Start/Fire" collar under each button. Put the blue buttons on the left and red buttons on the right.

CAUTION

Install the steering mounting plates under the control panel so the steering assemblies cannot be torn off the control panel.

Figure 1-3 Assembling the Control Panel

Table 1-3 JAMMA Wire Connections

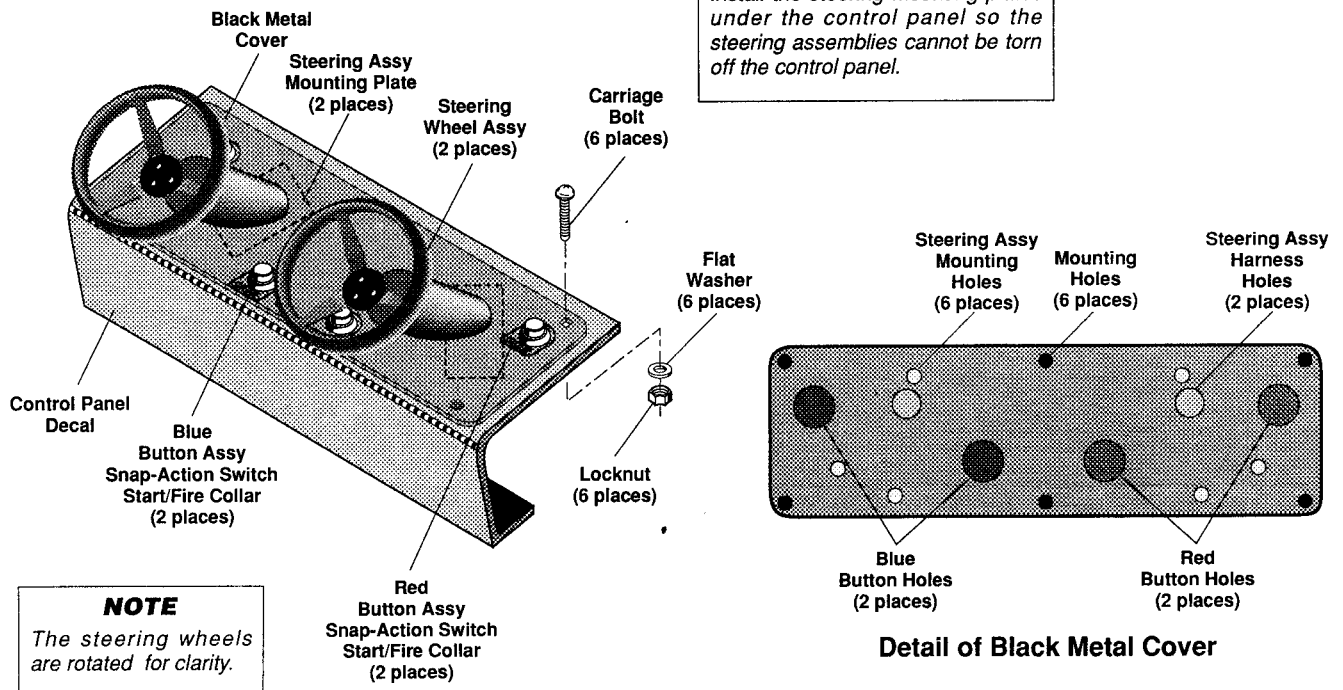| Signal	Note*	Wire Color	Pin		Wire Color	Note*	Signal
Component Side					**Solder Side**		
+V RTN	1	BN	1	A	BN	1	+V RTN
+V RTN	1	BN	2	B	BN	1	+V RTN
+5V	2	R	3	C	R	2	+5V
+5V	2	R	4	D	R	2	+5V
–5V	3	OR	5	E	OR	3	–5V
+12V	4	Y	6	F	Y	4	+12V
Key			7	H			Key
COIN CTR 1	5	BU/W	8	J	V/W	5	COIN CTR 2
Not used			9	K			Not used
SPKR +	TP, 17	BN	10	L	W	TP, 17	SPKR–
AUDIO+			11	M			AUDIO GND
RED	6	R	12	N	GN	6	GREEN
BLUE	6	BU	13	P	BN	6	COMPSYNC
VIDEO GND	6	BK	14	R	GY		Not used
SELF-TEST	7	W	15	S			Not used
Left Player					**Right Player**		
COIN 1	8	BK/Y	16	T	BK/OR	9	COIN 2
FIRE/START 1	10	W/BK	17	U	Y/BK	10	FIRE/START 2
Spare		W/BN	18	V	Y/BN		Spare
Spare		W/R	19	W	Y/R		Spare
Spare		W/OR	20	X	Y/OR		Spare
Spare		W/Y	21	Y	Y/W		Spare
FIRE/START 1	10	W/GN	22	Z	Y/GN	11	FIRE/START 2
PEDAL 1	15	W/BU	23	a	Y/BU	15	PEDAL 2
PEDAL 1	16	W/V	24	b	Y/V	16	PEDAL 2
STEERING D	12	W/GY	25	c	Y/GY	12	STEERING D
STEERING C	13	V	26	d	GY/W	13	STEERING C
GND	14	BK/W	27	e	BK/W	14	GND
GND	14	BK/W	28	f	BK/W	14	GND

* Notes for this table are on page 1-7.

Installing and Connecting the Harness

CAUTION

To meet FCC requirements, install the split beads included in the kit over all the wires in the harness as close to the connector as possible.

1. If your game does not already have a JAMMA harness, find the JAMMA harness (part no. A046501-01) in the kit and install it.

2. Using Table 1-3, *JAMMA Pin and Wire Connections,* for wiring information, connect the JAMMA harness to existing component harnessing. Use crimp splices or butt soldering.

WARNING

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

Connecting Power Wires

1. Connect the wires on the JAMMA harness to the wires for the power supply, as shown in Table 1-3. The Badlands kit requires +5V and +12V. If -5V is available, it should be used too.

   If -5V is *not* available, connect both wires to the 5 V RTN (GND) terminal on the power supply unless the power supply has 12V RTN. If it does, connect both wires to it.

Notes to Table 1-3 Jamma Wire Connections

TP Twisted pair.

1. Connect four of the large BN wires to the 5V RTN (GND) terminal on the power supply unless the power supply has a 12V RTN. If you have a 12V RTN, connect one of the wires to the 12V RTN (GND) terminal.

2. Three of the R wires go to the +5V terminal on the power supply. If the power supply has a +SENSE terminal, connect one of these three wires to the +SENSE instead of the +5V. The fourth wire goes to the red wires on the steering assemblies.

3. Connect both wires to the −5V terminal of the power supply. (If −5V is not available, connect both wires to the 5 V RTN (GND) terminal on the power supply unless the power supply has 12V RTN. If it does, connect both wires to it. *NOTE: If −5V is not used, the maximum power to the speaker is reduced by half.*)

4. Connect both wires to the +12V terminal of the power supply. (If your coin counter(s) require(s) 12V, you can use one of these two wires for the + side of the coin counter(s).)

5. Connect to the negative side of the coin counter(s). If your counter(s) require 5V, splice into the red wire that brings +5V to the steering assemblies. See Note 2, above. *Note: Do not use 24V counters.*

6. Attach to the video display.

7. Use this wire if you want an external self-test switch. The Badlands kit already has a self-test switch on the PCB. If you connect an external self-test switch, first make sure the switch on the PCB is switched off. Then connect this wire to the N.O. terminal on the external self-test switch. Connect the common terminal of the self-test switch to one of the BK/W wires (GND).

8. Connect to the N.O. terminal of the left coin switch. Connect the common terminal of the coin switch to one of the BK/W wires.

9. Connect to the N.O. terminal of the right coin switch. Connect the common terminal of the coin switch to one of the BK/W wires.

10. Connect to the N.O. terminals of the left Fire/Start switches. Connect the common terminals of the switches to one of the BK/W wires.

11. Connect to the N.O. terminals of the right Fire/Start switches. Connect the common terminals of the switches to one of the BK/W wires.

12. Connect to the gray wire on the steering assembly.

13. Connect to the white wire on the steering assembly.

14. Connect one wire to the negative sense terminal of the power supply (if it exists). Connect the second wire to the common terminals of the coin switches. Connect the third wire to the common terminals of the control switches. Connect the fourth wire to the black wires on the steering assembly harness.

15. Connect to the blue wire on the pedal.

16. Connect to the violet wire on the pedal.

17. Connect the brown wire to the plus terminal on the speaker and the white wire to the negative terminal on the speaker.

If your original game used other voltages, they are not needed. Tie off any unused wires on the power supply.

2. There is more than one wire for each voltage. Use more than one wire for each voltage (connecting them as described in Table 1-3) so that you do not overload the edge connector and cause it to burn.

Connecting Video Display Wires

NOTE

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

Connect the wires designated for the red, green and blue video guns along with the sync and ground wires, according to Table 1-3.

Connecting Coin Door Wires

1. Connect the wires on the JAMMA harness to the coin switches and meter according to Table 1-3.

2. Connect one side of the door lamps to one of the BK/W wires. Connect the other side of the door lamps to the R wire supplying +5V to the joysticks.

NOTE

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

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

Connecting the Control Wires

Connect the steering assembly harnesses and the button harnesses to the JAMMA harness according to the information in Table 1-3

Attraction Shield

Display Bezel   Attraction Film

Side Panel Decal

Display Shield

Game PCB
Assembly
Stand-offs
X-Rec Screw

Black
Metal Cover
Steering Assy
Mounting
Plate
Steering Carriage
Wheel   Bolt
Assy

Flat
Washer

Control
Panel Decal
Blue
Button Assy
Snap Action Switch
Start/Fire Collar

Locknut

Volume Control

Self-Test Switch

Red
Button Assy
Snap Action Switch
Start/Fire Collar

Self-Test Label

Foot Pedal

Control panel in closed position

NOTE
*The steering wheels are
shown rotated for clarity.*

Figure 1-4 Badlands Kit Parts Installed in a Cabinet

Grounding the Cabinet

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

Checking the JAMMA Connections

Before plugging in the game PCB, turn on the power to the game, and check +5 Volts on pins 3, 4, C, and D of the JAMMA connector; +12 Volts on pins F and 6; and -5 Volts on pins E and 5. Check that the video display and the attraction lamp have power.

Now turn off the power to the game.

Installing the Badlands Printed-Circuit Board

1. After you have checked the power on the JAMMA connector, above, install the Badlands game PCB in the cabinet. Use the nylon standoffs and four #6-32 screws in the kit.

2. Connect the JAMMA connector to the PCB.

3. Turn on the power to the game. Check that the game PCB functions. If a video picture is not present, see Chapter 3.

Installing the Display Bezel

Find the cardboard display bezel (part no. 047463-01). Measure the size of the existing display bezel and cut the new display bezel to size, if necessary.

Installing the Product ID and FCC Label

Place the product ID label (part no. 038158-01) and FCC label (part no. 039450-01) on the back of the cabinet.

Installing the Side Panel Decals

Find the side panel decals. Wet the left and right side panels of the cabinet with slightly soapy water. Then position the decals as shown in Figure 1-4. Remove any wrinkles in the artwork using a squeegee. Allow the sides to dry.

Installing the Attraction Assembly

Find the attraction shield and the attraction film. Using the existing shield as a template, cut the shield and film to size, if necessary. Install them on the cabinet as , shown in Figure 1-4.

Testing After Power-Up

Use the self-test to check the operation of the game. Refer to Chapter 2 for information about 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 failure.

Setting the Coin and Game Options

The Badlands coin and game options are set in the self-test. See Chapter 2 for information about the option settings.

Game Play

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

Introduction

It has been 50 years since the nuclear disaster. The sport of sprint racing is now a ruthless battle between armed cars. These races take place on tracks built in the ruins of the dangerous nuclear zone known only as the BADLANDS.

This is sprint racing gone BAD! It's all-out war on the track as players blast away at the drones (and each other) to finish first! Players shoot playfield targets for extra points and bonus missiles!

Game Play

One or two players can race at any time with Badlands' buy-in and game continuation features. If a player loses to one of the drone cars, the player can put in another coin to continue on to the next heat and retain any custom car options he has acquired.

Each race has four laps. Players continue on to the next racing heat as long as they beat the drone car.

Badlands has eight unique track layouts set in eight different animated backgrounds that react to player shots and crashes. These backgrounds change with the level of difficulty. The backgrounds are:

■ *The City*—watch out for falling power lines and the water tower that crashes, spilling water on the track that slows you down.

■ *The Desert*—the mountain rumbles and falls onto the track.

■ *The Freeway*—make your own shortcuts through the diner and gas station.

■ *The Volcano*—lava spills down upon the track.

■ *The Junkyard*—power lines fall and old cars explode on impact.

■ *The Military Base*—cannons fire and missiles explode.

- *The Prison Yard*—Use the gates to make shortcuts and avoid the towers that fire upon you.

- *The Refinery*—be careful of creating oil spills.

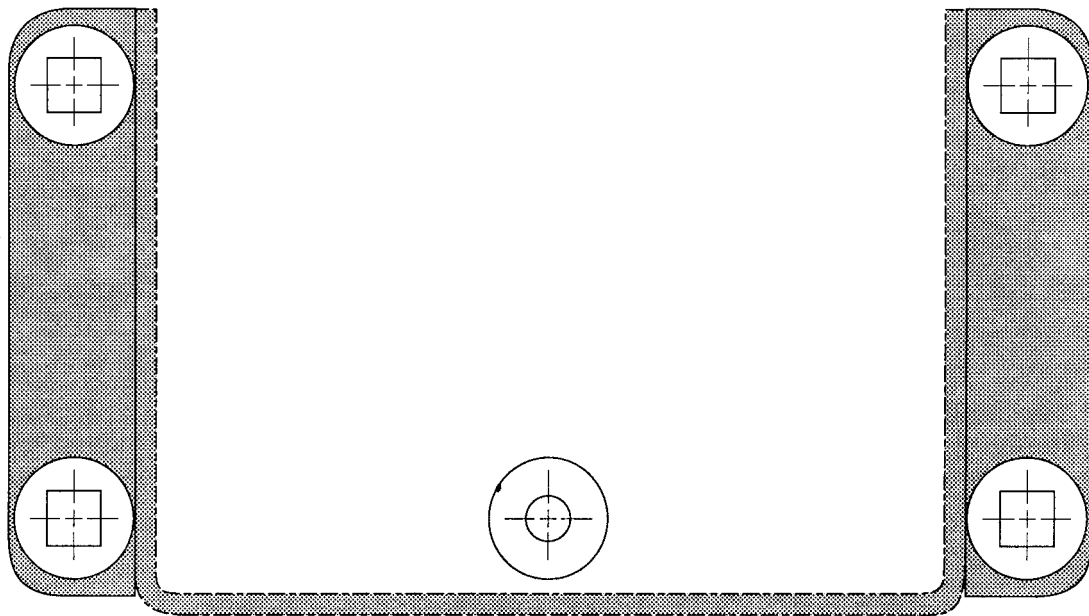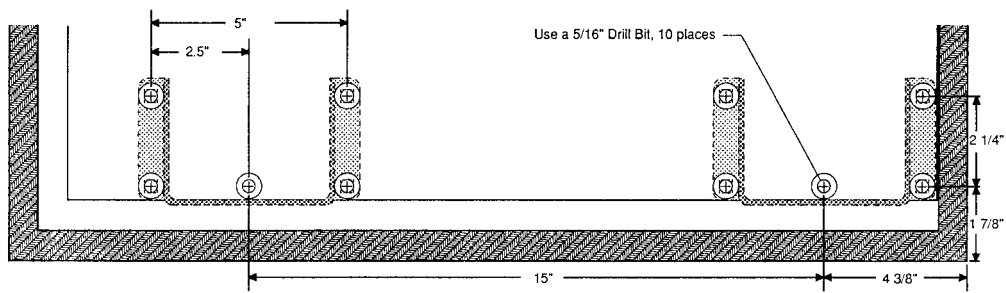Players can add coins to quickly customize their car. Custom car options include:

- *Missiles* to destroy other cars and walls to make short cuts.

- *Tires* to slide less around the turns.

- *Turbo* to get up to speed faster.

- *Speed* for higher top speed.

- *Shields* to protect the car from shots, missiles and crashing.

5"

2.5"

Use a 5/16" Drill Bit, 10 places

2 1/4"

1 7/8"

15"

4 3/8"
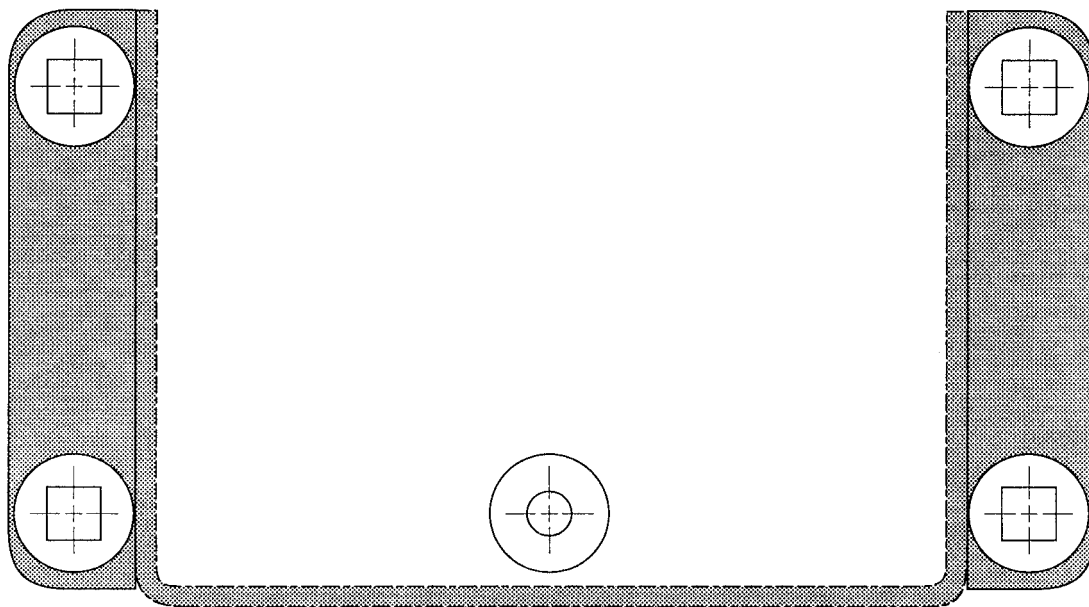
Pedal Installation Template

Chapter 2

Self-Test

The Badlands™ game tests itself and provides visual and audible indications of the condition of the game circuitry and controls. Self-test information is displayed on the screen and through the sound system. No additional equipment is required. Perform the self-test when you first set up the game, each time you collect the money, and when you suspect game failure. The self-test screens provide information pertaining to the game circuits and controls. 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 and their purposes.
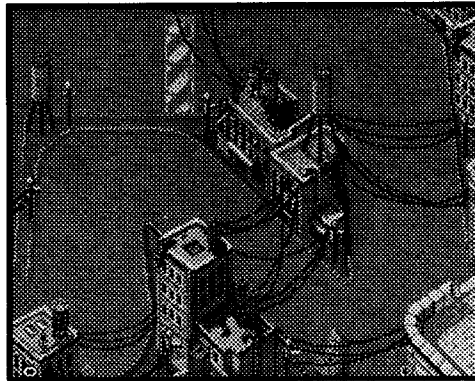
Table 2-1 Summary of the Self-Test Screens

Screen	Use or Purpose
RAM Screen	RAMs are tested only if the self-test switch is switched on first and then the power switch is turned on. Appears only if a RAM is bad.
ROM Screen	ROMs are tested only if the self-test switch is switched on first and then the power switch is turned on. Appears only if a ROM is bad.
Self-Test Menu Screen	Use to choose the self-test screen you want to see.
Statistics Screen	Displays game statistics.
Histogram Screen	Displays the game histogram.
Coin Options Screen	Use to set and check the coin options settings.
Game Options Screen	Use to set and check the game options settings.
Input Test Screen	Use to test the player controls.
Playfield Stamp Test Screen	Use to see the game stamps.
Motion Object Screen	Use to test the movement and color of game objects.
Motion Object Picture Test Screen	Use to test the game objects in the ROMs.
Playfield and Convergence Test Screens	Use to check and adjust video display convergence of red, blue, and green.
Violet Convergence Screen	Use to check and adjust video display convergence of red to blue.
Green Convergence Screen	Use to check and adjust video display convergence of red and blue to green.
Other Test Patterns	Used to check the video display convergence
Color Bars and Purity Test Screen	Use to check the dynamic range of the video display color circuits.
Cyan, Yellow and Magenta Test Screen	Use to check the dynamic range of the video display color circuits.
Red Color Purity Screen	Use to check the red color purity in the video display.
Green Color Purity Screen	Use to check the green color purity in the video display.
Blue Color Purity Screen	Use to check the blue color purity in the video display.
White Color Purity Screen	Use to check the white color in the video display.
Grey Color Purity Screen	Use to check the grey color in the video display.
Sound Test Screen	Use to check the audio circuits, RAM, and ROM. Also use to check the coin mechanism operation.

Entering and Exiting the Self-Test

To enter the self-test, turn on the self-test switch, located on the game PCB at 19B near the JAMMA connector.

If you turn on the self-test switch after the power is turned on, the self-test skips the RAM and ROM test. To test the RAMs and ROMs, first turn on the self-test switch and then turn on the power.

Turn off the self-test switch to exit the self-test and return to the Attract Mode. However, if you want to reset the coin or game options, leave the options screen and then turn off the self-test switch. If you turn off the self-test switch while you are on the options screen, the settings will not change.

RAM and ROM Test

Test the RAMs and ROMs by turning on the self-test switch first, and then the power switch. If the power was on when you turn on the self-test switch the RAM and ROM test is skipped. If the RAMs and ROMs pass the test, the display advances to the self-test menu screen automatically.

Testing Game RAMs

No message appears while the test is checking the RAMs. If the game has a bad RAM, you may see a message, or if the problem is severe, you may only see a colored screen. See Table 2-2 for the location of the bad RAM if you see a message. If the test finds no RAM errors, no message appears and the program goes to the ROM test after a 4-second delay.

The RAM test continues to run until it passes. You can advance to the next RAM or ROM test by pressing the left player Start/Fire button.

Table 2-2 Bad RAM Locations

RAM Type	Location	Video Display Characteristic
CPU/Video	22V	Background color is red and foreground is black.
Color RAM	8K	Black and yellow are the main colors.

Testing Game ROMs

If the ROMs have no errors, the ROM test displays no messages and advances to the Statistics screen. If a ROM fails, a message is displayed. If the game has an error in the program ROM, then the error number is shown at the bottom of the screen. See Table 2-3 for the location of the bad ROM.

Table 2-3 Bad Upper or Lower Main ROM Locations

Error Address	Location on Game PCB	
00000	U=20F	L=27F
20000	U=17F	L=24F

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 go to the self-test menu by pressing the left player Start/Fire button. If you have more than one ROM error, you must press the left player Start/Fire button several times to go to the self-test menu.

Self-Test Menu

Choose the screen you want to see from this menu, shown in Figure 2-1. Move through the menu by turning the left steering wheel. To choose a screen, press the left player Start/Fire button.
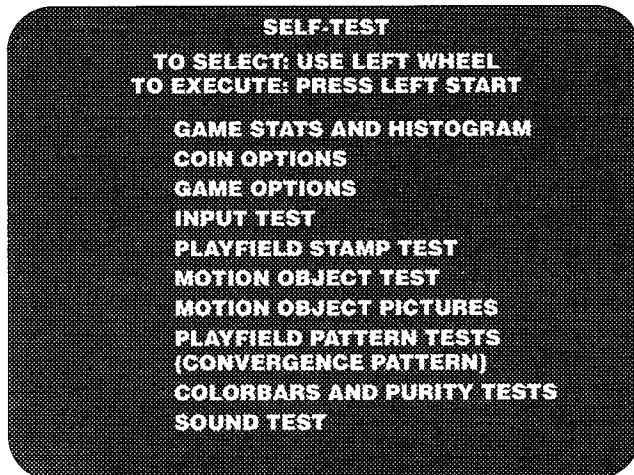

Figure 2-1 Self-Test Menu Screen

Statistics

The statistics screen is shown in Figure 2-2. The statistics information is accumulated either from the first time the game was turned on or from the last time the

Figure 2-2 Statistics Screen

statistics were reset. To reset the statistics information, spin either steering wheel and while the wheel is spinning, press the right player Start/Fire button.

Enter the information on the statistics screen on a copy of the statistics page in the back of this manual.

The following information appears on the statistics screen:

- *Left Coins* shows the number of coins deposited in the left coin mechanism.

- *Right Coins* shows the number of coins deposited in the right coin mechanism.

- *Continues* shows the number of times players continued their games.

- *Conversions* shows the number of times players converted credits to wrenches. (The *Convert Credits to Wrenches* game options setting must be set to *yes*.)

- *0 Plyr Mins* shows the minutes of idle time.

- *1 Plyr Mins* shows the minutes played as a 1-player game.

- *2 Plyr Mins* shows the minutes played as a 2-player game.

- *Sessions* shows the number of sessions played. One session is the game play starting at the left or right player position and play ending at that position, regardless of the number of coins or time played.

- *Total Games* shows the total number of games played. One "game" is the time between a player starting and that player losing to a drone car.

- *Error Count* shows the number of EEROM errors that were detected. If this is any number other than zero, all of the statistics may be wrong. If you have errors counted regularly, replace the EEROM at

location 27J on the Game PCB.

■ *Total Game Time* shows the total time, in minutes, that the game has been played.

■ *Total Credits* shows the total number of credits deposited in both coin mechanisms.

■ *Avg Time/Credit* shows the average game time per credit, in seconds, for all players.

■ *Avg Time/Game* shows the average game time per game, in seconds, for all players. The coin mode does not affect this figure, nor do credits converted to wrenches.

NOTE

Game time for Badlands will average about 3 1/2 minutes per game because of the nature of the game play.

■ *Avg Games/Session* shows the average number of games played in a session. This indicates continued games.

Press the left player Start/Fire button to go to the histogram screen.

Histogram

The histogram screen is shown in Figure 2-3. The histogram shows the average game time from 0 to 600 or more seconds. The histogram also provides a corresponding bar graph.

Enter the information on the histogram screen on a copy of the statistics page in the back of this manual.

The game times information is accumulated either from the first time the game was turned on or from the last time the game times were reset. To reset the his-
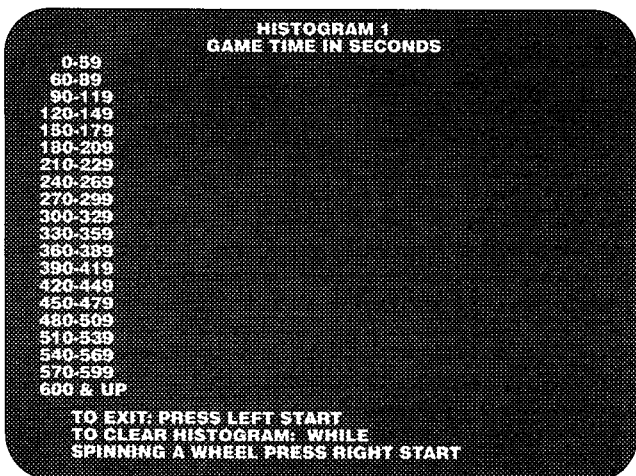

Figure 2-3   Histogram Screen

togram, spin either steering wheel and while the wheel is spinning, press the right player Start/Fire button.

Press the left player Start/Fire button to go to the self-test menu screen.

Coin Options

The coin options screen is shown in Figure 2-4. The coin options screen indicates the current coin option settings and allows you to change those settings.

The settings, with defaults, are shown in Table 2-4.

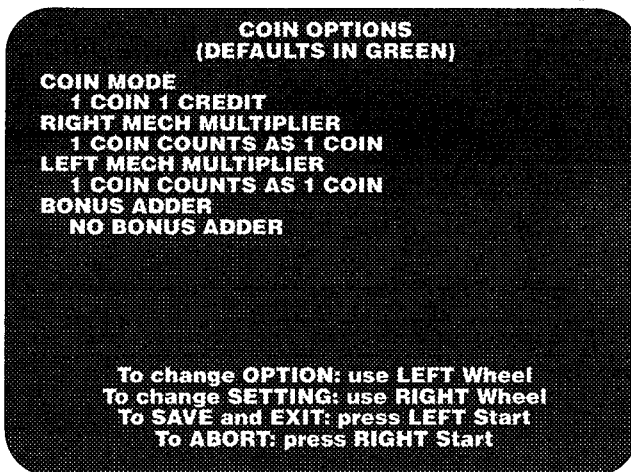To move through the options, turn the left wheel. The blue box around the option name indicates the option

Figure 2-4   Coin Options Screen

Table 2-4   Coin Options Settings

Options	Available Settings
Coin Mode	One Coin ✦
	Two Coins
	Three Coins
	Four Coins
Right Mech Multiplier	1 Coin Counts as 1 Coin ✦
	1 Coin Counts as 4 Coins
	1 Coin Counts as 5 Coins
	1 Coin Counts as 6 Coins
Left Mech Multiplier	1 Coin Counts as 1 Coin ✦
	1 Coin Counts as 2 Coins
Bonus Adder	No Bonus Adder ✦
	2 Coins Give 1 Extra Coin
	4 Coins Give 1 Extra Coin
	4 Coins Give 2 Extra Coins
	5 Coins Give 1 Extra Coin
	3 Coins Give 1 Extra Coin
	Free Play
✦ *Manufacturer's recommended settings*	

that can be changed. The default setting appears in green letters. To move through the settings, turn the right wheel. To save the settings and exit the screen, press the left Start/Fire button. To leave the screen *without* saving the settings, press the right Start/Fire button.

■ *Coin Mode* is the number of coins required for one credit. *Coin Mode* should have a blue box around it when you enter this screen.

■ *Right Mech Multiplier* is the number of coins each coin counts as in the coin mechanisms.

■ *Left Mech Multiplier* is the number of coins each coin counts as in the coin mechanisms.

■ *Bonus Adder* lets you choose bonus coins, no bonus, or free play.

If you replace the EEROM at location 27J or if a hardware problem occurs, the coin options will change to the default (green) settings.

NOTE

To save new coin option settings, first exit the screen by pressing the left Start/Fire button and then turn off the self-test switch.

Game Options

The game options screen is shown in Figure 2-5. This screen indicates the current game option settings, and is used to reset the high score table and change the game option settings. Refer to Table 2-5 for the available settings and Atari Games' recommended settings.

To move through the options, turn the left wheel. The blue box around the option name indicates the option
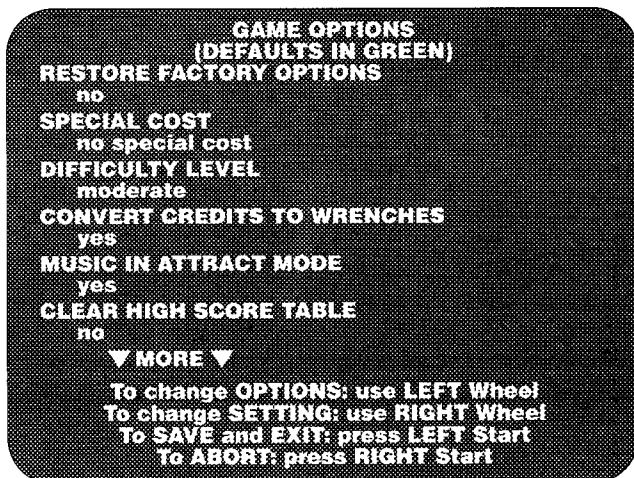

Figure 2-5 Game Options Screen

Table 2-5 Game Options Settings

Option Name	Available Settings	
Restore Factory Options	No ✦Yes	
Special Cost	No Special Cost ✦ Two Credits to Start; One to Continue	
Difficulty Level	Easy	Moderate ✦
	Hard	Hardest
Convert Credits to Wrenches	Yes ✦	No
Music in Attract Mode	Yes ✦	No
Clear High Score Table	Yes	No ✦
Auto High-Score-Table Reset	Yes ✦	No
Don't-Do-Drugs Screen	Yes ✦	No
✦ *Manufacturer's recommended settings*		

that can be changed. The default setting appears in green letters. To move through the settings, turn the right wheel. To save the settings and exit the screen, press the left Start/Fire button. To leave the screen *without* saving the settings, press the right Start/Fire button.

■ *Restore Factory Options* lets you set all the game options to the factory options or lets you use your own settings. Make sure you set this to *no* to use your own chosen settings.

■ *Special Cost* lets you choose two credits to start and one to continue, or no special cost, which is one credit to start and one to continue.

■ *Difficulty Level* lets you choose the difficulty level of the Badlands game.

■ *Convert Credits to Wrenches* controls whether players may convert credits to wrenches.

■ *Music in Attract Mode* lets you turn the music on or off in the attract mode.

■ *Clear High Score Table* resets the high score table if you select *Yes.*

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

■ *Don't Do Drugs* lets you turn off or on the FBI symbol screen in the attract mode.

NOTE

To save new game option settings, first exit the screen by pressing the left Start/Fire button and then turn off the self-test switch.

Input Test

The input test screen, shown in Figure 2-6, checks the player controls. The inputs that are checked are:

■ *Switches* and *Lev/Edge* are for Atari Games development.

■ *Leta Values, Raw* and *Delta* are the inputs for the steering wheels and the pedals.

■ *Left Wheel Delta* value increases from 01, as you turn the wheel clockwise. The faster you turn the wheel, the higher the delta number is. As you turn the wheel counterclockwise faster and faster, the value decreases from FF.

■ *Right Wheel Delta* value increases from 01, as you turn the wheel clockwise. The faster you turn the wheel, the higher the delta number is. As you turn the wheel counterclockwise faster and faster, the value decreases from FF.

■ *Left Pedal Delta* value increases when you press the left pedal.

■ *Right Pedal Delta* value increases when you press the right pedal.

■ *Self-Test* should have a pink box around it when this screen appears.

■ *VBLANK* is for Atari Games development.

■ *Right Start/Fire* tests the right Fire/Start buttons. Press either of the right buttons and a pink box appears around the words.

■ *Left Start/Fire* tests the left Fire/Start buttons. Press either of the left buttons and a pink box appears around the words.

■ *Freeze, Freeze-Step, Old Gas Pedals,* and *Old Steering Wheels* should never be highlighted.

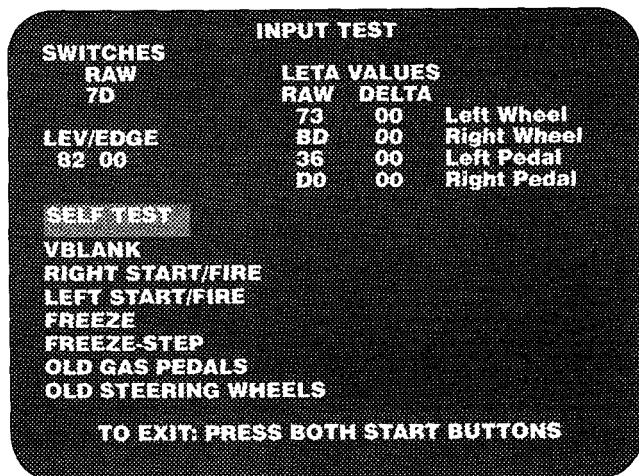Simultaneously press the right and left player Start/Fire

Figure 2-6   Input Test Screen

button to return to the self-test menu screen.

Playfield Stamp Test

This screen shows the different stamps used in the game and appears in Figure 2-7. If you turn the left wheel clockwise, you will see Bank 0 stamps. If you turn the left wheel counterclockwise, you will see Bank 1 stamps.

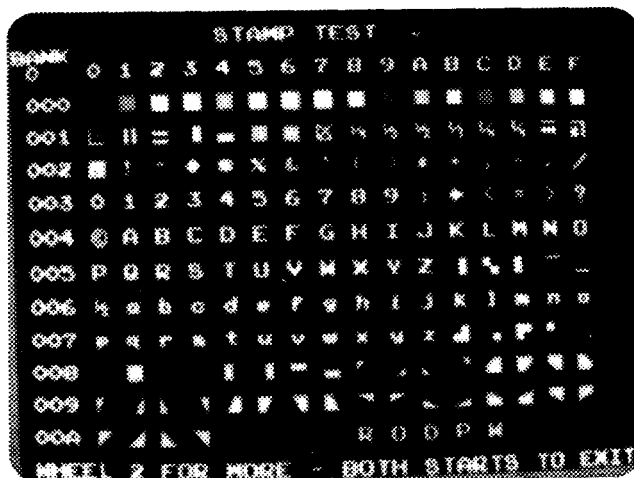Simultaneously press the right and left player Start/Fire button to return to the self-test menu screen.

Figure 2-7   Playfield Stamp Test Screen

Motion Object Test

The motion object test screen is shown in Figure 2-8. The motion object test indicates the condition of the motion-object buffer circuit. Use the controls to test the motion objects as described in Table 2-6.

Table 2-6   Motion Object Test

Control	Function
Right Start/Fire	Displays a different set of patterns. Press this button to view the stamps from 0 to C00.
Left Wheel	Turning the wheel moves the vertical position of object.
Right Wheel	Turning the wheel moves the horizontal position of object.
Left Start/Fire	Pressing this button increases the selected object number.
Left Pedal	Pressing the pedal increases the palette of the selected object. (The priority changes every eighth palette.)
Right Pedal	Pressing the pedal increases the vertical size of the selected object.

Motion objects with priority 0 *(PRI : 0)* move behind the orange and grey vertical stripes on the sides of the screen. Motion objects with priority 1 move in front of the stripes.

The following information is provided at the bottom of the screen:

■ *MOB* indicates the number of the motion object selected.

■ *PIX* indicates the stamp number in ROM.

■ *HPOS* indicates the horizontal position of the object.

■ *VPOS* indicates the vertical position of the object.

■ *VSIZ* indicate the number of stamps.

■ *PAL* indicates the palette number for colors.

■ *PRI* indicates priority.

Simultaneously press the left and right Start/Fire buttons to return to the self-test menu screen.
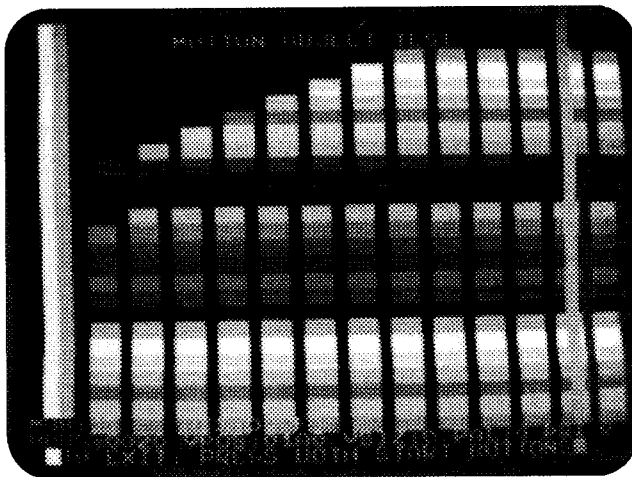

Figure 2-8 Motion Object Test Screen

Motion Object Picture Test

The motion object picture test checks the information in the EPROMs in the game and is shown in Figure 2-9. Press the right Fire/Start button to see the next picture and press the left Fire/Start button to see the previous picture. To change the palette, press a pedal.

Table 2-7 Motion Object Picture Test Error Locations

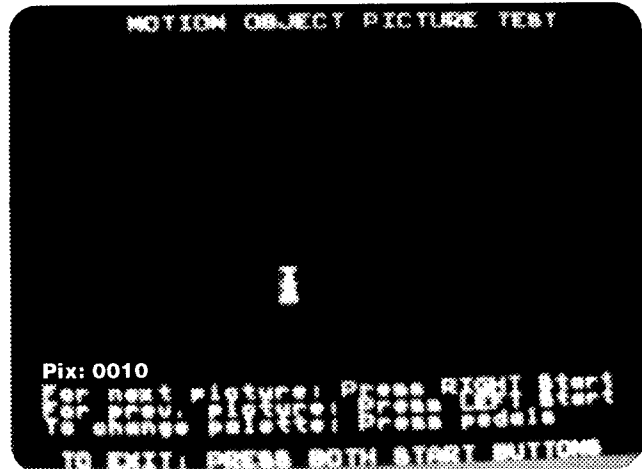| Picture Number	EPROM Location on Game PCB
0-3FF	14R
400-7FF	10R
800-BFF	14T

Figure 2-9 Motion Object Picture Test Screen

View the pictures, and if you think there are errors (other than unusual colors) check the EPROMs as shown in Table 2-7.

Simultaneously press the left and right Start/Fire buttons to return to the self-test menu screen.

Playfield and Convergence Pattern Test

The first playfield and convergence pattern screen is shown in Figure 2-10. This test indicates the condition of the display size, centering, linearity, and convergence. The grid pattern should be white.

Press the right player Start/Fire button and the grid pattern changes to violet. Pressing the right player Start/Fire button again should cause the grid pattern to turn green. Check the grid pattern for the following characteristics (the violet and white patterns are used
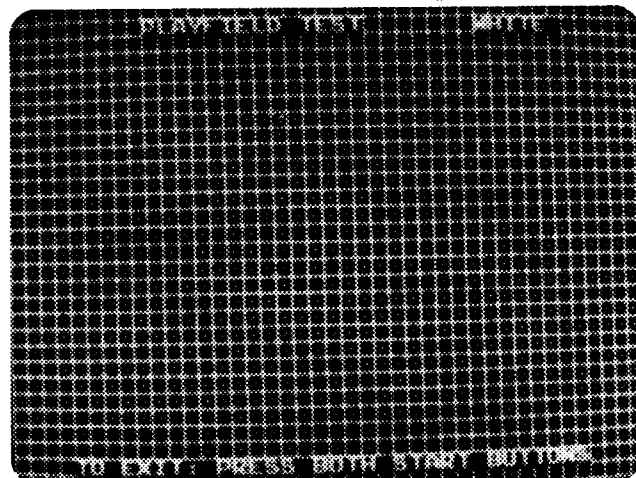

Figure 2-10 Playfield and Convergence Pattern Test Screen

to adjust the display convergence):

■ Grid lines should show no pincushioning or barreling, and the lines should be straight within 3.0 mm.

■ Violet and white pattern convergence should be within 2.0 mm.

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

If you press the left player Start/Fire button you will see a variety of patterns.

Simultaneously press the left and right Start/Fire buttons to return to the self-test menu screen.

Color Bars and Color Purity Test

The color bars and color purity test screen is shown in Figure 2-11. This test indicates the condition of the display color circuits.
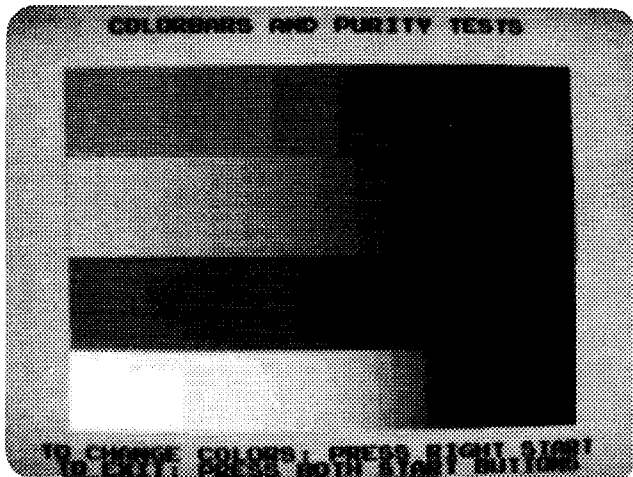

Figure 2-11 Color Bars Test Screen

The screen should show, from top to bottom, a row of red, a row of green, a row of blue and a row of grey, each with 32 vertical bars. The brightest bars should be on the left and darkest (black) on the right, with a grey frame around the screen. If the display characteristics are not correct, refer to the video display manual for the color-gun adjustment procedure or to determine the possible cause of failure.

If you press the right player Start/Fire button, you will see a screen with color bars of yellow, cyan, magenta, and grey.

Press the right player Start/Fire button again to see the color purity screens of red, green, blue, white and

grey. These screens show the adjustment of the color purity of the video display. Each screen should display a rectangle of color, with no curving at the corners, no unevenness of color, and no lines in the display.

If the screens are not correct, adjust the video display as described in the video display manual.

Simultaneously press the left and right Start/Fire buttons to return to the self-test menu screen.

Sound Test

The sound test screen is shown in Figure 2-12. This test indicates the condition of the coin mechanisms and the music and sound-effects circuits.
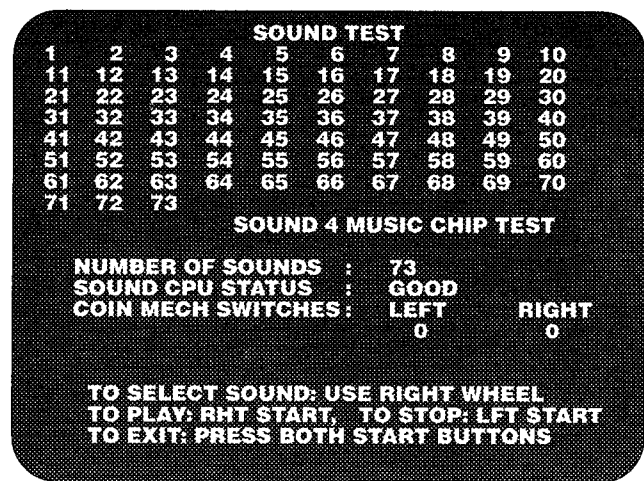

Figure 2-12 Sound Test Screen

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

■ *1,2,3,4, etc.* are the numbers assigned to each sound. Choose a sound by turning the right wheel Some sounds numbers cannot be selected.

To hear the sound, press the left player right Start/Fire button one or more times. Press the left player Start/Fire button to silence the sound.

■ *4 Music Chip Test* consists of eight tones in a major scale that alternate between sound channels (16 tones in all).

■ *Number of Sounds* indicate the number of sounds used in the Badlands game.

Table 2-8 Faulty Sound RAM and ROM Locations

Error Message	Location on Game PCB or Cause
Music Chip Time Out	9D
Sound CPU Interrupt Error	14E, 17J
Sound CPU RAM 1 Error	9B
Sound CPU ROM 1 Error	9C If the message appears when you enter the test, then sound processor cannot run further. Press both Start/Fire buttons to return to the Self-Test menu.
Communications Error #1	Counts the number of errors caused by audio part of the game PCB.
Sound Processor Not Responding	A major problem with the audio section of the game PCB.

■ *Sound CPU Status* indicates the condition of the sound microprocessor. If the sound microprocessor is good, the word *GOOD* should appear. If the sound microprocessor or associated circuitry is faulty, a number will appear (to indicate sound status) as well as an error message. See Table 2-7 for the error messages and faulty sound RAM and ROM locations.
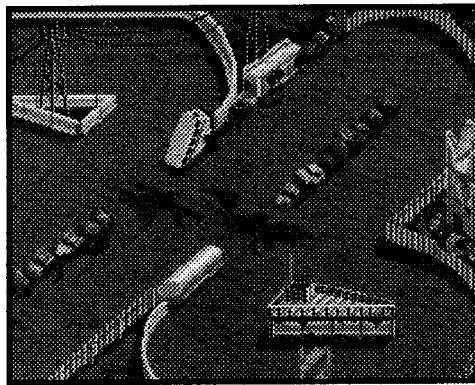
■ *Coin Mech Switches* shows the condition of the left and right coin mechanisms. The zeroes underneath *left* and *right* correspond to the left and right coin mechanisms. The zero should change to one when the coin switch is held down, and change back to zero when it is released.

Simultaneously press the left and right Start/Fire buttons to return to the self-test menu screen.

Chapter 3

Troubleshooting and Maintenance

This chapter contains regular maintenance information, troubleshooting tables, and repair procedures for your Badlands game. The chapter has two parts. The first part contains three troubleshooting tables. The first table has general troubleshooting information, the second contains the voltage levels and test points on the PCBs, and the last table is of ROM-caused problems with specific ROMs to check and replace. The last part of the chapter has information about connecting the video display to the Badlands kit and repair information for the steering assembly and the pedal assembly. If a part is mentioned, but not illustrated, see Chapter 4, *Illustrated Parts Lists*, for information.

Table 3-1 Troubleshooting Table

Problem	Suggested Action
Coin Mechanism Problems	1. Test the coin mechanisms with the sound test screen in the self-test. 2. Is the voltage to the + side of the mechanism correct? 3. Is the harness to the coin mechanism connected properly and in good condition?
Game Play Problems	1. Perform the self-test. 2. Are the harness and connectors good? Are the connectors firmly plugged in? 3. Are the voltage levels on the PCB correct? See Table 3-2, *Voltage Inputs and Test Points.* 4. If you think you have a ROM problem, check Table 3-3, *What ROM Problems Look Like.*
Steering Problems Wheel sticks or binds.	1. The steering assembly may be bolted too tightly to the control panel. The nuts should not be tighter than 40 inch-pounds. Loosen the nuts slightly that hold the assembly on the control panel. 2. If you have replaced the steering PCB, does the encoder wheel on the shaft fit between the sensors on the PCB?
Wheel turns, but there is no response on the screen.	1. Is the steering harness firmly plugged in at both ends? 2. Does the steering PCB need to be repaired or replaced?
Pedal Problems Pedal sticks.	1. Are there any obstructions? 2. Does the hinge pin need oil ? (This is very unlikely.)
No response on screen when the pedal is pressed.	1. Are the harness connections good? 2. Does the pedal assembly need to be replaced?

Sound Problems	1. Is the speaker volume turned up?
	2. Is the voltage on the JAMMA connector correct?
	3. Is the harness from the PCB to the speaker connected and in good condition?
	4. Is the audio ROM and RAM good?
	   a. Check the ROM and RAM in the self-test on the Sound Test screen. See Table 2-4, *Bad Sound RAM and ROM Locations.*
	   b. Check the ROM at 9C.
	5. Is the the voltage level to the PCB correct? See Table 3-2, *Voltage Inputs and Test Points.*
	6. Does the speaker need to be replaced?

Erratic sound	Is the audio ROM at 9C good?
Video Display Problems Sync Problems	Does your display need separate positive sync? See the *Video Display Sync Problems* section in this chapter.

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 solder connections on the line filter and transformer good?
	7. Is the JAMMA connector on the PCB tightly?
	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.) If the level is not correct, check the connectors and the harness.

Table 3-1 Troubleshooting Table, Continued

Problem	Suggested Action
Video Display Problems	
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? See the *Video Display Sync Problems* section in this chapter.
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.

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.
	CR3 LED	Lights when 5 V is applied to the main PCB and the reset (RST) jumper is open.
	CR6 LED	Lights when the +12 V supply is good.
	CR7 LED	Lights when the -5 V supply is good.
-5V	-VOP (pin 11 of any LM324)	Negative supply for the audio analog circuitry from the switching power supply.
+12V	+VOP (pin 4 of any LM324)	Positive supply for the audio analog circuitry from the switching power supply.

Table 3-3 What ROM Problems Look Like

Problem	ROM Causing the Problem	Check the ROM at:
Program works and the playfield looks OK, but the motion objects are wrong.	Motion object	10R, 14R, 14T
Program works, motion objects look OK, but the playfield is wrong.	Playfield	2N, 2S, 2U, 4N, 4S, 4U
Garbage on screen; program doesn't work.	Processor Program ROM	22E 17F, 20F, 24F, 27F
Game program is erratic.	Program ROM	17F, 20F, 24F, 27F
No sound or erratic sound.	Audio ROM	9C

Video Display

Sync Problems

Some video displays cannot use the composite negative sync that is on the JAMMA connector.

If you need separate positive sync the Badlands game PCB includes a standard Atari video connector (located at 14A) that provides separate positive sync. Refer to Table 3-4 and make the appropriate connections for your video display.

Table 3-4 Atari Video Connector Pin Assignments for Separate Positive Sync

Pin	Signal
1	Red
2	GND
3	Key (no connection required)
4	Green
5	GND
6	Blue
7	GND
8	GND
9	Negative composite sync
10	Positive V sync
11	Positive H sync

Horizontal Shifting

If you cannot center the display horizontally as described in your video display manual, you can shift it horizontally by altering the game PCB.

1. Remove the resistor at R98.

2. To shift the display to the right, add a resistor of less than 100 Ω (or a wire) at location R99. To shift the display to the left, add a resistor of less than 100 Ω (or a wire) at location R100.

Steering Assembly

Replacing the Steering Wheel

It is easier to replace the steering wheel if you remove the steering assembly from the control panel.

1. Open the control panel.

2. Unscrew the nuts that hold the steering assembly on the control panel. Remove the reinforcing plate.

3. Take off the connector to the PCB. Remove the steering assembly from the cabinet.

4. The screws that hold the steering wheel on the steering assembly are tightened to 90 inch-pounds, and are difficult to remove. One way to loosen the screws is to put the tamper-proof hex key in a vise, put the screw head into the key, and turn the steer-ing wheel until the screw is loosened. Loosen and remove all the screws.

5. Replace the steering wheel. Replace the screws. Tighten to 90 inch-pounds.

6. Install the steering assembly on the control panel.
   . Install the nuts on the studs. Tighten these nuts to 40 inch-pounds maximum. If you tighten the nuts too much, you can damage the steering assembly and the steering wheel will not turn easily.

Replacing the Steering PCB

The steering wheel assembly is shown in Figure 3-1.

1. Open the control panel.

2. Unscrew the nuts that hold the steering assembly on the control panel. Remove the reinforcing plate.

3. Take off the connector to the PCB. Remove the steering assembly.

4. Remove the two cross-recessed screws that hold the PCB bracket on the steering housing. Remove the bracket and the PCB.

5. Take the old PCB off the bracket. Repair or replace it. (The schematic for the PCB is in Chapter 5 of this manual.) Install the repaired or new PCB on the bracket.

5. Put the PCB and the bracket into the steering housing. Make sure the encoder wheel, inside the housing, fits between the two parts of the sensor on the board and does not scrape against the sensor.

6. Put the screws and the washers into the PCB and attach the PCB to the housing.

7. Install the steering assembly on the control panel. Install the nuts on the studs. Tighten these nuts to 40 inch-pounds maximum. If you tighten the nuts too much, you can damage the steering assembly and the steering wheel will not turn easily.

Pedal Assembly

The only parts of the pedal assembly you can replace separately are the set screws on the hinge (part number 75-4504) and the pedal tread (part number 047518-01). You must purchase the rest of the pedal as an assembly because special techniques are required to assemble it at the factory.
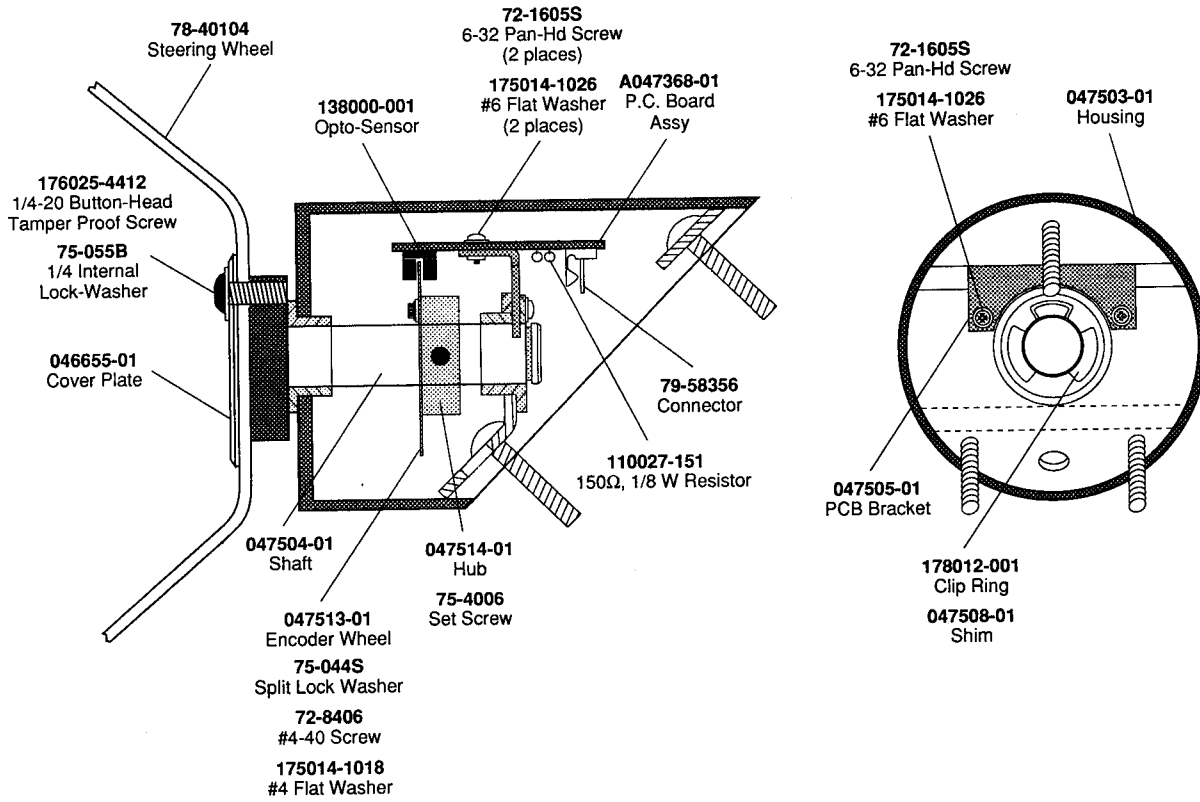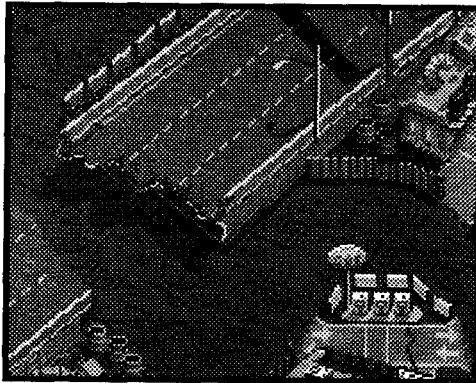
Figure 3-1 Maintaining the Steering Assembly

Chapter 4

Illustrated Parts Lists

This chapter provides information you need to order parts for your game. Common hardware parts, such as screws, nuts, washers, and so on usually are not listed in the parts lists. The parts lists (except for the PCB parts lists) are arranged alphanumerically by Atari part number. All A-prefix numbers, which are assemblies, come first. Next are part numbers with six numbers followed by a hyphen (000598- through 201000-). Ending the list are part numbers with a two-number designation followed by a hyphen (00- through 99-). The PCB parts lists are arranged in alphabetical order by component. Within each section the parts are arranged numerically by part number. When you order parts, give the part number, part name, the number of this manual, and the serial number of your 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.

Table 4-1 Badlands Kit Parts List
A047460-01 C

Part No.	Description	Part No.	Description
A047193-01	Badlands Game PCB Assembly	141026-001	Ferrite Split Bead
A046501-01	JAMMA Harness Assembly	160044-001	Snap-Action Microswitch
A047502-01	Steering Assembly (assembled at the factory with JS Harness Assembly part no. A047138-01)	177010-240	#10-24 Polymer Hex Locknut
		177010-244	#1/4-20 Polymer Hex Locknut
A047507-02	Pedal Assembly. Replaceable Parts:	178032-002	Wire Tie Wrap
75-4504	1/4-20 x 1/4-Inch Long Hex Socket Set Screw	178126-002	5/32 Tamperproof Hex Key
		178237-001	Red Button Assembly
047518-01	Pedal Tread	178237-005	Blue Button Assembly
047461-01	Black Metal Control Panel Cover Plate	178265-001	Nylon PCB Standoff
047512-01	Reinforcing Plate for Steering Assembly	178283-001	Start/Fire Identification Collar
047509-01	Pedal Mounting Bracket	72-6612S	#6-32 x 3/4-Inch Pan-Head Screw
047205-01	Attraction Shield	72-1108F	#10-24 x 1/2-Inch-Long Pan-Head Screw
047464-01	Attraction Film	175014-1040	#10 Flat Washer
047463-01	19" Display Bezel	175014-1050	1/4 Flat Washer
047462-01	Control Panel Decal	75-050	#10 Internal Lock Washer
047106-02	Badlands Poster	75-5116B	#10-24 x 1-Inch-Long Black Carriage Bolt
047106-01	Side Panel Decal	75-5520B	1/4-20 x 1 1/4-Inch-Long Black Carriage Bolt
038158-01	Product I.D. Label		
039450-01	FCC Compliance Label	TM-344	Badlands Universal Kit Installation Manual
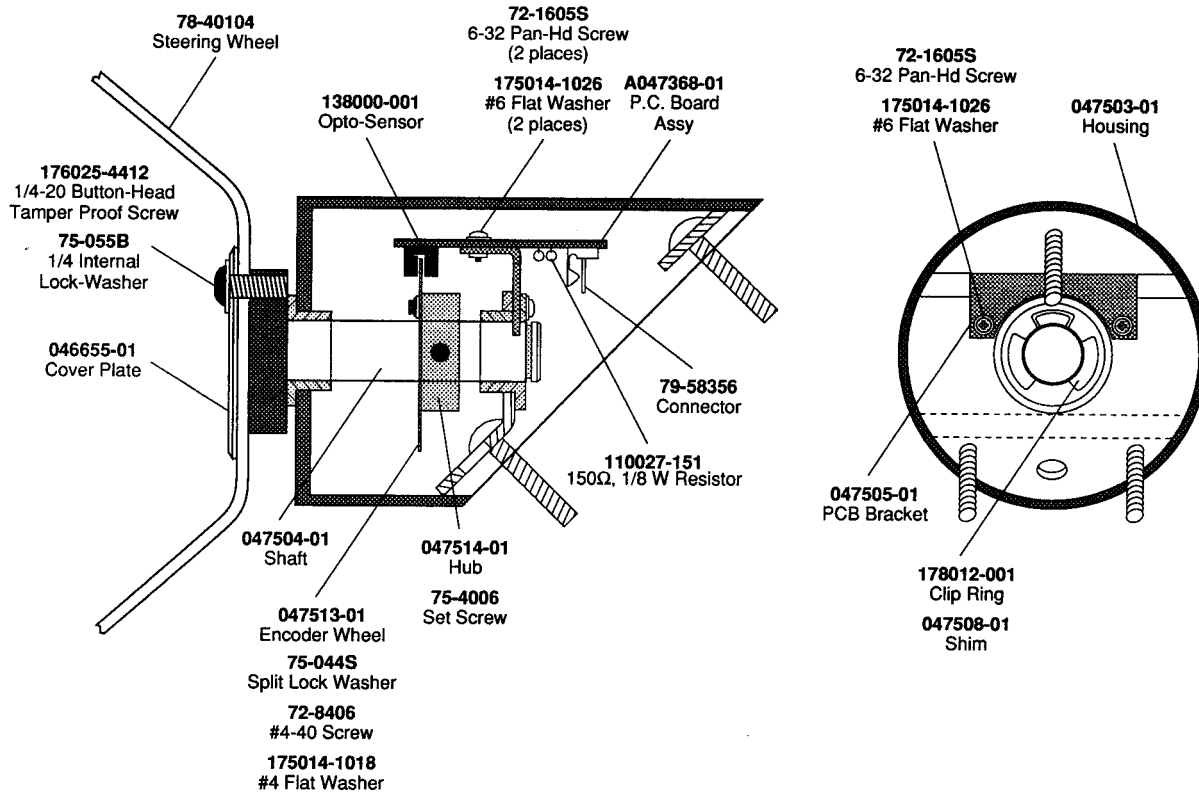
Figure 4-1 Steering Assembly
A047502-01 B

Steering Assembly
Parts List

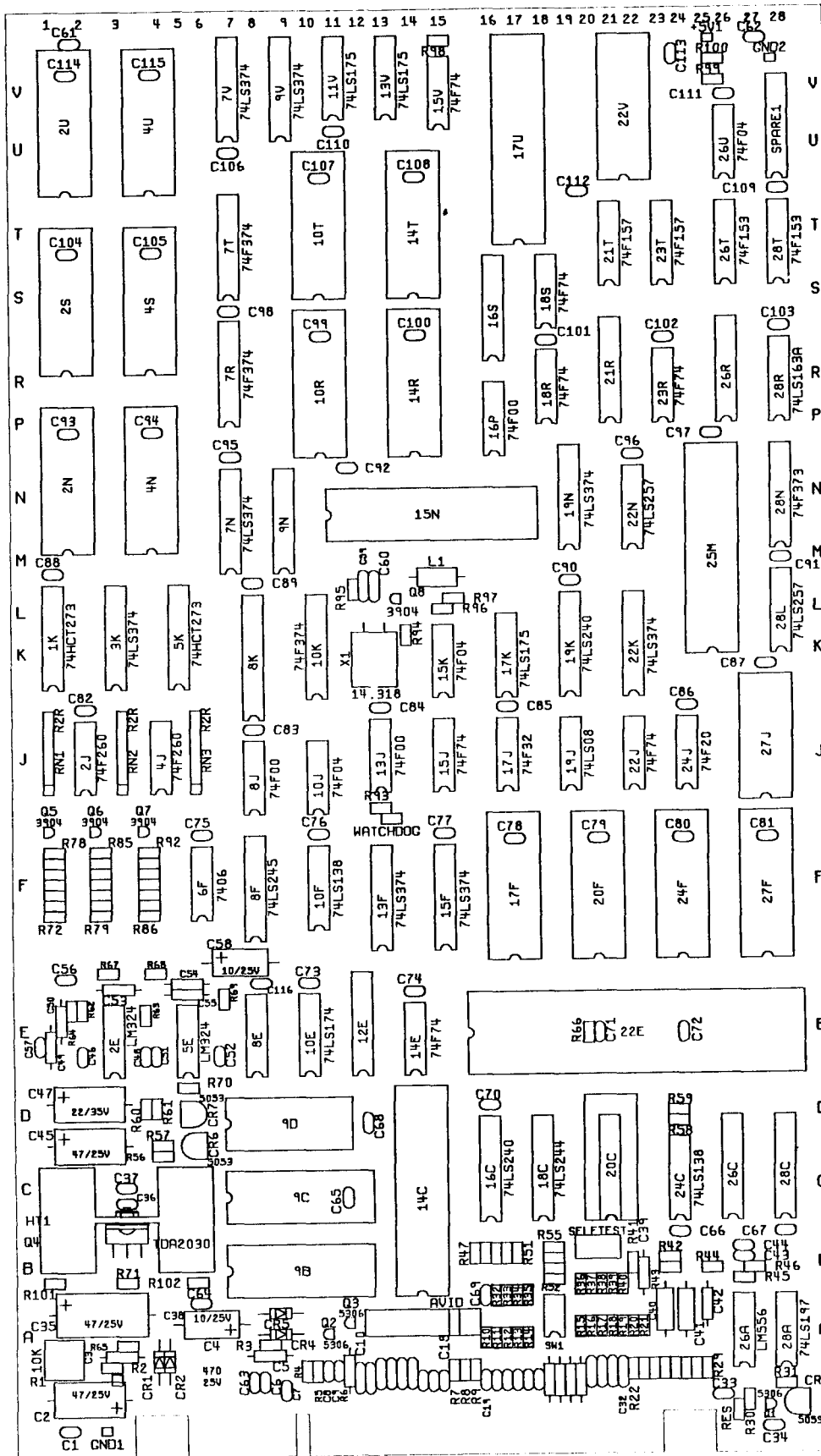| Part No.	Description	Part No.	Description
A047367-01	P.C. Board Assembly. Replaceable Parts:	176025-4412	1/4-20 x 3/4-Inch-Long Tamper-Proof
110027-151	150Ω, 1/8 W Resistor		Button-Head Screw
138000-001	Opto-Sensor	178012-001	3/4-Inch Diameter Klip Ring
79-58356	Connector	72-1605S	#6-32 x 5/16-Inch-Long Pan-Head Screw
		72-8406	#4-40 x 3/8-Inch-Long Cap Screw
046655-01	Cover Plate		
047503-01	Steering Housing	175014-1018	#4 Flat Washer
047504-01	Steering Shaft	175014-1026	#6 Flat Washer
047505-01	Steering Bracket	75-044S	#4 Split Lock Washer
		75-055B	1/4 Black Internal Lock Washer
047508-01	3/4-Inch Shaft Spacer Shim		
047513-01	Encoder Wheel	75-4006	#10-32 x 3/8-Inch-Long Set Screw
047514-01	Encoder Hub	78-40104	Steering Wheel

Figure 4-2 Badlands Game PCB Assembly
A047193-01 C

Badlands Game PCB Assembly
Parts List

Designation	Description	Part No.	Designation	Description	Part No.
Integrated Circuits					
1K	Integrated Circuit, 74HCT273	137655-001	16C	Integrated Circuit, 74LS240	137251-001
2E	Integrated Circuit, LM324	137582-001	16P	Integrated Circuit, 74F00	137327-001
2J	Integrated Circuit, 74F260	137570-001	16S	Integrated Circuit, GAL16V8	136074-1003
2N	Integrated Circuit, OTP, 250 nsec	136074-1013	17F	Integrated Circuit, EPROM, 250 nsec	136074-1009
2S	Integrated Circuit, OTP, 250 nsec	136074-1015	17J	Integrated Circuit, 74F32	137486-001
2U	Integrated Circuit, OTP, 250 nsec	136074-1017	17K	Integrated Circuit, 74LS175	137123-001
3K	Integrated Circuit, 74LS374	137144-001	17U	Integrated Circuit, VMATCH	137552-001
4J	Integrated Circuit, 74F260	137570-001	18C	Integrated Circuit, 74LS244	137038-001
4N	Integrated Circuit, OTP, 250 nsec	136074-1012	18R, 18S	Integrated Circuit, 74F74	137436-001
4S	Integrated Circuit, OTP, 250 nsec	136074-1014	19J	Integrated Circuit, 74LS08	137012-001
4U	Integrated Circuit, OTP, 250 nsec	136074-1016	19K	Integrated Circuit, 74LS240	137251-001
5E	Integrated Circuit, LM324	137582-001	19N	Integrated Circuit, 74LS374	137144-001
5K	Integrated Circuit, 74HCT273	137655-001	20C	Integrated Circuit, LETA	137304-2002
6F	Integrated Circuit, 7406	137052-001	20F	Integrated Circuit, EPROM, 250 nsec	136074-1008
7N	Integrated Circuit, 74LS374	137144-001	21R	Integrated Circuit, GAL16V8	136074-1002
7R, 7T	Integrated Circuit, 74F374	137420-001	21T	Integrated Circuit, 74F157	137494-001
7V	Integrated Circuit, 74LS374	137144-001	22E	Integrated Circuit, 68000, 8 MHz, PLAS	137289-003
8E	Integrated Circuit, YM3012	137402-001			
8F	Integrated Circuit, 74LS245	137134-001	22J	Integrated Circuit, 74F74	137436-001
8J	Integrated Circuit, 74F00	137327-001	22K	Integrated Circuit, 74LS374	137144-001
			22N	Integrated Circuit, 74LS257	137136-001
8K	Integrated Circuit, RAM, 2K x 8, 35 nsec	137534-001			
			22V	Integrated Circuit, RAM, 8KX8, 100 ns	137535-004
9B	Integrated Circuit, RAM, 8K x 8, 120 nsec	137535-005			
			23R	Integrated Circuit, 74F74	137436-001
9C	Integrated Circuit, OTP, 250 nsec	136074-1018	23T	Integrated Circuit, 74F157	137494-001
9D	Integrated Circuit, YM2151	137401-001	24C	Integrated Circuit, 74LS138	137177-001
9N	Integrated Circuit, GAL16V8	136074-1004	24F	Integrated Circuit, EPROM, 250 nsec	136074-1007
9V	Integrated Circuit, 74LS374	137144-001	24J	Integrated Circuit, 74F20	137530-001
10E	Integrated Circuit, 74LS174	137122-001	25M	Integrated Circuit, SOS	137550-001
10F	Integrated Circuit, 74LS138	137177-001	26A	Integrated Circuit, LM556, Dual Timer	137660-001
10J	Integrated Circuit, 74F04	137437-001			
10K	Integrated Circuit, 74F374	137420-001	26C	Integrated Circuit, GAL16V8	136074-1001
10R	Integrated Circuit, OTP, 250 nsec	136074-1011	26R	Integrated Circuit, GAL16V8	136074-2000
11V	Integrated Circuit, 74LS175	137123-001	26T	Integrated Circuit, 74F153	137492-001
			26U	Integrated Circuit, 74F04	137437-001
12E	Integrated Circuit, GAL16V8	136074-1005			
13F	Integrated Circuit, 74LS374	137144-001	27F	Integrated Circuit, EPROM, 250 nsec	136074-1006
13J	Integrated Circuit, 74F00	137327-001	27J	Integrated Circuit, EEPROM, 2816 A, 300 ns	137399-300
13V	Integrated Circuit, 74LS175	137123-001			
			28A	Integrated Circuit, 74LS197	137240-001
14C	Integrated Circuit, 6502 A	137577-001	28L	Integrated Circuit, 74LS257	137136-001
14E	Integrated Circuit, 74F74	137436-001			
14R	Integrated Circuit, OTP, 250 nsec	136074-1010	28N	Integrated Circuit, 74F373	137575-001
14T	Integrated Circuit, OTP, 250 nsec	136074-1019	28R	Integrated Circuit, 74LS163 A	137114-001
			28T	Integrated Circuit, 74F153	137492-001
15F	Integrated Circuit, 74LS374	137144-001	**Capacitors**		
15J	Integrated Circuit, 74F74	137436-001	C2	Capacitor, 47 µF, 25 V, Electrolytic	124009-476
15K	Integrated Circuit, 74F04	137437-001	C3	Capacitor, .1 µF, 50 V, Ceramic	122002-104
15N	Integrated Circuit, LB	137536-001	C4	Capacitor, 470 µF, 25 V, Electrolytic, Radial	123003-477
15V	Integrated Circuit, 74F74	137436-001			

Badlands Game PCB Assembly
Parts List, Continued

Designation	Description	Part No.	Designation	Description	Part No.
C6-C9	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R16-R19	Resistor, 3.3 K Ω, ±5%, 1/8 W	110027-332
C10-C15	Capacitor, 100 pF, 100 V, Ceramic	122016-101	R22-R25	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C16-C24	Capacitor, .1 µF, 50 V, Ceramic	122002-104	♦ R26, R27	Resistor, 24 K Ω, ±5%, 1/8 W	110027-243
C25-C28	Capacitor, .001 µF, ±10%, 50V	122015-102	R30	Resistor, 100 K Ω, ±5%, 1/8 W	110027-104
C29-C32	Capacitor, .01 µF, 50 V, Ceramic	122002-103	R31	Resistor, 220 Ω, ±5%, 1/8 W	110027-221
C33	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R32-R35	Resistor, 1 K Ω, ±5%, 1/8 W	110027-102
C35	Capacitor, 47 µF, 25 V, Electrolytic	124009-476	R37-R41	Resistor, 10 K Ω, ±5%, 1/8 W	110027-103
C36, C37	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R42	Resistor, 1 K Ω, ±5%, 1/8 W	110027-102
C38	Capacitor, 10 µF, 25 V, Electrolytic	124009-106	R43-R45	Resistor, 10 K Ω, ±5%, 1/8 W	110027-103
C39	Capacitor, .001 µF, ±10%, 50V	122015-102	R46-R56	Resistor, 1 K Ω, ±5%, 1/8 W	110027-102
C40, C41	Capacitor, .1 µF, 50 V, Ceramic	122015-104	R57	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C42	Capacitor, .001 µF, ±10%, 50V	122015-102	R58-R60	Resistor, 1 K Ω, ±5%, 1/8 W	110027-102
C43, C44	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R61	Resistor, 5.1 K Ω, ±5%, 1/8 W	110027-512
C45	Capacitor, 47 µF, 25 V, Electrolytic	124009-476	R62	Resistor, 12 K Ω, ±5%, 1/8 W	110027-123
C46	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R63	Resistor, 47 K Ω, ±5%, 1/8 W	110027-473
C47	Capacitor, 22 µF, 35 V, Electrolytic	124000-226	R64	Resistor, 12 K Ω, ±5%, 1/8 W	110027-123
C48	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R65	Resistor, 1.5 K Ω, ±5%, 1/8 W	110027-152
C49	Capacitor, .0022 µF, 50 V, Ceramic	122015-222	R66	Resistor, 1 K Ω, ±5%, 1/8 W	110027-102
C50	Capacitor, .001 µF, ±10%, 50V	122015-102	R67, R68	Resistor, 18 K Ω, ±5%, 1/8 W	110027-183
C51, C52	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R69	Resistor, 560 Ω, ±5%, 1/8 W	110027-561
C53	Capacitor, .22 µF, 50 V, Ceramic	122017-224	R70	Resistor, 470 Ω, ±5%, 1/8 W	110027-471
C54, C55	Capacitor, .001 µF, ±10%, 50V	122015-102	R71	Resistor, 1.5 K Ω, ±5%, 1/8 W	110027-152
C56, C57	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R72	Resistor, 100 Ω, ±5%, 1/8 W	110027-101
C58	Capacitor, 10 µF, 25 V, Electrolytic	124009-106	R74	Resistor, 2.4 K Ω, ±5%, 1/8 W	110027-242
C59, C60	Capacitor, 100 pF, 100 V, Ceramic	122016-101	R75	Resistor, 15 Ω, ±5%, 1/8 W	110027-150
C63-C116	Capacitor, .1 µF, 50 V, Ceramic	122002-104	R77	Resistor, 10 Ω, ±5%, 1/8 W	110027-100
	Diodes		R78	Resistor, 1.5 K Ω, ±5%, 1/8 W	110027-152
CR1, CR2	Diode, 1N4001	131048-001	R81	Resistor, 2.4 K Ω, ±5%, 1/8 W	110027-242
CR3	Diode, MV5053, Light Emitting	131027-002	R82	Resistor, 15 Ω, ±5%, 1/8 W	110027-150
CR4, CR5	Diode, 1N4001	131048-001	R83	Resistor, 1.5 K Ω, ±5%, 1/8 W	110027-152
CR6, CR7	Diode, MV5053, Light Emitting	131027-002	R84	Resistor, 10 Ω, ±5%, 1/8 W	110027-100
	Inductor		R85	Resistor, 100Ω, ±5%, 1/8 W	110027-101
L1	Inductor, 100 µH	141024-001	R86	Resistor, 2.4 K Ω, ±5%, 1/8 W	110027-242
	Transistors		R88	Resistor, 1.5 K Ω, ±5%, 1/8 W	110027-152
Q1-Q3	Transistor, 2N5306	133033-001	R89	Resistor, 15 Ω, ±5%, 1/8 W	110027-150
Q4	Integrated Circuit, TDA2030	137301-001	R91	Resistor, 10 Ω, ±5%, 1/8 W	110027-100
Q5-Q8	Transistor, 2N3904	133041-001	R92	Resistor, 100Ω, ±5%, 1/8 W	110027-101
	Resistors		R93-R95	Resistor, 10 K Ω, ±5%, 1/8 W	110027-103
R1	Potentiometer, 10 K Ω, Vert, with Knob	119020-103	R96, R97	Resistor, 100Ω, ±5%, 1/8 W	110027-101
R2	Resistor, 100Ω, ±5%, 1/8 W	110027-101	R98	Resistor, 10 Ω, ±5%, 1/8 W	110027-100
R3	Resistor, 18 K Ω, ±5%, 1/8 W	110027-183	R101	Resistor, 1.5 K Ω, ±5%, 1/8 W	110027-152
R4, R5	Resistor, 1 K Ω, ±5%, 1/8 W	110027-102	R102	Resistor, 3.3 K Ω, ±5%, 1/8 W	110027-332
R6	Resistor, 0Ω, ±5%, 1/4 W	110005-001	RN1-RN3	Resistor Network, R2R	118016-001
R7-R9	Resistor, 220 Ω, ±5%, 1/8 W	110027-221			
R10-R14	Resistor, 1 K Ω, ±5%, 1/8 W	110027-102			
R15	Resistor, 10 Ω, ±5%, 1/8 W	110027-100			

Badlands Game PCB Assembly
Parts List, Continued

Designation	Description	Part No.	Designation	Description	Part No.
	Miscellaneous			Socket, 28 Pin, .600"	179257-028
	Switch, Slide, SPDT	160040-001		Socket, 16 Pin, .300"	179259-016
X1	Crystal, 14.318	144000-004		Socket, 24 Pin, .300"	179259-024
	Connector, 11 Ckt, Header, .100 Ctr, Key 3	179118-011		Socket, 20 Pin, .300"	179259-020
	Connector, 2 Ckt, Header, .100 Ctr	179048-002		Socket, 40 Pin, .600"	179257-040
				Socket, 64 Pin, .900"	179256-064
	Connector, 2 Ckt, Header, .100 Ctr	179048-002			

Chapter 5

Schematic Diagrams

About this Chapter...

This chapter contains the schematics for your Badlands Universal Kit.™ The Badlands Game PCB schematic has six pages and is shown in ths chapter. (The assembly drawing and parts list for the game PCB are shown in Chapter 4, *Illustrated*
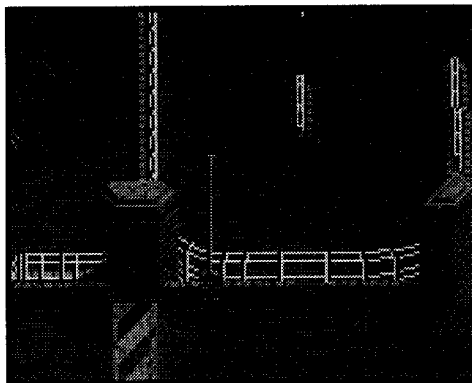
Parts Lists.) The Steering PCB, memory map and the faulty RAM/ROM tables are also shown. The part numbers for the steering PCB are shown in the steering assembly drawing in Chapter 4.

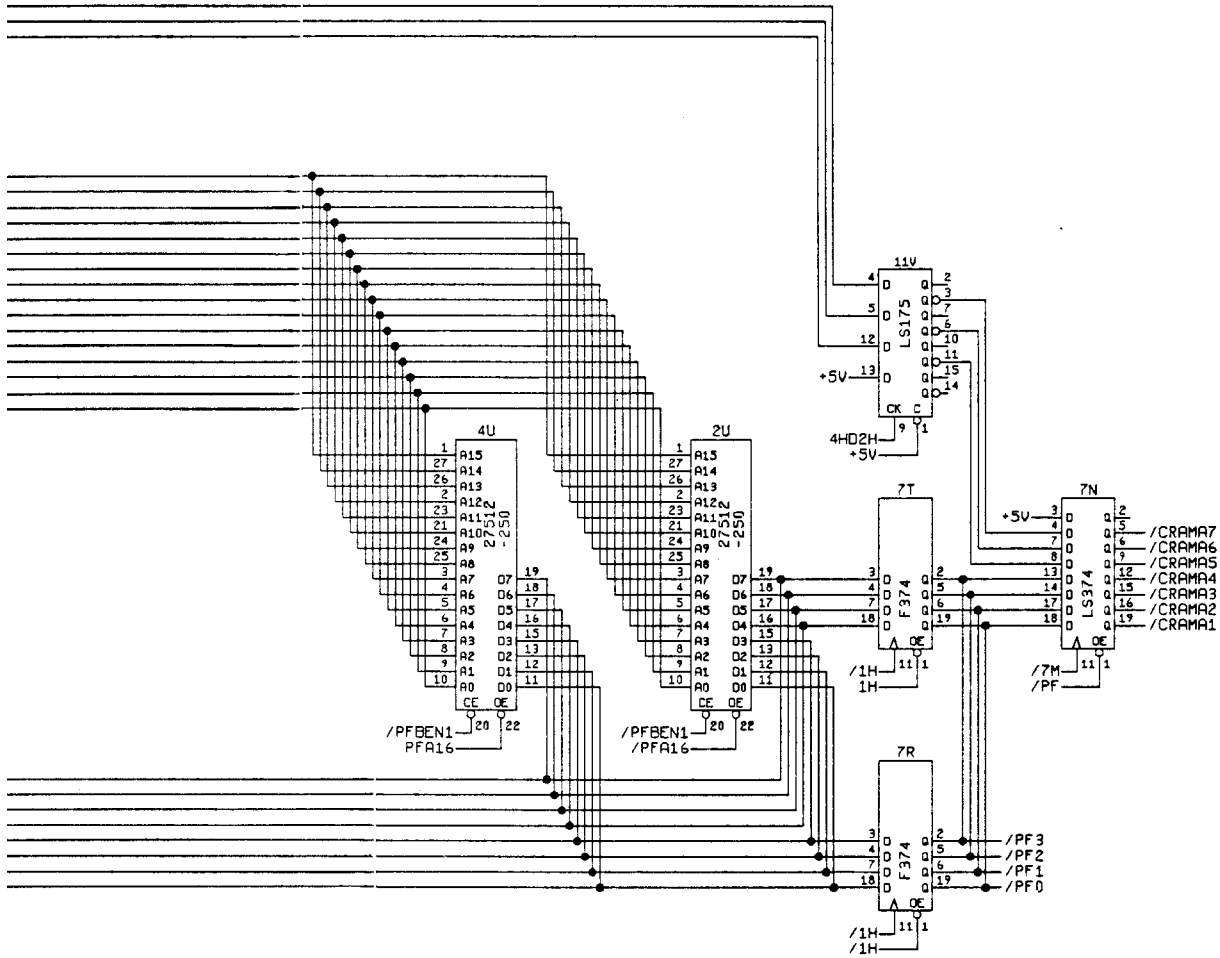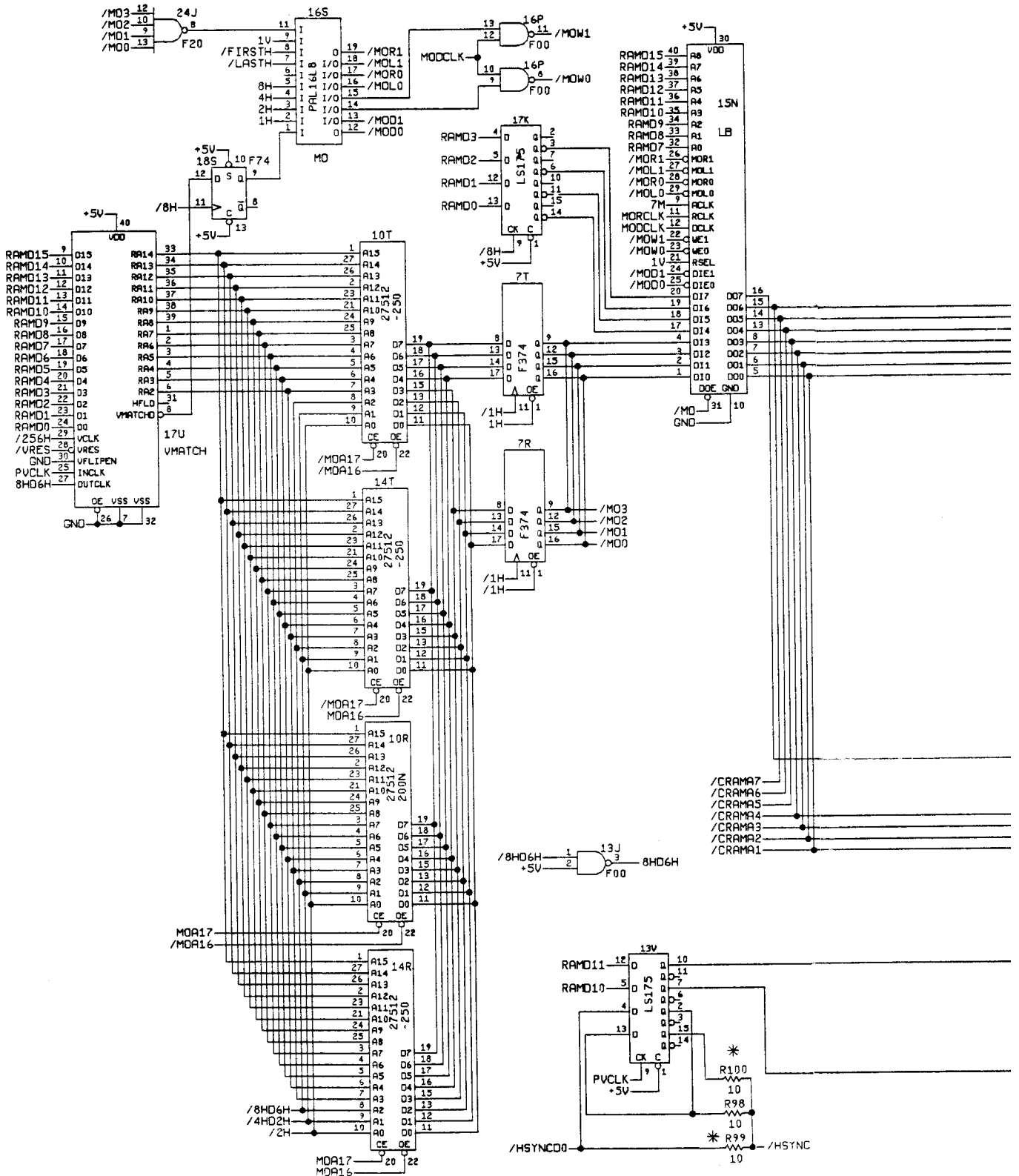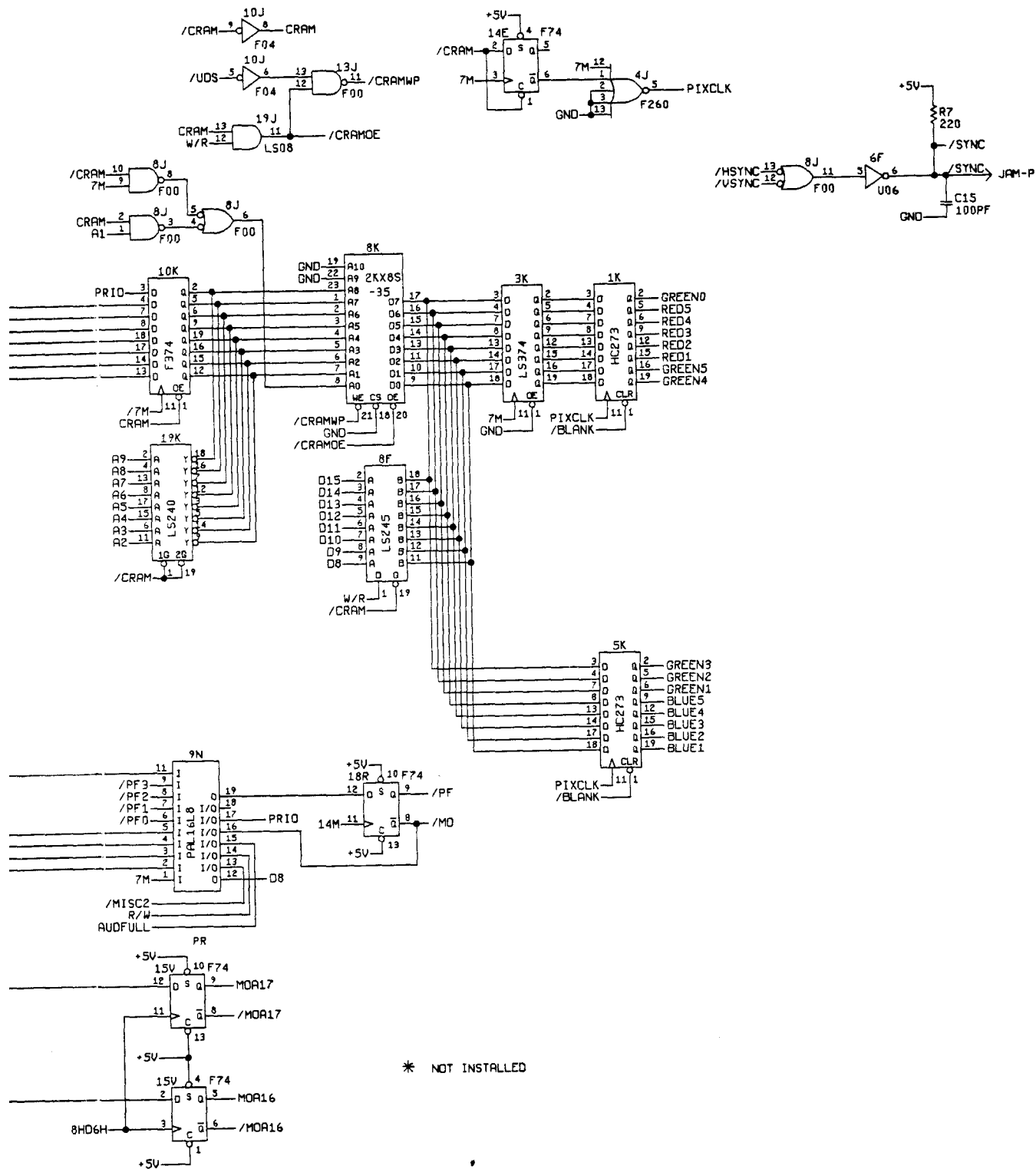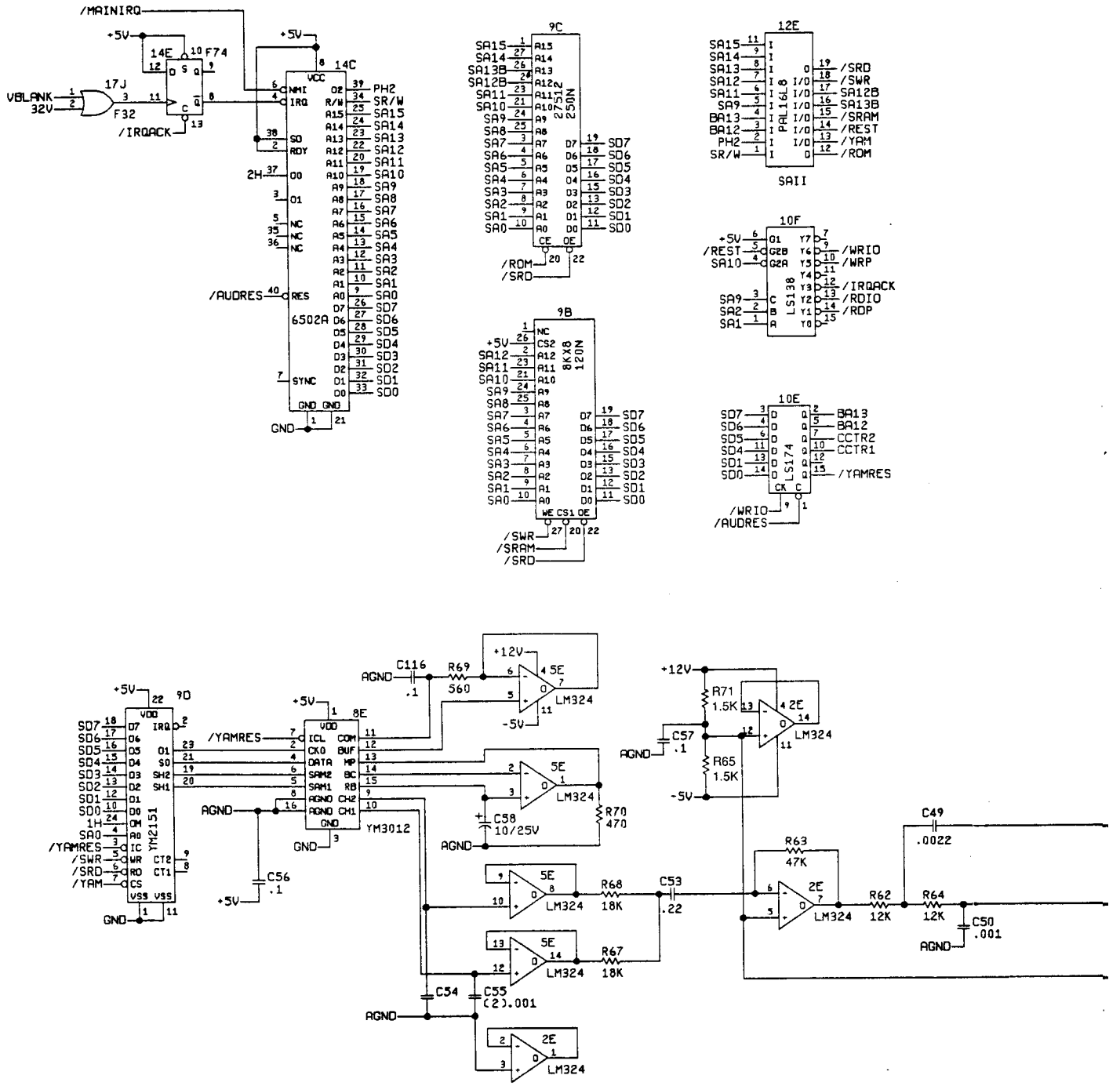The Badlands game does not have an audio PCB.
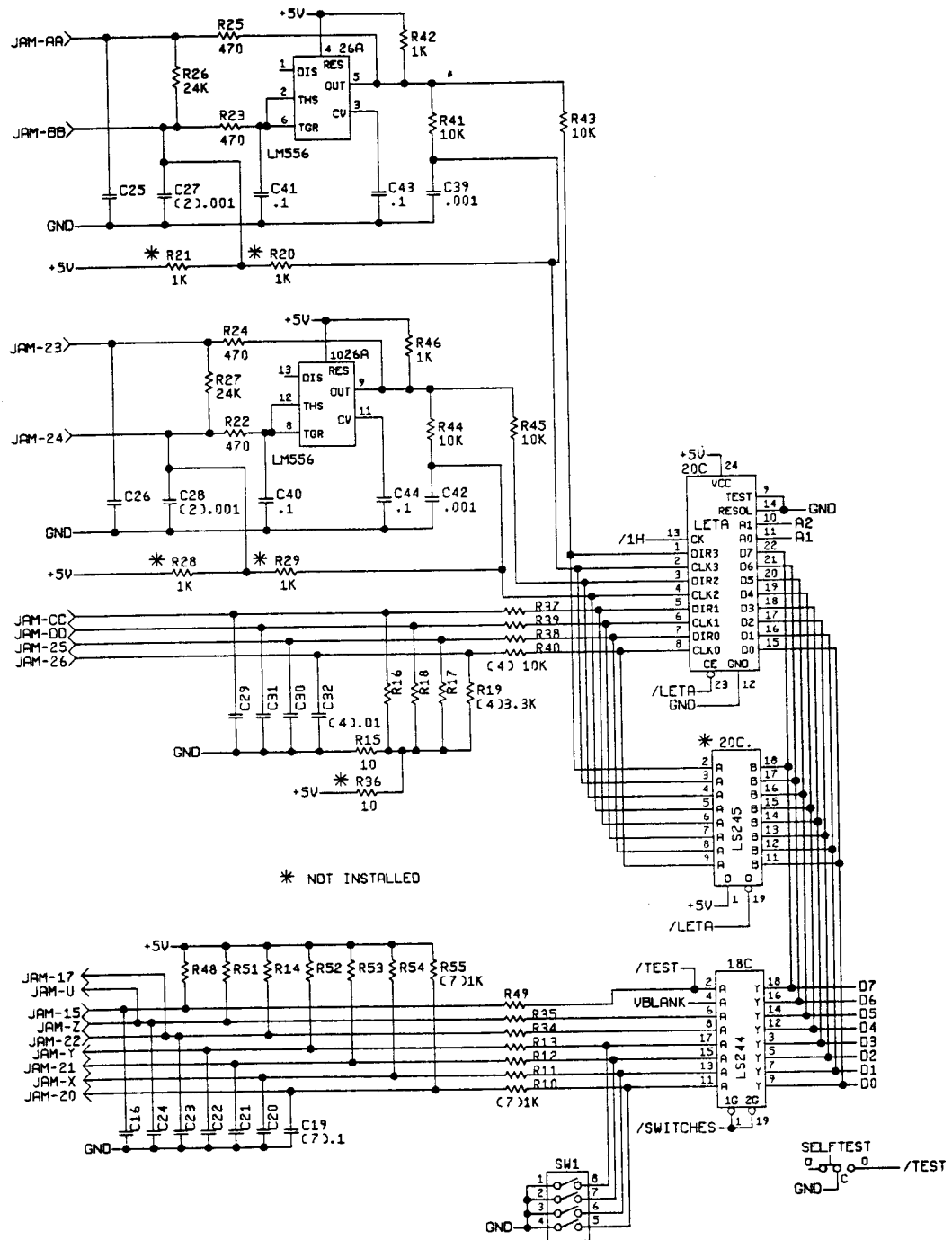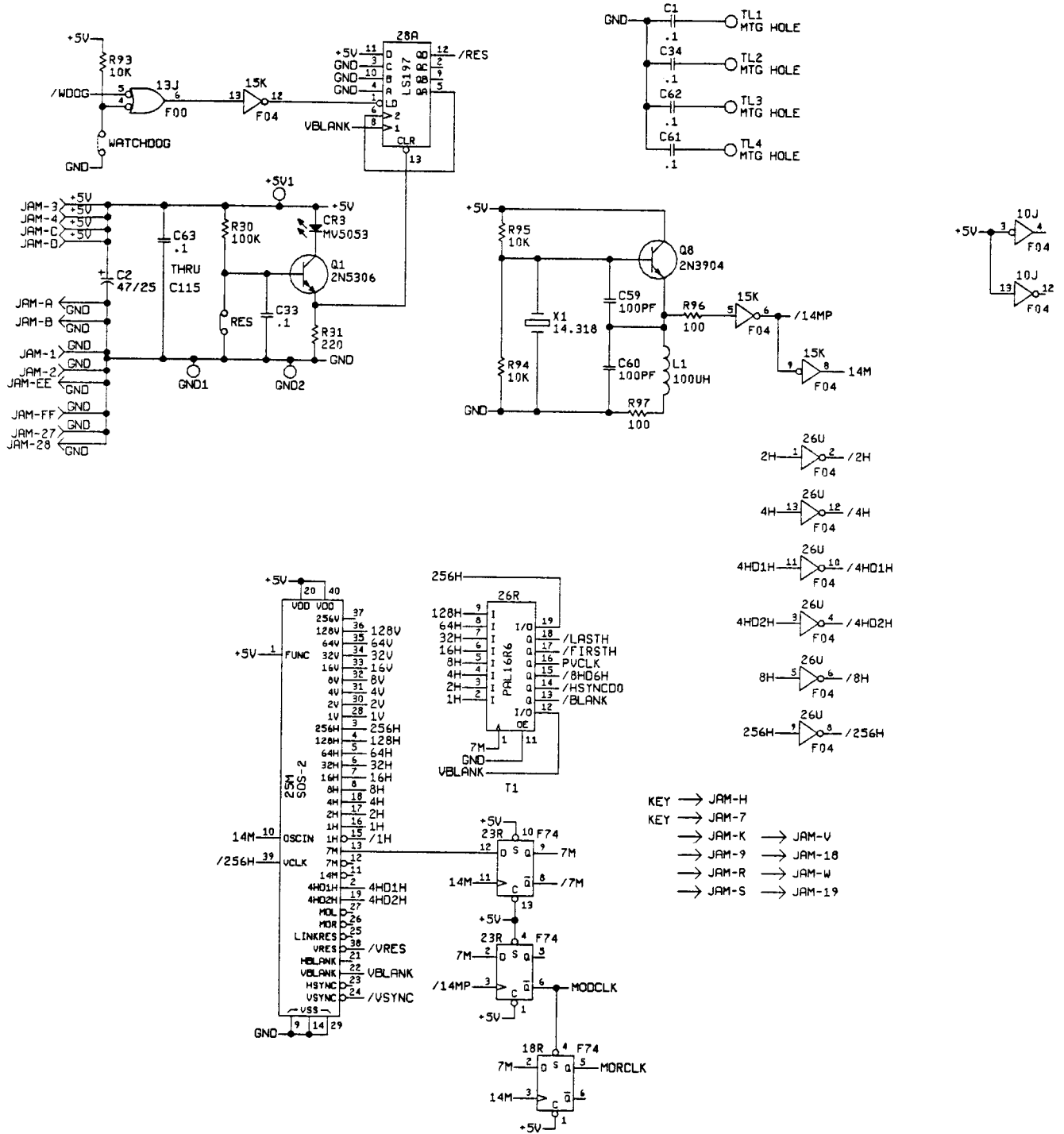
**Figure 5-1 Badlands Game PCB Assembly Schematic Diagram,
Sheet 1 of 6**

047194-01 C
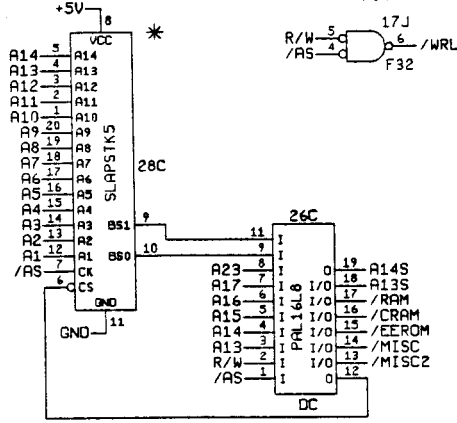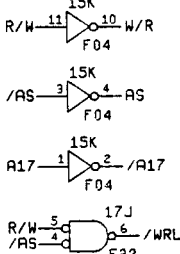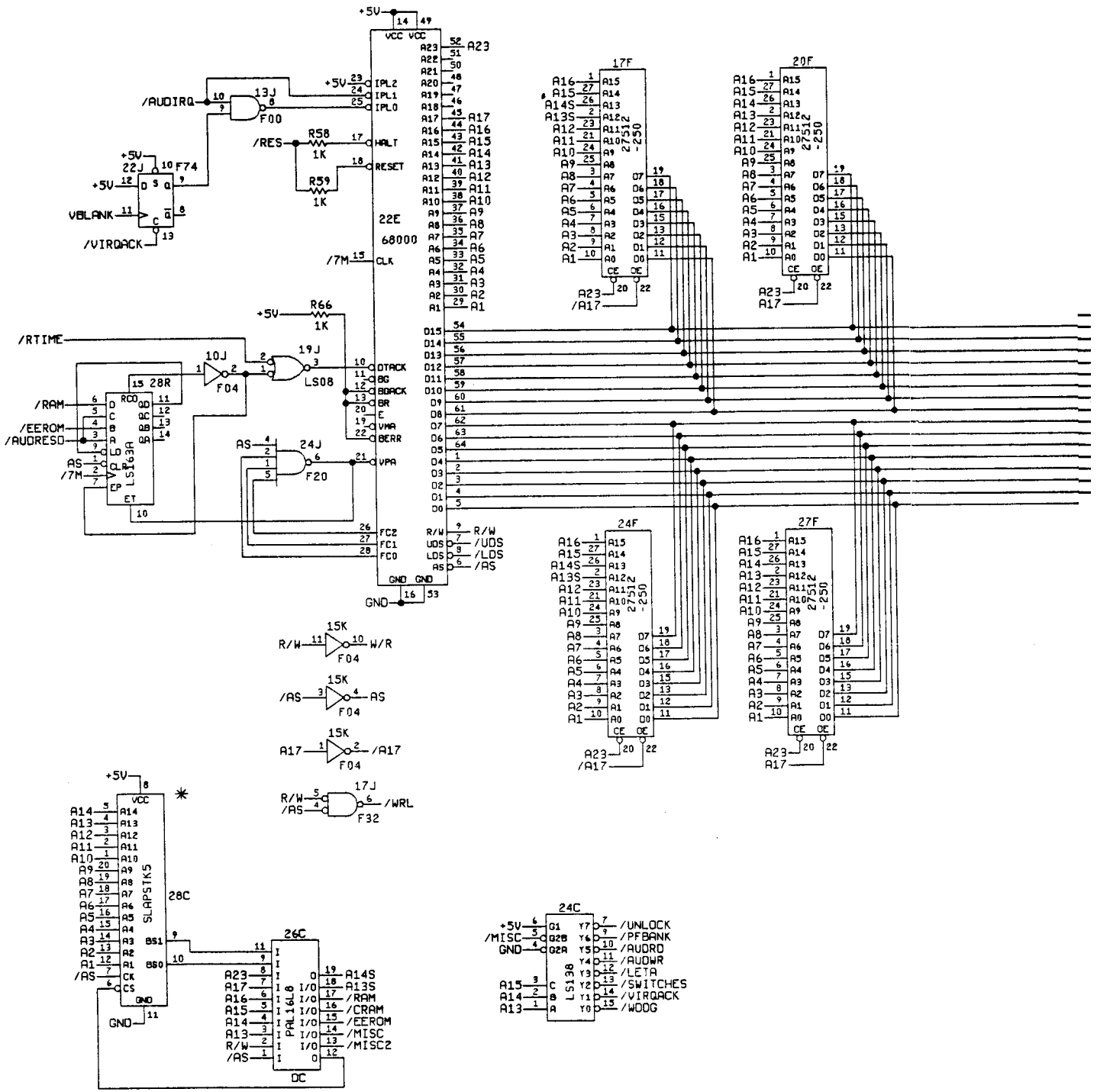
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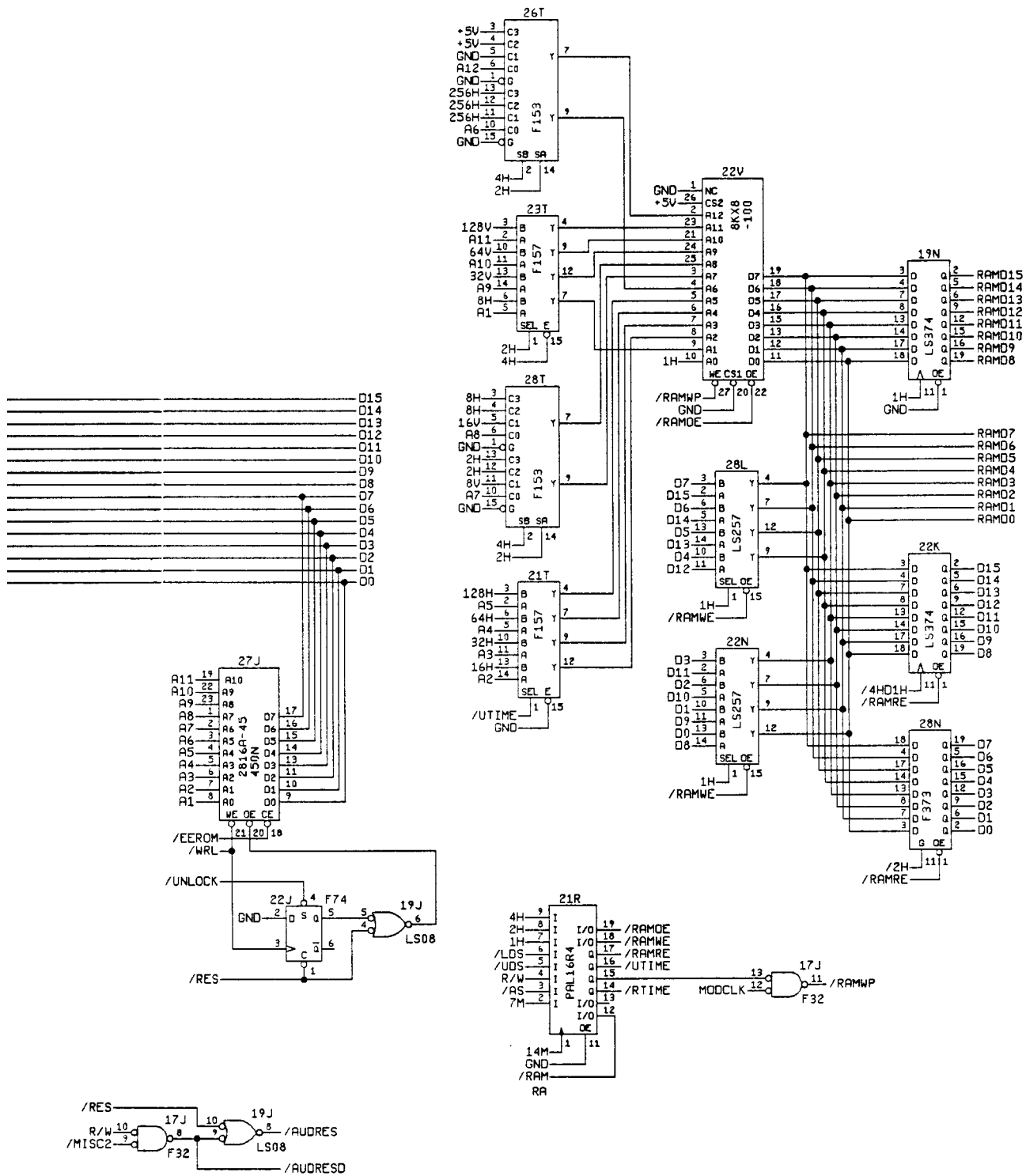
**Figure 5-1 Badlands Game PCB Assembly Schematic Diagram,
Sheet 2 of 6**
047194-01 C
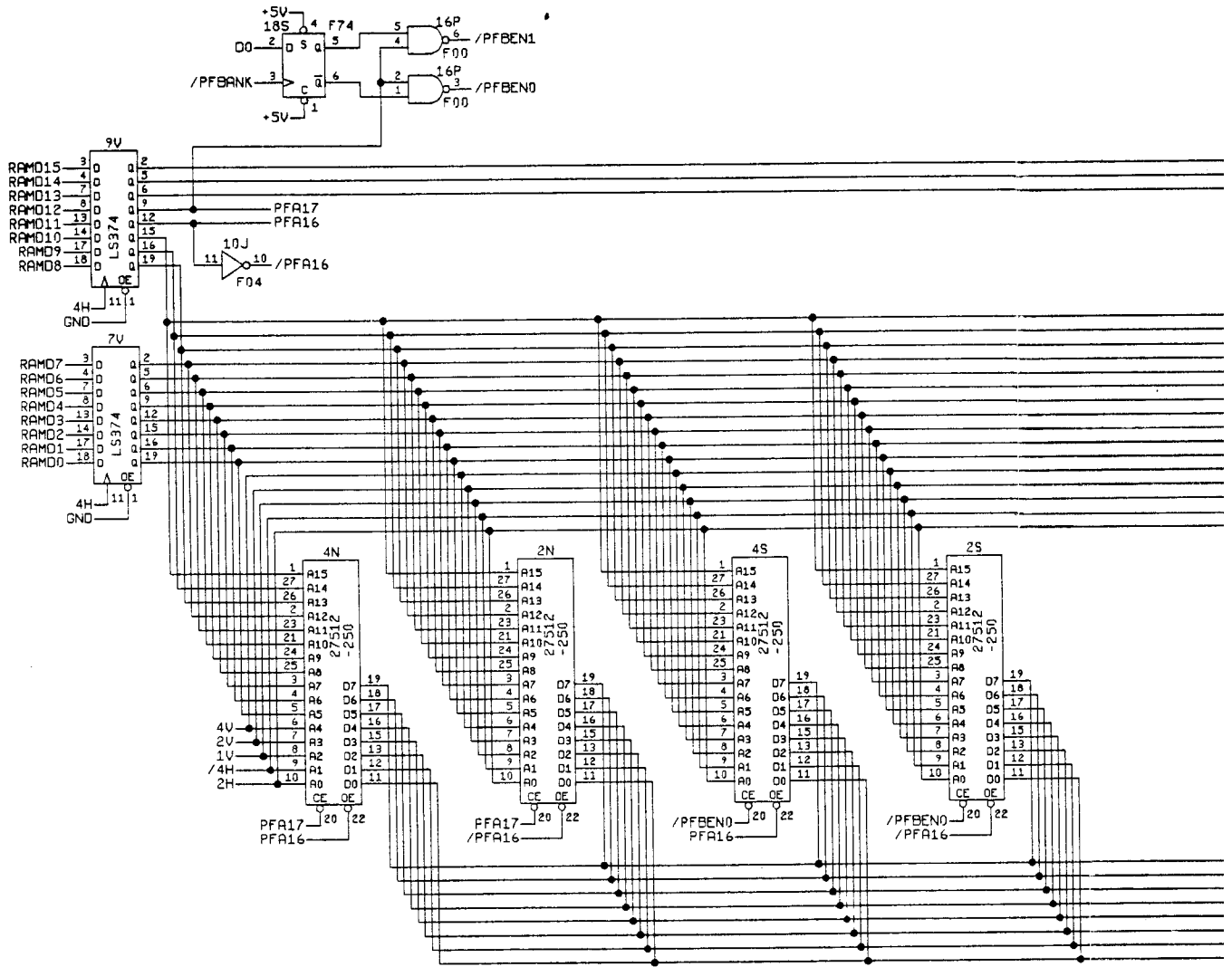
**Figure 5-1 Badlands Game PCB Assembly Schematic Diagram,
Sheet 3 of 6**

047194-01 C

✱   NOT INSTALLED

**Figure 5-1 Badlands Game PCB Assembly Schematic Diagram,
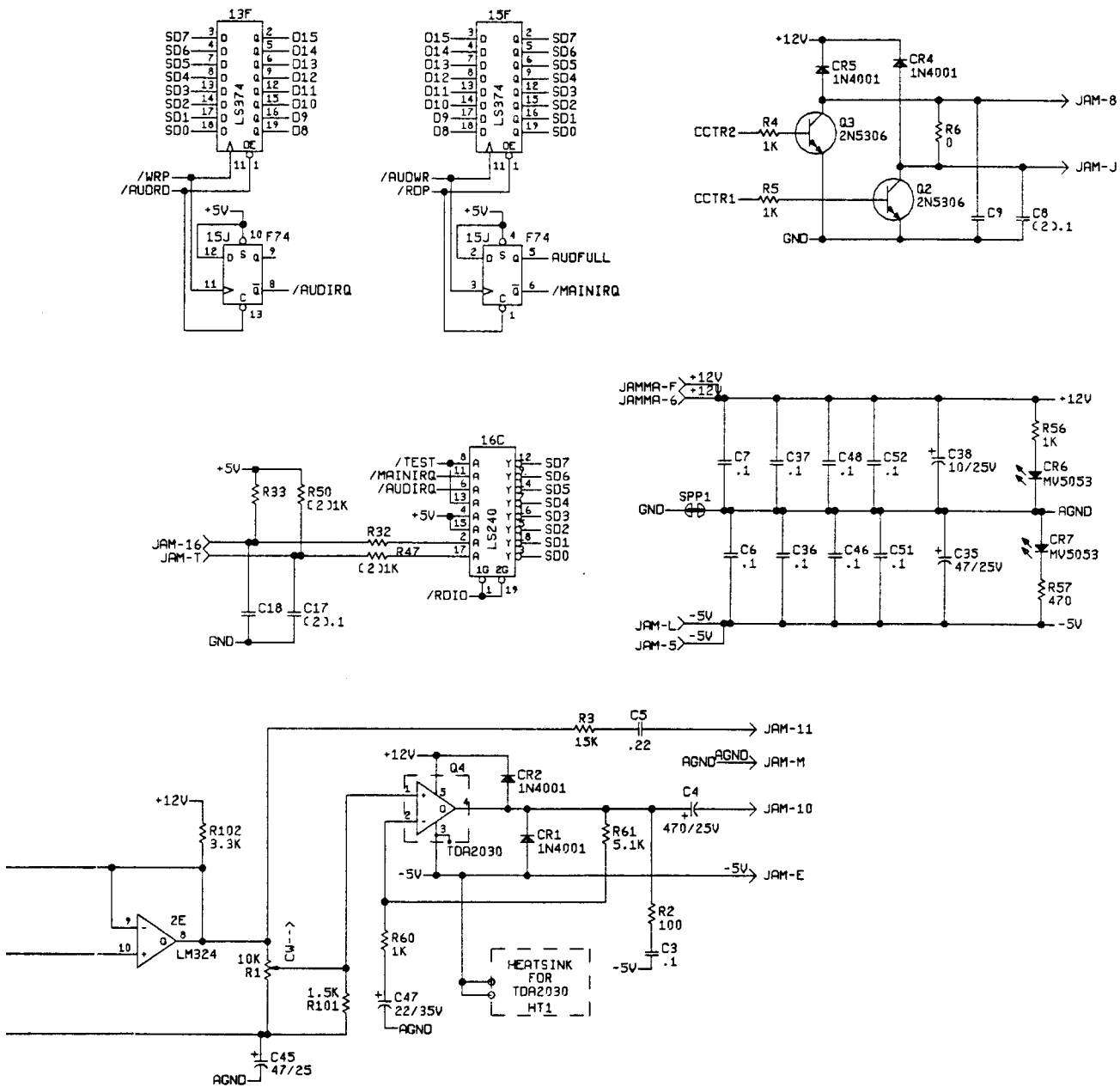Sheet 4 of 6**

047194-01 C

**Figure 5-1 Badlands Game PCB Assembly Schematic Diagram,
Sheet 5 of 6**
047194-01 C

INSTALLED = R73,76,79,80,87, AND 90 = JAMMA LEVELS
INSTALLED = R74,75,81,82,86, AND 89 = ATARI LEVELS
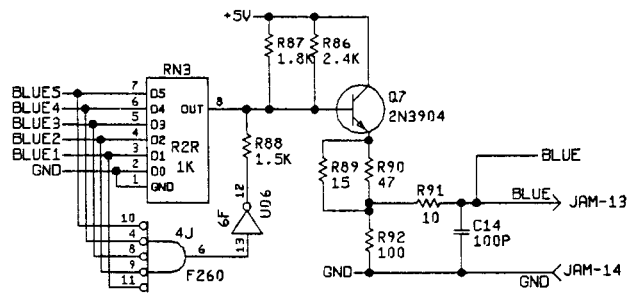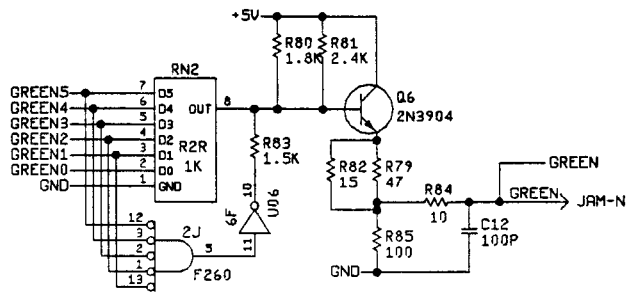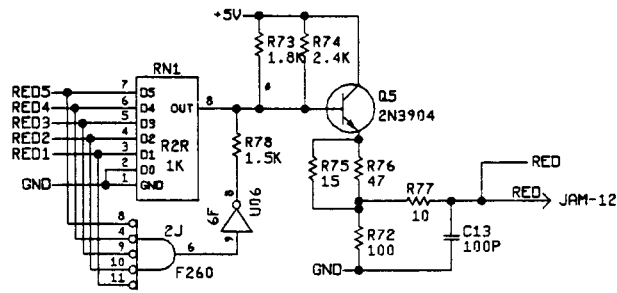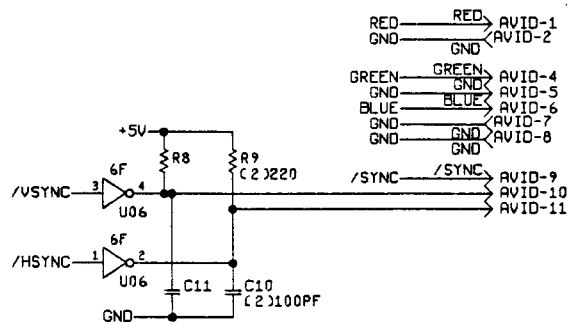* NOT INSTALLED
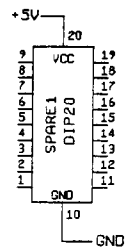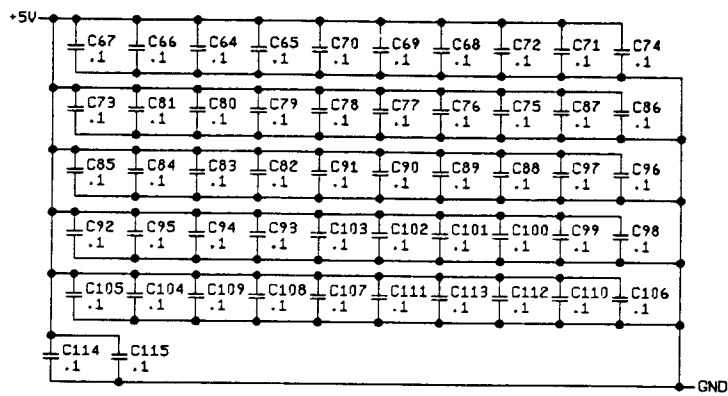
**Figure 5-1 Badlands Game PCB Assembly Schematic Diagram,
Sheet 6 of 6**

047194-01 C
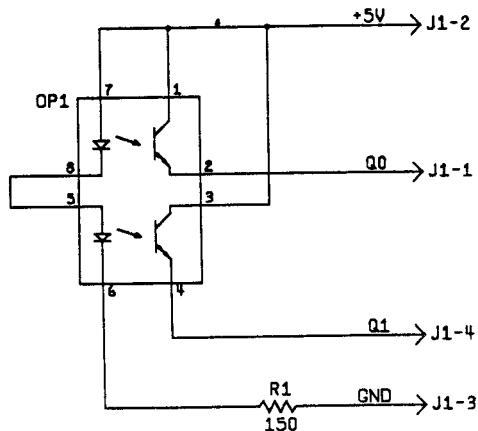
Steering PCB Assembly Schematic Diagram

Faulty RAM Locations

RAM Type	Location	Video Display Characteristic
CPU/Video	22V	Background color is red and foreground is black.
Color RAM	8K	Black and yellow are the main colors.

Faulty Upper or Lower
Main ROM Locations

Error Address	Location on Game PCB	
00000	U=20F	L=27F
20000	U=17F	L=24F

BADLANDS MEMORY MAP

ADDRESS	SIZE	ADDRESS BUS 2222 1111 1111 1100 0000 0000 3210 9876 5432 1098 7654 3210	R/W	DATA BUS 1111 1100 0000 0000 5432 1098 7654 3210	FUNCTION
000000 - 007FFF	16KW	0-- -00 0AAA AAAA AAAA AAAA	R	DDDD DDDD DDDD DDDD	SHORT ABSOLUTE PROGRAM PROM
008000 - 00FFFF	16KW	0-- -00 1BBA AAAA AAAA AAAA	R	DDDD DDDD DDDD DDDD	SLAPSTIC PROGRAM PROM
010000 - 03FFFF	96KW	0-- -AA AAAA AAAA AAAA AAAA	R	DDDD DDDD DDDD DDDD	LONG ABSOLUTE PROGRAM PROM
FC0000		1-- -00 000- --- --- ---	W		AUDIO RESET
FC0000		1-- -00 000- --- --- ---	R	D	AUDIO TRANSFER LATCH FULL
FD0001 - FD0FFF	2KB	1-- -01 000A AAAA AAAA AAAA	R/W	DDDD DDDD	EAROM
FE0001		1-- -10 000- --- --- ---	W		WATCH DOG
FE2001		1-- -10 001- --- --- ---	W		VIDEO IRQ ACKNOWLEDGE
FE4001		1-- -10 010- --- --- ---	R	DDDD DDDD	SWITCHES
				D	SELFTEST (ACTIVE LO)
				D	VBLANK
				D	BUTTON 1 (ACTIVE LO)
				D	BUTTON 2 (ACTIVE LO)
				DDDD	OPTION SWITCHES (ACTIVE LO)
FE6001		1-- -10 011- --- --- -AA-	R	DDDD DDDD	LETA
		00			WHEEL 1
		01			WHEEL 2
		10			PEDAL 1
		11			PEDAL 2
FE8000		1-- -10 100- --- --- ---	W	DDDD DDDD	AUDIO WRITE
FEA000		1-- -10 101- --- --- ---	R	DDDD DDDD	AUDIO READ
FEC001		1-- -10 110- --- --- ---	W	D	PLAYFIELD STAMP BANK
FEE001		1-- -10 111- --- --- ---	W		EAROM UNLOCK
FFC000 - FFC3FE	256W	1-- -11 110- -AA AAAA AAA0	R/W	DDDD DDDD	COLORAM
		0			PLAYFIELD COLORAM
		1			MOTION OBJECTS COLORAM
		A AA			PALETTE
		AA AA			COLOR
		0		DDD DD	RED
		0		DD	GREEN (MSB)
		1		DDD	GREEN (LSB)
		1		D DDDD	BLUE
FFE000 - FFEEFF	2520B	1-- -11 1110 AAAA AAAA AAAA	R/W	DDDD DDDD DDDD DDDD	PLAYFIELD PARAMETER RAM
		RRRR R			ROW ADDRESS
		CCC CCC			COLUMN ADDRESS
				DDD	COLOR PALETTE
				D DDDD DDDD DDDD	STAMP NUMBER
FFF000 - FFF1FF	168B	1-- -11 1111 0000 AAAA AA00	R/W	DDDD DDDD DDDD DDDD	MOTION OBJECTS PARAMETER RAM
		0 0MMM MM			MOP
				DDDD DDDD DDDD	STAMP NUMBER
		0 1MMM MM			MOV
				DDDD DDDD D	VERTICAL POSITION
				DDDD	VERTICAL SIZE
		1 1MMM MM			MOH
				DDDD DDDD D	HORIZONTAL POSITION
				D	VIDEO PRIORITY
				DDD	COLOR PALETTE
FFF000 - FFFFFF	4KB	1-- -11 1111 AAAA AAAA AAAA	R/W	DDDD DDDD DDDD DDDD	PROGRAM RAM

Figure 5-2 Steering PCB Assembly Schematic Diagram, Faulty RAM and ROM Tables and Badlands Memory Map

047368-01 A

Glossary

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

ACTIVE STATE
The true state of a signal. For example: The active state for is low.

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

ANALOG
Measurable in an absolute quantity (as opposed to on or off). Analog devices are volume controls, light dimmers, stereo amplifiers, etc.
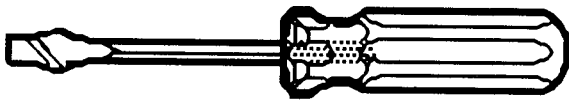
ANODE
The positive (arrow) end of a diode.

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

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

ASTABLE
Having no normal state. An astable device will free-run or oscillate as long as operating voltage is ap-

plied. The oscillation frequency is usually controlled by external circuitry.

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

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

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

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

BIT
A binary digit; expressed as 1 or 0.

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

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

BUFFER
1. An isolating circuit designed to eliminate the reaction of a driven circuit on the circuits driving it (e.g., a buffer amplifier).

2. A device used to supply additional drive capability.

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

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

CATHODE
The negative end of a diode.

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

CLOCK
A repetitive timing signal for synchronizing system functions.

COINCIDENCE
Occurring at the same time.

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

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

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

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

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

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

CRT
Cathode-ray tube.

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

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

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

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

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

DIODE
A semiconductor device that conducts in only one direction.

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

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

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

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

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

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

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

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

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

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

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

I/O
Input/Output.

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

LED
The abbreviation for a light-emitting diode.

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

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

Logic 0, Low = 0 VDC to +0.8 VDC

*Grey Area (Tri-State Level)* =
+0.8 VDC to +2.4 VDC

Logic 1, High = +2.4 VDC to +5 VDC

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

NMI
Non-maskable interrupt. NMI is a request for service by the microprocessor from external logic. The microprocessor cannot ignore this interrupt request.
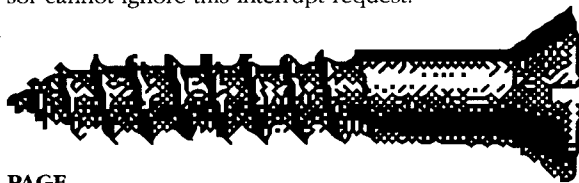
PAGE
A subsection of memory. A read-only memory device (see ROM) is broken into discrete blocks of data. These blocks are called pages. Each block has X number of bytes.

PCB
The abbreviation for a printed-circuit board.

PHOTOTRANSISTOR
A transistor that is activated by an external light source.

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

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

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

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

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

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

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

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

TROUBLESHOOT
The process of locating and repairing a fault.

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

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

X-Y DISPLAY
A display system whereby images are displayed with vectors.

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