Williams® ELECTRONICS, INC.

INSTRUCTION BOOKLET

This booklet provides game operation, bookkeeping, game adjustment, diagnostic, and self-test procedures for DEFENDER. For installation and special maintenance information refer to the blue-covered game manual.

SPECIAL CONSIDERATIONS WHEN REPLACING CIRCUIT BOARDS

CPU Board
1. Revision level 7 CPU Boards (batteries located on lower left corner at board) or later boards must be used.
2. Must be equipped with blue-labeled Flipper ROMs and blue-labeled Game ROMs.
3. Jumpers W3, W10, W11, W14, W17, W19, W20, and W22 must be connected. Jumpers W4, W9, W12, W15, W16, W18, W21, and W23 must be removed. With the exception of W25, (Factory Setting Jumper) all other jumpers are not changed.

Driver Board
Must be equipped with zero-ohm resistors or wire jumpers (W9-W16) in place of switch matrix drive series resistors R204-R211.

Sound Board
Must be jumpered for ROM operation and be equipped with Sound ROM 15. (Jumpers W2, W5, W7, W9, W10, W12, and W15 connected; W3, W4, W6, W11, and W13 removed.)

Power Supply Board
1. Model D 8345 board required (equipped with relay).
2. Fuse F4 (10A SB) for flipper solenoids must be installed.

Display Boards
Model C 8363 Master Display and 7-digit Slave Displays required.

Game Operation

*Indicates adjustable features.

Game Over Mode - Turn game ON; player 1 score shows 00; all player scores alternate the high score to date. Game Over lamp lights. All playfield lamps cycle in attract mode.

Credit Posting - Insert coins; sound produced, number of credits displayed. If maximum credits* exceeded by coin or high score to date, credits posted correctly and coin lockout de-energizes until remaining credits are below maximum. No credits may be won and coins are rejected while the coin lockout is de-energized.

Game Start - Three balls must be resting on ball ramp or ball shooter switches (maximum of one ball in ball shooter trough) before game will start. Push credit button; start-up tune played, ball served, credit display reduced by 1, and then displays wave number. Player 1 score flashes 00 until first scoring switch is made, ball in play display shows 1. Pushing credit button before ball 2 shows additional players.

MULTI-BALL and *LANE CHANGE* are trademarks of Williams Electronics, Inc.

WAVES - A Wave consists of 15 Landers that try to capture Humanoids (Bonus). Complete as many Waves as possible while preventing loss of Humanoids. Baiters appear randomly to block shots. To complete Wave hit all Lander drop targets. If any Landers become Mutants, they must also be hit to complete Wave. Ten Humanoids Lamps are lit at Game Start. Completing Wave scores Humanoid value times each lit Humanoid. Humanoid value lamps increase from 1,000 for first Wave, to 5,000 for fifth and subsequent Waves. Every fifth Wave awards Extra Ball and restores ten Humanoids. Completing tenth Wave awards Special*. Draining Ball scores bonus, starts Wave over and restores ten Humanoids.

LANDERS - During each Wave 15 Lander drop targets will appear at random trying to capture Humanoids. If a Humanoid is captured the Mutant lamp in front of Lander and Humanoid lamp will flash, allowing time to rescue Humanoid by hitting target. If flashing target is not hit, the Humanoid is lost, the Mutant lamp stays lit, and Lander Target disappears, allowing Mutant Bull's-Eye to change positions randomly, making Wave more difficult to complete. In higher Waves, Landers become more aggressive.

BOMBER LANES - Making the Bomber lanes 1 through 4, advances Bonus multiplier* and lights left drain lane for reverse*. To activate reverse, press reverse button on left side of cabinet. The flipper *Lane Change* switch rotates 1 through 4 lamps from left to right. Achieving 10X Bonus multiplier lights Bull's-Eye for Warp*. Warping advances player three Waves.

PODS - Hitting a Pod target lights a random number of Swarmer lamps. Destroy each Swarmer by hitting Swarmer Bull's-Eyes or Swarmer standup. Destroying all lit swarmers scores 50,000. Destroying all Swarmers from both Pod targets opens return gate.

MULTI-BALL PLAY - Locking a ball in the lockup trough scores 5,000 for first and second ball, and lights Bull's-Eye for *Multi-Ball* play. Hitting lit Bull's-Eye releases all captured balls and scores 5,000 for each ball released. Locking three balls automatically initiates 3 ball *Multi-Ball*.

SMART BOMBS - Play starts with three Smart Bombs. Press Smart Bomb button on right side of cabinet to eliminate all Landers, Baiters and Swarmers on playfield. Using Smart Bomb completes Wave if all Landers have appeared, and no Mutants exist. Completing odd numbered Waves awards extra Smart Bomb.

*Indicates adjustable features.

BOOKKEEPING AND GAME EVALUATION
(Functions 01-17)

1. Set AUTO-UP/MANUAL-DOWN switch to AUTO-UP and depress ADVANCE pushbutton. Test 04 is indicated in the credits display, Function 00 in Match display, and Game Identification in Player 1 display.

2. Operate the ADVANCE pushbutton to display Functions 01 thru 04 on the Match display (See Table 1) and record the corresponding totals (number of coins and total paid credits) from the Player 1 display. (To review a total that has been advanced past, set switch to MANUAL-DOWN and operate the ADVANCE pushbutton).

3. Operate the ADVANCE pushbutton to display Functions 05, 06, and 07 in the Match display and record the corresponding free credit totals from the Player 1 display.

4. Operate the ADVANCE pushbutton to display Function 08 in the Match display. Total credits is indicated in the Player 1 display, total free credits in the Player 2 display, and percentage of free credits in the Player 4 display.

5. Operate the ADVANCE pushbutton to display Function 09 thru 12 in the Match display and record the corresponding totals from the Player 1 display.

6. Operate the ADVANCE pushbutton to display Functions 13 thru 17 in the Match display and record the corresponding totals from the Player 2 display.

7. With switch set to MANUAL-DOWN operate ADVANCE to display Function 50 in the Match Display. From Function 50 you can return to game over or zero audit totals and return to game over. Perform step 8.a. or 8.b. as desired.

8. a. To return to game over, set the switch to AUTO-UP and depress ADVANCE.
   b. **To zero audit totals** and return to game over set switch to AUTO-UP, operate the credit button to display 35 in the Player 1 display, and depress ADVANCE.

Table 1. Audit Totals

FUNCTION	DESCRIPTION	
	PLAYER 1	PLAYER 2
00	Game Identification (2517 1)	—
01	Coins, Left chute (closest to coin door hinge)	—
02	Coin, center chute	—
03	Coin, right chute	—
04	Total Paid Credits	—
05	Special Credits	—
06	Replay Score Credits	—
07	Match Credits	—
08	Total Credits	Free Credits
09	Total Extra Balls	—
10	Ball Time in Minutes	—
11	Total Balls Played	—
12	Current High Score to Date	—
13	Backup High Score to Date	High Score to Date Credits Awarded
14	Replay 1 Score	Times exceeded
15	Replay 2 Score	Times exceeded
16	Replay 3 Score	Times exceeded
17	Replay 4 Score	Times exceeded

GAME ADJUSTMENT PROCEDURE
(Functions 13-41)

Coin door must be open to change settings.

1. Set AUTO-UP/MANUAL-DOWN switch to AUTO-UP and depress the ADVANCE pushbutton. Test 04 is indicated in the Credits display, Function 00 in Match display, and game identification in Player 1 display.

2. **To raise** Function number in Match display, operate ADVANCE pushbutton with switch set to AUTO-UP. **To lower** Function number, operate ADVANCE with switch set to MANUAL-DOWN.

3. With desired Function indicated in Match display, **raise** value in player 1 display by operating credit button with switch set to AUTO-UP; **lower** value by operating credit button with switch set to MANUAL-DOWN. Value left in Player 1 display is the new setting. For values see Table 2, and for pricing Table 3.

4. Repeat steps 2 and 3 until all required adjustments have been made.

5. Operate ADVANCE until Function 50 is indicated in Match display. From Function 50 you can return to game over or **restore factory settings**. Perform step 6 or 7 as desired.

6. To return to game over, depress ADVANCE with switch set to AUTO-UP.

7. To restore factory settings **and** zero audit totals:
    a. Operate Credit button with switch set to AUTO-UP until 45 is indicated in Player 1 Display.
    b. Depress ADVANCE. The game returns to Test 04, Function 00.
    c. Set switch to MANUAL-DOWN and depress ADVANCE to indicate Function 50.
    d. Set switch to AUTO-UP and depress ADVANCE.

RESETTING HIGH SCORE TO DATE

1. Using game adjustment procedure, set Function 13 to the desired reset value.

2. Depress HIGH SCORE RESET pushbutton.

FACTORY AUDIT TOTALS
(Functions 42-49)

The factory audit functions are not assigned.

Table 2. Game Adjustments

FUNCTION	DESCRIPTION	NOTES	*FACTORY SETTING
13	Backup High Score to Date [HSTD Credits Awarded]	1	2,500,000
14	Replay 1 Score [Times exceeded]	2	1,000,000
15	Replay 2 Score [Times exceeded]	2	2,000,000
16	Replay 3 Score [Times exceeded]	2	0
17	Replay 4 Score [Times exceeded]	2	0
18	Maximum Credits	3	30
19	Standard and Custom Pricing Control	4	01/02
20	Left Coin Slot Multiplier	4	01/09
21	Center Coin Slot Multiplier	4	04/45
22	Right Coin Slot Multiplier	4	01/18
23	Coin Units Required for Credit	4	02/05
24	Coin Units Bonus Point	4	04/45
25	Minimum Coin Units	4	00
26	Match: 00 = Match ON; 01 = Match OFF	-	00
27	Special: 00 = Awards Credit; 01 = No Special; 02 = Awards Points	-	00
28	Replay Scores: 00 = Awards Credit; 01 = Awards Extra Ball	-	00
29	Maximum Plumb Bob Tilts	-	03
30	Number of Balls (03 or 05)	-	03
31	Reverse Lane Lamp: 00 = Not Lit Initially, No Memory; 01 = Lit Initially, ON Memory	-	01
32	Wave to complete for Special (01 to 99)	-	10
33	Warp Lamp: 00 = No Memory; 01 = ON Memory	-	01
34	Bonus Multiplier: 00 = No Memory; 01 = ON Memory	-	01
35	Special Solenoid Test: 01 = To Activate	5	00
36	Not Used	-	00
37	Not Used	-	00
38	Not Used	-	00
39	Not Used	-	00
40	High Score Credits	1	03
41	Maximum Extra Balls at one time (00 = No Extra Ball)	-	07

NOTES:

* Second Factory Setting value is with jumper W25 on CPU Board connected.

[ ] Description in brackets shown in Player 2 Display.

1. Function 13 may be set to any multiple of 100,000 points. Setting Function 40 to zero with Function 13 set to any score but zero permits the High Score to Date feature to operate but no credits are awarded.

2. Functions 14-17 (Replay Scores) may be set to any multiple of 100,000 points. Setting a function to zero disables the replay score point.

3. Setting Maximum Credits (Function 18) to zero places the game in a **free play mode**.

4. With Function 19 set to 00, Functions 20-25 must be set manually. Refer to Table 2 for eight standard pricing schemes (selected by values of 01-08 for Function 19) and custom pricing values. For straight quarter play, set Function 19 to 00, Function 23 to 01 and Function 24 to 00. All other pricing functions should remain at their factory settings.

5. Function 35 activates a Special Solenoid Test to exercise multiplexed solenoids. See Diagnostic Procedures—Solenoid Test.

Table 3. Standard and Custom Price Settings

COIN DOOR MECHANISM	CREDITS	FUNCTION						
		19	20	21	22	23	24	25
Twin-Quarter	1/25¢, 3/50¢, 7/$1	00	03	12	03	02	12	00
Quarter, Dollar, Quarter	1/25¢, 3/50¢, 7/$1 coin only	00	03	14	03	02	08	08
	1/25¢, 7/$1 coin only	00	01	07	01	01	08	08
	1/25¢, 3/50¢, 6/$1	00	01	04	01	01	02	08
	1/25¢, 6/$1 coin only	00	01	06	01	01	08	08
	1/25¢, 5/$1	00	01	04	01	01	04	08
	2/50¢, 5/$1	00	01	04	01	01	04	02
	1/25¢, 5/$1 coin only	00	01	05	01	01	08	08
	•1/25¢, 4/$1	01	01	04	01	01	00	00
	2/50¢, 4/$1	00	01	04	01	01	00	02
	•1/50¢, 2/75¢, 3/4 x 25¢ 4/$1 or 5 x 25¢	05	03	15	03	04	15	00
	1/50¢, 3/$1, 4/$1.25	00	03	12	03	04	15	00
	1/50¢, 3/$1, 7/$2	00	12	48	12	14	96	18
	•1/50¢, 3/$1, 6/$2	03	01	04	01	02	04	00
	1/50¢	00	01	04	01	02	00	00
1DM, 5DM, 2DM	•1/1DM, 3/2DM, 10/5DM	02	09	45	18	05	45	00
	2/1DM, 5/2DM, 14/5DM	00	13	65	26	05	65	00
20-Cent, 50-Cent	1/20¢, 3/50¢	00	06	00	15	05	00	00
1 Franc, 10 Franc, 5 Franc	•1/2F, 3/5F only, 8/10F only	04	01	16	06	02	00	00
25 Cent, 1 Guilder,	•1/25¢, 4/1G	06	01	00	04	01	00	00
	1/25¢, 5/1G	00	01	00	04	01	04	00
Twin 100 Yen	2/100Y	00	02	00	02	02	00	00
1 Franc or Twin-1 Franc	1/1F, 3/2F	00	01	01	01	01	02	00
	1/1F	00	01	01	01	01	00	00
5 Franc, 10 Franc	•1/5F, 2/10F	07	01	00	02	01	00	00
	•1/10F	08	01	00	02	02	00	00
Twin-2 Franc	•1/2F	03	01	04	01	01	00	00
10, 20 Franc	•1/10F, 2/20F	07	01	00	02	01	00	00
Twin-1 Sucre	1/3S, 2/5S	00	02	00	02	05	00	00

•Indicates standard price settings by adjusting only Function 19. For other price settings, set Function 19 to 00 and set Functions 20 through 25 to the values indicated in the chart.

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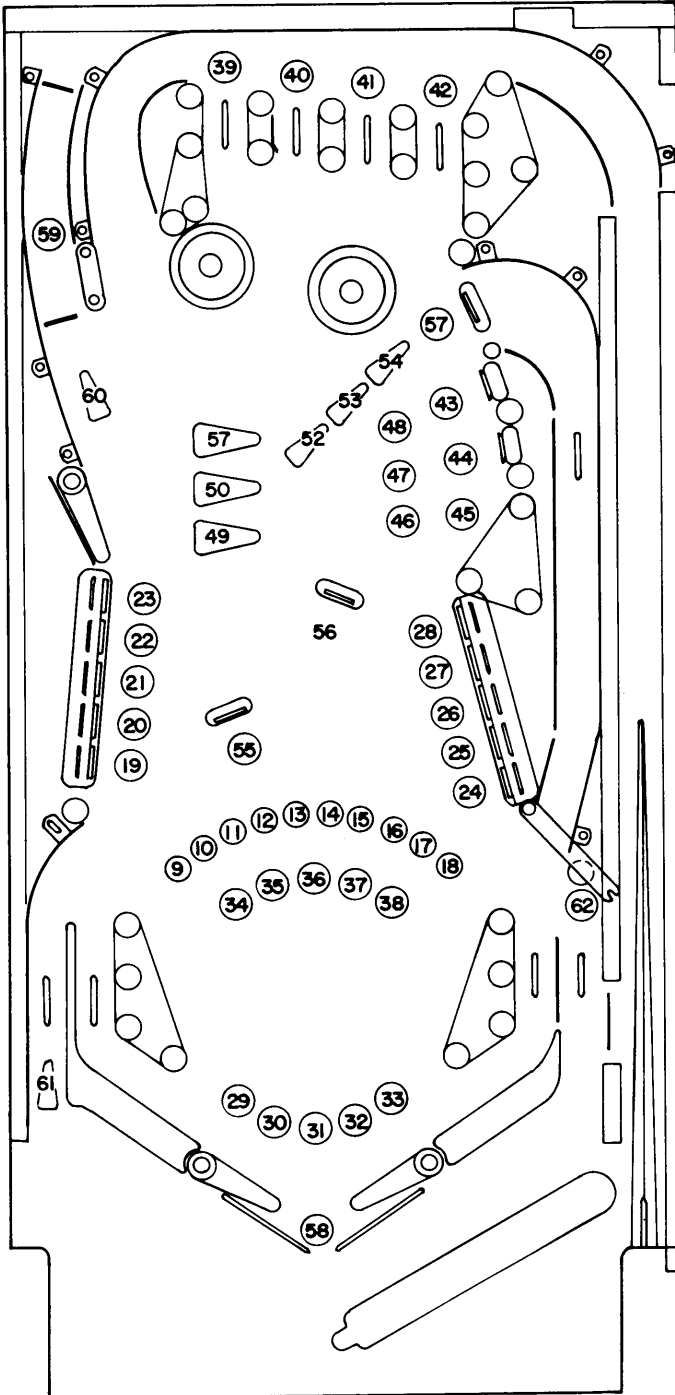## DIAGNOSTIC PROCEDURES

Display Digits Test

1. Set AUTO-UP/MANUAL-DOWN switch to MANUAL-DOWN and depress ADVANCE. Displays should indicate all 0's.

2. Set the switch to AUTO-UP. Displays should sequence from all 0's thru all 9's. Comma segments should come on when odd digits are displayed.

3. To stop cycling, set switch to MANUAL-DOWN. Operate ADVANCE pushbutton to step through the tests one number at a time. Set switch to AUTO-UP to resume cycling.

Sound Test

1. From Display Digits Test depress ADVANCE with the switch set to AUTO-UP. Test 00 should be indicated in the Credits display and the Match display should sequence from 00 thru 06. Different sounds should be produced for 00, 01, 02, 03, and 04.

2. To continuously pulse a single sound, set the toggle switch to MANUAL-DOWN. Operate ADVANCE pushbutton to sequence through sounds one at a time. Set toggle switch to AUTO-UP to resume sequencing.

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Lamp Test

From Sound Test depress ADVANCE with the switch set to AUTO-UP. Test 01 should be indicated in the Credits display and all multiplexed lamps should flash.

COLUMN ROW	1 YEL-BRN 2J5-8	2 YEL-RED 2J5-9	3 YEL-ORN 2J5-6	4 YEL-BLK 2J5-7	5 YEL-GRN 2J5-3	6 YEL-BLU 2J5-5	7 YEL-VIO 2J5-1	8 YEL-GRY 2J5-2
1 RED-BRN 2J7-1	Same Player Shoots Again (Backbox) **1**	Humanoid 1 (Left) **9**	Humanoid 9 **17**	Right Mutant 2 **25**	Humanoid Value −5,000 **33**	Bomber Lane 3 **41**	Smart Bomb 1 (Bottom) **49**	Baiter 3 (Top) **57**
2 RED-BLK 2J7-2	Ball in Play **2**	Humanoid 2 **10**	Humanoid 10 (Right) **18**	Right Mutant 3 **26**	Humanoid Value Multiplier 2X **34**	Bomber Lane 4 **42**	Smart Bomb 2 (Center) **50**	Same Player Shoots Again (Playfield) **58**
3 RED-ORN 2J7-3	Tilt **3**	Humanoid 3 **11**	Left Mutant 1 (Bottom) **19**	Right Mutant 4 **27**	Humanoid Value Multiplier 3X **35**	Swarmer 1 (Upper Right) **43**	Smart Bomb 3 (Top) **51**	Warp W/Lit **59**
4 RED-YEL 2J7-4	Game Over **4**	Humanoid 4 **12**	Left Mutant 2 **20**	Right Mutant 5 (Top) **28**	Humanoid Value Multiplier 4X **36**	Swarmer 2 (Center Right) **44**	Lockup 1 **52**	*MULTI-BALL* Play **60**
5 RED-GRN 2J7-5	Match **5**	Humanoid 5 **13**	Left Mutant 3 **21**	Humanoid Value −1,000 **29**	Humanoid Value Multiplier 5X **37**	Swarmer 3 (Lower Right) **45**	Lockup 2 **53**	Reverse **61**
6 RED-BLU 2J7-6	High Score To Date **6**	Humanoid 6 **14**	Left Mutant 4 **22**	Humanoid Value −2,000 **30**	Humanoid Value Multiplier 10X **38**	Swarmer 4 (Lower Left) **46**	Lockup 3 **54**	Gate **62**
7 RED-VIO 2J7-9	Not Used **7**	Humanoid 7 **15**	Left Mutant 5 (Top) **23**	Humanoid Value −3,000 **31**	Bomber Lane 1 **39**	Swarmer 5 (Center Left) **47**	Baiter 1 (Bottom) **55**	Not Used **63**
8 RED-GRY 2J7-8	Wave In Play **8**	Humanoid 8 **16**	Right Mutant 1 (Bottom) **24**	Humanoid Value −4,000 **32**	Bomber Lane 2 **40**	Swarmer 6 (Upper Left) **48**	Baiter 2 (Center) **56**	Not Used **64**

Figure 1. Lamp Matrix

Solenoid Test—NOTE: SPECIAL PROCEDURE REQUIRED

1. Enter Test 04 and operate ADVANCE to display function 35 on the Match Display.

2. Operate credit button to display 01 on the Player 1 display.

3. Operate ADVANCE until function 50 is advanced through and the special Solenoid Test will be activated. Test 05 is indicated in the credits display and the match display sequences from 1 to 25 showing the solenoid being pulsed.

4. For multiplexed solenoids 1 through 10, Solenoid 11 selects whether the A or B solenoids are pulsed. The left digit on the match display shows 1 and pulses solenoid 1A then the right digit shows 1 and pulses solenoid 1B and continues cycling from left to right pulsing the **A** and then the **B** solenoids.

5. For solenoids 10A and 10B, the match display shows 0.

6. Next, the Match Display sequences from 11 to 25 and pulses the associated solenoids. The flipper relay is de-energized for solenoid number 25.

7. To continuously pulse a single solenoid set switch to MANUAL-DOWN. To resume sequencing set to AUTO-UP.

8. To exit test turn game off and on *with coin door open.*
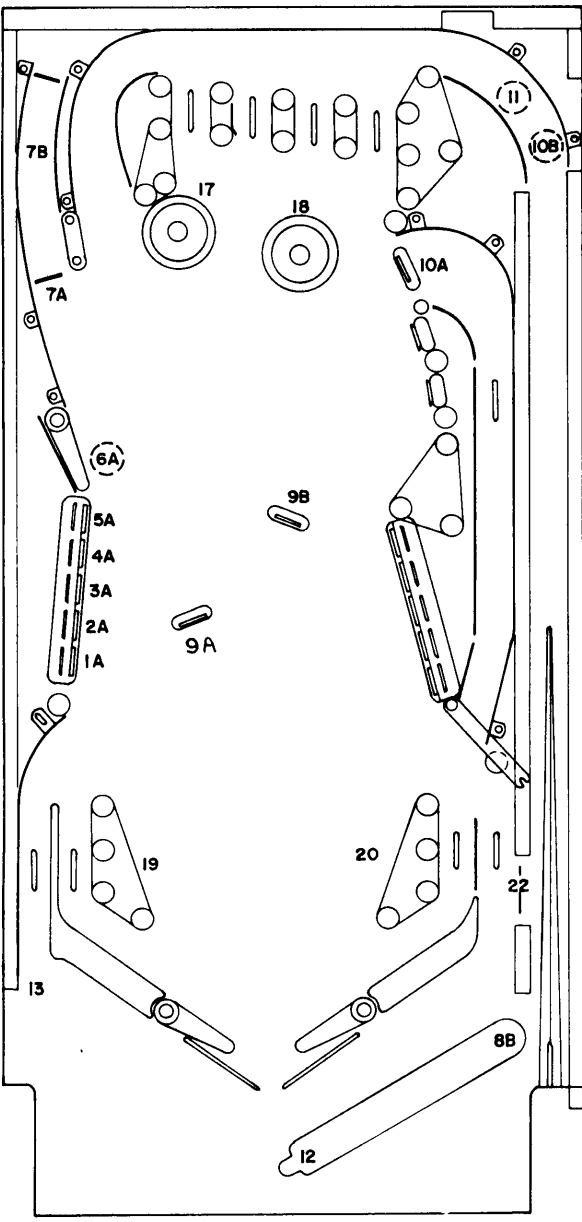
SOL. NO.	FUNCTION
1A	Left Bank Drop Target #1 Reset (Bottom)
1B	Right Bank Drop Target #1 Reset (Bottom)
2A	Left Bank Drop Target #2 Reset
2B	Right Bank Drop Target #2 Reset
3A	Left Bank Drop Target #3 Reset
3B	Right Bank Drop Target #3 Reset
4A	Left Bank Drop Target #4 Reset
4B	Right Bank Drop Target #4 Reset
5A	Left Bank Drop Target #5 Reset (Top)
5B	Right Bank Drop Target #5 Reset (Top)
6A	Left Bank Drop Target Release
6B	Right Bank Drop Target Release
7A	Disappearing Pod Target Reset (Bottom)
7B	Disappearing Pod Target Reset (Top)
8A	Ball Ramp Thrower
8B	Lockup Trough Release
9A	Disappearing Baiter Target Reset (Bottom)
9B	Disappearing Baiter Target Reset (Center)
10A	Disappearing Baiter Target Reset (Top)
10B	Disappearing Baiter Target Release Relay
11	Solenoid B + Select Relay
12	Ball Release
13	Reverse Ball Shooter
14	General Illumination Relay
15	Bell
16	Coin Lockout
17	Left Jet Bumper
18	Right Jet Bumper
19	Left Kicker
20	Right Kicker
21	Not Used
22	Ball Shooter Return Gate

NOTE: SOLENOID TEST 02 can be entered from Lamp Test 01, but is not recommended because it does not exercise Solenoids 1B through 10B.

Figure 2. Playfield Solenoid Locations and Solenoid Chart

Table 4. Solenoid Connections

SOL. NO.	FUNCTION	WIRE COLOR	CONNECTIONS	DRIVER TRANS.	SOLENOID PART NO.
1A	Left Bank Drop Target #1 Reset (Bottom)	GRY-BRN, VIO-BRN	2P11-4, 8P3-1	Q15	SA5-24-750-DC
1B	Right Bank Drop Target #1 Reset (Bottom)	GRY-BRN, BLK-BRN	2P11-4, 8P3-1	Q15	SA5-24-750-DC
2A	Left Bank Drop Target #2 Reset	GRY-RED, VIO-RED	2P11-5, 8P3-2	Q17	SA5-24-750-DC
2B	Right Bank Drop Target #2 Reset	GRY-RED, BLK-RED	2P11-5, 8P3-2	Q17	SA5-24-750-DC
3A	Left Bank Drop Target #3 Reset	GRY-ORN, VIO-ORN	2P11-7, 8P3-3	Q19	SA5-24-750-DC
3B	Right Bank Drop Target #3 Reset	GRY-ORN, BLK-ORN	2P11-7, 8P3-3	Q19	SA5-24-750-DC
4A	Left Bank Drop Target #4 Reset	GRY-YEL, VIO-YEL	2P11-8, 8P3-4	Q21	SA5-24-750-DC
4B	Right Bank Drop Target #4 Reset	GRY-YEL, BLK-YEL	2P11-8, 8P3-4	Q21	SA5-24-750-DC
5A	Left Bank Drop Target #5 Reset (Top)	GRY-GRN, VIO-GRN	2P11-9, 8P3-5	Q23	SA5-24-750-DC
5B	Right Bank Drop Target #5 Reset (Top)	GRY-GRN, BLK-GRN	2P11-9, 8P3-5	Q23	SA5-24-750-DC
6A	Left Bank Drop Target Release	GRY-BLU, VIO-BLU	2P11-3, 8P3-6	Q25	SA6-24-750-DC
6B	Right Bank Drop Target Release	GRY-BLU, BLK-BLU	2P11-3, 8P3-6	Q25	SA6-24-750-DC
7A	Disappearing Pod Target Reset (Bottom)	GRY-VIO, VIO-BLK	2P11-2, 8P3-7	Q27	SA5-24-750-DC
7B	Disappearing Pod Target Reset (Top)	GRY-VIO, BLK-VIO	2P11-2, 8P3-7	Q27	SA5-24-750-DC
8A	Ball Ramp Thrower	GRY-BLK, VIO-GRY	2P11-1, 8P3-8	Q29	SG1-23-850-DC
8B	Lockup Trough Release	GRY-BLK, BLK-GRY	2P11-1, 8P3-87	Q29	SG1-23-850-DC
9A	Disappearing Baiter Target Reset (Bottom)	BRN-BLK, VIO-WHT	2P9-9, 8P3-9	Q31	SA5-24-750-DC
9B	Disappearing Baiter Target Reset (Center)	BRN-BLK, BLK-WHT	2P9-9, 8P3-9	Q31	SA5-24-750-DC
10A	Disappearing Baiter Target Reset (Top)	BRN-RED, ORN-WHT	2P9-7, 8P3-10	Q33	SA5-24-750-DC
10B	Disappearing Baiter Target Release Relay	BRN-RED, BLU-WHT	2P9-7, 8P3-10	Q33	A-8592
11	Solenoid B + Select Relay	BRN-ORN	2P9-1, 8P3-11	Q35	A-8592
12	Ball Release	BRN-YEL	2P9-2, 8P3-12	Q37	SA-23-850-DC
13	Reverse Ball Shooter	BRN-GRN	2P9-3, 8P3-13	Q39	SG-23-850-DC
14	General Illumination Relay	BRN-BLU	2P9-4, 3P7-1	Q41	5580-09555-00
15	Bell	BRN-VIO	2P9-5, 7P1-15	Q43	SM-29-1000-DC
16	Coin Lockout	BRN-GRY	2P9-6, 7P1-18, 7P2-4	Q45	904218-696
17	Left Jet Bumper	BLU-BRN	2P12-7, 8P3-17	Q2	SG-23-850-DC
18	Right Jet Bumper	BLU-RED	2P12-4, 8P3-18	Q4	SG-23-850-DC
19	Left Kicker	BLU-ORN	2P12-3, 8P3-19	Q6	SG1-23-850-DC
20	Right Kicker	BLU-YEL	2P12-6, 8P3-20	Q8	SG1-23-850-DC
21	Not Used	BLU-GRN	2P12-8, 8P3-21	Q10	—
22	Ball Shooter Return Gate	BLU-BLK	2P12-9, 8P3-22	Q12	SZ-35-4000-DC
	Lower Left Flipper	BLU-GRY	7SW73, 7P1-10, 8P3-32		SFL-19-400/ 30-750
	Upper Left Flipper	BLK-BLU	7SW77, 7P1-30, 8P3-31		SFL-19-400 30-750
	Lower Right Flipper	BLU-VIO	7SW72, 7P1-8, 8P3-34		SFL-19-400/ 30-750

NOTES:

1. Contacts of Solenoid 11 Switch + 28VDC from solenoids 1A through 10A to solenoids 1B through 10B.

2. Contacts of Solenoid 10B Switch + 28VDC to the releae coils on solenoids 9A, 9B, and 10A.

3. Second wire color for solenoids 1 through 10 are between isolation diodes on playfield and solenoid.

4. Solenoid 16 (Coin Lockout) Part No. is Coin-Co number.

5. Special Switch connections for solenoids 17 through 20 are as follows:
   17—ORN-BRN—2P13-5
   18—ORN-RED—2P13-3
   19—ORN-BLK—2P13-2
   20—ORN-YEL—2P13-4

6. Connections for flipper switches 7SW72, 7SW73, and 7SW77 are as follows:
   Lower Left—ORN-GRY—2P12-2, 7P1-9
   Upper Left—ORN-GRY—2P12-2, 7P1-9
   Lower Right—ORN-VIO—2P12-1, 7P1-7

7. Typical Wiring for solenoids and special switches:
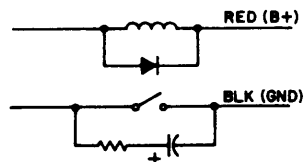
Switch Test

1. From Lamp Test depress ADVANCE two times with the switch set to AUTO-UP. Solenoid Test 02 (do not use) is momentarily displayed. Test 03 should be indicated in the Credits display and any stuck switches in the Master Display. As stuck switch(es) is displayed a sound is produced. The display continuously cycles through the stuck switches and as they are opened, the number is removed from the sequence. When all switches are open, the Match display is blank and the sounds stop.

2. If all switches in a row are displayed, first verify that all are open and then check for a short to ground on the row wire.

3. Operate switches; a sound is produced and switch number is momentarily indicated in the ball in play display. If two switches in a row are indicated with one switch closed, check for a short between the column wires; for multiple indication check column wire for short to ground. If two switches in a column are indicated with one switch closed, check for short between row wires.

4. If proper indications are obtained in Test 03 but matrix problem is suspected in game play, disconnect lamp connectors 2P5 and 2P7. Recheck in game play. Perform CPU Self-Test if problem remains. If problem is cleared, check for short between lamp matrix and jet bumper mounting brackets.

5. Shorted diodes can cause "rectangle" switch problems. For example, consult the switch matrix chart and visualize a situation where the drop target switches, nos. 17 & 23 are down. If the ball makes the left kicker switch no. 57, a shorted diode on switch no. 17 would cause a playfield tilt. Note that the faulty switch is diagonally opposite the invalidly indicated switch.
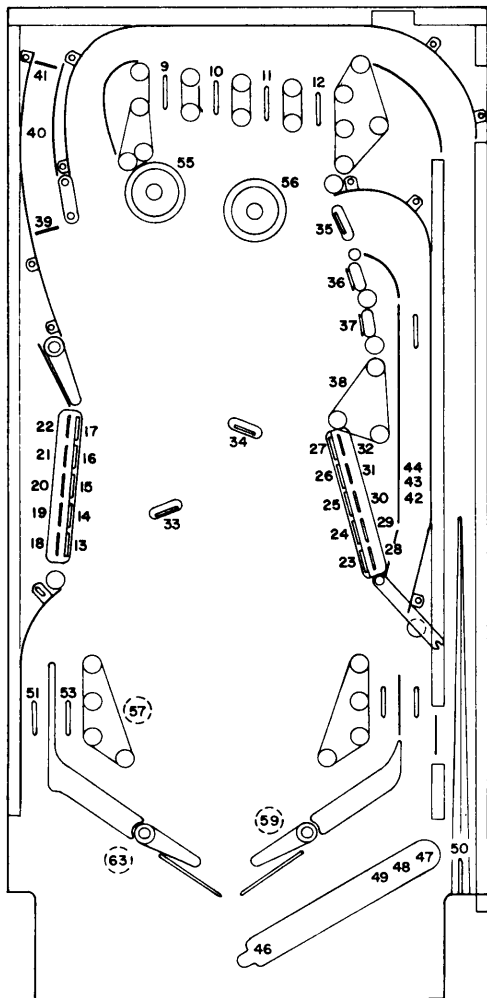
Figure 3. Playfield Switch Locations and Switch Chart

Switch No.	Function (Score*)
**01	Plumb Bob Tilt
**02	Ball Roll Tilt
**03	Credit Button
**04	Right Coin
**05	Center Coin
**06	Left Coin
**07	Slam Tilt
**08	High Score Reset
09	Bomber Lane 1 Rollover (1,000/3,000)
10	Bomber Lane 2 Rollover (1,000/3,000)
11	Bomber Lane 3 Rollover (1,000/3,000)
12	Bomber Lane 4 Rollover (1,000/3,000)
13	Left Lander Drop Target 1 (Bottom) (500/5,000)
14	Left Lander Drop Target 2 (500/5,000)
15	Left Lander Drop Target 3 (500/5,000)
16	Left Lander Drop Target 4 (500/5,000)
17	Left Lander Drop Target 5 (Top) (500/5,000)
18	Left Mutant Bull's Eye Target 1 (Bottom) (10/2,000)
19	Left Mutant Bull's Eye Target 2 (10/2,000)
20	Left Mutant Bull's Eye Target 3 (10/2,000)
21	Left Mutant Bull's Eye Target 4 (10/2,000)
22	Left Mutant Bull's Eye Target 5 (Top) (10/2,000)
*23	Right Lander Drop Target 1 (Bottom) (500/5,000)
*24	Right Lander Drop Target 2 (500/5,000)
*25	Right Lander Drop Target 3 (500/5,000)
*26	Right Lander Drop Target 4 (500/5,000)
*27	Right Lander Drop Target 5 (Top) (500/5,000)
28	Right Mutant Bull's Eye Target 1 (Bottom) (10/2,000)
29	Right Mutant Bull's Eye Target 2 (10/2,000)
30	Right Mutant Bull's Eye Target 3 (10/2,000)
31	Right Mutant Bull's Eye Target 4 (10/2,000)
32	Right Mutant Bull's Eye Target 5 (Top) (10/2,000)
33	Disappearing Baiter Target (Bottom) (3,000)
34	Disappearing Baiter Target (Center) (3,000)
35	Disappearing Baiter Target (Top) (3,000)
36	Swarmer Bull's Eye Target (Top) (10/3,000)
37	Swarmer Bull's Eye Target (Bottom) (10/3,000)
38	Swarmer Standup (10/3,000)
39	Disappearing Pod Target (Bottom) (10,000)
40	Disappearing Pod Target (Top) (10,000)
41	Pod Bull's Eye Target (10,000)
42	Lockup Trough (Bottom)
43	Lockup Trough (Center)
44	Lockup Trough (Top)
45	Lockup Trough Rollover
46	Outhole
47	Ball Ramp (Right)
48	Ball Ramp (Center)
49	Ball Ramp (Left)
50	Ball Shooter Trough
51	Left Outlane (5,000)
52	Right Outlane (5,000)
53	Left Flipper Return Lane (3,000)
54	Right Flipper Return Lane (3,000)
55	Left Jet Bumper (1,000)
56	Right Jet Bumper (1,000)
57	Left Kicker (10)
58	Right Kicker (10)
59	Flipper *Lane Change* Switch
**60	Smart Bomb
**61	Reverse
62	Not Used
63	Playfield Tilt
64	Not Used

NOTES:

*Second Value when lit or flashing

**Switches 1 through 8 and 60 and 61 are located in cabinet.

COLUMN ROW	1 GRN-BRN 2J2-9	2 GRN-RED 2J2-8	3 GRN-ORN 2J2-7	4 GRN-YEL 2J2-6	5 GRN-BLK 2J2-5	6 GRN-BLU 2J2-3	7 GRN-VIO 2J2-2	8 GRN-GRY 2J2-1
1 WHT-BRN 2J3-9	Plumb Bob Tilt 1	Bomber Lane 1 Rollover 9	Left Lander Drop Target 5 (Top) 17	Right Lander Drop Target 3 25	Disappearing Baiter Target (Bottom) 33	Bull's Eye Target 41	Ball Ramp (Left) 49	Left Kicker 57
2 WHT-RED 2J3-8	Ball Roll Tilt 2	Bomber Lane 2 Rollover 10	Left Mutant Bull's Eye Target 1 (Bottom) 18	Right Lander Drop Target 4 26	Disappearing Baiter Target (Center) 34	Lockup Trough (Bottom) 42	Ball Shooter Trough 50	Right Kicker 58
3 WHT-ORN 2J3-7	Credit Button 3	Bomber Lane 3 Rollover 11	Left Mutant Bull's Eye Target 2 19	Right Lander Drop Target 5 (Top) 27	Disappearing Baiter Target (Top) 35	Lockup Trough (Center) 43	Left Outlane 51	Flipper *Lane Change* Switch 59
4 WHT-YEL 2J3-6	Right Coin 4	Bomber Lane 4 Rollover 12	Left Mutant Bull's Eye Target 3 20	Right Mutant Bull's Eye Target 1 (Bottom) 28	Swarmer Bull's Eye Target (Top) 36	Lockup Trough (Top) 44	Right Outlane 52	Smart Bomb 60
5 WHT-GRN 2J3-5	Center Coin 5	Left Lander Drop Target 1 (Bottom) 13	Left Mutant Bull's Eye Target 4 21	Right Mutant Bull's Eye Target 2 29	Swarmer Bull's Eye Target (Bottom) 37	Lockup Trough Rollover 45	Left Flipper Return Lane 53	Reverse 61
6 WHT-BLU 2J3-4	Left Coin 6	Left Lander Drop Target 2 14	Left Mutant Bull's Eye Target 5 (Top) 22	Right Mutant Bull's Eye Target 3 30	Swarmer Standup 38	Outhole 46	Right Flipper Return Lane 54	Not Used 62
7 WHT-VIO 2J3-3	Slam Tilt 7	Left Lander Drop Target 3 15	Right Lander Drop Target 1 (Bottom) 23	Right Mutant Bull's Eye Target 4 31	Disappearing Pod Target (Bottom) 39	Ball Ramp (Right) 47	Left Jet Bumper 55	Playfield Tilt 63
8 WHT-GRY 2J3-1	High Score Reset 8	Left Lander Drop Target 4 16	Right Lander Drop Target 2 24	Right Mutant Bull's Eye Target 5 (Top) 32	Disappearing Pod Target (Top) 40	Ball Ramp (Center) 48	Right Jet Bumper 56	Not Used 64

Figure 4. Switch Matrix

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INITIATING AUTO-CYCLE MODE

1. Set AUTO-UP/MANUAL-DOWN switch to AUTO-UP and depress ADVANCE pushbutton. Test 04 is indicated in Credit display and Function 00 in Match Display.

2. Set switch to MANUAL-DOWN and depress ADVANCE to indicate Function 50 in the Match Display.

3. Set switch to AUTO-UP and operate Credit button to indicate 15 in Player 1 Display.

4. Depress ADVANCE pushbutton to start Auto-Cycle mode. Each cycle of this mode sequences thru the Display Digits Test, Sound Test (00), Lamp Test (01), and Solenoid test (02).

5. To terminate the test and return to game over, turn the game OFF and back ON.

CPU BOARD SELF-TEST

Depress the DIAGNOSTIC pushbutton on the left side of the CPU Board. The following indications are provided. With 0 indication the game returns to the game over mode.

0 - Test Passed
1 - IC13 RAM Faulty
2 - IC16 RAM Faulty
3 - IC17 ROM 2 Faulty
4 - IC17 ROM 2 Faulty
5 - IC20 ROM 1 Faulty
6 - IC14 Game ROM 1 Faulty
7 - IC26 Game ROM 0 Faulty
8 - IC19 CMOS RAM or Memory Protect Circuit Faulty
9 - Coin-door closed, Memory Protect Circuit Faulty, or IC19 CMOS RAM Faulty.

Note that "0" remaining after power turn-on indicates CPU Board lockup.

SOUND BOARD SELF-TEST

Depress DIAGNOSTIC pushbutton on the top of the Sound Board. Several electronic sounds should be produced. This sequence of sounds is repeated until the game is turned OFF and back ON.