Bally

RADICAL! ™

OPERATIONS MANUAL

including
Essential Information Concerning
Game Operation & Adjustments;
Game Testing & Problem Diagnostics,
Parts Information, &
Reference Diagrams

MIDWAY MANUFACTURING COMPANY

RADICAL! Jumper Chart

GAME	P/N-U15 Game uP	P/N-U27 G. ROM 1	P/N-U26 G. ROM 2	P/N-U21 S. ROM 1	P/N-U22 S.ROM 2	P/N-U24 Sound uP	JUMPERS
Transporter	5400-09150-00	A-5343-2008-2	A-5343-2008-1	A-5343-2008-4	A-5343-2008-3	5400-09150-00	W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, 19
Elvira	5400-09150-00	A-5343-2011-2	A-5343-2011-1	A-5343-2011-4	A-5343-2011-3	5400-09150-00	W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, 19
Mousin' Around	5400-09150-00	A-5343-2009-2	A-5343-2009-1	A-5343-2009-4	A-5343-2009-3	5400-09150-00	W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, 19
Game Show	5400-09150-00	A-5343-2003-2	A-5343-2003-1	Not Used	Not Used	Not Used	W1, 2, 4, 5, 7, 11, 14, 16,
Pool Sharks	5400-09150-00	A-5343-2014-2	A-5343-2014-1	Not Used	Not Used	Not Used	W1, 2, 4, 5, 7, 11, 14, 16,
Radical	5400-09150-00	A-5343-2015-2	A-5343-2015-1	Not Used	Not Used	Not Used	W1, 2, 4, 5, 7, 11, 14, 16,

RADICAL! Solenoid Table

Sol. No.	Function	Solenoid Type	Wire [1] Color	Connections CPU Bd	Connections Playfield/Cabinet	Driver Trnsfr	Solenoid Part Number Flashlamp Type d= Display Bd; p=Playfield	
01A [3]	Outhole	Switched	Vio-Brn	1P11-1	5J1-9; 5J4-9 (A)	Q33	AE-23-800	
01C [3]	Ball Lock Flasher	Switched	Blk-Brn	(Gry-Brn)	5J5-9 (C)	Q33	#906 flashlamp	1p
02A [3]	Ball Shooter Lane Feeder	Switched	Vio-Red	1P11-3	5J1-7; 5J4-8 (A)	Q25	AE-23-800	
02C [3]	Left Ramp Flasher	Switched	Blk-Red	(Gry-Red)	5J5-8 (C)	Q25	#906 flashlamp	1p
03A [3]	Ball Popper	Switched	Vio-Orn	1P11-4	5J1-6; 5J4-7 (A)	Q32	AE-23-800	
03C [3]	Top Left Flipper Flasher	Switched	Blk-Orn	(Gry-Orn)	5J5-7 (C)	Q32	#906 flashlamp	1p
04A [3]	Top Drop Target Bank	Switched	Vio-Yel	1P11-5	5J1-5; 5J4-6 (A)	Q24	AE-26-1200	
04C [3]	Top Left & Left Girl Flashers	Switched	Blk-Yel	(Gry-Yel)	5J5-5 (C)	Q24	#89 flashlamp	1p 1b
05A [3]	Knocker	Switched	Vio-Grn	1P11-6	5J1-4; 5J4-5 (A)	Q31	AE-23-800	
05C [3]	Top Spin & Jackpot Flashers	Switched	Blk-Grn	(Gry-Grn)	5J5-4 (C)	Q31	#89 flashlamp	1p 1b
06A [3]	Bottom Drop Target Bank	Switched	Vio-Blu	1P11-7	5J1-3; 5J4-4 (A)	Q23	AE-26-1200	
06C [3]	Drop Hole & Title Flasher	Switched	Blk-Blu	(Gry-Blu)	5J5-3 (C)	Q23	#89 flashlamp	1p 3b
07A [3]	Ball Diverter	Switched	Vio-Blk	1P11-8	5J1-2; 5J4-2 (A)	Q30	AE-23-800	
07C [3]	Top Right & T-Shirt Flasher	Switched	Blk-Vio	(Gry-Vio)	5J5-2 (C)	Q30	#89 flashlamp	1p 1b
08A [3]	Ball Locker	Switched	Vio-Gry	1P11-9	5J1-1; 5J4-1 (A)	Q22	AE-23-800	
08C [3]	Ball Gate & Shooter Lane Flshr	Switched	Blk-Gry	(Gry-Blk)	5J5-1 (C)	Q22	#89/#906 flshlmps	1p 1b
09	Lwr Dr Bank & Lt Face Flasher	Controlled	Brn-Blk	1P12-1	5J2-9; 5J6-9; 2J4-3	Q17	#89/#906 flshlmps	1p 1b
10	Playfield Gnl Illum Relay	Controlled	Brn-Red	1P12-2	5J2-8; 5J6-8; 2J4-5	Q9	5580-09555-01 4a	
11	Insert Illum Relay	Controlled	Brn-Orn	1P12-4	5J2-6; 5J6-7; 2J4-6	Q16	5580-09555-01 4a	
12	A/C Select Relay	Controlled	Brn-Yel	1P12-5	5J2-5	Q8	5580-09555-01 5	
13	Right Ball Gate	Controlled	Brn-Grn	1P12-6	5J2-4; 5J6-5	Q15	AE-26-1500	
14	Left Outlane Kicker	Controlled	Brn-Blu	1P12-7	5J2-4; 5J6-3	Q7	AE-24-900	
15	Top Kicker (Sling)	Controlled	Brn-Vio	1P12-8	5J2-2; 5J6-2	Q14	AE-23-800	
16	Left Curl Ramp	Controlled	Brn-Gry	1P12-9	5J2-1; 5J6-1	Q6	#906 flashlamp	1p
17	Left Jet Bumper	Special #1	Blu-Brn	1P19-7	5J3-7; 5J7-7	Q75	AE-23-800	
18	Left Kicker (Sling)	Special #2	Blu-Red	1P19-4	5J3-6; 5J7-6	Q71	AE-26-1500	
19	Right Jet Bumper	Special #3	Blu-Orn	1P19-3	5J3-3; 5J7-3	Q73	AE-23-800	
20	Right Kicker (Sling)	Special #4	Blu-Yel	1P19-6	5J3-4; 5J7-5	Q69	AE-26-1500	
21	Bottom Jet Bumper	Special #5	Blu-Grn	1P19-8	5J3-2; 5J7-2	Q77	AE-23-800	
22	Top Jet Bumper	Special #6	Blu-Blk	1P19-9	5J3-1; 5J7-1	Q79	AE-23-800	
-	Lower Right Flipper	-	Orn-Vio	1P19-1	2J5-5; 2P10-7	-		
	Upper Right Flipper		(Blu-Vio) [2]		(2J10-1; 2P8-15)		FL11630/50VDC	
			(Blk-Blu)		(2J10-4; 2P8-12)		FL 11630/50VDC	
-	Lower Left Flipper	-	Orn-Gry	1P19-2	2J5-4; 2P10-8	-		
	Upper Left Flipper		(Blu-Gry) [2]		(2J10-2; 2P8-14)		FL11630/50VDC	
			(Blk-Yel)		(2J10-3; 2P8-13)		FL11630/50VDC	

Notes 1. Wire colors, except flipper Orn-Vio and Orn-Gry, are ground connections (to coil terminal with unbanded end of diode). Flipper Orn-Vio and Orn-Gry wires connect from CPU Board to flipper switch. 2. Flipper connections shown in braces are from flipper switch to flipper coil. 3. "A" circuits are pulsed, when Sol. 12 is de-energized; "C" circuits are pulsed, with Sol. 12 energized. Wire colors in brackets are those from respective A and C terminals corresponding to the J1-terminal connection listed for the Aux Power Driver Bd, which controls the device pulsing by Sol. 12. 4. Relay is mounted on Relay Bd, (4a) p/n C-11998-1; (4b) C-11902-1. 5. Relay is mounted on Aux Power Driver Bd, D-12247 in the backbox.

RADICAL!

RADICAL! RULES

1)   Lighting R-A-D-I-C-A-L lights all 3 Lock lights, awards 100K outhole Bonus, and turns on Kickback and lower 1M lamp.

2)   Lighting R-A-D-I-C-A-L letters increases Letter Bonus value. The value decreases with time. Range 20K to 1M.

3)   Multiple Vertical Ramp shots or completing Snake lights Extra Ball which is timer controlled; then transfers to Right Outlane which is timer controlled.

4)   Lighting first "A" lights 50K on Loop.
    Lighting second "A" lights Tail Slider.

5)   For each completion of the Top Drop Bank:
    A) Lights Snake Run which is timer controlled.
    B) Lights Million when Snake Run is made.
    C) Advances Bonus Multiplier.

6)   For each completion of the Bottom Drop Bank:
    A) Lights letter "C" in RADICAL.
    B) Lights Spot Letter if "C" is already lit.
    C) Awards Million when lit.

7)   Plunger skill shot to Left Ramp Spots a Letter in RADICAL.

8)   . Completing first R-A-D-I-C-A-L lights ball Lock for one ball. Completing second R-A-D-I-C-A-L lights second ball Lock for two balls. Locking two balls awards Multi-ball, qualifying for Mega-million (range 3M to 10M).

9)   Snake Run feature awards the following when lit:
    A) Skate or Die
    B) Extra Ball
    C) One Million
    D) Mystery Score
    E) Collect Tail Slider
    F) Collect Verticals

10)   Special is 2% via game adjustment 45 and is awarded randomly.

TABLE OF CONTENTS

SECTION 1   Game Operation &Test Information

SECTION 3   **Reference Diagram & Schematics**

1

Game Operation

and

Test Information

RADICAL! ROM SUMMARY

IC	DESCRIPTION	TYPE	IDENTIFIER	BOARD	PART NUMBER
Game ROM 1	32K x 8 ROM	27256	U27	CPU	A-5343-2015-2
Game ROM 2	32K x 8 ROM	27256	U26	CPU	A-5343-2015-1
Music/Speech ROM	64K x 8 ROM	27512	U4	AUDIO	A-5343-2015-3
Music/Speech ROM	64K x 8 ROM	27512	U19	AUDIO	A-5343-2015-4
Music/Speech ROM	64K x 8 ROM	27512	U20	AUDIO	A-5343-2015-5

Connector Identification

RADICAL! uses WILLIAMS ELECTRONICS GAMES System 11C. The connectors have an identification number. Each plug or jack receives a prefix number (which identifies the circuit board), followed by a letter ("J" or "P"), and a number. J-designations refer to the male part of a connector. P-designations refer to the female part of a connector. For example, 1J1 designates jack 1 of board 3 (a CPU Board jack); 3P6 designates plug 6 of board 3 (a Power Supply Board plug). Identifying the specific pin number of a connector involves a hyphen, which separates the pin number from the plug or jack designation. For example, 1J1-3 refers to pin 3 of jack 1 on board 1.

Other game components may also have similar prefixes preceding their designator to clarify their locations or related circuit.

Prefix numbers for the System 11C circuit boards and other major assemblies are listed below. A prefix number may precede a component designator to identify its associated unit (e.g., connector 1J1).

1	- CPU	6	- Backbox
2	- Master Interconnect	7	- Cabinet
3	- Backbox Power Supply	8	- Playfield
4	- Score Display	9	- Insert Board
5	- Aux Power Driver	10	- Sound Board

Circuit Boards

System 11C Circuit Boards for *RADICAL!* are in the backbox. They are accessible by unlocking the Backbox lock, removing the Backbox glass, unlatching the Insert Board (with lamps and the Digital Display Boards), and swinging it open.

Lamp circuit boards are mounted on the Playfield.

CPU BOARD

The System 11C CPU Board (p/n D-11883-2015) must be equipped with the ROMs specified in the *RADICAL!* ROM Summary. CPU Board jumpers W1, W2, W4, W5, W7, W11, W14, and W16 must be connected.

SOUND BOARD

The Sound Board is p/n D-11581-2015, including ROMs and micro-processor.

SCORE DISPLAY BOARD

RADICAL! has two Score Display Boards. The BALLY Right Score Display Board is p/n D-12502-1, and the BALLY Left Score Display Board is p/n D-12706.

POWER SUPPLY BOARD
The Power Supply Board is p/n D-12246.

AUX POWER DRIVER BOARD
The Aux Power Driver Board is D-12247.

MASTER INTERCONNECT BOARD
The Master Interconnect Board is D-12313-2015.

CIRCUIT BOARD & MAJOR MECHANISMS
LOCATION DIAGRAM
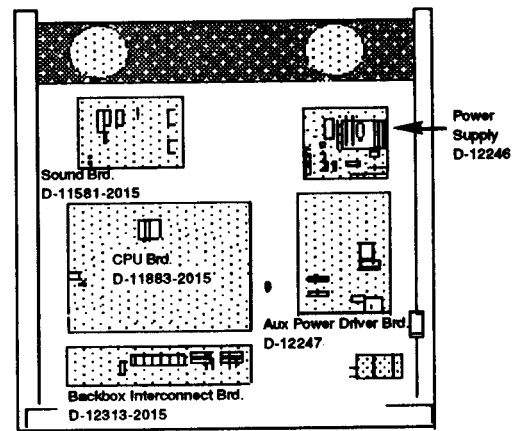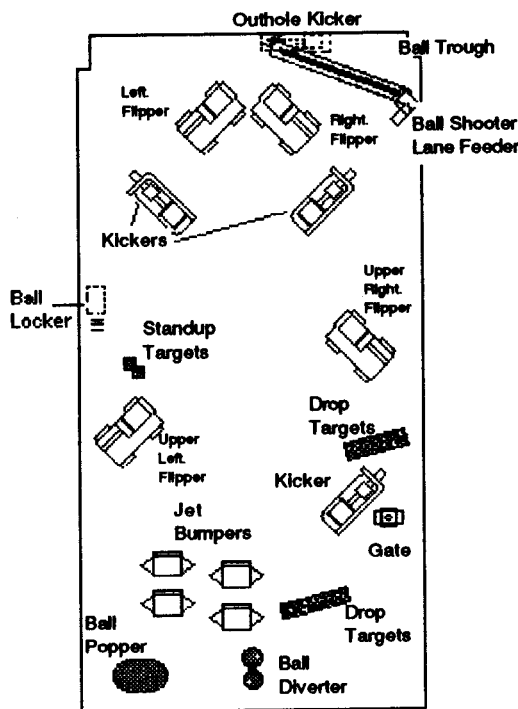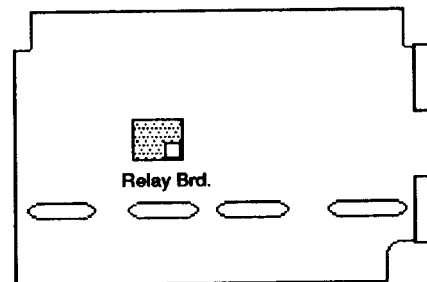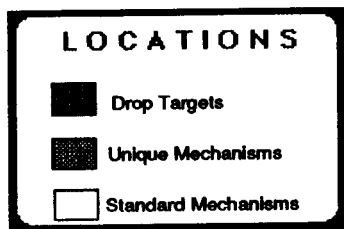
Figure 1. Locations Diagram - Game Circuit Boards and Major Mechanisms.

Game Control Locations

Figure 2 shows the locations of the following switches, except for the CPU Diagnostic switch, which is shown in the Circuit Board Locations Diagram, figure 1.

THE ON-OFF SWITCH is on the bottom of the cabinet near the right front leg.

THE VOLUME CONTROL is on the left inner wall of the cabinet on the tilt mechanism board. It is accessible by opening the coin box door.

THE START BUTTON (or **CREDIT BUTTON**) is a pushbutton to the left of the coin door on the cabinet exterior.

GAME ADJUSTMENT/DIAGNOSTIC SWITCHES. *RADICAL!* allows the operator to control all game adjustments, obtain bookkeeping information, and diagnose problems, using only three switches mounted on the inside of the coin door, along with the Start button beside the coin door.

ADVANCE, AUTO-UP/MANUAL-DOWN, and **HIGH-SCORE RESET** are the switches located on the inside of the coin door. Refer to the text discussing Game Status Displays and the Test/Diagnostic Procedures for details concerning button operation.

THE MEMORY PROTECT SWITCH is on the inside frame of the coin door. This interlock switch must be open to clear bookkeeping totals and to make game adjustments. It automatically opens, when the coin door opens.

On the previous page, the Circuit Board Locations Diagram (Figure 1) shows the location of the CPU Board switch (left edge of CPU Board, Backbox View).

THE CPU DIAGNOSTIC SWITCH (SW 2) is mounted on the left edge of the CPU Board near a large, socketed microprocessor chip. This switch initiates the Memory Chip Test explained in the Test/Diagnostic Procedures.
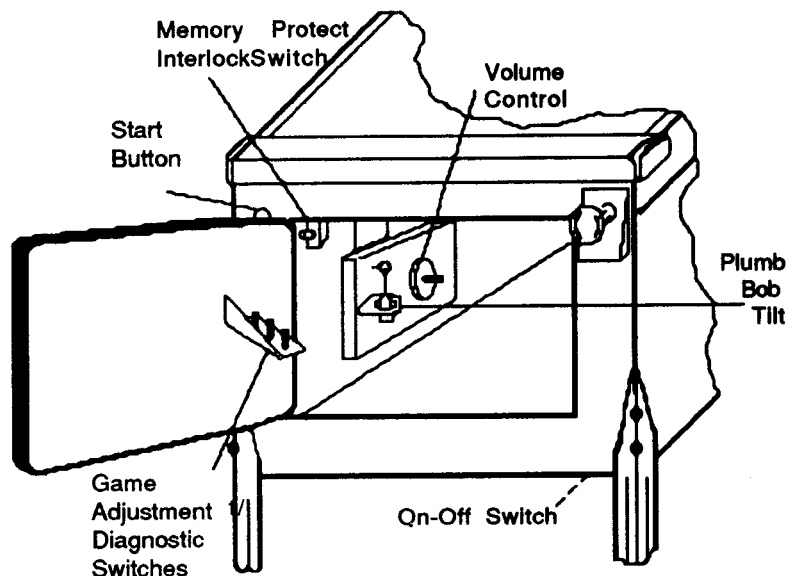
Figure 2. Control Locations

Pinball Game Assembly Instructions

INSTALLATION PROCEDURE

1. Open the shipping container; remove all cartons, parts, and other items, and set them aside.

2. Leg levelers and bolts are provided in the cashbox. Place cabinet on a support and attach rear legs (after installing leg levellers), using leg bolts.

3. Attach the front legs (after installing leg levellers), using leg bolts. See Figure 3 for details.

0 degrees
Approx
Playfield
Pitch
Angle:
7 degrees

See
Detail View

Leg
Leg Leveller
Shaft
Nut
Leveller
Foot Pad

**Detail View -
Leg Leveller**
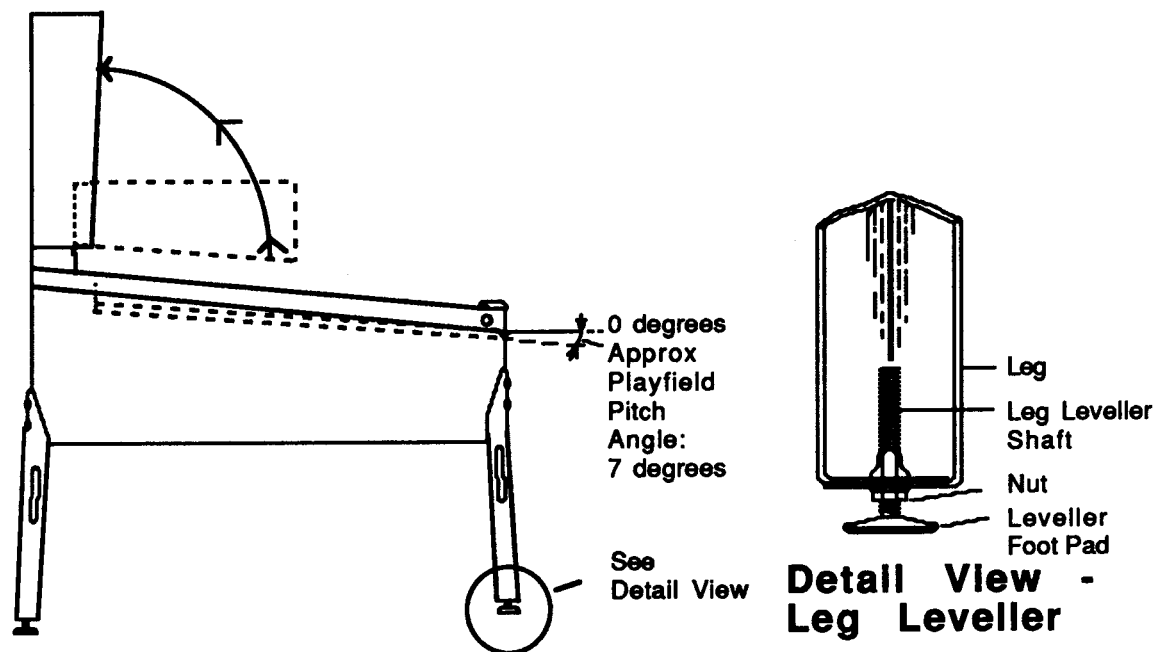
Figure 3. Pinball Assembly, Playfield Pitch Angle, and Leg Leveler Details.

CAUTION

Ensure that the interconnecting cables are free to move (not kinked or pinched). Be careful not to damage wires at any stage of the assembly process.

4. Raise the hinged backbox upright and stabilize it into position. Unlock the backbox, and remove the backbox glass, storing it carefully to avoid scratches. Remove the shipping block holding the Insert Board. This allows access to the bolt holes used for securing the backbox upright. Install the mounting bolts (locaterd in printed envelope), through the bottom holes of the backbox into the cabinet to secure the backbox. Close and latch the Insert Board, and install the backbox glass, and lock the backbox.

WARNING

NEVER transport a pinball game with hinged backbox erect. **ALWAYS** lower the backbox forward onto the playfield cabinet on a layer of protective material to prevent marring or damage and possible personal injury.

5. Extend each leg leveller slightly below the leg bottom, so that all four foot pads are extended about the same distance. Remove the cabinet from its support and place it on the floor.

6. Adjust the leg levellers for proper playfield level (side-to-side) and playfield pitch angle (incline) of approximately 7 degrees. (Again, it is recommended that these measurements be made ON the playfield, not the cabinet nor the playfield cover glass.) Tighten the nut on each leg leveller shaft to maintain this setting, as shown in Figure 3.

CAUTION

Playing pitch angle adjustments can affect the operation of the plumb bob tilt, inside the cabinet. The plumb bob weight is among the parts in the cash box; the operator should install the weight and adjust the tilt mechanism for proper operation, after completion of the desired playfield pitch angle setting.

7. Move the game into the desired location; recheck the level and pitch angle of the playfield.

8. Verify that the required number of balls are inside the game. *RADICAL!* uses two balls.

9. Clean and re-install the playfield cover glass. Prepare the game for player operation.

Game Operation

```
┌─────────────────────┐
│     WARNING         │
└─────────────────────┘
```

After assembly and installation at its site location, this game must be plugged into a properly grounded outlet to prevent shock hazard, and to assure proper game operation. DO NOT use a 'cheater' plug to defeat the ground pin on the line cord. DO NOT cut off the ground pin.

POWERING UP

With the coin door closed, plug the game in, and switch it ON, using the On-Off switch. In normal operation, the player 1 score display initially shows 00. Then, the game goes into the Attract Mode (playfield and backbox lamps flashing, sounds being heard, etc., if the operator does not change the Factory Setting).

Open the coin door and press the AUTO-UP/MANUAL-DOWN switch to MANUAL-DOWN. Press the ADVANCE button to begin the game test routine. Return to AUTO-UP and perform the entire test to verify that the game is operating satisfactorily.

NOTE

The SYSTEM 11C game program has a great capability to aid the operator and service personnel: At game Turn-On (and also at the beginning of the Test/Diagnostic Procedures), the player score displays now signal with a message, "Press ADVANCE for Report", that the game program has detected a possible problem with the game. Usually, this report indicates that at least one switch has NOT been actuated during ball play for 90 balls (approximately 30 games). However, the game program compensates the game play requirements affected by each disabled switch to allow 'nearly normal' play. This helps keep *RADICAL!* earning good profits! More information is available in the Test/Diagnostic Procedures text describing the Switch Testing.

ATTRACT MODE*

Playfield and backbox lamps blink. The player score displays exhibit a series of messages informing the player concerning:

    A. Recent highest scores*;
    B. A "custom message";
    ("LIVE TO SKATE, SKATE TO LIVE, START THRASHIN.")*;
    C. The score to achieve to obtain a
        Replay award*;

These (or similar) displays reappear occasionally, accompanied by sounds and music, until a player initiates game play by inserting a coin or, when credits are available, pressing the Start button.

*-operator -adjustable feature

CREDIT POSTING

Insert coin(s). A sound is heard for each coin, and the player score displays show the number of credits purchased. So long as the number of maximum allowable credits* are NOT exceeded by coin purchase or high score, credits are posted correctly.

STARTING A GAME

Press the Start button. A startup sound plays, and the credit amount shown in the player score display decreases by one. Player display 1 flashes 00 (until the first playfield switch is actuated), and the Player 4 display shows ball 1, except for 4-player games where the ball # shows in the individual player's display. Additional players may enter the game by pressing the Start button once for each player, before the end of play on the first ball.

SLAM TILT

Actuating the Slam Tilt switch on the coin door inside the cabinet ends the current game; *RADICAL!* then proceeds to the Game Over Mode. With the third closure* of the plumb bob tilt switch, the player loses the remaining play of that ball, but can complete the game.

END OF GAME

All earned scores and bonuses are awarded. If a player's final score exceeds the specified value, the player receives a designated award for achieving the current highest score. A random digit set* appears in the Match display. Credit* may be awarded, when the last two digits of any player's score display (1 through 4) match the random digits of the Match display. Match, high score, and game over sounds are made, as appropriate.

GAME OVER MODE

The GAME OVER display shows in the player score displays. Then, the high scores flash on the appropriate player score displays. The game proceeds to the Attract Mode.

=====================================

* - operator-adjustable feature

Game Status Displays

INTRODUCTION

RADICAL! provides the game owner/operator with a display of information concerning the game's bookkeeping and game play feature adjustments. Basically, three classes of information now become available in this status display mode:

- Id (Identification);
- Au (Audit);
- Ad (Adjustment).

Each of the two-letter abbreviations for these classes appears in the score display, while the system microprocessor for the *RADICAL!* game is displaying the items within each class.

IDENTIFICATION INFORMATION--Id

With the game turned on, the coin door open, and the AUTO-UP/MANUAL-DOWN switch in the AUTO-UP position, the operator can press the ADVANCE switch once, briefly. Player displays immediately change from the Attract Mode to the Game Status Display Mode. This is evident by the following display, shown in columnar form. The column headings refer to the various backbox displays.

Player 1	Player 2	Player 3	Player 4
RADICAL!		2015 LA-x*	Id00

* x - indicates ROM revision level; e.g., 1 is initial issue; 2, 3, etc. for later revisions; A indicates American.

The game is named in the Player 1 and 2 score displays. The ROM revision level appears in the Player 3 score display. The Player 4 score display shows the status display mode in abbreviated form, Id. The Player 4 score display also shows the status display mode item (00) for this particular display. Pressing advance (to Id 01) once more shows the Game Revision information.

Player 1	Player 2	Player 3	Player 4
DOMESTIC	LEVEL 1	4-9-90	Id01

The country is named in the Player 1 score display. The Production Level appears in the Player 2 score display. The game's release date appears in the Player 3 score display and the status display mode information is shown in the Player 4 display.

Pressing ADVANCE once more causes the Id 02 display to appear. This display describes which of the "Install" options is currently in effect. For example, if the YES option of the INSTALL FACTORY Adjustment Item (Ad 70) was last selected, FACTORY SETTING appears on the player score displays. Changing the setting of any other game adjustment item, after selecting the YES option for Ad 70 causes the display to change to FACTORY ALTERED. Similarly, if the operator selects the YES option for INSTALL HARD (Ad 65), the display indicates HARD SETTING. Changing a game adjustment item later then causes the display to show HARD ALTERED.

AUDIT INFORMATION - Au

While the AUTO-UP switch remains in the Up position, the operator can press the ADVANCE switch once, briefly, to begin the backbox displays of Audit (sometimes called "bookkeeping") Information. Fifty-three audit entries are now available. Calculation of the various factors is no longer necessary because the System 11C game program now performs all the mathematical factor computations. This information is intended to aid the owner/operator in evaluating how the game is performing in each location, by providing knowledge about which game features are receiving the most play. With this information, the owner/operator can determine whether adjusting the game features to other settings will contribute to increased game earnings.

The operator can press the ADVANCE button once to view each Audit Information display item. To proceed more rapidly through this information, the operator only has to press and hold the ADVANCE button. If a desired item is passed, the operator can use the MANUAL-DOWN switch position with the ADVANCE button to back up to the desired item.

The *RADICAL!* Audit Table lists the 53 items of the Audit Information portion of the *RADICAL!* Game Status Displays. Presentation of this Audit Information again utilizes the player score displays; however, the Player 1 and 2 displays are combined as a descriptive phrase. The light type below the table's column headings names the respective backbox displays where the information appears. Because the Player 4 display contains information which depends on game play, only a few example entries are shown in the table. The Credits display shows Au for all 53 audit items, so its entry is omitted from the tabular listing. Detection of erroneous data affecting any of the counters used in these audit items causes the message, ERROR, to be displayed in the Player 3 display, during display of any audit item associated with that particular counter. (The program does not analyze the cause of the error; it merely alerts the operator of the error's existence by the message.)

ADJUSTMENT INFORMATION - Ad

At end of the Audit Information presentation, with the AUTO-UP switch in the Up position, the operator can press the ADVANCE button to proceed to the Adjustment Information portion of the *RADICAL!* Game Status Displays, as listed in the *RADICAL!* Game Adjustment Table.

The operator can press the ADVANCE button once to view each Adjustment Information display item. To proceed more rapidly through this information, the operator only has to press and hold the ADVANCE button. If a desired item is passed, the operator can use the MANUAL-DOWN switch position with the ADVANCE button to back up to the desired item.

The *RADICAL!* Game Adjustment Table lists the 70 items of the Adjustment Information portion of the *RADICAL!* Game Status Displays. Presentation of the displays is similar to that for the Audit Information (that is, the player 1 and 2 displays combine as a descriptive phrase; the light type below the column headings names the respective backbox displays where the information appears, etc.). The

RADICAL! AUDIT TABLE

Audit Item (Right)	Descriptive Phrases (Left Display)	Audit Factor [1] Value (Right)
AU 01	LEFT COINS [chute next to coin door hinge]	432
02	CENTER COINS	0
03	RIGHT COINS	398
04	PAID CREDITS	830
05	TOTAL PLAYS	
06	TOTAL FREE (Total Free Plays)	
07	PERCENT FREE (% Free Plays)	
08	REPLAY AWARDS	
09	PERCENT REPLAY (% Replay Awards)	
10	SPECIAL AWARDS	
11	PERCENT SPECIAL (% Special Awards)	
12	MATCH AWARDS	
13	HSTD (High Score to Date) CREDITS	
14	PERCENT HSTD (% HSTD Credits)	
15	EXTRA BALLS	
16	PERCENT EX. BALL (% Extra Balls)	
17	AV. BALL TIME (Average Time in Seconds)	
18	MINUTES OF PLAY (Minutes of Play)	
19	BALLS PLAYED	
20	REPLAY1 AWARDS	
21	REPLAY2 AWARDS	
22	REPLAY3 AWARDS	
23	REPLAY4 AWARDS	
24	1 PLAYER GAMES	
25	2 PLAYER GAMES	
26	3 PLAYER GAMES	
27	4 PLAYER GAMES	
28	BURN-IN CYCLES	
29	MADE 4 RADS (# of times Radical made)	
30	MADE MULTI-BALL (# of times Multi-ball made)	
31	MADE MEGA MILLION (# of times Mega Million made)	
32	MADE BONUS 5 X (# of times Bonus 5 X made)	
33	MADE TOP MILLION (# of times Top Million made)	
34	BONUS 1 MILLION (# of times Bonus 1 Million made)	
35	RAD MILLION (# of times Rad Million made)	
36	MADE SNAKE LANE (# of times Snake made)	
37	MADE SNAKE RUN (# of Snake Run made)	
38	CONSOLATION EXTRA BALL (# of times Consol. Ex. Ball awarded)	
39	H.S.RESET COUNTER	
40	0.0-0.4 MIL. SCORE (# of games <500K)	
41	0.5-0.9 MIL. SCORE (# of games ≥500K, <1M)	
42	1.0-1.4 MIL. SCORE (# of games ≥1M, <1.5M)	
43	1.5-1.9 MIL. SCORE (# of games ≥1.5M, <2.0M)	
44	2.0-2.9 MIL. SCORE (# of games ≥2.0M, <2.9M)	
45	3.0-3.9 MIL. SCORE (# of games ≥3.0M, <3.9M)	
46	4.0-4.9 MIL. SCORE (# of games ≥4.0M, <4.9M)	
47	5.0-5.9 MIL. SCORE (# of games ≥5.0M, <5.9M)	
48	6.0-7.9 MIL SCORE (# of games ≥6.0M, <7.9M)	
49	8.0-9.9 MIL SCORE (# of games ≥8.0M, <9.9M)	
50	10-99 MIL. SCORE (# of games ≥10.0M, <99 M)	
51	AV. MIN. GAME TIME (Avg Game Time in minutes)	
52	LEFT OUTLANE (Total # of times ball hit Left Outlane)	
53	RIGHT OUTLANE (Total # of times ball hit Right Outlane)	

NOTE:
1. The numbers shown in this column for Items 1 through 4 are examples.
   Entries for all items depend on the amount of play; thus, they will vary
   from location to location.

RADICAL! Game Adjustment Table

Adjustment Item (Player 3)	Descriptive Phrases (Player 1 and 2 Displays)		Factory Setting Domestic (US/Can.)	W.Ger./ European
Ad 01	AUTO REPLAY [1] *or*		10 (%)	ON
	FIXED REPLAY [1]		SCORES[1]	
02	REPLAY START (or REPLAY LEVEL 1) [1]		6,000,000	7,000,000
03	REPLAY LEVELS (or REPLAY LEVEL 2) [1]		02	
04	(REPLAY LEVEL 3) [1]		(see text)	
05	(REPLAY LEVEL 4) [1]		(see text)	
06	REPLAY AWARD		Credit	
07	SPECIAL AWARD		Credit	
08	MATCH FEATURE	[Off,1-50%]	7 (%)	
09	BALLS/GAMES		03	
10	TILT WARNING		03	
11	MAXIMUM EXTRA BALL		02	02
12	MAXIMUM CREDITS		10	30
13	HIGHEST SCORES		On	
14	BACKUP HI. SCR.1		8,000,000	8,500,000
15	BACKUP HI. SCR. 2		7,500,000	8,000,000
16	BACKUP HI. SCR. 3		7,000,000	7,500,000
17	BACKUP HI. SCR. 4		6,500,000	7,000,000
18	HI. SCR.1 CREDITS		01	03
19	HI. SCR.2 CREDITS		01	00
20	HI. SCR.3 CREDITS		01	00
21	HI. SCR.4 CREDITS		01	00
22	H. S. RESET EVERY		3,000	1,000
23	FREE PLAY		NO	
24	U.S.A. 1 COINAGE (1 COIN 1 PLAY) [2,3,6]		USA 2	GERMAN 2
25	LEFT UNITS		01	06
26	CENTER UNITS		04	12
27	RIGHT UNITS		01	30
28	UNITS/ CREDIT		01	05
29	UNITS/ BONUS		00	00
30	MINIMUM UNITS		00	00
31 - 48	Game-specific Adjustments (detailed in text and the Game Adjustment Setting Comparison Table)			
49[4]	CUSTOM MESSAGE		ON	
50	DISPLAY AU (01 - 04)		YES	
51 - 52	NOT USED			
53 -58 [5,6]	Special Adjustments- See text for 53-58 details.			
59 [5]	INSTALL ADDABALL		NO	
60 [5]	INSTALL 5-BALL		NO	
61 [5]	INSTALL NOVELTY		NO	
62 [5]	INSTALL EX. EASY		NO	
63 [5]	INSTALL EASY		NO	
64 [5]	INSTALL MEDIUM		NO	
65 [5]	INSTALL HARD		NO	
66 [5]	INSTALL EX. HARD		NO	
67	AUTO BURN-IN		NO	
68	INSTALL FACTORY		NO	
69 [7]	CLEAR AUDITS		NO	
70	CLEAR COINS		NO	

NOTES:

1 Automatic Replay percentage value range is adjustable from 5 to 50%, via the Start Button. Item 02 permits changing the factory setting value for Replay Start Level valid for the next 500 games played. Item 03 permits setting up four replay levels, values as detailed in text describing Item 03. For Fixed Replay Scores set Auto Replay value to 1 less than 5% via the Start Button. Go to items 02, 03, 04, and 05; install their replay level scores. Turn off any replay level by setting 00 as its value.

2 Phrase in parentheses is Factory Setting. Phrase appears in player 2 and 4 displays. Press Start button to change setting of the game pricing of Item 24.

3 To change country OR coinage setting, press Start button to obtain 24 Standard settings, followed by a Custom Setting. The Custom Setting activates items 25 through 30. When a Standard Setting is used Items 25 through 30 are set automatically, and cannot be changed.

4 To install Custom Message, press flipper button for alphabet and special characters. Press Start Button for next message letter or character.

5 Special Preset Adjustment, whose effects are noted in the Game Adjustment text.

6 Refer to Pricing Table and text describing these items.

7 Approximates Ad 64, yet includes all factors listed in Factory Setting column, not just Ad 31 through 47 provided by Ad 64.

Player 3 display shows Ad for all 70 adjustment items, so its entry is omitted from the tabular listing.

The *RADICAL!* Game Adjustment Setting Comparison Table shows the five game 'difficulty' Adjustment Items (ranging from Ad 62 - Extra Easy through Ad 66 - Extra Hard). Installing any one of these 'difficulty' Adjustments causes the values shown for each of the included game play Adjustment Items to be installed as a group, changing the level of play from one difficulty level to another. The owner/operator can use the information provided by the Audit Table items to determine whether the 'difficulty level' for this game in this location needs to change to obtain a higher level of earnings from the game or to provide a greater challenge to the location's players.

Once the 'difficulty level' is changed, a careful review of the Audit Items will reveal whether the change has achieved this higher-earnings goal. Sometimes, one (or more) of the Adjustment Items needs further change to keep the number of plays high, while still keeping the earnings level high.

RADICAL! Game Adjustment Comparison Table

Adj #	Adj Description	Extra Easy Ad 62	Easy Ad 63	USA Factory Settings Medium Ad 64	German & French Factory Settings Hard Ad 65	Extra Hard Ad 66
31	Easy Million	Yes	Yes	Yes	No	No
32	Spot Return Lane	Yes	Yes	No	No	No
33	Memory 100K Bonus	Yes	Yes	Yes	Yes	No
34	Allow Bitchin	Yes	Yes	Yes	Yes	Yes
35	Easy Extra Ball	Yes	Yes	Yes	No	No
36	Easy Spot Letter	Yes	Yes	Yes	No	No
37	Vertical Ramp Ex. Ball	Yes	Yes	No	No	No
38	Easy Kickback	Yes	Yes	No	No	No
39	Easy Mega Million	Yes	Yes	Yes	No	No
40	Snake Run Multi-ball	15%	10%	5%	5%	5%
41	Snake Run Extra Ball	10%	5%	5%	5%	5%
42	Snake Run Million	15%	15%	15%	15%	15%
43	Snake Run Tail Slider	20%	20%	25%	25%	25%
44	Snake Run Vertical	10%	20%	20%	20%	20%
45	Percent Special	2%	2%	2%	2%	2%
46	Consolation Extra Ball	Yes	Yes	Yes	Yes	Yes
47	Average Ball Time	40 sec	40 sec	40 sec	30 sec	30 sec
48	Attract Mode Sound	None	None	None	None	None

Game Adjustment Procedure

Adjustment Items 01 through 70

The coin door must be open to access the Game Adjustment/Diagnostic switches. All readings and setting changes require operation of these coin door switches. Some setting changes utilize the Start button; Adjustment #49 also uses the flipper buttons. Additional text describing the game adjustment items follows this procedure; the value of the Factory Setting for each Game Adjustment item is in the preceding *RADICAL!* Game Adjustment Table.

1. Use AUTO-UP and press ADVANCE. The Id 00 display initially appears. Press ADVANCE until the Player 3 display indicates Ad 01. If the factory setting has not changed, the Player 1 and 2 Score displays indicate AUTO REPLAY, and the Player 4 display shows 10%, indicating a 10% replay percentage. (The game program adjusts itself automatically, as discussed in the following text concerning the 'details' about Adjustment Item 01.)

2. To reach a higher item number (in the Player 3 display), use AUTO-UP and press ADVANCE. To return to a previous item number, use MANUAL-DOWN and press ADVANCE.

3. With the desired Game Adjustment Item number showing in the Player 3 display, increase the setting value (or select another option) shown in the Player 4 display by using AUTO-UP and pressing the Start button. Repeat this step for each item, until all changes to the factory settings for the Game Adjustment Items have been made. The preceding Game Adjustment Table consolidates the Factory Settings into one grouping.

    (The same procedure can be used for Audit Items. To zero Au 01 - 04 [concerning the coin chutes and the total coins], the operator can proceed to item 68, Clear Coins, and press the Start button to obtain the YES option. The operator then presses the ADVANCE button and notes the "DONE" display, which verifies that the entry values for items 01 through 04 of the Audit Items are now reset to zero.)

    For example, the operator may desire to change the degree of game play difficulty from the Factory Setting (equivalent to the Install Medium [Ad 64] difficulty, along with a number of other automatically installed settings, as shown in the right column of the Game Adjustment Table) to another difficulty more suitable for the players at a particular game site. Four other 'automatic' play difficulty settings (Ad 62 - Ad 66) are available, each of which, if selected, installs all the adjustments listed for that difficulty in the Game Adjustment Setting Comparison Table, which precedes the 'details' text.

4. To proceed rapidly through the entire adjustments series, press and hold ADVANCE, until Ad 70 shows in the Player 3 display. From item 70, you can: (A) return to the Game-Over Mode; or (B) restore factory settings and zero audit (bookkeeping) totals. Perform either of the following, as desired:

A. To reach Game-Over Mode, use AUTO-UP and press ADVANCE once. *RADICAL!* now goes to the Game-Over Mode.

B. To restore the Factory Settings for Game Adjustment Items (as listed in the Game Adjustments Table), zero all audit (bookkeeping) totals, and return to Game-Over Mode, use AUTO-UP or MANUAL-DOWN to display Ad 70 in the Player 3 display. Press the Start button to display the YES option in the Player 4 display. Using AUTO-UP, press ADVANCE once. *RADICAL!* now zeroes ALL Audit Item totals and changes ALL Game Adjustment Items back to those originally selected as Factory Settings. It then shows the operator a message ("FACTORY SETTING") that this has occurred. (A problem in the Memory Protect Circuit or closing the coin door will cause the message "ADJUST FAILURE" to appear.) Press ADVANCE once more to return to the Game-Over Mode.

Details of Adjustment Items 01 through 70

▲ 01 Auto Replay (or Fixed Replay)

Of the two options, AUTO REPLAY is the percentage of replays automatically awarded per game. The game program aids a pinball's initial installation by causing a comparison of the value of the Replay Level to the value of all players' scores every 50 games. At each comparison, the program increases (or decreases) the Replay Level by an amount necessary to achieve the replay percentage specified either via the factory setting or later operator selection. Use the Start button to change the percentage within the range of 5 to 25 (%), with the value increasing using AUTO-UP (or decreasing using MANUAL-DOWN). The next Start button change below 5%, selects the FIXED REPLAY option.

For AUTO REPLAY, Ad 02 provides the Starting Replay Level (Player 1 and 2 displays show REPLAY START). Ad 03 provides the number of replay levels (01, 02, 03, or 04). *RADICAL!* then proceeds to Ad 06 automatically.

For FIXED REPLAY, Ad 02 is the first replay level (REPLAY LEVEL 1). Ad 03, 04, and 05 are the other replay levels.

▲ 02 Starting Replay Level (or Replay Level 1)

For AUTO REPLAY (refer to Ad 01), the initial Factory Setting is listed in the Game Adjustment Table. The range of settings is 800,000 through 9,800,000 (by increments of 100,000 with AUTO-UP or decrements of 100,000 with MANUAL-DOWN).

For FIXED REPLAY, the operator can enter the value to be used for the first fixed replay score level via the Start button. The range of settings is: OFF; 100,000 through 9,900,000 (by increments of 100,000 with AUTO-UP, or decrements of 100,000 with MANUAL-DOWN).

▲ 03 Replay Levels (or Replay Level 2)

For AUTO REPLAY (refer to Ad 01), this is the number of replay levels in a game. The option range is one, two, three, or four replay level(s). When the operator chooses two replay levels, *RADICAL!* automatically adjusts the second replay level to be twice the value selected for Ad 02, the starting replay level. Choosing three or four replay levels automatically adjusts their replay levels to three times or four times the Ad 02 value.

For FIXED REPLAY, the technique of value entry and the range of settings are identical to those of Ad 02.

▲ 04 (Replay Level 3)

For AUTO REPLAY, this Adjustment Item is not applicable. *RADICAL!* automatically bypasses this adjustment.

For FIXED REPLAY, the technique of value entry and the range of settings are identical to those of Ad 02.

▲ 05 (Replay Level 4)

For AUTO REPLAY, this Adjustment Item is not applicable. *RADICAL!* automatically bypasses this adjustment.

For FIXED REPLAY, the technique of value entry and the range of settings are identical to those of Ad 02.

▲ 06 Replay Award

For either AUTO REPLAY or FIXED REPLAY (Ad 01), the operator can select the form of the award automatically provided when the player exceeds any Replay Level (Automatic or Fixed). The choices are:

Credit - Reaching each replay level obtains a credit (free game).
Ball   - Reaching each replay level obtains an extra ball.
Audit - Reaching each replay level obtains nothing to the player; it does increase the entry value of the Audit Item(s) maintaining a tally of these awards (Au 08, and Au 20 through 23, as applicable).

▲ 07 Special Award

The operator can select the form of the award automatically provided when the player scores a Special. The choices are:

Credit - Scoring each Special, when lit, obtains a credit (free game).
Ball   - Scoring each Special, when lit, obtains an extra ball.
Score - Scoring each Special, when lit, obtain a score advance of 100,000 points to the player.

▲ 08 Match Award

The operator can select (via the Start button) the desired percentage for the Match action occurring at the completion of each game. The choices are:

1%-50% -   1% is 'hard'; 50% is 'extremely easy'. During Match action, the game selects a random two-digit number at end of game and compares each player's score for an identical two digits in the rightmost two positions. A matching of the two digits results in the award of a credit.

Off   -   The MATCH display does not operate at completion of the game; no award is given.

▲ 09 Balls/Game

The operator can define a "game" by specifying the number of balls to be played. The range of this setting is 1 through 9.

▲ 10 Tilt Warning

The operator can specify the number of total actuations of the plumb bob and playfield tilt mechanisms that can occur before the game is "tilted". The range of this setting is 1 through 5.

▲ 11 Maximum Extra Ball

The operator can choose (via the Start button) the number of Extra Balls to be awarded to a player. The range of this setting is:

00   -   NO extra ball play: displays a message, NO EX. BALL
               A score is awarded in lieu of the extra ball.
1-9 E.B./Ball -1 through 9 Extra Balls per ball (i.e., all balls including Extra Balls) are awarded.

▲ 12 Maximum Credits

The operator can specify the maximum number of credits the game can accumulate, either through game play awards or coin purchases. The range of settings is 5 through 10. Reaching the specified setting prevents the award of additional credits by game play. Coin purchases do continue to accumulate and are displayed.

▲ 13 Highest Scores

The operator can specify (via the Start button) whether the game is to maintain a record of the four highest scores achieved to date. The choices are:

Off   -   NO high scores are recorded.
On   -   The four highest scores are stored in memory for use by Game Adjustment 22.

▲ 14 Backup High Score 1

The operator can set the Backup High Score value in the Player 1 Score display, using the Start button. The game automatically restores this value, when the operator presses, and holds, the HIGH SCORE RESET switch, or when an automatic High Score Reset event (Ad 22) occurs.

▲ 15 Backup High Score 2

This adjustment is similar to Ad 14, except that this applies to the Player 2 Score display. The adjustment technique is identical to Ad 14. It is also restored as described for Ad 14.

▲ 16 Backup High Score 3

This adjustment is similar to Ad 14, except that this applies to the Player 3 Score display. The adjustment technique is identical to Ad 14. It is also restored as described for Ad 14.

▲ 17 Backup High Score 4

This adjustment is similar to Ad 14, except that this applies to the Player 4 Score display. The adjustment technique is identical to Ad 14. It is also restored as described for Ad 14.

▲ 18 Credits for Highest Score 1

The operator can select the number of credits to be awarded, by using the Start button, whenever a player exceeds the previous Highest Score. The range of this setting is 00 through 10.

▲ 19 Credits for Highest Score 2

This adjustment is similar to Ad 18, except that this applies to the player's exceeding the second highest score. The Start button adjustment technique is the same as for Ad 18. The range of this setting is 00 to 03.

▲ 20 Credits for Highest Score 3

This adjustment is similar to Ad 18, except that this applies to the player's exceeding the third highest score. The Start button adjustment technique is the same as for Ad 18. The range of this setting is 00 through 03.

▲ 21 Credits for Highest Score 4

This adjustment is similar to Ad 18, except that this applies to the player's exceeding the fourth highest score. The Start button adjustment technique is the same as for Ad 18. The range of this setting is 00 through 03.

▲ 22 Automatic High Score Reset

The operator can specify (via Start button) that the game will provide an automatic reset of the displayed "Highest Scores", and the number of games to be played before the reset occurs. (Audit item 39 displays the games remaining before the reset.) The values provided upon reset are those selected by the operator in Ad 14 through 17, the Backup High Scores. The range of this setting is Off (to disable this adjustment), and 250 to 24,750 games (in increments of 250).

▲ 23 Free Play

The operator can select (via the Start button) whether a player can operate the game without a coin (free play) or with a coin. The choices are:

No - A coin is necessary for game play.
Yes - Game play is free; no coin is required.

▲ 24 Coinage Selections

The operator can specify (via the Start button) any of the Standard Settings for game pricing, each of which exhibits a message identifying the country and the number of coins required and the number of games that the coin requirement purchases. Choosing a Standard Setting permits the game to omit items Ad 25 through 30, which are adjustments allowing for a special custom coinage setting.

Following the last Standard Setting is a Custom Coinage Setting, which allows the operator to utilize Ad 25 through 30 in establishing a special coinage setting. A message, CUSTOM COINAGE, indicates that the operator can enter the appropriate values into the Ad 25 through 30 adjustment items.

The values for Ad 25 through 30 of each Standard Setting, as well as other possible values for the Custom Coinage Setting are shown in the Pricing Table.

▲ 25 Left Chute Coin Units

The operator can specify (via the Start button) the number of coin units purchased by a coin passing through the left coin chute.

▲ 26 Center Chute Coin Units

The operator can specify (via the Start button) the number of coin units purchased by a coin passing through the center coin chute.

▲ 27 Right Chute Coin Units

The operator can specify (via the Start button) the number of coin units purchased by a coin passing through the right coin chute.

▲ 28 Units Required for Credit

The operator can define (via the Start button) the number of coin units required to obtain 1 Credit. A coin unit counter in the game program totals the number of coin units purchased through all coin chutes prior to each game. If the total of these coin units matches, or exceeds, the Units per Credit value by a multiple (or more, coin units) of the specified Units per Credit value, the Credits display shows the proper number of Credits. The coin unit counter retains any remaining coin units, until the start of a game; then, the coin unit counter is cleared (its contents are zeroed).

▲ 29 Units Required for Bonus

The operator can specify (via the Start button) that 1 additional Credit is to be indicated in the Credits display, when a certain number of coin units are accumulated.

▲ 30 Minimum Units Required for any Credits Posted

The operator can specify that NO Credits are to be posted (indicated in the Credits display), until the credit units counter reaches a particular value, by setting this value to 02 (or more). A setting of 01 allows the Credits display to show fractional coin units.

The System 11C game program defines the following Adjustment Items as "game specific"; that is, they are unique for each game. The Game Designer/Engineer/Programmer team members work together to use these as controlling factors for game play. By varying the setting of these Adjustment Items, it is possible to "fine-tune" a game to suit a particular location, enabling the owner/operator to reap maximum earnings, while still providing the players with sufficient challenge to keep them playing.

▲ 31 Easy Million

The operator can choose (via the Start button) whether to allow the player more time to achieve the Million shot. The choices are:

Yes - (Liberal) The player is allowed additional time.
No - (Conservative) The player is not allowed additional time.

▲ 32 Spot Return Lane

The operator can choose (via the Start button) whether the Return Lanes spot letters in R-A-D-I-C-A-L. The choices are:

Yes - (Liberal) The Return Lanes spot letters in R-A-D-I-C-A-L.
No - (Conservative) The Return Lanes do not spot letters R-A-D-I-C-A-L.

▲ 33 Memory 100K Bonus

The operator can choose (via the Start button) whether Outhole Bonus is stored in memory for "next ball" play (continues from ball to ball) or is reset for each ball. The choices are:

Yes - (Liberal) The Outhole Bonus is stored in memory.
No - (Conservative) The Outhole Bonus is reset for each ball.

▲ 34 Allow "Bitchin"

The operator can choose (via the Start button) whether to allow the phrase 'Bitchin" to used as a part of the speech mode. The choices are:

Yes - (Liberal) The phrase "Bitchin" is used as a part of the speech mode.
No - (Conservative) The phrase "Bitchin" is omitted from the speech mode.

▲ 35 Easy Extra Ball

The operator can choose (via the Start button) whether to allow the player more time to achieve an Extra Ball. The choices are:

Yes - (Liberal) The player is allowed additional time.
No - (Conservative) The player is not allowed additional time.

▲ 36 Easy Spot Letter

The operator can choose (via the Start button) whether to allow the player more time to Spot Letters in R-A-D-I-C-A-L. The choices are:

Yes - (Liberal) The player is allowed additional time.
No - (Conservative) The player is not allowed additional time.

▲ 37 Vertical Ramp Extra Ball

The operator can choose (via the Start button) whether achieving the Vertical Ramp X amount of times turns on the Extra Ball light for 5 seconds.   The choices are:

Yes - (Liberal) The Extra Ball light does turn on.
No - (Conservative) The Extra Ball light does not turn on.

▲ 38 Easy Kickback

The operator can choose (via the Start button) how often the Kickback is enabled at ball start. The choices are:

Yes - (Liberal) The Kickback is enabled at the start of every ball.
No - (Conservative) The Kickback is enabled at the first ball start only.

▲ 39 Easy Mega Million

The operator can choose (via the Start button) whether to allow the player more time to achieve the Mega Million. The choices are:

Yes - (Liberal) The player is allowed more time to achieve the Mega Million.
No - (Conservative) The player is not allowed more time to achieve the Mega Million.

The following adjustments, #40 to #44, deal with the SNAKE RUN payout. The sum total percentage of the these adjustments should add up to less then 80%.

▲ 40 Snake Run Multi-ball

The operator can choose (via the Start button) what percentage of the Snake Run awards Multi-ball. The range of this setting is 1% to 25%.

▲ 41 Snake Run Extra Ball

The operator can choose (via the Start button) what percentage of the Snake Run awards an Extra Ball. The range of this setting is 1% to 25%.

▲ 42 Snake Run 1 Million

The operator can choose (via the Start button) what percentage of the Snake Run awards 1 Million points. The range of this setting is 1% to 25%.

▲ 43 Snake Run Tail Sliders

The operator can choose (via the Start button) what percentage of the Snake Run awards Tail Slider. The range of this setting is 1% to 25%.

▲ 44 Snake Run Verticals

The operator can choose (via the Start button) what percentage of the Snake Run awards the Vertical payoff. The range of this setting is 1% to 25%.

▲ 45 Random Special

The operator can choose (via the Start button) the percent of games that award a Random Special from the Left Outlane. The range of this setting is 1% to 25%

▲ 46 Consolation Extra Ball Time

The operator can choose (via the Start button) whether a less-skilled player can obtain an Extra Ball. The choices are:

Yes - (Liberal) With a ball time less than the setting of Ad 47, the player receives an opportunity to obtain an Extra Ball.

No - (Conservative) The player cannot receive an Extra Ball.

▲ 47 Average Ball Time

The operator can choose (via the Start button) the desired ball time for a game. On the last ball, if a player has not reached this 'game time' a form of consolation play becomes effective to encourage players to continue playing. The calculation involves determining at ball start for the last ball, whether at least 2/3 of the 'desired game time' has elapsed. If not, the Extra Ball light turns on to allow the player a chance to obtain an Extra Ball. The range of this setting is OFF (Extra Ball is not lit, because there is no minimum game time limit), 1 second (Conservative) through 99 seconds (Liberal).
NOTE: Consolation Extra Balls are not audited as Extra Balls.

▲ 48 Attract Mode Sounds

The operator can select (via the Start button) the frequency of Attract Mode sounds. The choices are:

Alot - (Liberal)
Less
None - (Conservative)

▲ 49 Custom Message

The operator can choose (via the Start button) whether to display a message during the Attract Mode. (When display of a message is selected, the operator can either utilize the message provided or change the message). Three choices are available:

1 - Display a message during the Attract Mode. The Player 4 display shows this choice as ON. The message provided is: "LIVE TO SKATE, SKATE TO LIVE, START THRASHIN"

2 - Do NOT display a message during the Attract Mode. (Player 4 shows OFF.)

3 - The Player 4 display shows this choice as CHANGE. The operator can enter a special ("custom") message, as follows:

A. Press ADVANCE once. The operator can now enter as many as three 14-character lines for display during the Attract Mode.

B. Use the flipper button(s) to select each message character (alphabet, numbers, and special symbols are available). In case of error, enter a "back arrow" (just before "space") to correct, followed by correct character. For a period after any letter, use letters with periods (following the special symbols). The entire character set is the following:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0 1 2 3 4 5 6 7 8 9 < > ? - / * '
A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z. _

C. Move to the next character via the Start button. No entirely blank lines will be displayed.

▲ 50 Display AU 01 - 04

The operator can choose (via the Start button) how to display the coinage audit information, Au 01 - 04. No information is lost; it remains stored in the CPU memory. The information is now available for readout via the player score displays. Three choices are available:

Yes - Both the audit text (slot identification) and the value is displayed.

Value - Only the value is displayed.

No - NO display occurs.

▲ 51-52 Not Used

▲ 53-55 Not used in USA games (see Adjustments for German games).

SPECIAL PRESET ADJUSTMENTS CAUTION

Adjustments 53 through 66 are Special Preset Adjustments to enable the operator to perform the setting of multiple adjustments at once. They permit the operator to: (1) either modify a game for a specific area (for example, USA coinage settings, Ad 56 through 58, or special German coinage settings, Ad 53 through 58) (2) change a group of adjustments to conform with laws of certain localities (Ad 59 through 61); and (3) to change the degree of difficulty of game play (Ad 62 through 66). A list of the preceding individual Adjustments affected accompanies each of these Special Preset Adjustments. Whenever the operator chooses to use any Special Preset Adjustment, the operator can later access any or all of the individual Adjustments affected by that Special Adjustment for subsequent changes.

A similar technique is recommended in the event of error or uncertainty concerning any Special Preset Adjustment, after the operator selects it: The operator can restore the factory setting of each individual Adjustment, then select the desired Special Preset Adjustment, and then return to any of the preceding individual adjustments to determine whether use of the Special Adjustment has had the desired effect.

The Backbox displays for each Special Preset Adjustment indicate whether the operator has selected it, by identifying the Adjustment in the Player 1 and 2 displays by name and the selection choice of NO, meaning Not Selected (this is the Factory Setting), or YES, meaning Selected, in the Player 4 display. Operator installation of the 'selected' Preset Adjustment occurs by using the Start button to choose YES and then pressing the ADVANCE switch. The displays then show the name of the Adjustment again, with DONE to show that the installation is now in effect.

Note that, when an operator installs any of the Special Preset Adjustments, Adjustment Items using the automatic adjust feature of the game program reset to the auto adjust value listed for that Adjustment Item.

NOTE

Games in which the CPU has ROMs installed for German (Deutsch) language and play adjustments automatically have certain Adjustment Items preset. The following table shows these Preset Adjustment Items for each of the special German Coinage Adjustments.

▲ 53 through 58 for German/European Games Only:
Install German 1, 2, 3, 4, 5 or 6.

The operator can use these Adjustment Items to modify the game pricing selection of the Standard Setting named "German1 or German 2" in the Pricing Table to permit the style of play for the particular price shown in the *RADICAL!* Preset game Adjustment Table for German/European Games.

Preset Game Adjustments Table For GERMAN/EUROPEAN GAMES

AD	ADJ DESCRIPTION	GERMAN 1 AD 53	GERMAN 2 AD 54	GERMAN 3 AD 55	GERMAN 4 AD 56	GERMAN 5 AD 57	GERMAN 6 AD 58
06	Replay Award	Credit	Credit	Credit	Credit	Credit	Credit
07	Special Award	Credit	Ball	Score	Credit	Ball	Score
08	Match Feature	7%	7%	Off	7%	7%	Off
09	Balls/Game	03	03	03	03	03	03
14	Backup High Score 1	8,500,000	8,500,000	00	8,500,000	8,500,000	00
15	Backup High Score 2	8,000,000	8,000,000	00	8,000,000	8,000,000	00
16	Backup High Score 3	7,500,000	7,500,000	00	7,500,000	7,500,000	00
17	Backup High Score 4	7,000,000	7,000,000	00	7,000,000	7,000,000	00
18	High Score 1 Credits	03	03	00	03	03	00
19	High Score 2 Credits	00	00	00	00	00	00
20	High Score 3 Credits	00	00	00	00	00	00
21	High Score 4 Credits	00	00	00	00	00	00
24	Coinage Setting	6 spiele/5 DM	6 spiele/5 DM	6 spiele/5 DM	7 spiele/5 DM	7 spiele/5 DM	7 spiele/5 DM

▲ 56 Install 3 Balls/2 Coins

The operator can use this adjustment to modify the current game pricing selection to enable game play to begin when the specified number of coins are deposited. In this instance, the player now receives a 3 ball game when 2 coins of proper denomination (USA: 50 cents) passes through the coin chute.

▲ 57 Install 3 Ball/ 1 Coin

The operator can use this adjustment to modify the current game pricing selection to enable game play to begin when the specified number of coins are deposited. In this instance, the player now receives a 3 ball game when 1 coin of the proper denomination (USA: 25 cents) passes through the coin chute.

▲ 58 Install 5 Balls/2 Coins

The operator can use this adjustment to modify the current game pricing selection to enable game play to begin when the specified number of coins are deposited. In this instance, the player now receives a 5 ball game when 2 Coins of the proper denomination (USA: 50 cents) passes through the coin

Preset Game Adjustments Table For **US/CANADIAN GAMES**

AD	ADJ DESCRIPTION	AD 54 Not Used	AD 55 Not Used	AD 56 3-ball/ 2 Coins	AD 57 3-balls/ 1 Coin	AD 58 5-balls/ 2 Coins
02	Replay Start	-	-	6,000,000	6,000,000	7,000,000
09	Balls/Game	-	-	3	3	5
14	Backup High Score 1	-	-	8,000,000	8,000,000	9,000,000
15	Backup High Score 2	-	-	7,500,000	7,500,000	8,500,000
16	Backup High Score 3	-	-	7,000,000	7,000,000	8,000,000
17	Backup High Score 4	-	-	6,500,000	6,500,000	7,500,000
24	Coinage	-	-	USA 3	USA 1	USA 3
64	Install Medium	-	-	Yes	Yes	No
65	Install Hard	-	-	No	No	Yes

▲ 59 Install Add-A-Ball

The operator can utilize this option to delete all Free Play awards and replace them with Extra Ball awards. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
06	Replay Award	Ball	18	Hi Scr 1 Credits	00
07	Special Award	Ball	19	Hi Scr 2 Credits	00
08	Match Feature	Off	20	Hi Scr 3 Credits	00
11	Ex. Ball	4/BIP	21	Hi Scr 4 Credits	00

▲ 60 Install 5-Ball

The operator can change the game to 5-ball play, including the changing of certain features to the recommended 5-ball difficulty level. NOTE Ad 65 (Install Hard) settings are also set when the game is changed to '5-ball play'. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
02	Replay Start	7,000,000	09	Balls/Game	05

▲ 61 Install Novelty

The operator can remove all Free Play and Extra Ball awards. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
01	Fixed Replay	Scores	07	Special Award	Score
02	Replay Level 1	Off	08	Match Feature	Off
03	Replay Level 2	Off	11	No Extra Ball	00
04	Replay Level 3	Off	18	Hi Scr 1 Credits	00
05	Replay Level 4	Off	19	Hi Scr 2 Credits	00
06	Replay Award	Audit	20	Hi Scr 3 Credits	00
			21	Hi Scr 4 Credits	00

▲ 62 Install Extra Easy

The operator can change the game play difficulty adjustments to a combination that is extremely easy (sometimes called "liberal"). The Game Adjustment Setting Comparison Table, which precedes these 70 individual Adjustment descriptions, lists the Adjustments and the settings that comprise the 'Extra Easy' group.

▲ 63 Install Easy

The operator can change the game play difficulty adjustments to a combination that is slightly easier than the Factory Settings. The Game Adjustment Setting Comparison Table, which precedes these 70 individual Adjustment descriptions, lists the Adjustments and the settings that comprise the 'Easy' group.

▲ 64 Install Medium

The operator can change the game play difficulty adjustments to a combination that matches the Factory Settings. The Game Adjustment Setting Comparison Table, which precedes these 70 individual Adjustment descriptions, lists the Adjustments and the settings that comprise the 'Medium' group.

▲ 65 Install Hard

The operator can change the game play difficulty adjustments to a combination that is more difficult than the Factory Settings. The Game Adjustment Setting Comparison Table, which precedes these 70 individual Adjustment descriptions, lists the Adjustments and the settings that comprise the 'Hard' group.

▲ 66 Install Extra Hard

The operator can change the game play difficulty adjustments to a combination that is much more difficult than the Factory Settings. The Game Adjustment Setting Comparison Table, which precedes these 70 individual Adjustment descriptions, lists the Adjustments and the settings that comprise the 'Extra Hard' group.

▲ 67 Auto Burn-in

The operator can choose the YES option for this Special Preset Adjustment to perform certain automatic testing of the game, as used in the factory. It does not affect the game operation, but merely provides for a cycle testing of most of the game's mechanisms.

▲ 68 Install Factory

The operator can request the game (via the Start button) to provide the normal Factory Settings, essentially restoring the game to its 'factory condition'. The operator must select the 'YES' option for this adjustment. This Adjustment clears all Audits, resets all Game Adjustments to the respective Factory Settings, and provides a restart of the Auto Replay (Ad 01). After selecting the YES option, the operator must press the ADVANCE button. The game then displays FACTORY SETTING.

Closing of the coin door before appearance of the FACTORY SETTING message or a problem in the Memory Protect Circuit will cause the game to display ADJUST FAILURE.

A loss of battery power or improper treatment of the Game Adjustments will cause the game to attempt to restore Factory Settings. The game announces the results of this reset process with the appropriate message, FACTORY SETTING or ADJUST FAILURE.

▲ 69 Clear Audits

The operator can request the clearing of the non-coinage audits (Au 05 through 55) by selecting (via the Start button) the YES option, as shown in the player 4 display. This Adjustment zeroes the counters tallying the remaining Audit factors. Please note that this does NOT affect the Automatic Replay Percentaging data nor the automatic High Score Reset counter.

After the YES option is displayed, the operator must press the ADVANCE button. The game then displays DONE to show that the non-coinage audits have been reset to zero.

▲ 70 Clear Coins

The operator can request the clearing of the coinage audits (Au 01 through 04) by selecting (via the Start button) the YES option, as shown in the player 4 display. This adjustment zeroes the counters tallying the number of coins through each slot, the Paid Credits counter, and the Credits display.

After the YES option is displayed, the operator must press the ADVANCE button. The game then displays DONE to show that the coinage audits have been reset to zero.

Resetting the High Scores

The challenge of exceeding the High Score (either the factory setting or a higher score by another player) is the goal of any pinball game players. To keep a pinball game challenging requires a method of resetting the High Score value for those occasions when a skilled player registers a truly excellent score. Other players note this score and may decide not to play simply because their skill is not adequate to exceed an extremely high score.

For *RADICAL!*, in fact, three methods of resetting the High Score values are available. The simplest method involves allowing Game Adjustment Item Ad 22 to reset the High Score values automatically after the specified number of plays designated by the operator. The second method requires pressing the High Score Reset switch on the inside of the coin door in the Attract Mode. This action simply erases the previous high score values and replaces them with the Backup High Score values. The third method establishes new values replacing the factory setting values or previous operator setting values; it requires performing the following steps:

1. Using AUTO-UP or MANUAL-DOWN, reach item Ad 14 (and items Ad 15, 16, and 17, if desired). The High Score value of the factory setting (or previous operator-adjusted setting) appears in the Player 1 display. If this value is satisfactory, go to step 4 below.

2. If you wish to increase the High Score value from that displayed in the Player 1 display, use AUTO-UP, and press the Start button, until the desired value shows in the Player 1 display.

3. If you wish to decrease the High Score value, use MANUAL-DOWN, and press the Start button, until the desired value shows in the Player 1 display.

4. Using AUTO-UP, press and hold down ADVANCE, until the Player 3 display shows Ad 70 Press ADVANCE once, to return to Game-Over Mode.

5. Press the High Score Reset switch (on coin door), and listen for the sound signifying that the score reset action is complete. Observe player score displays (Player 1, Player 2, etc.) to verify that the new High Score values are displayed.

Game Pricing

___PRICING MADE EASY

Game Adjustment Item Ad 24 allows the operator an easy method of setting the pricing functions. Pressing the Start button allows the operator a choice of one of the 16 "Standard" Settings, with associated automatic pricing (Player 1 and 2 displays show the Country identifier, with a number for a country having more than one "Standard" Setting; player 3 and 4 displays show the games per coin(s) information). In the Pricing Table, each "Standard" Setting is denoted by a Country Identifier. Automatic Pricing causes each of the other pricing items (columns 25 through 30) to change to the value shown in the table for that selected "Standard" Setting. In the table where the word "CUSTOM" appears, the owner/operator must enter the values shown (columns 25 through 30) to obtain the games per coin factor shown in the Games/Coin column of the table. To make these setting adjustments, the owner/operator must press the Start button until the words "CUSTOM COINAGE" appear in the player score displays.

RADICAL! Pricing Table

Country	Coin Chute Left Center Right			Games/Coin	Ad 24 Display	Pricing Functions 25 26 27 28 29 30					
USA and Canada	25¢	-	25¢	1/25¢, 4/$1 [2]	U.S.A. 1	01	04	01	01	00	00
				1/50¢, 2/75¢, 3/$1 [1,2]	U.S.A. 2	03	12	03	04	00	00
				1/50¢, 2/$1 [2]	U.S.A. 3	01	04	01	02	00	01
				1/25¢, 3/$1 [2]	U.S.A. 4	01	00	01	02	04	01
				1/25¢, 3/50¢, 6/$1	CUSTOM	01	04	01	01	02	00
				1/25¢, 5/$1	CUSTOM	01	00	01	01	04	00
				1/50¢ ; Add'l game: 25¢	CUSTOM	98	00	98	99	00	00
Austria	5 Sch	10 Sch	10 Sch	1/2x5 Sch, 3/2x10 Sch [2]	AUSTRIA	01	02	02	02	04	01
	5 Sch	-	10 Sch	2/5 Sch, 5/10 Schilling	CUSTOM	02	00	05	01	00	00
	1 Sch	5 Sch	10 Sch	2/5x1 Sch, 2/5 Sch, 5/10 Sch	CUSTOM	02	10	25	05	00	00
Australia	20¢	-	$1	1/3x20¢, 2/$1 [2]	AUSTRAL.	02	00	10	05	00	00
United Kingdom	10 P	50 P	1£	1/2x10 P, 3/50 P, 7/1£ [2]	U.K.	03	15	30	05	30	00
	10 P	50 P	20 P	1/10 P, 5/50 P, 2/20 Pence	CUSTOM	03	15	30	05	30	00
Switzerland	1 F	2 F	5 F	1/1 F, 3/2 F, 7/5 Franc [2]	SWISS	01	03	07	01	00	00
	1 F	-	2 F	1/1 F, 3/2 F	CUSTOM	03	00	06	02	00	00

Country	Coin Chute			Games/Coin	Ad 24 Display	Pricing Functions					
	Left	Center	Right			25	26	27	28	29	30
Belgium	5 F	20 F	50 F	1/4 x 5F, 1/1 x 20F, 3/1 x 50F[2]	BELGIUM	03	12	30	10	00	00
	5 F	-	20 F	1/2x5 F, 2/20 Franc	CUSTOM	01	00	04	02	00	01
	5 F	20 F	20 F	1/2x5 F, 2/20 F, 2/20 F	CUSTOM	01	04	04	02	00	01
	5 F	5 F	20 F	1/2X5 F, 1/2X5 F, 2/20 F	CUSTOM	01	01	04	02	00	01
West Germany	1 DM	2 DM	5 DM	1/1 DM, 2/2 DM, 7/5 DMark [2,3]	GERMAN1	06	12	30	05	30	00
				1/1 DM, 2/2 DM, 6/5 DM [1,2]	GERMAN2	06	12	30	05	00	00
				1/1 DM, 3/2 DM, 9/5 DM	CUSTOM	09	18	45	05	00	00
				1/2x1 DM, 1/2 DM, 3/5 DM	CUSTOM	03	06	15	05	00	00
				2/1 DM, 5/2 DM, 14/5 DM	CUSTOM	13	26	65	05	65	00
Netherlands	1 HFl	2.5 HFl	2.5 HFl	1/1 HFl, 3/2.5 Holland Florin[2]	NETHERL.	06	15	15	05	00	00
	25¢	-	1 G	1/25¢, 5/1 Guilder	CUSTOM	01	00	05	01	00	00
	1 G	-	1 G	1/1 Guilder [2]	HOLLAND	01	00	01	01	00	00
Sweden	5 Kr	5 Kr	5 Kr	1/5 Krona [2]	SWEDEN	01	01	01	01	00	00
	1 Kr	-	1 Kr	1/2x1 Krona	CUSTOM	01	04	01	02	00	01
France	1 F	5 F	10 F	1/3x1 F, 2/5 F, 5/10 Franc [1,2]	FRANCE	02	10	20	05	20	00
	1 F	5 F	10 F	1/2x1 F, 3/5 F, 7/10 Franc	CUSTOM	03	15	30	05	30	00
	5 F	10 F	10 F	1/5 F, 3/10 F, 7/2x10 Franc	CUSTOM	03	15	30	10	60	15
	5 F	10 F	10 F	2/5 F, 4/10 F, 9/2x10 Franc	CUSTOM	02	10	20	05	40	10
	5 F	10 F	10 F	2/5 F, 5/10 F, 11/2x10 Franc	CUSTOM	01	05	10	02	20	05
Italy	500 L	500L	500 L	1/500 L, 1/2x 200L, 3/2 x 500L	ITALY	06	00	15	01	10	00
Spain	25 P	-	100P	1/25 P, 5/100 Peseta [2]	SPAIN	05	00	20	04	00	00
	25 P	-	100P	1/25 P, 4/100 Peseta	CUSTOM	01	00	04	01	00	00
	25 P	-	100P	1/2x25 P, 2/100 Peseta	CUSTOM	01	00	04	02	00	00
	25 P	-	100P	1/2x25 P, 3/100 Peseta	CUSTOM	03	00	12	04	00	06
Japan	100 ¥	-	100 ¥	1/100 Yen [2]	JAPAN	01	00	01	01	00	00
	-	100 ¥	-	2/100 ¥	CUSTOM	01	04	01	02	00	01
Antilles, Netherl.	25¢	-	1 G	1/25¢, 4/1 Guilder [2]	ANTILLES	01	01	04	01	00	00
Chile	Token	-	Token	1/1 Token [2]	CHILE	01	04	01	01	00	00
Denmark	1 Kr	5 Kr	10 Kr	1/2x1 Kr, 3/5 Kr, 7/10 Krone [2]	DENMARK	03	15	30	05	30	00
Finland	1 Mka	-	5 Mka	1/2x1 Mka, 3/5 Markka [2]	FINLAND	03	00	15	05	00	00
New Zealand	20¢	-	20¢	1/3x20¢ [2]	N. Z.	01	00	01	03	00	01
Norway	1 Kr	-	1 Kr	1/2x1 Kr, 3/5x1 Krone [2]	NORWAY	01	00	01	02	05	00
Argentina	10¢	10¢	10¢	1/1 Token [2]	ARG.	01	01	01	01	00	00
Greece	10D	20D	50D	1/2x10D, 1/20D, 3/50 Drachma[2]	GREECE	03	06	15	05	00	00

Notes:
1. Factory Default.   2. Standard Setting - Change by pressing Credit button.   3. Other functions are also affected; see the explanations for Adjustment Items 53 through 58.

CUSTOM PRICING

Adjustment Item 24 must be set to the Custom Coinage Setting (player 1 and 2 displaying CUSTOM COINAGE) to enable the operator to enter desired custom pricing selections for Items 25 through 30, based on the Pricing Table. Item 25 is the left coin chute multiplier. Item 26 is the center coin chute multiplier. Item 27 is the right coin chute multiplier. Item 28 is the number of coin units equal to one Credit. (A Credit is usually equal to one game.)

The calculation of the ratio of Games : Price uses the ratio equation of $X : VC$, where:

X = Coin Chute Multiplier (Item 25, 26, or 27 in Pricing Table);
V = Value of coin;
C = Coin units equivalent to one Credit (Item 28).

For example, for 25¢ chutes at the factory setting, substituting values in the Games : Price ratio calculation gives 1 : 25 x 1, or one game for 25¢.

UNITS REQUIRED FOR BONUS CREDIT

Item 29 is the number of coin units that must pass through the coin chute(s) before an additional Credit (game) is posted (displayed). At the factory setting, the number in this item is 00. (This 00 means that NO bonus credit [free game] is awarded, although purchase of more than one game at a time occurs.)

MINIMUM COIN UNITS

Item 30 determines the number of coin units that must pass through the coin chute(s) before play may begin. The Factory Setting for this item is 00. (This 00 means that the Minimum Coin Units feature (Item 30) is disabled; a 01 setting also means that this feature is still disabled, yet the Credits message display should display fractional coin units.)

Test/Diagnostic Procedures

RADICAL! provides a series of diagnostic tests to aid the operator in determining game condition (that is, whether the game's features and highlights are operating satisfactorily). These tests activate virtually all the electronic and electromechanical devices comprising the game, so that the operator can readily locate a malfunctioning device or simply verify that all devices are working properly. In order, these tests deal with the music, the displays, the lamps, the solenoids, the switches and the A/C select relay (C-side test).

In addition to the diagnostic testing, a feature called the Auto Burn-in Mode is available. Activating this mode enables the operator to observe the game while all of the diagnostic tests, except the switch test, occur. This can be very helpful in locating 'intermittent' problems.

Activating either the entire test series or one of the individual tests requires use of the Game Adjustment/ Diagnostic switches. Open the coin door for access to these switches. To proceed to the Diagnostic Tests, the operator must simply switch the game On, set the AUTO-UP/MANUAL- DOWN switch to MANUAL-DOWN, and press the ADVANCE button.

Caution

The System-11C game program greatly aids the operator and service personnel: At the beginning of the Test/Diagnostic Procedures (and also at game Turn-On), the player score displays now signal, with a message ("Press ADVANCE for Report") that at least one switch has NOT been actuated during ball play for a lengthy period of time (90 balls, or 30 games). Moreover, the Problem Reporting activity at the beginning of the Test/ Diagnostic Procedures, the display of problem switches now includes ALL switches exhibiting problems. Refer to the text on Switch Tests for additional information. To proceed with the Test/Diagnostic Procedures, use AUTO-UP, and press ADVANCE.

MUSIC TEST

1. In the Music Test, observe that the player 1 and 2 displays show the message, MUSIC TEST. Switching to AUTO-UP, observe that the message now reads MUSIC OFF, and that the player 3 score display shows 00 00. Press the Start button to select the desired music selection: 01 - 'Main Theme' through 07. Adjust the volume control for proper sound level for the game location.

2. Use the AUTO-UP position to proceed to the next test.

DISPLAY TEST

1. To initiate the Display Test, press ADVANCE. Observe that player 1 and 2 displays briefly show the message, DISPLAY TEST, and that the player 3 score display shows 01 (the Display Test identifier).

2. Use AUTO-UP. Observe that all displays begin a display cycle of all 0s through all 9s, one digit at a time. Verify that the proper comma segments light during display of the odd-numbered digits. Next, a special "all segments" character 'walks' from left to right across each player score display.

3. To halt the display cycle, use MANUAL-DOWN. Then, press ADVANCE to step through the sequential digit display, digit by digit, and the subsequent "all segments" characters display test. Use AUTO-UP to resume cycling, and to proceed to the next test.

LAMP TESTS

1. **All Lamps**

   (From Display Test) To initiate the first Lamps Test, press ADVANCE. Observe that the Player 1 and 2 displays show the message, ALL LAMPS, and that the Player 3 display shows 02 (All Lamps Test identifier) and that all feature lamps (playfield and backbox) blink on and off. (Note, however, that the General Illumination lamps remain lighted steadily.) To locate the wiring associated with a particular feature lamp, refer to the Lamp-Matrix Table. CPU Board connections at jacks 1J6 (columns) and 1J7 (rows) are also listed in the table.

2. **Single Lamps**

   From the All Lamps test, using AUTO-UP, press ADVANCE to initiate the Single Lamps Test. The Player 1 and 2 displays initially show the message, SINGLE LAMPS, and the Player 3 display shows 03. Then, the Player 3 display shows 04 01, and the Player 1 and 2 displays change to show "SHOOT AGAIN", the name of the lamp currently blinking. Press the Start button to proceed through an ascending series of designator numbers (01 through 64), with the Player 1 and 2 displays showing the individual lamp's name. (To proceed through a descending series of lamp identifiers, use MANUAL-DOWN.) Press and hold the Start button to proceed rapidly to the desired lamp.

RADICAL! Lamp Matrix

column row	1 Q66 YEL-BRN 1J7-1	2 Q64 YEL-RED 1J7-2	3 Q62 YEL-ORN 1J7-3	4 Q60 YEL-BLK 1J7-4	5 Q58 YEL-GRN 1J7-6	6 Q56 YEL-BLU 1J7-7	7 Q54 YEL-VIO 1J7-8	8 Q52 YEL-GRY 1J7-9
Q80 RED-BRN 1J6-1	Shoot Again 1	Spot Letter R 9	Word-R 17	Lock Lane S 25	Lock Bottom 33	Left Kickback 41	Bonus Multiplier 2X 49	Inset Vertical 57
Q81 RED-BLK 1J6-2	Bonus 20K 2	Spot Letter A 10	Word-A 18	Lock Lane N 26	Lock Middle 34	Loop Ramp 25K 42	Bonus Multiplier 3X 50	Insert Tail 58
Q82 RED-ORN 1J6-3	Bonus 40K 3	Spot Letter D 11	Word-D 19	Lock Lane A 27	Lock Top 35	Loop Ramp Extra Ball 43	Bonus Multiplier 4X 51	Insert Mystery 59
Q83 RED-YEL 1J6-5	Bonus 60K 4	Spot Letter I 12	Word-I 20	Lock Lane K 28	Snake Run 36	Bonus Advance 44	Bonus Multiplier 5X 52	Insert Million 6
Q84 RED-GRN 1J6-6	Bonus 80K 5	Spot Letter C 13	Word-C 21	Lock Lane E 29	Left Special 37	Bonus Value 45	Bonus 100K 53	Insert Extra Ball 61
Q85 RED-BLU 1J6-7	Bonus 100K 6	Spot Letter A 14	Word-A 22	Top Drop Tgt Right 30	Left Return 38	Jackpot Mega Million 46	Bonus 200K 54	Insert Skate 62
Q86 RED-VIO 1J6-8	Bonus 500K 7	Spot Letter L 15	Word-L 23	Top Drop Tgt Middle 31	Right Return 39	Spinner 3K 47	Bonus 300K 55	Spot Letter 63
Q87 RED-GRY 1J6-9	Bonus 1 Million 8	Top Million 16	Letter Value 24	Top Drop Tgt Left 32	Right Extra Ball 40	Tail Slider 48	Bonus 400K 56	Right Million 64

SOLENOID TEST

1. (From Lamp Test) Using AUTO-UP, press ADVANCE. Observe that the Player 1 and 2 displays show the message, COIL TEST, the Player 3 display shows 04 (Solenoid Test identifier). Next, the Player 3 display shows a series of test steps from 01 through 22, while the Player 1 and 2 displays show the solenoid/circuit name. During each of these steps, pulsing of the respective solenoid/circuit occurs. The test cycles repeatedly, unless halted via the MANUAL-DOWN switch. Refer to the Solenoid Table for solenoid numbers and wiring information. CPU Board connections at 1P11, 1P12, and 1P19 are also listed in the table.

    To continuously pulse a single solenoid/circuit, use MANUAL-DOWN. Press ADVANCE to sequence through the switched, controlled, and special solenoids. Use AUTO-UP to resume test cycling, and to proceed to the next test.

RADICAL! Solenoid Table

Sol. No.	Function	Solenoid Type	Wire Color [1]	CPU Bd	Playfield/ Cabinet	Driver Trnstr	Solenoid Part Number Flashlamp Type d= Display Bd; p=Playfield
01A [3]	Outhole	Switched	Vlo-Brn	1P11-1	5J1-9: 5J4-9 (A)	Q33	AE-23-800
01C [3]	Ball Lock Flasher	Switched	Blk-Brn	(Gry-Brn)	5J5-9 (C)	Q33	#906 flashlamp	1p
02A [3]	Ball Shooter Lane Feeder	Switched	Vlo-Red	1P11-3	5J1-7: 5J4-8 (A)	Q25	AE-23-800
02C [3]	Left Ramp Flasher	Switched	Blk-Red	(Gry-Red)	5J5-8 (C)	Q25	#906 flashlamp	1p
03A [3]	Ball Popper	Switched	Vlo-Orn	1P11-4	5J1-6: 5J4-7 (A)	Q32	AE-23-800
03C [3]	Top Left Flipper Flasher	Switched	Blk-Orn	(Gry-Orn)	5J5-7(C)	Q32	#906 flashlamp	1p
04A [3]	Top Drop Target Bank	Switched	Vlo- Yel	1P11-5	5J1-5: 5J4-6 (A)	Q24	AE-26-1200
04C [3]	Top Left & Left Girl Flashers	Switched	Blk-Yel	(Gry-Yel)	5J5-5 (C)	Q24	#89 flashlamp	1p 1b
05A [3]	Knocker	Switched	Vlo-Grn	1P11-6	5J1-4: 5J4-5 (A)	Q31	AE-23-800
05C [3]	Top Spin & Jackpot Flashers	Switched	Blk-Grn	(Gry-Grn)	5J5-4 (C)	Q31	#89 flashlamp	1p 1b
06A [3]	Bottom Drop Target Bank	Switched	Vlo-Blu	1P11-7	5J1-3: 5J4-4 (A)	Q23	AE-26-1200
06C [3]	Drop Hole & Title Flasher	Switched	Blk-Blu	(Gry-Blu)	5J5-3 (C)	Q23	#89 flashlamp	1p 3b
07A [3]	Ball Diverter	Switched	Vlo-Blk	1P11-8	5J1-2: 5J4-2 (A)	Q30	AE-23-800
07C [3]	Top Right & T-Shirt Flasher	Switched	Blk-Vlo	(Gry-Vlo)	5J5-2 (C)	Q30	#89 flashlamp	1p 1b
08A [3]	Ball Locker	Switched	Vlo-Gry	1P11-9	5J1-1: 5J4-1 (A)	Q22	AE-23-800
08C [3]	Ball Gate & Shooter Lane Flshr	Switched	Blk-Gry	(Gry-Blk)	5J5-1 (C)	Q22	#89/#906 flshlmps 1p 1b
09	Lwr Dr Bank & Lt Face Flasher	Controlled	Brn-Blk	1P12-1	5J2-9: 5J6-9: 2J4-3	Q17	#89/#906 flshlmps	1p 1b
10	Playfield Gnl Illum Relay	Controlled	Brn-Red	1P12-2	5J2-8: 5J6-8: 2J4-5	Q9	5580-09555-01 4a
11	Insert Illum Relay	Controlled	Brn-Orn	1P12-4	5J2-6: 5J6-7: 2J4-6	Q16	5580-09555-01 4a
12	A/C Select Relay	Controlled	Brn-Yel	1P12-5	5J2-5	Q8	5580-09555-01 5
13	Right Ball Gate	Controlled	Brn-Grn	1P12-6	5J2-4: 5J6-5	Q15	AE-26-1500
14	Left Outlane Kicker	Controlled	Brn-Blu	1P12-7	5J2-4: 5J6-3	Q7	AE-24-900
15	Top Kicker (Sling)	Controlled	Brn-Vlo	1P12-8	5J2-2: 5J6-2	Q14	AE-23-800
16	Left Curl Ramp	Controlled	Brn-Gry	1P12-9	5J2-1: 5J6-1	Q6	#906 flashlamp	1p
	Left Jet Bumper	Special #1	Blu-Brn	1P19-7	5J3-7: 5J7-7	Q75	AE-23-800
	Left Kicker (Sling)	Special #2	Blu-Red	1P19-4	5J3-6: 5J7-6	Q71	AE-26-1500
	Right Jet Bumper	Special #3	Blu-Orn	1P19-3	5J3-3: 5J7-3	Q73	AE-23-800
	Right Kicker (Sling)	Special #4	Blu-Yel	1P19-6	5J3-4: 5J7-5	Q69	AE-26-1500
	Bottom Jet Bumper	Special #5	Blu-Grn	1P19-8	5J3-2:5J7-2	Q77	AE-23-800
	Top Jet Bumper	Special #6	Blu-Blk	1P19-9	5J3-1: 5J7-1	Q79	AE-23-800
	Lower Right Flipper	-	Orn-Vlo	1P19-1	2J5-5: 2P10-7	-	
	Upper Right Flipper		(Blu-Vlo) [2]		(2J10-1: 2P8-15)		FL11630/50VDC
			(Blk-Blu)		(2J10-4: 2P8-12)		FL 11630/50VDC
	Lower Left Flipper	-	Orn-Gry [2]	1P19-2	2J5-4: 2P10-8	-	
	Upper Left Flipper		(Blu-Gry)		(2J10-2: 2P8-14)		FL11630/50VDC
			(Blk-Yel)		(2J10-3: 2P8-13)		FL11630/50VDC

Wire colors, except flipper Orn-Vlo and Orn-Gry, are ground connections (to coil terminal with unbanded end of diode). Flipper Orn-Vlo and these connect from CPU Board to flipper switch. 2. Flipper connections shown in braces are from flipper switch to flipper coil. 3. "A" is pulsed, when Sol. 12 is de-energized; "C" circuits are pulsed, with Sol. 12 energized. Wire colors in brackets are those from respective A leads corresponding to the J1-terminal connection listed for the Aux Power Driver Bd, which controls the device pulsing by Sol. 12. 4. mounted on Relay Bd, (4a) p/n C-11998-1; (4b) C-11902-1. 5. Relay is mounted on Aux Power Driver Bd, D-12247 in the backbox.

"On" State Logic - Special Solenoid
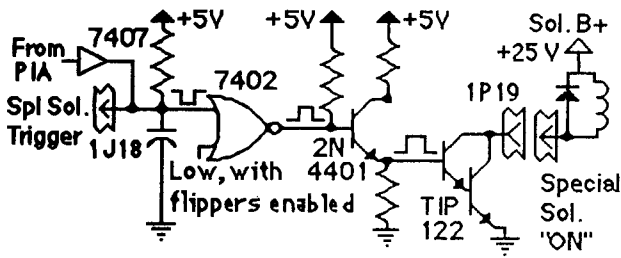
"On" State Logic - Controlled
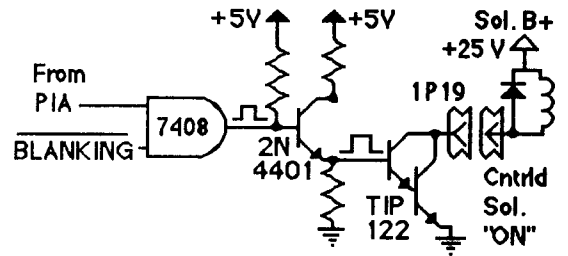
"Off" State - Special Solenoid:
The Special Switch Trigger Input goes low. Meanwhile, the PIA line remains high. The remaining signals reverse their states.

"Off" State - Controlled Solenoid:
The Enable Input (from the PIA) goes low. Meanwhile, the BLANKING signal remains high. The rest of the signals reverse their states.

NOTE

As directed by the game program, the Solenoid A/C Select Relay (solenoid 12) switches the solenoid B+ power between two power busses to permit actuating two groups of solenoids at the proper times. In its de-energized state, the Relay connects the 'circuit A power' to 16 "controlled" and "switched" solenoids (identified in the table with no suffix letter or the letter A, after the solenoid number). Individual solenoid operation then depends on the game program enabling the ground path for solenoid actuation via the driver transistor associated with each solenoid circuit. For example, the game program can actuate the Outhole Kicker solenoid (sol. 01A), via the driver transistor Q33.

When the game program determines that the Solenoid A/C Select Relay (sol. 12) must be energized, the relay connects 'circuit C power' to eight group C solenoids (01C through 08C). Now, driver transistor Q33 can actuate the Flasher circuit (sol. 01C), which has a lamp circuit. Using this "multiplexing" technique, the same driver transistor can control actuation of two separate solenoid circuits.
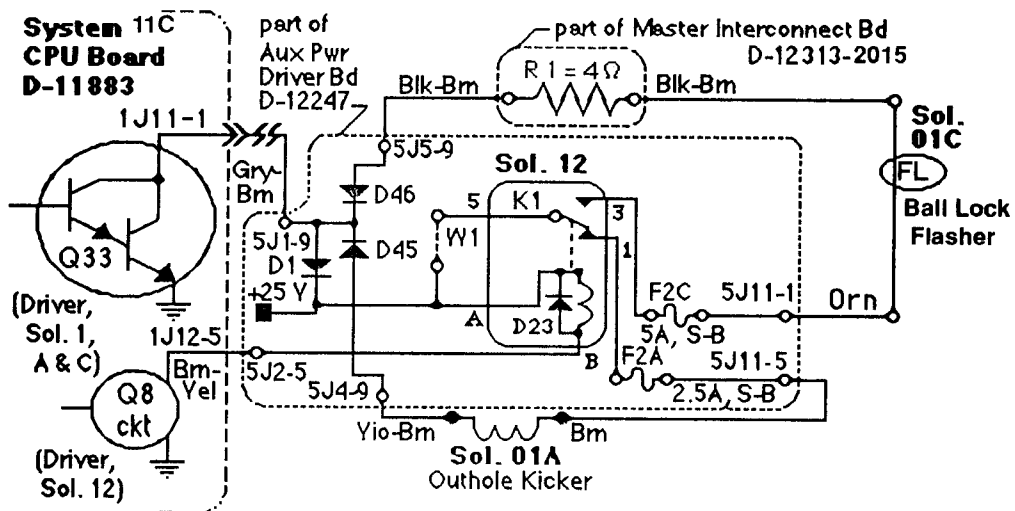

Figure 4. Typical Solenoid A/C Select Relay Circuit, showing the function of Solenoid 12, the Solenoid A/C Select Relay

SWITCH TESTS

1. Switch Levels

(From Solenoid Test) To initiate the Switch Levels Test, press ADVANCE.
Observe that the Player 1 and 2 displays show the message, SWITCH
LEVELS, and the Player 3 display shows 05 (Switch Levels Test identifier).
Normally, the right portion of the Player 3 display remains blank, indicating
that no switch is actuated.

If, however, a switch is actuated (possibly stuck closed), the Player 3 display
shows that switch's number, while the Player 1 and 2 displays indicate the
switch's name. A sound also accompanies the displays. (This is another
facet of the *RADICAL!* system-11C's switch testing capability.) If
more than one switch is closed, a series of displays show each actuated
switch's name and number.

(In addition, either of these problems could result in the reporting of a
switch problem (or problems) at game Turn-On or at the beginning of
Diagnostic Tests.)

As soon as the operator opens a closed switch, its name and number are
eliminated from the Switch Levels display series. For *RADICAL!*
switch numbers can range from 01 through 64. Refer to the Switch-Matrix
Table for switch numbers and wiring information. CPU Board
connections at jacks 1J8 (columns) and 1J10 (rows) are also listed in the
table.

RADICAL! Switch Matrix

Column / Row	1 Q45 GRN-BRN 1J8-1	2 Q49 GRN-RED 1J8-2	3 Q44 GRN-ORN 1J8-3	4 Q48 GRN-YEL 1J8-4	5 Q43 GRN-BLK 1J8-5	6 Q47 GRN-BLU 1J8-7	7 Q42 GRN-VIO 1J8-8	8 Q46 GRN-GRY 1J8-9
WHT-BRN 1J10-9	Plumb Bob Tilt 1	Not Used 9	Top Spinner 17	Not Used 25	Not Used 33	Not Used 41	Top Sling 49	Right Flipper 57
WHT-RED 1J10-8	Not Used 2	Outhole 10	X Ramp Left 18	Not Used 26	Not Used 34	Not Used 42	Top Jet 50	Left Flipper 58
WHT-ORN 1J10-7	Start Button 3	Trough 1 Right 11	X Ramp Right 19	Middle Man 27	Not Used 35	Advance Bonus 43	Left Outlane 51	Not Used 59
WHT-YEL 1J10-6	Right Coin Slot 4	Trough 2 Left 12	Ball Diverter 20	Advance Bonus X 28	Not Used 36	Bonus Increase 44	Left Jet 52	Not Used 60
WHT-GRN 1J10-5	Center Coin 5	Not Used 13	Not Used 21	Right Spin 29	Left Loop 37	Not Used 45	Right Jet 53	Not Used 61
WHT-BLU 1J10-	Left Coin Slot 6	Shooter Lane 14	Bottom Drop Tgt Right 22	Top Drop Tgt Right 30	Lock Lane 38	Left Return 46	Bottom Jet 54	Not Used 62
WHT-VIO 1J10-2	Slam Tilt 7	Left Ramp 15	Bottom Drop Tgt Middle 23	Top Drop Tgt Middle 31	Left Lockup Top 39	Right Return 47	Left Sling 55	Not Used 63
WHT-GRY 1J10-1	High Score 8	Ball Popper 16	Bottom Drop Tgt Left 24	Top Drop Tgt Left 32	Left Lockup 40	Right Outlane 48	Right Sling 56	Not Used 64

▼ **Row Problems.** If a display of two (or more) switch numbers of a row occurs, although only one switch is closed, check for a short circuit to ground.

▼ **Multiple Switch Number Indications.** Check for a bad diode on any of the switches.

▼ **Column Problems.** If display of two (or more) switch numbers in a column occurs (while only one switch is actuated), check for a short circuit to ground or, a bad transistor (Q42-Q49) on the CPU Board.

Use AUTO-UP to proceed to the next test.

2. **Switch Edges**

   From the Switch Levels Test, press ADVANCE. Observe that the Player 1 and 2 displays show the message, SWITCH EDGES; the Player 3 display shows 06 (Switch Edges Test identifier). The right portion of the Player 3 display is blank, indicating that no switch is actuated.

   This test permits the operator to test whether actuating a switch provides the proper signal to the System-11C switch testing program. When actuating a switch, the operator should see the switch's name and number (in the Player 1, 2, and 3 displays, respectively). If no indication appears at the time the switch is actuated, the operator then knows that there is a malfunction associated with that switch. Using this technique, the operator can test each switch appearing in the *RADICAL!* switch problem reporting displays (either at game Turn-On or at the beginning of the Diagnostic Tests) to determine whether the switch can be actuated. If the switch's name and number are displayed while the operator checks its operation, the operator then knows that the reported problem with that switch is NOT currently caused by a switch malfunction. The operator can then seek other causes for the reported problem, being almost certain now that the switch did not fail. This test is also useful when the operator is adjusting the sensitivity of a particular switch's actuation mechanism.

   Among the possibilities is the fact that the players have not actuated that switch because of some other problem; the operator should try to analyze what could cause the switch to be missed during game play, and remedy that problem cause. With these new tests, switch problems are, therefore, more easily isolated.

3. **Playfield or CPU Board?** To determine whether a switch problem is in the playfield or the CPU Board, remove connectors 1P8 and 1P10 from the CPU Board. Begin the Switch Test. Use a jumper wire to simulate switch actuation. For example, placing a jumper between 1J10-9 and 1J8-2 should (based on the Switch-Matrix Table) should produce an indication of switch 09 being actuated. If only one number is produced for every simulated switch actuation that occurred then the CPU is good and the problem is elsewhere.

C-SIDE TEST

From the Switch Test, press ADVANCE. Observe that the Player 1 and 2 displays show the message, C-SIDE TEST, and that the Player 3 displays shows 07 (C-Side Test identifier). This test confirms that the Solenoid A/C Select Relay (Sol. 12) is actually in the 'C' position (ready to power flashlamp circuits).

The Player 1 and 2 displays then change to show the 'side' of the circuit being tested, alternating the A/C Relay between "SELECTED A-SIDE" and "SELECTED C-SIDE", while the Player 4 display shows the state of the C-Side Switch. When the switch is closed, the Player 4 display shows "C-SIDE".

The message "Err" appears whenever the C-Side Switch is not operating properly. Causes of improper operation can be blown fuses (F8 or F2C) or a faulty relay on the Aux Power Driver Board; failure of the +24 volt power circuit; a switch matrix failure; or faulty connections between the circuit boards in the game's backbox (CPU Board, Aux Power Driver Board, Backbox Interconnect Board). To halt the A/C Relay's operation, press MANUAL-DOWN and press ADVANCE to activate the A/C Relay manually.

ENDING THE DIAGNOSTIC TESTS

To end the Diagnostic Tests, reach the C-Side Test use AUTO-UP and press ADVANCE. The backbox displays should show the RADICAL! game's Identification Information (the Id 00 screen). Use MANUAL-DOWN, and press ADVANCE to reach Adjustment Item 70 (INSTALL FACTORY). Use AUTO-UP, and press ADVANCE to go to the Attract Mode.

AUTO BURN-IN MODE

The Auto Burn-in Mode permits the operator to check intermittent (or nonrecurring) problems associated with most portions of the game's circuitry. Repeatedly cycling through a group of tests can sometimes bring a problem, which occurs only randomly or occasionally, to exhibit itself more frequently, thereby aiding in the isolation of the problem. To activate the Auto Burn-in Mode:

1.   While in the Game Adjustments, reach Ad 67 and change the Factory Setting of NO to YES, via the Start button. Set the AUTO-UP/MANUAL-DOWN switch to AUTO-UP.

2.   Press ADVANCE to start the Auto Burn-in Mode. This mode repeatedly sequences through the Music Test, the Display Test, the All Lamps portion of the Lamp Test, and the Solenoid Test.

3.   To halt the Auto Burn-in Mode, switch the game Off and then On. *RADICAL!* now starts in the Attract Mode. (If a switch problem is now reported by the displays, perform the Switch Tests again to determine the nature of the problem; then, perform necessary repairs.)

CPU LED Indicator Codes Table

Blinks/ Flashes	CPU Problem	Explanation
1	U25 RAM FAILURE	U25 RAM could not be used properly (NO other tests are performed; the game is locked here, until the game is turned off).
2	MEM. PROT. FAILURE	This message means that (A) the Coin Door may be shut; (B) the Memory Protect Switch may be stuck in the ON position; (C) the memory protect logic is protecting the memory; or (D) a U25 RAM failure is occurring. (See Note 1)
3	U51 PIA FAILURE	U51 has a malfunction. (See Note 2)
4	U38 PIA FAILURE	U38 has a malfunction. (See Note 2)
5	U41 PIA FAILURE	U41 has a malfunction. (See Note 2)
6	U42 PIA FAILURE	U42 has a malfunction. (See Note 2)
7	U54 PIA FAILURE	U54 has a malfunction. (See Note 2)
8	U10 PIA FAILURE	U10 has a malfunction. (See Note 2)
9	IRQ FAILURE	IRQ has a malfunction. It may be missing or too fast or too slow.
10	U27 ROM FAILURE	U27's internal checksums do not match. It may be a ROM failure, or its associated connections and connecting devices are causing it to appear to have a problem. (The following U26 test is skipped.)
11	U26 ROM FAILURE	U26's internal checksums do not match.

Notes: 1. This test assumes that the Coin Door is OPEN; it is initiated ONLY by pressing the CPU Diagnostic Switch (SW2).

2. Alternatively, its associated connections or connecting devices are causing the IC to appear to have problems.

SYSTEM-11C MEMORY CHIP TEST

A new feature is now included in the Memory Chip Test for System 11C. During power-up, the CPU performs a self-testing routine. When all tests are satisfactory, the game proceeds to the Attract Mode, allowing players to use the game. Whenever a portion of the testing does not produce satisfactory results, the game displays a message, before proceeding to the next portion of the testing. ONLY after all tests are satisfactory does the game allow play to begin.

In addition to the displayed message, when a test fails, LED 2 ('DIAGNOSTIC') mounted on the CPU Board can be observed to determine the probable cause of the problem. This LED blinks, or flashes, a certain number of times to identify the probable cause, as described in the CPU LED Indicator Codes Table. The operator can also reset the program by pressing the CPU Switch (SW 2) on the edge of the CPU Board.

SYSTEM-11C SOUND CIRCUITRY TESTS

Tests of the System-11C Sound circuitry, including the Audio Board, are possible only after successful completion of the System-11C Memory Chip Test.

Audio Board Test. A brief check of the Audio Board (D-11581) circuitry occurs at game Turn-on; the game reports the test results by brief sounds, as follows: No sound = Audio Board is not operating, or a failure is affecting the sound circuitry (broken cable; dead amplifier; etc.); 1 sound = system OK; 2 sounds = RAM problem; 3 sounds = U4 problem; 4 sounds = U19 problem; 5 sounds=U20.

If the this test did not isolate the problem, turn the Volume Control for maximum output. Momentarily touch a powered-up AC soldering iron on the center tap of the Volume Control.

Be sure the Audio Board has +12V, -12V, +5V and Ground.

CAUTION

DO NOT use a soldering iron over 40 watts. Note also that cordless soldering irons will NOT work for this test.

Hearing a low hum or a 'click' indicates that the power amplifier, the Volume Control, and the speaker are operating satisfactorily, as is the sound circuit cabling. Not hearing a sound requires repeating the test with the Volume Control turned part way down, to determine whether the Volume Control is faulty. Also, check the cable connectors for proper mating, and that no broken wires affect this circuit.

Problem Analysis Messages

The SYSTEM 11C game program has a great capability to aid the operator and service personnel: At game Turn-on (and also at the beginning of Test/Diagnostic Procedures) after the game has been operating for an extended period, the player score displays now signals a message, "Press ADVANCE for Report", that the game program has detected a possible problem with the game.

To obtain details of the problem, open the coin door and press the AUTO-UP/MANUAL-DOWN switch to MANUAL-DOWN. Press the ADVANCE button to begin displaying the message(s). The following messages apply to *RADICAL!*.

Malfunction Check Switch ## (name). This message indicates that at least one switch has not been actuated during ball play (for 90 balls or approximately 30 games) by displaying the message "Check Switch ## (name)", listing each problem switch by number and name. (The game program compensates the game play requirements affected by each disabled switch to allow 'nearly normal' play. This helps keep *RADICAL!* earning good profits).

To verify the problem, refer to the Test/Diagnostic Procedures text describing Switch Testing, and check each reported switch using applicable Switch Levels and Switch Edges tests. Always check switch operation using a ball to simulate game conditions. (Switch problems may often be resolved by adjusting the wire switch actuators, fixing electrical problems, securing loose connectors, etc).

Malfunction Pinball Missing. *RADICAL!* normally uses two balls. When the game is turned on, this message announces that a ball is missing or stuck somewhere. When the ball is located, return it to the playfield via the Outhole. Other possibilities for this problem could be malfunctions of the Ball Trough Switches (#11 or #12) or the Ball Shooter Switch (#14).

Music Error. This message means that no signals are coming from the Audio Board. Check the Audio Board for presence of *RADICAL!* ROMs. Also, check that the cable connecting the Audio and CPU Boards is firmly seated, and that the red line on the cable is going to the same pin on both boards. Turn the game Off, then On, to be sure only one 'Bing' sounds. More then one 'Bing' or *no* 'Bing' indicates an Audio Board problem. Refer to text about System 11C Sound Circuitry tests for more information.

Factory Settings. Repeated appearence of this message indicates that the CMOS RAM no longer retains any custom Pricing or Game Adjustment settings and has reverted to factory default settings. Generally, the following CPU checks will isolate the cause of the CMOS RAM memory failure. The voltage at pin 24 of U25 should be +5V (game turned on) and at least +3.8V (game off). When the voltage drops below +3.8V, memory reset occurs. Check the batteries and battery holder. Be sure that the batteries are good and that there is no contamination on the battery holder terminals. Turn the game OFF, and use an ohmmeter to check diodes D1 and D2. D1 should read 0 ohms when forward-biased and   ohms when reverse-biased. D2 should read 15 ohms when forward-biased and   ohms when reverse-biased. Turn the game ON, and use an oscilloscope to check Q40. Q40 should display square waves on all three terminals.

Maintenance Information

• Ball Shooter Lane Feeder

Figure 5 shows the two main lubrication points of the Ball Shooter Lane Feeder. The shaded arrows show the directions in which the Ball Shooter Lane Feeder and other parts of its related assemblies can be adjusted for proper operation. Note that there are mechanisms quite similar to this Assembly; they have the same lubrication requirements and adjustment capabilities as the Ball Shooter Lane Feeder.
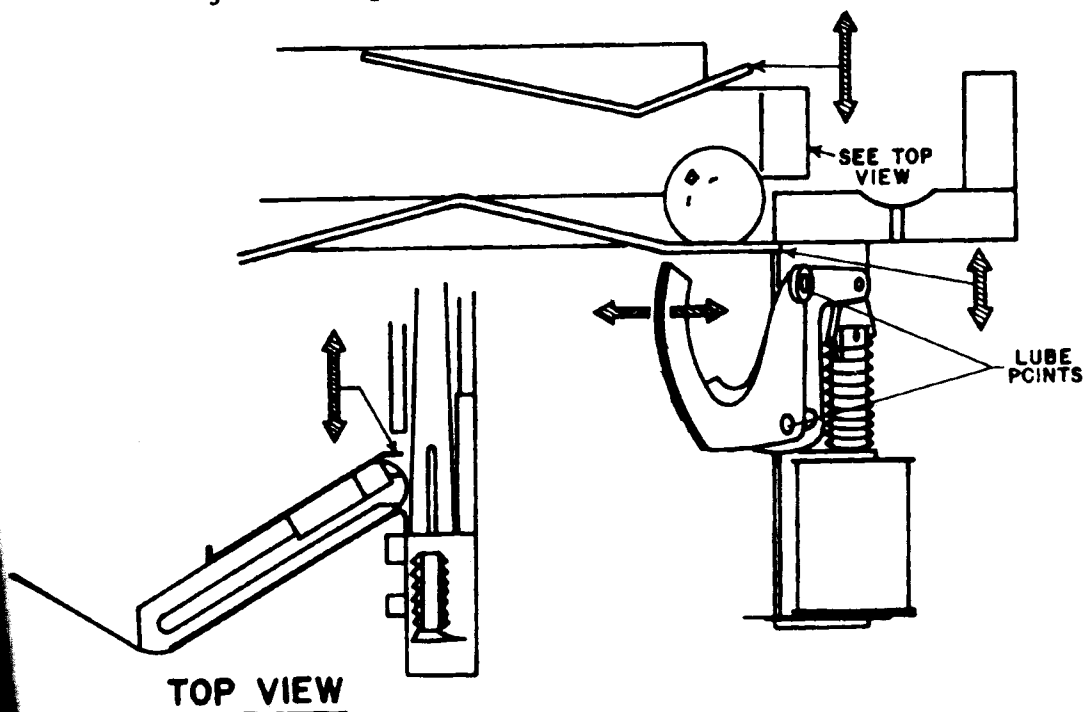
Figure 5. Adjustments and Lubrication Points, Shooter Lane Feeder

• Left & Right Kickers

Because of the functional design (arm-actuated via solenoid plunger operation), the pivot points of the Left and Right Kickers ("Slingshots") all require lubrication as a regular servicing procedure. Mechanical adjustments are simple and somewhat similar to the Ball Shooter Lane Feeder. These mechanisms should also be checked for proper fit (snugly tight) where they attach to the playfield.

• Playfield

Playfield life expectancy and play can be extended by periodic cleaning. Inspect and hand polish the balls in a clean cloth. Replace chipped balls; otherwise, these balls will ruin the playfield finish in a short time. Don't use quantities of water, caustic or abrasive cleaners or cleaning pads on the playfield. Don't allow polish or wax to build-up, (waxes yellow with age and spoil the appearance of the playfield).

• Switches

Switch contacts should be free of dust, dirt, and corrosion. Filing or burnishing most switch contacts breaks the finish and encourages corrosion. Effective contact cleaning requires gentler treatment. Gently close the contacts on a clean business card or piece of paper. Wipe the contacts until they're clean. If necessary, regap the contacts to 1/16 inch.

Flipper End-of-Stroke switch contacts must be treated differently from other switch blade contacts; they provide heavier current carrying capability than other pinball game switch contacts. Severely pitted contacts cause flippers to be weak. Smooth the pitted contact surface of the E.O.S. switch contacts with a contact file.Then, polish your work with a burnishing tool. regap the contacts, if necessary, to 1/16 inch.

Fuse Locations Diagram & Listing
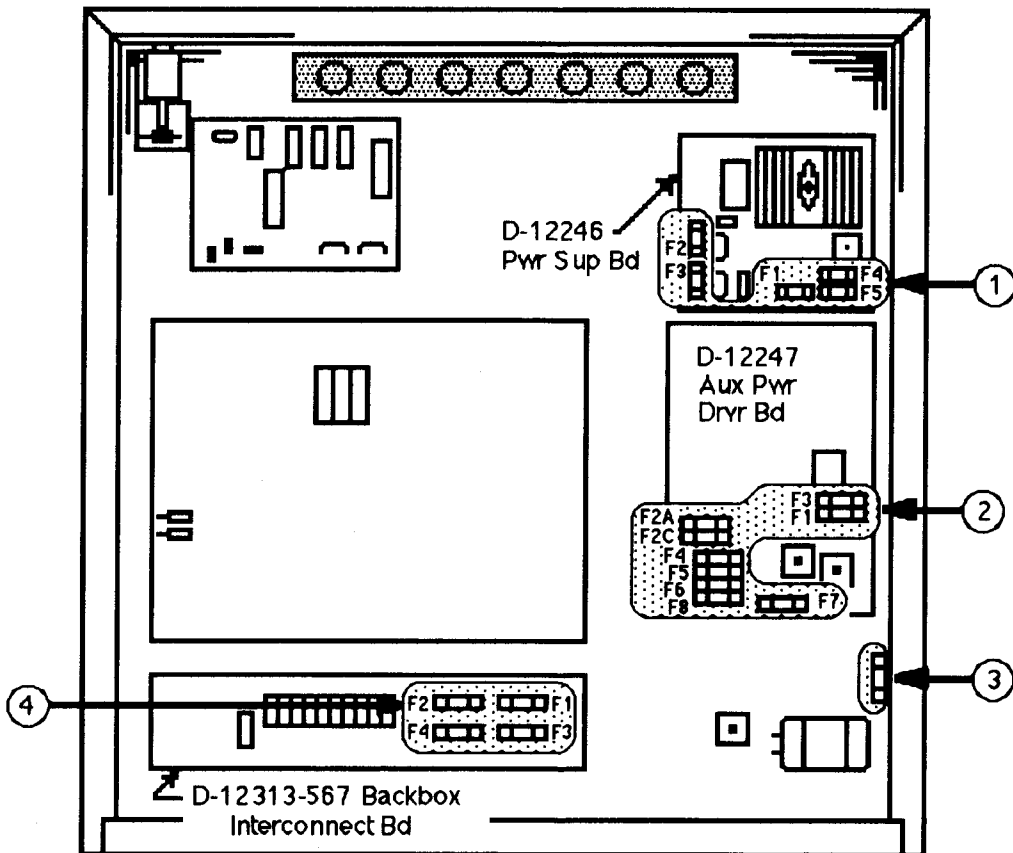
Fuse Listing

PART NUMBER	DESCRIPTION	CIRCUIT/LOCATION
5731-12328-00	Fuse, 3/8A., S-B, 250V	F1; D-12246 Power Supply Board
5731-12327-00	Fuse, 1/8A., S-B, 250V	F2, F3; D-12246 Power Supply Board
5731-09432-00	Fuse, 7A S-B, 250v	F4, F5; D-12246 Power Supply Board
5731-09128-00	Fuse, 2-1/2A., S-B, 250v	F1, F2A, F3, F4; D-12247 Aux Pwr Driver Board
5731-09651-00	Fuse, 5A., S-B, 250v	F2C; D-12247 Aux Pwr Driver Board
5731-08665-00	Fuse, 2A., S-B, 250v	F5, F6; D-12247 Aux Pwr Driver Board
5731-06314-00	Fuse, 4A., S-B, 250v	F7; D-12247 Aux Pwr Driver Board
5731-09432-00	Fuse, 7A., S-B, 250v	F8; D-12247 Aux Pwr Driver Board
5730-09071-00	Fuse, 8A., S-B, 32v	+18 Vdc Lamp Ckt/ Lwr Rt B/box fuseholder (1)
5731-09651-00	Fuse, 5A., S-B, 250v	F1 - F4: Gen. Illum./B'box Interconnect Board
5730-09252-00	Fuse, 8A,Slow-Blow(S-B),125v	Input ("high voltage") Power Line/Cabinet Box*

One 4A., S-B, 250v fuse (5731-06314-00) is provided for an overseas (220v) game installation.

concerns fuses listed as Item 2 (Aux Power Driver Board fuses).
25V dc Special Solenoid Circuit connected with the Red-White wire. F2A protects "A" Solenoids
h Brown wires. F2C protects "C" Solenoids connected with Orange wires. F3 protects Controlled
ected with Red wires. F4 protects +50V dc solenoids connected with Violet-Yellow wires. F5 protects
pers. F6 protects Left Side Flippers. F7 protects the input to the +50V rectifier, and F8 protects the
5V rectifier.

NOTES

Game Parts Information

CABINET PARTS

SPEAKER
5555-12015-00

TRANSFORMER
5610-12136-00

STAY ARM
01-4028

VOLUME CONTROL
A-8550-1

PLUMB BOB TILT
20-6502-A

CASH BOX ASS
A-8567

LATCH BRACK
001-8956

Left Flipper Switch
B-9989

Right Flipper S
B-9989

Start Button Assy
A-5069-3

TEST SWITCH
p/o COIN DOOR
27-1008

COIN DOOR ASSY
09-17002B-26

BALL SHOOTER ASSY
B-12445-1

CIRCUIT BOARD & MAJOR MECHANISMS
LOCATION DIAGRAM

Outhole Kicker

Ball Trough

Left. Flipper

Right. Flipper

Ball Shooter Lane Feeder

Kickers

Upper Right. Flipper

Standup Targets

Drop Targets

Upper Left. Flipper

Kicker

Jet Bumpers

Gate

Drop Targets

Ball Diverter

Power Supply D-12246

Sound Brd. D-11581-2015

CPU Brd. D-11883-2015

Aux Power Driver Brd. D-12247

Backbox Interconnect Brd. D-12313-2015

Master Display Bd

Display Panel, Rear View

Relay Brd.

Insert Board, Inner Side View

OCATIONS

Drop Targets

Unique Mechanisms

Standard Mechanisms

System 11C CPU Board
p/n D-11883-2015

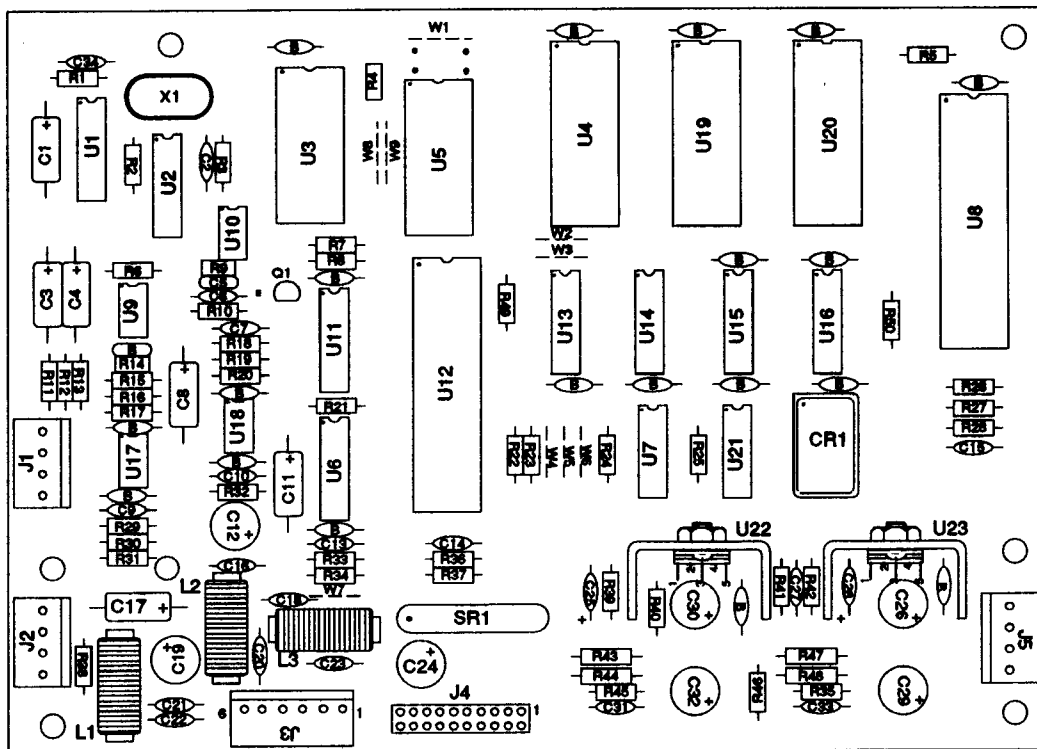| Part No.	Ckt Designator	Description
5764-12206-00		Bare P. C. Board
5281-09306-00	U16	IC, Octal Bus Xcvr, 74LS245
5430-08972-00	U9, U10, U38, U41, U42, U51, U54	IC, PIA, MC6820/6821
5340-10139-00	U25	IC, 2K x 8 CMOS Static RAM
5280-09010-00	U44	IC, 4-16 Decoder, 74154
5281-09246-00	U7, U8, U12	IC, 2-4 Decoder, 74LS139
5075-09406-00	ZR3 - ZR8	Diode, Zener, 6.2v, 0.5w
5164-10998-00	Q42 - Q49	Transistor, NPN, 2N5550, TO-92
5431-09449-00	U43	IC, Timer, MC1455
5310-09236-00	U29	IC, 14-b Counter, 4020
5281-09743-00	U32	IC, Quad 2-Input AND, 74LS08
5281-09247-00	U14	IC, Quad 2-Input NOR, 74LS02
5281-09235-00	U35	IC, Triple 3-Input NAND, 74LS10
5280-09013-00	U36	IC, Hex Inverter, 7404
5281-09499-00	U31, U34	IC, Quad 2-Input NAND, 74LS00
5281-10014-00	U33	IC, Dual 4-Input NAND, 74LS20
5281-09486-00	U28	IC, Octal D Flip-flop, 74LS374
5281-09745-00	U37	IC, 3-8 Decoder, 74LS138
5281-09867-00	U11, U13, U40	IC, Octal Buffer, 74LS244
5280-08973-00	U17-U20, U52, U53	IC, Quad 2-Input AND, 7408
5280-08974-00	U55, U56	IC, Hex Inverter, 7406
5310-09155-00	U30, U39	IC, Quad 2-Input NAND, MC14011
5280-08948-00	U45, U50	IC, Quad 2-Input NOR, 7402
5280-09309-00	U49	IC, Hex Buffer, 7407
5671-09019-00	LED1-LED3	LED, Red, Display
5521-10506-00	CR1	Oscillator, 4 MHz
5162-08976-00	Q51, Q53, Q55, Q57, Q59, Q61, Q63, Q65	Transistor, NPN Darl. 2N6427, TO-92
5191-08978-00	Q52, Q54, Q56, Q58, Q60, Q62, Q64, Q66	Transistor, PNP, TIP42, TO-220
5162-09410-00	Q6-Q9, Q14-Q17, Q22-Q25, Q30-Q33, Q69, Q71, Q73, Q75, Q77, Q79, Q80-Q87	Transistor, NPN, TIP122, TO-220
5160-08938-00	Q2-Q5, Q10-Q13, Q18-Q21, Q26-Q29, Q34-Q38, Q41, Q67, Q68, Q70, Q72, Q74, Q76, Q78	Transistor, NPN, 2N4401, TO-92
5160-10269-00	Q1, Q40	Transistor, NPN, 2N3904, TO-92
5190-09016-00	Q39, Q50	Transistor, PNP, 2N4403, TO-92
5130-09014-00	S1-S8	SCR, 30v, 0.8A, 2N5060
5070-06258-00	D3-D19	Diode, 1N4001
5070-08919-00	D2	Diode, 1N4148, 150mA
5070-09266-00	D1	Diode, 1N5817, 1.0A
5075-09018-00	ZR1	Diode, Zener, 1N5996A, 6.8v, 0.5w
5075-09059-00	ZR2	Diode, Zener, 1N5990, 3.9v, 0.5w
5010-08992-00	R94, R97, R100, R103, R106, R109	Resistor, 560Ω, 5%, 1/4w, C. F.
5010-09039-00	R56	Resistor, 10Ω, 5%, 1/4w, C. F.
5010-09534-00	W1, W2, W4, W5, W7, W8, W11, W14, W16, W17, W19	Resistor, 0Ω, 5%, 1/4w, C. F.
5010-08991-00	R31, R32, R35, R52, R55, R68, R92, R146	Resistor, 4.7KΩ, 5%, 1/4w, C. F.
5010-09358-00	R54, R57, R58, R64, R66, R138-R145	Resistor, 1.0KΩ, 5%, 1/4w, C. F.
5010-09113-00	R79	Resistor, 33KΩ, 5%, 1/4w, C. F.
5010-08983-00	R7, R8, R10, R70, R80	Resistor, 3.3KΩ, 5%, 1/4w, C. F.
5010-09034-00	R11-R14, R25, R26, R53, R60, R65, R90	Resistor, 10KΩ, 5%, 1/4w, C. F.
5010-09086-00	R81	Resistor, 6.8KΩ, 5%, 1/4w, C. F.
5010-08997-00	R23, R24, R91, R93, R96, R99, R102, R105, R108, R112, R115, R118, R121, R124, R127, R130, R133	Resistor, 2.7KΩ, 5%, 1/4w, C. F.
5012-09037-00	R113, R116, R119, R122, R125, R128, R131, R134	Resistor, 0.4Ω, 5%, 3w, Wire-Wnd.
5010-08993-00	R36-R51, R95, R98, R101, R104, R107, R110	Resistor, 68Ω, 5%, 1/2w, C. F.
5012-10860-00	R82-R89	Resistor, 27Ω, 5%, 2w, C. F.

Part No.	Ckt Designator	Description
5010-10003-00	R62, R63	Resistor, 390Ω, 5%, 1/4w, C. F.
5010-10171-00	R67	Resistor, 56Ω, 5%, 1/4w, C.F.
5010-10170-00	R69	Resistor, 47Ω, 5%, 1/4w, C. F.
5010-09160-00	R59, R61, W12, W13	Resistor, 220Ω, 5%, 1/4w, C. F.
5010-09416-00	R33, R34, R71-R78, R135-R137	Resistor, 470Ω, 5%, 1/4w, C. F.
5010-10631-00	R111, R114, R117, R120, R123, R126, R129, R13	Resistor, 1.2KΩ, 5%, 1/2w, C. F.
5019-09783-00	SR18	SIP, 9R, 10-pin, 6.8KΩ, .125w/R,
5019-09362-00	SR3, SR15, SR17, SR19, SR20	SIP, 9R, 10-pin, 4.7KΩ, .125w/R,
5019-09808-00	SR4, SR6, SR11	SIP, 9R, 10-pin, 560Ω, .125w/R,
5019-09785-00	SR16	SIP, 9R, 10-pin, 2.2KΩ, .125w/R,
5019-10472-00	SR14	SIP, 9R, 10-pin, 3.3KΩ, .125w/R,
5019-09669-00	SR8	SIP, 9R, 10-pin, 1.0KΩ, .125w/R,
5019-09780-00	SR9, SR10	SIP, 4R, 8-pin, 1KΩ, 5%
5019-09786-00	SR1, SR2	SIP, 5R, 6-pin, 4.7KΩ, .125w/R,
5019-09792-00	SR5, SR7	SIP, 9R, 10-pin, 2.7KΩ, .125w/R,
5060-10396-00	SRC1 - SRC5, SRC7 - SRC9	SIP, 8R, 8C,10-pin, 4.7KΩ & 470
5043-08980-00	C14, C17-C21, C31, C32, C49-C56, C59, +54 Bypass, marked B	Capacitor, 0.01 µfd, 50v(+80,-20
5043-09845-00	C22, C23, C25, C27, C28	Capacitor, 1K pfd, 50v(±20%), A
5043-08996-00	C9, C70-75, C77, C78	Capacitor, 0.1 µfd, 50v(±20%), A
5040-10974-00	C24, C26, C29	Capacitor, 100 µfd, Electr., 25v(+ Axial
5045-09796-00	C60-C67	Capacitor, 0.1 µfd, Polycarbonat 100v(±10%)
5043-09065-00	C33-C40, C68, C69, C76, C10, C12	Capacitor, 470 pfd, 50v(±20%), A
5040-09545-00	C30	Capacitor, 22 µfd, Electr., 10v(+5 Axial
5041-09031-00	C58	Capacitor, 1 µfd, Tant., 25v(±20%
5043-09030-00	C16, C57	Capacitor, 0.047 µfd, 50v(±20%),
5551-09822-00	L1-L3	Inductor, 4.7 µH, 3A
5641-09312-00) 5641-09653-00)	SW2	Switch, Pushbutton, DPDT, 100v
5880-09022-00	B1-B3	Battery, Alkaline, 1.5v, AA
5881-09021-00		Battery Holder, #171
5700-10176-00		IC Socket, 28 pin
a) A-5343-2015-1	U26	IC, Game ROM 2, 27256
b) A-5343-2015-2	U27	IC, Game ROM 1, 27256
5700-08985-00		IC Socket, 40 pin
a) 5400-09150-00	U15	IC, µProcessor, 6802
5824-09248-00	TP1, TP2	Test Point
20-9229		Thermal Compound
5580-08994-01	K1	Relay, 4-pole, 40Ω, 6v
5791-10862-09	1J1, 1J2, 1J4-1J8, 1J10-1J12, 1J17-1J19	Connector, 9 pin (Hdr)
5791-10862-04	1J13, 1J14,1J16	Connector, 4 pin (Hdr)
5791-10862-12	1J3	Connector, 12 pin (Hdr)
5791-10850-00	1J22	Connector, 26 pin Ribbon (Hdr)
5791-09437-00	1J21	Connector, 20 pin Ribbon (Hdr)

NOTES:

1. For Schematic, refer to drawing #16-9019.
2. Items 56 and 58 (resistors) must be mounted 1/8" above PCB surface.
3. Standard Jumper: W1, W2, W4, W5, W7, W11, W14, W16
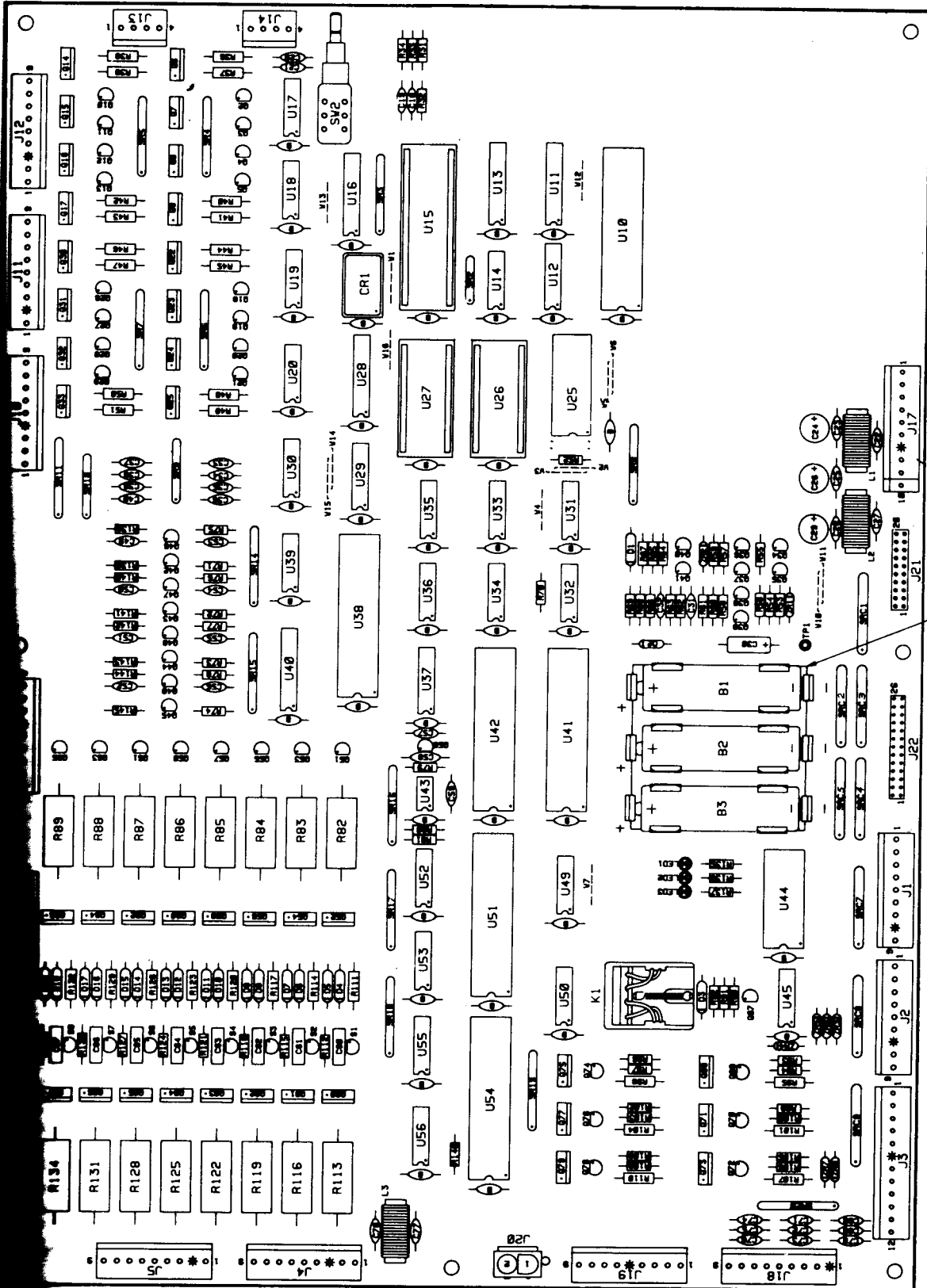
CPU BOARD (D-11883)

Audio Board Assembly
p/n D-11581-2015

Part No.	Ckt Designator	Description	Part No.	Ckt Designator	Description
5766-12130-00		Bare P. C. Board	5010-10985-00	R14, R15	Resistor, 20K, 1/4w, 5%
5371-11067-00	U1	IC, D/A Conv, YM3012	5010-09034-00	R22-R24, R17, R34	Resistor, 10K, 1/4w, 5%
a) 5700-09006-00		Socket, IC, 16-pin (U1)	5010-09324-00	R6, R19, R20, R21	Resistor, 27K, 1/4w, 5%
5370-11086-00	U3	IC, Sound Processor, YM2151	5010-09162-00	R39	Resistor, 100K, 1/4w, 5%
a) 5700-09004-00		Socket, IC, 24-pin (U3)	5010-09331-00	R16	Resistor, 13K, 1/4W, 5%
5400-10320-00	U8	IC, µProcessor, MC68B09E	5013-09427-00	R13	Resistor, 4.99KΩ, 1/4W, 1%
a) 5700-08985-00		Socket, IC, 40-pin (U8)	5010-08772-00	R18	Resistor, 15KΩ, 1/4W, 5%
B-13720	U6	CVSD Fix	5010-08824-00	R32	Resistor, 43KΩ, 1/4W, 5%
a) 5700-12655-14		Socket, CVSD Fix,14-pin	5010-08846-00	R31	Resistor, 220KΩ, 1/4W, 5%
A-5343-2015-3	U4	IC, Audio ROM 1	5010-08991-00	R12	Resistor, 4.7KΩ, 1/4W, 5%
A-5343-2015-4	U19	IC, Audio ROM 2	5010-09219-00	R38	Resistor, 8.2K, 1/4w, 5%
A-5343-2015-5	U20	IC, Audio ROM 3	5010-10258-00	R40	Resistor, 1M, 1/4w, 5%
a) 5700-10176-00		Socket, IC, 28-pin (U4, U19)	5010-09179-00	R10	Resistor, 3.3M, 1/4w, 5%
5371-09152-00	U11	IC, D/A Convtr, MC1408	5010-09333-00	R29	Resistor, 180KΩ, 1/4W, 5%
5430-10322-00	U12	IC, PIA, MC68B21	5010-09342-00	R30	Resistor, 36KΩ, 1/4W, 5%
5340-10139-00	U5	IC, RAM/S 5516-2 2Kx8	5010-09534-00	W2, W9, W11	Resistor, 0Ω, 1/4w, 5%
5281-09487-00	U16, U7	IC, Dual D Flipflop, 74LS74	5046-09350-00	C9	Capacitor, 180pfd, 100V, ± 5%
5281-10043-00	U13	IC, 74LS175	5048-10992-00	C10	Capacitor, 4700pfd, 50V, ±10%
5281-09235-00	U21	IC,Triple NAND, 74LS10	5046-09346-00	C7	Capacitor, 1200pfd, 50V, ±5%
5370-09321-00	U9, U10, U17, U18	IC, Op Amp, MC1458	5040-09365-00	C11	Capacitor, 1µfd, 63V, ±10%
5281-09215-00	U2	IC, Hex Inv, 74LS04	5040-09343-00	C1, C3, C4, C8, C17	Capacitor, 10µfd, 20v, ±20%
5281-09246-00	U14	IC, 2-4 Dec, 74LS139	5040-10974-00	C12, C19, C24	Capacitor, 100µfd, 35v
5281-09745-00	U15	IC, Dual Mux, 74LS138	5040-09776-00	C26, C30	Capacitor, 470µfd, 16v; +50, -10%
5370-09156-00	U22, U23	IC, Audio Amp, TDA2002	5040-12006-00	C29, C32	Capacitor, 1000µfd, 16v, 20%
a) 5705-09199-00		Heatsink, #6030B	5041-09243-00	C25, C28	Capacitor, 10µfd, 10v,±10%
b) 4006-01003-06		Mach. Screw, 6-32 x 3/8	5043-08960-00	C5, B (17)*	Capacitor, 0.01µfd, 50v,+80, -20%
c) 4406-01117-00		Nut, 6-32 Hex.	5043-08996-00	C31, C33	Capacitor, 0.1µfd, 50v, ±20%
d) 4703-00007-00		Lockwasher, #6 Ext.	5043-09065-00	C13 - C15	Capacitor, 470 pfd, 50v, ±20%
5160-10269-00	Q1	Transistor, 2N3904, NPN	5043-09492-00	C2, C34	Capacitor, 100 pfd, 50v, ±10%
5060-10396-00	SP1	SIP 4.7K & 470pfd, 8R8C	5043-09844-00	C6	Capacitor, 47 pfd, 50v, ±20%
5010-09181-00	R44, R48	Resistor, 1.0Ω, 1/2w, 5%	5043-09845-00	C16, C18, C20 - C23, C27	Capacitor, 1000 pfd, 50v, ±20%
5010-09161-00	R35, R45	Resistor, 2.2Ω, 1/4w, 5%			
5010-09361-00	R43, R46, R47	Resistor, 220Ω, 1/2w, 5%	5520-09020-00	X1	Crystal, 3.58 MHz
5010-09358-00	R41, R42	Resistor, 1K, 1/4w, 5%	5521-10931-00	CR1	Oscillator, 8 MHz
5010-08998-00	R2, R3,	Resistor, 2.2K, 1/4w, 5%	5551-09822-00	L1 - L3	Inductor, 4.7 µH, 3A
5010-08983-00	R7-R9	Resistor, 3.3K, 1/4w, 5%	5791-09437-00	J4	Connector, 20 pin, (Hdr), Rib. Cbl
5010-08991-00	R1, R4, R5, R11, R25 - R28, R33, R36, R37, R49, R50	Resistor, 4.7K, 1/4w, 5%	5791-10862-04	J1, J2, J5	Connector, 4 pin (Hdr)
			5791-10862-06	J3	Connector, 6 pin (Hdr)
			16-8650-300		P.C.B. I.D. Label
			20-9229		Thermal Compound

NOTES:
* 17 capacitors (shown on diagram with "B" symbol) provide +5VDC filtering for ICs.
  All capacitors are ceramic, 50v, axial, unless otherwise noted.
 All resistors are 5%, 1/4w, Carbon Film, unless otherwise noted.
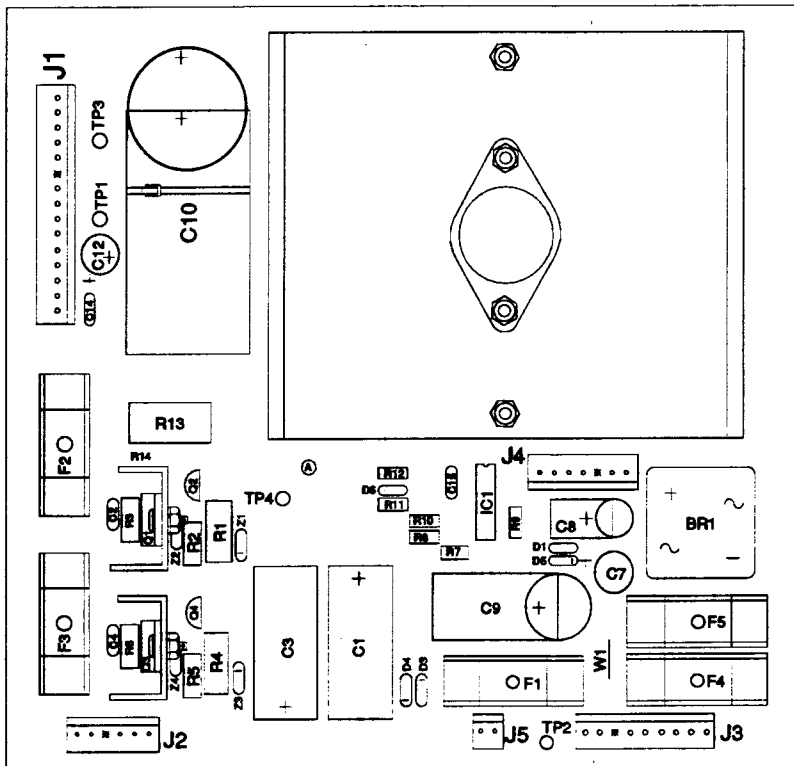
Power Supply
p/n D-12246

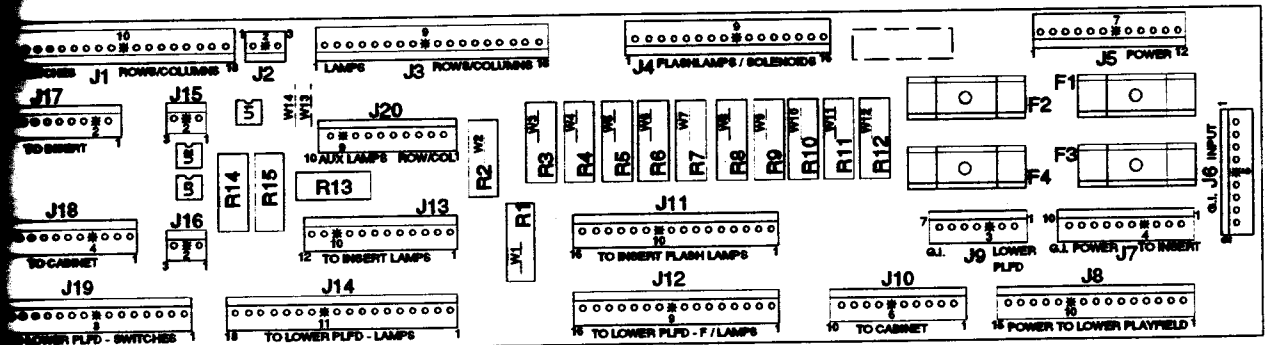| No.	Ckt Designator	Description	Item	Part No.	Ckt Designator	Description
17-00		Power Supply PCB	26	5075-09060-00	ZR2, ZR4	Zener, 1N4764, 100v, 1w
00-01	F1-F5	Fuse Holder	27	5460-09424-00	IC1	IC, Volt. Reg., MC1723C5
02-00	F4, F5	Fuse, 7A., S-B, 250v	28	5010-09069-00	R3, R6	Resistor, 330K, 5%, 1/2w, C.F.
03-00	F1	Fuse, 3/8A., S-B, 250v	29	5010-10631-00	R2, R5	Resistor, 1.2K, 5%, 1/2w
27-00	F2, F3	Fuse 1/8 A., 250v	30	5010-09536-00	R1, R4	Resistor, 39K, 5%,1w
02-15	J1	Connector, 15-pin Hdr, Sq Pin .156	31	5013-09426-00	R7	Resistor, 2.15K, 1%, 1/4w, C. F.
02-06	J2	Connector, 6-pin Hdr, Sq Pin .156	32	5013-09427-00	R8	Resistor, 4.99K, 1%, 1/4w, C. F.
02-09	J3	Connector, 9-pin Hdr, Sq Pin .156	33	5010-09541-00	R9	Resistor, 2.7K, 2%,1/4w, C. F.
00-00	BR1	Bridge Rectifier, 35A., 200V	34	5010-09085-00	R10	Resistor, 1.5K, 5%,1/4w, C. F.
04-00	Q1	Transistor, MJE15030, NPN	35	5010-09428-00	R11	Resistor, 1.5K, 2%, 1/4w, C. F.
05-00	Q3	Transistor, MJE15031, PNP	36	5010-09508-00	R12	Resistor, 270Ω, 2%, 1/4w, C. F37
06-00	Q2	Transistor, MPSD52, PNP	37	5012-09429-00	R13	Resistor, 0.12Ω, 5%,5w
09-00	Q4	Transistor, MPSD02, NPN	38	5040-12324-00	C1, C3	Capacitor, 150 mfd, 160v, radial
05-00	Q5	Transistor, 2N6057, NPN	39	5043-09072-00	C2, C4	Capacitor, 0.1 mfd, 500v, disc
02-00		Thermal Pad TO-3	40	5040-09421-00	C7	Capacitor, 100 mfd, 25v, radial
09-06		Mach. Screw, 6-32 x 3/8	41	5040-09422-00	C8	Capacitor, 47 mfd, 50v, radial
09-08		Mach. Screw, 6-32 x 1/2	42	5040-09420-00	C9	Capacitor, 1000 mfd, electr,
		Thermal Compound		5040-08893-00		25v, axial or radial
17-00		Nut, 6-32 Hex.	43	5040-09419-00	C10	Capacitor, 18,000 mfd, electr,
04-00	W1	Resistor,0Ω				20v, axial
07-00		Lockwasher, #6 Ext.	44	5040-09423-00	C12	Capacitor, 330 mfd, electr,
00-00		Heatsink 4"				10v,radial
09-00		Heatsink 6030B	45	5043-09446-00	C14	Capacitor, 0.1 mfd, 50v, disc
04-00	D1, D3 - D6	Diode, 1N4004	46	5043-09065-00	C15	Capacitor, 470 pfd
09-00	ZR1, ZR3	Zener, 1N5990, 3.9v, 1/2w	47	5824-09248-00	TP1-TP4	Terminal, #1502-1 (Test Post)
			48	03-7947		Tie Wrap, 8" Long

compound must be applied between transistor and heat sink.
dex mark on integrated circuit, polarity of capacitors and diodes, and position of

of Q5 and its related heat sink and hardware is from the bottom of the heatsink, to
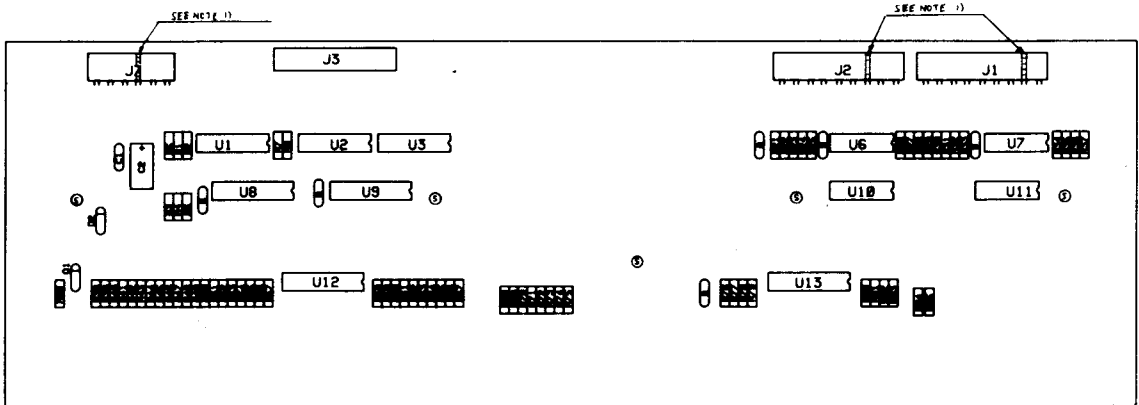ation.
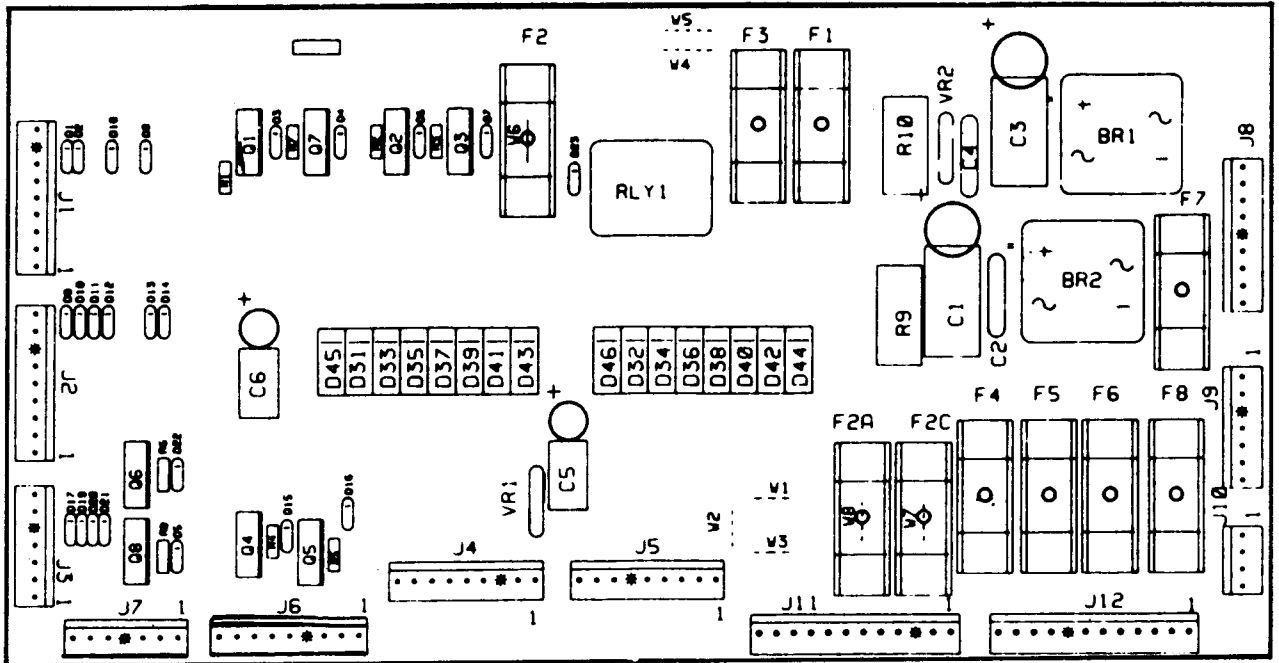
Aux Power Driver Unit Board
p/n D-12247-566

| Part No.	Ckt Designator	Description
5763-12184-00		Bare P.C. Board
5040-09537-00	C1, C3	Capacitor, 100 µfd., 100v, Radial
5040-12181-00	C5, C6	Capacitor, 10 µfd., 100v, Radial
5043-09072-00	C2, C4	Capacitor, 0.1 µfd., 500v
5010-09160-00	R1 - R8	Resistor, 220Ω, 1/4w C.F., 5%
5012-12238-00	R9	Resistor, 3.3KΩ, 5w, 10%
5010-09534-00	W1, W3, W4, W6	Resistor, 0Ω, 1/4w
5017-12180-00	VR1, VR2	Varistor, 100v
5100-09690-00	BR1, BR2	Bridge Rectifier, 35A, 200v
5070-08785-00	D1 - D23	Diode, 1N4003
5070-09045-00	D31 - D46	Diode, MR501
5191-12179-00	Q1 - Q8	Transistor, TIP36C
5580-09555-01	K1	Relay, DPDT, 13A
5733-12060-01		Fuse Holder
5731-08665-00	F5, F6	Fuse, 2A, S-B, 250v
5731-09128-00	F1, F2A, F3, F4	Fuse, 2-1/2A, S-B, 250v
5731-09651-00	F2C,	Fuse, 5A, S-B, 250v
5731-06314-00	F7	Fuse, 4A, S-B, 250v
5731-09432-00	F8	Fuse, 7A, S-B, 250v
5791-10862-09	J1, J2, J4 - J6, J8	Connector, 9-pin Hdr, Sq Pin
5791-10862-07	J3, J7, J9	Connector, 7-pin Hdr, Sq Pin
5791-10862-12	J11, J12	Connector, 12-pin Hdr, Sq Pin
5791-10862-04	J10	Connector, 4-pin Hdr, Sq Pin

Backbox Interconnect Board
p/n D-12313-2015

| Part No.	Ckt Designator	Description
5768-12332-00		Master Interconnect Board
5010-09534-00	R12	Resistor, 0Ω
5012-12238-00	R14, R15	Resistor, 3.3KΩ, 5w, 10%
5012-12337-00	R13	Resistor, 1.5KΩ, 5w, 10%
5012-12163-00	R11	Resistor, 11Ω, 5w, 10%
5012-10024-00	R1-R10	Resistor, 5.6Ω, 5W, 10%
5490-10892-00	U1 - U3	Opto Isolator 4N25
5731-09651-00	F1-F4	Fuse, 5A.S.B., 250v
5733-12060-01		Fuse Holder, F1-F4
5791-10862-03	J2, J16	Connector, 3-pin Hdr Sq Pin .156
5791-10862-07	J9	Connector, 7-pin Hdr Sq Pin .156
5791-10862-09	J6	Connector, 9-pin Hdr Sq Pin .156
5791-10862-10	J7, J10	Connector, 10-pin Hdr Sq Pin .156
5791-10862-12	J5, J13, J18	Connector, 12-pin Hdr Sq Pin .156
5791-10862-15	J8	Connector, 15-pin Hdr Sq Pin .156
5791-10862-16	J4, J11, J12, J19	Connector, 16-pin Hdr Sq Pin .156
5791-10862-18	J1, J3, J14	Connector, 18-pin Hdr Sq Pin .156
16-8850-243		P.C.B. I.D. Label

Bally Left Display Board
D-12706

DESCRIPTION	QTY.	DESIGNATION NO.	PART NUMBER
Axial Cap., 0.01mfd, 50v, +80, -20%	6	B (Bypass Cap)	5043-08980-00
Axial Cap., 0.1mfd, 50v, +80, -20%	1	C1	5043-08996-00
Axial Cap., 10mfd, 25v, ±20%	1	C2	5040-09343-00
Zener, 1N4740, 10v	2	D1, D2	5075-09135-00
Display, 16-Character A/N	1	DSPL1	5670-12308-00
9-Pin Header, Right Angle, .156	2	J1, J2	5791-10869-09
26-Pin Header, Right Angle, .100	1	J3	5791-10851-00
6-Pin Header, Right Angle, .156	1	J7	5791-10869-06
Resistor, 18KW, 1/4w, 5%	25	R1-R8, R21-R37	5010-08773-00
Resistor, 100KW, 1/4w, 5%	32	R38, R40, R42, R44, R46, R48, R50, R52, R54, R55-R61, R63, R65, R67, R69, R71, R73, R75-R83, R85	5010-09162-00
Resistor, 10KW, 1/2w, 5%	9	R39, R41, R43, R47, R53 R66, R70, R72, R84	5010-08981-00
Resistor, 1MW, 1/4w, 5%	1	R86	5010-10258-00
Resistor, 8.2KW, 1/2w, 5%	7	R45, R49, R51, R62, R64, R68, R74	5010-10927-00
I.C. 4049	3	U1-U3	5310-08975-00
I.C. 4001		U6, U7, U10, U11	5310-09882-00
I.C. 7180, Catode Driver	2	U8, U9	5680-08969-00
I.C. 6118, Anode Driver	2	U12, U13	5680-08968-00
Bally-Hi-Display PCB	1		5768-12408-00
Support Display5		S (Support)	03-8088-1
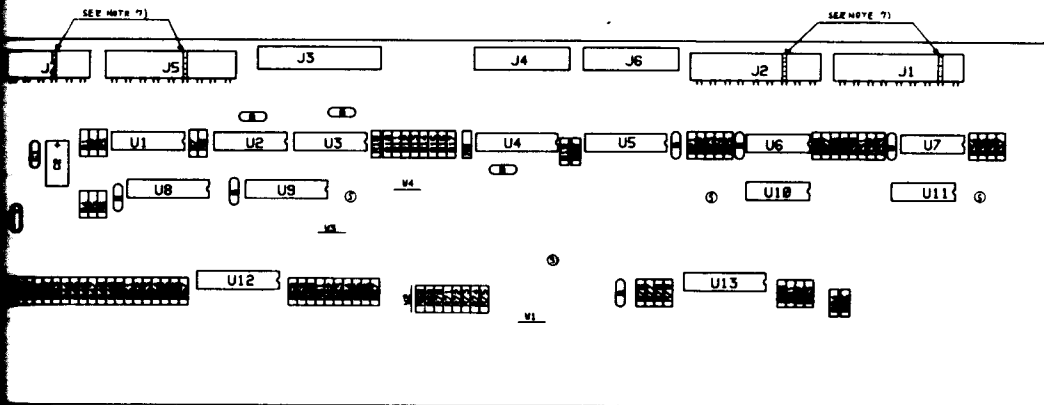
Bally Right Display Board
D-12502-1

CRIPTION	QTY.	DESIGNATION NO.	PART NUMBER
Cap., 0.01mfd, 50v, +80, -20%	9	B (Bypass Cap)	5043-08980-00
Cap., 0.1mfd, 50v, +80, -20%	1	C1	5043-08996-00
Cap., 10mfd, 25v, ±20%	1	C2	5040-09343-00
r, 1N4740, 10v	2	D1, D2	5075-09135-00
ay, 16-Character A/N	1	DSPL1	5670-12308-00
Header, Right Angle, .156	3	J1, J2, J5	5791-10869-09
n Header, Right Angle, .100	1	J3	5791-10851-00
Header, Right Angle, .156	1	J7	5791-10869-06
tor, 18KW, 1/4w, 5%	25	R1-R8, R21-R37	5010-08773-00
tor, 100KW, 1/4w, 5%	32	R38, R40, R42, R44, R46,R48, R50, R52, R54-R61,R63, R65, R67, R69, R71, R73, R75-R83, R85	5010-09162-00
tor, 1MW, 1/4w, 5%	1	R86	5010-10258-00
tor, 8.2KW, 1/2w, 5%	7	R45, R49, R51, R62, R64, R68, R74	5010-10927-00
tor, 0W	2	W3, W4	5010-09534-00
049	3	U1-U3	5310-08975-00
001	4	U6, U7, U10, U11	5310-09882-00
7180, Catode Driver	2	U8, U9	5680-08969-00
118, Anode Driver	2	U12, U13	5680, 08968-00
-Lo-Display PCB	1		5768-12378-00
rt Display	5	S (Support)	03-8088-1
bly, I.D. Label	1		16-8850-251
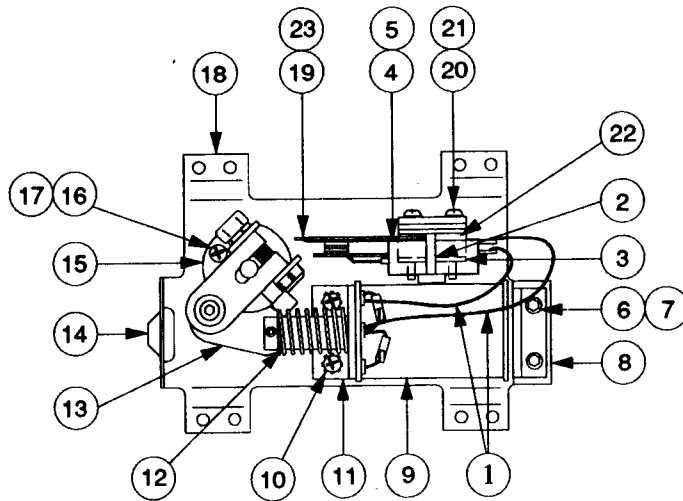
Lower & Upper Right Flipper Assembly
C-11626-R-3

Item	Part Number	Description	Item	Part Number	Description
1	HW-30018-6	Wire, 18 AWG, Blue	g)	B-10657-R	Flipper Crank Assy,
2	03-7520-2	Ty-Wrap, Nylon	1.)	01-8073-R	Flipper Crank, R.
3	20-6516	Speednut, Tinnerman	2.)	17-1037	Crank Washer
4	5045-12098-00	Capacitor, 2.2 µFd, 250V, 20%	3.)	4010-01066-18	Cap Screw,10-32x1
5	RM-21-06	Sleeve, Vinyl (Cap. leads)	4.)	4410-01127-00	Nut, 10-32 Hex Hd
6	4010-01066-06	Cap Screw, 10-32 x 3/8, SH	5.)	4700-00107-00	Washer, 5/8 o.d.x1
7	4701-00004-00	Lockwasher, #10 Split			i.d. x 12ga.
8	A-12111	Flipper Stop Assembly	6.)	4701-00004-00	Lockwasher, #10 S
9	FL-11630	Flipper Coil (Red)	7.)	RM-23-06	Tubing, H. S. 1/4 D
10	4006-01017-04	Mach. Screw, 6-32 x 1/4	14	23-6577	Bumper Plug
11	01-7695	Solenoid Bracket	15	03-7568	Flipper Bushing
12	10-376	Coil Plunger Spring	16	4006-01005-06	Mach. Screw, 6-32
13	B-10655-R	Crank Link Assembly, Right	17	4406-01117-00	Nut, 6-32 Hex.
a)	02-4179	Link Spacer Bushing	18	C-11627-R	Flipper Base Assy,
b)	4010-01086-14	Cap Screw, 10-32 x 7/8, SH	19	06-14G	Insulating Blade
c)	4700-00023-00	Washer, 5/8 x13/64 x16ga.	20	4105-01019-10	Sh. Metal Screw,
d)	4701-00004-00	Lockwasher, #10 Split			#5 x 5/8
e)	4410-01132-00	Nut, 10-32 ESNA	21	4701-00002-00	Lockwasher, #6 S
f)	A-10656**	Flipper Link Assembly	22	23-6622	Tape, Double-sid
1.)	02-4219	Coil Plunger	23	03-7811	End of Stroke (E
2.)	20-9370-1	Spring Pin, 5/32 dia. x 7/16			
3.)	03-8050-1	Flipper Link			

** Also See Separate Diagram

....

Associated Parts:.

20-9250-5	Flipper Arm on Shaft
23-6519-4	Red Rubber Ring
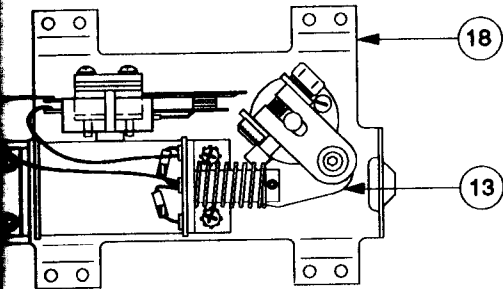
Lower & Upper Left Flipper Assembly
p/n C-11626-L-3
(Parts listed replace same items of C-11626-R-3)

Item	Part No.	Description
13	B-10655-L	Crank Link Assembly, Left
g)	B-10657-L	Flipper Crank Assembly, L
1.)	01-8073-L	Flipper Crank, Left
18	C-11627-L	Flipper Base Assembly, L

Assembly Notes...

Each Flipper Assembly on the Lower Playfield is mounted beneath the playfield, in conjunction with the plastic Flipper Paddle and Shaft (20-9250-5) and flipper Rubber (23-6519-4) on the upper side of the playfield.

The tip of the EOS Switch must travel 0.0150 (+ .010, - .000) inch, before the contacts fully open, with the flipper in the actuated position. The EOS Switch contacts must have a gap of 0.062 (± .015) inch. Adjustment of the EOS Switch must be made at a minimum distance of 0.25 inch from the switch body.

All moving elements of the assembly must operate freely, with no evidence of binding.

The large end of the Coil Plunger Spring (item 12) must fit within the four lugs of the Solenoid Bracket.

For coil replacement, remove the Solenoid Bracket (item 11) to prevent screw damage.

Use Loctite™ 242 when reattaching screws to the Flipper Stop Assembly, the Solenoid Bracket, and the Flipper Bushing.

When replacing the Bumper Plug (Item 14) to restore proper flipper operation, readjust the flipper paddle and shaft position.

Solid color blue wire connects to the banded end of each diode, mounted on the connector end of the Flipper Coil (item 9). Trace color wire connects to the unbanded end of the diode.
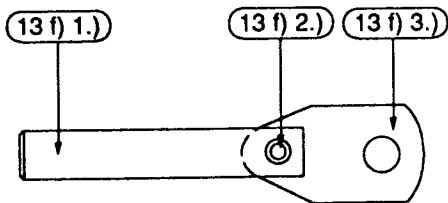
Flipper Link Assembly
p/n A-10656
[Items listed refer to items listed for C-11626-R-3]

Item	Part No.	Description
13 f) 1.)	02-4219	Coil Plunger
13 f) 2.)	20-9370-1	Spring Pin, 5/32 dia. x 7/16
13 f) 3.)	03-8050-1	Flipper Link

KICKER ARM (SLINGSHOT)
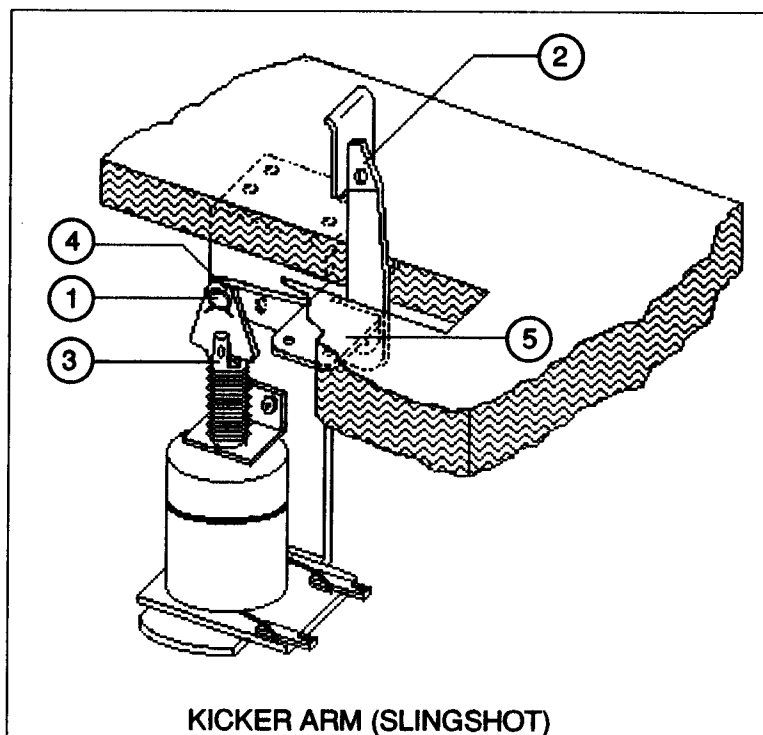
Kicker Arm ("Slingshot") Assembly
p/n B-12665
(Left & Right Kickers)

Item	Part No.	Description
1	12-6227	Clip, Hairpin
2	A-12664	Kicker Crank Assembly
3	A-5103	Coil Plunger Assembly
	02-2364	Coil Plunger
	20-8716-5	Roll Pin, 1/8 x 7/16
	03-8085	Armature Link
4	4700-00003-00	Flat Washer, .265 x .500 x .067
5	A-5653	Mounting Bracket Assy

Associated Parts for Right Kicker

Part No.	Description
B-11203-L-1	Coil & Bracket Assey
B-7572-1	Bracket & Stop Assy
01-8-508-S	Coil Retaining Bracket
4006-01017-06	Mach. Screw, 6-32 x 3/8
4406-01119-00	Nut, 6-32 ESN
AE-26-1500	Coil Assembly
03-7066	Coil Tubing

Associated Parts for Left Kicker

Part No.	Description
B-11203-R-1	Coil & Bracket Assy
B-7572-1	Bracket & Stop Assy
01-8-508-S	Coil Retaining Bracket
4006-01017-06	Mach. Screw, 6-32 x 3/8
4406-01119-00	Nut, 6-32 ESN
AE-26-1500	Coil Assembly
03-7066	Coil Tubing

Ball Shooter Lane Feeder
C-9638
& Associated Parts
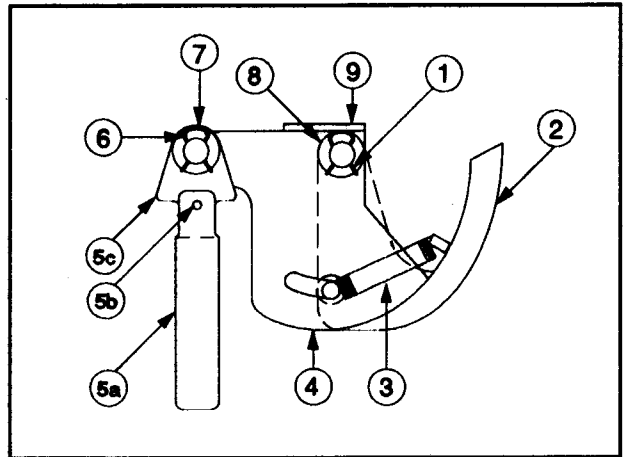
Item	Part No.	Description
1	12-6227	Clip, Hairpin
2	A-8247	Eject Cam Assy
3	10-362	Ejector Spring (Plain)
4	A-6949-L	Spring Plate Assy
5	A-8050-1	Coil Plunger Assy
a)	02-3407-2	Coil Plunger
b)	20-8716-5	Roll Pin
c)	03-8085	Armature Link
6	4700-00030-00	Flat Washer, 17/64 x 1/2 x 15 ga
7	4700-00103-00	Flat Washer, 17/64 x 1/2 x 28 ga.
8	A-8268	Mounting Bracket Assy

Associated Parts

B-9362-L-1	Coil & Bracket Assy
B-7572-1	Bracket & Stop Assy
01-8-508-S	Coil Retaining Bracket
4006-01017-06	Mach. Screw, 6-32 x 3/8
4406-01119-00	Nut, 6-32 ESN
AE-23-800	Coil Assembly
03-7066	Coil Tubing

Outhole Kicker Assembly
p/n B-8039-2

OUTHOLE KICKER ASSEMBLY

Item	Part No.	Description
1	A-6378	Mounting Plate Assy
2	A-8335	Coil Plunger Assy
a)	02-2364	Coil Plunger
b)	20-8716-5	Roll Pin, 1/8 x 7/16
c)	01-4251	Ball Return Link
3	03-7066	Coil Tubing
4	A-6889	Kicker Lever Assy
5	A-8038	Coil Stop Assy
6	AE-23-800	Coil Assy
7	03-7176-1	Striker Ring
8	10-101-4	Spring-Reset
9	20-8712-25	"E" Ring, 1/4" Shaft
10	4006-01003-03	Mach. Screw, 6-32 x 3/16
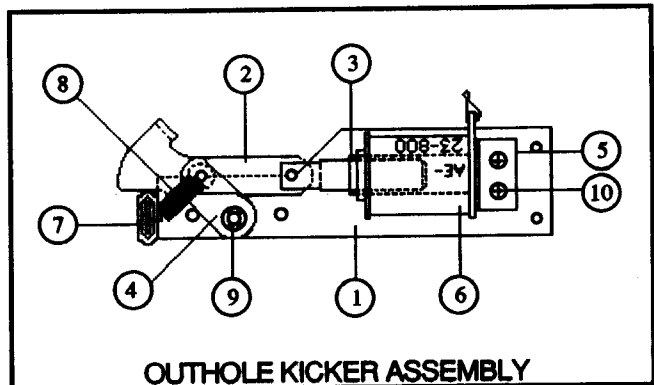
Jet Bumper Assembly
p/n B-9414

Item	Part No.	Description
1	A-4754	Bumper Ring Assy
2	03-6009-A5	Bumper Base-Wht
3	03-6035-5	Bumper Wafer-Wht
4	03-7443-5	Bumper Body-Wht
5	10-7	Spring-Jet Bumper
6	A-11199	Socket & Bulb Assy
7	03-8254-9	Bumper Cap

Associated Parts:

B-12030-2	Switch & Diode Assy
SW-11A-37	Switch Assembly
5070-06258-00	Diode, 1N4001, 1.0A
B-12029-2	Switch & Brkt Assy
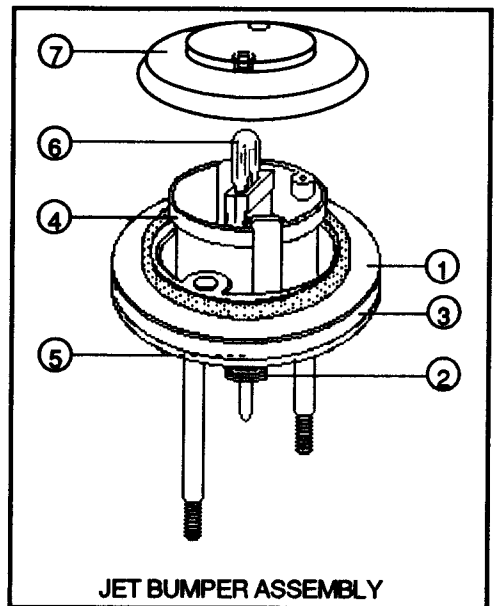
JET BUMPER ASSEMBLY

Jet Bumper Coil Assembly
p/n B-9415-1

Item	Part No.	Description
1	B-7417	Bracket & Stop Assy
2	01-1747	Coil Retaining Bracket
3	01-5492	Armature Link (Plate), Steel
4	01-5493	Armature Link (Plate), Bakelite
5	02-3406-1	Coil Plunger
6	10-326	Armature (Compression) Spring
7	AE-23-800	Coil Assembly
8	4006-01017-04	Mach. Screw, 6-32 x 1/4
9	03-7066	Coil Tubing
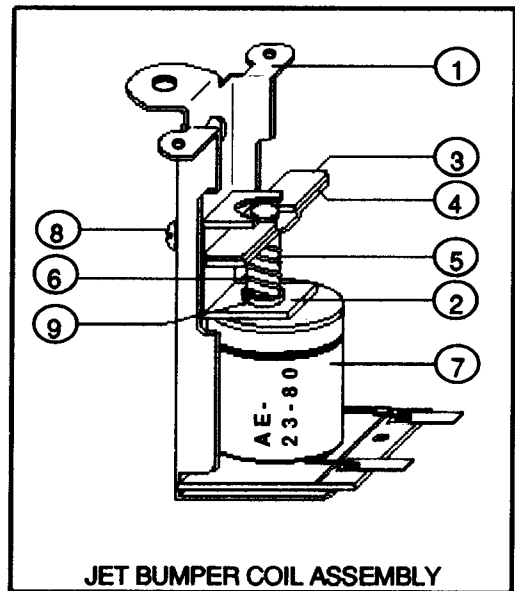
JET BUMPER COIL ASSEMBLY

Bottom Arch Kicker Assembly (Kickback)
p/n B-11873-1

Item	Part No.	Description
1	A-6306-2	Bell Armature
2	AE-24-900	Coil Assembly
3	B-7409-2	Mtg. Bracket Assembly
4	01-8-508-T	Coil Retain Bracket
5	03-7067-5	Coil Tubing
6	10-135	Solenoid Spring
7	23-6420	Rubber Grommet
8	4008-01017-05	Mach. Screw 8-23 x 5/16
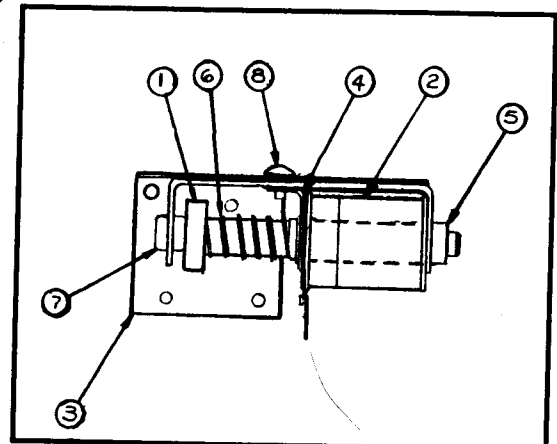
Standup Target Assemblies
(Including Diode)

Item	Part No.	Description
1	B-11696-4	Standup Target (Red)
2	B-13900-4	Standup Target (Red)

STANDUP TARGET

STANDUP TARGET

01-8652
BRACKET

5070-06258-00
DIODE

A-8645
SW WIRE & BRKT

5647-12073-00
MICROSWITCH

A-5844-44
SW WIRE & BRKT

B-13623
MOUNTING PLATE

RM-21-03
TUBING

5647-09957-00
MICROSWITCH

5070-06258-00
DIODE

BALL TROUGH SWITCHES
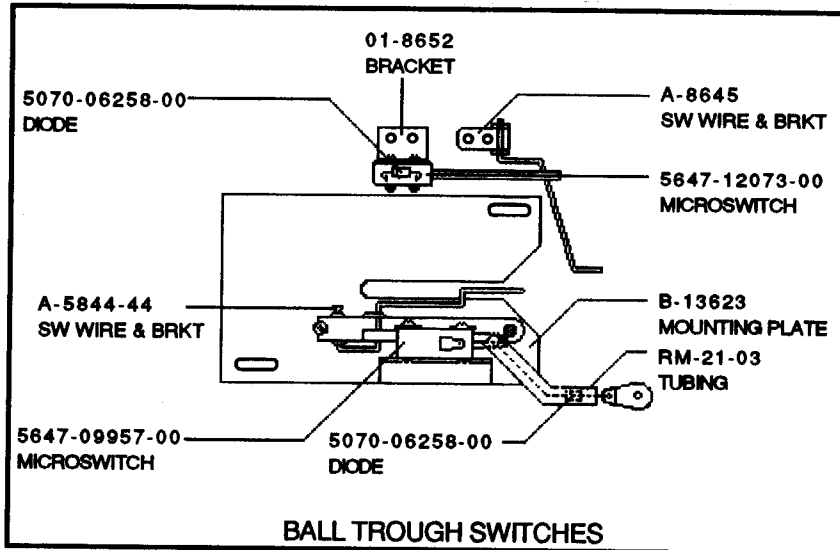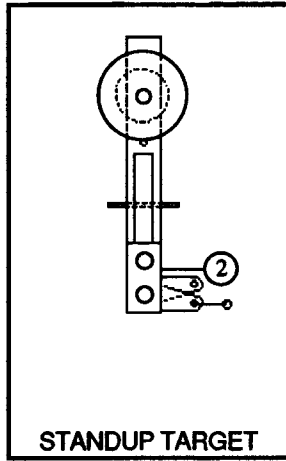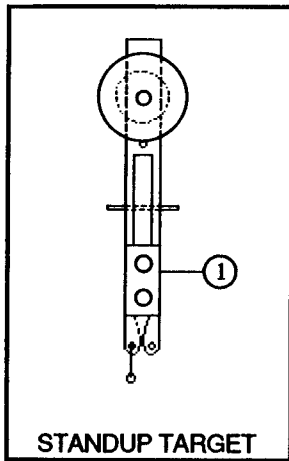
Ball Trough Switches

Part No.	Description
B-13623	Switch Plate Assembly
A-5844-44	Switch Wire & Bracket Assy
B-13622	Switch Mounting Plate Sub-Assy
RM-21-03	#10 Tubing
4004-01060-08	MS 4-40 x 1/2 SL-PH-S
4005-01005-02	MS 5-40 x 1/8 P-PH
5070-06258-00	Doide, 1N4001, 1A
5647-09957-00	µSwitch E21-50H
5825-09373-00	#4 Solder Lug-bent
A-11680	Ball Trough Switch, Right
01-8652	Mounting Bracket
5647-12073-08	Submin. Switch
5070-06258-00	Diode, 1N4001, 1.0A
A-8645	Switch Wire & Bracket Assy

Knocker Assembly
p/n B-10686-1

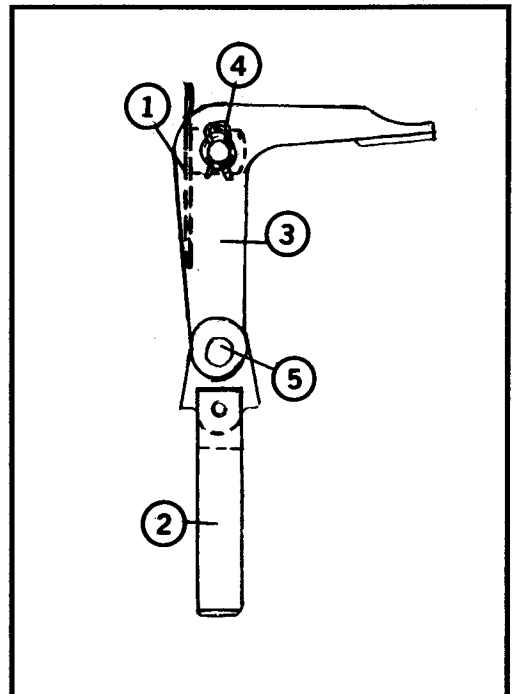| Item	Part No.	Description
1	A-5387	Coil Plunger Assembly
a)	02-2653	Coil Plunger
b)	03-6013	Bell Arm Ext.
2	B-7409-2	Mtg. Bracket Assembly
3	AE-23-800	Coil Sub-Assembly
4	01-8-508-T	Coil Retaining Bracket
5	23-6420	Rubber Grommet
6	4008-01017-06	Mach. Screw, 8/32 x 3/8
7	H-11835	Knocker Cable
8	03-7067-5	Coil Tubing
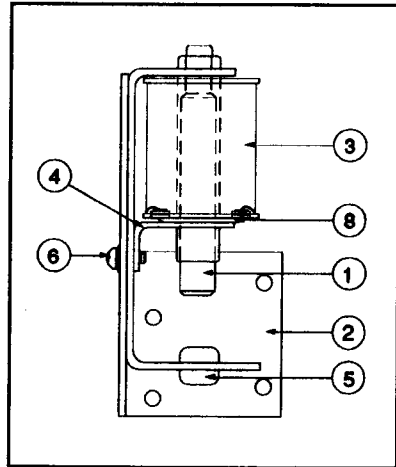
Left Kicker Assembly
(Ball Locker)
p/n B-11395-1

Item	Part No.	Description
1	A-11396	Kicker Mounting Bracket Assy
2	A-5103	Coil Plunger Assembly
3	A-5652-1	Kicker Crank Assembly
4	12-6227	Hairpin Clip
5	4700-00030-00	Flatwasher, .265 x .500 x .067

Associated Parts

B-9362-L-1		Coil & Bracket Assy
	AE-23-800	Coil Assy
	B-7572-1	Bracket & Stop Assy
	01-8-508-S	Coil Retaining Brkt
	03-7066	Coil Tubing

Ball Shooter
p/n B-12445-1

Item	Part No.	Description
1	03-7357	Sleeve
2	10-149	Rod Spring
3	20-9253-7	Rod Assembly
4	21-6645-1	Ball Shooter Housing
5	10-148-1	Shooter Spring
6	20-8718-1	"C" Ring
7	23-6327	Shooter Tip
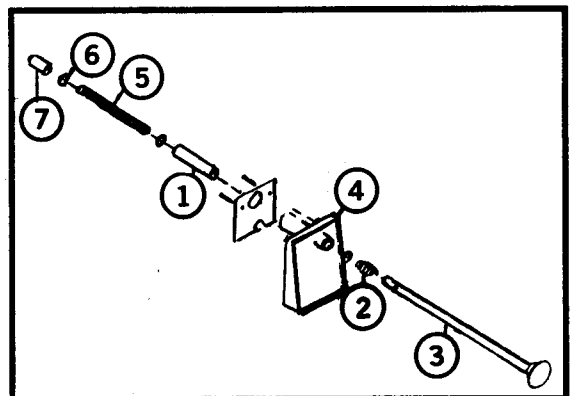
Diverter Assembly
(Right Ball Gate)
p/n B-13496-1

Item	Part No.	Description
1	B-13493	Mounting Bracket Assy
2	AE-26-1500	Coil Assembly
3	A-10821	Flipper Stop Bracket Assy
4	03-7066	Coil Tubing
5	01-8413	Bracket Coil Tubing
6	4010-01008-06	Mach. Screw, 10-32 x 3/8
7	4701-00004-00	Lockwasher, #10 Split

Associated Parts

Item	Part No.	Description
8	A-13494	Diverter Shaft & Paddle
a)	02-4444	Shaft
b)	03-8388	Diverter
c)	20-8716-1	Roll Pin, 3/32 x 1/2
d)	20-8712-25	"E"-Ring, 1/4" Shaft
9	A-13278	Plunger Assembly
a)	02-4241	Coil Plunger
b)	10-389	Spring
c)	20-8712-43	"E"-Ring, 7/16" Shaft
d)	20-8716-5	Roll Pin, 1/8 x 7/16
10	A-13279	Drive Arm Assembly
11	C-13811	Funnel Gate Assembly
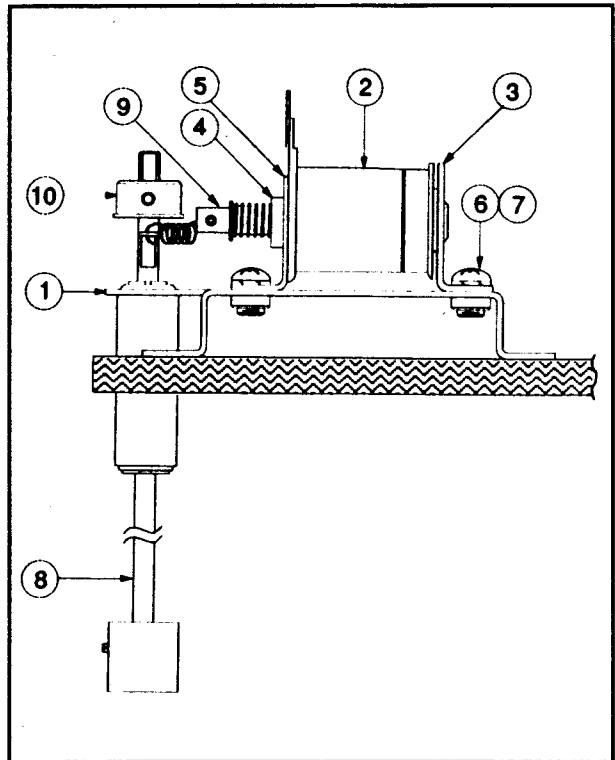
Diverter Assembly
(Bowtie)
p/n C-13809

Item	Part No.	Description
1	B-13808	Plunger Assembly
2	B-11660	Main Frame Sub-assembly
3	03-8090	Flat Cam
4	01-8639	Coil Support Bracket
5	A-10821	Flipper Stop Bracket Assembly
6	5070-06258-00	Diode, 1N4001
7	10-406	Compression Spring
8		Extension Spring
9	10-392	Compression Spring
10	5647-12073-06	Mini Microswitch
11	AE-23-800	Coil Assembly
12	4701-00024-00	Split Lock Washer #2
13	4700-00103-00	Flat Washer #12
14	20-8712-25	E-Retaining Ring
15	20-7890-7	Nylined Bearing
16	4010-01008-06	M.S. #10-32 P-PH
17	4701-00004-00	Split Lock Washer #10
18	4700-00021-00	Flat Washer .203 x .437 x .032
	Associated	Parts (Not Shown)
19	03-8403	Diverter Plastic
20	B-13629	Diverter Shaft Assembly
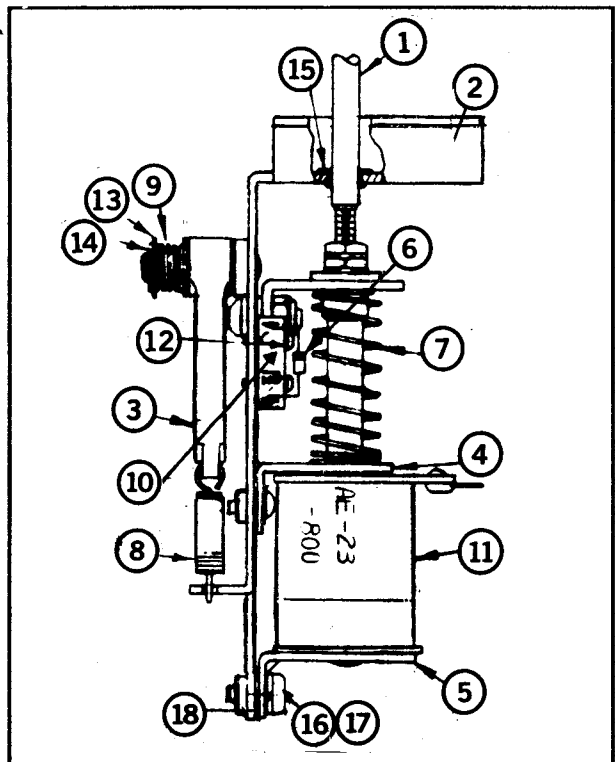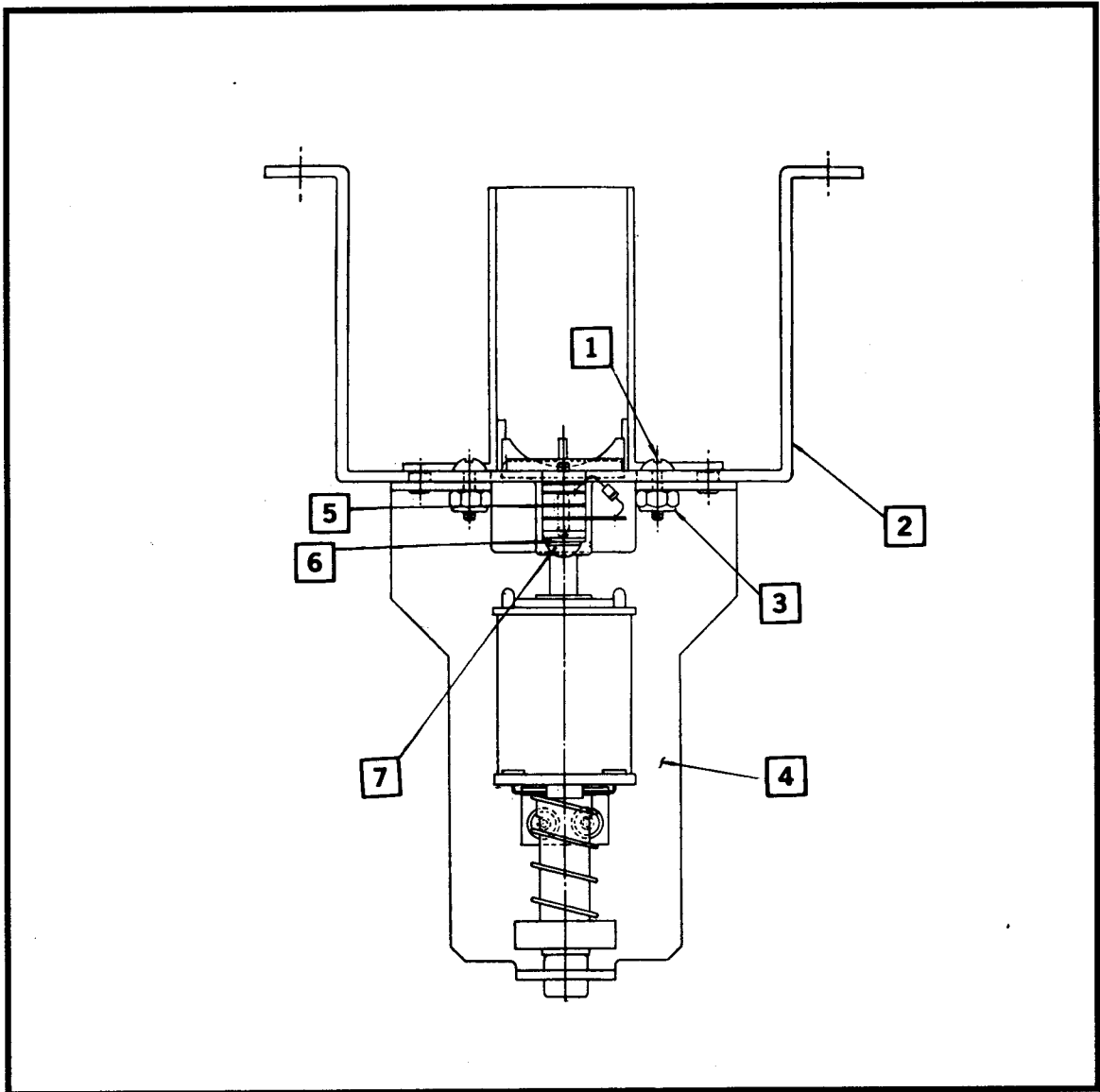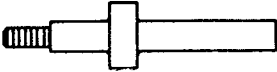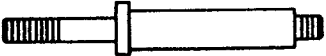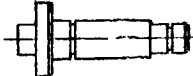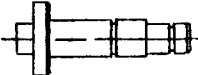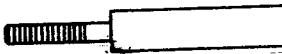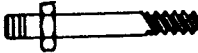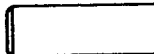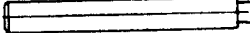
Ball Popper & Extension Assembly
p/n D-13306

Item	Part No.	Description
1	4008-01016-08	8-32 x 1/2 M.S. P-RH
2	B-13307	Extension Bracket Assembly
3	4408-01119-00	8-32 Hex Nut E.S.N.
4	D-11335-2	Ball Popper Assembly*
5	A-12792	Switch & Diode Assembly
6	01-3670-1	Switch Plate
7	4005-01051-10	5-40 x 5/8 M.S.-SL-RH

*Ball Popper Assembly

Part No.	Description
A-11336	Armature Assy
A-11721	Bracket Assy
AE-23-800	Coil Assy
B-11631	Popper Brkt As
03-7067	Coil Tubing
03-8053	Popper Cap
10-135	Coil Plunger Spri
20-9314-7	Dowl Pin
23-6420	Grommet
4008-01017-05	M.S. 8-32 x 5/16 P-RH-S

Posts

	02-3408	Playfield Post
	02-4020	Support Post
	02-4036	Rubber Bumper Post
	02-4056	Bumper Post
	02-4271-1	Post
	02-4271-2	Post
	02-4271-3	Post
	02-4334	Mounting Post
	02-4423	Bumper Post
	02-4426	Post #6-32/#8-32
	02-4433	#8 1-3/16"
	02-4434	Post #8 1"
	02-4451	Post
	03-8319-9	#8 Red Star Post
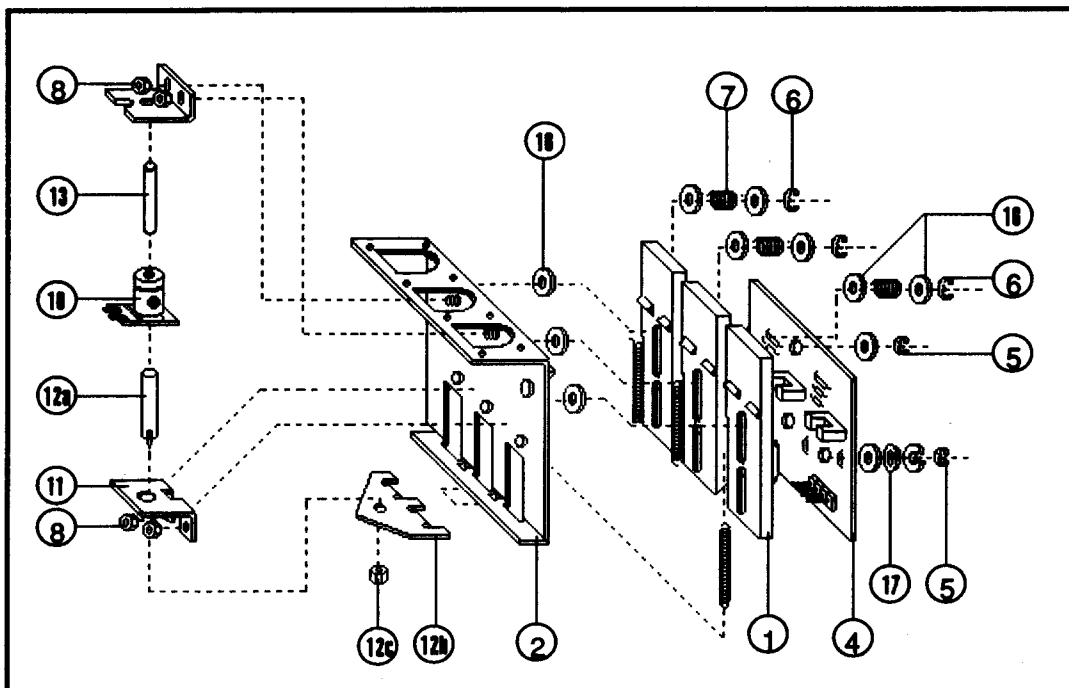
3-Bank Drop Target Assembly
p/n C-11223-4

Item	Part No.	Description
1	03-8033	Plain Target
2	B-13271	3-Bank Target Sub-assembly
3	10-364	Target Retractor Spring
4	C-13205-1	3-Bank Target Opto assembly
5	20-8712-18	"E" Ring, 3/16" Shaft
6	20-8712-25	"E" Ring, 1/4" Shaft
7	10-392	Compression Spring
8	4408-01119-00	Nut, 8-32 ESN
9	A-11397	Stop Bracket Assembly
10	AE-26-1200	Coil Assembly
11	01-8413	Coil Mounting Bracket
12	A-11389	Plunger & Reset Plate Assembly
a)	02-3972-1	Plunger
b)	01-8408	3-Bank Reset Plate
c)	4410-01132-00	Nut, 10-32 ESN
13	03-7066-4	Coil Tubing
14	4700-00016-00	Flatwasher, 3/16 x 7/16 x 17 ga.
15	4008-01016-10	Mach. Screw, 8-32 x 5/8 P-RH
16	4700-00072-00	Flatwasher, 17/64 x 1/2 x 21 ga.
17	23-6626	Rubber Grommet
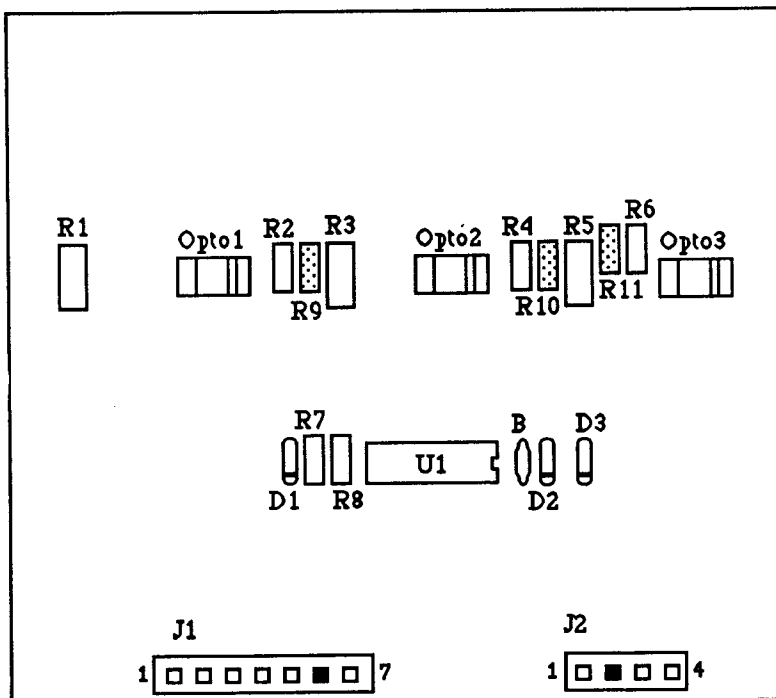
3-Bank Drop Target Opto Board
p/n C-13205-1

Part No.	Ckt Designation	Description
5768-12546-00		3-Bank Opto Board
5490-10159-00	Opto 1- Opto3	Opto Interruptor, MDL, S/G
5010-08930-00	R1, R3, R5	Resistor, C.F., 470 Ω, 1/2w, 5%
5010-09162-00	R8	Resistor, C.F., 100KΩ, 1/4w, 5%
5010-09324-00	R2, R4, R6	Resistor, C.F., 27KΩ, 1/4w, 5%
5010-08774-00	R7	Resistor, C.F., 22KΩ, 1/4w, 5%
5043-08980-00	B	Capacitor, .01µfd., +80 -20%
5370-12272-00	U1	I.C., Quad. Comp., LM339
5791-12548-07	J1	7 pin header R/A lock Sq. .100
5070-09054-00	D1, D2, D3	Diode, 1N4004, 1.0A

COIN DOOR ASSEMBLY

USA Door with decals, p/n C-13155-1
2-Chute Door - 09-17002-x
3-Chute Door - 09-17003-x
("x" is the country designator)

Item	Part Number	Description	Quantity
1	27-1038	Button Cover	2 or 3
2	27-1041-1-54	Price Panel	2 or 3
3	27-1026-1-15	Coin Entry Plate	2 or 3
4	27-1016	Lock Assembly	1
5	27-1061-1	Coin Return - Bezel	1
6	27-1062	Coin Return Flap	1
7	27-1021	Button Housing - 2-slot	1
	27-1022	Button Housing - 3-slot	1
8	27-1111	Interlock Switch	1
9	27-1006-1	Coin Door , 2-Slot	1
	27-1007-1	Coin Door , 3-Slot	1
10	27-1005	Coin Door Frame	1
11	27-1003	M/C Screw, 6-32 x 3/16	4
12	27-1008	Diagnostic Switch	1
13	27-1101	M/C Screw, 4-40 x 1/4	2
14	27-1102	Bracket, Diagnostic Switch	1
15	27-1037	Button	2 or 3
16	27-1078	M/C Screw, 6-32 x 3/8	2 or 3
17	27-1039	Conical Spring	2 or 3
18	27-1079	Self-tapping Screw, #6 x 1/4	2
19	27-1077-1	Coinbox Cover	1
20	27-1066	Slam Switch	1
21	27-1067	M/C Screw, 4-40 x 1/2	2
22	27-1017	Nut (key)	1
23	27-1012	Locking Cam	1
24	27-1011	Locking Arm	2
25	27-1020	Washer	1
26	27-1018	Star Washer	1
27	27-1019	M/C Screw 1/4-28 x 5/16	1
30	27-1112	Coin Inlet Chute	2 or 3
31	27-1088	Cable Clamp	2 or 3
32	27-1025	Key Hook	1
33	27-1086	Washer, #6	2 or 3
34	27-1078	M/C Screw, 6-32 x 3/8	1 or 2
	27-1113	M/C Screw, 6-32 x 7/16	1
35	27-1079	Self-tapping Screw, #6 x 1/4	2 or 3
36	27-1084	Lamp Socket	2 or 3
	27-1085	Lamp	2 or 3
37	27-1096	Self-tapping Screw, #5 x 3/8	2 or 3
38	27-1087	M/C Screw, 6-32 x 5/8	2 or 3
39	27-1082	Lever Arm	2 or 3
40	27-1097	Switch Cover	2 or 3
41	27-1091-1	Coin Accept Chute	2 or 3
42	27-1075	Wire Form (small)	2 or 3
	or		
	27-1093	Wire Form (large)	
43	27-1094	M/C Screw, 4-40 x 7/8	4 or 6
44	27-1087	M/C Screw, 6-32 x 5/8	4 or 6
45	27-1086	Washer, #6	4 or 6
46	27-1095	Nut, 4-40 ESNA	4 or 6
47	27-1076-1	Coin Return Box	1
48	27-1078	M/C Screw, 6-32 x 3/8	2
49	27-1092	Microswitch	2 or 3

Cashbox Cover
01-7173

Cashbox
03-7626

Cashbox Handle
12-6587

2-Chute Coin Door
09-17002-x

3-Chute Coin Door
09-17003-x

(x = Coin Designator)
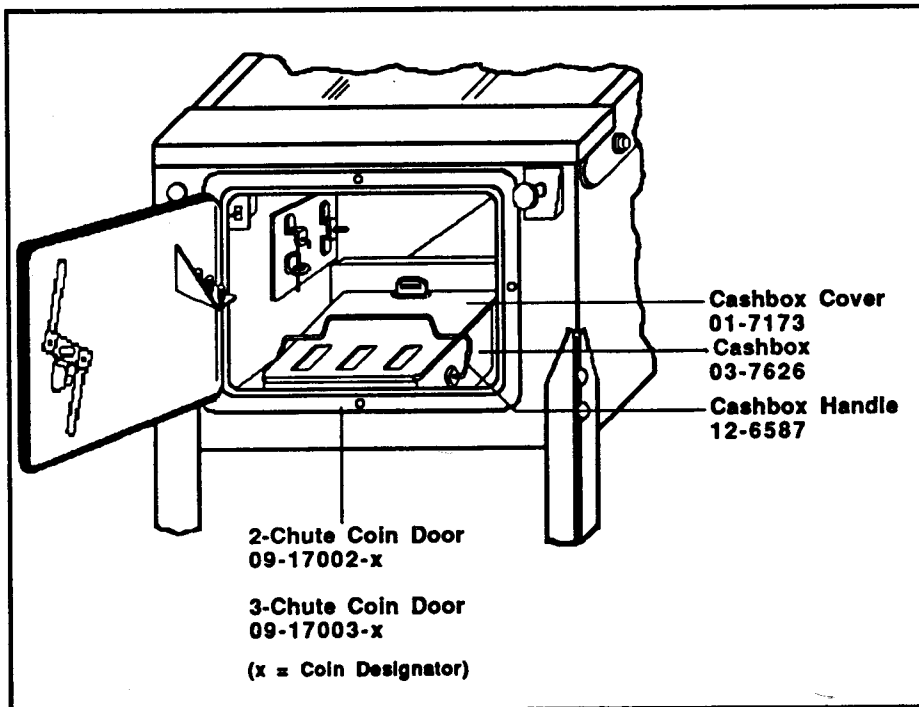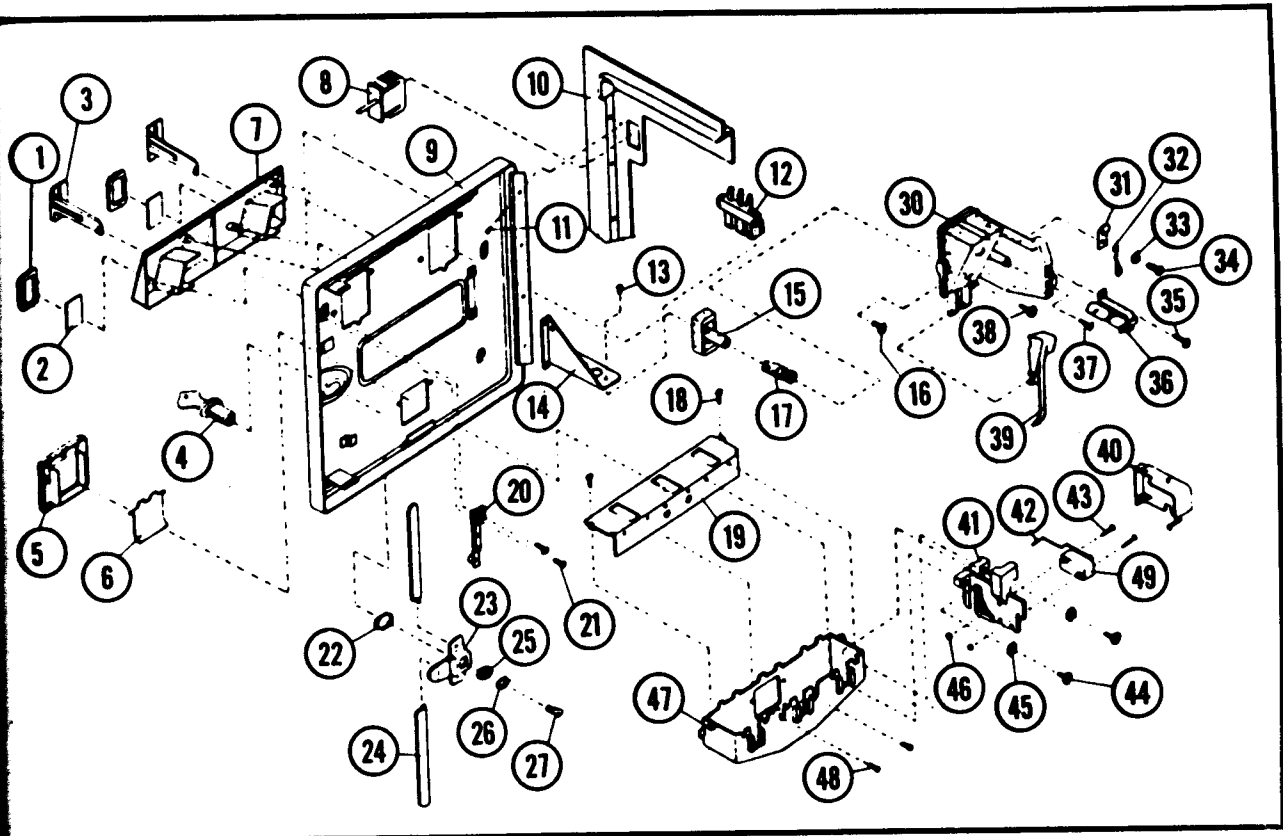
LAMPS

Item	Part No.	Description
1	#44 Bulb	Shoot Again
2	#555 Bulb	Bonus 20K
3	#555 Bulb	Bonus 40K
4	#555 Bulb	Bonus 60K
5	#555 Bulb	Bonus 80K
6	#555 Bulb	Bonus 100K
7	#555 Bulb	Bonus 500K
8	#555 Bulb	Bonus 1 M
9	#555 Bulb	Spot Letter-R
10	#555 Bulb	Spot Letter-A
11	#555 Bulb	Spot Letter-D
12	#44 Bulb	Spot Letter-I
13	#44 Bulb	Spot Letter-C
14	#44 Bulb	Spot Letter-A
15	#44 Bulb	Spot Letter-L
16	#44 Bulb	Top Million
17	#44 Bulb	Word-R
18	#555 Bulb	Word-A
19	#555 Bulb	Word-D
20	#555 Bulb	Word-I
21	#555 Bulb	Word-C
22	#555 Bulb	Word-A
23	#44 Bulb	Word-L
24	#555 Bulb	Letter Value
25	#555 Bulb	Lock Lane-S
26	#555 Bulb	Lock Lane-N
27	#555 Bulb	Lock Lane-A
28	#555 Bulb	Lock Lane-K
29	#555 Bulb	Lock Lane-E
30	#44 Bulb	Top Drop Tgt-Rt
31	#44 Bulb	Top Drop Tgt-Mid
32	#44 Bulb	Top Drop Tgt-Lt
33	#44 Bulb	Lock Bottom
34	#44 Bulb	Lock Middle
35	#44 Bulb	Lock Top
36	#555 Bulb	Snake Run
37	#555 Bulb	Left Special
38	#555 Bulb	Left Return
39	#44 Bulb	Right Return
40	#44 Bulb	Right Ex Ball
41	#555 Bulb	Left Kickback
42	#44 Bulb	Loop Ramp 50K
43	#44 Bulb	Loop Ramp Ex Ball
44	#44 Bulb	Bonus Advance
45	#44 Bulb	Bonus Value
46	#555 Bulb	Mega Million
47	#555 Bulb	Spinner 3K
48	#44 Bulb	Tailslider
49	#555 Bulb	Bonus 2X
50	#555 Bulb	Bonus 3X
51	#555 Bulb	Bonus 4X
52	#555 Bulb	Bonus 5X
53	#555 Bulb	Bonus 100K
54	#555 Bulb	Bonus 200K
55	#555 Bulb	Bonus 300K
56	#555 Bulb	Bonus 400K
57	#44 Bulb	Insert Vert
58	#44 Bulb	Insert Tail
59	#44 Bulb	Insert Mystery
60	#44 Bulb	Insert Million
61	#44 Bulb	Insert Ex Ball
62	#44 Bulb	Insert Skate
63	#44 Bulb	Spot Letter
64	#44 Bulb	Right Million
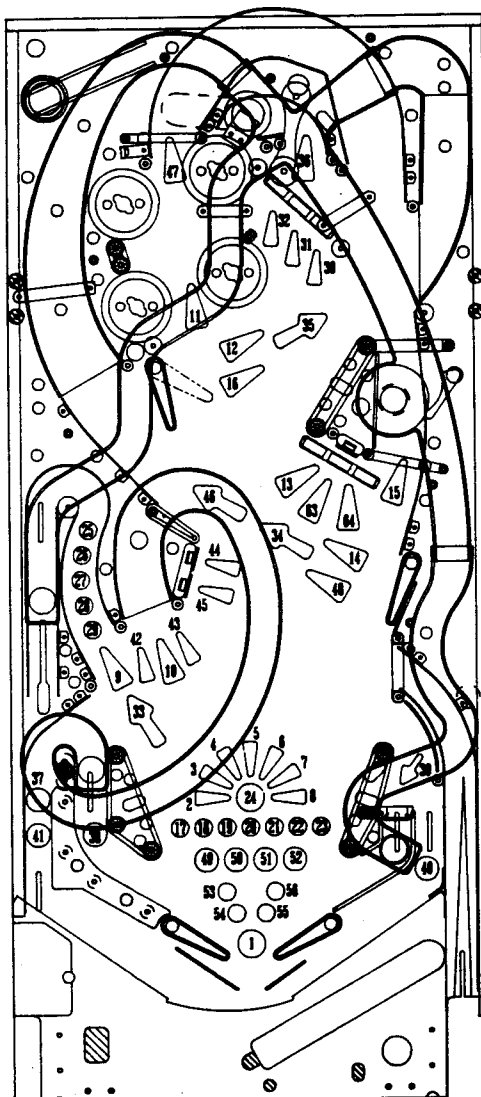
NOTE:

p/n	#44	24-6549
p/n	#555	24-8768

RADICAL LAMP MATRIX

Yel/Gry — Column 8
Yel/Vio — Column 7
Yel/Blu — Column 6
Yel/Grn — Column 5
Yel/Blk — Column 4
Yel/Orn — Column 3
Yel/Red — Column 2
Yel/Brn — Column 1

Red/Brn Row 1 — 01 09 17 25 33 41 49 57
Red/Blk Row 2 — 02 10 18 26 34 42 49 58
Red/Orn Row 3 — 03 11 19 27 35 43 51 59
Red/Yel Row 4 — 04 12 20 28 36 44 52 60
Red/Grn Row 5 — 05 13 21 29 37 45 53 61
Red/Blu Row 6 — 06 14 22 30 38 46 54 62
Red/Vio Row 7 — 07 15 23 31 39 47 55 63
Red/Gry Row 8 — 08 16 24 32 40 48 56 64

Column
Row

Typical Lamp Circuit

Column	1 Q66 YEL-BRN 1J7-1	2 Q64 YEL-RED 1J7-2	3 Q62 YEL-ORN 1J7-3	4 Q60 YEL-BLK 1J7-4	5 Q58 YEL-GRN 1J7-6	6 Q56 YEL-BLU 1J7-7	7 Q54 YEL-VIO 1J7-8	8 Q52 YEL-GRY 1J7-9
Q80 RED-BRN 1J6-1	Shoot Again 1	Spot Letter R 9	Word-R 17	Lock Lane S 25	Lock Bottom 33	Left Kickback 41	Bonus Multiplier 2X 49	Inset Vertical 57
Q81 RED-BLK 1J6-2	Bonus 20K 2	Spot Letter A 10	Word-A 18	Lock Lane N 26	Lock Middle 34	Loop Ramp 25K 42	Bonus Multiplier 3X 50	Insert Tail 58
Q82 RED-ORN 1J6-3	Bonus 40K 3	Spot Letter D 11	Word-D 19	Lock Lane A 27	Lock Top 35	Loop Ramp Extra Ball 43	Bonus Multiplier 4X 51	Insert Mystery 59
Q83 RED-YEL 1J6-5	Bonus 60K 4	Spot Letter I 12	Word-I 20	Lock Lane K 28	Snake Run 36	Bonus Advance 44	Bonus Multiplier 5X 52	Insert Million 6
Q84 RED-GRN 1J6-6	Bonus 80K 5	Spot Letter C 13	Word-C 21	Lock Lane E 29	Left Special 37	Bonus Value 45	Bonus 100K 53	Insert Extra Ball 61
Q85 RED-BLU 1J6-7	Bonus 100K 6	Spot Letter A 14	Word-A 22	Top Drop Tgt Right 30	Left Return 38	Jackpot Mega Million 46	Bonus 200K 54	Insert Skate 62
Q86 RED-VIO 1J6-8	Bonus 500K 7	Spot Letter L 15	Word-L 23	Top Drop Tgt Middle 31	Right Return 39	Spinner 3K 47	Bonus 300K 55	Spot Letter 63
Q87 RED-GRY 1J6-9	Bonus 1 Million 8	Top Million 16	Letter Value 24	Top Drop Tgt Left 32	Right Extra Ball 40	Tail Slider 48	Bonus 400K 56	Right Million 64

SWITCHES

Item	Part No.	Description
1	20-6502-A	Plumb Bob Tilt
2		Not Used
3	SW-1A-126	Start Button
4	27-1092	Right Coin Sw.
5	Not Used	Center Coin Sw.
6	27-1092	Left Coin Sw.
7	27-1066	Slam Tilt
8	27-1008	Hi Scr Reset
9		Not Used
10	5647-12133-12	Outhole
11	5647-12073-08	Trough 1
12	5647-12073-00	Trough 2
13		Not Used
14	5647-12073-04	Shooter Lane
15	5647-12073-11	Left Ramp
16	A-12792	Ball Popper
17	p/o B-11916	Top Spinner
18	5647-12073-24	X Ramp Left
19	5647-12073-24	X-Ramp Right
20	p/o B-13629	Ball Diverter
21		Not Used
22	p/o C-11223-4	Bot Drop Tgt-Rt
23	p/o C-11223-4	Bot Drop Tgt- Mid
24	p/o C-11223-4	Bot Drop Tgt-Lt
25		Not Used
26		Not Used
27	5647-12073-24	Middle Man
28	p/o B-13900-4	Advance Bonus X
29	p/o B-11916	Right Spin
30	p/o C-11223-4	Top Drop Tgt-Rt
31	p/o C-11223-4	Top Drop Tgt-Mid
32	p/o C-11223-4	Top Drop Tgt-Lt
33		Not Used
34		Not Used
35		Not Used
36		Not Used
37	A-13301	Left Loop
38	A-12688	Lock Lane
39	5647-12073-33	Top Left Lockup
40	5647-12133-01	Left Lockup
41		Not Used
42		Not Used
43	p/o B-11696-4	Advance Bonus
44	p/o B-11696-4	Bonus Increase
45		Not Used
46	5647-12073-19	Left Return
47	5647-12073-19	Right Return
48	5647-12073-19	Right Outlane
49	SW-1A-114	Top Sling (Kick)
	SW-1A-120	Top Sling (Score)
50	SW-11A-37	Top Jet Bumper
51	5647-12073-19	Left Outlane
52	SW-11A-37	Left Jet Bumper
53	SW-11A-37	Right Jet Bumper
54	SW-11A-37	Bottom Jet Bumper
55	SW-1A-114	Left Sling (Kick)
	SW-1A-120	Left Sling (Score)
56	SW-1A-114	Right Sling (Kick)
	SW-1A-120	Right Sling (Score)
57	A-9989	Right Flippers
58	A-9989	Left Flippers
59 to 64		Not Used
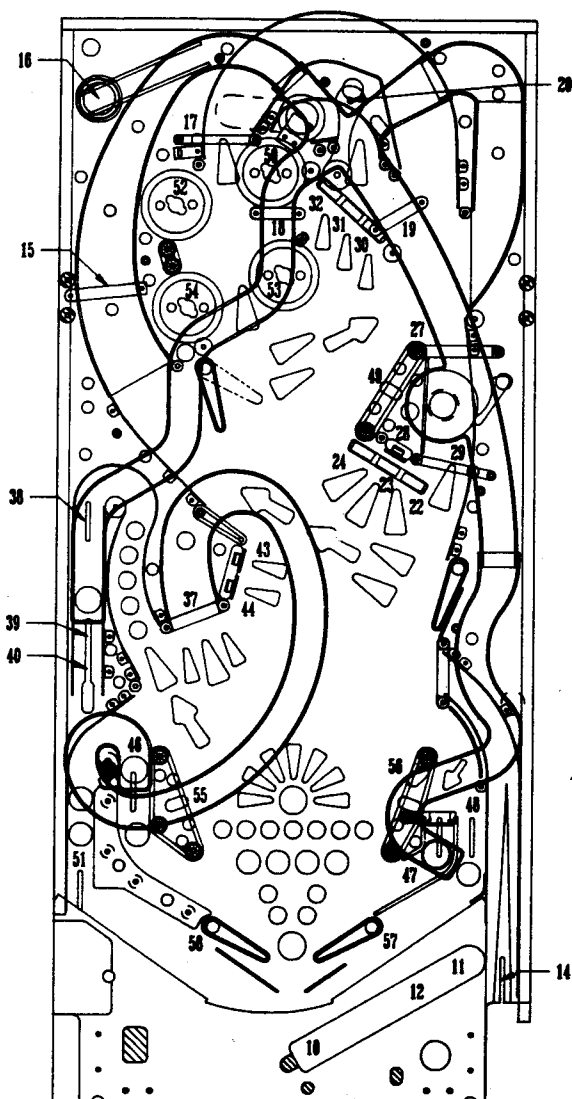
RADICAL SWITCH MATRIX

Typical Switch Circuit

Column	1 Q45 GRN-BRN 1J8-1	2 Q49 GRN-RED 1J8-2	3 Q44 GRN-ORN 1J8-3	4 Q48 GRN-YEL 1J8-4	5 Q43 GRN-BLK 1J8-5	6 Q47 GRN-BLU 1J8-7	7 Q42 GRN-VIO 1J8-8	8 Q46 GRN-GRY 1J8-9
WHT-BRN 1J10-9	Plumb Bob Tilt 1	Not Used 9	Top Spinner 17	Not Used 25	Not Used 33	Not Used 41	Top Sling 49	Right Flipper 57
WHT-RED 1J10-8	Not Used 2	Outhole 10	X Ramp Left 18	Not Used 26	Not Used 34	Not Used 42	Top Jet 50	Left Flipper 58
WHT-ORN 1J10-7	Start Button 3	Trough 1 Right 11	X Ramp Right 19	Middle Man 27	Not Used 35	Advance Bonus 43	Left Outlane 51	Not Used 59
WHT-YEL 1J10-6	Right Coin Slot 4	Trough 2 Left 12	Ball Diverter 20	Advance Bonus X 28	Not Used 36	Bonus Increase 44	Left Jet 52	Not Used 60
WHT-GRN 1J10-5	Center Coin 5	Not Used 13	Not Used 21	Right Spin 29	Left Loop 37	Not Used 45	Right Jet 53	Not Used 61
WHT-BLU 1J10-	Left Coin Slot 6	Shooter Lane 14	Bottom Drop Tgt Right 22	Top Drop Tgt Right 30	Lock Lane 38	Left Return 46	Bottom Jet 54	Not Used 62
WHT-VIO 1J10-2	Slam Tilt 7	Left Ramp 15	Bottom Drop Tgt Middle 23	Top Drop Tgt Middle 31	Left Lockup Top 39	Right Return 47	Left Sling 55	Not Used 63
WHT-GRY 1J10-1	High Score 8	Ball Popper 16	Bottom Drop Tgt Left 24	Top Drop Tgt Left 32	Left Lockup 40	Right Outlane 48	Right Sling 56	Not Used 64

SOLENOIDS

Item	Part No.	Description
01A	AE-23-800	Outhole
01C	#906 flashlamp	Ball Lock Flasher
02A	AE-23-800	Ball Shooter Lane Feeder
02C	#906 flashlamp	Left Ramp Flasher
03A	AE-23-800	Ball Popper
03C	#906 flashlamp	Top Lt Flipper Flshr
04A	AE-26-1200	Top Drop Bank
04C	#89 flashlamp	Top Lt & Insert-Lt Girl Flshr
05A	AE-23-800	Knocker
05C	#89 flashlamp	Top Spin & Insert-Jckpt Flshr
06A	AE-26-1200	Bottom Drop Bank
06C	#89 flashlamp	Drop Hole & Insert-Title Flshr
07A	AE-23-800	Ball Diverter
07C	#89 flashlamp	Top Rt & Insert-T-Shirt Flshr
08A	AE-23-800	Ball Locker
08C	#89/#906 fishlmp	Ball Gate & Shooter Ln Flshr
09	#89/#906 fishlmp	Lower Drop Bank Flasher
10	5580-09555-01	Playfield G.I.
11	5580-09555-01	Backbox G.I.
12	5580-09555-01	A/C Select
13	AE-26-1500	Right Ball Gate
14	AE-24-900	Left Kicker (Kickback)
15	AE-23-800	Top Sling
16	#906 flashlamp	Left Curl Ramp
17	AE-23-800	Left Jet Bumper
18	AE-26-1500	Left Sling
19	AE-23-800	Right Jet Bumper
20	AE-26-1500	Right Sling
21	AE-23-800	Bottom Jet Bumper
22	AE-23-800	Top Jet Bumper
	FL-11630	Left Flippers
	FL-11630	Right Flippers

RADICAL Solenoid Table

Sol. No.	Function	Solenoid Type	Wire Color [1]	CPU Bd	Playfield/ Cabinet	Driver Trnstr	Solenoid Part Number / Flashlamp Type d= Display Bd; p=Playfield
01A [3]	Outhole	Switched	Vio-Brn	1P11-1	5J1-9: 5J4-9 (A)	Q33	AE-23-800
01C [3]	Ball Lock Flasher	Switched	Blk-Brn	(Gry-Brn)	5J5-9 (C)	Q33	#906 flashlamp 1p
02A [3]	Ball Shooter Lane Feeder	Switched	Vio-Red	1P11-3	5J1-7: 5J4-8 (A)	Q25	AE-23-800
02C [3]	Left Ramp Flasher	Switched	Blk-Red	(Gry-Red)	5J5-8 (C)	Q25	#906 flashlamp 1p
03A [3]	Ball Popper	Switched	Vio-Orn	1P11-4	5J1-6: 5J4-7 (A)	Q32	AE-23-800
03C [3]	Top Left Flipper Flasher	Switched	Blk-Orn	(Gry-Orn)	5J5-7(C)	Q32	#906 flashlamp 1p
04A [3]	Top Drop Target Bank	Switched	Vio- Yel	1P11-5	5J1-5: 5J4-6 (A)	Q24	AE-26-1200
04C [3]	Top Left & Left Girl Flashers	Switched	Blk-Yel	(Gry-Yel)	5J5-5 (C)	Q24	#89 flashlamp 1p 1b
05A [3]	Knocker	Switched	Vio-Grn	1P11-6	5J1-4: 5J4-5 (A)	Q31	AE-23-800
05C [3]	Top Spin & Jackpot Flashers	Switched	Blk-Grn	(Gry-Grn)	5J5-4 (C)	Q31	#89 flashlamp 1p 1b
06A [3]	Bottom Drop Target Bank	Switched	Vio-Blu	1P11-7	5J1-3: 5J4-4 (A)	Q23	AE-26-1200
06C [3]	Drop Hole & Title Flasher	Switched	Blk-Blu	(Gry-Blu)	5J5-3 (C)	Q23	#89 flashlamp 1p 3b
07A [3]	Ball Diverter	Switched	Vio-Blk	1P11-8	5J1-2: 5J4-2 (A)	Q30	AE-23-800
07C [3]	Top Right & T-Shirt Flasher	Switched	Blk-Vio	(Gry-Vio)	5J5-2 (C)	Q30	#89 flashlamp 1p 1b
08A [3]	Ball Locker	Switched	Vio-Gry	1P11-9	5J1-1: 5J4-1 (A)	Q22	AE-23-800
08C [3]	Ball Gate & Shooter Lane Flshr	Switched	Blk-Gry	(Gry-Blk)	5J5-1 (C)	Q22	#89/#906 fishlmps 1p 1b
09	Lwr Dr Bank & Lt Face Flasher	Controlled	Brn-Blk	1P12-1	5J2-9: 5J6-9: 2J4-3	Q17	#89/#906 fishlmps 1p 1b
10	Playfield Gnl Illum Relay	Controlled	Brn-Red	1P12-2	5J2-8: 5J6-8: 2J4-5	Q9	5580-09555-01 4a
11	Insert Illum Relay	Controlled	Brn-Orn	1P12-4	5J2-6: 5J6-7: 2J4-6	Q16	5580-09555-01 4a
12	A/C Select Relay	Controlled	Brn-Yel	1P12-5	5J2-5	Q8	5580-09555-01 5
13	Right Ball Gate	Controlled	Brn-Grn	1P12-6	5J2-4: 5J6-5	Q15	AE-26-1500
14	Left Outlane Kicker	Controlled	Brn-Blu	1P12-7	5J2-4: 5J6-3	Q7	AE-24-900
15	Top Kicker (Sling)	Controlled	Brn-Vio	1P12-8	5J2-2: 5J6-2	Q14	AE-23-800
16	Left Curl Ramp	Controlled	Brn-Gry	1P12-9	5J2-1: 5J6-1	Q6	#906 flashlamp 1p
17	Left Jet Bumper	Special #1	Blu-Brn	1P19-7	5J3-7: 5J7-7	Q75	AE-23-800
18	Left Kicker (Sling)	Special #2	Blu-Red	1P19-4	5J3-6: 5J7-6	Q71	AE-26-1500
19	Right Jet Bumper	Special #3	Blu-Orn	1P19-3	5J3-3: 5J7-3	Q73	AE-23-800
20	Right Kicker (Sling)	Special #4	Blu-Yel	1P19-6	5J3-4: 5J7-5	Q69	AE-26-1500
21	Bottom Jet Bumper	Special #5	Blu-Grn	1P19-8	5J3-2:5J7-2	Q77	AE-23-800
22	Top Jet Bumper	Special #6	Blu-Blk	1P19-9	5J3-1: 5J7-1	Q79	AE-23-800
-	Lower Right Flipper	-	Orn-Vio	1P19-1	2J5-5: 2P10-7	-	
	Upper Right Flipper		(Blu-Vio) [2]		(2J10-1: 2P8-15)		FL11630/50VDC
			(Blk-Blu)		(2J10-4: 2P8-12)		FL 11630/50VDC
-	Lower Left Flipper	-	Orn-Gry	1P19-2	2J5-4: 2P10-8	-	
	Upper Left Flipper		(Blu-Gry) [2]		(2J10-2: 2P8-14)		FL11630/50VDC
			(Blk-Yel)		(2J10-3: 2P8-13)		FL11630/50VDC

Notes 1. Wire colors, except flipper Orn-Vio and Orn-Gry, are ground connections (to coil terminal with unbanded end of diode). Flipper Orn-Vio and Orn-Gry wires connect from CPU Board to flipper switch. 2. Flipper connections shown in braces are from flipper switch to flipper coil. 3. "A" circuits are pulsed, when Sol. 12 is de-energized; "C" circuits are pulsed, with Sol. 12 energized. Wire colors in brackets are those from respective A and C terminals corresponding to the J1-terminal connection listed for the Aux Power Driver Bd, which controls the device pulsing by Sol. 12. 4. Relay is mounted on Relay Bd, (4a) p/n C-11998-1; (4b) C-11902-1. 5. Relay is mounted on Aux Power Driver Bd, D-12247 in the backbox.
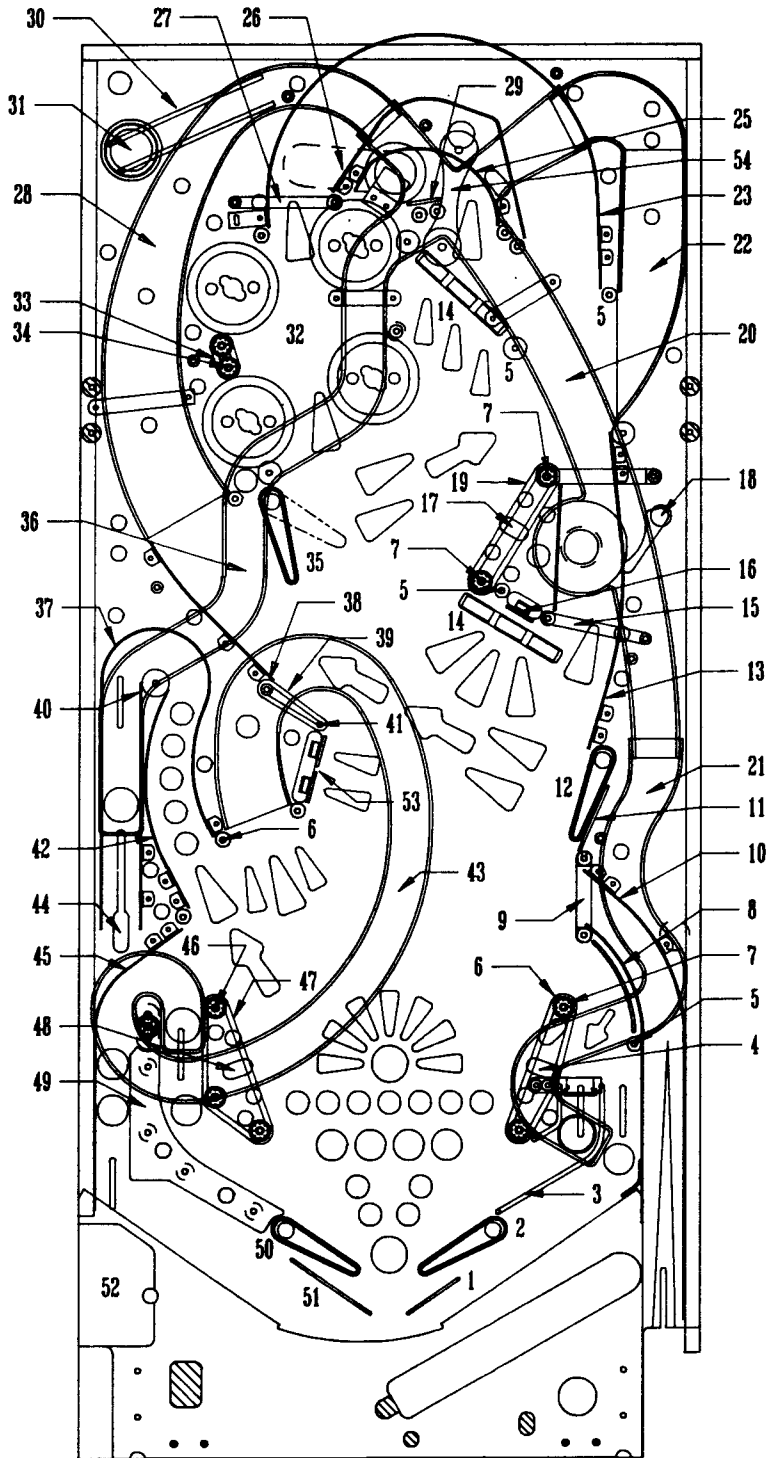
PLAYFIELD PARTS

PLAYFIELD PARTS

Item	Part No.	Description
	12-6484-2	Anti-Rebound Wire
	C-11626-R-3	Flipper
	23-6519-4	Rubber Ring Red
	B-13598	Wire Ball Guide Assembly
	B-12665	Kicker (Slingshot)
	02-4036	Post
	23-6552	Rubber Ring Yellow
	23-6305	Rubber Ring 2"
	03-8319-9	Post
	B-13621	Ball Guide Assembly
	A-13626	Ball Guide Assembly
10	C-13620	Ball Guide Assembly
11	12-6466-9	Wire Guide
12	C-11626-R-3	Flipper
	23-6519-4	Rubber Ring Red
13	B-13619	Ball Guide Assembly
14	C-11223-4	Drop Target Bank
15	B-11916	Bracket
16	B-13756-16	Standup Target
17	B-12665	Kicker (Slingshot)
18	B-13496-1	Right Ball Gate
19	23-6306	Rubber Ring 2-1/2"
20	R-13586	X Ramp
21	C-13802	Ramp
22	C-13804	Ramp
23	C-13616	Ball Guide Assembly
24		Not Used
25	B-13618	Ball Guide Assembly
26	B-13625	Trough
27	B-11916	Bracket
28	C-13803	Ramp
29	12-6466-4	Wire Guide
30	12-6913	Wire Guide
31	D-13306	Ball Popper w/ Extension Assembly
32	B-9414	Jet Bumper
33	23-6301	Rubber Ring
34	03-8319-9	Post
35	C-11626-L-3	Flipper
	23-6519-4	Rubber Ring Red
36	B-13615	Ball Guide Assembly
37	C-13612	Ball Guide Assembly
38	03-8247-13	Post
39	23-6304	Rubber Ring 1-1/2"
40	B-13613	Ball Guide Assembly
41	02-4423	Post
42	B-13614	Ball Guide Assembly
43	C-13801	Ramp
44	B-11395-1	Ball Locker
45	B-13611	Ball Guide Assembly
46	03-8319-9	Post
47	23-6306	Rubber Ring 2-1/2"
48	B-12665	Kicker (Slingshot)
49	B-13631	Flipper Ball Guide Assembly
50	C-11626-L-3	Flipper
	23-6519-4	Rubber Ring Red

Item	Part No.	Description
51	12-6468-2	Anti-Rebound Wire
52	B-11873-1	Kickback
53	B-11696-4	Standup Target
54	B-13629	Diverter

PARTS UNDER BOTTOM ARCH

Part No.	Description
A-10417	Micro Switch Assembly
B-8623	Guide & Baffle Assembly
12-6857	Handle Wire
C-8235	Ball Runway Assembly
B-9362-L-1	Coil & Bracket Assembly
C-9638	Ball Shooter Lane Feeder
A-8645	Wireform & Bracket Assy
A-11680	Sub-mini Switch Assembly
01-3569-1	Ball Return Runway
10-128	Kicker Spring

Single Lamp Assembly
p/n B-12224

Part No.	Description
24-8768	#555 Bulb, 6.3V
24-8767	Twist Lamp Socket
5070-09054-00	Diode, 1N4004, 1.0A
5768-12312-00	Bare PCB

Radical Lamp Assembly
p/n C-13578

Part No.	Description
24-8768	#555 Bulb, 6.3V
24-8767	Twist Lamp Socket
5070-09054-00	Diode, 1N4004, 1.0A
5768-12620-00	Bare PCB
5791-10871-12	Header, Square Flat pin

Lock Lamps Assembly
p/n C-13577

Part No.	Description
24-8768	#555 Bulb, 6.3V
24-8767	Twist Lamp Socket
5070-09054-00	Diode, 1N4004, 1.0A
5768-12619-00	Bare PCB
5791-10871-07	Header, Square, Flat pin

Snake Lamp Assembly
p/n C-13749

Part No.	Description
24-8768	#555 Bulb, 6.3 V
24-8804	V-Wedge PCB Socket
5070-09054-00	Diode, 1N4004, 1.0A
5768-12664-00	Bare PCB
5791-10871-08	Header, Square, Flat pin

Relay Board Assembly
p/n C-11998-1

Part No.	Description
5010-09534-00	Resistor, 0Ω
5070-09054-00	Diode, 1N4004, 1.0A
5580-09555-01	Relay, DPDT, 24V, 13A
5768-12243-00	Bare PCB
5791-12273-02	Header, 2 pin Sq. .156
5791-12273-07	Header, 7 pin Sq. .156
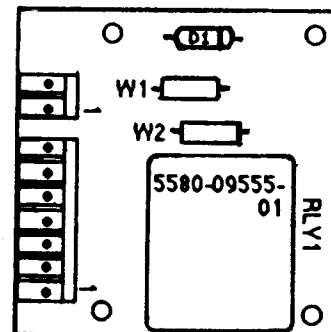
Wire Ramp
p/n 12-6913

Ramp Assembly #1
p/n R-13586

Part No.	Description
A-13806	Ball Stop Assembly
H-13713	X-Ramp Right Cable
H-13714	X-Ramp Left Cable
H-13740	Flash Lamp 1C Cable
H-13744	Flash Lamp 7C Cable
H-13745	Flash Lamp 8C Cable
01-9587-1	Switch Gate Bracket
03-8149-17	Mini Dome, Lime
03-8149-18	Mini Dome, Violet
03-8397	Ramp-1 Radical

Ramp Assembly #2
p/n C-13801

Part No.	Description
H-13712	Left Ramp Cable
H-13741	Flashlamp 2C Cable
01-9715	Ramp Flap
03-8398	Ramp-2 Radical
47-00-00003-00	F.W. .125 x .291 x .032

Ramp Assembly #3
p/n C-13802

Part No.	Description
H-13745	Flashlamp 8C Cable
03-8149-17	Mini Dome, Lime
03-8399	Ramp-3 Radical

Ramp Assembly #4
p/n C-13803

Part No.	Description
01-9716	Ramp Flap
03-8149-17	Mini Dome, Lime
03-8400	Ramp-4 Radical
C-13337	Single Flashlamp
A-13627-2	Gate Assembly
4006-01027-06	M.S. 6-32 x 3/8 P-RWH
4406-01128-00	Nut ESN 6-32
4106-01004-06	SMS 6x 1/2 P-PH
4700-00003-00	F.W. .125 x .281 x .032

Ramp Assembly #5
p/n C-13804

Part No.	Description
01-9717	Ramp Flap
03-8401	Ramp-5 Radical
4700-00003-00	F.W. .125 x .291 x .038

Backbox Parts List

Part No.	Description
A-11-957-2015	Backbox Assembly
A-12497	Upper Hinge Assembly
A-12498	Lower Hinge Assembly
A-12948	3 Lug T/S Resistor Assy
B-10686-1	Knocker Assembly
B-12437-1	Speaker Panel Assembly
5555-12068-00	4" Piezo Speaker 50W
5555-12469-00	4 Ω Round Speaker
B-12704	Speaker Grill/Logo Assy
01-8996	Grille Speaker
C-11602-1	Cap & Cable Assembly
D-11581-2015	Audio Board
D-11883-2015	System 11C CPU Board
D-12246	Power Supply
D-12247-566	Aux. Power Driver Assy
D-12313-2015	Backbox Interconnect Bd
D-13336	PCB Mounting Plate Assy
01-6645	Vent Screen
01-8397	Trunk Latch Bracket
01-9047	Stop Bracket
03-8230-3	Glass Retainer
2015-IN	Insert Assembly
C-11998-1	Relay Board
D-12502-1	Bally Right Display
D-12706	Bally Left Display
01-6655	Insert Latch
01-9295-1	Holddown Bracket
11-2015-IN	Wood Insert
20-9504-10	Display Mounting Standoff

Miscellaneous Part List

Part No.	Description
A-13204-2015	Bottom Arch Assembly
A-5610-12136	Transformer 115V/230V
A-8550-1	Pot & Bracket Assembly
A-8552-2015	Back Glass Assembly
B-10698-1	Line Voltage Cable Assy
C-10843-1	Metal Leg Assembly
C-11026	Line Filter Assembly
C-13155-1	Coin Door 2 slot USA
D-11920-16	Mech Panel Assembly
D-12615	Front Molding Assembly
01-2263-3	Gray Metal Leg
01-3493-1	Lock Bracket
01-3527	Latch Plate
01-3569-1	Ball Return Runway
01-6592	Vent Screen
01-6733	Speaker Grille
01-8169	Vent Hole Screen
03-8091	Rear Molding
08-7028-T	Playfield Glass
08-7377	Leg Adjuster 3.0"
09-17002-26	USA Coin Door
09-8803	25¢ Rejector
20-6500	Steel Ball 1-1/16"
20-6502-A	Plumb Bob
20-9592-6	Yellow Flipper
24-6549	#44 Bulb
24-8704	#89 Bulb
24-8768	#555 Bulb
24-8802	#906 Bulb

Cable List

Part No.	Description
H-10978	AC Cable
H-11834	18V Rectifier Cable
H-11835	Knocker Cable
H-12190-2015	Main Backbox Cable
H-12192-2015	Cabinet Cable
H-12196-576	Secondary Cable
H-12199	Lamp Interconnect Cable
H-12200	Switch Interconnect Cable
H-12299-2008	Logic/Power Speaker Cbl
H-12775	Speaker Panel Cable
H-12776	Main Display Cable
H-13544-2015	Switch Cable
H-13545-2015	Lamp Cable

Part No.	Description
H-13546-2015	Solenoid Cable
H-13547-2015	Insert Cable
H-13712	Left Ramp Cable
H-13713	X-Ramp Right Cable
H-13714	X-Ramp Left Cable
H-13739	Middle Man Cable
H-13740	Flashlamp 1C Cable
H-13741	Flashlamp 2C Cable
H-13742	Flashlamp 3 & 6 Cable
H-13743	Flashlamp 4C Cable
H-13744	Flashlamp 7C Cable
H-13745	Flashlamp 8C Cable

Unique Parts

Part No.	Description	Part No.	Description
A-13204-2015	Bottom Arch Assembly	11-957-2015	Wood Backbox
A-13627-1	Switch Gate Assy-Left		
A-13627-2	Switch Gate Assy-Left	12-6909-1	Switch Wireform
A-8567-2015	Coin Box Assembly	12-6906-2	Switch Wireform
		12-6909-3	Switch Wireform
B-13625	Trough Assembly	12-6913	Wire Ramp
B-13628	Switch Gate Assy-Right		
B-13629	Diverter Assembly	16-2015-1	Instruction Card
B-13630	Bracket & Post Assembly	16-2015-101	Instruction Manual
		16-2015-103	Operating Manual
C-13577	Lock Lamp Assembly		
C-13578	Radical Lamp Assembly	2015-BB	Radical Backbox
C-13749	Snake Lamp Assembly	2015-IN	Radical Insert
		2015-PL	Radical Playfield
D-11920-16	Mech Panel Assembly		
D-13757	Back Panel Assembly	31-1002-2015	Screened Playfield
		31-1006-2015	Playfield Plastics
R-13586	Ramp Assembly 1#	31-1008-2015	Screened Bottom Arch
		31-1009-2015	Screened Shooter Gauge
01-9587-1	Switch Gate Bracket	31-1357-2015	Screened Backglass
01-9652	Trough	31-1463-2015-1	Drop Target Decal
01-9653	Ball Gate Bracket	31-1463-2015-2	Drop Target Decal
01-9654-1	Left Switch Gate Bracket	31-1463-2015-3	Drop Target Decal
01-9654-2	Left Switch Gate Bracket	31-1463-2015-4	Drop Target Decal
01-9655	Diverter Bracket		
01-9675	Switch Gate Bracket		
01-9684	Ball Trough Deflector		
01-9694	Ball Gate Bracket		
02-4447	Shaft		
02-4451	Post		
02-4452	Diverter Push Rod		
03-7690-2015-1	Playfield Mylar		
03-7690-2015-2	Playfield Mylar		
03-8397	1 Radical Ramp		
03-8398	2 Radical Ramp		
03-8399	3 Radical Ramp		
03-8400	4 Radical Ramp		
03-8401	5 Radical Ramp		
03-8403	Plastic Diverter		
11-2015-IN	Wood Insert		
11-2015-PL	Wood Playfield		
11-831-2015	Wood Back Panel		
11-956-2015	Wood Cabinet		

Pinout Table for Display Glasses used on
Bally L-Display Board (D-12706)
## and R-Display Board (D-12502)
(Also applicable to Williams Master Display, D-12232-1 and D-12232-2)

| Board Pin #	Glass Pin #	Signal/ Function	Board Pin #	Glass Pin #	Signal/ Function	Board Pin #	Glass Pin #	Signal/ Function
1	1	Not connected	25	31	Strobe 11	36	61	Strobe 6
2	2	Segment A		32	cut		62	cut
3	3	Segment J	26	33	Strobe 11	37	63	Strobe 5
4	4	Segment B		34	cut		64	cut
5	5	Strobe 16		35	cut	38	65	Strobe 5
6	6	Segment K		36	cut		66	cut
7	7	Strobe 16	27	37	Strobe 10		67	cut
8	8	Segment H		38	cut		68	cut
9	9	Segment F	28	39	Strobe 10	39	69	Strobe 4
10	10	Segment M		40	cut		70	cut
11	11	Strobe 15	29	41	Strobe 9	40	71	Strobe 4
12	12	Segment C		42	cut		72	cut
13	13	Strobe 15	30	43	Strobe 9		73	cut
14	14	Not connected		44	cut		74	cut
15	15	Strobe 14		45	cut	41	75	Strobe 3
16	16	Dot		46	cut		76	cut
17	17	Strobe 14	31	47	Strobe 8	42	77	Strobe 3
18	18	Segment D		48	cut		78	cut
19	19	Strobe 13	32	49	Strobe 8	43	79	Strobe 2
20	20	Dot		50	cut	44	80	Comma
21	21	Strobe 13		51	cut	45	81	Strobe 2
22	22	Not connected		52	cut	46	82	Segment P
	23	cut	33	53	Strobe 7	47	83	Segment R
	24	cut		54	cut	48	84	Segment E
23	25	Strobe 12	34	55	Strobe 7	49	85	Strobe 1
	26	cut		56	cut	50	86	Segment N
24	27	Strobe 12	35	57	Strobe 6	51	87	Strobe 1
	28	cut		58	cut	52	88	Segment
	29	cut		59	cut	53	89	- 100V dc
	30	cut		60	cut			

S
E
C
T
I
O
N

3

Diagrams
and
Schematics
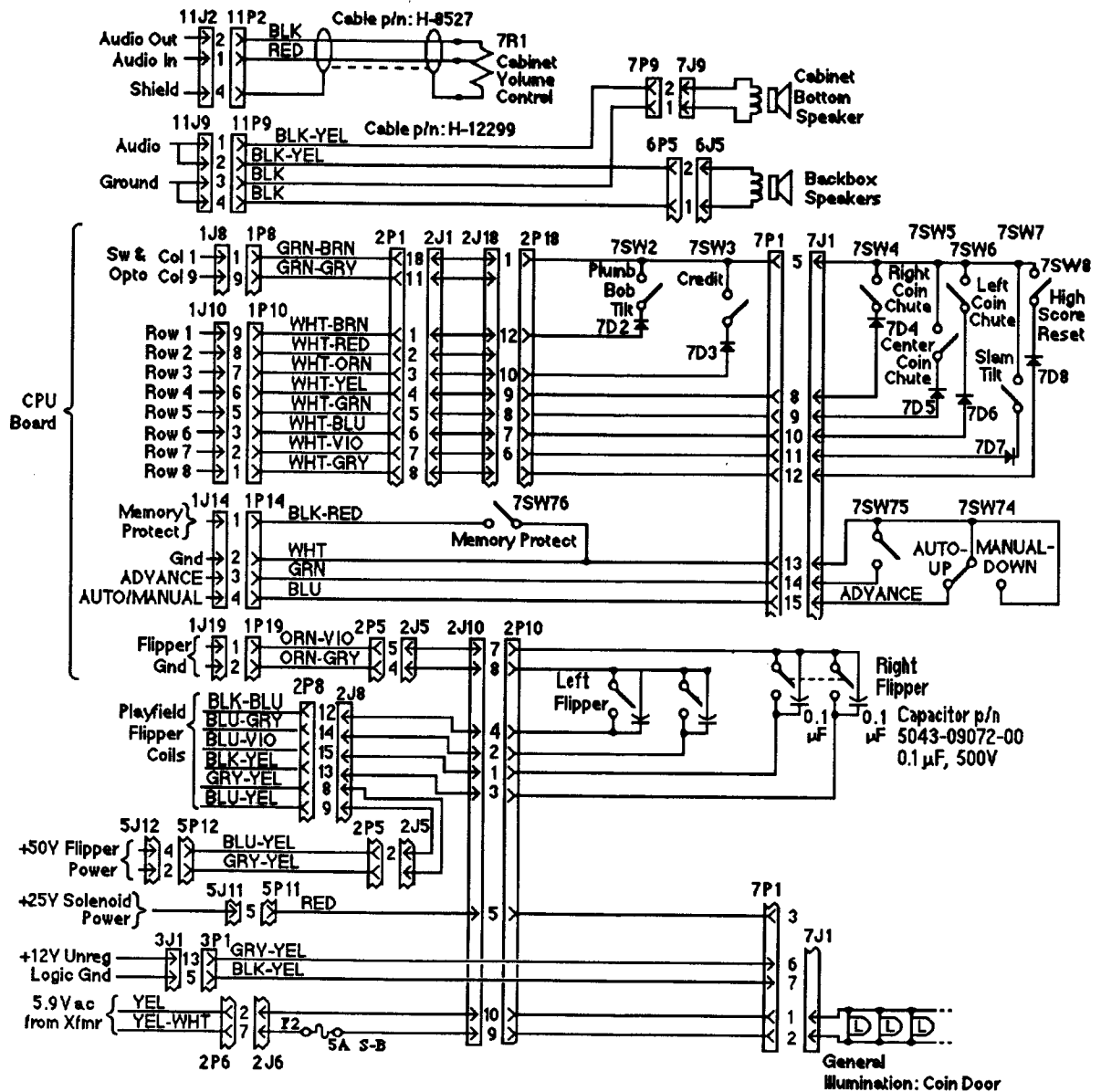
RADICAL! Cabinet Wiring

3-Bank Drop Target Opto Board
p/n C-13205-1
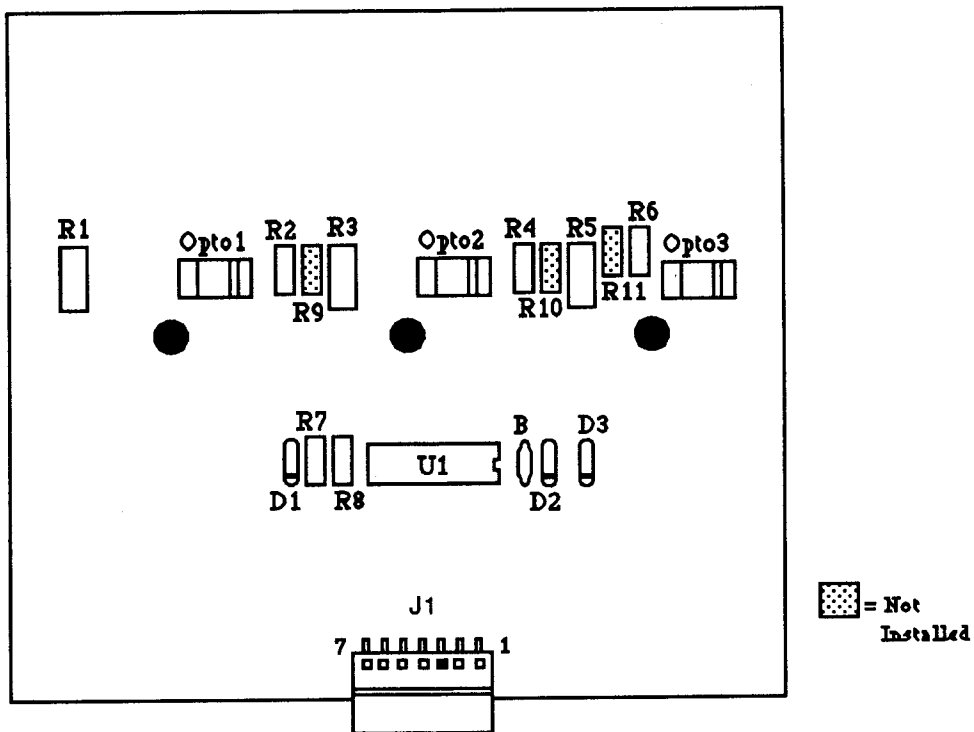
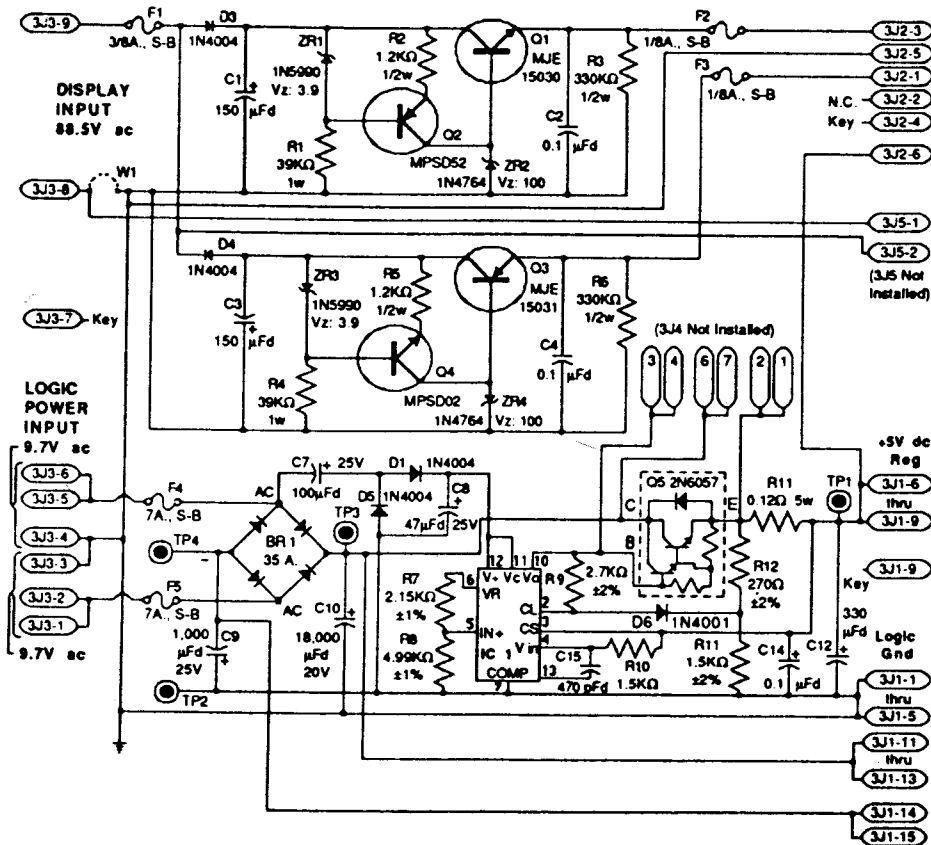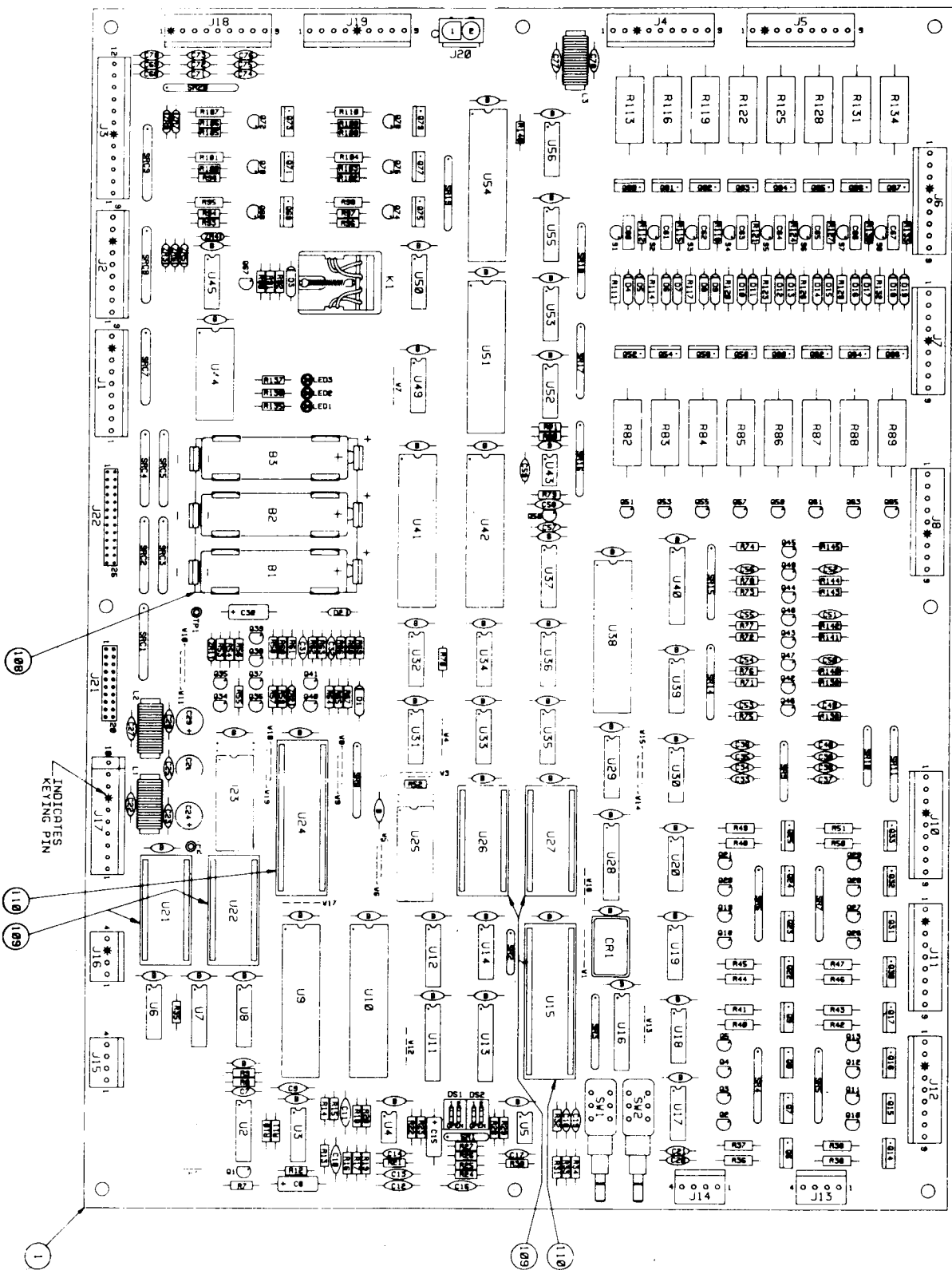**3-Bank Drop Target
Opto Board Schematic**
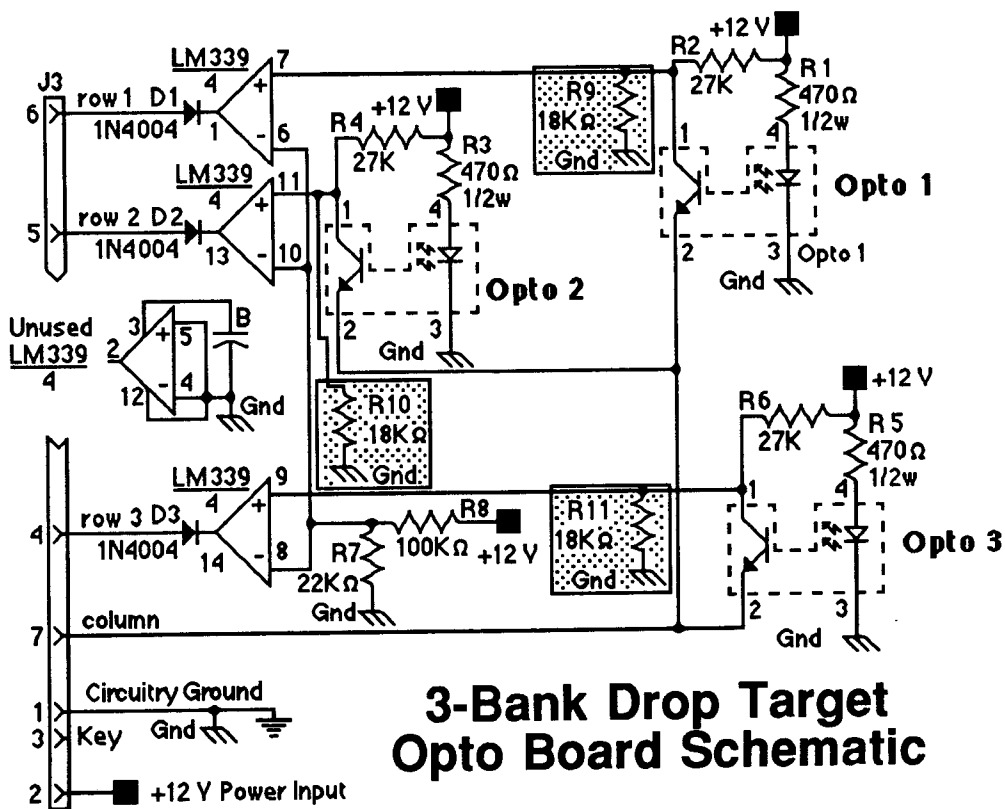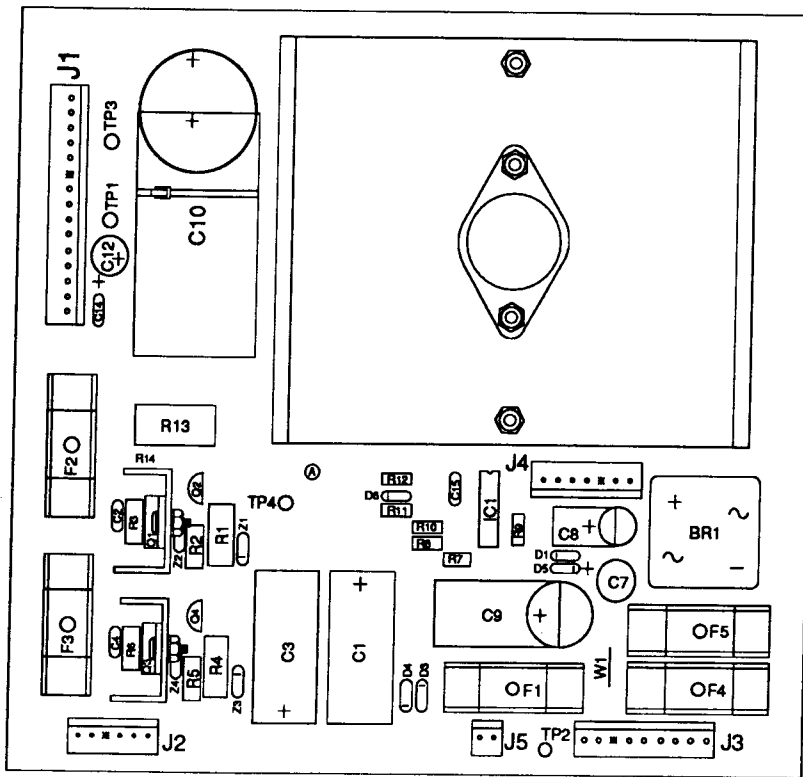
Power Supply Board
p/n D-12246

Power Supply Board Schematic

CPU Board (D-11883)

RADICAL! LAMP MATRIX

column	1 Q66 YEL-BRN 1J7-1	2 Q64 YEL-RED 1J7-2	3 Q62 YEL-ORN 1J7-3	4 Q60 YEL-BLK 1J7-4	5 Q58 YEL-GRN 1J7-6	6 Q56 YEL-BLU 1J7-7	7 Q54 YEL-VIO 1J7-8	8 Q52 YEL-GRY 1J7-9
row Q80 RED-BRN 1J6-1	Shoot Again 1	Spot Letter R 9	Word-R 17	Lock Lane S 25	Lock Bottom 33	Left Kickback 41	Bonus Multiplier 2X 49	Inset Vertical 57
Q81 RED-BLK 1J6-2	Bonus 20K 2	Spot Letter A 10	Word-A 18	Lock Lane N 26	Lock Middle 34	Loop Ramp 25K 42	Bonus Multiplier 3X 50	Insert Tail 58
Q82 RED-ORN 1J6-3	Bonus 40K 3	Spot Letter D 11	Word-D 19	Lock Lane A 27	Lock Top 35	Loop Ramp Extra Ball 43	Bonus Multiplier 4X 51	Insert Mystery 59
Q83 RED-YEL 1J6-5	Bonus 60K 4	Spot Letter I 12	Word-I 20	Lock Lane K 28	Snake Run 36	Bonus Advance 44	Bonus Multiplier 5X 52	Insert Million 6
Q84 RED-GRN 1J6-6	Bonus 80K 5	Spot Letter C 13	Word-C 21	Lock Lane E 29	Left Special 37	Bonus Value 45	Bonus 100K 53	Insert Extra Ball 61
Q85 RED-BLU 1J6-7	Bonus 100K 6	Spot Letter A 14	Word-A 22	Top Drop Tgt Right 30	Left Return 38	Jackpot Mega Million 46	Bonus 200K 54	Insert Skate 62
Q86 RED-VIO 1J6-8	Bonus 500K 7	Spot Letter L 15	Word-L 23	Top Drop Tgt Middle 31	Right Return 39	Spinner 3K 47	Bonus 300K 55	Spot Letter 63
Q87 RED-GRY 1J6-9	Bonus 1 Million 8	Top Million 16	Letter Value 24	Top Drop Tgt Left 32	Right Extra Ball 40	Tail Slider 48	Bonus 400K 56	Right Million 64

RADICAL! SWITCH MATRIX

column	1 Q45 GRN-BRN 1J8-1	2 Q49 GRN-RED 1J8-2	3 Q44 GRN-ORN 1J8-3	4 Q48 GRN-YEL 1J8-4	5 Q43 GRN-BLK 1J8-5	6 Q47 GRN-BLU 1J8-7	7 Q42 GRN-VIO 1J8-8	8 Q46 GRN-GRY 1J8-9
row WHT-BRN 1J10-9	Plumb Bob Tilt 1	Not Used 9	Top Spinner 17	Not Used 25	Not Used 33	Not Used 41	Top Sling 49	Right Flipper 57
WHT-RED 1J10-8	Not Used 2	Outhole 10	X Ramp Left 18	Not Used 26	Not Used 34	Not Used 42	Top Jet 50	Left Flipper 58
WHT-ORN 1J10-7	Start Button 3	Trough 1 Right 11	X Ramp Right 19	Middle Man 27	Not Used 35	Advance Bonus 43	Left Outlane 51	Not Used 59
WHT-YEL 1J10-6	Right Coin Slot 4	Trough 2 Left 12	Ball Diverter 20	Advance Bonus X 28	Not Used 36	Bonus Increase 44	Left Jet 52	Not Used 60
WHT-GRN 1J10-5	Center Coin 5	Not Used 13	Not Used 21	Right Spin 29	Left Loop 37	Not Used 45	Right Jet 53	Not Used 61
WHT-BLU 1J10- 6	Left Coin Slot 6	Shooter Lane 14	Bottom Drop Tgt Right 22	Top Drop Tgt Right 30	Lock Lane 38	Left Return 46	Bottom Jet 54	Not Used 62
WHT-VIO 1J10-2	Slam Tilt 7	Left Ramp 15	Bottom Drop Tgt Middle 23	Top Drop Tgt Middle 31	Left Lockup Top 39	Right Return 47	Left Sling 55	Not Used 63
WHT-GRY 1J10-1	High Score 8	Ball Popper 16	Bottom Drop Tgt Left 24	Top Drop Tgt Left 32	Left Lockup 40	Right Outlane 48	Right Sling 56	Not Used 64

WARNINGS & NOTICES

WARNING

FOR SAFETY AND RELIABILITY, substitute parts and equipment modifications are not recommended.

USE OF NON-BALLY PARTS or circuit modifications may cause injuries or equipment damage.

SUBSTITUTE PARTS OR MODIFICATIONS may void FCC Type Acceptance.

THIS GAME IS PROTECTED by Federal copyright, trademark and patent laws. Unauthorized software or hardware modifications may be illegal under Federal law.

THIS "MODIFICATION" PRINCIPLE ALSO APPLIES to unauthorized facsimiles of BALLY logos, designs, publications, and assemblies. Moreover, facsimiles of *BALLY* equipment (or any feature thereof) may be illegal under Federal law. Whether or not such facsimiles are manufactured with *BALLY* components, this rule applies.

WARNING

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

WARNING

Transport this game ONLY with hinged backbox down!

WARNING

FCC STICKER. Check the back of your gam for an FCC sticker. When *BALLY* ships a game, the game has been found to comply wi FCC Rules. The sticker is proof. If the sticke is missing, legal repercussions to the owner and distributor of the game may result. If yo game (manufactured after December 1982) has no FCC sticker, call *BALLY* for advice. O write us a note on your game-registration ca Be sure the card bears your game's serial number.

WARNING

THREE-WIRE PLUG. Prevent shock hazard and assure proper game operation! Only plu this game into a properly grounded outlet. D NOT use a "cheater" plug to defeat the power cord's ground pin. DO NOT cut off the ground pin.

RF-INTERFERENCE NOTICE

YOUR GAME'S CABLE-HARNESS PLACEMENT and ground-strap routing are very important. They are designed to keep F radiation and conduction within levels accepted by FCC Regulations.

MAINTAIN THESE LEVELS. Servicing may require that you disconnect harnesses or ground straps. When you're finished, reposition and reconnect them as they were.

NOTICE

MIDWAY and *RADICAL* are trademarks and BALLY, a trade name, of MIDWAY MANUFACTURING COMPANY. *WILLIAMS*, *MULTI-BALL* is a trademark of *WILLIAMS ELECTRONICS GAMES, INC.* Entire content: of this manual *(c)1990 MIDWAY MANUFACTURING COMPANY,* Manufacturer: *BALLY* Amusement Games. All rights reserved.

MIDWAY MANUFACTURING COMPANY
3401 N. CALIFORNIA AVENUE
CHICAGO, IL. 60618