TORPEDO ALLEY

INSTRUCTION MANUAL

DATA EAST PINBALL

750-5103-00

CPU Jumper Table

Game	*CPU Version	ROM Location	Jumpers Installed	Jumpers Removed
Laser Wars	Ver 1	5C	J1b, J3, J4, J6a, J7a, & J8	J1a, J2, J5, J6b, & J7b
	Ver 2	5C	J1b, J3, J4, J5a, J6a, J7b, & J8	J1a, J2, J5, J5b, J6b, & J7a
Secret Service	Ver 2	5B, 5C	J1b, J3, J4, J5b, J6b, J7b, & j8	J1a, J2, J5, J5a, J6a, & J7a
Torpedo Alley	Ver 2	5B, 5C	J1b, J3, J4, J5b, J6b, J7b, & J8	J1a, J2, J5, J5a, J6a, & J7a

* Version 1 has a 2K RAM and a 24-pin IC at location 5D.
* Version 2 has an 8K RAM and a 28-pin IC at location 5D.

Power-up CPU Self Tests

Upon power-up, the CPU board performs a series of self tests of major components. Turn the game on while observing the LEDS on the CPU board. Tests of the PIAs, RAM, and EPROMs are performed automatically and results of the test are indicated by the PIA LED.

With all tests passed, the LEDs illuminate in the following sequence at power turn-on. The PIA and +5V LEDs illuminate immediately. Approximately 1/2-second later the PIA LED goes out and the Blanking LED illuminates; the +5V and Blanking LEDs remain illuminated until the game is turned off. Test failures are indicated with the PIA LED:

PIA LED	SUSPECT COMPONENT
Stays On	One of the 6821 PIAs.
Flashes 1 Time	6064 RAM at location D5.
Flashes 2 Times	EPROM at location B5.
Flashes 3 Times	EPROM at location C5.

QUICK REFERENCE FUSE CHART

PPB BOARD	POWER SUPPLY BOARD
F1 5A Slo-Blo	F1 7A Slo-Blo
F2 5A Slo-Blo	F2 7A Slo-Blo
F3 5A Slo-Blo	F3 0.25A Slo-Blo
F4 5A Slo-Blo	F4 8A Slo-Blo
F5 5A Slo-Blo	F5 3A Slo-Blo
F6 3A Slo-Blo	F6 5A Slo-Blo

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DATA EAST LIMITED WARRANTY

Data East USA, Inc., ("Seller") warrants only to the initial purchaser of its products that the items listed below are free from defects in material and workmanship under normal use and service for the warranty period specified:

PRINTED CIRCUIT BOARDS (GAME LOGIC) 60 DAYS

No other parts of Seller's product are warranted.

Warranty periods are effective from the initial date of shipment from Seller to its authorized distributors.

Seller's sole liability shall be, at its option, to repair or replace products which are returned to Seller during the warranty periods specified, provided:

1. Seller is notified promptly upon discovery by purchaser that stated products are defective.

2. Such products are properly packaged and then returned freight prepaid, to Seller's plant.

This warranty does not apply to any parts damaged during shipment and/or due to improper handling, or due to improper installation or usage, or alteration. In no event shall the Seller be liable for any anticipated profits, loss of profits, loss of use, accidental or consequential damages or any other losses incurred by the customer in connection with the purchase of a Data East USA,. product.

WARRANTY DISCLAIMER

EXCEPT AS SPECIFICALLY PROVIDED IN A WRITTEN CONTRACT BETWEEN SELLER AND PURCHASER, THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

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.

GAME SPECIFICATIONS

POWER REQUIREMENTS

This game is provided with a 3-prong plug and **must be connected to a properly grounded outlet to reduce shock hazard** and insure proper game operation. Refer to AC Power Wiring Diagram for transformer connections required for normal, high, and low line conditions.

Normal Line: 109 to 129 Vac (211 to 225 Vac)
High Line: (226 to 235 Vac)
Low Line: 95 to 108 Vac (200 to 210 Vac)

MAJOR ASSEMBLY AND FUSE LOCATIONS

Refer to the Game Illustration to identify locations of the major assemblies, and fuse values and locations.

PROM SUMMARY

CPU Board: Location 5B, 5C
Sound Board: Locations 6F (Voice ROM 1), 4F (Voice ROM 2), and 7F (Sound ROM)

TRANSPORTATION

To reduce the possibility of damage, observe the following precautions whenever transporting the game. Lower the backbox and secure it to the cabinet. Remove the legs and secure the game within the transporting vehicle.

GAME ASSEMBLY PROCEDURES
(Refer to the Game Illustration)

1. Open the top of the carton and lay it on its side with the bottom of the cabinet down. Using the plastic banding strip as a handle, slide the game out of the carton.

2. Remove all packing material. Locate cabinet legs in corner packing inserts and assembly parts package in the cashbox. There should be four leg levelers, eight leg bolts, two head bolts with washers, and three pinballs.

3. Attach leg leveler from the parts package to each leg, make sure that each leveler is threaded through a hex nut before threading it into the leg.

4. Support rear of cabinet and attach rear legs using two leg bolts for each leg.

5. Support front of cabinet and attach front legs using two leg bolts for each leg.

6. Reach into the pedestal opening at the rear of the cabinet and free the power cord. Pull the cord from the cabinet and seat it in the slot provided in the pedestal.

7. While assuring that no cables are being pinched, carefully raise the backbox and temporarily secure it in its upright position with the clamp provided on the rear of the cabinet.

WARNING

Do not attempt to move the game with the backbox secured in this temporary manner. If moved, the backbox could come unclamped and suddenly fall to the lowered positions resulting in possible **injury to personnel and equipment damage.**

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Labels in illustration:

Capacitor 2C1
Bridge Rectifiers
BR1 — BR2
Lamp 13VAC 8A
Sol 25VAC 8A
Power Supply
Sound Board
CPU Board
Power Supply Fuses
See Detail A
PPB Fuses
+32V Coils 5A
PPB Board
Master Display Board
Speaker
MRB Board
Volume Control
Service Switches

Coils
Flash Lamps
Controlled Lamps
Digital Displays
7A S.B.
F1 F2
+/-12 VDC
+5 VDC
F6 F5 F4 F3
5A S.B. 3A S.B. 8A S.B. 1/4A S.B.
Power Supply Board

F5
5A
PPB Board
G.I. Fuses All 5A S.B.
F1 F2 F3 F4
F6 3A
Cabinet
Backbox Door
Playfield
Speaker Panel

DETAIL A

GAME ILLUSTRATION

8. Remove backbox keys from the clip on the inside of the coin door and unlock and carefully remove the backglass. Set the backglass aside.

9. Carefully remove the playfield glass and set it aside.

10. Obtain the two bolts and washers from the parts package and open the backbox insert board. Secure the backbox to the cabinet pedestal with the two bolts and washers.

11. Check all connectors in the backbox for loose wire terminations. Reseat any loose wires by pushing in on the terminal.

12. Push on all connectors plugged into the CPU board, Sound Board, Power Supply Boards, and (on insert board) Display board to check that they are properly seated.

13. Check that the fuses on the Power Supply board and fuse panel are are seated properly.

14. Raise the playfield and the support bar on the right side of the cabinet; support the playfield by inserting the support bar into the countersunk notch on the bottom side.

15. Check all cabinet cable connector terminations.

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16. Remove the Plumb tilt from the parts package and install on the panel on the inside left of the cabinet. Note that this game is not equipped with a ball roll tilt.

17. Lower the playfield and level the playfield side-to-side by adjusting leg levelers.

18. The playfield front-to-back incline is factory set at approximately 6 degrees. If a pitch indicating meter is not available, adjust the front and rear levelers to the lowest position for the proper pitch. Readjust side-to-side level as required.

NOTE

The playfield incline affects difficulty of play. Use the recommended incline; game difficulty is best varied using game adjustments.

19. Check the plumb tilt and adjust as required.

20. If desired, perform any self tests at this time. With the insert door closed, carefully re-install and lock the backglass.

21. Place the three pinballs on the playfield near the outhole and carefully reinstall the playfield glass.

21. If desired, make game pricing and Add-A-Ball, Novelty, or 5-Ball Play adjustments at this time.

GAME OPERATION

STANDARD FEATURES

Insert coin(s), the game says REQUEST PERMISSION TO COME ABOARD for the first credit and produces sounds for each subsequent coin and the Player 4 display indicates the number of credits posted. Depress the credit button and a start-up sound is produced, the posted credits are reduced by one, Player 1 display flashes, Player 4 display indicates BALL 1, and a ball is served to the plunger trough. Additional players may be added by depressing the Credit button before the end of ball 1.

The second closure (adjustable) of the plumb bob tilt switch tilts the ball in play. Closure of the slam tilt switch in the coin door ends the current game(s).

At the end of each ball, earned bonuses are collected. At the end of the last ball for the last player and after bonuses are collected, the system produces a random 2-digit number (a multiple of 10; 00 to 90) for a Match feature (adjustable). Matching the last two digits of a player score with this number awards a credit. Players exceeding high score levels receive free credits (adjustable) and are able to enter their initials with the new High Score achieved. The game then proceeds into the game-over mode and then to the attract mode. A custom message (adjustable) can be displayed during the attract mode.

AUTOMATIC BALL TIME AVERAGING

A ball time averager feature is provided which can make automatic adjustments affecting player appeal. This feature is provided by 'quick look' adjustment Ad 15 and is enabled as the factory setting. Periodically a check is made of the average ball time and adjustments are made to maintain approximately 65-second ball time. This check is made at the same time that highest scores are reset (expanded ADJUSTMENT Ed 36) so make sure that Ed 36 is not set to OFF. (Note that the other highest score adjustments may be disabled if desired.) Refer to Game Adjustments for additional details.

MANUAL PERCENTAGING

This game is equipped with Manual Percentage Adjustment.

As previously with our games, you can either set operator adjustments for a replay percent or you can set a fixed replay score.

If you set operator adjustments for a particular replay percent, the game will compute a recommended score. When the game coin door is opened, the displays will indicate a recommended replay score to beat, if a change is recommended. By pressing the start button, the score to beat will be changed to the recommended level. If you close the coin door or go into audit or adjustment mode, no score change will be made.

You may choose to ignore the recommended change; for example, you may not think last week's players were the usual crowd. Or you may choose to make a different score to beat adjustment; this is done by utilizing adjustment AD02.

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GAME SPECIFIC FEATURES

S-U-B Lanes — The S-U-B lanes perform three functions:

1) They advance the bonus multipliers.

2) They light the 5K spinner lamp.

3) They spot their corresponding ship targets. (S spots a green 'destroyer' target, U spots a blue 'cruiser' target, and B spots a yellow 'aircraft carrier' target.)

Sinking Ships — Once a ship is ready to sink (all three of its targets are lit) a player must hit one of the ships three targets with the pinball to sink the ship. Every time a ship is sunk, two things take place:

1) A bonus torpedo is lit in the center of the playfield.

2) A missile leading up to the top left roll-under wireform is lit.

Destroying the Fleet — Sinking one of each ship lights the destroy the fleet feature for approximately ten seconds. :If the top left roll- under wire is made within the ten seconds, three things are awarded:

1) 100K for making the feature.

2) 150K for sinking the three ships.

3) One of each of the bonus torpedoes are lit.

If the destroy fleet roll-under switch is not made within ten seconds, it can be re-qualified by sinking any one of the ships one time. If the roll-under wire is made within ten seconds, one of each of the three ships must be sunk to re-qualify the Destroy Fleet feature.

Jackpot — Sinking a ship three times (adjustable) qualifies the Jackpot feature. The Jackpot is awarded by making the right ramp and awards 100K for each lit torpedo bonus lamp. A maximum of 1,200,000 can be awarded from the jackpot.

2X Scoring Time Shot — Both Lites Time Shot flipper return lanes are flashing at the beginning of the game. Making either lane flashes the opposite top Playfield 2X lamp (top left scoring gate or top right spinner) for 10 seconds. Making the Time Shot while the lamp is still flashing awards 15 seconds of 2X playfield scoring.

Drop Target 3-Bank — Making a drop target starts a 40-second timer which, when elapsed, resets the drop targets. Completing the 5-bank advances lighting and awarding of 25K, 50K, 100K, and Extra Ball; after winning Extra Ball, the value remains at 25K.

Instant 2-Ball Play — Making the left kicker twice or making the center kicker (from the ramp shot) and then making the left kicker initiates 2-ball, multi-ball play.

Instant 3-Ball Play — Making the left kicker and then making the center kicker locks balls for 3-ball, multi-ball play. Subsequently making either the left or center kicker releases the three balls for multiball play.

Ramp — The ramp value is lit at the beginning of the game to score 20K. Making the spinner shot cycles the lit value through 20K-30K-40K- Hold Bonus-Extra Ball-Special. The flashing value is awarded when the ramp shot is made and the lit value returns to 20K.

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AUDIT FUNCTIONS

GENERAL

There are 58 audit functions provided for accounting purposes and for evaluation of game difficulty adjustments. Audit functions are split into two groups. There are eleven most-used audits (AU 01 through AU 11) in a 'quick look' group and 48 less-used audits EU 13 through EU 59) in an 'expanded' group. The various auditing functions are summarized in the **Auditing Features Table** and, when accessed, are shown on the player score displays. The *Audit Number* is shown in the Player 3 Display, the *Description* in the Player 1 and 2 Displays, and the *Audit Total* in the Player 4 Display. Access and control is provided from switches located on the inside of the coin door.

To access audit functions the game must be in the game-over mode. Open the coin door and make sure that the FORWARD/REVERSE switch is in the FORWARD (up) position. Depress the STEP switch and the game name is shown in the Player 1 and 2 displays, the Player 3 display is blank, and the PROM revision level is shown in the Player 4 display. This indicates access to audit functions.

With the FORWARD/REVERSE pushbutton switch still in the FORWARD (up) position, depressing the STEP pushbutton switch advances through the audit functions one at a time. To review lower-numbered functions, set the FORWARD/REVERSE pushbutton switch to to the REVERSE (down) position and operate the STEP pushbutton switch.

To access expanded audits, operate the step pushbutton until AU 12, EXPAND AUDITS is displayed. Set the choice to ON as indicated in the Player 4 display by depressing the Credit pushbutton and then depress the step pushbutton. The request is installed and EU 13 is displayed. When you exit audits and adjustments, the AU 12 setting is returned to off for the next time that a review of audits are required.

Audit totals may be reset to zero using Game Adjustment Ad 17, Audits Reset. Game adjustments (Ad 01 to Ad 19 and Ed 20 to Ed 60) begin after the last audit function (AU 12 or EU 58). Once audits functions have been recorded, and if no adjustments are required, you may return the game to the attract mode. If adjustments are requierd, continue pressing the STEP button unitl the game adjustments are required, continue pressing the STEP button until the game adjustments are reached. See Game Adjustments for details

'QUICK LOOK' FUNCTIONS

Total Paid Credits (AU 01) - the total number of paid credits is displayed.

Free Percent (AU 02) is Free Total (EU 14) divided by Plays Total (EU13).

Ball Time Average (in seconds) (AU 02) is Total Play Time (in minutes) (EU 20) divided by Total Balls Played (EU 21) with the result multiplied by 60.

Coins (AU 04, 05, and 06) - These three audit totals are provided to show the amount of coins registered for the left, right, and center coin chutes, respectively.

Replay Percentage (AU 07) is the Replay Total awards for exceeding replay score levels (EU 15) divided by Plays Total (EU 13).

High Score Percentage (AU 08) is High Score Total (EU 19) divided by Plays Total (EU 13).

Extra Ball Total (AU 09) is the total number of extra balls awarded.

Extra Ball Percentage (AU 10) is AU 09 divided by Balls Total (EU 21).

Cycles Burn In (AU 11) provides the number of diagnostic burn-in cycles (factory use).

Expand Audits (AU 12) permits viewing of expanded audits.

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GAME AUDITS

Audit Number (Player 3 Display)	Audit Description (Players 1 & 2 Displays; totals in Player 4 Display)
--	Torpedo Alley PROM ID
AU 01	Total Paid Credits
Au 02	Free Percent
AU 03	Ball Time Average
AU 04	Coins Left
AU 05	Coins Right
AU 06	Coins Center
AU 07	Replay Percent
AU 08	High Score Percent
AU 09	Extra Ball Total
AU 10	Extra Ball Percent
AU 11	Cycles Burn In
AU 12	Expand Audits (ON/OFF)
EU 13	Plays Total
EU 14	Free Total
EU 15	Replay Total
EU 16	Special Total
EU 17	Special Percent
EU 18	Match Total
EU 19	High Score Wins
EU 20	Play Time (Minutes)
EU 21	Balls Total
EU 22	1 Replay Awards
EU 23	2 Replay Awards
EU 24	3 Replay Awards
EU 25	4 Replay Awards
EU 26	Games 1 Player
EU 27	Games 2 Player
EU 28	Games 3 Player
EU 29	Games 4 Player
EU 30	Cycles Attract Mode
EU 31	Reset High Score
EU 32	Ramp Shots
EU 33	Extra Ball Drop
EU 34	100K Drop
EU 35	Bonus Hold
EU 36	Extra Ball Ramp
EU 37	Left Kicker Hold
EU 38	Center Kicker Hold
EU 39	Torpedo Kicker
EU 40	Destroyer Sinking
EU 41	Cruiser Sinking
EU 42	Aircraft Sinking
EU 43	Special Lit
EU 44	Jackpot Lit
EU 45	Destroy Fleet Lit
EU 46	Destroy Fleet Won
EU 47	Laser Kick Scored
EU 48	Laser Kick Relit
EU 49	Drain Left
EU 50	Drain Center
EU 51	Drain Right
EU 52	Jackpot Shots
EU 53	Right 2X Lit
EU 54	Right 2X Shot
EU 55	Left 2X Lit
EU 56	Left 2X Shot
EU 57	Right Return
EU 58	Left Return
EU 59	Buy In

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EXPANDED FUNCTIONS

Plays Total (EU 13) is the sum of Total Paid Credits (AU 01) and Free Total (EU 14). Note that free credits are not recorded in the audits until they are actually used.

Free Total (EU 14) is the total free credits for replays, high-score-to-date, specials, and match.

Replay Total (EU 15) is the total awards (credits, extra balls, or audit only) for exceeding replay score levels.

Special Total (EU 16) is the total awards (credits, extra balls, or scores) for making specials.

Special Percentage (EU 17) is Special Total (EU 16) divided by Plays Total (EU 13).

Match Total (EU 18) is the total credits awarded for matching the last two digits of the score with the system-generated Match Number at the end of the game. Percentage of match credits will be approximately 10%, if enabled.

High Score Wins (EU 19) is the total credits awarded for exceeding the high-score-to-date scores.

Play Time (EU 20) is the cumulative time of balls in play (in minutes).

Balls Total (EU 21) is the total of regular and extra balls.

Replay Awards (EU 22 through 25) provide the total awards (credit, extra ball, or audit) for replay levels 1 through 4, respectively.

Games – Player (EU 24 through 29) provide individual totals of 1- player, 2-player, 3-player, and 4-player games, respectively.

Cycles Attract Mode (EU 30) provides the number of cycles through the attract mode (factory use).

Reset High Score (EU 31) provides the number of times that the high score levels have been automatically reset (if enabled).

GAME SPECIFIC FUNCTIONS

Ramp Shots (EU 32) provides the number of times that ramp shots have been made.

Extra Ball Drop (EU 33) provides the number of extra balls awarded from the drop targets.

100K Drop (EU 34) provides the number times that 100K was awarded from from the drop targets.

Bonus Hold (EU 35) provides the number times that bonus was held over.

Extra Ball Ramp (EU 36) provides the number of extra balls awarded from the ramp shot.

Left Kicker Hold (EU 37) provides the number of times that a ball was locked in the left kicker.

Center Kicker Hold (EU 38) provides the number of times that a ball was locked in the center kicker.

Torpedo Kicker (EU 39) provides the number of times that a ball was shot into the torpedo kicker.

Destroyer Sinking (EU 40) provides the number of times a Destroyer was sunk.

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Cruiser Sinking (EU 41) provides the number of times a Cruiser was sunk.

Aircraft Sinking (EU 42) provides the number of times an Aircraft Carrier was sunk.

Special Lit (EU 43) provides the number of times the Special was lit.

Jackpot Lit (EU 44) provides the number of times the Jackpot was lit.

Destroy Fleet Lit (EU 45) provides the number of times that Destroy Fleet was lit.

Destroy Fleet Won (EU 46) provides the number of times that Destroy Fleet was won.

Laser Kick Scored (EU 47) provides the number of times that the Laser Kick has kicked the ball.

Laser Kick Relit (EU 48) provides the number of times that the Laser Kick was relit.

Drain Left (EU 49) provides the number of balls lost through the left drain.

Drain center (EU 50) provides the number of balls lost through the center drain.

Drain Right (EU 51) provides the number of balls lost through the right drain.

Jackpot Shots (EU 52) provides the number of times the Jackpot was lit.

Right 2X Lit (EU 53) provides the number of times that the upper right Playfield 2X Scoring lamp was lit.

Right 2X Shot (EU 54) provides the number of times that the upper right Playfield 2X was scored.

Left 2X Lit (EU 55) provides the number of times that the upper left Playfield 2X Scoring lamp was lit.

Left 2X Shot (EU 56) provides the number of times that the upper left Playfield 2X was scored.

Right Return (EU 57) provides the number of times the right return switch was made.

Left Return (EU 58) provides the number of times the left return switch was made.

Buy In (EU 59) provides the number of times player inserted coin(s) to retain playfield achievements for the next game.

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GAME ADJUSTMENTS

GENERAL

There are 60 adjustable functions provided to vary difficulty of play and to periodically reset audits and the high score levels. The various game adjustments are summarized in the **Game Adjustments Table** and, when accessed, are shown on the player score displays. The *Adjustment Number* is shown in the Player 3 Display, the *Description* in the Player 1 and 2 Displays, and the *Setting* in the Player 4 Display. Access and control is provided from switches located on the inside of the coin door.

Game adjustments are accessed from the audit mode. With the audits displaying game identification and the FORWARD/REVERSE switch in the REVERSE (down) position, depress the STEP switch and ED 60 (Expanded Adjustment 60) is shown in the the Player 3 display, INSTALL FACTORY is shown in the Player 1 and 2 displays, and OFF is shown in the Player 4 display. With the audits displaying AU 12 (or expanded EU 58) and the FORWARD/REVERSE switch in the FORWARD (up) position, depress the STEP switch and Ad 01 is shown in the the Player 3 display, AUTO/FIXED REPLAY is shown in the Player 1 and 2 displays, and the setting is shown in the Player 4 display.

With the FORWARD/REVERSE pushbutton switch in the FORWARD (up) position, depressing the STEP pushbutton switch advances through the game adjustments one at a time. With it in the RE-VERSE (down) position, the STEP pushbutton switch selects lower-numbered adjustments. To rapidly scroll through adjustments, hold the STEP pushbutton switch depressed. Adjustment values are changed by operating the GAME START pushbutton switch and the FORWARD/REVERSE pushbutton switch setting determines whether the values are increased or decreased. When the STEP pushbutton switch is depressed the Player 1 and 2 displays indicate REQUEST INSTALLED.

REPLAY AND GENERIC FEATURES

Replays may be adjusted either for fixed levels or for a system-adjusted manual percentage of replay awards. Four levels may be selected. Adjustments allow awarding of a credit or an extra ball as each level is exceeded. With the manual percentage feature, if the the actual replay percentage is higher or lower than that desired, the game computes new recommended manual percentage score(s). When the coin door is subsequently opened (during the attract mode) the player displays indicate the recommended level (if appropriate). This new level is entered into adjustments simply by pressing the game start button. (If the coin is closed or you enter audits/adjustments or diagnostics, the replay level is not changed.)

REPLAYS (Ad 01 through 06)

Ad 01 Manual/Fixed Replay

Manual: Adjust for percentage of awards for replay levels (1% through 50%). Proceed to Ad 02 and 03 for starting replay levels.

Fixed: Lower the automatic value below 1% and Player 1 display indicates FIXED. Proceed to Ad 02 through 05 for fixed replay levels.

Ad 02 Start Replay/Level 1 Replay

Manual: With Ad 01 set for manual, adjust the starting Replay 1 setting to between 800,000 and 9,900,000.

Fixed: With Ad 01 set for fixed, adjust Replay 1 level to between 100,000 and 9,900,000. To disable Replay 1, lower the setting to 00.

Ad 03 Levels Replay/Level 2 Replay

Manual: With Ad 01 set for manual, adjust the number of replay levels to be active (1 to 4). Any additional starting replay levels are automatically set to values higher than Replay 1. Proceed to Ad 06.

Fixed: With Ad 01 set for fixed, adjust Replay 2 level to between 100,000 and 9,900,000. To disable Replay 2, lower the setting to 00.

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GAME ADJUSTMENT TABLE

Adjustment Number (Player 3)	Description (Players 1 & 2)	Factory Setting (Player 4)
AD 01	REPLAY/MANUAL	15%
AD 02	START REPLAY/LEVEL 1 REPLAY	2,500,000
AD 03	LEVELS REPLAY/LEVEL 2 REPLAY	01
AD 04	LEVEL 3 REPLAY	- -
AD 05	LEVEL 4 REPLAY	- -
AD 06	EXEASY RULES	OFF
AD 07	EASY RULES	OFF
AD 08	FACTORY RULES	ON
AD 09	HARD RULES	OFF
AD 10	EX HARD RULES	OFF
AD 11	NOVELTY RULES	OFF
AD 12	5 BALL RULES	OFF
AD 13	ADDABAL RULES	OFF
AD 14	STANDARD/CUSTOME PRICING	USA 1
AD 15	TIME SETTING	ON
AD 16	COIN RESET	OFF
AD 17	AUDITS RESET	OFF
AD 18	RESTORE HISCR	OFF
AD 19	EXPAND ADJUSTMENTS	OFF
ED 20	AWARDS REPLAY	CREDITS
ED 21	AWARDS SPECIAL	CREDITS
ED 22	MATCH	ON
ED 23	BALLS/GAME	03
ED 24	WARNING TILT	01
ED 25	LIMIT EX BALL	03
ED 26	CREDITS LIMIT	30
ED 27	SCORES HIGHEST	ON
ED 28	CREDITS HSCR 1	03
ED 29	CREDITS HSCR 2	00
ED 30	CREDITS HSCR 3	00
ED 31	CREDITS HSCR 4	00
ED 32	HSCR 1 BACKUP	5.000,000
ED 33	HSCR 2 BACKUP	4,000,000
ED 34	HSCR 3 BACKUP	3,000,000
ED 35	HSCR 4 BACKUP	2,500,000
ED 36	HSRESET EVERY	300
ED 37	FREE PLAY	OFF
ED 38	LEFT COIN PULSES	-
ED 39	RIGHT COIN PULSES	-
ED 40	CENTER COIN PULSES	-
ED 41	PULSES FOR CREDIT	-
ED 42	PULSES FOR BONUS CREDIT	-
ED 43	MESSAGE CUSTOM	ON
ED 44	TEXT	ENGLISH
ED 45	ATTMODE MUSIC	ON
ED 46	BUYIN FEATURE	ALL
ED 47	RAMP SPOTS SUBLANE	OFF
ED 48	RAMP SPOTS TARGETS	ON
ED 49	RAMP SPOTS LASER KICK	OFF
ED 50	SUBLANE MEMORY	ON
ED 51	SPECIAL MEMORY	OFF
ED 52	TARGET MEMORY	ON
ED 53	ARROW MEMORY	ON
ED 54	LANE SPOTS	ON
ED 55	LASER KICK START	ON
ED 56	3-BANK TIME	FACTORY
ED 57	JACKPOT LAMPS	04
ED 58	KNOCKER ALARM	ON
ED 59	RETURN 2X LIT	ON
ED 60	FACTORY RESTORE	OFF

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Ad 04 Level 3 Replay (Fixed Only) - With Ad 01 set for fixed, adjust Replay 3 level to between 100,000 and 9,900,000. To disable Replay 3, lower the setting to 00.

Ad 05 Level 4 Replay (Fixed Only) - With Ad 01 set for fixed, adjust Replay 4 level to between 100,000 and 9,900,000. To disable Replay 4, lower the setting to 00.

SINGLE-FUNCTION DIFFICULTY ADJUSTMENTS (Ad 06 to 10)

Any one of these five INSTALL adjustments may be activated to automatically select settings for multiple adjustments affecting game difficulty. After activation, the individual adjustments may be readjusted if desired. Refer to **Install Adjustment Table** for details.

Ad 06 Extra Easy Rules - Set to ON or OFF.

Ad 07 Easy Rules - Set to ON or OFF.

Ad 08 Factory Rules - Set to ON or OFF.

Ad 09 Hard Rules - Set to ON or OFF.

Ad 10 Extra Hard Rules - Set to ON or OFF.

NOVELTY/5-BALL/ADD-A-BALL RULES (Ad 11, 12, 13)

One of these three INSTALL adjustments may be activated to automatically select settings for multiple adjustments. After activation, the individual adjustments may be readjusted if desired.

NOTE: When more than one of these features is required (for example, Add-A-Ball rules with 5-Ball Play) set only one of these rule features and then change additional adjustments. For the Add-A-Ball and 5-Ball Play example:

Ad 13 Add-a-ball Rules = ON	Ed 51 Special Memory = OFF
Ed 23 Balls/Game = 05	Ed 52 Target Memory = ON
Ed 47 Ramp Spots S-U-B Lanes = OFF	Ed 53 Arrow Memory = ON
Ed 48 Ramp Spots Targets = OFF	Ed 55 Laser Kick Start = ON
Ed 49 Ramp Spots Laser Kick = OFF	Ed 56 3-Bank Time = Factory
Ed 50 S-U-B Lane Memory = ON	

By setting the game up in this fashion, all specials and replay levels will award an extra ball. However, because the operator desires 5-ball play, all game play features are set to conservative.

Ad 11 Novelty Play Rules - Set to establish settings for no free play or extra balls; ON or OFF. If on the following settings are established:

Ad 01 Fixed Replay = Fixed
Ad 02 to 05 Replays 1 to 4 = OFF
Ed 20 Replay Award = Audit
Ed 21 Special Award = Score
Ed 22 Match Feature = OFF
Ed 25 Limit Extra Balls = 0
Ed 27 Highest Scores = OFF
Ed 28 to Ed 31 High Score Credits = 00

Ad 12 5-Ball Play Rules - Set to establish recommended settings for 5- ball play; ON or OFF. If ON the following settings are established:

Ad 01 Replay Manual = 7%	Ed 50 S-U-B Lane Memory = ON
Ad 02 Replay Start = 3,000,000	Ed 51 Special Memory = OFF
Ad 03 Replay Levels = 01	Ed 52 Target Memory = ON
Ed 23 Balls/Game = 05	Ed 53 Arrow Memory = ON
Ed 47 Ramp Spots S-U-B Lanes = OFF	Ed 55 Laser Kick Start = ON
Ed 48 Ramp Spots Targets = OFF	Ed 56 3-Bank Time = Factory
Ed 49 Ramp Spots Laser Kick = OFF	

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INSTALL ADJUSTMENT TABLE

Install Adjustment	Ad 06 Extra Easy	Ad 07 Easy	Ad 08 Medium	Ad 09 Hard	Ad 10 Extra Hard
Ed 47 Ramp Spots S-U-B Lane	ON	ON	OFF	OFF	OFF
Ed 48 Ramp Spots Targets	ON	ON	ON	OFF	OFF
Ed 49 Ramp Spots Laser Kick	ON	OFF	OFF	OFF	OFF
Ed 50 S-U-B Lane Memory	ON	ON	ON	ON	ON
Ed 51 Special Memory	ON	OFF	OFF	OFF	OFF
Ed 52 Target Memory	ON	ON	ON	ON	ON
Ed 53 Arrow Memory	ON	ON	ON	ON	ON
Ed 54 Lane Spots	OFF	OFF	OFF	ON	ON
Ed 55 Laser Kick Start	ON	ON	ON	ON	OFF
Ed 56 3-Bank Time	EASY	EASY	FACTORY	HARD	HARD

Ad 13 Add-A-Ball Rules - Set to disable awarding of credits, replacing replay and Special awards with an extra ball; ON or OFF. If ON the following settings are established:

    Ed 20 Awards Replay = Extra Ball
    Ed 21 Awards Special = Extra Ball
    Ed 22 Match Feature = Off
    Ed 27 Scores Highest = OFF
    Ed 28 to 31 High Score Credits = 00

GAME PRICING (Ad 14 and Ed 38 to 42)

There are two methods available for coin switch programming; Standard and Custom. Standard pricing uses a single adjustment (Ad 14) to select a pricing scheme shown in the **Standard Pricing Table**. Custom pricing is used to select additional pricing schemes defined by expanded adjustments Ed 38 to 42. In order to program Ed 38 to 42, Ad 14 must be set to CUSTOM and Ad 19 must be set to ON for expanded adjustments.

With Ad 14 set to CUSTOM and expanded adjustments selected, Ed 38, 39, and 40 represent coin switch units for the left, right, and center coin slots. Ed 41 prescribes the number of units required for one credit. For example, if Ed 38 was set to 02 and Ed 41 to 01, a coin in the left slot would produce two credits. Further, if Ed 38 was set to 01 and Ed 41 to 02, two coins in the left slot would be required for one credit.

Ed 43 may be set to post bonus credits when a minimum amount of coins are inserted at one time. For example, if Ed 38 was set to 01, Ed 41 to 01, and Ed 42 to 04, one credit would be posted for each of the first three coins in the left slot and two credits for the fourth coin.

Ad 14 Standard/Custom Pricing - Set for the desired pricing scheme from the **Standard Pricing Table** as indicated in the Player 1 and 2 Displays. For Custom Pricing, set to CUSTOM. When set to CUSTOM, Expanded adjustments Ed 38 to 42 must be set to ON.

Ed 38 Left Coin Switch Pulses - Set the number of pulses egistered for closure of the left coin switch; 00 to 99.

Ed 39 Right Coin Switch Pulses - Set the number of pulses registered for closure of the right coin switch; 00 to 99.

Ed 40 Center Coin Switch Pulses - Set the number of pulses registered for closure of the center coin switch; 00 to 99.

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STANDARD PRICING TABLE

Ad 24 Standard Pricing Select (Player) 1 2 4	Coin Mechs			Plays/Coins		
	Left	Center	Right	Left	Center	Right
USA 1 1 COIN 1 PLAY	25¢	$1.00	25¢	1 PLAY/1 COIN	4 PLAY/1 COIN	1 PLAY/1 COIN
USA 2 4 COINS 3 PLAYS	25¢	$1.00	25¢	1 PLAY/2 COIN 2 PLAY/3 COIN 3 PLAY/4 COIN	3 PLAY/1 COIN	1 PLAY/2 COIN 2 PLAY/3 COIN 3 PLAY/4 COIN
USA 3 2 COINS 1 PLAY	25¢	$1.00	25¢	1 PLAY/2 COIN	2 PLAY/1 COIN	1 PLAY/2 COIN
AUSTRIA COINAGE	5 SCH	10 SCH	10 SCH	1 PLAY/2 COIN 2 PLAY/3 COIN 3 PLAY/4 COIN	2 PLAY/1 COIN 3 PLAY/2 COIN	2 PLAY/1 COIN 3 PLAY/2 COIN
AUSTRAL COINAGE	20¢		$1.00	1 PLAY/2 COIN		3 PLAY/1 COIN
UK COINAGE	10P	50P	10P	1 PLAY/1 COIN	5 PLAY/1 COIN	1 PLAY/1 COIN
SWISS COINAGE	1 SFR		2 SFR	1 PLAY/1 COIN 3 PLAY/2 COIN		3 PLAY/1 COIN
BELGIUM COINAGE	5F	5F	20F	1 PLAY/2 COIN 2 PLAY/3 COIN 3 PLAY/4 COIN	1 PLAY/2 COIN 2 PLAY/3 COIN 3 PLAY/4 COIN	3 PLAY/1 COIN
GERMAN 1 5 DM 7 PLAYS	1 DM	2 DM	5 DM	1 PLAY/1 COIN 7 PLAY/5 COIN	2 PLAY/1 COIN 8 PLAY/3 COIN	7 PLAY/1 COIN
GERMAN 2 5 DM 9 PLAYS	1 DM	2 DM	5 DM	1 PLAY/1 COIN 3 PLAY/2 COIN 5 PLAY/3 COIN 7 PLAY/4 COIN 9 PLAY/5 COIN	3 PLAY/1 COIN 7 PLAY/2 COIN 10 PLAY/3 COIN 14 PLAY/4 COIN	9 PLAY/1 COIN
NETHLND COINAGE	1 HFI	2-5 HFI	2-5 HFI	1 PLAY/1 COIN 6 PLAY/5 COIN	3 PLAY/1 COIN	3 PLAY/1 COIN
SWEDEN COINAGE	1 KR	5 KR	2 KR	1 PLAY/3 COIN 2 PLAY/5 COIN	2 PLAY/1 COIN	2 PLAY/1 COIN
FRANCE COINAGE	1F	5F	10F	1 PLAY/3 COIN 2 PLAY/5 COIN	2 PLAY/1 COIN	4 PLAY/1 COIN
ITALY COINAGE	500L		500L	1 PLAY/1 COIN		1 PLAY/1 COIN
SPAIN COINAGE	25P		100P	1 PLAY/1 COIN		5 PLAY/1 COIN
JAPAN COINAGE		100¥			1 PLAY/1 COIN	

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CUSTOM PRICING TABLE

| Coin Mechs | | | Plays/Coins | Adjustment Numbers | | | | | | |
Left	Right	Center		14	19	38	39	40	41	42
25¢	25¢	$1	1/25¢ 3/50¢	custom	ON	01	01	04	01	02
			1/25¢ 5/$1.00	custom	ON	01	01	04	01	04
			1/25¢ 6/$1.00	custom	ON	05	05	20	04	20
5SCH	10SCH	10SCH	1/10SCH	custom	ON	01	02	02	02	00
			1/10SCH 4/30SCH	custom	ON	04	08	08	06	00
20c	$1.00	--	1/20¢	custom	ON	01	05	00	01	00
			1/60¢ 2/$1.00	custom	ON	01	05	00	03	05
10P	10P	50P	1/10P 6/50P	custom	ON	01	01	05	01	05
			1/20P 3/50P	custom	ON	01	01	05	02	05

Ed 41 Coin Switch Pulses Required for 1 Credit - Set the number of coin switch pulses required to post one credit; 00 to 99.

Ed 42 Coin Switch Pulses Required for Bonus Credit - Set the number of coin switch pulses required to award a bonus credit; 00 to 99.

ADDITIONAL GENERIC FEATURES

Ad 15 Time Setting - Maintains average ball time close to 65 seconds. Every 300 (vary with Ed 36) games, average is checked. If greater than 65 seconds, Ed 55 is set to OFF. If less than 65 seconds, Ed 55 is set to ON. Set this function to ON or OFF.

Ad 16 Coin Reset - When enabled (set to ON) all coin and paid credit totals will be reset to zero when STEP is depressed.

Ad 17 Audits Reset - When enabled (set to ON) all audit totals except for coins and paid credits will be reset to zero when STEP is depressed with FORWARD/REVERSE button in the FORWARD position.

Ad 18 Restore High Score - When enabled (set to ON) the High Score Levels and associated initials will be restored to backup settings when STEP is depressed with FORWARD/REVERSE button in the FORWARD position.

Ad 19 Expand Adjustments - When set to OFF, depressing the STEP pushbutton advances directly to Ed 60, RESTORE FACTORY. When set to ON, depressing the STEP pushbutton sequences through the expanded adjustments. When exiting from expanded adjustments, this function is reset to OFF for the next time that adjustments are required.

Ed 20 Awards Replay - Set for replays to award: CREDIT, EXTRA BALL, or AUDIT (no award but recorded in the audit totals).

Ed 21 Awards Special - Set for Special to award: CREDIT, EXTRA BALL, or SCORE LEVEL.

Ed 22 Match - Set Match ON or OFF.

Ed 23 Balls Per Game - Adjust the number of balls per game; 2 to 9.

Ed 24 Warning Tilt - Adjust the number of plumb bob tilt switch closures before the ball in play is tilted; 1 to 3 or OFF.

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Ed 25 Limit Extra Balls - Adjust for the maximum number of extra balls that may be accumulated per ball; 1 to 9 or OFF.

Ed 26 Credits Limit - Adjust the maximum number of credits that may be posted; 5 to 99.

HIGH SCORE LEVELS (Ed 27 through 36)

There are four high score levels with associated player initials that are displayed during the attract mode. This provides a high-score-to-date feature. When players exceeds these levels, the player initials may be entered to replace the previous ones. These levels may be adjusted to award credits and to be reset to backup values after a selected number of games

Ed 27 Scores Highest - Set to enable or disable the four high score levels; ON or OFF.

Ed 28 Credits High Score Level 1 - Adjust the number of credits awarded for exceeding level 1 (the highest of the four levels); 0 to 9.

Ed 29 Credits High Score Level 2 - Adjust the number of credits awarded for exceeding level 2; 0 to 9.

Ed 30 Credits High Score Level 3 - Adjust the number of credits awarded for exceeding level 3; 0 to 9.

Ed 31 Credits High Score Level 4 - Adjust the number of credits awarded for exceeding level 4; 0 to 9.

Ed 32 High Score 1 Backup - Adjust the backup score level to which level 1 (the highest of the four levels) may be reset.

Ed 33 High Score 2 Backup - Adjust the backup score level to which level 2 may be reset.

Ed 34 High Score 3 Backup - Adjust the backup score level to which level 3 may be reset.

Ed 35 High Score 4 Backup - Adjust the backup score level to which level 4 may be reset.

Ed 36 High Score Reset Every - Adjust the number of games between automatic resets of high score levels to backup settings and ball time averager adjustments; 300 to 99,000 or OFF (no reset or adjustment).

Ed 37 Free Play - When set to ON, no coins are required for games.

Ed 38 to Ed 42 - Described previously in Game Pricing.

Ed 43 Message Custom - When desired, this function is used to establish a custom message periodically displayed during the attract mode. Set the feature ON using the Credit button and depress STEP. The letter A is indicated in the first position of the Player 1 display. Vary the letter by operating the left and right flippers. With the desired letter indicated, depress the CREDIT button to lock in the letter and advance to the next display character. Repeat this procedure until the desired message is indicated in the Player 1 and 2 displays. At this time, depress the STEP pushbutton switch to advance to Ed 44.

NOTE

To lock in the custom message, the game must be returned to Game Over by depressing STEP with Ed 60 displayed.

Ed 44 English/French/German Text - Select English, French, or German for display during Audits, Adjustments, and Game Diagnostics.

Ed 45 Attract Mode Music - Set to ON (once every seven attract mode cycles), OFTEN (every attract mode cycle), or OFF.

Ed 46 Buy-In Feature - Permits player to choose to retain certain playfield achievements for the next game. Set to ALL to retain playfield lamps and locked balls, set to BALLS ONLY to retain locked balls, or set to OFF to disable the feature.

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Ed 58 Knocker Warning - When the game is first powered up, any suspect switches or coils are displayed in the Player Displays. With this feature enabled (set to ON), the credit knocker is pulsed to alert the location attendant if there are any suspect switches or coils. With this feature disabled (set to OFF), the credit knocker is not pulsed during indications of suspect switches or coils.

GAME SPECIFIC FEATUES (Ed 47 to 59)

Ed 47 Ramp Spots S-U-B Lane - Set to ON or OFF. When **ON**, each time the ramp shot is completed, one of the unlit S-U-B lane letters is lit.

Ed 48 Ramp Spots Targets - Set to ON or OFF. When **ON**, each time the ramp shot is completed, one unlit target of each color (Red, Green, and Blue) is lit on the playfield.

Ed 49 Ramp Spots Laser Kick - Set to ON or OFF. When **ON**, completing the ramp shot turns on the Laser Kick When Lit target.

Ed 50 S-U-B Lane Memory - Set to ON or OFF. When **ON**, any S-U-B letters lit at the end of a ball are relit for the next ball.

Ed 51 Special Memory - Set to ON or OFF. When **ON**, any Specials lit on the playfield at the end of a ball are relit for the next ball.

Ed 52 Target Memory - Set to ON or OFF. When **ON**, all targets lit at the end of a ball are relit for the next ball.

Ed 53 Arrow Memory - Set to ON or OFF. When **ON**, the 25K arrows lit in the left lane at the end of a ball are relit for the next ball.

Ed 54 Lane Spots - Set to ON or OFF. When **ON**, the S-U-B Lanes spot the corresponding color target each time, up to a **maximum of three times**. When **OFF**, targets are spotted an unlimited number of times.

Ed 55 Laser Kick Start - Set to ON or OFF. When **ON**, the Laser Kick feature is turned on at the start of each ball. When **OFF**, the feature is enabled for the second and subsequent balls only by making the Laser Kick When Lit target.

Ed 56 3-Bank Time - Set to EASY, FACTORY, or HARD. This adjustment increases or decreases the time on the drop target countdown timer which starts when the first target is made. The targets are reset when completed or when the timer elapses.

Ed 57 Jackpot Lamps - Set to 03 or 04. This adjustment determines how many ships of the same color (bonus lamps) must be lit to turn on the Jackpot feature.

Ed 58 Knocker Alarm - Previously described at the end of Generic Game Features.

Ed 59 Return 2X Lit - Set to ON or OFF. When **ON**, the return lanes enable the 2X spinner timer each time they are made. When **OFF**, the return lanes enable the respective spinner when made while lit. Note that in this mode, making the return lane once lites the lamp. The lit lamp alternates with slingshot switch closures.

Ed 60 Factory Restore - Depressing STEP without changing the value shown in the Player 4 display from OFF locks in any custom message set with Ed 49 and returns the game to Game Over. Set the value to ON and depress STEP to revert all game adjustments to factory settings; depress STEP a second time to return to Game Over.

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GAME DIAGNOSTICS

The Data East Pinball system provides tests for sounds, digital displays, lamps, switches, and solenoids. Each feature may be tested manually or automatically using the STEP and FORWARD/-REVERSE pushbutton switches inside the coin door and the Game Start pushbutton switch on the front of the cabinet. The automatic tests may be used for a quick verification of automatic test functions and the manual tests, for troubleshooting.

During game play, activation of switches and operation of coils with associated switches are monitored. If a switch is not made for 100 games it is considered bad. When operation of a coil should close or open a switch and does not, the coil is considered bad. Each time the game is powered up, bad switches and coils (if any) are reported; to alert the location attendant, the credit knocker is pulsed. Note that reporting of an unused switch does not constitute a problem and that a bad coil could mean that the associated switch requires adjustment.

Wiring to switches and controlled lamps uses color-coded wires that basically follows a resistor color-code scheme for the eight rows and eight columns. During the the switch tests and during the discrete lamp test, identification of the color of the row and column wires are indicated in the Player 3 Display. For example, making the right coin switch during the Switch Test results in the switch functional name (RIGHT COIN) shown in the Player 1 and 2 Displays, the row (94) and column (51) wire color codes shown in the Player 3 display, and the switch number shown in the Player 4 display. The 94 code (refer to the chart below) indicates a White wire with Yellow stripe for the row wire and the 51 code indicates a Green wire with Brown stripe.

0 = Black	5 = Green
1 = Brown	6 = Blue
2 = Red	7 = Violet
3 = Orange	8 = Grey
4 = Yellow	9 = White

ENTERING DIAGNOSTICS

With the game in the game-over mode, open the coin door and make sure that the FORWARD/-REVERSE pushbutton switch is set to REVERSE (down) and depress the STEP pushbutton switch. The Player displays will show the toll-free Customer Service number 1-800-KICKERS, that is 1-800-542-5377 (outside Illinois) and the toll number (312) 345-7700 (inside Illinois). This indicates entry into game diagnostics.

SOUND TESTS

The Data East Pinball sound system produces true digital stereo sound on left and right speakers and mono on a center speaker. During Sound tests, the Player 1 and 2 displays show the sound board circuit under test and the corresponding sounds are produced. Refer to the **Sound Test Chart** for the sound circuits displayed and the sounds produced.

The sine wave functions allow verification that all channels are functioning properly and that the speaker connections are correct. Speaker Phase Testing procedures follow for checking speaker connections.

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SOUND TEST CHART

Auto/Manual Tests (Player 1 & 2)	Sounds Produced
LEFT SINE	60 CYCLE TONE (Left Speaker Only)
CENTER SINE	60 CYCLE TONE (All Speakers)
RIGHT SINE	60 CYCLE TONE (Right Speaker Only)
VOICE ROM 1 (Loc F6)	foghorn, aaoooga, STAND BY TO TAKE HER DOWN FAST, AYE AYE
VOICE ROM 2 (Loc F4)	DIVE DIVE, PERISCOPE UP, PRESS START TO CONTINUE MISSION, WELL DONE COMMANDER
MUSIC TEST (Sound ROM Loc F7)	MUSIC

Automatic Test

With Customer Service telephone numbers displayed, depress the STEP pushbutton switch. Player 1 and 2 displays indicate SOUNDS AUTO and the system sequences through the test producing the sounds indicated in the Sound Test Chart.

Manual Test

Operate the STEP pushbutton switch during the Automatic tests until SOUNDS MANUAL is indicated in the Player 1 and 2 displays. Depressing the Game Start pushbutton switch allows you to advance through each sound function.

Speaker Phase Testing

Connections to each of the three speakers are polarized and each must be connected appropriately for the best quality sound. If one speaker has the positive and negative connections reversed with respect to the other two, bass frequencies will not be produced properly and the overall sound quality will be poor.

To test for proper speaker phasing, use the manual sound test to cycle through the Left, Center, and Right Sine functions. If the Center Sine produces more volume and bass than the Left and Right Sines, the speakers are connected properly. If it produces the same or less, one speaker is connected improperly. To isolate and correct reversed speaker connections, one of two methods may be used.

1. Check each speaker for polarity markings. If the speakers have polarity markings, verify that the single-color wire (BLK, YEL, or RED) is connected to the negative (-) terminal.

2. Disconnect the speaker output connector from the Sound Board and connect a 1.5-volt battery across each speaker pair one at time while observing the speakers. Make sure that the positive battery terminal is connected the the positive lead (CN1-pin 1, 3, or 6) each time. As the connection is made, check speaker cone movement; proper connections are indicated by outward movement.

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DIGITAL DISPLAY TEST

Digital displays are driven by digit and segment driver circuits. Digit drivers sequentially select individual character positions (Player 1 and 2 displays) and digit positions (Player 3 and 4 displays). Segment drivers (16 for Player 1 and 2 characters; 7 for Player 3 and 4 digits) select the individual segments of each position.

Automatic Test

To enter Display tests, operate the STEP pushbutton switch from the Sound Manual test. Player 1 and 2 displays indicate DISPLAY AUTO. The displays will sequence from all ZEROS to all nines in the four displays. Next all segments are lit for each digit position in sequence.

Manual Test

Operate the TEST pushbutton switch from the automatic test; Player 1 and 2 displays indicate DISPLAY MANUAL and then display ZEROS in all positions. Operate the Game Start pushbutton switch to cycle through each portion of the test.

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Switch Test

Switches are configured on an 8 x 8 matrix of columns (switch drives) and rows (switch returns) with up to 64 switches possible. The switch tests include three parts; switch test, active switches, and bad switches. Row and column wire colors are indicated in each test using corresponding resistor color code numbers.

Switch Test

From the Display Manual test, operate the STEP pushbutton switch. Player 1 and 2 displays indicate SWITCH TEST. Close each switch and observe the displays. The Player 1 and 2 displays will indicate the switch name, the Player 3 display indicates the row and column wire colors, and the Player 4 display indicates the switch number. When a switch is released, the name disappears but the switch number remains until another switch is closed or the test is exited.

Active Switches

Operate the STEP pushbutton switch from the Switch Test. Player 1 and 2 Displays indicate ACTIVE SWITCHES. If any switches are stuck closed (or made from the presence of a ball), the Player 1 and 2 displays sequence through switch names, the Player 3 display indicates the row and column wire colors, and the switch numbers are indicated in the Player 4 display. This cycle continues until all switches are cleared or until the STEP pushbutton switch is depressed.

Bad Switches

Operate the STEP pushbutton switch from the Switch Test. Player 1 and 2 Displays indicate BAD SWITCHES. During game play, the system keeps track of the last game in which each switch was made. Should a switch not be made for 100 games, it is considered to be bad. If there are any, the Player 1 and 2 displays sequence through switch names, the Player 3 display indicates the row and column wire colors, and the switch numbers are indicated in the Player 4 display. This cycle continues until the STEP pushbutton switch is depressed.

SWITCH MATRIX CHART

COLUMN (*) / ROW (*)	1 GRN-BRN (51)	2 GRN-RED (52)	3 GRN-ORN (53)	4 GRN-YEL (54)	5 GRN-BLK (50)	6 GRN-BLU (56)	7 GRN-VIO (57)	8 GRN-GRY (58)
1 WHT-BRN (91)	Plumb Tilt 1	Not Used 9	Laser Kick 17	Top Left Spinner 25	Left Yellow Target 33	Left Kicker #1 41	Left Pop Bumper 49	Not Used 57
2 WHT-RED (92)	Not Used 2	Outhole 10	Left Return 18	"S" Lane 26	Center Yellow Target 34	Left Kicker #2 42	Right Pop Bumper 50	Not Used 58
3 WHT-ORN (93)	Credit Button 3	Trough #1 11	Not Used 19	"U" Lane 27	Right Yellow Target 35	Vertical Up Kicker 43	Center Pop Bumper 51	Not Used 59
4 WHT-YEL (94)	Right Coin 4	Trough #2 12	Left Green Target 20	"B" Lane 28	Right Star RO 36	Center Kicker #1 44	Left Slingshot 52	Not Used 60
5 WHT-GRN (95)	Center Coin 5	Trough #3 13	Center Green Target 21	Left Drop Target 29	Left 50 Point Switch 37	Center Kicker #2 45	Right Slingshot 53	Not Used 61
6 WHT-BLU (96)	Left Coin 6	Shooter Lane 14	Right Green Target 22	Center Drop Target 30	Left Blue Target 38	Ramp 46	Right Outlane 54	Not Used 62
7 WHT-VIO (97)	Slam Tilt 7	Left EOS 15	Bottom Left Star RO 23	Right Drop Target 31	Center Blue Target 39	Not Used 47	Right Return Switch 55	Not Used 63
8 WHT-GRY (98)	Not Used 8	Right EOS 16	Spots Laser Kick 24	Right Spinner 32	Right Blue Target 40	Not Used 48	Right 50 Point 56	Not Used 64

(*) 2-DIGIT NUMBER IN PARENTHESES INDICATES RESISTOR COLOR CODE NUMBER DISPLAYED DURING DIAGNOSTICS.

Number	Description	Part No.
*01	Plumb Tilt	500-5023-00
02	Not Used	--
*03	Credit Button	500-5097-00
*04	Right Coin	180-5024-00
*05	Center Coin	180-5024-00
*06	Left Coin	180-5024-00
*07	Slam Tilt	180-5022-00
08	Not Used	--
09	Not Used	--
10	Outhole	180-5011-00
11	Trough :1	180-5009-00
12	Trough :2	180-5009-00
13	Trough :3	180-5010-00
14	Shooter Lane	180-5033-00
15	Left EOS	180-5026-00
16	Right EOS	180-5026-00
17	Laser Kick	180-5047-00
18	Left Return	180-5032-00
19	Not Used	--
20	Left Green Target	180-5049-04
21	Center Green Target	180-5049-04
22	Right Green Target	180-5049-04
23	Bottom Left Star Rollover	180-5003-00
24	Spots Laser Kick Target	180-5049-09
25	Top Left Spinner	180-5004-00
26	"S" Lane	180-5032-00
27	"U" Lane	180-5032-00
28	"B" Lane	180-5032-00
29	Left Drop Target	180-5042-00
30	Center Drop Target	180-5042-00
31	Right Drop Target	180-5042-00
32	Right Spinner	180-5004-00
33	Left Yellow Target	180-5049-06
34	Center Yellow Target	180-5049-06
35	Right Yellow Target	180-5049-06
36	Right Star Rollover	180-5003-00
37	Left 50 Point Switch	180-5017-00
38	Left Blue Target	180-5049-05
39	Center Blue Target	180-5049-05
40	Right Blue Target	180-5049-05
41	Left Kicker :1	180-5031-00
42	Left Kicker :2	180-5040-00
43	Vertical Up Kicker	180-5041-00
44	Center Kicker :1	180-5031-00
45	Center kicker :2	180-5040-00
46	Ramp	180-5045-00
47	Not Used	--
48	Not Used	--
49	Left Thumper Bumper	180-5035-00
50	Right Thumper Bumper	180-5035-00
51	Center Thumper Bumper	180-5035-00
52	Left Slingshot	180-5023-00
53	Right Slingshot	180-5023-00
54	Right Outlane	180-5032-00
55	Right Return	180-5032-00
56	Right 50 Point Switch	180-5017-00
57	Not Used Thru 64	

* Indicates cabinet switches.

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LAMP TESTS

Controlled lamps are configured on an 8 x 8 matrix of columns (lamp drives) and rows (lamp returns) with up to 64 lamps possible. The lamp tests include four parts, all lamps, lamp return (row), lamp drive (column), and discrete lamps. Row and column wire colors are indicated in the discrete lamp test using corresponding resistor color code numbers.

All Lamps

From the Bad Switch test, operate the STEP pushbutton switch. Player 1 and 2 displays indicate ALL LAMPS and all controlled lamps will light.

Lamp Returns

From the ALL LAMPS test, depress the STEP pushbutton switch. Player 1 and 2 displays indicate LAMP ROWS and the Player 4 display indicates 01 for row 1. All controlled lamps in row 1 should be lit. Operating the Game Start pushbutton switch cycles through each of the rows separately.

Lamp Drives

From the LAMP ROWS test, depress the STEP pushbutton switch. Player 1 and 2 displays indicate LAMP COLUMNS and the Player 4 display indicates 01 for column 1. All controlled lamps in column 1 should be lit. Operating the Game Start pushbutton switch cycles through each of the columns separately.

Discrete Lamp

From the LAMP COLUMNS test, depress the STEP pushbutton switch. Player 1 and 2 displays indicate LAMP TEST and then the name assigned to lamp 01; the Player 1 and 2 displays indicate the lamp name, the Player 3 display indicates the row and column wire colors, and the Player 4 display indicates 01. Lamp 01 should light. With the FORWARD/REVERSE pushbutton switch in the FORWARD (up) position, operating the Game Start pushbutton switch selects higher-numbered lamps; with it in the REVERSE (down) position, Game Start selects lower-numbered lamps.

LAMP MATRIX CHART

COLUMN (*) / ROW (*)	1 YEL-BRN (41)	2 YEL-RED (42)	3 YEL-ORN (43)	4 YEL-BLK (40)	5 YEL-GRN (45)	6 YEL-BLU (46)	7 YEL-VIO (47)	8 YEL-GRY (48)
1 RED-BRN (21)	Lockball #2 (2) — 1	"S" Lane — 9	Top Right Playfield 2X — 17	Ramp 20K Clear — 25	Green Arrow #1 — 33	Shield Playfield 2X — 41	Laser Kick — 49	Jackpot 100K Shield — 57
2 RED-BLK (20)	Spot Laser Kick — 2	"U" Lane — 10	5K When Lit — 18	Ramp 30K Yellow — 26	Green Arrow #2 — 34	Blue 10K — 42	Green 30K — 50	Blue 40K — 58
3 RED-ORG (23)	Destroy Fleet 100K — 3	"B" Lane — 11	Yellow Arrow #1 — 19	Ramp 40K Green — 27	Green Arrow #3 — 35	Green 10K — 43	Yellow 30K — 51	Green 40K — 59
4 RED-YEL (24)	Destroy Fleet 25K Green — 4	Extra Ball Triangle — 12	Yellow Arrow #2 — 20	Ramp Bonus Hold Orange — 28	Destroyer Hotdog — 36	Yellow 10K — 44	2X — 52	Yellow 40K — 60
5 RED-GRN (25)	Destroy Fleet 25K Blue — 5	Flagship 25K Clear — 13	Yellow Arrow #3 — 21	Ramp Extra Ball Amber — 29	Blue Arrow #1 — 37	Blue 20K — 45	3X — 53	Blue 30K — 61
6 RED-BLU (26)	Destroy Fleet 25K Yellow — 6	Flagship 50K Yellow — 14	Aircraft Carrier Hotdog — 22	Ramp Hotdog Special — 30	Blue Arrow #2 — 38	Green 20K — 46	5X — 54	Left Special — 62
7 RED-VIO (27)	Top Left Playfield 2X — 7	Flagship 100K Orange — 15	Lockball #1 (2) — 23	Periscope Left (2) — 31	Blue Arrow #3 — 39	Yellow 20K — 47	Fire Again — 55	Left Return — 63
8 RED-GRY (28)	Release Torpedoes Hotdog (2) — 8	Insert 2 Torpedo (2) — 16	Insert 1 Torpedo (2) — 24	Periscope Right (2) — 32	Cruiser Hotdog — 40	Right Return — 48	Right Outlane — 56	Release Balls — 64

(*) 2-DIGIT NUMBER IN PARENTHESES INDICATES RESISTOR COLOR CODE NUMBER DISPLAYED DURING DIAGNOSTICS.

22

Lamp Number	Description
01	Lockball :2 (2)
02	Spot Laser Kick
03	Destroy Fleet 100K
04	Destroy Fleet 25K Green
05	Destroy Fleet 25K Blue
06	Destroy Fleet 25K Yellow
07	Top Left Playfield 2X
08	Release Torpedoes Hotdog (2)
09	"S" Lane
10	"U" Lane

Lamp Number	Description
11	"B" Lane
12	Extra Ball Triangle
13	Flagship 25K Clear
14	Flagship 50K Yellow
15	Flagship 100K Orange
*16	Insert 2 Torpedo
17	Top Right Playfield 2x
18	5K When Lit
19	Yellow Arrow :1
20	Yellow Arrow :2
21	Yellow Arrow :3
22	Aircraft Carrier Hotdog
23	Lockball :1 (2)
*24	Insert 1 Torpedo (2)
25	Ramp 20K Clear
26	Ramp 30K Yellow
27	Ramp 40K Green
28	Ramp Hold Bonus Orange
29	Ramp Extra Ball Amber
30	Ramp Hotdog Special
31	Periscope Left (2)
32	Periscope Right (2)
33	Green Arrow :1
34	Green Arrow :2
35	Green Arrow :3
36	Destroyer Hotdog
37	Blue Arrow :1
38	Blue Arrow :2
39	Blue Arrow :3
40	Cruiser Hotdog
41	Shield Playfield 2X
42	Blue 10K
43	Green 10K
44	Yellow 10K
45	Blue 20K
46	Green 20K
47	Yellow 20K
48	Right Return
49	Laser Kick
50	Green 30K
51	Yellow 30K
52	2X
53	3X
54	5X
55	Fire Again
56	Right Outlane
57	Jackpot 100K Shield
58	Blue 40K
59	Green 40K
60	Yellow 40K
61	Blue 30K
62	Left Special
63	Left Return
64	Release Balls

* Indicates insert board lamps.

23
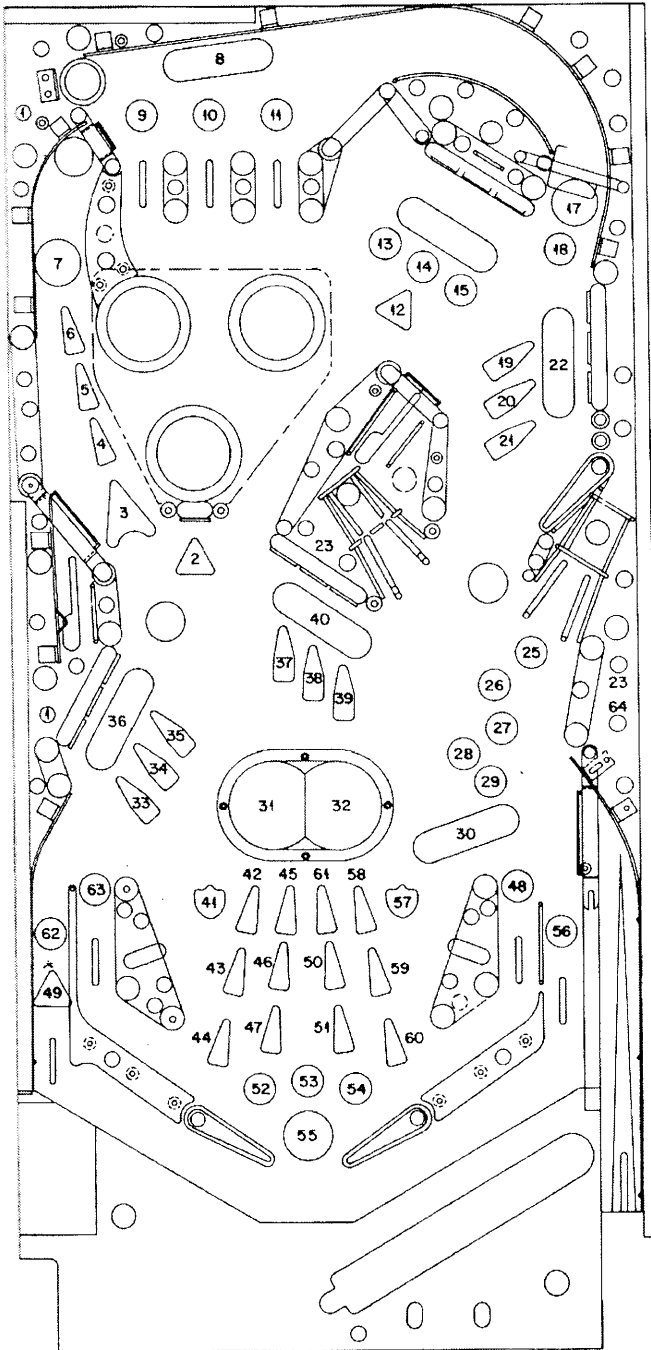
COIL TEST

Sixteen regular (pulsed under microprocessor control) and six switch-triggered coil drivers are provided to switch ground to coils. Coil number 10 is used in conjunction with drives 1 through 8 to switch +34 volts between coils or flash lamps; these sets are termed "left" and "right"'. Coil number 10 is located on the MRB board which provides isolation diodes and current limiting and heater resistors. This effectively provides 23 regular coils.

There are two coil tests for testing the regular coils; COIL TEST and SELECT COIL. The first test sequentially pulses each coil and the second pulses a selected coil repeatedly. Pop bumper and slingshot coils are switch-triggered and may be tested by closing the associated switch triggers.

Automatic Test

From the Discrete Lamps test, depress the STEP pushbutton switch. Player 1 and 2 displays indicate COIL TEST. The test the pulses each regular solenoid or flash lamp sequentially with the coil/flash lamp name indicated in the Player 1 and 2 displays and the drive number in the Player 4 display.

Select Coil

From the Coil Test, depress the STEP pushbutton switch. Player 1 and 2 displays indicate SELECT COIL and then the name of drive 1L, the drive number is indicated in the Player 4 display. Operate the Game Start pushbutton switch to select the coil or flash lamp to be tested. With the desired drive number indicated in the Player 4 display, depress the STEP pushbutton switch to cause it to be pulsed repeatedly.

RETURN TO GAME OVER

From the Select Coil test, depress the STEP pushbutton switch one time if a selected coil is pulsing or two times none is pulsing. The game returns to the game-over mode.
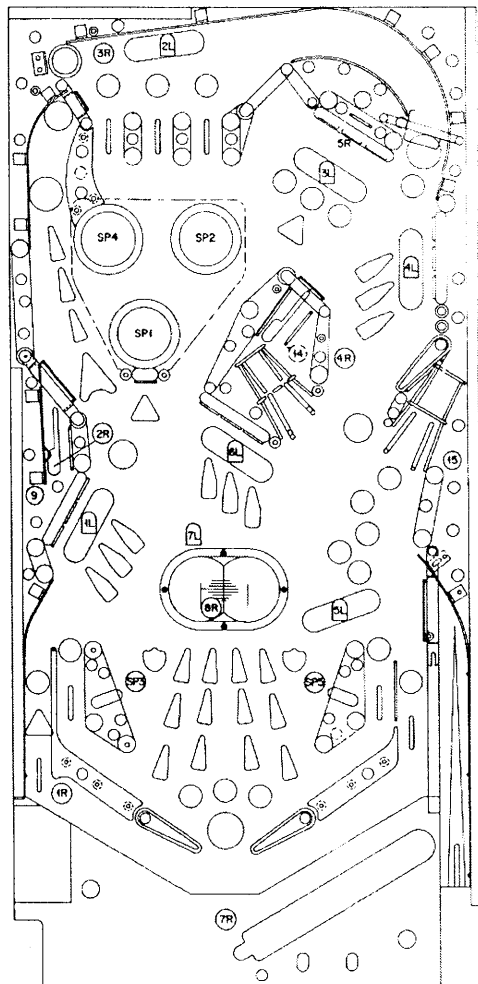
LEGEND:
(7R) = COIL
(7L) = FLASH LAMP
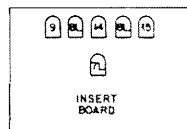
SWITCH TRIGGERED SOLENOIDS

Coil Number	Coil Description	Control Line (CPU to Coil)	Power Line (PS to Coil)	Trigger Line (Coil Sw to CPU)	Drive Transistor (TIP122)	Coil Type
SP1	Center Thumper Bumper	BLU-ORN CPU CN19-3	RED PS CN3-6	ORN-BRN CPU CN18-2	Q8	23-800
SP2	Right Thumper Bumper	BLU-RED CPU CN19-4	RED PS CN3-6	ORN-RED CPN CN18-3	Q9	23-800
SP3	Left Slingsho	BLU-YEL CPU CN19-6	RED PS CN3-6	ORN-YEL CPU CN18-4	Q10	23-800
SP4	Left Thumper Bumper	BLU-BRN CPU CN19-7	RED PS CN3-6	ORN-BRN CPU CN18-5	Q11	23-800
SP5	Right Slingshot	BLU-GRN CPU CN19-8	RED PS CN3-6	ORN-GRN CPU CN18-8	Q12	23-800
SP6	NOT USED	-- CPU CN19-9	-- PS CN3-6	-- CPU CN18-9	Q13	--

FLIPPER SOLENOIDS

Coil Description	Flipper GND (CPU to Cab)	(Cab to Coil)	Power Line (PPB to Coil)	Coil Type
Left Flipper	ORN-BLU CPU CN19-2	BLU-GRY 1M/F-24	GRY-YEL PPB J7-5	23-700/30-2600
Right Flipper	ORN-RED CPU CN19-1	BLU-VIO 1M/F-21	BLK-WHT PPB J7-1,2	23-700/30-2600
Upper Right Flipper	ORN-RED CPU CN19-1	WHT-BLK 1M/F-19	BLK-WHT PPB J7-1,2	23-700/30-2600

TORPEDO ALLEY COIL PART NUMBER CHART

QTY USED	COIL TYPE	DATA EAST PINBALL PART NUMBER
8	23-800	090-5001-00
2	24-900	090-5002-00
2	23-840	090-5005-00
1	23-1200	090-5008-00
1	30-800	090-5010-00
3	23-700/30-2600	090-5013-00

CPU CONTROLLED COIL AND FLASH LAMP CONNECTIONS
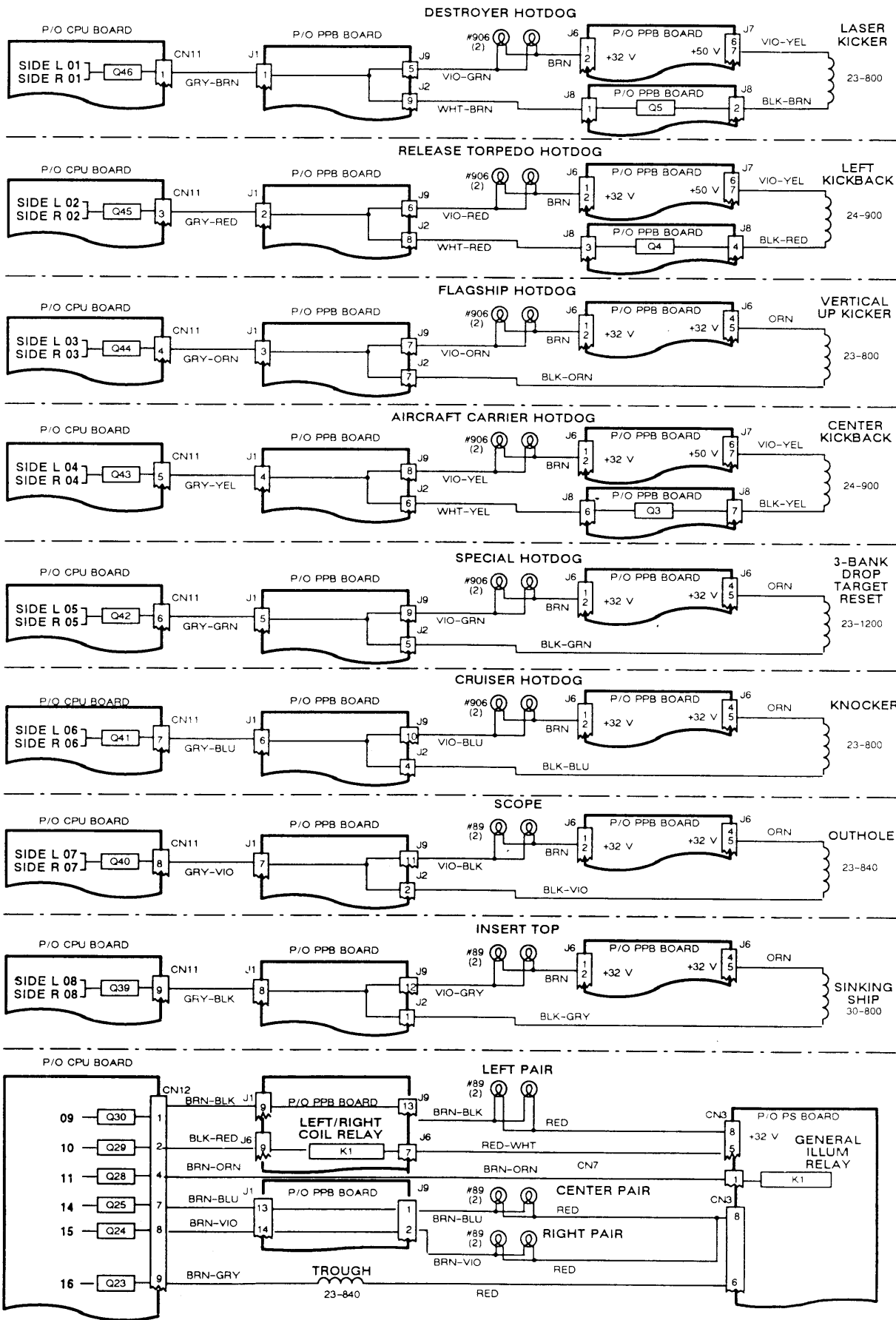
IDENTIFICATION OF COIL/FLASH LAMP NUMBERS (SHOWN BOLD IN CPU BLOCKS) PROVIDED IN PLAYER 1 AND 2 DISPLAYS.

COIL/FLASH LAMP DESCRIPTIONS (SHOWN IN BOLD) PROVIDED IN PLAYER 3 AND 4 DISPLAYS.

25 -

TO POWER SUPPLY BOARD

TO BRIDGE RECTIFIERS

TO PPB BOARD

TO POWER SUPPLY BOARD

18 VAC FOR LOGIC +8-12/ +5 VDC

90 VAC FOR DISPLAY

13 VAC FOR LAMPS

25 VAC FOR SOLENOIDS

48 VAC FOR FLIPPERS

6 VAC FOR G.I. LAMPS

CN1

9 VAC   9 VAC

2F1

8A SLO BLO

8A SLO BLO

CN4

2F2

1   2   3   4

IF/M2

3   5   4   1   2   9   10   7   6   11   12

IF/M3

1   2   3   4

GRY   GRY-WHT   GRY-GRN   WHT   WHT   BLU-WHT   BLU-WHT   WHT-RED   WHT-RED   BLK-YEL   BLK-YEL

YEL   YEL-WHT

IT1

THIS CONFIGURATION FOR 115 V

FOR LOWER LINE VOLTAGES OR 230 VOLT OPERATION SEE SAMPLES BELOW

IF/M1

1   2   6   9   3   5   4   8   7

BLK

WHT

JUMPERS FOR VOLTAGE VARIATION

100/105 VOLTS
IF1 = 8A SLO BLO
IV1 = 130V VARISTOR

IF1
1   2   6   9   3   5   4   8   7
BLK   WHT

230/218/206 VOLTS
IF1 = 4A SLO BLO
IV1 = 275V VARISTOR

IF1
1   2   6   9   3   5   4   8   7
BLK   206 V   218/230V   WHT 206/218V   WHT 230V

REMOVE PIN 9

LINE FILTER 120/240V 50/60Hz

1L1

IF1 8A SLO BLO

IV1 VARISTOR 130V

SERVICE OUTLET

BLK

GRN

WHT

LINE CORD

Cabinet Wiring Diagram

27

DISPLAY

Combined Display Connections

SOUND

CN2 NOT USED 1 2 3 4

CN1
CAB.	YEL-BRN	7	C−
	YEL-GRY	6	C+
	N.C.	5	KEY
PANEL	RED	4	L−
	RED-BLK	3	L+
	BLK	2	R−
	BLK-YEL	1	R+

CN3
CAB.	GRN	6	L SHIELD
	WHT	5	L IN
		4	L OUT
	RED	3	R SHIELD
		2	R IN
	BLK	1	R OUT

PS CN6 CN4
+12V KEY N.C. −12V GND +5V
6 5 4 3 2 1
WHT-GRY / N.C. / BLK-WHT / BLK / GRY-WHT

CPU CN25 CN5
| | E | R/W | SC2 | SS6 | SS4 | SS2 | SS0 |
| N.C. | SPARE | SPARE | RESET | SC1 | SS7 | SS5 | SS3 | SS1 | BLNK | GND |

CPU

PS CN6 CN17
BLK BLK BLK GRY GRY GRY
GND +5V KEY N.C.

SOUND CN5 / CN2(19)
| 20 | E | SPARE | SPARE | RESET | SC1 | SS7 | SS5 | SS3 | SS1 | BLNK | GND |
| | | R/W | SPARE | SC2 | SS6 | SS4 | SS2 | SS0 |

DISPLAY CN5 / CN22(26)
COMMA G E F D A DEC. R B J K M N H NC NC NC NC NC BLNK GND

DISPLAY CN1 / CN1
S8 S7 S6 S5 S4 S3 S2 KEY S1
BRN-GRY BRN-VIO BRN-BLU BRN-YEL BRN-GRN BRN-ORN BRN-RED N.C. BRN-BLK

DISPLAY CN2 / CN2
S16 S15 S14 S13 S12 S11 S10 KEY S9
VIO-GRY VIO-BLK VIO-BLU VIO-GRN VIO-YEL VIO-ORN VIO-RED N.C. VIO-BRN

DISPLAY CN3 / CN3
COMMA G F E D KEY C B CA2 CB2 BLANKING
BLU-BRN BLU-RED BLU-ORN BLU-YEL BLU-GRN BLU-BLK BLU-VIO

CN18
SPEC COIL	KEY	1	N.C.
	SW3	2	ORN-BLK
	SW2	3	ORN-RED
	SW4	4	ORN-YEL
	SW4	5	ORN-BRN
	GND	6	WHT
	N.C.	7	N.C.
	SW5	8	ORN-GRN
	SW6	9	N.C.
PLAYFIELD

CN19
FLIPPER GND	RIGHT	1	ORN-VIO
	LEFT	2	ORN-GRY
SPEC COIL DRIVE 3		3	BLU-ORN
		4	BLU-RED
	KEY	5	N.C.
	4	6	BLU-YEL
		7	BLU-BRN
	5	8	BLU-GRN
	6	9	N.C.
CABINET / PLAYFIELD

FLIPPER GND 3 / 4 N.C.

CN4
LAMP B+ +48V	1	BLU
KEY	3	N.C.
	4	BLU
	5	
LAMP B+ +48V	6	BLU
	7	
	8	BLU
	9	
PS CN4

CN5
LAMP GND	1	BLK
	2	N.C.
	3	
	4	BLK
	5	
LAMP GND	6	BLK
	7	
	8	BLK
	9	BLK
PS CN4

CN14
CABINET	BLU	4	STEP
	GRN	3	FORWARD/REVERSE
	WHT	2	GND
	BLK-RED	1	MEM LOCK

CN13
PS CN4	BLK	4	
	BLK	3	
	BLK	2	COIL GND
	BLK	1	

CN12
16 15 14 13 12 11 KEY 10 9
BRN-GRY BRN-VIO BRN-GRN BRN-ORN N.C. BLK-RED BRN-BLK
CABINET / PPB J4 / PS CN7 / PPB J4

CN4
8 7 6 5 4 3 2 KEY 1
GRY-BLK GRY-VIO GRY-BLU GRY-GRN GRY-YEL GRY-ORN N.C. GRY-BRN
COIL DRIVES 1-8 / PPB J5

CN10
1 2 3 4 5 6 7 8
WHT-BRN WHT-RED WHT-ORN WHT-YEL N.C. WHT-BLU WHT-VIO WHT-GRY
SWITCH RETURNS (ROWS) / PLAYFIELD CABINET (1M,F5)

CN8
8 7 6 5 4 3 2 KEY 1
GRN-GRY GRN-VIO GRN-BLU N.C. GRN-BLK GRN-GRN GRN-ORN GRN-RED GRN-BRN
SWITCH DRIVES (COLUMNS) / PLAYFIELD / CAB

CN7
8 7 6 5 4 3 2 KEY 1
YEL-GRY YEL-VIO YEL-BLU N.C. YEL-BLK YEL-GRN YEL-RED YEL-ORN YEL-BRN
LAMP DRIVES (COLUMNS) / PLAYFIELD

CN6
8 7 6 5 4 3 2 KEY 1
RED-GRY RED-VIO RED-BLU RED-GRN N.C. RED-BLK RED-RED RED-ORN RED-BRN
LAMP RETURNS (ROWS) / PLAYFIELD

PPB
BOARD

P S
POWER SUPPLY

Backbox Wiring Diagram

29

+50VB

VIO-YEL

1R LASER KICK
2R LEFT KICKBACK
4R CENTER KICKER
8R SINKING SHIP
7R

+32VB

ORN

ORN

BLK-BRN
BLK-RED
BLK-YEL
WHT-YEL
WHT-RED

J8 2 4 7 6 3

P/O
PPB BOARD

Q3

J4
BLK-YEL 4
BLK-YEL 5
48VAC   1
         3

F5

BR1

+ C1
100μF
250V

C2
0.1μF

R20
8.2K
5W

+50V

J3
BLK 1
BLK 2
GND BLK 3
BLK 4

+32VA

16 15 14 13 12 9 7L 8L 4L 2L 3L 4L 5L 6L

3 2 1 15 14 13 11 12 5 6 7 8 9 10 J9   1 2 3 5 8 9

N.C.

BRN-VIO
BRN-BLU
BRN-BLK
VIO-BLK
VIO-GRY
VIO-RED
VIO-BRN
VIO-ORN
VIO-YEL
VIO-GRN
VIO-BLU

N.C.

BLK-WHT
BLK-WHT
N.C.
GRY-YEL
50V
N.C.

FLIPPER
+50V

SINKING SHIP   LEFT PAIR   CENTER PAIR   RIGHT PAIR   +32VA

BRN

CRUISER HOTDOG   SPE HOT

BRN

BLU

9 14 15 7L 8L

INSERT TOP LEFT   INSERT TOP CENTER   INSERT TOP RIGHT   SUB INSERT   INSERT BOARD

7L 9 14 15

6L 5L

30   *Playfield Coil/Flash Lamp Wiring Diagram*

ORN 6R KNOCK (CABINET)

7 8 P/O 1M/F

+32VB

OUTHOLE 5R 3-BANK RESET 3R VERTICAL UP KICKER 16R TROUGH

WHT-RED WHT-BRN

BLK-GRY BLK-VIO BLK-BLU BLK-GRN WHT-YEL BLK-ORN WHT-RED WHT-BRN

3 4 J2 1 2 4 5 6 7 8 9

Q4 Q5

J1 CN11

1L 1 > GRY-BRN 1 SOL. DRIVE 1 Q46
2L 2 > GRY-RED 3 SOL. DRIVE 2 Q45
3L 3 > GRY-ORN 4 SOL. DRIVE 3 Q44
4L 4 > GRY-YEL 5 SOL. DRIVE 4 Q43
5L 5 > GRY-GRN 6 SOL. DRIVE 5 Q42
6L 6 > GRY-BLU 7 SOL. DRIVE 6 Q41
7L 7 > GRY-VIO 8 SOL. DRIVE 7 Q40
8L 8 > GRY-BLK 9 SOL. DRIVE 8 Q39

CPU BOARD

CN12

9 9 > BRN-BLK 1 SOL. DRIVE 9 Q30
BRN-RED 2 SOL. DRIVE 10 Q29
12 10 > BRN-YEL 5 SOL. DRIVE 12 Q27
13 BRN-GRN 6 SOL. DRIVE 13 Q26
14 12 > BRN-BLU 7 SOL. DRIVE 14 Q25
15 13 > BRN-VIO 8 SOL. DRIVE 15 Q24
14 > BRN-GRY 9 SOL. DRIVE 16 Q23

K1

F6 SOL. 10

16 15 > N.C.

5 8 9 6 7 J7 1 2 3 4 5 8 7 9 J6

GRY-YEL 50V N.C. VIO-YEL VIO-YEL BRN BRN BLU ORN GRN N.C. RED-WHT

+32VA +32VB

+32V FROM P.S.

+50VB

SPECIAL HOTDOG AIRCRAFT CARRIER HOTDOG FLAGSHIP HOTDOG RELEASE TORPEDO HOTDOG DESTROYER HOTDOG

5L 4L 3L 2L 1L

SP5 RIGHT SLINGSHOT   SP4 LEFT THUMPER BUMPER   SP3 LEFT SLINGS

RIGHT SLINGSHOT   LEFT THUMPER BUMPER   LEFT SLING

LEFT FLIPPER

Q10   Q8   50 52

Q8
Q10

57

CN3
RED < 6 } POWER
            SUPPLY

LEFT
SLINGSHOT   SP2   CENTER   SP1   RIGHT
                  THUMPER   THUMPER
                  BUMPER   BUMPER

CN19
BLU-ORN < 3   SW. SOL. DRIVE 1 Q8
BLU-RED < 4   SW. SOL. DRIVE 2 Q9
BLU-YEL < 6   SW. SOL. DRIVE 3 Q10   } CPU
BLU-BRN < 7   SW. SOL. DRIVE 4 Q11   BOARD
BLU-GRN < 8   SW. SOL. DRIVE 5 Q12

CN18
ORN-GRN < 8   SOL. SW. 5
ORN-BRN < 5   SOL. SW. 4
ORN-YEL < 4   SOL. SW. 3   } CPU
ORN-RED < 3   SOL. SW. 2   BOARD
ORN-BLK < 2   SOL. SW. 1

LEFT   CENTER   RIGHT
SLINGSHOT   THUMPER   THUMPER
            BUMPER   BUMPER

CN6
WHT < 14 GROUND } POWER
                     SUPPLY

J7
GRY-YEL < 5   +50V
BLK-WHT < 1 } PPB
         < 2   BOARD

RIGHT   UPPER
FLIPPER   RIGHT
               FLIPPER

1M/F
WHT-BLK < 19
BLU-VIO < 21   FLIPPER BUTTON
BLU-GRY < 24   GND CABINET

Playfield Special Coil and Flipper Wiring Diagram   31

Switch
Number   Description

*01	Plumb Tilt	16	Right EOS	31	
02	Not Used	17	Laser Kick	32	
*03	Credit Button	18	Left Return	33	
*04	Right Coin	19	Not Used	34	
*05	Center Coin	20	Left Green Target	35	
*06	Left Coin	21	Center Green Target	36	
*07	Slam Tilt	22	Right Green Target	37	
08	Not Used	23	Bottom Left Star Rollover	38	
09	Not Used	24	Spots Laser Kick Target	39	
10	Outhole	25	Top Left Spinner	40	
11	Trough :1	26	"S" Lane	41	
12	Trough :2	27	"U" Lane	42	
13	Trough :3	28	"B" Lane	43	
14	Shooter Lane	29	Left Drop Target	44	
15	Left EOS	30	Center Drop Target	45	

32   *Playfield Switch Wiring Diagram*

Right Drop Target
Right Spinner
Left Yellow Target
Center Yellow Target
Right Yellow Target
Right Star Rollover
Left 50 Point Switch
Left Blue Target
Center Blue Target
Right Blue Target
Left Kicker :1
Left Kicker :2
Vertical Up Kicker
Center Kicker :1
Center Kicker :2

46   Ramp
47   Not Used
48   Not used
50   Right Thumper Bumper
49   Left Thumper Bumper
51   Center Thumper Bumper
52   Left Slingshot
53   Right Slingshot
54   Right Outlane
55   Right Return
56   Right 50 Point Switch
57   Not Used

Thru 64

* Indicates cabinet switches.

CN8

GRN - RED	2	SWITCH DRIVE 2
GRN - ORG	3	SWITCH DRIVE 3
GRN - YEL	4	SWITCH DRIVE 4
GRN - BLK	5	SWITCH DRIVE 5
GRN - BLU	7	SWITCH DRIVE 6
GRN - VIO	8	SWITCH DRIVE 7
GRN - GRY	9	SWITCH DRIVE 8

SW 57
SW 58
SW 59
SW 60
SW 61
SW 62
SW 63
SW 64

CN 10

WHT - BRN	9	SWITCH RETURN 1
WHT - RED	8	SWITCH RETURN 2
WHT - ORN	7	SWITCH RETURN 3
WHT - YEL	6	SWITCH RETURN 4
WHT - GRN	5	SWITCH RETURN 5
WHT - BLU	3	SWITCH RETURN 6
WHT - VIO	2	SWITCH RETURN 7
WHT - GRY	1	SWITCH RETURN 8

CPU BOARD

* Indicates insert board lamps.

01	Lockball :2 (2)
02	Spot Laser Kick
03	Destroy Fleet 100K
04	Destroy Fleet 25K Green
05	Destroy Fleet 25K Blue
06	Destroy Fleet 25K Yellow
07	Top Left Playfield 2X
08	Release Torpedoes Hotdog (2)
09	"S" Lane
10	"U" Lane
11	"B" Lane
12	Extra Ball Triangle
13	Flagship 25K Clear
14	Flagship 50K Yellow
15	Flagship 100K Orange
*16	Insert 2 Torpedo

17	Top Right Playfield 2x
18	5K When Lit
19	Yellow Arrow :1
20	Yellow Arrow :2
21	Yellow Arrow :3
22	Aircraft Carrier Hotdog
23	Lockball :1 (2)
*24	Insert 1 Torpedo (2)
25	Ramp 20K Clear
26	Ramp 30K Yellow
27	Ramp 40K Green
28	Ramp Hold Bonus Orange
29	Ramp Extra Ball Amber
30	Ramp Hotdog Special
31	Periscope Left (2)
32	Periscope Right (2)

33
34
35
36
37
38
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41
42
43
44
45
46
47
48

33	Green Arrow :1
34	Green Arrow :2
35	Green Arrow :3
36	Destroyer Hotdog
37	Blue Arrow :1
38	Blue Arrow :2
39	Blue Arrow :3
40	Cruiser Hotdog
41	Shield Playfield 2X
42	Blue 10K
43	Green 10K
44	Yellow 10K
45	Blue 20K
46	Green 20K
47	Yellow 20K
48	Right Return

49	Laser Kick
50	Green 30K
51	Yellow 30K
52	2X
53	3X
54	5X
55	Fire Again
56	Right Outlane
57	Jackpot 100K Shield
58	Blue 40K
59	Green 40K
60	Yellow 40K
61	Blue 30K
62	Left Special
63	Left Return
64	Release Balls

CN7

Wire	Pin	
YEL - BRN	1	LAMP DRIVE 1
YEL - RED	2	LAMP DRIVE 2
YEL - ORN	3	LAMP DRIVE 3
YEL - BLK	4	LAMP DRIVE 4
YEL - GRN	6	LAMP DRIVE 5
YEL - BLU	7	LAMP DRIVE 6
YEL - VIO	8	LAMP DRIVE 7
YEL - GRY	9	LAMP DRIVE 8

CPU BOARD

LB57
LB58
LB59
LB60
LB61
LB62
LB63
LB64

CN6

Wire	Pin	
RED - BRN	1	LAMP RETURN 1
RED - BLK	2	LAMP RETURN 2
RED - ORN	3	LAMP RETURN 3
RED - YEL	5	LAMP RETURN 4
RED - GRN	6	LAMP RETURN 5
RED - BLU	7	LAMP RETURN 6
RED - VIO	8	LAMP RETURN 7
RED - GRY	9	LAMP RETURN 8

G.I. LAMPS

4M / F6

Pin	Wire	
1	YEL	
2	WHT - YEL	
3	VIO	
4	WHT - VIO	

TO G.I. FUSES

Playfield Lamp Wiring Diagram   33

520-5003-02
MADE IN USA

GND +5V LOGIC POWER
CN17

SOUND DRIVE
CN21

SOUND
6 PIA
6821

ALP
SEG
CO

BATTERIES

B1

B2

B3

CMOS RAM -B+
B+
D25 D23
A

C102 C103
C157
L2

E CLK

POWER ON RESET

R65
C130
R64
C1

BLANKING GENE-RATOR

R4

HALT RESET
X1

CPU 8 CLOCK

R110

B 2764-27128
C101

PROMS
C100
27128-27512

LS244

ADDRESS DRIVERS
LS244

LS20

ADDRESS

LS00

BLANKING

C87

R3

C86

6808
C95

D CMOS RAM
6264L
C99

C85

E DATA-BUS TRANSCEIVER
LS245
C98
C94

RA4

LS08

C60

RA5

CMOS RAM WRITE PROTECT
LS10

C83

C82

RA30

a
b J1

F

R106
C
Q47 R10

MISC
7404

C108

C159

C84

LS02

DIAG/ MEMORY PROTECT
R82

LS107
CLOCK DIVIDER
C91 C93

COIL 9-16 68PIA

SW1

NMI SWITCH

R5
R6

H COIL 1-8 DATA LATCH
LS273
C97

C105

SWITCH PIA
6821
C110

DIAG/ CMOS SWITCH
CN14

COILS 9-16 DRIVE

7408
C90

7408
C92

7408
C96

7408
C104

J

4011

4011
C109

SWITCH DRIVE (COLUMN

COIL GND
CN13

RA9

R66 R67 R68 R69 R70 R71 R72 R73

RA25

R74 R75 R76 R77 R78 R79 R80 R81

RA26

COILS 1-8 DRIVE
R10

SWITCH RETURN (ROWS)

D26 C58 D27 C59 D28 C60 D29 C61 D30 C62 D31 C63 D32 C64 D33 C65

1 2 3 4 5 6 7 8

R116 R117 R118 R119 R120 R121 R122 R123

RA16

R101 R77 R100 C76 R99 R75 R98 C74

(8)(7)(6)(5)

Q48 Q49 Q50 Q51

RA6

Q16 Q17 Q18 Q19 Q20 Q21 Q22
24 25 26 27 28 29 30

Q31 Q33 Q34 Q35 Q36 Q37 Q38
40 41 42 43 44 45 46

Q39

16 15 14 13 12 11 10 9

8 7 6 5 4 3 2 1

CN12

COILS 9-16 DRIVE

COILS 1-8 DRIVE

CN11

SWITCH RET (ROWS)

CN10

GND

CN8

SWI
(C

CPU Board Assembly Drawing

ALPHANUMERIC SEGMENT DRIVE

DIGIT STROBE S1 – S9

DIGIT STROBE S9 – S16

7-SEGMENT DRIVE

CN22 C16 C24 C32 CN

C23 RA22 C31 RA23 C39

CN2

DISPLAY STROBE OUTPUT

RA1 RA2

CN3

7-SEGMENT OUTPUT

RA3

C156 C155 C154

CN18

SPEC COIL SWITCH INPUT

ALPHANUMERIC SEGMENT/SOUND 8 9 CONTROL PIA

6821

J8

DISPLAY STROBE DECODER 74154

10

11

C129

SPECIAL COIL SWITCH INPUT

12

7402

D1 C41 D2 C42 D3 C43 D4 C44 D5 C45 D6

1 2 3 4 5 6

SPEC COIL SWITCH INPUT

DISPLAY STROBE 7-SEGMENT PIA

6821

R13 R14 R15 R16 R17 R18

SPECIAL COIL DRIVE

R19 R20 R21 R22 R23 R24 R25 R26 R27 R28 R29 R30

Q2 Q3 Q9 Q4 Q10 Q5 Q11 Q6 Q12 Q7 Q13

B Q8 E

1 2 3 4 5 6

B Q13 E

CN9

SPEC COIL DRIVES FLIPPER GND

ESS DECODER LS135

LS126

C120

R11 R12

C161

J5b J6b

LS138

C119

J3 J2 J4 J5

C118

LS139

LS32

C160

C122

R114 R115

C126

LAMP PIA 6821

BLANK +5V

DIAG LEDS

R111 R112 R113

C46 C47

FLIPPER GROUND RELAY

Q80

R107 R108 D24

CN20

FLIPPER 3,4 GND

4020

J7 a b

C159

LS08 LS08

LAMP DRIVE

C121

7406 7406

LAMP RETURN

C124 C125

C48

LAMP B+ FILTER

C127

RA7 RA8

RB1 RB2

C49

CN4

LAMP B+ (+18V)

PIA 6821

C116

Q56 Q57

LAMP DRIVE (COLUMNS)

R31 R32

8 7

Q64 Q65

D39 D7 D8 D40 D9 D10

Q81 C50 R47 Q82 R48

LAMP RETURN (ROWS)

B Q72 E B Q73 E

R55 R56

1 2

SWITCH DRIVE (COLUMNS)

C244 C115

Q58 Q59

R33 R34

6 5

Q66 Q67

D41 D11 D12 D42 D13 D14

Q83 C52 R49 Q84 C53 R50

B Q74 E B Q75 E

R57 R58

3 4

R105 C81 R104 C80 R103 C79 R102 C78 R101 C77 R100 C76 R99 C75

Q60 Q61

R35 R36

4 3

Q68 Q69

D43 D15 D16 D44 D17 D18

Q85 C54 R51 Q86 C55 R52

B Q76 E B Q77 E

R59 R60

5 6

CN5

LAMP GND

(7)(6)(5)(4)(3)(2)(1)

Q50 Q51 Q52 Q53 Q54 Q55

Q62 Q63

R37 R38

2 1

Q70 Q71

D45 D19 D20 D46 D21 D22

Q87 C56 R53 Q88 C57 R54

B Q78 E B Q79 E

R61 R62

7 8

RA6

CN8

CN7

CN6

CPU Board Logic Diagram (Sheet 2 of 4)
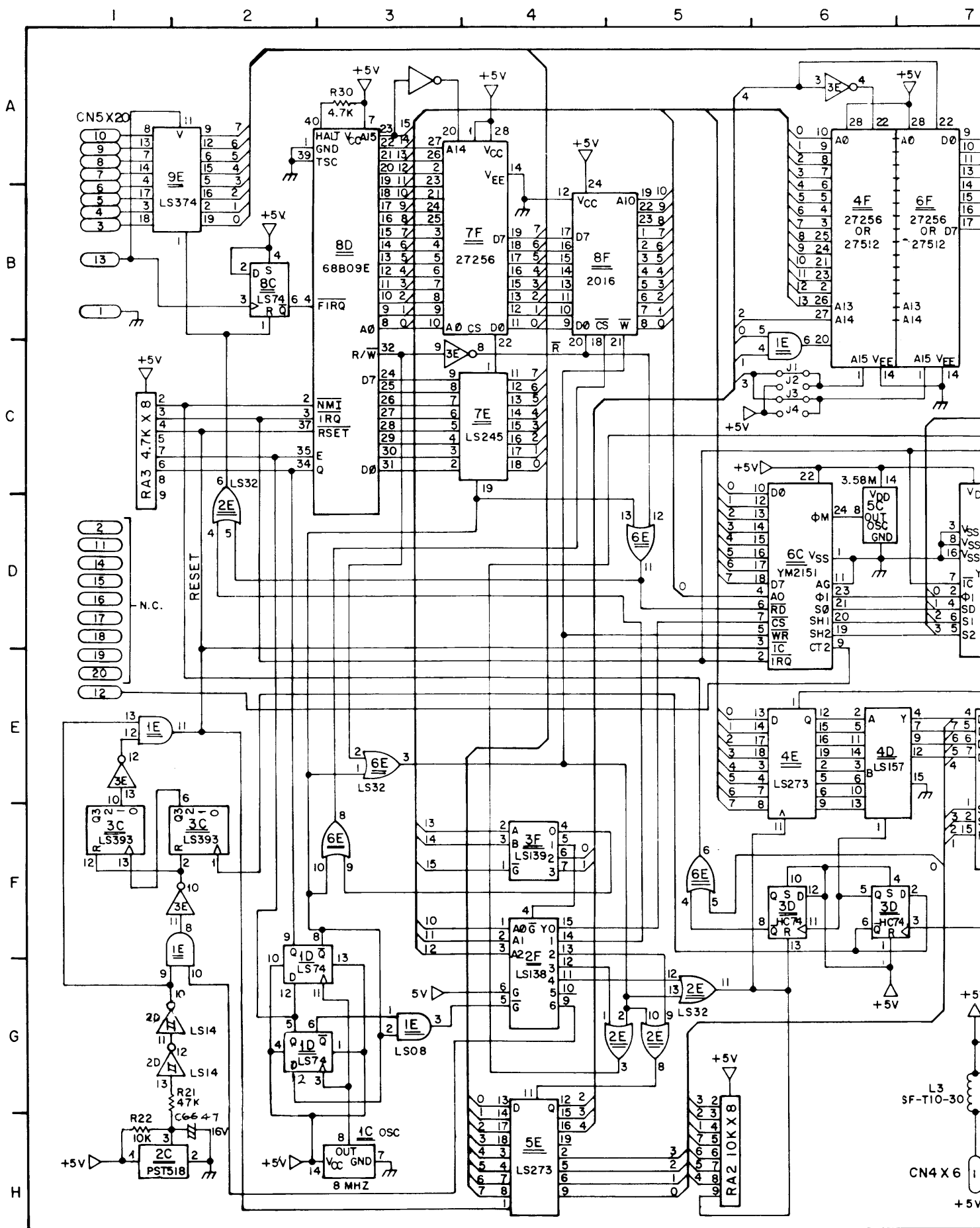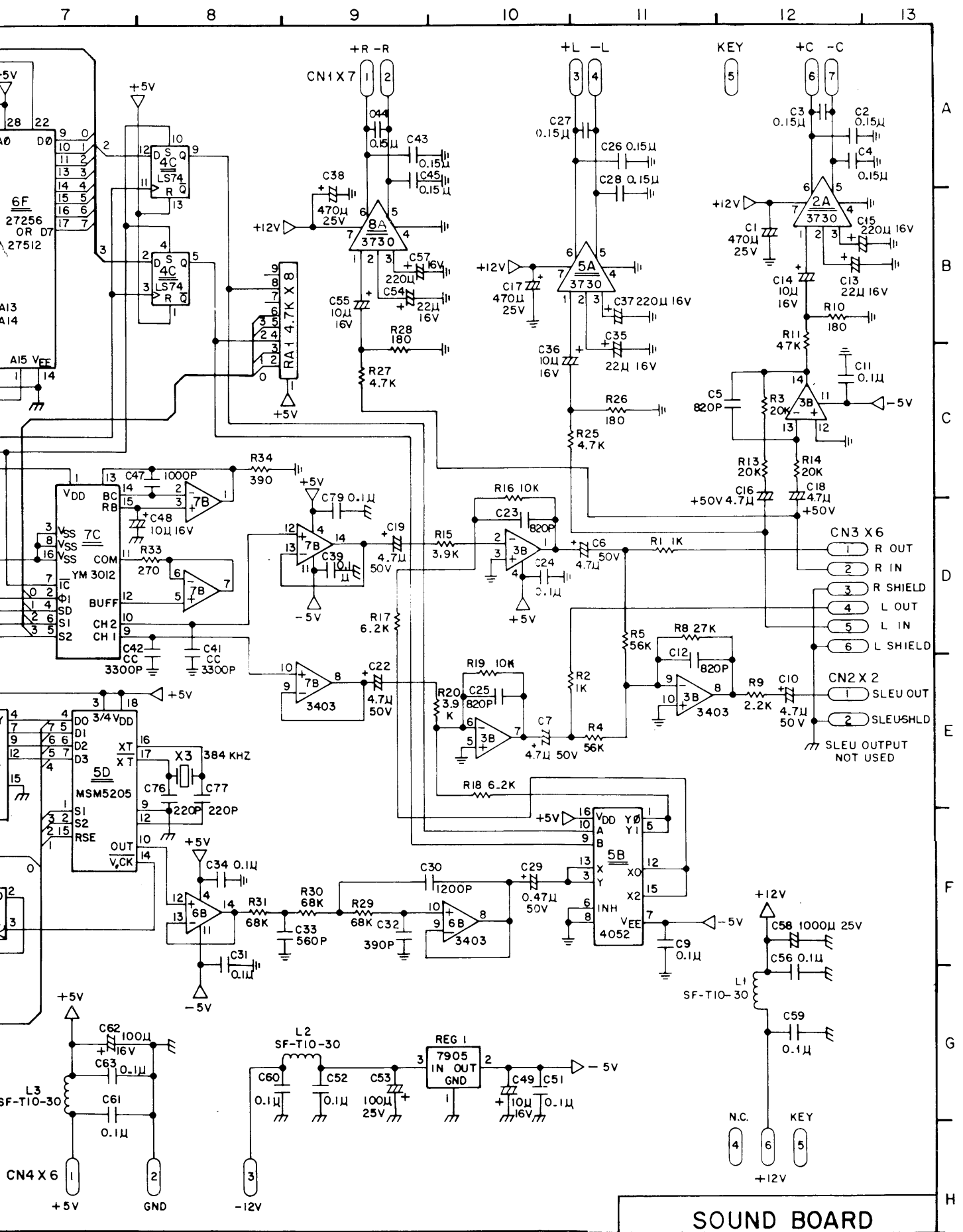
CPU BOARD SHT 2 OF 4

LAMP MATRIX CONT. 0~7

LAMP CNT (4-8A)

+5

R81
68Ω/2W

Q31~Q38 2N4403

SOL. DRV. 9   CN12 1

Q38 9

Q46

SOL. DRV. 1   CN11 1

R80
68Ω 1/2W

TIP122

SOL. DRV. 10   CN12 2

Q37 8

Q45

SOL. DRV. 2   CN11 3

R79
68Ω 1/2W

TIP122

SOL. DRV. 11   CN12 4

Q36 7

Q44

SOL. DRV. 3   CN11 4

R78
68Ω 1/2W

TIP122

SOL. DRV. 12   CN12 5

Q35 6

Q43

SOL. DRV. 4   CN11 5

R77
68Ω 1/2W

TIP122

SOL. DRV. 13   CN12 6

Q34 5

Q42

SOL. DRV. 5   CN11 6

R76
68Ω 1/2W

TIP122

SOL. DRV. 14   CN12 7

Q33 4

Q41

SOL. DRV. 6   CN11 7

R75
68Ω 1/2W

TIP122

SOL. DRV. 15   CN12 8

Q32 3

Q40

SOL. DRV. 7   CN11 8

R74
68Ω 1/2W

TIP122

SOL. DRV. 16   CN12 9

Q31 2

Q39

SOL. DRV. 8   CN11 9

TIP122

RA26 2.7K×8

SOLNOID GND

LAMP (4-8G)

+5
10F LS08
+5
12A 7482
+5

R19 560Ω   R13 68Ω 1/2W   Q2

2N4401

Q8
TIP122

SWITCHED SOL. DRV. 1   CN19 3

R21 560Ω   R14 68Ω 1/2W   Q3
27K R20

2N4401

Q9
TIP122

SWITCHED SOL. DRV. 2   CN19 4

R23 560Ω   R15 68Ω 1/2W   Q4
27K R22

2N4401

Q10
TIP122

SWITCHED SOL. DRV. 3   CN19 6

R25 560Ω   R16 68Ω 1/2W   Q5
27K R24

2N4401

Q11
TIP122

SWITCHED SOL. DRV. 4   CN19 7

R27 560Ω   R17 68Ω 1/2W   Q6
27K R26

2N4401

Q12
TIP122

SWITCHED SOL. DRV. 5   CN19 8

R29 560Ω   R18 68Ω 1/2W   Q7
27K R28

2N4401

Q13
TIP122

SWITCHED SOL. DRV.   CN19 9

SOL. GND (4-6E)

R30

RA7 4.7K×8
RA14 4.7K×8

10F LS08
10F LS08
10F LS08
9F LS08
9F LS08
9F LS08
9F LS08

SOLNOID SW

12A 7482
12A 7482
12A 7482
12B 7482
12B 7482

CPU BOARD 3 OF 4

CPU Board Logic Diagram (Sheet 3 of 4)   37

CPU Board Logic Diagram (Sheet 4 of 4)

A

D7~D22 1N4002

R39
1.2K 1/2W
2N5068　Q81
RB1
8　　7
6.8K
D8

CN6
1
LAMP RET. 1

Q22
TIP122
R47　　R55
1K　.4Ω 3W
1μ　C50

B

R40
1.2K 1/2W
2N5068　Q82
RB1
6　　5
6.8K
D10

CN6
2
LAMP RET. 2

Q73
TIP122
R48　　R56
1K　.4Ω 3W
1μ　C51

R41
1.2K 1/2W
2N5068　Q83
RB1
4　　3
6.8Ω
D12

CN6
3
LAMP RET. 3

Q24
TIP122
R49　　R57
1K　.4Ω 3W
1μ　C52

C

R42
1.2K 1/2W
2N5068　Q84
RB1
6.8K
D14

CN6
5
LAMP RET. 4

Q75
TIP122
R50　　R58
1K　.4Ω 3W
1μ　C53

D

R43
1.2K 1/2W
2N5068　Q85
RB2
D16

CN6
6
LAMP RET. 5

Q26
TIP122
R59
1K　.4Ω 3W
C54

R44
1.1K 1/2W
2N5068　Q86
RB2
6
6.8K
D18

CN6
7
LAMP RET. 6

Q77
TIP122
R57　　R60
1K　.4Ω 3W
1μ　C55

E

R45
1.2K 1/2W
2N5068
RB2
4
6.8K
D18

CN6
8
LAMP RET. 7

TIP122
R21
1Ω
1K　C56

F

R46
1.2K 1/2W
2N5068　Q88
RB2
2
6.8K
D22

CN6
9
LAMP RET. 8

Q72
TIP122
R54　　R62
1K　.4Ω 3W
1μ

G

LAMP DRV. 1
CN7 1
Q71 TIP42
R63
R25
2N6427
R8-3　2.2K

LAMP DRV. 2
CN7 2
2N6427
R62
R8　TIP42

LAMP DRV. 3
CN7 3
2N6427
R61
R8-4　2.2K

LAMP DRV. 4
CN7 4
2N6427
R60
R65
TIP42
RA8-6　2.2K

LAMP DRV. 5
CN7 5
2N6427
Q59
R34
Q67 TIP42
RA8-7　2.2K

LAMP DRV. 6
CN7 7
2N6427
Q58
RA8-8　TIP42

LAMP DRV. 7
CN7 8
2N6427
Q57
R32
Q65 TIP42
R8-9　2.2K

LAMP DRV. 8
CN7 9
2N6427
Q56
R31
Q64 TIP42

R31~R38 27Ω 3W

CPU BOARD SHT 4 OF 4

H

TR5   B E C B

TP3 +12V UNREG   TP4 −12V UNREG

5V TP1   GROUND TP2

CN9   IN   3   2   4

RY1

CN8   OUT

D1

+5V ±12V UNREG.

7A SB   F1

7A SB   F2

GEN. ILLUM.

CN7   RELAY DRIVE   3

CN2   GND   3   6   4

C2

IC1   723PC

D2 D3 D4

C3

R6

CN6   LOGIC POWER   15

+100V   −100V

C5   R4 R3 R2   R1

C7

C6   R7 R5

DB1   AC   AC

C4

CN1   IT SECONDARY   10 11 12   2 3 1

C1

CN5   DISPLAY PWR   6

520-5000-00

+100V −100V

E TR3 C B   E TR4 C B

R13   TR2

R12   TR1

D7 D6 D5   D8

COIL +34V

C8 C9

Z1

C11 C10

C12 C13

R8 R9 R10 R11   D10 D9

+100V −100V

±100V 1/4 ASB   F3

+18V 8A SB   F4

+34V COILS 3A SB   F5

+34V FLASH LAMPS 5A SB   F6

CN3   COIL & LAMP DC   9   1

CN4   COIL & LAMP GROUND   12   1

SPKR DRIVE

CNTR SPKR AMPL.

MB3730

A

C1

R1

R2

C2

C3

C4

C6 C7

C11 R3 C5

B

R13 R14

R11

R10

MC3403

C13 C15

C16 R15 R16 C23 R18 C24 R17 C25 R19 R20

C14 C17

C18 C19

VOICE CHANNEL SELECTOR

4052

C22

C8

X2

C9

LEFT SPKR AMPL.

MB3730

C26

C27

C28

R25

R26

R31 R30 C31 C33 C32 R29 C30

C35 C37 C34

C36

VOICE AMP

MC3403

C29

C38

C39

MUSIC AMP

MC3403

C41 C42

RIGHT SPKR AMPL.

MB3730

C43

C44

C45

R27

R28

C54 C57

C55

C56

C58

C79

C49 C47

C48

R33

R34

-5V REG

C51

C52

C53

C62

+5V

C63

C61

L1

L2 L3

C59 C60 CN4

POWER IN

+12V   -12V GND +5V

+12V

VOL. CONT.

CN3

CN1

SP3

SP1 SP2

POT1 POT2

C

X1

OSC 8MHZ

C64

SYSTEM CLOCK

D

C72

LS74

R21

R22

C65

3

2 1

PST 518A

C66

POWER ON RESET

LS14

LS393

HC74

C67

C75

LS74

LS157

C68

X3

C76

C77

OSC 3.58M

MSM5205

RA2

C69

C78

YM2151

MUSIC CIRCUIT

YM3012

RA1

C70

DATA BUS TR

R35

RA3

CPU

63B09E

LS74

DIGITAL S

C80

SOUND SELECT INPUT

CN5

19

20

C72 E ──┤├── C81 **ADDRESS DECODER** I

┌──────┐
│ LS08 │   **F**
└──────┘   ──┤├── C88

OCK

┌──────┐   J1 ¦ J2   ┌──────┐
│ LS32 │   │ LS138 │ **2**
└──────┘   └──────┘

MISC. GATES

┌──────┐   J3 ¦ J4   ┌──────┐
│ LS04 │   │ LS139 │ **3**
└──────┘   └──────┘

CT ──┤├── C84   ──┤├── C90

┌──────┐   ┌──────────────┐ **4**
│ LS273 │   │ **VOICE ROM 1** │
└──────┘   │ 27512 / 27256 │
                           └──────────────┘
**VOICE
CIRCUIT**   ──┤├── C91   **5**

┌──────┐   ┌──────────────┐
│ LS273 │   │ **VOICE ROM 2** │
└──────┘   │ 27512 / 27256 │
                           └──────────────┘ **6**

┌──────┐   ──┤├── C92
│ LS32 │
└──────┘   ┌──────────────┐
                           │ **SOUND ROM** │
──┤├── C87   │   27256   │
TRANSCEIVER   └──────────────┘ **7**

┌──────┐
│ LS245 │   ──┤├── C93
└──────┘

┌──────┐   ┌──────────────┐
PU   │ **RAM**   │
309E   │ TMM2016   │
                           └──────────────┘ **8**

STEREO

──┤├──   520 5002 01

CT   ──┤├── C94   **MADE IN USA**

┌──────┐   ┌──────┐
│   1 │   │ LS374 │   **9**
│   2 │   └──────┘
└──────┘   **SOUND SELECT DATA LATCH**

Sound Board Logic Diagram

PLAYER 1 & 2 SEGMENTS

CN5

POWER IN

CN4

−100 +100 +5 GND +5

PLAYER 2 & 4 DIGIT STROBES

CN3

R24 R23 R22 R21 R20 R19 R18 R17

PLAYER 1 & 3 DIGIT STROBES

CN2

R16 R15 R14 R13 R12 R11 R10

PLAYER 1 & 3 DIGIT DRIVERS

C6

U8

U7

C5

U12

PLAYER 1 & 2 SEGMENTS

C6 C4

U5

U10

R45 R44 R43 R42 R41 R40 R39 R38 R37 R36

PLAYER 1 SEGMENT DRIVERS

U4

PLAYER 3 & 4 SEGMENT DRIVERS

D1

PLAYER 1

DS2

PLAYER 3

U15

R49 R48

U14

DS4

R57 R56 R55 R54 R53 R52

Combined Display Assembly Drawing

42

PLAYER 3 & 4
SEGMENTS

CN1

9

R9
R10
R11

R1
R2
R3
R4
R5
R6
R7
R8

U3
C3
U4

U2
U1
C1
R25

PLAYER 2
SEGMENT
DRIVERS

C2
U9

R35
R34
R33
R32
R31
R30
R29
R28
R27
R26

PLAYER 2 & 4
DIGIT DRIVERS

U11

PLAYER 2

DS1

U14

R47
R46

U13

PLAYER 4

DS3

R53
R52
R51
R50

Tolerances: (except as noted)	PART NO.: DATABASE 520-5014-00		
Angular: ± Decimal: ± Fractional: ±	DESCRIPTION: COMPONENT LEGEND		
Drawn: J. Drexel	Date: 8 Dec 87	DRAWING NO.	
Checked:		ELECTRONIC DESIGN & MANUFACTURING, INC.	
Approved		Size:	Scale: 2:1	Sheet: Of

A B C D E

0

CN4

POWER

+5V

C1 C1 C1 C1 C1 C1
0.1 0.1 0.1 0.1 0.1 10
UF UF UF UF UF UF

KEY
NC

D1
1N4740

VCC

+90V VBB
-100V VKK

4050

7 U5C 6
U4B 4
U4C 7
9 U5D 10
9 U5D 10
5 U5B 4
U6A 2
5 U6B 4
7 U6C 6
14 U5F 15
11 U6E 12
3 U5A 2
11 U5E 12
11 U4E 12
9 U4D 10
14 U6F 15

1 IN1 OUT1 18 R26 18K
2 IN2 OUT2 17 R27 10K
3 IN3 OUT3 16 R28 8.2K
4 IN4 U OUT4 15 R29 8.2K
5 IN5 9 OUT5 14 R32 18K
6 IN6 OUT6 13 R33 8.2K
7 IN7 OUT7 12 R34 10K
8 IN8 OUT8 11 R35 8.2K
9 GND VKK 10
VKK
UDN7180

CN5

COM 26
G 25
F 24
E 23
D 22
C 21
B 20
A 19
DOT 18
R 17
P 16
N 15
M 14
K 13
J 12
H 11
10
9
8
7
6
5
4
3
BLANK 2
1

SEGMENT SELECT
PLAYERS 1 & 2

KK100 2*13

1 IN1 OUT1 18 R41 18K
2 IN2 OUT2 17 R42 8.2K
3 IN3 OUT3 16 R38 10K
4 IN4 U OUT4 15 R37 8.2K
5 IN5 10 OUT5 14 R36 8.2K
6 IN6 OUT6 13 R43 10K
7 IN7 OUT7 12 R44 18K
8 IN8 OUT8 11 R45 8.2K
9 GND VKK 10
VKK
UDN7180

VCC
R25
18K
BLANKING

4001

2 U7A 3
1 12 U7D 11
13 U7B 4
5 U7B 4
6 9 U7C 10
2 U8A 3
U8D
5 U8B 4
6 U8C
8

1 IN1 OUT1 18
2 IN2 OUT2 17 NC
3 IN3 OUT3 16
4 IN4 U OUT4 15
5 IN5 12 OUT5 14
6 IN6 OUT6 13
7 IN7 OUT7 12
8 IN8 OUT8 11
9 GND VBB 10
VBB
UDN6118

CN3

9
8 KEY
D7 7
D6 6
D5 5
D4 4
D3 3
D2 2
D1 1

DIGIT SELECT
PLAYERS 2 & 4

R24 R23 R22 R21
18K 18K 18K 18K

KK156 1*9

1 IN1 OUT1 18
2 IN2 OUT2 17 NC
3 IN3 OUT3 16
4 IN4 U OUT4 15
5 IN5 15 OUT5 14
6 IN6 OUT6 13
7 IN7 OUT7 12
8 IN8 OUT8 11
9 GND VBB 10
VBB
UDN6118

4001

8 U2C 10
9 6 U2B
U2D 11
U2A 3
U1A
U1B 4
5 U1C 10
12 U1D 11
13

VCC

R16
18K

CN2

9
8 KEY
D7 7
D6 6
D5 5
D4 4
D3 3
D2 2
D1 1

DIGIT SELECT
PLAYERS 1 & 3

KK156 1*9

1 IN1 OUT1 18
2 IN2 OUT2 17
3 IN3 OUT3 16 NC
4 IN4 U OUT4 15
5 IN5 11 OUT5 14
6 IN6 OUT6 13
7 IN7 OUT7 12
8 IN8 OUT8 11
9 GND VBB 10
VBB
UDN6188

1 IN1 OUT1 18
2 IN2 OUT2 17
3 IN3 OUT3 16
4 IN4 U OUT4 15
5 IN5 13 OUT5 14
6 IN6 OUT6 13
7 IN7 OUT7 12
8 IN8 OUT8 11 NC
9 GND VBB 10
VBB
UDN6188

4050

14 U3F 15
3 U3A
5 U3B
U3E
U3C
9 U3D
U4A
U4F

CN1

A 9
B 8
C 7
6 KEY
D 5
E 4
F 3
G 2
COM 1

SEGMENT SELECT
PLAYERS 3 & 4

KK156 1*9

R8 R7 R6 R5 R4 R3 R2 R1
18K 18K 18K 18K 18K 18K 18K 18K

1 IN1 OUT1 18 A
2 IN2 OUT2 17 B
3 IN3 OUT3 16 C
4 IN4 U OUT4 15 D
5 IN5 14 OUT5 14 E
6 IN6 OUT6 13 F
7 IN7 OUT7 12 G
8 IN8 OUT8 11 COM
9 GND VKK 10
VKK
UDN7180

A B C D E

DS1 ALPHA DISPLAY

PLAYER 1

DS2 ALPHA DISPLAY

PLAYER 2

DS3 NUMERIC DISPLAY

PLAYER 3

DS4 NUMERIC DISPLAY

PLAYER 4

VKK

R30 1M

R31 1M

VBB

VKK

R39 1M

R40 1M

VBB

VBB

R47 1M

VBB

R46 1M

R46 1M VKK

R45

VKK

M
C 10K
R 8.2K 1/2 W
N 8.2K 1/2 W
G 18K
K 8.2K 1/2 W
F 10K
J 8.2K 1/2 W

COM
D 18K
B 8.2K 1/2 W
H 8.2K 1/2 W
A 10K
E 10K
DOT 18K
P 8.2K 1/2 W

D1
D2
D3
D4
D5
D6
D7

R50 10K
R51 10K
R52 10K
R53 10K
R54 10K
R55 10K
R56 10K
R57 15K

Combined Display Logic Diagram   43

PPB Board Servicing Diagrams

DATA EAST

NAME		
DWG	PART NO	REV A
C	MODEL 520-5021-00	
SIZE	SHEET 1 OF 1	PPB-1

Prepared by: PRO LOGIC LTD.
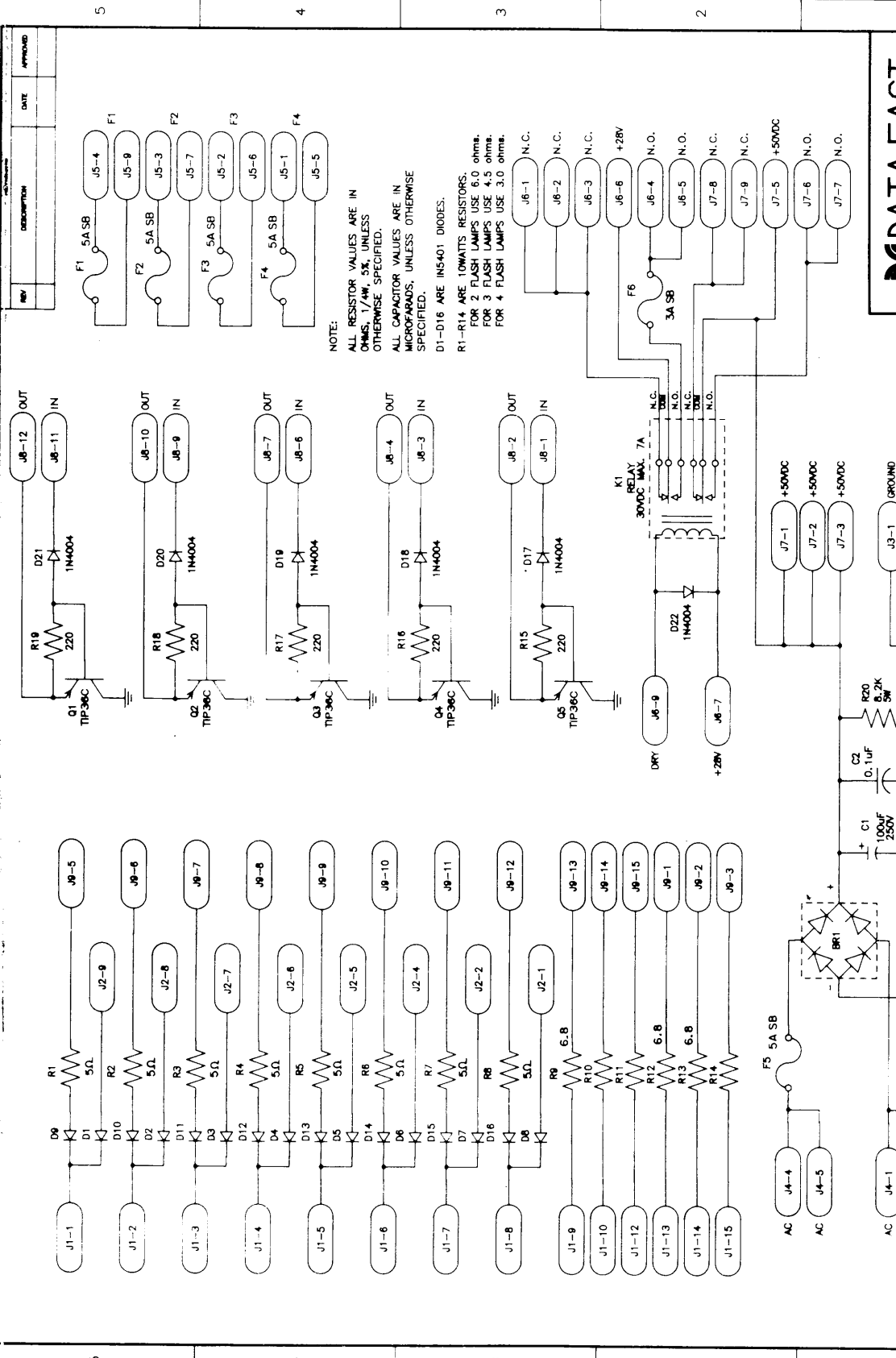
NOTE:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%, UNLESS OTHERWISE SPECIFIED.

ALL CAPACITOR VALUES ARE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.

D1-D16 ARE 1N5401 DIODES.

R1-R14 ARE 10WATTS RESISTORS.
FOR 2 FLASH LAMPS USE 6.0 ohms.
FOR 3 FLASH LAMPS USE 4.5 ohms.
FOR 4 FLASH LAMPS USE 3.0 ohms.

F1 5A SB — F1 — J5-4, J5-9
F2 5A SB — F2 — J5-3, J5-7
F3 5A SB — F3 — J5-2, J5-6
F4 5A SB — F4 — J5-1, J5-5

J8-12 OUT, J8-11 IN — D21 1N4004 — R19 220 — Q1 TIP36C
J8-10 OUT, J8-9 IN — D20 1N4004 — R18 220 — Q2 TIP36C
J8-7 OUT, J8-6 IN — D19 1N4004 — R17 220 — Q3 TIP36C
J8-4 OUT, J8-3 IN — D18 1N4004 — R16 220 — Q4 TIP36C
J8-2 OUT, J8-1 IN — D17 1N4004 — R15 220 — Q5 TIP36C

K1 RELAY 30VDC MAX. 7A
D22 1N4004
J6-8 DRV
J6-7 +28V

J6-1 N.C.
J6-2 N.C.
J6-3 N.C.
J6-6 +28V
J6-4 N.O.
J6-5 N.O.
J7-8 N.C.
J7-9 N.C.
J7-5 +50VDC
J7-6 N.O.
J7-7 N.O.

F6 3A SB

N.C. COM N.C. N.O. COM N.O.

J7-1 +50VDC
J7-2 +50VDC
J7-3 +50VDC
J3-1 GROUND
J3-2 GROUND
J3-3 GROUND
J3-4 GROUND

R20 8.2K 5W
C2 0.1uF
C1 100uF 250V
BR1
F5 5A SB

J9-5 — J2-9 — R1 5Ω — D9/D1 — J1-1
J9-6 — J2-9 — R2 5Ω — D10/D2 — J1-2
J9-7 — J2-8 — R3 5Ω — D11/D3 — J1-3
J9-8 — J2-7 — R4 5Ω — D12/D4 — J1-4
J9-9 — J2-6 — R5 5Ω — D13/D5 — J1-5
J9-10 — J2-5 — R6 5Ω — D14/D6 — J1-6
J9-11 — J2-4 — R7 5Ω — D15/D7 — J1-7
J9-12 — J2-2 — R8 5Ω — D16/D8 — J1-8
J9-13 — J2-1 — R9 6.8 — J1-9
J9-14 — R10 — J1-10
J9-15 — R11 6.8 — J1-12
J9-1 — R12 — J1-13
J9-2 — R13 6.8 — J1-14
J9-3 — R14 — J1-15

AC J4-4
AC J4-5
AC J4-1
AC J4-3

CABINET PARTS ILLUSTRATION
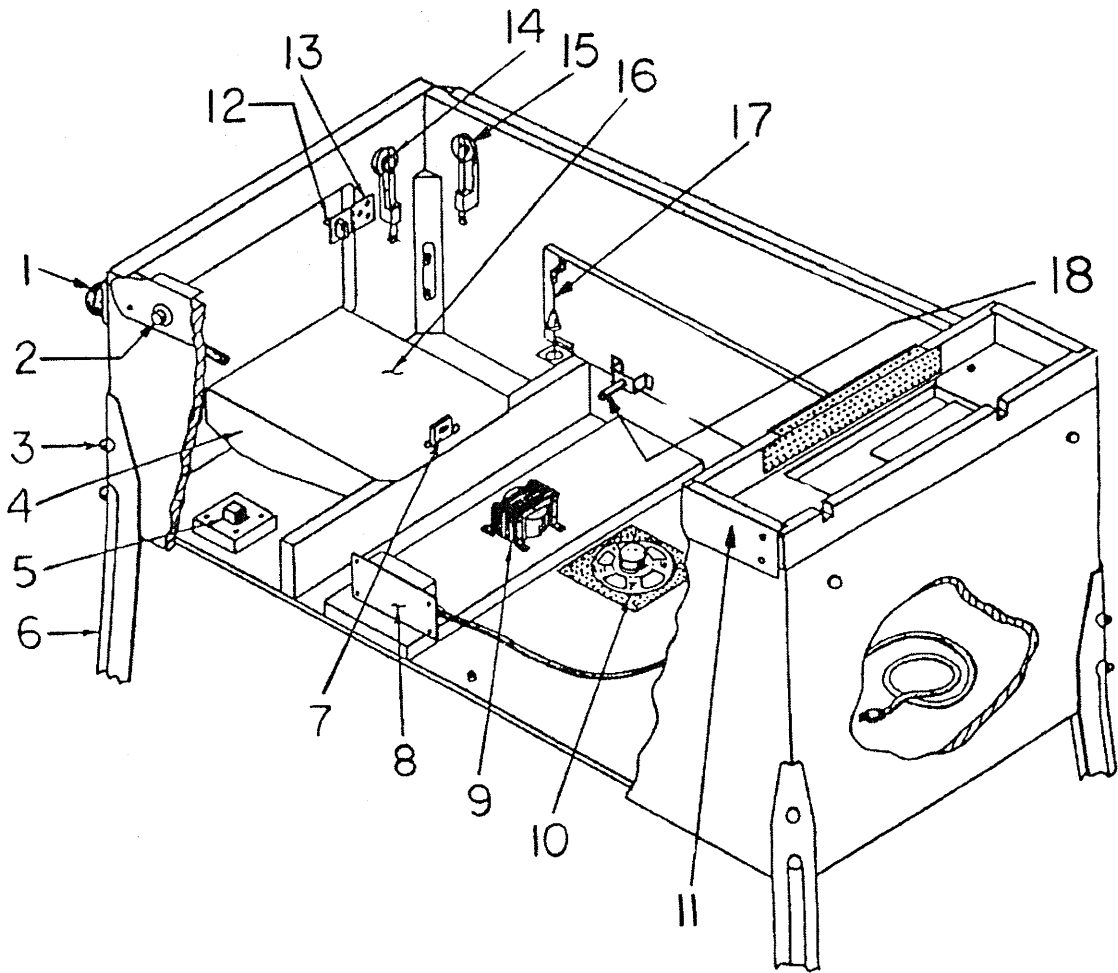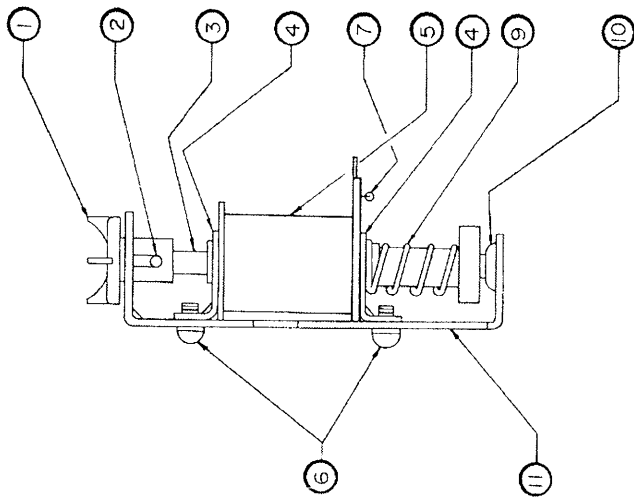

Item	Description	Part No.
1	Ball-shooter Assy	500-5019-02
2	Flipper Button	500-5026-02
3	Leg Bolt (Chrome)	231-5000-00
4	Cash Box Bottom	535-5014-00
5	On/Off Switch DP/ST	180-5001-00
6	Leg (Chrome)	535-5020-10
7	Lock Bracket - Cash Box	535-5215-00
8	Power Input Box Assy	515-5018-10
9	Transformer	010-5002-00
10	Speaker-Round (6")	031-5000-00
11	Side Armor-Right	535-5010-01
12	Memory Protect Switch	180-5000-00
13	Memory Protect Switch Bracket	535-5225-00
14	Start Switch	180-5016-00
15	Tungston Switch-Flipper	180-5013-00
16	Cash Box Top	535-5013-00
17	Plumb Bob Tilt Mech. Assy	500-5023-00
18	Volume Control	123-5000-00

500-5067-00 Vertical Up Kicker

Item	Part No.	Description	Qty
1	545-5073-00	Ball Poppers	1
2	.094 x .500	Pin	1
3	515-5096-00	Plunger Assy - Ball Popper	1
4	535-5203-01	Coil Retainer Brkt.	2
5	090-5001-01	Coil: 23-800	1
6	#8-32 x 1/4" Lg.	Ph. Pan Sems w/Ext. Th. Lckwshr	4
7	112-5003-00	IN4004 Diode	1
9	266-5009-00	Spring-Ball Popper	1
10		Gromet	1
11	535-5271-00	Ball Poppers Brkt.	1

## 500-5084-00 Ship. Tilt Assembly

Item	Part No.	Description	Qty
1	545-5067-00	Lens-Periscope	1
2	535-5266-00	Mounting Bracket	1
3	090-5010-00	Coil (30-800)	1
4	515-5090-00	Ship Mounting Plate Assy	1
5	535-5061-00	Plunger Link	1
6		Nyliner (Thompson #4 L1-FF)	1
7	266-5014-00	Spring	1
8	535-5267-00	Coil Bracket	1
9	515-5089-00	Plunger Assy	1
10	1/8" Dia.	Rivet	2
11	077-5100-00	Lamp Socket	2
12	254-5000-07	3/4" Plastic Spacer	2
13	830-5403-01	Small Sky Plastic	1
14	830-5403-02	Large Sky Plastic	1
15	#6-32 x 1" Lg.	Slotted Round Hd. M.S	2
16	077-5002-00	Lamp Socket	2
17	—	5/16" Retaining Ring	1
18	830-5403-03	Ship Plastic	1
19	545-5068-00	Flipper Bushing	1
20	#6-32 x 1/4" L.G.	P.H. Pan Sem W/Ext. Th. Lckwshr	11
21	1/32" Thick	Flat Washer	2
22	3/32" Dia.	Rivet	2
23	112-5003-00	IN4004 Diode	1
24	—	1/4" Retaining Ring	3
25	077-5006-00	Lamp Socket	2
26	036-5043-00	Sinking Ship Assembly Cable	2
27	165-5000-89	#89 Bulb	2
28	165-5000-44	#44 Bulb	4
29	112-5001-00	IN4001 Diode	2

(SHOWN FOR LOCATION)

PLAYFIELD
(SHOWN FOR LOCATION)

PLAYFIELD PARTS ILLUSTRATION
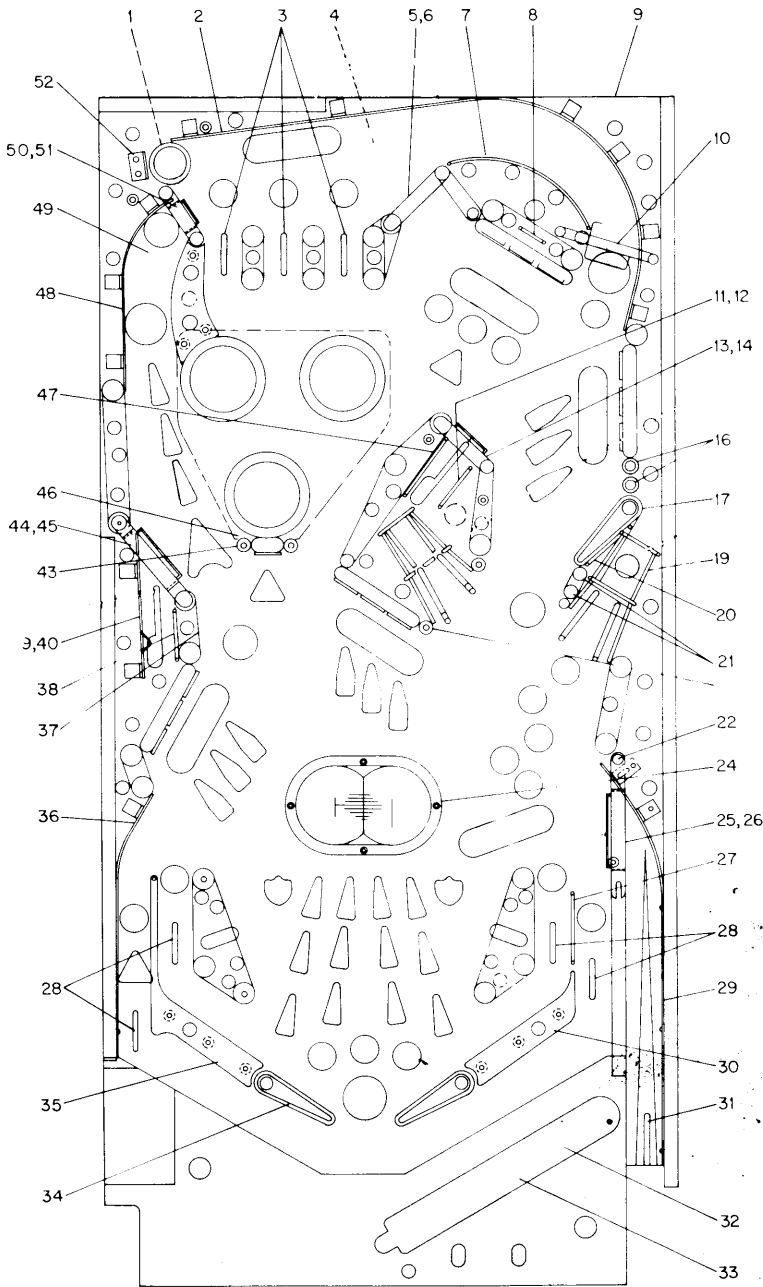
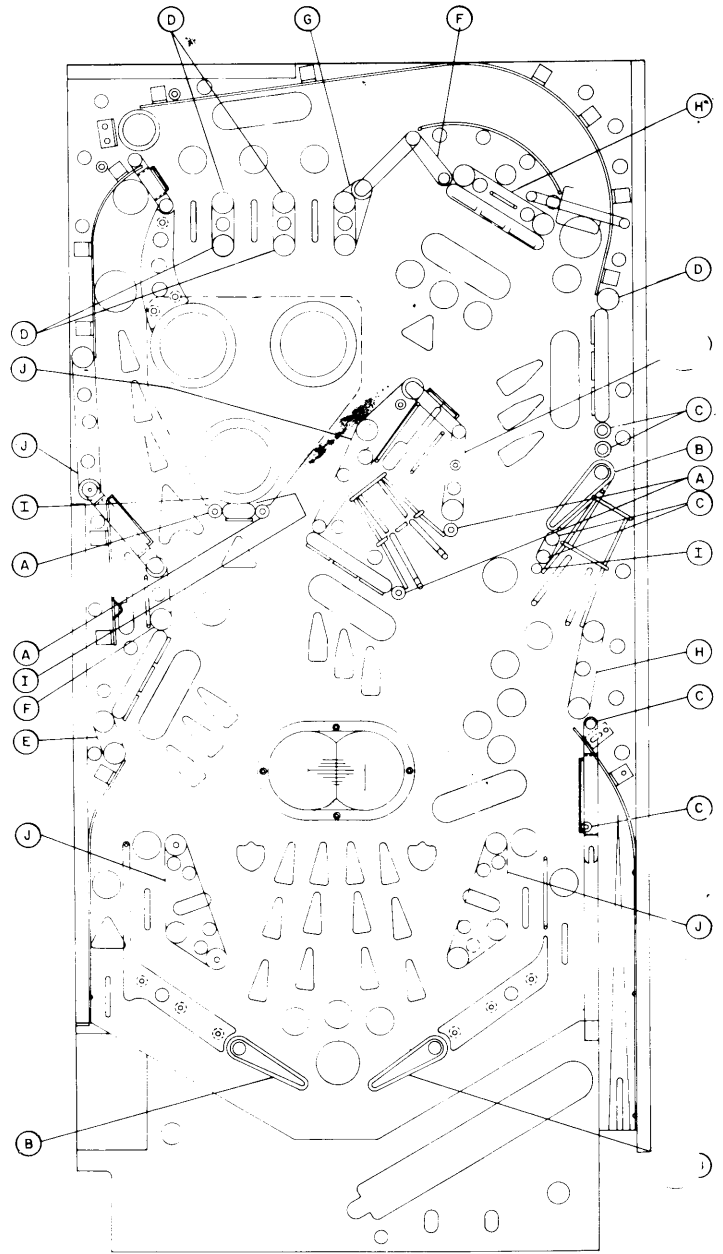| Item	Description	Part No.
*1	Wire Ramp-Left	535-5335-00
2	Ball Guide Assy - Top	500-5087-00
3	Micro Switch Rollover & Brkt Assy	500-5109-00
*4	Wire Ramp - Center	535-5334-00
5	Mounting Brkt	535-5269-02
6	Wire Gate	535-5302-02
7	Wire Form - Curved	535-5338-00
8	Wire Form Staight - 1"	535-5300-05
9	P/F Back Panel Assy	515-5106-00
10	Spinning Target & Brkt Assy	500-5060-01
11	Switch Ball Guide Assy	500-5093-00
12	Micro Switch Ball Guide	180-5031-00
13	Mounting Brkt	535-5210-00
14	Wire Gate, Short	535-5314-01
15	——	——
16	Metal Standoff W/Groove	530-5035-01
17	Flipper & Shaft Assy. Yellow	515-5133-02
18	——	——
*19	Wire Ramp Right	515-5108-00
20	Wire Form Straight - 2"	535-5300-10
21	Mounting Standoff W/Groove	530-5035-01
22	Bumper Post - Mach	530-5001-00
23	Mounting Standoff W/Groove	530-5035-01
24	Lens - Periscope	545-5067-00
25	Mounting Gate Brkt	535-5250-00
26	Wire Gate	535-5323-01
27	Wire Form Straight - 3"	535-5300-02
28	Micro Switch Rollover & Brkt Assy	500-5109-00
29	Ball Guide Assy - Lower Right	500-5086-00
30	Return Ball Guide - Right	535-5407-00
31	Micro Switch Rollover & Brkt Assy	500-5110-00
32	Wire Form & Brkt Assy	500-5042-00
33	Switch Plate Assy	500-5041-00
34	Flipper & Shaft Assy. White	515-5133-01
35	Return Ball Guide - Left	535-5406-00
36	Ball Guide Assy - Lower Left	500-5090-00
37	Wire Form Straight - 1"	535-5300-05
38	Wire Form Straight - 1¾"	535-5300-09
39	Micro Switch - Ball guide	180-5031-00
40	Ball Guide Assy - Micro Switch	500-5089-00
41, 42	——	——
43	Bumper Post Mach	530-5007-00
44	Wire Gate	535-5307-01
45	Mounting Brkt	535-5269-01
46	Mini-Post Wood Thd.	530-5004-00
47	Wire Form Straight - 2½"	535-5300-01
48	Ball Guide Assy - Top Left	500-5088-00
49	Wire Form Brkt Assy	500-5068-00
50	Wire Gate	535-5307-03
51	Mounting Brkt	535-5269-03
52	Ball Stop	535-5273-00

* Not Shown

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BACKBOX PARTS ILLUSTRATION
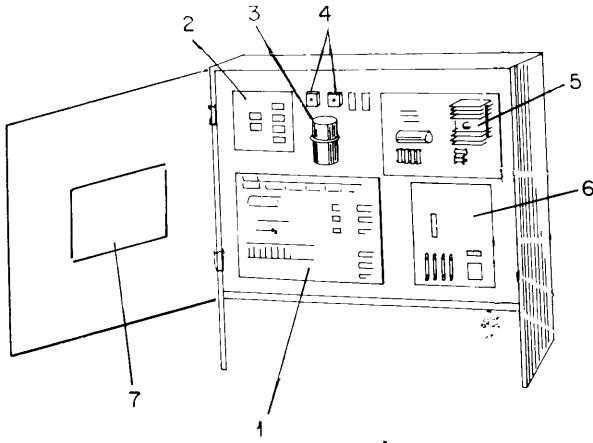
Item	Description	Part No.
1	CPU Board Assy	520-5003-02
2	Sound Board Assy	520-5002-01
3	Capacitor 2C1	125-5000-00
4	Bridge Rectifiers	112-5000-00
5	Power Supply Bd Assy	520-5000-00
6	PPB Board	520-5021-00
7	Combined Display Bd Assy	520-5014-00

RUBBER PARTS ILLUSTRATION

Item	Description	Part No.
A	Bumper Post	545-5009-01
B	Flipper Rubber (Red)	545-5024-02
C	3/16" I.D. Ring	545-5025-01
D	5/16" I.D. Ring	545-5025-02
E	3/4" I.D. Ring	545-5025-04
F	1" I.D. Ring	545-5025-05
G	1-1/4" I.D. Ring	545-5025-06
H	1-1/2" I.D. Ring	545-5025-07
I	7/16" O.D. Ring	545-5025-17
J	2 3/4" I.D. Ring	545-5034-00

S.P

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