Supplement to MILLIPEDE™

Operation, Maintenance, and Service Manual (TM-217, 1st printing) and Schematic Package Supplement (SP-217, 1st printing)

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1. Installation Requirements

Power	150 W
Temperature	0 to 38°C (32 to 100°F)
Humidity	Not over 95% relative
Upright Cabinet	
Space Required	62 x 85 cm (25 ½ x 33 ¾ in.)
Game Height	186 cm (73 in.)
Ireland-Built Cabinet	
Space Required	60 x 68 cm (24 x 27 in.)
Game Height	170 cm (67 in.)

2. Selecting the Voltage Plug

The power supply used in this game operates on the line voltage of almost any country in the world. The power supply comes with either one, two, or three separate voltage-selection plugs. Plug voltages and wire colors are 100 VAC (violet wire color), 120 VAC (yellow wire color), 220 VAC (blue wire color), and 240 VAC (brown wire color).

Before plugging in your game, check your line voltage. Next, check the wire color on the voltage selection plug that is plugged into your power supply. Make sure the voltage selection plug is correct for the voltage of your location (see *Figure 3-16*). Now, plug the game into a grounded 3-wire outlet.

D. Locating the Switches

1. On/Off Switch

The power on/off switch is located on the back of the cabinet on the lower left side (see *Figure 1-2*).

2. Utility Panel Switches

The volume control, self-test switch, coin counter(s), and auxiliary coin switch are located on the utility panel (inside the upper coin door). Refer to *Figure 1-2.* Use the volume control to adjust game audio. Use the self-test switch to place the game in the Self-Test Mode. Use the coin switch to credit the game without activating a coin counter.

3. Option Switches

Option switches are located on the game PCB (see *Figure 1-2*).

- Price options are at PCB location B5.
- Play options are at PCB location D5.
- Special options are at PCB location P8.

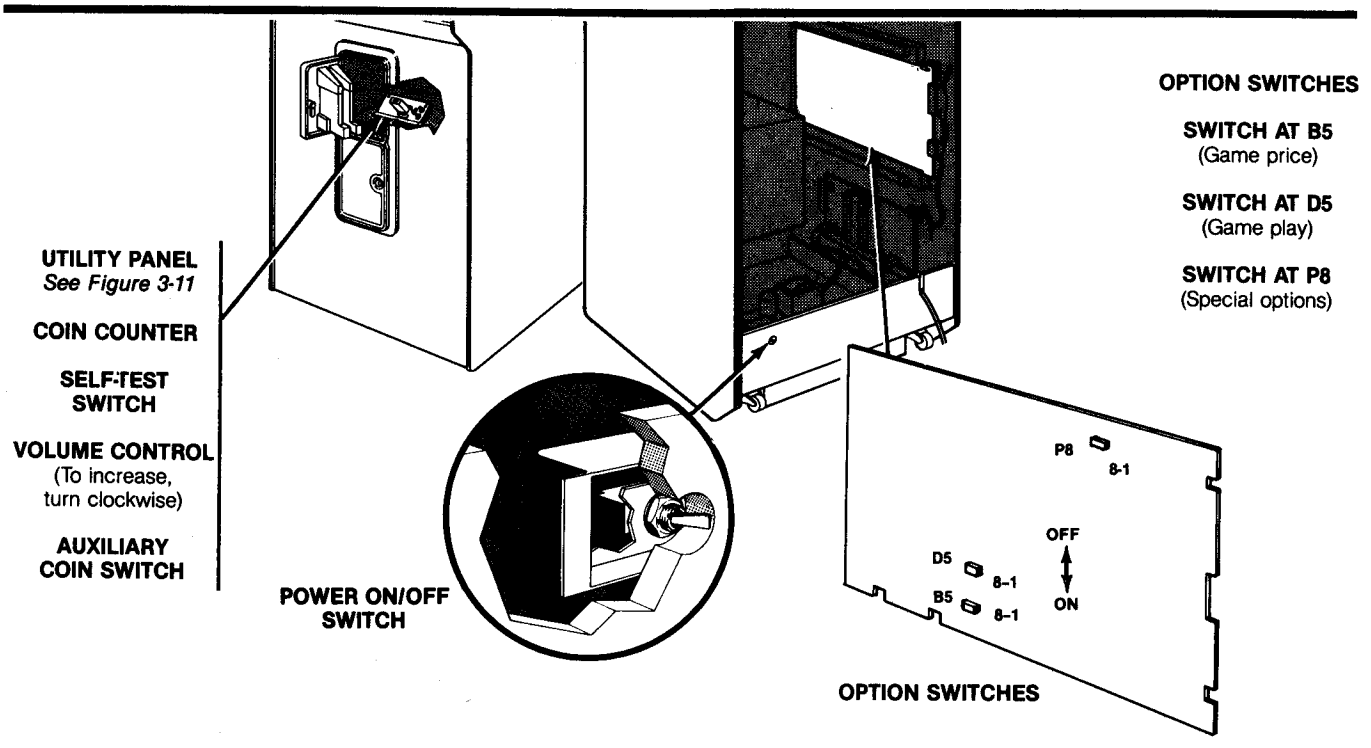


Figure 1-2 Location of Game Switches

E. Setting the Option Switches

Tables 1-1, 1-2, and 1-3 contain settings of the game option switches. Options preset at the factory are shown by the ◄ symbols. However, you may change the settings according to your individual needs.

To verify option switch settings, set the self-test switch to the ***on*** position. Compare the information on the screen to the option switch settings listed in the Table 1, Table 2, and Table 3. Then set the self-test switch to the ***off*** position.

Table 1-1 describes the switch settings for options relating to game price, coin mechanism multipliers, and bonus play. These switches are on the game PCB at location B5.

The *multipliers* (switches 3-5) determine the value of the coin mechanisms to the game's logic. A *coin mechanism* is a device on the inside of the coin door that inspects the coin to determine if the correct coin has been inserted. After this inspection, the mechanism either accepts or rejects the coin. The coin door has two mechanisms.

The basic unit of measurement is a coin worth $.25 or 1 DM, which equals a multiplier of x1. For example, if you have a 2 DM/1 DM coin door, you may want to set the left multiplier at x2 and the right multiplier at x1.

You may offer *bonus play* for certain combinations of coins inserted. For example, with the game set at $.25 per play, players who deposit four successive $.25 coins before pressing the start switch can receive a bonus play. The bonus feature encourages players to insert more money than the minimum $.25 required for one game.

Table 1-1 Switch Settings for Price Options

Settings of 8-Toggle Switch on Millipede™ PCB *(at B5)*								
8	7	6	5	4	3	2	1	Option
On	On					Off	Off	Demonstration Mode
On	Off	On						For every 3 coins inserted, logic adds 1 more coin
On	Off	Off						For every 5 coins inserted, logic adds 1 more coin
Off	On	On						For every 4 coins inserted, logic adds 2 more coins
Off	On	Off						For every 4 coins inserted, logic adds 1 more coin
Off	Off	On						For every 2 coins inserted, logic adds 1 more coin
Off	Off	Off						No Bonus Coins ◄
			Off					Left coin mechanism x 1 ◄
			On					Left coin mechanism x 2
				Off	Off			Right coin mechanism x 1 ◄
				Off	On			Right coin mechanism x 4
				On	Off			Right coin mechanism x 5
				On	On			Right coin mechanism x 6
						On	On	2 coins for 1 credit
						On	Off	1 coin for 1 credit ◄
						Off	On	1 coin for 2 credits
						Off	Off	Free Play

◄*Manufacturer's recommended settings*

Table 1-2 details switch settings for Select Mode, game difficulty, number of lives, and bonus life options. The switches are on the game PCB at location D5.

The Select Mode (switch 8 at location D5 is *off*) allows a player to start a game at an advanced level of play. He receives points for starting play at that level. The maximum level that the player may select will be the bonus level below the last level achieved, up to a maximum of 300,000. For example, if the player scores 46,000 points, and the bonus life setting is at 15,000 (switch 5 is *on* and switch 6 is *off*), his last bonus was at 45,000. Therefore, he may select a starting score of 0, 15,000, or 30,000 points.

In the easy **spider** setting (switch 7 is *off*), the spider moves slowly for the first 10,000 points. In the hard spider setting (switch 7 is *on*) the spider moves slowly for the first 5,000 points. After 5,000 points the spider moves rapidly.

In the easy **beetle** setting (switch 2 is *off*), the beetle moves slowly until 400,000 points, and four beetles appear in each wave after 500,000 points. In the hard beetle setting (switch 2 is *on*), the beetle moves slowly until 300,000 points, and four beetles appear in each wave after 350,000 points.

In the easy **millipede head** setting (switch 1 is *off*), millipede heads enter from the sides of the screen at timed intervals. In the hard millipede head setting (switch 1 is *on*), millipede heads enter from the sides of the screen faster than in the easy setting.

Table 1-2 Switch Settings for Play Options

Settings of 8-Toggle Switch on Millipede™ PCB *(at D5)*								
8	7	6	5	4	3	2	1	Option
Off								Select Mode ◄
On								No Select Mode
	Off							Easy spider ◄
	On							Hard spider
		Off	Off					Bonus life every 12,000 points
		Off	On					Bonus life every 15,000 points ◄
		On	Off					Bonus life every 20,000 points
		On	On					No bonus life
				Off	Off			2 lives per game
				Off	On			3 lives per game ◄
				On	Off			4 lives per game
				On	On			5 lives per game
						Off		Easy beetle ◄
						On		Hard beetle
							Off	Easy millipede head ◄
							On	Hard millipede head

◄*Manufacturer's recommended settings*

Table 1-3 details option settings for coin counters, minimum credits, Select Mode starting scores, and language. The switches are on the game PCB at location P8.

You may choose the Select Mode starting score with switches 3 and 4. Make sure to enable the Select Mode by setting switch 8 at PCB location D5 to is *off*. The starting scores you may choose are 0, the amount of the bonus life setting, or multiples of the bonus. For example, with the bonus life setting at 15,000 points and the Select Mode starting score at 3 x bonus life level, the player may choose a starting score of 0, 15,000, 30,000 and 45,000 points.

Table 1-3 Switch Settings for Special Options

Settings of 8-Toggle Switch on Millipede™ PCB *(at P8)*								
8	7	6	5	4	3	2	1	Option
On								1 coin counter - U.S. only
Off								2 coin counters
	On							1 credit minimum ◄
	Off							2 credit minimum
								Select Mode Starting Score
		Not used	*Not used*	On	On			0 points
				On	Off			0 and bonus life level
				Off	On			0, bonus life level, and 2 x bonus life level ◄
				Off	Off			0, bonus life level, and 2 x bonus life level, and 3 x bonus life level
						On	On	English ◄
						On	Off	German
						Off	On	French
						Off	Off	Spanish

◄*Manufacturer's recommended settings*

F. Performing the Initial Self-Test

This game will test itself and provide data to show that the game's circuitry and controls are operating properly. The data is provided on the video display and speaker. No additional equipment is necessary.

We suggest you perform the self-test procedure when you first set up the game, any time you collect money from the game, when you change game options, or when you suspect game failure.

Wait at least 10 seconds after playing a game before switching to the Self-Test Mode. Otherwise, you may erase the top three scores in the high-score table or distort the statistics. All credits will be cancelled when you switch to self-test.

Refer to *Figure 1-2* to locate the self-test switch and option switches. Set the self-test switch to the *on* position (see *Figure 1-3*) to see the Self-Test Display in the Self-Test Mode. To end the Self-Test Mode, set the self-test switch to the *off* position.

The complete self-test procedure is explained in *Chapter 2, B. Self-Test Procedure*. If a part of the test described in Table 1-4 fails, refer to Chapter 2.

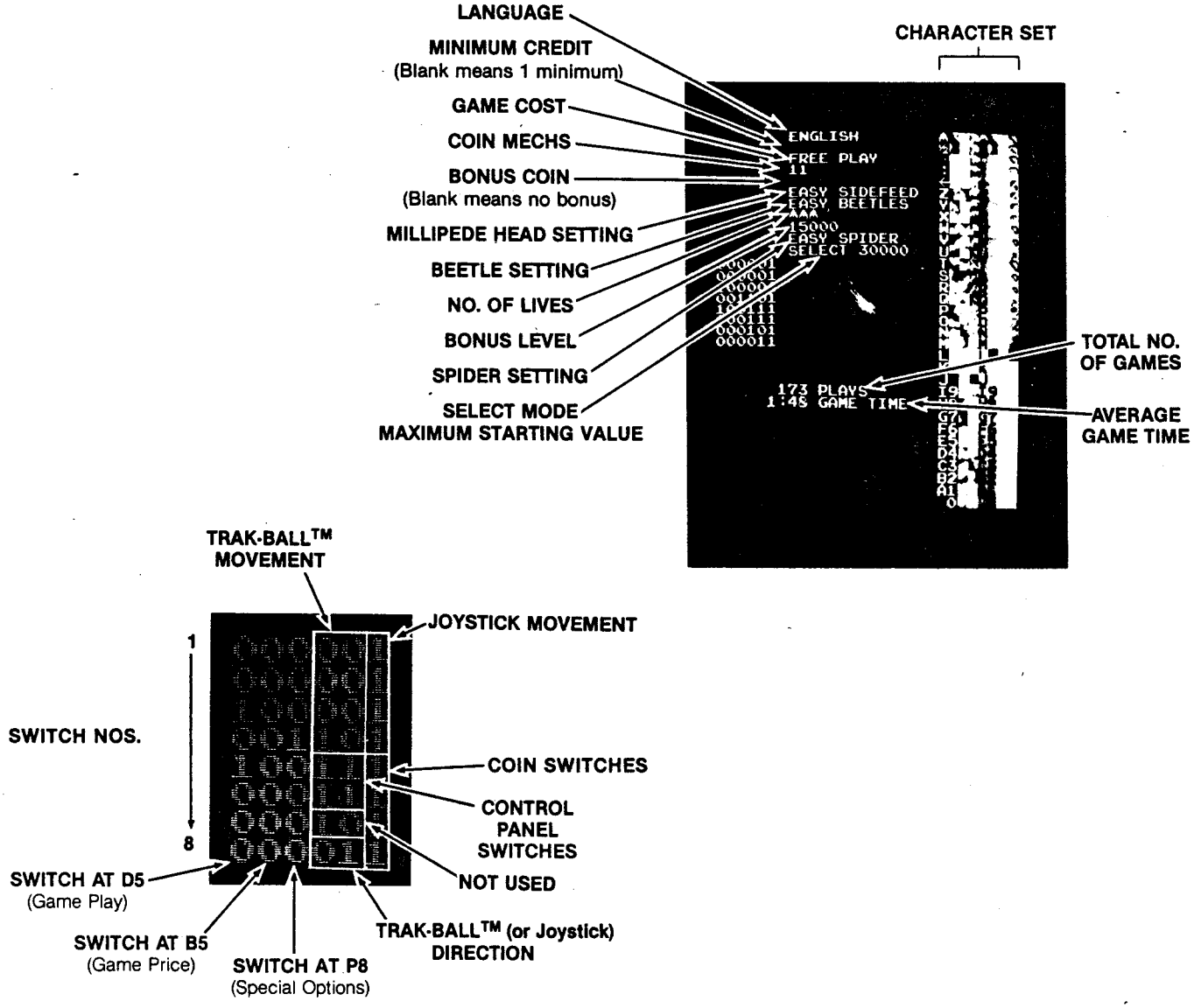


Figure 1-3 Self-Test Display

Table 1-4 Self-Test Procedure

Instruction	Test Passes
1. Set the self-test switch to *on* (see *Figure 1-2*). All credits will be cancelled.	The self-test display appears. RAMs and ROMs are tested. The start LEDs remain on during the test. If the screen is different from the self-test display, or if there are sounds, refer to *Chapter 2, Self-Test Procedure.*
2. Press each control panel and auxiliary coin switches. Insert coins into both coin slots (coins will not be counted on the coin counter).	When you press a switch, the appropriate 1 changes to 0 on the screen and you will hear a high tone. If the test fails refer to *Chapter 2.*
3. Roll the Midi Trak-Ball™	A motion object picture moves around on the screen in directions corresponding to the Midi Trak-Ball™ If the test fails, refer to *Chapter 2.*
4. Press the 1-player start switch at least 64 times.	Each time you press the 1-player start switch, a tone occurs. The motion object changes shape and the background changes color. If test fails refer to *Chapter 2.*
5. Press the 1-player start switch eight times.	You will hear a high tone and the background will change color each time you press the 1-player start switch. If the test fails refer to *Chapter 2.*
6. Observe 16 blocks of color in the character set on right side of the screen.	Each of the 16 blocks should contain a different color. If test fails refer to *Chapter 2.*
7. Press the 2-player start switch and the FIRE switch.	Playfield objects change color with each press of FIRE or 2-player start switch and a tone occurs. If test fails refer to *Chapter 2.*
8. Roll the Midi Trak-Ball™ and press 2-player start switch 16 times.	Each time you roll the Midi Trak Ball™ and press 2-player start switch a motion object is moved from the diagonal group of objects in the center of the screen and placed in a new location on the screen. Test for 16 motion objects in this manner. If test fails refer to *Chapter 2.*
9. To **erase the EAROM** (erases the high-score table and game statistics), simultaneously press both start switches and FIRE.	The message *EA FF* appears in the upper left corner of the screen. The message remains on the self-test screen until the next game is completed and the EAROM is rewritten.
10. To end the test, set the self-test switch to *off.*	

A. Comments on Troubleshooting

When troubleshooting, first determine the symptom(s) of the failure. After determining the symptom, look over the wiring diagram and determine what assemblies could cause the failure. Could it be caused by the power supply, Regulator/Audio II printed-circuit board (PCB), or the video display?

The next step is to check all harness wires and connectors to the suspected assembly. If you find no harness or connector problem, substitute an assembly known to be good for the suspected failing assembly. If the game functions properly, you have successfully isolated the failure. If it doesn't, repeat the procedure with another assembly.

When you have isolated the failing assembly, you must troubleshoot that assembly and make the necessary repairs. If the video display fails, we suggest that a qualified video display technician handle the troubleshooting and repair.

Be sure to refer to *The Book—A Guide to Electronic Game Operation and Servicing*, published by Atari, Inc., whenever you need help with the techniques, tools, and terminology associated with coin-operated electronic games.

To effectively troubleshoot a game PCB, learn as much as you can about the PCB. The diagrams in the *Schematic Package* (included with the game) show the functions of the circuitry. Again, while troubleshooting the PCB, first determine the symptom of the failure, then locate the suspected area on the schematic diagram.

SELF-TEST SCREEN 1—Test Passes:

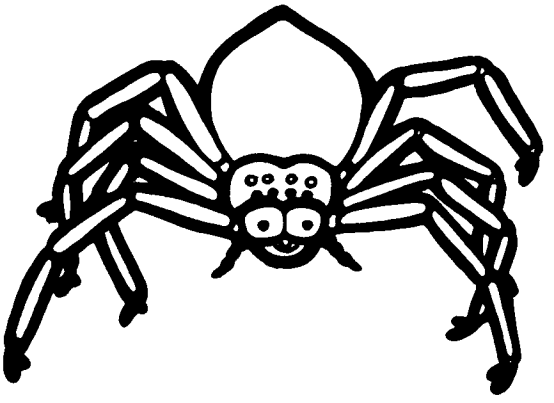
If the test passes, the screen displays the picture in Figure 2-1—Test Passes. See *Chapter 1, Section F, Performing the Initial Self-Test* for a complete description of this picture. To see self-test screen two, set the self-test switch to *off*. Press the auxiliary coin switch and set the S-T switch to on. To see self-test screen three, press the auxiliary coin switch.

Figure 2-1 Self-Test Screen 1—Test Passes

B. Performing the Self-Test

This game will test itself and provide data to show that the game's circuitry and controls are operating properly. The data is provided on the video display and speaker. No additional equipment is necessary.

To switch to the Self-Test Mode, set the self-test switch, located on the utility panel, to the *on* position.



SELF-TEST SCREEN 1—Test Fails:

RAM failure is indicated by a blank or "garbage"-filled screen and a number of tones. Count the tones to determine the failed RAM. The tone number and matching RAM location are shown in Table 2-1. The number of tones continue to repeat.

Replace the failed RAM and restart the test (set the self-test switch to *off*, and then to *on*).

Table 2-1 Locating the Failed RAM

Number of Tones	Failed RAM Location on Game PCB
1	F2
2	E2
3	M2
4	N4
5	L2
6	M4
7	K2
8	L4
9	J2
10	K4

ROM failure is indicated by two groups of alphanumeric characters in the upper left corner of the screen (see *Figure 2-2*). The group at the far left indicates the location of the failed ROM/PROM. Ignore the group at the right of the ROM number. The failed ROM and its location are listed in Table 2-2.

Table 2-2 Location of Failed ROM

Screen Display	Failed ROM Location on Game PCB
R1	M/N1
R2	L1
R3	J/K1
R4	H1
EA	P2
P0	D4
P1	B4

EAROM failure is indicated by the absence of game accounting statistics. When you erase the EAROM (by simultaneously pressing both start switches and Fire), the message *EA FF* should appear in the upper left corner of the self-test screen. The message will remain on the self-test screen until the next game is completed and the EAROM is rewritten. At this time, the self-test screen should contain game accounting statistics. If there are no statistics, suspect the EAROM at P2 or associated circuitry, and troubleshoot using game schematics.

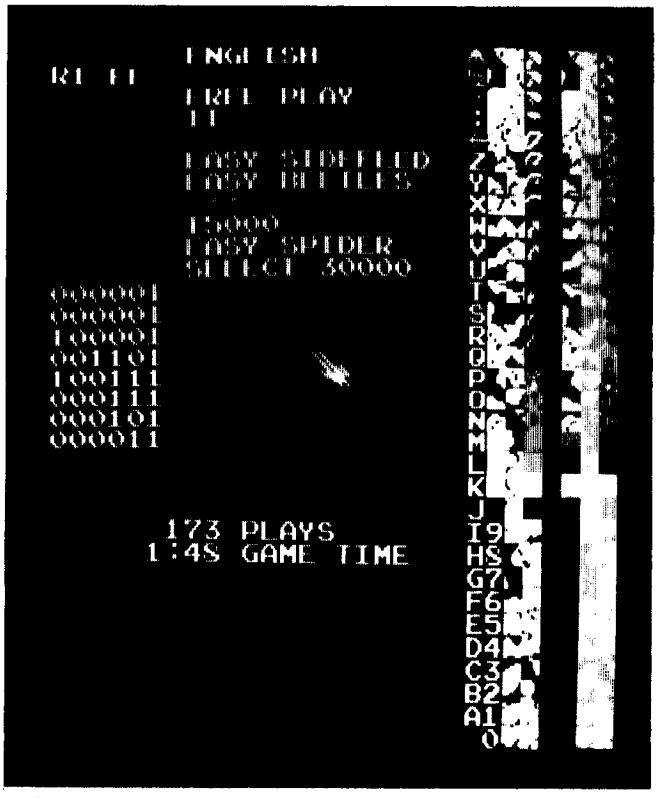


Figure 2-2 Self-Test Screen 1— Test Fails

SWITCH failure is indicated by the appropriate *1* not changing to a *0* on the screen when you press a switch. There may be a constant tone, or no tone at all. Check if the volume control is turned off. Or check the switch, loose harness or connector wires, or the custom audio I/O chip. Troubleshoot using the information in *Chapter 3, Section B,* and the game schematics.

MIDI TRAK-BALL™ failure is indicated by no movement or jerky movement of the player's shooter when you roll the Midi Trak-Ball™. If the cursor fails to move, or if movement is reversed or jerky, suspect the Midi Trak-Ball™ or the harness (see *Figure 3-5*).

SOUND failure is indicated by the absence of any sound when any of the control panel or coin switches are pressed. Press the 1-player start switch 8 times to test all 8 channels. No increase in volume or change in pitch, or no tone when you press and hold the 2-player start switch and press the 1-player start switch, indicates failure. Suspect the volume control on the utility panel, the custom I/O chips, or troubleshoot using the game schematics.

COLOR failure is indicated by no color change in the background or playfield objects. Background color should change when you press the 1-player start switch. Playfield and motion objects should change when you press the 2-player start switch and FIRE switch. Troubleshoot using the game schematics and the video display manual.

MOVING OBJECT failure is indicated when the object represented as the shooter does not change shape each time you press the 1-player start switch. Press the 1-player start switch 64 times to see all shapes. Suspect the EPROM may be bad, or troubleshoot using the game schematics.

To see self-test screen two, set the self-test switch to *off*, then press the auxiliary coin switch and the self-test switch to on.

SELF-TEST SCREEN 2:

This screen displays 64 rectangles, each with varying intensities of red and blue (see *Figure 2-3*). The column on the left edge of the screen should show eight shades of blue from black at the bottom to bright blue at the top. The bottom row should show eight shades of red from black at the left to bright red at the right. The remainder of the screen shows blends of red and blue. Adjust the color guns (see the video display manual) so the lower left corner is black and the other corners are bright blue and red.

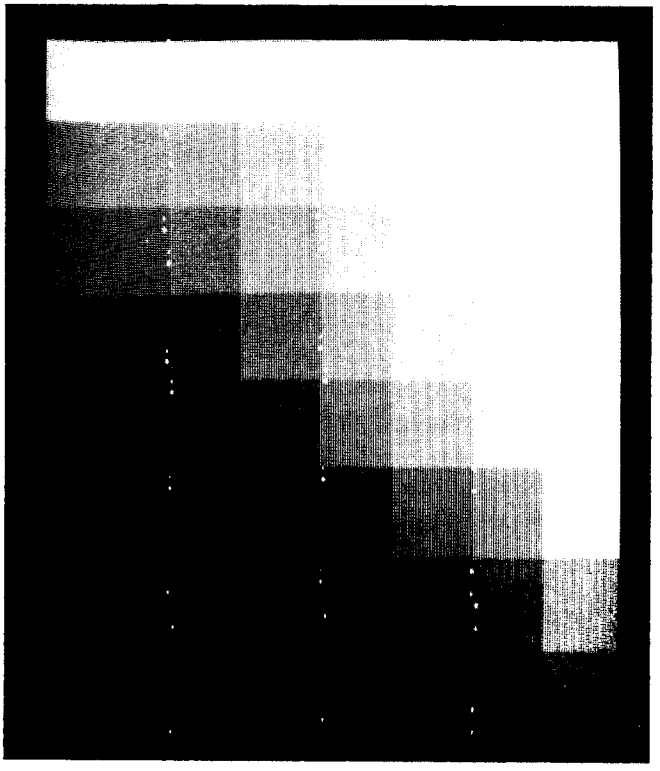


Figure 2-3 Self-Test Screen 2

Press FIRE and the screen displays 64 intensities of green. The lower left corner should be dark green. Press FIRE again, and the green becomes more intense. Press FIRE a third time, and the green becomes even more intense. The upper right corner should now be white.

SELF-TEST SCREEN 3:

Press the auxiliary coin switch and the screen displays a test pattern with white dots on a black background (see *Figure 2-4).* Troubleshoot convergence using the video display manual.

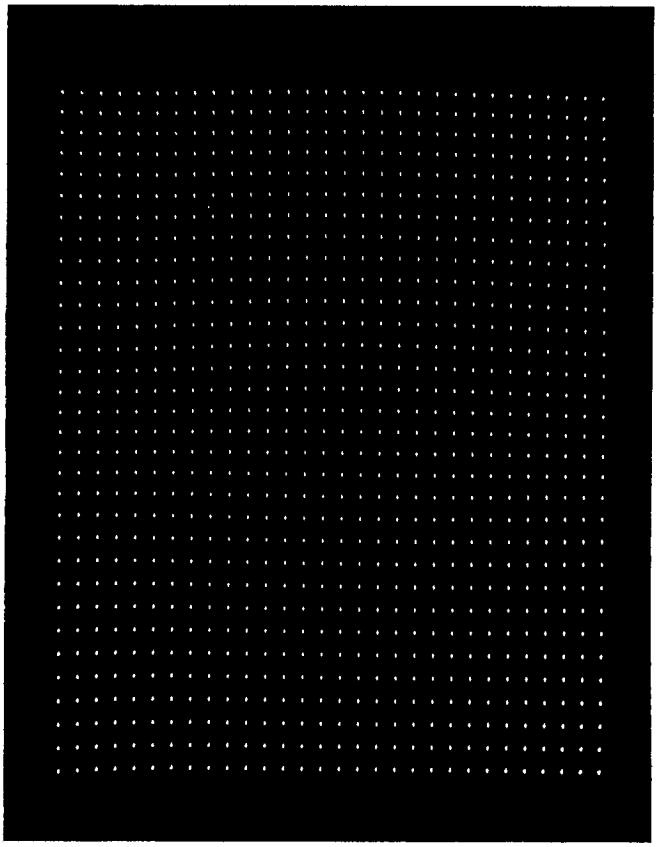
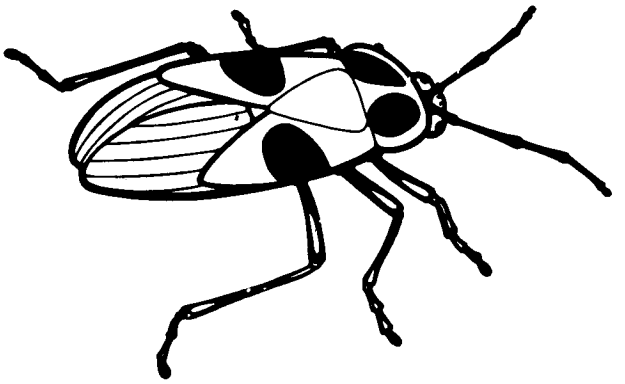


Figure 2-4 Self-Test Screen 3



Cabinet-Mounted Assemblies
Upright Cabinet
Parts List

Assemblies and components in the following parts list are shown in Figure 3-1.

Part No.		*Description*
A037453-03		Strain-Relief Power Cord *(U.S. and Canada)*
A037455-03		Strain-Relief Power Cord *(Australia and New Zealand)*
A037470-01		Power On/Off Switch/Mounting Plate Assembly
A037701-01		EMI Cage Assembly
A037784-03		Strain-Relief Power Cord *(United Kingdom, Ireland, Lebanon, Saudi Arabia, India, Hong Kong, Singapore, Egypt, Nigeria, Republic of South Africa, Zimbabwe)*
A038881-01		Lock Assembly *(for rear access panel) Acceptable substitute is part no. A038881-03*
A039259-01		Main Harness Assembly
A039260-01		Power Harness Assembly
A039301-01		Cabinet Assembly *(includes glides and PCB retainers, but not the rear access panel)*
A039502-01		Electromagnetic Interference (EMI) Shield PCB Assembly
		The following four items are the technical information supplements to this game:
SP-217		Millipede Schematic Package
ST-217-01		Millipede Label with Self-Test Procedure and Option Switch Settings
TM-217		Millipede Operation, Maintenance, and Service Manual
TM-220		Service Manual for 19-Inch Matsushita Color Raster-Scan Display *(use with part no. 139003-1004) Acceptable substitute is TM-210, use with part no. 139003-1006*
78-6900402		Vinyl Foam Single-Coated Adhesive Tape, ¼-Inch Wide x ⅛-Inch Thick *(not shown)*
78-3201		Adjustable Glide
009992-01		On/Off Switch Cover
037332-01		Ventilation Grille
038091-01		Molded Coin Box
038178-03		Dual-Slotted PCB Cleat
038870-01		Metal Coin Box Enclosure
039317-01		Video Display Shield
039349-01		Rear Access Panel *(does not include lock)*
178013-001		Spring Draw Latch *(not shown)*
178034-024		¾-Inch Black Plastic T-Molding
178048-001		2-Inch Rigid Caster

Cabinet-Mounted Assemblies
Ireland-Built Cabinet
Parts List

Assemblies and components in the following parts list are shown in Figure 3-2.

Part No.	*Description*
A037454-03	Strain-Relief Power Cord *(Austria, Belgium, Chile, Denmark, Finland, France, Germany, Greece, Indonesia, Italy, Netherlands, Norway, Spain, Sweden, and Uruguay)*
A037470-01	Power On/Off Switch/Mounting Plate Assembly
A038854-01	Power Harness Assembly
A038881-01	Lock Assembly *(for rear access panel)*
A039257-01	Main Harness Assembly
A039448-01	Cabinet Assembly *(includes glides and PCB retainers, but not the rear access panel)*
	The following four items are the technical information supplements to this game:
SP-217	Millipede Schematic Package
ST-217-01	Millipede Label with Self-Test Procedure and Option Switch Settings
TM-217	Millipede Operation, Maintenance, and Service Manual
TM-220	Service Manual for 19-Inch Matsushita Color Raster-Scan Display *(use with part no. 139003-1004) Acceptable substitute is TM-210, use with part no. 139003-1006*
78-3201	Adjustable Glide
78-6900402	Vinyl Foam Single-Coated Adhesive Tape, ¼-Inch Wide x ⅛-Inch Thick *(not shown)*
009992-01	On/Off Switch Cover
038091-01	Molded Coin Box
038240-1800	Printed Circuit Board Cleat
038770-01	Metal Coin Box Enclosure *Acceptable substitute is part no. 038781-01*
038790-01	Front Video Display Support Bracket *(not shown)*
038805-01	Display Shield Retainer *(not shown)*
038976-02	Rear Access Panel *(does not include lock)*
038986-01	Attraction Panel Retainer
038988-01	Ventilation Grille
038992-01	Display Shield
039009-01	Rear Video Display Support Bracket *(not shown)*
178013-002	Spring Draw Latch
178034-024	¾-Inch Black Plastic T-Molding

WARNING

Switch the game to *off* before removing or repairing the Midi Trak-Ball.

Lubricating the Midi Trak-Ball™

1. Remove the entire Midi Trak-Ball™ assembly from the control panel (see *Figure 3-4*). Remove the six screws that secure the upper and lower frames together (see *Figure 3-5*).
2. Lift off the upper frame.
3. Lubricate each of the six ball bearings with two drops of a light-duty oil, such as 3-in-One oil. Lubricate the bearings approximately every three months or 6,000 credits (credits are counted on the coin counter).

Removing the Midi Trak-Ball™, Coupler PCB, and Encoding Wheel:

4. Follow steps 1 and 2 above. Then remove the Midi Trak-Ball™.
5. Lift the PCB out of its slot. Carefully disconnect the red connector and remove the PCB.
6. Remove the socket-head screw, flat washer, and split-lock washer that secure the encoding wheel.
7. Remove the encoding wheel.
8. Reassemble and reinstall in reverse order.

NOTE

When you replace the PCB, make sure that the metal encoding wheel is not bent or damaged. It should turn freely between the two halves of the radial optical coupler.

Adjusting the Midi Trak-Ball™ Control:

9. When you tighten the encoding wheel, rotate the socket-head screw on the end of the roller shaft until a hole in the shaft is visible through the hole in the top of the frame.
10. Insert a ⅛-inch diameter pin or screwdriver through the hole in the shaft.
11. Tighten the socket-head screw with an Allen wrench.

Midi Trak-Ball™ Assembly Parts List

Part No.	*Description*
A035220-02	Coupler PCB Assembly *(includes Radial Optical Coupler)*
A036096-01	Harness Assembly
72-8406	#4-40 x ⅜-Inch, Hex Socket-Head Steel Machine Screw
75-014S	#4 Flat SAE-Standard, Zinc-Plated Steel Washer
75-044S	#4 Split-Lock, Zinc-Plated Steel Washer
034168-01	Label with Lubrication Instructions *(not shown)*
035937-01	Ball Bearing *(6 per assembly)*
035938-01	Etched Encoding Wheel
038039-01	Upper Black Plastic Frame
038040-01	Lower Black Plastic Frame
038041-01	Roller Shaft
038042-01	Idler Shaft
038043-01	Midi-Trak-Ball *(3-inch diameter)*
139002-001	Radial Optical Coupler *(located on the Coupler PCB Assembly)*
176010-106	#8 x ⅜-Inch Cross-Recessed, Pan-Head, Zinc-Plated Steel Screw

Video Display
Upright and Ireland-Built Cabinets
Parts List

Assemblies and components in the following parts list are shown in Figures 3-9 and 3-10.

Part No.	*Description*	
	For Upright Cabinet	
037750-01	Display Support Bracket	
039317-01	Display Shield	
039320-01	Display Bezel	
139003-1004	19-Inch Matsushita Color Raster-Scan Display	*Acceptable substitute is part no. 139003-1004.*
	For Ireland-Built Cabinet	
039018-01	Display Bezel	
038790-01	Front Display Support Bracket	
038805-01	Display Shield Retainer	
038992-01	Display Shield	
039009-01	Rear Display Support Bracket	
139003-1004	19-Inch Matsushita Color Raster-Scan Display	*Acceptable substitute is part no. 139003-1006*

G. Printed-Circuit Boards

WARNING

Before you remove or repair any printed-circuit board (PCB), switch the game to *off.*

Removing the Printed-Circuit Boards:

1. Open the rear access panel.
2. The *Upright* game PCB is located inside the electromagnetic interference (EMI) cage (see *Figure 3-13*). Unplug the two edge connectors on the EMI shield PCB.
3. To remove the PCB, pull the eight nylon snap-in fasteners on the EMI shield PCB to the unlocked position. Carefully slide the shield PCB with attached game PCB straight out of its guide. Be careful not to twist the board, as this may loosen connections or components. Replace or repair as required, and reinstall the PCBs.
4. To remove the *Ireland-Built* game PCB, remove the screw and two washers that secure the PCB to the cabinet. **Carefully** slide the PCB straight out of its retainer. Be careful not to twist the board, as this may loosen connections or components. Replace or repair as required, and reinstall the PCB.
5. To remove the *Regulator/Audio II PCB,* first disconnect the five small harness connectors on this board.
6. Remove the hardware that secures the Regulator/Audio II PCB to the cabinet, and carefully remove the board from its retainer. Do not twist the board, as this may loosen connections or components. Replace or repair as required, and reinstall the PCB.

CAUTION

Make sure that the connectors on each PCB are properly plugged in. Note that they are keyed to fit only one way. If they do not slip on easily, do not force them. **A reversed connector may damage your game** and void the warranty.

7. Close and lock the rear access panel.
8. **Important:** Perform the self-test.

NOTE

The Federal Communications Commission requires that the game PCB be housed in the EMI cage with the Shield PCB attached.

Game PCB Removal from EMI Cage *New*

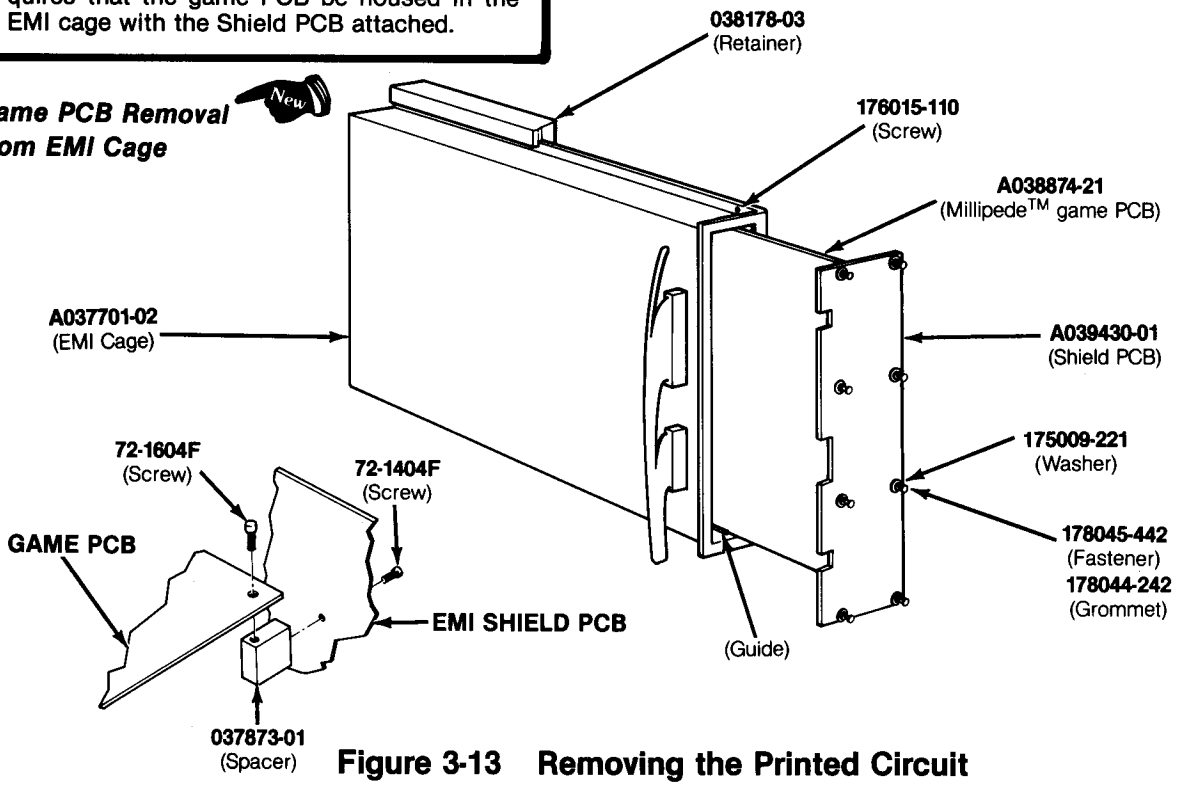


Figure 3-13 Removing the Printed Circuit Boards (PCBs)

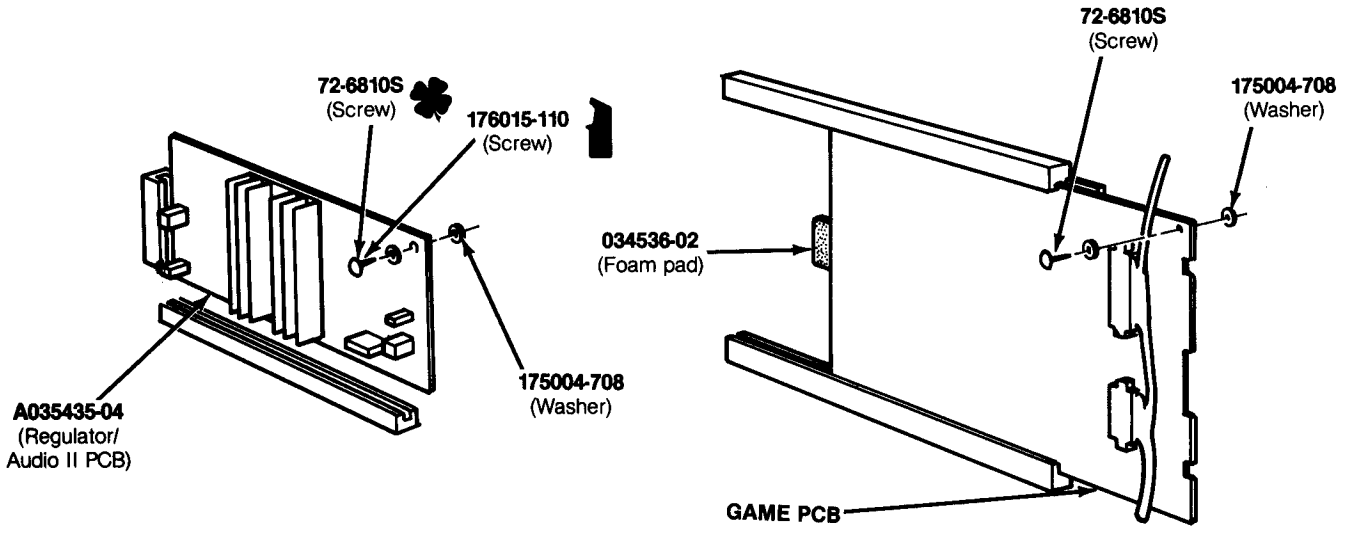


Figure 3-13 Removing the Printed Circuit Boards (PCBs)

Printed-Circuit Board Mounting Hardware Parts List

Assemblies and components in the following parts list are shown in Figure 3-13.

Part No.	*Description*
	Upright Cabinet
A037701-02	Electromagnetic Interference (EMI) Cage *(includes guide)*
A039430-01	EMI Shield PCB
72-1404F	#4-40 x ¼-Inch Cross-Recessed Steel Screw
72-1604F	#6-32 x ¼-Inch Cross-Recessed Steel Screw
037873-01	Spacer
038178-03	Dual-Slotted Retainer
175009-221	Plastic Washer
176015-110	#10 x ⅝-Inch Cross-Recessed Pan-Head Screw
178044-242	Grommet
178045-442	Snap-In Fastener
	Plastic Guide
	Upright and Ireland-Built Cabinets
72-6810S	#8 x ⅝-Inch Cross-Recessed Pan-Head Screw
034536-02	Foam Pad
175004-708	#8 Fiber Washer

Millipede™ Game Printed-Circuit Board Assembly Parts List, continued

Designator	*Description*	*Part No.*
9H, 9J	Type-74LS74 Integrated Circuit	37-74LS74
9K	Type-74LS157 Integrated Circuit	37-74LS157
9M, 9N	Type-74LS257 Integrated Circuit	37-74LS257
9P	Type-74LS191 Integrated Circuit	37-74LS191
10C	Type-74LS157 Integrated Circuit	37-74LS157
10D	Type-74LS74 Integrated Circuit	37-74LS74
10E	Type-74LS00 Integrated Circuit	37-74LS00
10F	Type-555 Timer Integrated Circuit	37-555
10K, 10L	Type-74LS257 Integrated Circuit	37-74LS257
10N	Type-4584B Hex Schmitt Trigger Integrated Circuit	37-4584B
10P	Type-74LS157 Integrated Circuit	37-74LS157
10R	Type-74LS74 Integrated Circuit	37-74LS74
11F	Dual Operational-Amplifier Integrated Circuit	37-LM324
11H	Quad Operational-Amplifier Integrated Circuit	37-TL082CP
11P	Type-4584B Hex Schmitt Trigger Integrated Circuit	37-4584B
12A	Type-74LS273 Integrated Circuit	37-74LS273
12B	Type-74LS27 Integrated Circuit	37-74LS27
12C	Type-7406 Integrated Circuit	37-7406
12D	Type-7407 Integrated Circuit	37-7407
12E	Type-74LS259 Integrated Circuit	37-74LS259
	Programmable Read-Only Memories	
1H	Erasable Programmable Read-Only Memory	136013-101
1J/K	Erasable Programmable Read-Only Memory	136013-102
1L	Erasable Programmable Read-Only Memory	136013-103
1M/N	Erasable Programmable Read-Only Memory	136013-104
7E	Programmable Read-Only Memory	136001-213
	Random-Access Memories	
2E, 2F	Random-Access Memory	90-7033
2J-2M	Random-Access Memory *Acceptable substitute is part no. 137250-002*	137250-001
4K-4N	Random-Access Memory *Acceptable substitute is part no. 137250-002*	137250-001
8B	Random-Access Memory *Acceptable substitute is part no. 137271-001*	137178-001
10A, 10B	Random-Access Memory	90-7005
11B, 11C	Random-Access Memory	90-7005
	Read-Only Memories	
2P	Electrically-Alterable Read-Only Memory	137161-001
5P	Read-Only Memory	136013-109
5R	Read-Only Memory	136013-110

(Continued on next page)

Millipede™ Game Printed-Circuit Board Assembly Parts List, continued

Designator	Description	Part No.
	Resistors	
R1, R2	10 KΩ, ±5%, ¼ W Resistor	110000-103
R3	220 Ω, ±5%, ¼ W Resistor	110000-221
R4	1 KΩ, ±5%, ¼ W Resistor	110000-102
R5	10 KΩ, ±5%, ¼ W Resistor	110000-103
R6	22 KΩ, ±5%, ¼ W Resistor	110000-223
R7	1 KΩ, ±5%, ¼ W Resistor	110000-102
R8	220 Ω, ±5%, ¼ W Resistor	110000-221
R9-R19	1 KΩ, ±5%, ¼ W Resistor	110000-102
R20-R27	470 Ω, ±5%, ¼ W Resistor	110000-471
R28-R43	1 KΩ, ±5%, ¼ W Resistor	110000-102
R44-R46	470 Ω, ±5%, ¼ W Resistor	110000-471
R47	1.2 KΩ, ±5%, ¼ W Resistor	110000-122
R48	470 Ω, ±5%, ¼ W Resistor	110000-471
R49	1.8 KΩ, ±5%, ¼ W Resistor	110000-182
R50, R51	3.9 KΩ, ±5%, ¼ W Resistor	110000-392
R52	82 Ω, ±5%, ¼ W Resistor	110000-820
R53	1.2 KΩ, ±5%, ¼ W Resistor	110000-122
R55	1.8 KΩ, ±5%, ¼ W Resistor	110000-182
R56	3.9 KΩ, ±5%, ¼ W Resistor	110000-392
R57	82 Ω, ±5%, ¼ W Resistor	110000-820
R58	1.2 KΩ, ±5%, ¼ W Resistor	110000-122
R60	1.8 KΩ, ±5%, ¼ W Resistor	110000-182
R61, R62	3.9 KΩ, ±5%, ¼ W Resistor	110000-392
R63	82 Ω, ±5%, ¼ W Resistor	110000-820
R64-R66	270 Ω, ±5%, ¼ W Resistor	110000-271
R70-R76	470 Ω, ±5%, ¼ W Resistor	110000-471
R77-R83	1 KΩ, ±5%, ¼ W Resistor	110000-102
R84-R91	3.3 KΩ, ±5%, ¼ W Resistor	110000-332
R92-R108	10 KΩ, ±5%, ¼ W Resistor	110000-103
R109, R110	1 KΩ, ±5%, ¼ W Resistor	110000-102
R111, R112	220 Ω, ±5%, ¼ W Resistor	110000-221
R113-R119	470 Ω, ±5%, ¼ W Resistor	110000-471
R120-R152	10 KΩ, ±5%, ¼ W Resistor	110000-103
R153	220 Ω, ±5%, ¼ W Resistor	110000-221
R154	100 KΩ, ±5%, ¼ W Resistor	110000-104
R155	1 KΩ, ±5%, ¼ W Resistor	110000-102
R156-R158	39 KΩ, ±5%, ¼ W Resistor	110000-393
R159	220 Ω, ±5%, ¼ W Resistor	110000-221
R160	68 KΩ, ±5%, ¼ W Resistor	110000-683
R161, R162	1 KΩ, ±5%, ¼ W Resistor	110000-102
R163	470 Ω, ±5%, ¼ W Resistor	110000-471
R164	10 KΩ, ±5%, ¼ W Resistor	110000-103
R165	39 KΩ, ±5%, ¼ W Resistor	110000-393
R166-R170	1 KΩ, ±5%, ¼ W Resistor	110000-102

(Continued on next page)

Millipede™ Game Printed-Circuit Board Assembly Parts List, continued

Designator	*Description*	*Part No.*
R171, R172	1.8 KΩ, ±5%, ¼ W Resistor	110000-153
R173, R174	1 KΩ, ±5%, ¼ W Resistor	110000-102
R175-R177	100 KΩ, ±5%, ¼ W Resistor	110000-101
	Sockets	
1H, 1L, 1M/N	24 Contact, Medium-Insertion-Force IC Socket	79-42C24
2C	40 Contact, Medium-Insertion-Force IC Socket	79-42C40
2P	22 Contact, Medium-Insertion-Force IC Socket	79-42C22
4B, 4D	40 Contact, Medium-Insertion-Force IC Socket	79-42C40
5P, 5R	24 Contact, Medium-Insertion-Force IC Socket	79-42C24
	Switches	
5B, 5D, 8P	8-Station, Single-Throw, Dual-Inline-Package Bit Switch	66-118P1T
	Transistors	
Q1-Q4	Type-2N3904, 60 V, 1 W, NPN Transistor	34-2N3904
Q5	Type-2N3906, 40 V, 1 W, PNP Transistor	33-2N3906
Q6, Q7	Type-2N6044 Darlington NPN Transistor	34-2N6044
Q8, 9	Type-2N3906, 40 V, 1 W, PNP Transistor	33-2N3906
	Miscellaneous	
L1-L3	100 μH Inductor *Acceptable substitute is part no. 41-3003*	141002-001
L4-L6	1.0 μH Inductor	141007-001
VR1	Voltage Regulator	37-7815
VR2	Voltage Regulator	37-7915
Y1	12.09 MHz Crystal	144000-001
	Test Point *Acceptable substitute is part no. 020670-01*	179051-002
	Nylon Snap-In Fastener	81-4302

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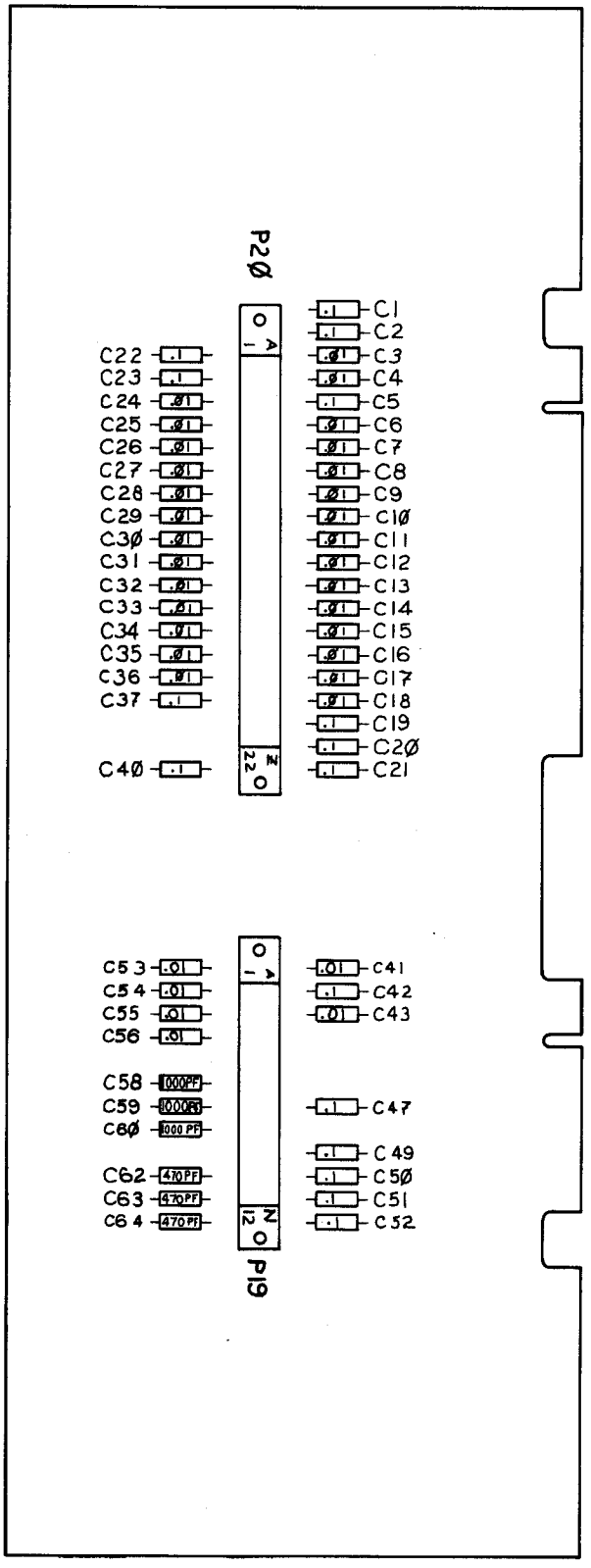


Figure 3-16 EMI Shield PCB Assembly A037430-01 A

EMI Shield PCB Assembly
Parts List

Components in the following parts list are shown in Figure 3-16.

Designator	Description	Part No.
	Capacitors	
C1, C2	0.1 μF, +80, -20%, 50 V Ceramic-Disk Radial-Lead Capacitor	122002-104
C3, C4	0.1 μF, +80, -20%, 25 V Ceramic-Disk Radial-Lead Capacitor	122005-103
C5	0.01 μF, +80, -20%, 50 V Ceramic-Disk Radial-Lead Capacitor	122002-104
C6-C18	0.01 μF, +80, -20%, 25 V Ceramic-Disk Radial-Lead Capacitor	122005-103
C19-C23	0.01 μF, +80, -20%, 50 V Ceramic-Disk Radial-Lead Capacitor	122002-104
C24-C36	0.1 μF, +80, -20%, 25 V Ceramic-Disk Radial-Lead Capacitor	122005-103
C37	0.01 μF, +80, -20%, 50 V Ceramic-Disk Radial-Lead Capacitor	122002-104
C40	0.1 μF, +80, -20%, 50 V Ceramic-Disk Radial-Lead Capacitor	122002-104
C41	0.01 μF, +80%, -20%, 25 V Ceramic-Disk Radial-Lead Capacitor	122005-103
C42	0.1 μF, +80, -20%, 50 V Ceramic-Disk Radial-Lead Capacitor	122002-104
C43	0.01 μF, +80%, -20%, 25 V Ceramic-Disk Radial-Lead Capacitor	122005-103
C47	0.1 μF, +80, -20%, 50 V Ceramic-Disk Radial-Lead Capacitor	122002-104
C49-C52	0.1 μF, +80, -20%, 50 V Ceramic-Disk Radial-Lead Capacitor	122002-104
C53-C56	0.01 μF, +80, -20%, 25 V Ceramic-Disk Radial-Lead Capacitor	122005-103
C58-C60	1000 μF, +80, -20%, 100 V Ceramic-Disk Radial-Lead Capacitor *Acceptable substitute is part no. 122002-102*	122016-102
C62-C64	470 μF, +80, -20%, 100 V Ceramic-Disk Radial-Lead Capacitor *Acceptable substitute is part no. 122013-471*	122016-471
	Connectors	
P19	24-Pin Card-Edge Connector	179073-024
P20	44-Pin Card-Edge Connector	179073-044
	Miscellaneous	
	#4-40 x ½-Inch Cross-Recessed Pan-Head Machine Screw *(not shown)*	72-1408C
	#4 Flat Washer *(not shown)*	75-024C
	#4-40 Nut/Washer Assembly *(not shown)*	75-99514

H. Power Supply Assembly

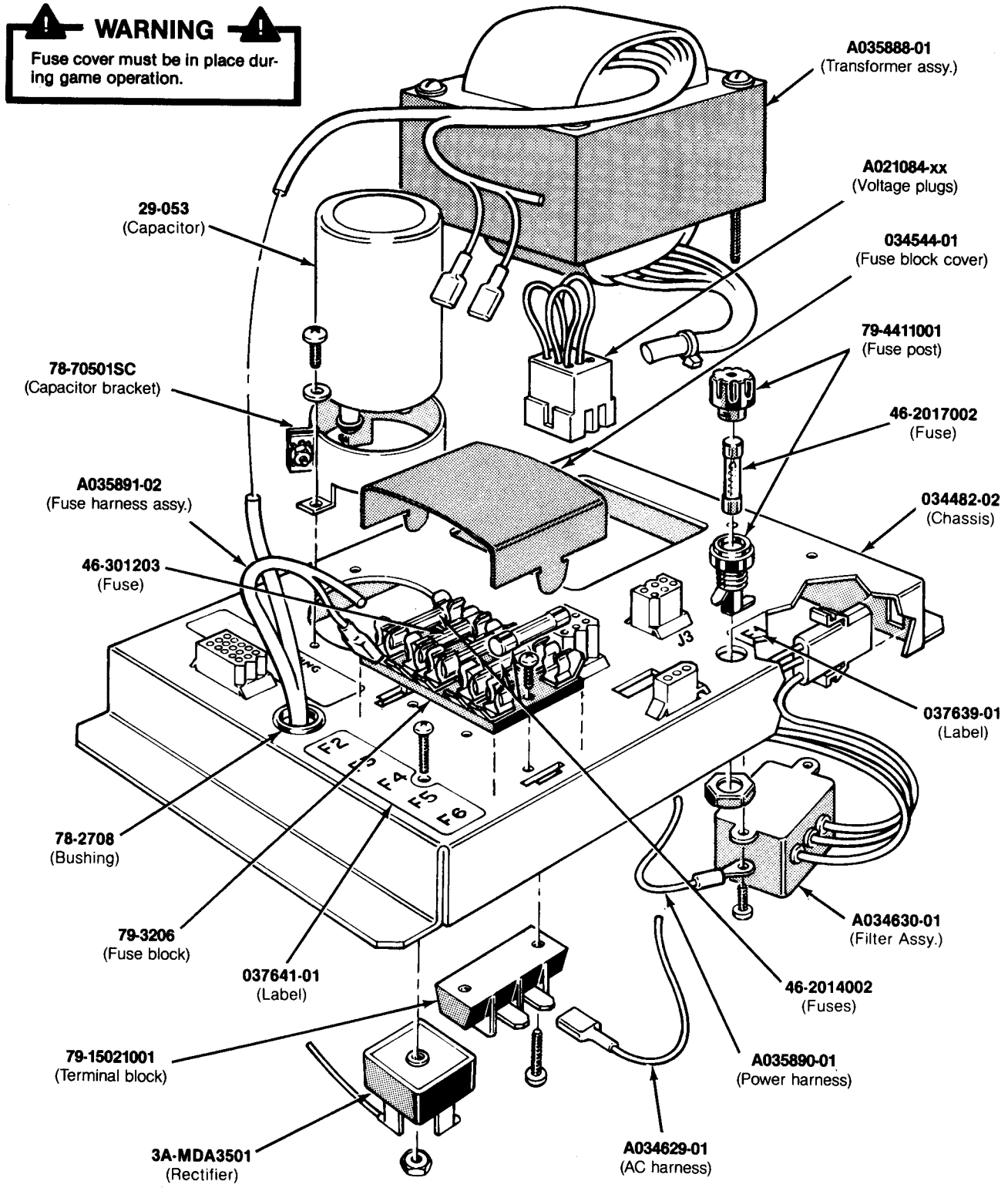


Figure 3-17 Power Supply Assembly A037671-01 & -02 E

Power Supply Assembly
Parts List

Assemblies and components in the following parts list are shown in Figure 3-17

Part No.	*Description*
A021084-01	Voltage Plug for 100 V (90-110 VAC) *(violet wire color—plugs into* **J3***)*
A021084-02	Voltage Plug for 120 V (105-135 VAC) *(yellow wire color—plugs into* **J3***)**
A021084-04	Voltage Plug for 220 V (200-240 VAC) *(blue wire color—plugs into* **J3***)*
A021084-05	Voltage Plug for 240 V (220-260 VAC) *(brown wire color—plugs into* **J3***)*
A034629-01	AC Harness Assembly **(J4A)**
A034630-01	RFI Filter Assembly **(FL1***—designation not marked)*
A035888-01	Transformer Assembly **(T1***—designation covered) (Acceptable substitute is part no. A035888-02)*
A035890-01	Power Harness Assembly **(J2)**
A035891-02	Fuse Harness Assembly **(F2-F6)**
29-053	27,000 μF, 15 VDC Electrolytic Capacitor **(C1)**
3A-MDA3501	Type-MDA 3501 Bridge Rectifier **(CR1)**
46-2014002	4 A, 250 V, 3AG Slow-Blow Glass Cartridge-Type Fuse **(F2, F4-F6)**
46-2017002	7 A, 250 V, 3AG Slow-Blow Glass Cartridge-Type Fuse **(F1)**
46-301203	20 A, 32 V, 3AG Slow-Blow Glass Cartridge-TypeFuse **(F3)**
78-2708	Nylon Type 6/6 Hole Bushing with ⅜-Inch Inside Diameter x ⅝₄-Inch Outside Diameter x ¼-Inch Thick
78-70501SC	2-Inch Diameter Capacitor Mounting Bracket **(C1)**
79-15021001	2-Circuit Single-Row Terminal Block *(located under* **F4***)*
79-3206	5-Position 3AG Fuse Block with ¼-Inch Quick-Disconnect Terminals **(F2-F6)**
79-4411001	Panel-Mounting Non-Indicating 3AG Cartridge-Type Fuse Post **(F1)**
034482-02	Power Supply Chassis Base
034544-01	Fuse Block Cover **(F2-F6)**
037243-01	Metal Base Plate *(not shown in illustration)*
037639-01	Label for Fuse Value **(F1)**
037641-01	Label for Fuse Values **(F2-F6)**

**This is the only plug provided on the North American power supply.*

NOTE

A037671-01 power supply assembly has the 120 V plug.
A037671-02 has the 100 V, 220 V, and 240 V plugs.
A037671-03 has the 220 V and 240 V plugs.

Millipede™ Troubleshooting with the CAT Box

Troubleshooting with the Read/Write Controller

A. CAT Box Preliminary Set-Up

1. Remove the electrical power from the game and the CAT Box.
2. Remove the game PCB from the game cabinet.
3. Remove Microprocessor 2C from the game PCB.
4. Connect the harness from the game to the game PCB.
5. Connect together the Φ0 and Φ2 test points on the game PCB with the shortest possible jumper.
6. Connect the $\overline{\text{WDDIS}}$ test point to ground.
7. Connect the CAT Box flex cable to the game PCB edge test connector.
8. Apply power to the game and to the CAT Box.
9. Set CAT Box switches as indicated:
   a. TESTER SELF-TEST: OFF
   b. TESTER MODE: R/$\overline{\text{W}}$
10. Press TESTER RESET.
11. Connect the DATA PROBE to the CAT Box. Connect the DATA PROBE ground clip to a game PCB ground test point.

B. Checking the Address Lines

1. Perform the CAT Box preliminary set-up.
2. Set CAT Box switches as indicated:
   a. BYTES: 1
   b. PULSE MODE: UNLATCHED
   c. R/$\overline{\text{W}}$ MODE: (OFF)
   d. R/$\overline{\text{W}}$: READ
3. Key in the address pattern given in Table 1 *(use AAAA to start)* with the CAT Box keyboard.
4. Set R/$\overline{\text{W}}$ MODE to STATIC.
5. Probe the IC-pin with the DATA PROBE and check that the 1 or 0 LED indicated in Table 1 lights up. Repeat this step for each address line listed in Table 1.
6. Repeat parts 2-c through 5 using address *5555*.

Table 1 Address Lines

Logic State For Address *AAAA*	IC-Pin	Logic State For Address *5555*
1	2C-25	0
0	1B-13	1
1	1B-14	0
0	1C/D-16	1
1	1C/D-7	0
0	1C/D-9	1
1	1C/D-5	0
0	1C/D-3	1
1	1D/E-5	0
0	1D/E-3	1
1	1D/E-7	0
0	1D/E-9	1
1	1D/E-18	0
0	1D/E-14	1
1	1D/E-12	0
0	1D/E-16	1

C. Checking the Data Lines

1. Perform the CAT Box preliminary set-up.
2. Set CAT Box switches as indicated:
   a. BYTES:1
   b. R/$\overline{W}$ MODE: (OFF)
   c. R/$\overline{W}$: WRITE
3. Key in address *0000* with the keyboard.
4. Press DATA SET. Key in data *AA* with the keyboard.
5. Set R/$\overline{W}$ MODE to STATIC.
6. Probe the IC-pin with the DATA PROBE and check that the 1 or 0 LED indicated in Table 2 lights up. Repeat this check for each IC-pin in Table 2.
7. Set R/$\overline{W}$ MODE to (OFF).
8. Repeat parts 4 through 6 using data *55* in part 4.

Table 2 Data Lines

Logic State For Data *AA*	IC-Pin	Logic State For Data *55*
1	4E-18	0
0	4E-17	1
1	4E-16	0
0	4E-15	1
1	4E-14	0
0	4E-13	1
1	4E-12	0
0	4E-11	1
1	4E-2	0
0	4E-3	1
1	4E-4	0
0	4E-5	1
1	4E-6	0
0	4E-7	1
1	4E-8	0
0	4E-9	1

D. Checking the RAM

1. Perform the CAT Box preliminary set-up.
2. Set CAT Box switches as indicated:
   a. DBUS SOURCE: ADDR
   b. BYTES:1024
   c. R/$\overline{W}$ MODE: (OFF)
   d. R/$\overline{W}$: WRITE
3. Enter address *0000* with the keyboard.
4. Set the CAT Box switches as indicated:
   a. R/$\overline{W}$ MODE to PULSE and back to (OFF)
   b. R/$\overline{W}$ to READ
   c. R/$\overline{W}$ MODE to PULSE and back to (OFF)
5. If the CAT Box reads an address that doesn't compare with that written, the COMPARE ERROR LED will light up. The ADDRESS/SIGNATURE display of the CAT Box will show the failing address location and the ERROR DATA DISPLAY switch is enabled. Using this switch, determine if the error is in the high-order or low-order RAM.
6. Repeat this test with DBUS SOURCE set to $\overline{ADDR}$.
7. Set the CAT Box switches as indicated:
   a. BYTES: 256
   b. DBUS SOURCE: ADDR
   c. R/$\overline{W}$ MODE: (OFF)
   d. R/$\overline{W}$: WRITE
8. Repeat parts 5 through 6 using addresses *1000, 1100, 1200,* and *1300.*

E. Checking the Custom Audio I/O Chips

NOTE

Millipede has two custom audio I/O chips. Each must be tested separately. There are several ways to test these chips:

- Perform the self-test.
- Substitute a known good part for a suspected defective part.
- Use the following procedure.

1. Perform the CAT Box preliminary set-up.
2. Set CAT Box switches as indicated:
   a. BYTES: 1
   b. R/$\overline{W}$: WRITE
   c. R/$\overline{W}$ MODE: (OFF)
3. Enter the address from Table 3 with the keyboard.
4. Press DATA SET and enter the data from Table 3 with the keyboard.
5. Set R/$\overline{W}$ MODE to PULSE and back to (OFF).
6. Repeat parts 3 through 5 for each address and data listed in Table 3. Check for the response indicated.

Table 3 Custom Audio I/O Chips

Address	Data	Test Results
040F	*00*	
040F	*03*	
0400	*55*	
0401	*AF*	Custom Audio I/O Chip 4D channel 1 produces pure tone.
0401	*00*	Custom Audio I/O Chip 4D channel 1 turns off.
0402	*55*	
0403	*AF*	Custom Audio I/O Chip 4D channel 2 produces pure tone.
0403	*00*	Custom Audio I/O Chip 4D channel 2 turns off.
080F	*00*	
080F	*03*	
0800	*55*	
0801	*AF*	Custom Audio I/O Chip 4B channel 1 produces pure tone.
0801	*00*	Custom Audio I/O Chip 4B channel 1 off.
0802	*55*	
0803	*AF*	Custom Audio I/O Chip 4B channel 2 produces pure tone.
0803	*00*	Custom Audio I/O Chip 4B channel 2 off.

F. Checking the Player Switch, Option Switch, and Trak-Ball™ Inputs

1. Perform the CAT Box preliminary set-up.
2. Set CAT Box switches as indicated:
   a. BYTES: 1
   b. R/$\overline{W}$: WRITE
   c. R/$\overline{W}$ MODE: (OFF)
3. Enter address *2505* with the keyboard.
4. Press DATA SET and enter data *00* with the keyboard.
5. Set R/$\overline{W}$ MODE to PULSE and back to (OFF).
6. For each entry listed in Table 4, do the following:
   a. Set R/$\overline{W}$ MODE to (OFF).
   b. Set R/$\overline{W}$ to WRITE.
   c. Enter the first address with the keyboard.
   d. Press DATA SET and enter the data for that address with the keyboard.
   e. Set R/$\overline{W}$ MODE to PULSE and back to (OFF).
   f. Set R/$\overline{W}$ to READ.
   g. Enter the next address.
   h. Set R/$\overline{W}$ MODE to STATIC.
   i. Activate the input switch or signal indicated in Table 4 and check the test result.
   j. Set R/$\overline{W}$ MODE to (OFF).
   k. Repeat parts g through j for each subsequent address given for the entry.

Table 4 Player Switches, Option Switches, and Trak-Ball™ Inputs

Entry	Address	Data	Input Switch/Signals	Test Results
1	*2507*	00		
	2000		Option Switch 0 Toggles 1-4, Trak-Ball™ 1 HDIR, FIRE1, VBLANK, START1	DATA display changes when any of these switches or signals is activated.
	2001		Option Switch 0 Toggles 5-8, Trak-Ball™ 1 VDIR, FIRE2, START2	
	2010		Left Coin Switch, Right Coin Switch, Auxillary Coin Switch, SLAM	
	2011		Self-Test Switch, CABINET	
2	*2505*	FF		
	2000		Trak-Ball™ 1 HCOUNT and HDIR, VBLANK, START1, FIRE1	DATA display changes when any of these switches or signals is activated.
	2001		Trak-Ball™ 1 VCOUNT and VDIR, START2, FIRE2	
3	*2507*	FF		
	2000		Trak-Ball™ 2 HCOUNT and HDIR, VBLANK, START1, FIRE1	DATA display changes when any of these switches or signals is activated.
	2001		Trak-Ball™ 2 VCOUNT and VDIR, START2, FIRE2	

G. Checking the LED, Coin Counter, and Video Rotate Outputs

1. Perform the CAT Box preliminary set-up.
2. Set CAT Box switches as indicated:
   a. DBUS SOURCE: DATA
   b. BYTES: 1
   c. R/$\overline{W}$: WRITE
   d. R/$\overline{W}$ MODE: (OFF)
3. Enter the address in Table 5 with the keyboard.

CAUTION

If you write ON data to activate a solenoid, *deactivate the solenoid immediately* by writing the OFF data. If you leave a solenoid activated for more than 10 seconds, you may have to replace the solenoid and/or its driver, due to overheating.

4. For each address listed in Table 5, do the following:
   a. To activate the output:
      • Press DATA SET.
      • Enter the ON data with the keyboard.
      • Set R/$\overline{W}$ MODE to STATIC and back to (OFF).
   b. To deactivate the output:
      • Press DATA SET.
      • Enter the OFF data with the keyboard.
      • Set R/$\overline{W}$ MODE to STATIC and back to (OFF).

Table 5 LED and Coin Counter Outputs

Address	On Data	Off Data	Output Device
2501	*FF*	*00*	Left Coin Counter
2502	*FF*	*00*	Right Coin Counter
2503	*00*	*FF*	Player 1 LED
2504	*00*	*FF*	Player 2 LED
2506	*FF*	*00*	VIDROT

Troubleshooting with Signature Analysis

A. Checking the Address Bus

1. Perform the CAT Box preliminary set-up.
2. Connect the three BNC-to-EZ clip cables supplied with the CAT Box to the SIGNATURE ANALYSIS CONTROL START, STOP, and CLOCK jacks of the CAT Box.
3. Connect the three black EZ clips to a game PCB ground test point.
4. Set the CAT Box switches as indicated:
   a. TESTER MODE: SIG
   b. TESTER SELF-TEST: OFF
   c. PULSE MODE: LATCHED
   d. START: Negative-going edge trigger
   e. STOP: Negative-going edge trigger
   f. CLOCK: Negative-going edge trigger
5. Press TESTER RESET on the CAT Box.
6. Connect the CAT Box Signature Analysis probe tips as indicated:
   a. START: Pin 25 of Microprocessor 2C
   b. STOP: Pin 25 of Microprocessor 2C
   c. CLOCK: Φ2 test point
7. Verify the set-up connections by connecting the DATA PROBE to a game PCB ground test point. The CAT Box ADDRESS/SIGNATURE display should show *0000*. Now connect the DATA PROBE to a +5V test point. The ADDRESS/SIGNATURE display should show *0001*.
8. Probe the IC-pin listed in Table 6 with the DATA PROBE and check for the signature indicated. Repeat this check for each IC-pin listed.

NOTE

To avoid faulty readings while performing these troubleshooting tests, take care **NOT** to short-circuit two or more IC pins with the CAT Box DATA PROBE. Should this accidentally occur, you must start the test again.

Table 6 Address Bus Signatures

IC-Pin	Signal Name	Signature
1D/E-16	ABO	*UUUU*
1D/E-12	AB1	*5555*
1D/E-14	AB2	*CCCC*
1D/E-18	AB3	*7F7F*
1D/E-9	AB4	5H21
1D/E-7	AB5	*0AFA*
1D/E-3	AB6	*UPFH*
1D/E-5	AB7	*52F8*
1C/D-3	AB8	*HC89*
1C/D-5	AB9	*2H70*
1C/D-9	AB10	*HPPO*
1C/D-7	AB11	*1293*
1C/D-16	AB12	*HAP7*
1B-14	A13	*3C96*
1B-13	A14	*3827*
2C-25	A15	*755U*

B. Checking the Address Decoders

1. Perform *A. Checking the Address Bus.*
2. Probe the IC-pin listed in Table 7 with the DATA PROBE and check for the signature indicated. Repeat this check for each IC-pin listed.

Table 7 Decoder Signatures

IC-PIN	Signal Name	Signature
1B-1	$\overline{\text{MOS}}$	*822A*
1B-2	$\overline{\text{SCRAM}}$	*A169*
1B-3	$\overline{\text{I/O}}$	*C5U3*
1B-5	$\overline{\text{ROM1}}$	*ICFH*
1B-6	$\overline{\text{ROM2}}$	*0319*
1B-7	$\overline{\text{ROM3}}$	*U6U2*
1B-9	$\overline{\text{ROM4}}$	*H601*
3E-4	$\overline{\text{INPUTS}}$	*72P5*
3E-5	$\overline{\text{OUTPUTS}}$	*062F*
3E-10	$\overline{\text{I/OS1}}$	*HCC5*
3E-11	$\overline{\text{I/OS0}}$	*9PPA*
3E-12	$\overline{\text{ZRAM}}$	*9ACA*
4F-3	$\overline{\text{ROM}}$	*96C0*
4H-9	$\overline{\text{EAROMRD}}$	*61F3*
4H-11	$\overline{\text{IN1}}$	*4696*
4H-12	$\overline{\text{IN0}}$	*4H6H*

Troubleshooting with Checksums

NOTE

This procedure can only be done with those CAT Boxes equipped with a Checksum Switch.

While testing with checksums, adding 270 pF capacitors to A14 and A13 may be necessary.

1. Perform the CAT Box preliminay set-up.
2. Set the CAT Box switches as indicated:
   a. BYTES: 256
   b. DBUS SOURCE: DATA
   c. R/$\overline{\text{W}}$ MODE: OFF
   d. CHECKSUM SWITCH: ON
3. Key in the address pattern given in Table 8 *(use 4000 to start).*
4. Set the R/$\overline{\text{W}}$ MODE switch to PULSE and then back to (OFF).
5. Check the CAT Box ADDRESS/SIGNATURE display for the appropriate checksum.
6. Repeat parts 3 through 5 for each address listed in Table 8.

Table 8 ROM Checksums

Address	Checksum
8000	*CE95*
5000	*1203*
6000	*7A4B*
7000	*176F*

Troubleshooting the Watchdog Circuit

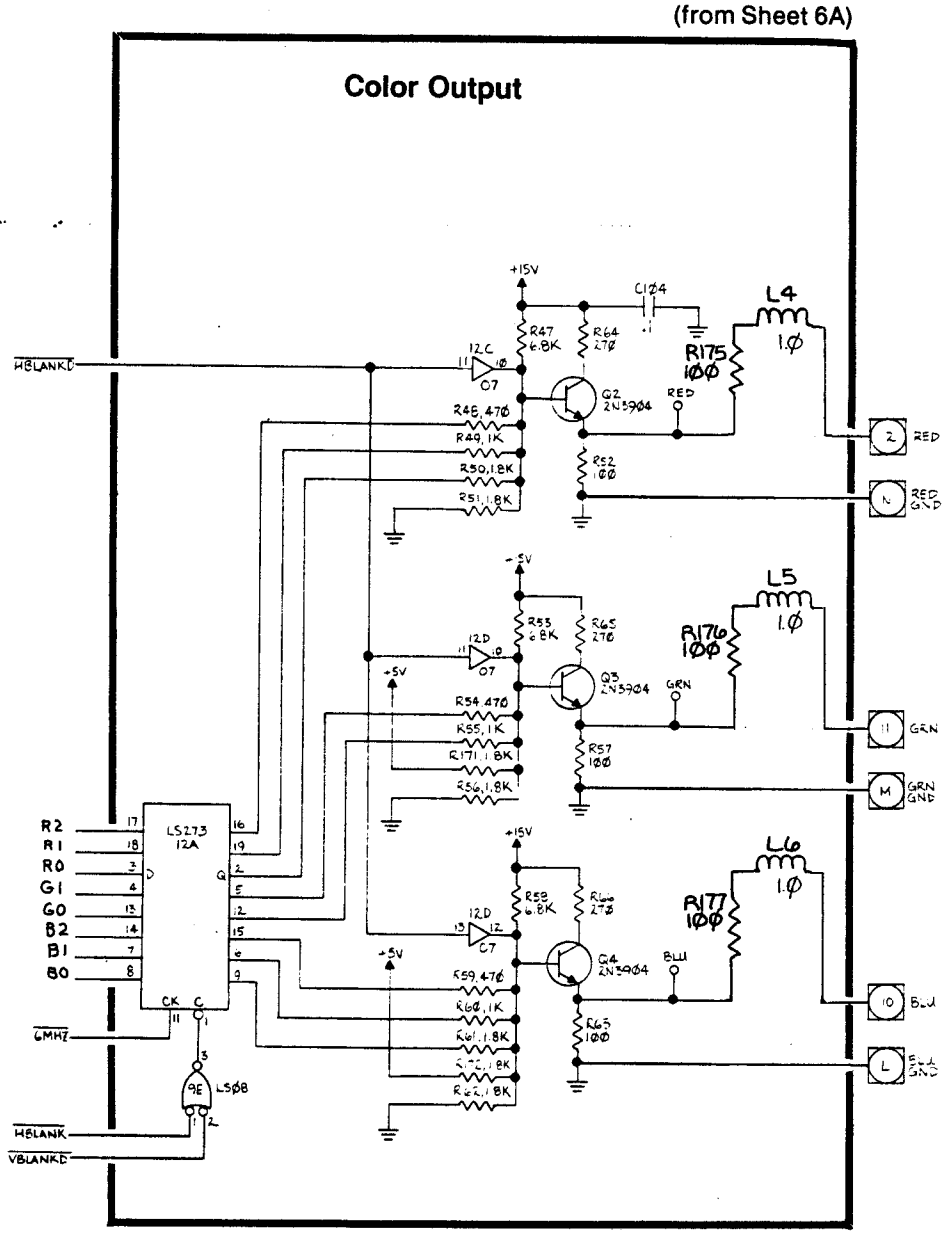
The Watchdog circuit will send continuous reset pulses to the microprocessor if a problem exists within the microprocessor circuit. If the self-test fails to run, it is a good practice to check the RESET line.

$\overline{\text{RESET}}$ is a microprocessor input (pin 40). In a properly operating game, reset should occur during power-up or when the $\overline{\text{RESET}}$ test point is grounded. A pulsing $\overline{\text{RESET}}$ line indicates that something is causing the microprocessor to lose its place within the program. Typical causes are:

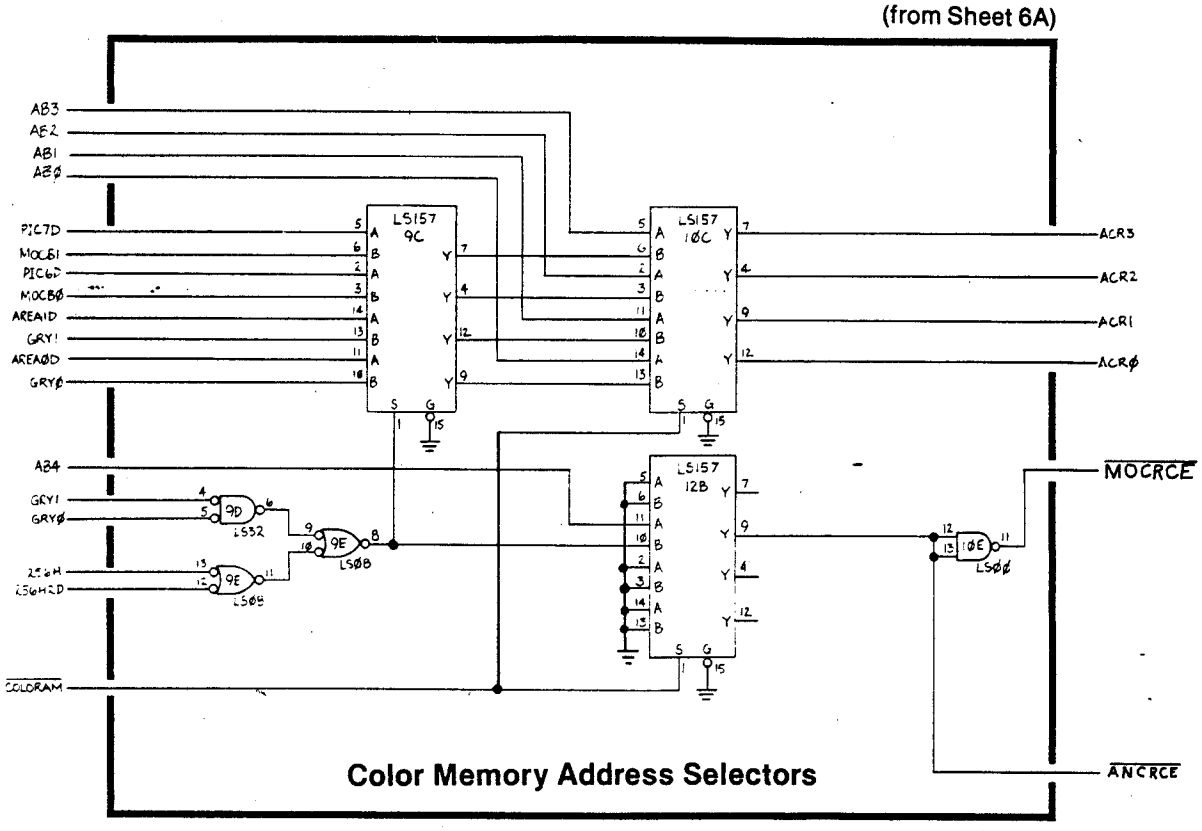
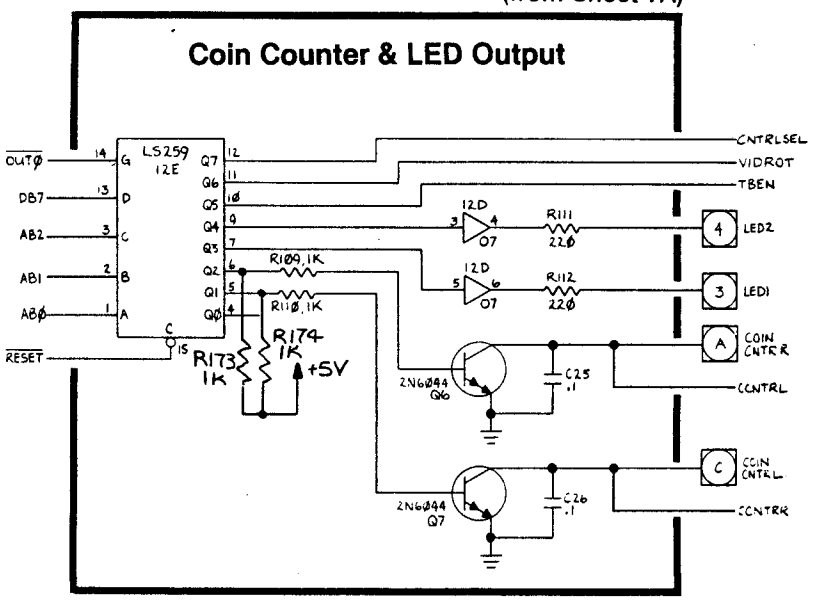
1. Open or shorted address or data bus lines.
2. Bad microprocessor chip.
3. Bad bus buffers.
4. Bad ROM.
5. Bad RAM.
6. Any bad input or output that causes an address or data line to be held in a constant high or low state.

A pulsing $\overline{\text{RESET}}$ signal indicates a problem exists somewhere within the microprocessor circuitry. To aid in troubleshooting, the $\overline{\text{WDDIS}}$ test point can be connected to a ground test point to prevent resets. This will sometimes allow the Self-Test to be used to diagnose the failure during a RESET condition.

(from Sheet 6A)



(from Sheet 6A)



(from Sheet 7A)