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GRAVITAR™ RETROFIT

Instructions

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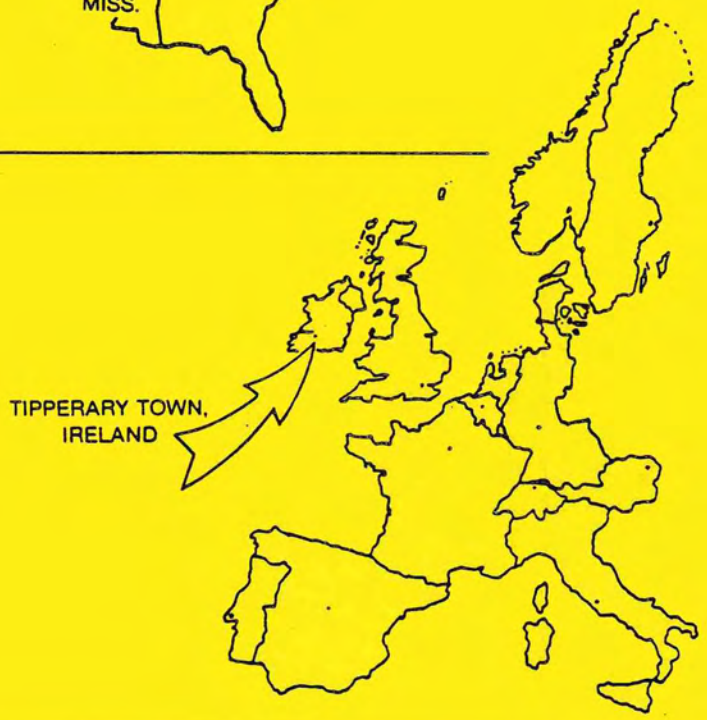

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Gravitar™ Retrofit Instructions

Introduction

The following information includes the necessary retrofit instructions for changing the Gravitar upright game into a Black Widow game. The modifications include changing the cabinet graphics, the control panel, the harness assembly, certain game board components, and the self-test label. Information is also provided for changing the Gravitar Schematic Package Supplement (SP-206) to reflect the Black Widow circuitry.

Kit Parts Inventory

Check the contents of the Black Widow Retrofit Kit (A040037-01) before proceeding with the retrofit procedure. Note that the integrated circuit (IC) components included in the retrofit kit are labeled with their respective part numbers. The parts included in this retrofit kit are listed in Table 1.

Table 1 Retrofit Kit Contents

Part No.	Quantity	Description
A040039-01	1	Electronics Kit—Includes the following:
110000-223	1	22 kΩ, ±5%, 1/4 W resistor
128002-101	1	100 pF, 100 V fixed mica capacitor
136017-101 to -110	10	Integrated circuits
A039975-01	1	Control panel with decal
A039989-01	1	Control panel harness assembly
A039990-01	1	Main conversion harness assembly
A040040-01	1	Attraction glass assembly
ST-234-01	1	Self-test chart
TM-234	1	Black Widow Operators Manual
62-039	2	SPDT momentary pushbutton start switch with red light-emitting diode
75-010S	8	#10 flat washer
75-5112B	8	10-24 x 3/4-inch black carriage bolt
75-941S	8	10-24 hexagonal locknut
036895-01	2	Black molded switch bezel

(continued on next page)

Table 1 Retrofit Kit Contents (continued)

Part No.	Quantity	Description
039978-01	1	Left side-panel decal
039978-02	1	Right side-panel decal
040002-01	1	Printed-circuit board (PCB) label
171021-001	2	8-position joystick

Tools Required for Retrofit

The tools listed in Table 2 (or their equivalents) are required to perform a complete retrofit modification.

Table 2 Tools Required for Retrofit

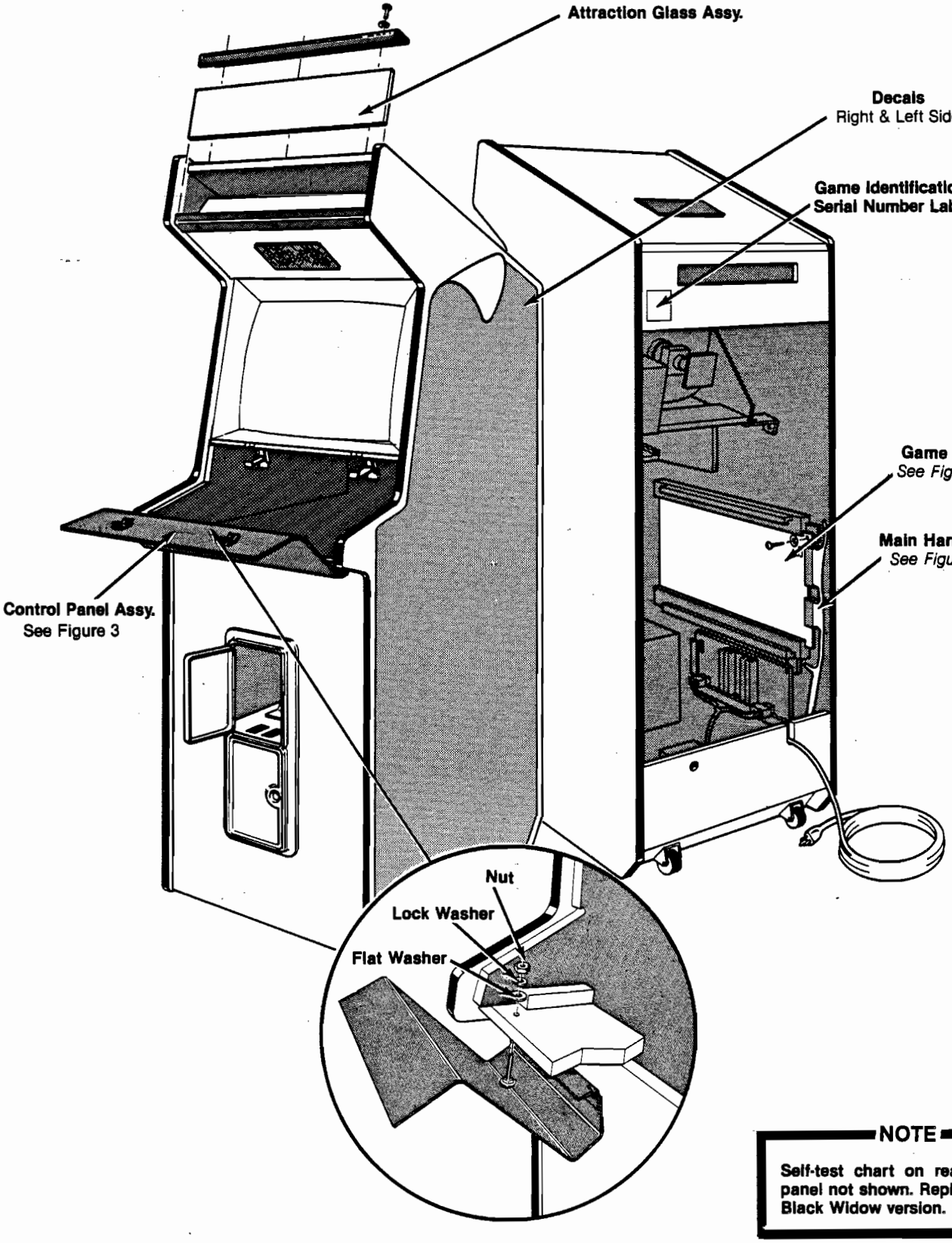
Quantity	Description	Purpose
1	1/8-inch Allen wrench	Install attraction glass
1	3/8-inch hex-nut driver	Assemble control panel
1	7/16-inch hex-nut driver	Install control-panel
1	Diagonal cutters	Remove PCB components
1	Needle-nose pliers	Install PCB components
1	Phillips-head screwdriver	Remove access panel and PCB
1	16-27 W soldering iron	Install PCB components
1	Squeegee	Install decal graphics

Retrofit Instructions

NOTE

These procedures must be performed by qualified service personnel.

The following procedures are arranged in a sequence recommended for performing the retrofit modification. The parts of the Gravitar game that are affected by the modification (see Figure 1) are removed first. Next, the game PCB is modified. Then, the modified PCB and the remaining kit parts are installed.



NOTE

Self-test chart on rear access panel not shown. Replace with Black Widow version.

Figure 1 Location of Gravitar Parts Affected by Retrofit

WARNING

Unplug the game before performing the following procedures.

Remove the Attraction Glass

1. Use the 1/8-inch Allen wrench to remove the three screws and washers that fasten the top retainer to the cabinet. Remove the retainer. Keep the screws and washers for reassembly.

2. Loosen the three screws that fasten the bottom retainer to the cabinet. Remove the attraction glass.

3. Remove the three screws and washers from the bottom retainer. Keep the screws and washers for reassembly.

4. Remove and discard the foam tape from the underside of the top and bottom retainers. Keep the retainers for reassembly.

Remove the Control Panel

1. Use the Phillips-head screwdriver to remove the screws that fasten the access panel to the back of the game cabinet. Remove the access panel.

2. Reach inside the game cabinet and release the two spring-draw latches on the back of the control panel.

3. Grasp the top edge of the control panel from the front of the game cabinet and swing the panel down to expose the three mounting bolts.

4. Disconnect the cable connector at the back of the control panel.

5. Use the 7/16-inch hex-nut driver to remove the Gravitar control panel from the cabinet. Keep the bolts, washers, and nuts for reassembly.

Remove the Game PCB

1. Disconnect the two edge connectors from the game PCB.

2. Use the Phillips-head screwdriver to remove the screw and spacer that secure the game PCB to the cabinet. Keep the screw and spacer for reassembly.

3. Carefully slide the PCB straight out of its slots. Be careful not to twist the board to avoid loosening connections or components.

Modify the Game PCB

NOTE

The game PCB must be removed from the cabinet before performing this procedure.

1. Remove the 10 integrated circuits (EPROMS) from the locations shown in Figure 2.

2. Install the 10 integrated circuits from the retrofit kit in the PCB locations shown in Table 3. Refer to the part numbers labeled on each IC and use Figure 2 to determine their locations.

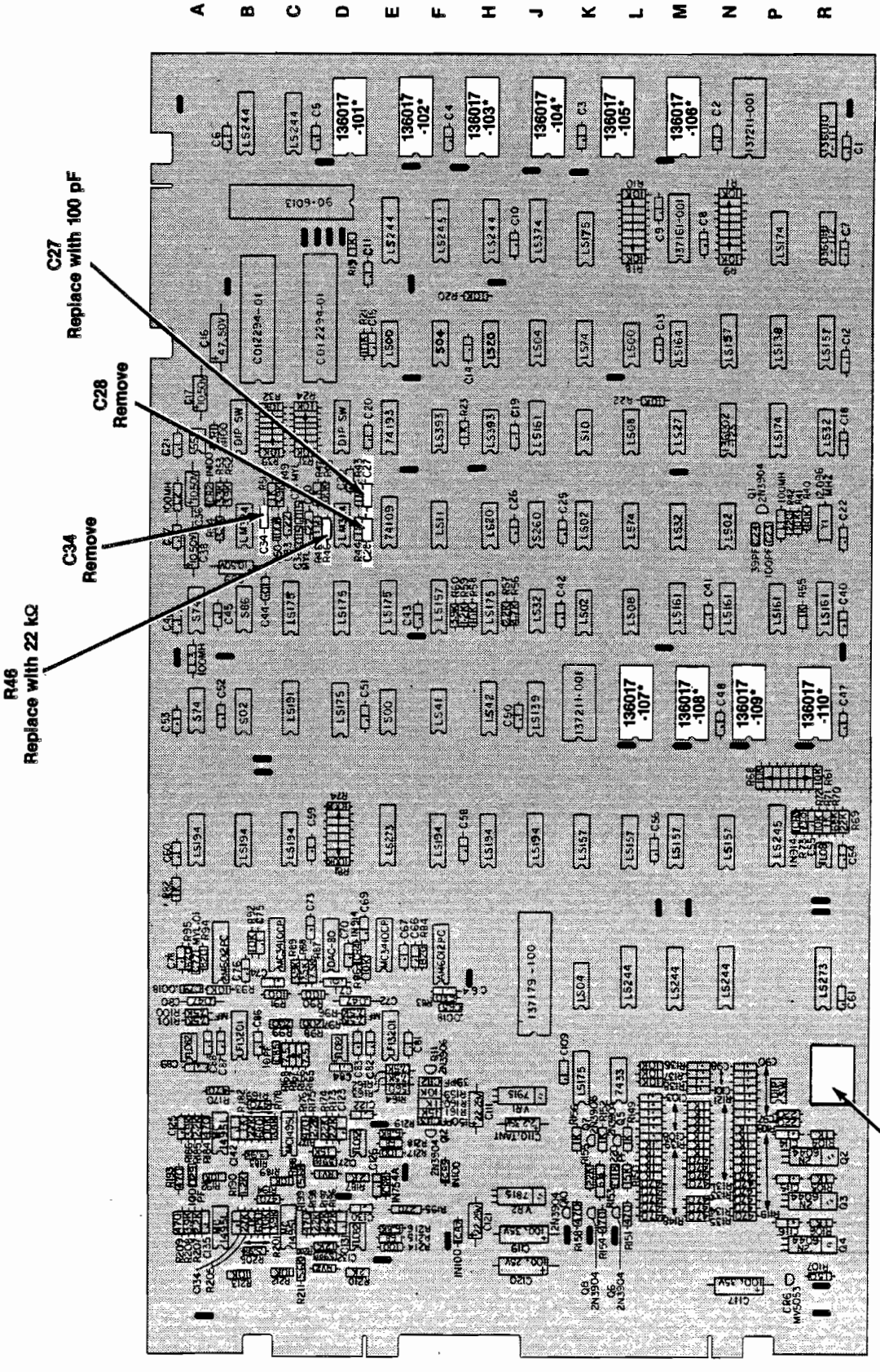
Table 3 IC Component Locations

IC Part No.	Location
136017-101	D1
136017-102	E/F1
136017-103	H1
136017-104	J1
136017-105	K/L1
136017-106	M1
136017-107	L7
136017-108	M/N7
136017-109	N/P7
136017-110	R7

NOTE

Refer to Figure 2 for the locations of the components removed and replaced in steps 3 through 5.

3. Use the diagonal cutters to remove capacitors C28 (0.001 µF) and C34 (0.22 µF). These components are not used in the Black Widow game.



*Replace these integrated circuits with those from the retrofit kit that have part numbers as shown in each location.

Figure 2 Location of PCB Components Affected by Retrofit

4. Use the soldering iron and needle-nose pliers to remove capacitor C27 (0.001 µF) and resistor R46 (10 kΩ). Replace C27 with the 100 pF capacitor and R46 with the 22 kΩ resistor from the kit. Be careful not to overheat the PCB. Excessive heat can separate the conductive material from the board.

5. Remove the protective backing and attach PCB label (040002-01).

Assemble the Control Panel

> **NOTE**
>
> Refer to Figure 3, Assembling the Control Panel, when performing the following procedure.

1. Insert the two black molded switch bezels into the two holes on the left front of the control panel. Make sure the switch bezel tabs are inserted into the hole slots.

2. Hold the bezels in position and hand-tighten the two pushbutton start switches into the bezels.

3. Insert the 8-position joystick handles through the control panel holes and use the 3/8-inch hex-nut driver to attach the carriage bolts, flat washers, and hexagonal locknuts.

4. Connect the wire harness leads to the pushbutton start switches and joysticks. The lead pairs to each joystick switch can be attached to either terminal.

5. Peel the protective backing from the 1-inch wire harness cable mounts and firmly attach the wire harness to the control panel.

6. Attach the ground clip to the control-panel latch bracket so that the clip contacts rest in the clean unpainted area on the bracket.

Install the Wiring Harness

1. Insert the four wires from the main conversion harness assembly into the pin sockets of the 44-pin PCB edge connector as shown in Figure 4. Make sure the contacts are positioned properly before locking the pins in place.

2. Use five wire ties from the retrofit kit to secure the four harness assembly wires to the existing Gravitar main wire harness that runs underneath the game PCB and toward the control panel.

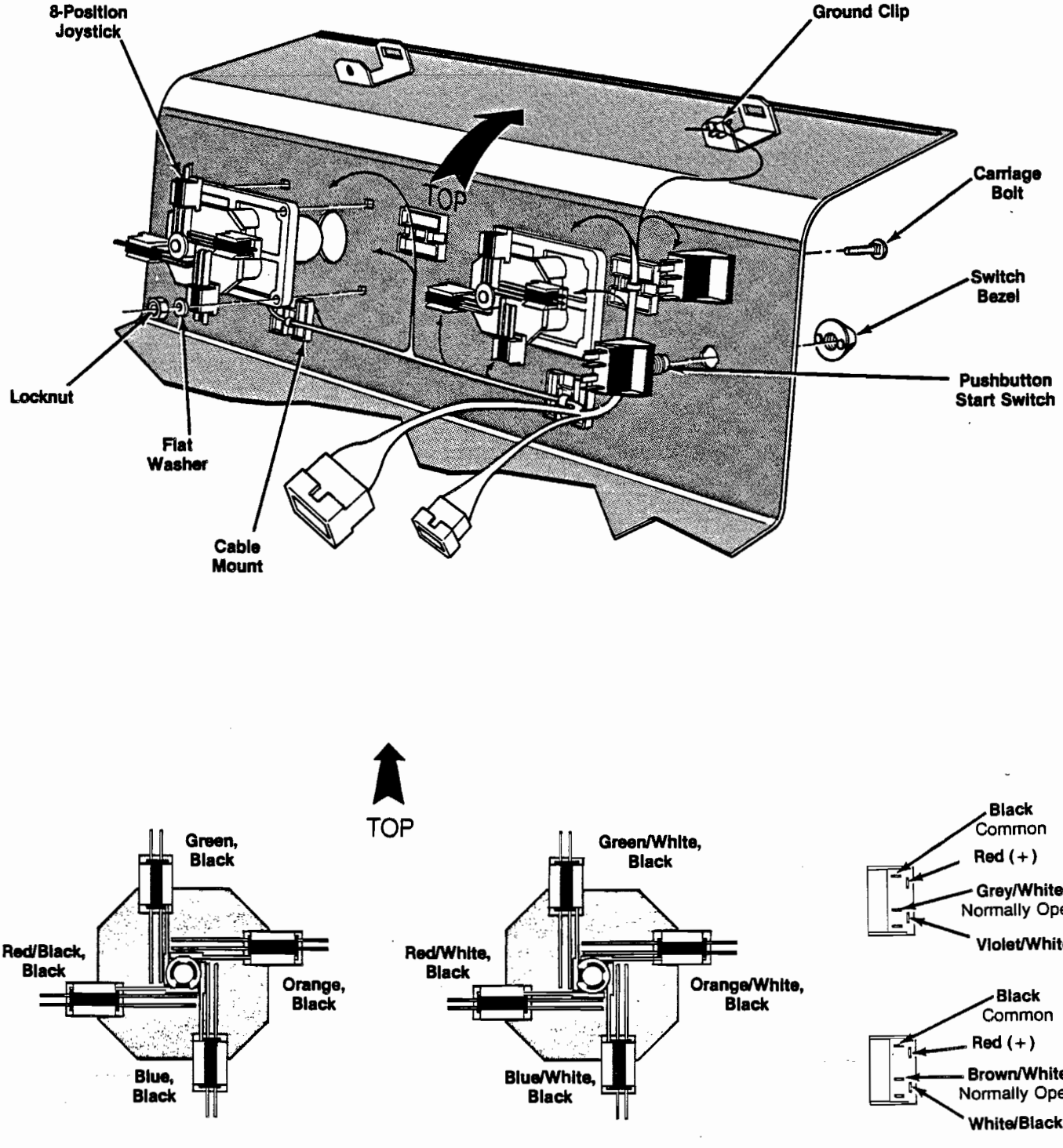
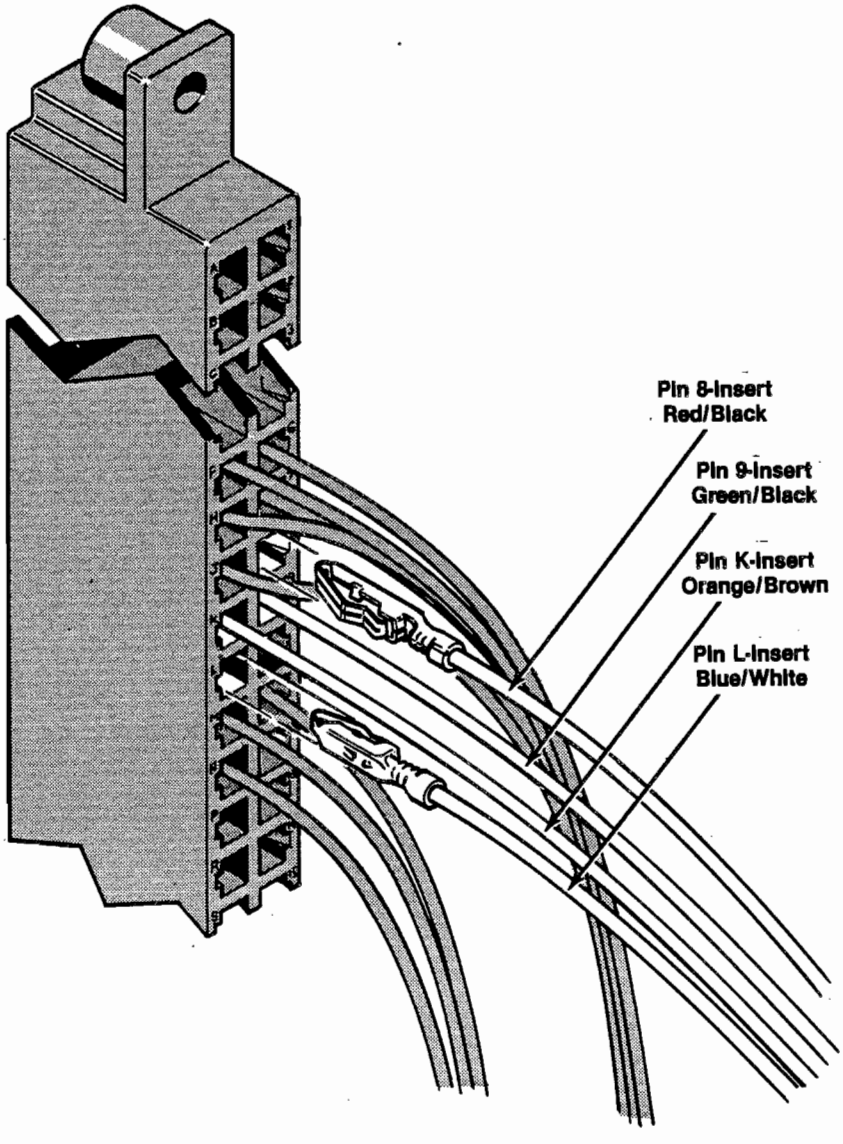


Figure 3 Assembling the Control Panel



NOTE

Insert new pins with spring contact facing center of connector.

Figure 4 Harness Wire Installation

Install the PCB

1. Carefully slide the modified game PCB into its mounting slots. Make sure the foam pad is secured to the cabinet near the center of the PCB.

2. Attach the PCB to the cabinet with the screw and spacer.

3. Connect the two edge connectors to the PCB. Make sure the PCB is inserted firmly against the back of the connectors.

4. Secure the edge connectors to the PCB by fastening a wire tie around the eye at each end of the two connectors and through the hole in the PCB as shown in Figure 5 (total of four ties).

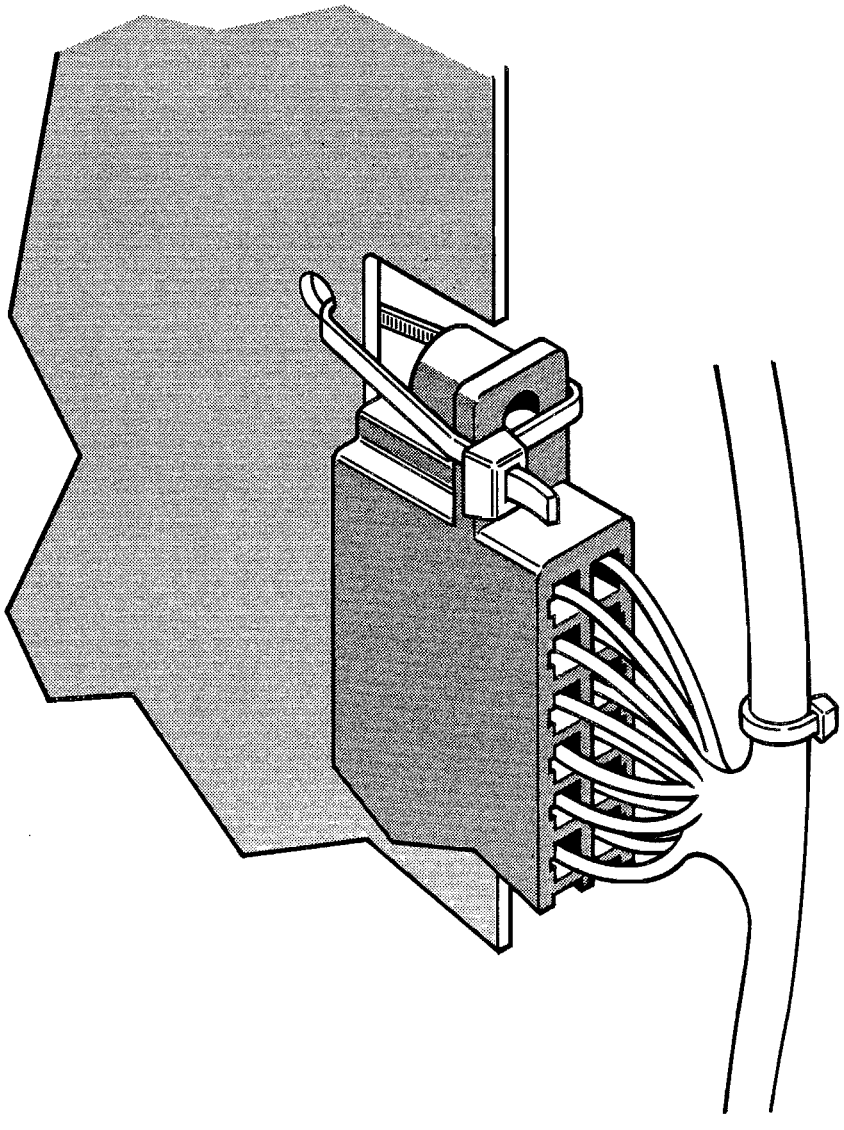


Figure 5 PCB Edge-Connector Wire-Tie Installation

Install the Control Panel

1. Securely fasten the Black Widow control panel to the game cabinet with the three mounting bolts, washers, and nuts previously removed from the Gravitar control panel.

2. Securely fasten the two connectors at the back of the control panel to their mating connectors on the main harness assembly.

3. Close the control panel. Reach into the back of the game cabinet and fasten the two spring-draw latches at the top edge of the control panel.

Install the Attraction Glass

1. Loosely fasten the bottom retainer to the game cabinet with the three mounting screws and washers.

2. Slide the Black Widow attraction glass into the bottom retainer.

3. Hold the top retainer tight against the top of the attraction glass and securely attach the top retainer to the game cabinet with the three mounting screws and washers.

4. Press the bottom retainer tight against the attraction glass and tighten the three mounting screws.

Install the Decals

NOTE

We recommend that the following installation procedure be performed by two persons. One person may have difficulty handling the cabinet and the large decals.

1. Tip the game cabinet sideways and gently lay it on a soft blanket.

2. Thoroughly clean the side of the game cabinet to ensure the removal of all dust.

3. Grasp the top edge of the appropriate decal for the side of the game cabinet. Hold the decal up off the floor and peel away the protective backing.

4. Gently lay the decal, sticky side down, in the center of the game cabinet. Position the decal to allow about three-quarters of an inch between the edges of the decal and the edges of the cabinet.

NOTE

The adhesive side of the decal has glass beads that will permit positioning of the decal. DO NOT PRESS DOWN on the decal until it is in position or the glass beads will break and set the adhesive.

5. With the decal down and in position, use the squeegee to break the glass beads and set the adhesive by quickly working from the center to the outside edges.

6. When the wrinkles are removed and the decal is in position, gently turn the game cabinet over to the opposite side. Be careful to avoid damaging the freshly applied decal.

7. Repeat steps 1 through 6 for the remaining decal.

8. Carefully raise the cabinet to the upright position.

9. When both decals are firmly affixed, remove the protective covering. Allow time to dry before proceeding!

Change the Model Number

Permanently mark the game identification serial number label (see Figure 1) with model number 33100-01.

Install the Self-Test Chart

Replace the Gravitar self-test chart on the inside of the rear access panel with the Black Widow self-test chart.

Set the Option Switches

1. Set the option switches as described in the Black Widow Operators Manual.

2. Replace the rear access panel on the game cabinet.

Perform a Self-Test

1. Plug the game in.

2. Set the power on/off switch to the on position.

3. Perform the self-test procedure as described in the Black Widow game manual. Be sure to adjust the x- and y-axis potentiometers as described on sheet 8B in the Gravitar Schematic Package Supplement.

Change the Gravitar Schematic Package

The circuitry given in the Gravitar Schematic Package Supplement, SP-206, applies to the Black Widow game after the following changes have been made:

- Sheet 1B, Gravitar Main Wiring Diagram: Replace the Control Panel section of the wiring diagram with Figure 6.
- Sheet 5A, Gravitar PCB Schematic Diagram: Replace the Option Switch Input, Audio Output, and Coin Door and Control Panel Input schematics with Figures 7 and 7A.
- Sheet 5B, 6A, 6B, 7A & 7B, Gravitar PCB Schematic Diagrams: The signatures shown in color do not apply for the Black Widow game.
- Sheet 11A, Gravitar PCB Troubleshooting: Replace the Memory Map with Figure 8.
- Sheet 11B, Gravitar PCB Troubleshooting: Replace Table 4, Player and DIP Switch Inputs, with Figure 9.
- Sheet 12B, Gravitar PCB Troubleshooting (2nd printing only): Delete Troubleshooting with Checksums procedure.

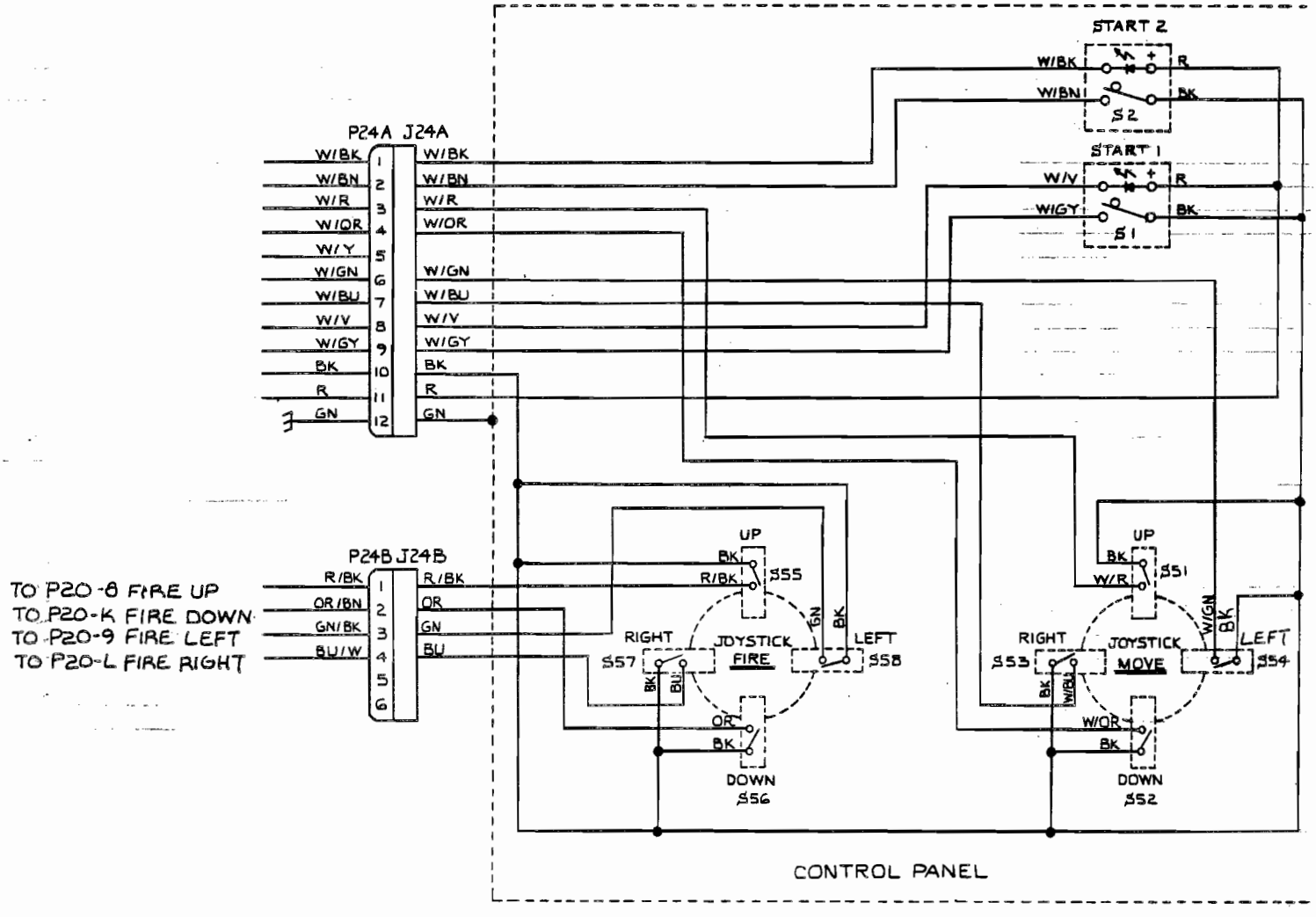


Figure 6 Sheet 1B (Gravitar Main Wiring Diagram) Changes

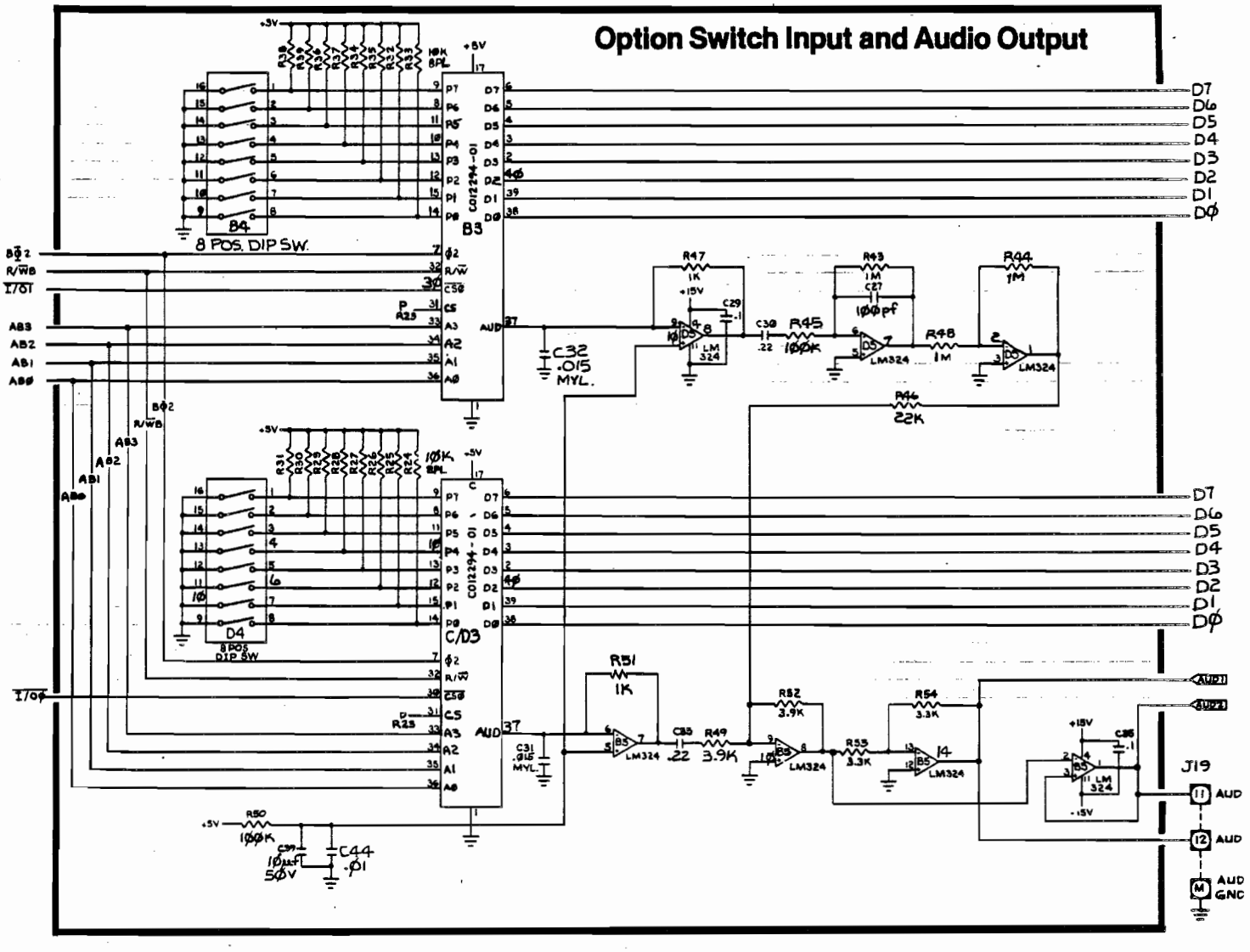


Figure 7 Sheet 5A (Gravitar PCB Schematic Diagram) Changes

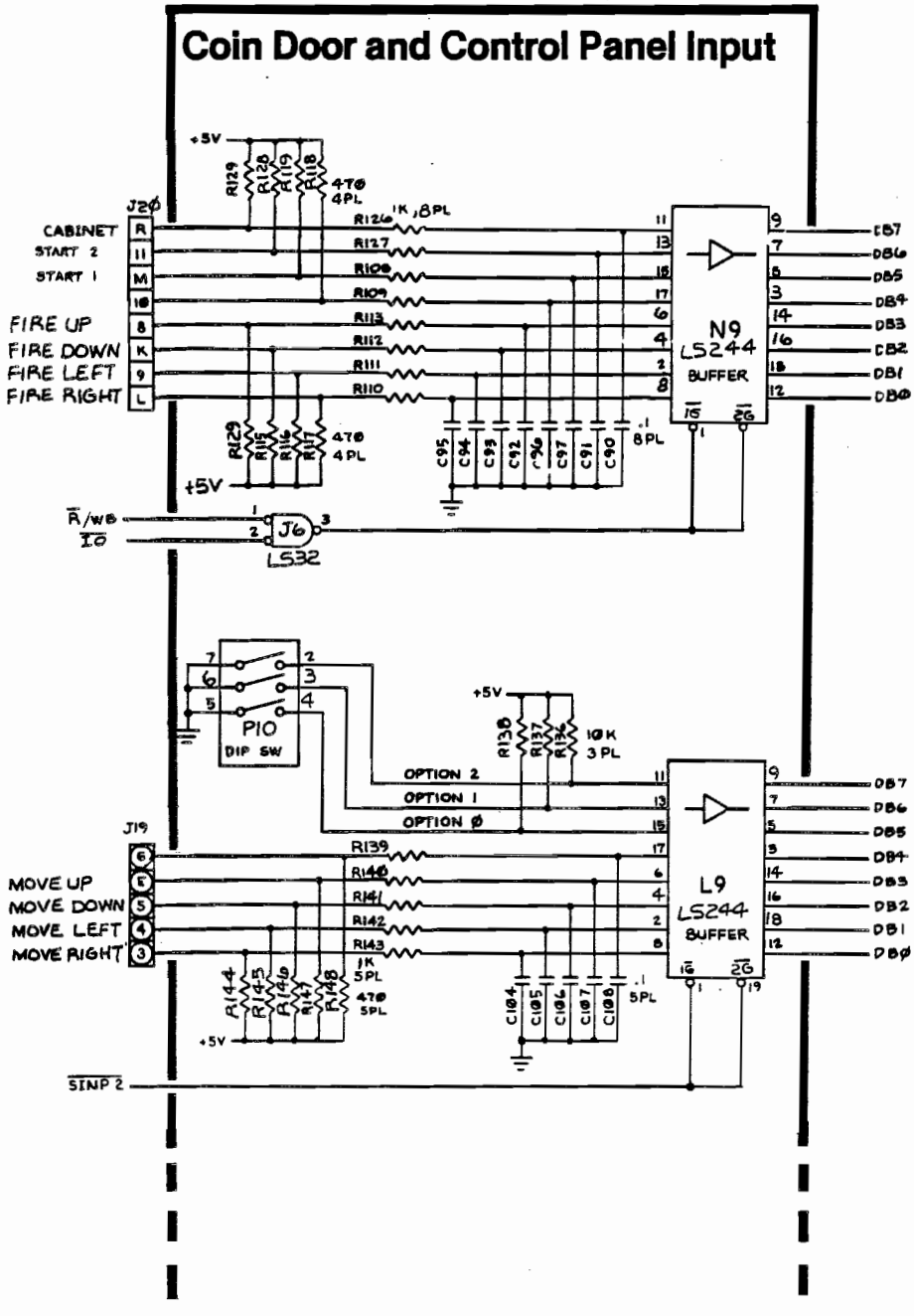


Figure 7A Sheet 5A (Gravitar PCB Schematic Diagram) Changes

MEMORY MAP

HEXA-DECIMAL ADDRESS	ADDRESS BUS																R/W	DATA BUS								FUNCTION
	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0		D7	D6	D5	D4	D3	D2	D1	D0	
E000-EFFF	1	1	1		A	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	$\overline{\text{ROM 5}}$
D000-DFFF	1	1	0	1	A	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	$\overline{\text{ROM 4}}$
C000-CFFF	1	1	0	0	A	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	$\overline{\text{ROM 3}}$
B000-BFFF	1	0	1	1	A	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	$\overline{\text{ROM 2}}$
A000-AFFF	1	0	1	0	A	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	$\overline{\text{ROM 1}}$
9000-9FFF	1	0	0	1	A	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	$\overline{\text{ROM 0}}$
8800	1	0	0	0	1												R	D								CABINET 1
																			D							$\overline{\text{START 2}}$
																				D						$\overline{\text{START 1}}$
																					D					SPARE
																						D				$\overline{\text{FIRE UP}}$
																							D			$\overline{\text{FIRE DOWN}}$
																								D		$\overline{\text{FIRE LEFT}}$
																									D	$\overline{\text{FIRE RIGHT}}$
89C0	1	0	0	0	1	0	0	1	1	1							W									SPARE WT
8980	1	0	0	0	1	0	0	1	1	0							W									WDCLR
8940	1	0	0	0	1	0	0	1	0	1	A	A	A	A	A	A	W	D	D	D	D	D	D	D	D	EAROMWR
8900	1	0	0	0	1	0	0	1	0	0							W					D	D	D	D	EAROMCON
88C0	1	0	0	0	1	0	0	0	1	1							W									INTACK
8880	1	0	0	0	1	0	0	0	1	0							W									VORST
8840	1	0	0	0	1	0	0	0	0	1							W									VGGO
8800	1	0	0	0	1	0	0	0	0	0							W	D								$\overline{\text{INVERT Y}}$
																			D							$\overline{\text{INVERT X}}$
																				D						$\overline{\text{PLAYER 2 LED}}$
																					D					$\overline{\text{PLAYER 1 LED}}$
																						D				$\overline{\text{COIN LOCKOUT}}$
																							D			BANK SEL
																								D		COIN CNTR-L
																									D	COIN CNTR-R
8000	1	0	0	0	0												R	D								OPTION 2
																			D							OPTION 1
																				D						OPTION 0
																					D					SPARE
																						D				$\overline{\text{MOVE UP}}$
																							D			$\overline{\text{MOVE DOWN}}$
																								D		$\overline{\text{MOVE LEFT}}$
																									D	$\overline{\text{MOVE RIGHT}}$
7800	0	1	1	1	1												R	D								3 KHZ
																			D							HALT
																				D						$\overline{\text{SA}}$
																					D					SELF-TEST
																						D				$\overline{\text{COIN-AUX}}$
																							D			$\overline{\text{COIN L}}$
																								D		$\overline{\text{COIN R}}$
7000	0	1	1	1	0												R	D	D	D	D	D	D	D	D	$\overline{\text{EAROMRD}}$
6800	0	1	1	0	1												R/$\overline{\text{W}}$	D	D	D	D	D	D	D	D	I/O1
6000	0	1	1	0	0												R/$\overline{\text{W}}$	D	D	D	D	D	D	D	D	$\overline{\text{I/O}\emptyset}$
5000-5FFF	0	1	0	1	A	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	$\overline{\text{VROM 3}}$
4000-4FFF	0	1	0	0	A	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	$\overline{\text{VROM 2}}$
3000-3FFF	0	0	1	1	A	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	$\overline{\text{VROM 1}}$
2800-2FFF	0	0	1	0	1	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	$\overline{\text{VROM 0}}$
2000-27FF	0	0	1	0	0	A	A	A	A	A	A	A	A	A	A	A	R/$\overline{\text{W}}$	D	D	D	D	D	D	D	D	$\overline{\text{VRAM}}$
0000-07FF	0	0	0	0	0	A	A	A	A	A	A	A	A	A	A	A	R/$\overline{\text{W}}$	D	D	D	D	D	D	D	D	$\overline{\text{RAM}}$

Figure 8 Sheet 11A (Gravitar PCB Troubleshooting) Changes

Table 4 Player and DIP Switch Inputs

ADDRESS	INPUT SWITCH	TEST RESULTS
7800	Right coin switch, Left coin switch, Auxiliary coin switch, Self-Test switch	DATA display changes when any coin switch or the Self-Test switch is activated. Upper nybble of DATA display is unstable.
8000	Left Joystick	DATA display changes when any of these input switches is activated.
8800	Right Joystick Start 1 Start 2	DATA display changes when any of these input switches is activated.

Figure 9 Sheet 11B (Gravitar PCB Troubleshooting) Changes

Kit Warranty

Seller warrants that its electronic parts supplied in this kit are free from defects in material and workmanship under normal use and service for a period of ninety (90) days from date of shipment. None of the Seller's other products or parts thereof are warranted.

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

(a) Seller is promptly notified in writing upon discovery by Buyer that said products are defective;

(b) Such products are returned prepaid to Seller's plant; and

(c) Seller's examination of said products discloses to Seller's satisfaction that such alleged defects existed and were not caused by accident, misuse, neglect, alteration, improper repair, installation, or improper testing.

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

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

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